

# Women's Preferences for Attributes of First-Trimester Miscarriage Management: A Stated Preference Discrete-Choice Experiment

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## ABSTRACT

**Objective:** To elicit women's preferences for attributes of alternative management options for first-trimester miscarriage.

**Methods:** A stated preference discrete-choice experiment was conducted among 1198 women with a confirmed pregnancy of less than 13 weeks gestation, who had been diagnosed with either an incomplete miscarriage or missed miscarriage/early fetal demise and who had been recruited as part of a randomized controlled trial (miscarriage treatment [MIST] trial) comparing expectant, medical, and surgical miscarriage. Six attributes, each with three or four levels, were used in the statistical design. An orthogonal main effects design was generated (i.e., a design where the attributes are independent of each other) and the choice sets devised according to the principles of minimum overlap and level balance. A cost attribute was included to allow estimation of willingness to pay (WTP) values. Three different questionnaires were designed such that women were asked their preferences for attributes of the two management options they had not been allocated to in the trial.

**Results:** A total of 630 women completed the stated preference discrete-choice survey questionnaires: 189 out of 398 women (47.5%) allocated to expectant management, 223 out of 398 women (56.0%) allocated to medical management, and 218 out of 402 women (54.2%) allocated to surgical management. For each of the three discrete-choice survey questionnaires, women expressed a clear preference for decreased levels of all six attributes (time spent at the hospital receiving treatment, level of pain

experienced, number of days of bleeding after treatment, time taken to return to normal activities after treatment, cost of treatment to women, and chance of complications requiring more time or readmission to hospital). For each of the three discrete-choice survey questionnaires, the highest valued attribute in terms of WTP was for a reduction in pain levels followed by time taken to return to normal activities after treatment. On aggregate, surgical management was valued more highly than expectant and medical management by women allocated to medical and expectant management, respectively, and medical management was valued more highly than expectant management by women allocated to surgical management. This held true regardless of the application of either hypothetical data for each attribute generated by the pretrial-designed discrete-choice experiment questionnaires or actual data for each attribute observed in the MIST trial.

**Conclusions:** The preference results generated by this study suggest that many women undergoing management of first-trimester miscarriage would value being offered alternatives to expectant management. The data from this study should be considered by decision-makers in conjunction with the clinical and cost-effectiveness evidence base in this area as well as consideration of the budgets available to them for such services.

**Keywords:** discrete-choice experiment, miscarriage, willingness to pay, women's preferences.

## Introduction

Approximately one in nine confirmed early pregnancies end in miscarriage during the first trimester [1]. The optimal strategy for managing first-trimester miscarriage remains uncertain [2,3]. The traditional approach of surgical evacuation developed during the first half of the 20th century as a result of high rates of gynecological infection from the retained products of conception and the ensuing mortality from septicemia [4]. Nevertheless, surgical management has been associated with a number of further complications, including uterine perforation, cervical laceration and infection as a result of instrumentation of the uterus [5]. Two alternative options to surgical management, expectant management and medical management, have increasingly been offered to women with a diagnosed first-trimester miscarriage. Expectant management allows spontaneous passage of the retained products of conception, while medical management has translated the treatment regimens widely used for medical terminations of pregnancy to the management of spontaneous miscarriage [4].

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Randomized controlled trials that have compared alternative management options for first-trimester miscarriage do not provide clear evidence of superiority for any one method. Three trials have compared expectant management with surgical management [6–8], five trials have compared medical management with surgical management [9–13], and one trial has compared expectant management with medical management [14]. Only two trials to date have directly compared all three management options. The first was curtailed after only 40 women were randomized as a result of recruitment difficulties [15]. The second, the miscarriage treatment (MIST) trial, the largest trial of management of first-trimester miscarriage to date, found no evidence of a difference in gynecological infection rates by management option [16]. Nevertheless, significantly more unplanned admissions and unplanned surgical curettage occurred after expectant management and medical management than after surgical management. The authors of the study concluded that a similarly sized trial in this area seems unlikely to be repeated because of a tendency on the part of women to express a definite preference for one management method and therefore decline randomization [16].

In the absence of clear evidence of clinical superiority from randomized controlled trials, the decision about which management option to offer women with a diagnosed first-trimester miscarriage should be informed by evidence on cost-effectiveness

and women's preferences. Indeed, the importance of synthesizing the valuable aspects of evidence-based, cost-effective, and preference-driven medicine is being increasingly recognized by decision-makers in many jurisdictions [17]. Only one of the randomized controlled trials of the alternative management options, the MIST trial, conducted a prospective assessment of cost-effectiveness. The economic evaluation revealed that expectant and medical management of first-trimester miscarriage possess economic advantages over traditional surgical management [18]. The net societal cost per woman was estimated at £1086 in the expectant group, £1410 in the medical group, and £1585 in the surgical group (£ sterling, 2001–2002 prices). Expectant management was found to have a 97.8% probability of being the most cost-effective management method at a decision-maker's willingness to pay (WTP) threshold of £10,000 for preventing one gynecological infection, while medical management only had a 2.2% probability of being the most cost-effective management method with this threshold.

As with evidence on cost-effectiveness, there is a paucity of evidence on women's preferences for alternative management options for first-trimester miscarriage. Two studies assessed women's preferences for expectant management versus surgical management [19,20]. Both studies identified strong treatment preferences on the part of women, but their experimental designs precluded cardinal estimation of strength of preference or the disentanglement of attributes of the process and consequences of treatment that directly influenced women's responses. One study used stated preference discrete-choice experiment (SPDCE) methodology to elicit women's preferences for attributes of surgical and medical management of miscarriage [21]. The study was based on a randomized controlled trial of surgical versus medical management conducted in Scotland. The authors estimated the trade-offs women were willing to make between five attributes of treatment (level of pain experienced, time in hospital receiving treatment, time taken to return to normal household activities, cost of treatment to women, and complications after treatment), and indirectly inferred women's WTP for changes in the levels of the noncost attributes. A probit model developed by the authors implied that overall there was a general preference for surgical over medical management. In this article, we extend this line of research by presenting the results of a SPDCE of women's preferences for attributes of all three management options of first-trimester miscarriage: expectant, medical, and surgical. In so doing, we aim to make a contribution to the limited evidence base for decision-makers as they consider the relative merits of alternative management options.

## Methods

### SPDCE Methodology

SPDCEs, also sometimes referred to in the literature as conjoint analysis or discrete-choice modeling, originated in mathematical psychology but have subsequently been adopted and developed by market researchers, transport economists, environmental economists, and more recently health economists. In the health arena, the technique has been used as a means of eliciting individuals' and the community's preferences for interventions, models of care, or drug regimes [22]. The technique is based on the premise that any "good," for example any health care intervention, drug therapy, treatment or model of care, can be described by its attributes (or characteristics) and that the extent to which an individual values a "good" depends on the level of these attributes. The attributes might describe the impact of the intervention or model of care on health outcomes, but might also describe nonhealth outcomes or the process by which the inter-

vention or model of care is delivered [23]. As such, the technique shares many of the features of the stated preference WTP approach [24] but has the additional feature of being able to generate marginal rates of substitution (MRS) between the attributes, that is, the degree to which respondents are willing to trade one attribute for another. Indeed, if cost is included as one of the study attributes, then marginal WTP values can be inferred for changes in the levels of the remaining attributes. There are five identifiable stages in the design and analysis of SPDCEs: 1) identifying the attributes to include in the study; 2) assigning levels to these attributes; 3) designing the orthogonal matrix of attributes and levels using design theory; 4) eliciting preferences for these scenarios; and 5) analyzing the responses. Previous applications of SPDCEs in the perinatal context include Ryan and Hughes's [21] study of women's preferences for surgical versus medical management of miscarriage, and studies by Ratcliffe and Longworth [25] and Hundley et al. [26] on women's preferences for alternative models of intrapartum care.

### Study Background and Population

Women recruited into the MIST trial formed the study population. Full details of the design, conduct, and analysis of the MIST trial are reported elsewhere [16]. In brief, the MIST trial was a pragmatic randomized controlled trial that evaluated the benefits, risks, and costs associated with expectant and medical management, in comparison with surgical management, of first-trimester miscarriage. A total of 1200 women with a confirmed pregnancy of less than 13 weeks gestation, who had been diagnosed through transvaginal scan with either an incomplete miscarriage (expulsion of products of conception has begun) or missed miscarriage/early fetal demise (visible fetus but absent heart activity), were recruited from one of seven early pregnancy assessment units in southern England. Women who consented to participate in the trial were randomized by telephone to expectant, medical, or surgical management. Minimization was used to ensure comparability between women allocated to the three management groups with respect to four prognostic variables: participating center, parity (nulliparous or parous), miscarriage type (incomplete miscarriage or missed miscarriage/early fetal demise), and gestation (<56 days, 56–76 days, 77 or more days, or unknown). Women allocated to the expectant group were allowed home with no intervention. The management of women allocated to the medical group depended on the type of miscarriage. Those with incomplete miscarriages were admitted to hospital and given a single vaginal dose of 800 µg misoprostol (Cytotec, G.D. Serle & Co., Chicago, IL), while those with missed miscarriages were pretreated with a single oral dose of 200 mg mifepristone (Mifeprex, Danco Laboratories, New York, NY) and then admitted 24 to 48 hours later for a single vaginal dose of 800 µg misoprostol. Women allocated to surgical management were admitted for surgical evacuation of the retained products of conception in line with the usual policy of each participating center. Documented gynecological infection within 14 days of trial entry constituted the primary clinical outcome of the MIST trial. This was defined as two or more of the following: purulent vaginal discharge; pyrexia >38.0°C; tenderness over the uterus on abdominal examination; and/or increase in white cell count above  $15 \times 10^9/\text{ml}$ . The trial was also designed to include a prospective economic evaluation that took the form of an incremental cost-effectiveness analysis [18].

### Research Instruments

All women participating in the MIST trial were sent a SPDCE postal questionnaire 3 months after their miscarriage. A stamped

addressed envelope was enclosed in the postal pack, and if the questionnaire had not been returned within 1 month of postage, then a reminder was sent. Ethical approval for the SPDCE was received from the South West Multi-Centre Research Ethics Committee in England.

Three different questionnaires were designed such that women in each arm of the trial were asked their preferences for the two management options they had not been allocated to. For example, women allocated to the surgical management arm received a SPDCE questionnaire that elicited their preferences for medical versus expectant management. The purpose of this approach was to control for the effect of women expressing a preference for the management option they had been allocated to [27]. Furthermore, such an approach is in line with cost-benefit analysis (CBA) theorists who recommend that WTP values that are to be used within a CBA framework should ideally be elicited *ex ante* (i.e., the value of a health change in the case of uncertainty) [28]. Hence, questionnaires 1 (surgical vs. medical), 2 (surgical vs. expectant), and 3 (medical vs. expectant) were administered to women who had been allocated to expectant, medical, and surgical management, respectively. In summary, the survey instrument offered the women a choice between two management options, neither of which they had been allocated to as part of the MIST trial.

The attributes and levels included in the experiment were informed by a literature review and evidence synthesis of previous research on the approaches to managing first-trimester miscarriage and their consequences. The attributes (levels) were time spent at the hospital receiving treatment (overnight, half a day, 1 day), level of pain experienced (low, moderate, severe), number of days of bleeding after treatment (3 days, 8 days, 14 days), time taken to return to normal activities after treatment (1–2 days, 3–4 days, 7 days, or more), cost of treatment to women (£50, £150, £250), and chance of complications requiring more time or readmission to hospital (very unlikely [about 5 in 100], quite unlikely [about 10 in 100], unlikely [about 20 in 100]). Women were informed that, although cost was one of the attributes, the government has no intention of charging for the treatment of miscarriage; rather, cost had been included as one way of gauging how strongly patients valued the different methods of care.

The six attributes and their levels, indicated in Table 1, generated a total of 972 ( $3^3 \times 4^1$ ) possible scenarios. A fractional factorial design was used to reduce this to a total of 26 scenarios

**Table 1** Attributes and levels used in the stated preference discrete-choice experiment design

Attribute	Levels
Time spent at the hospital receiving treatment	Overnight Half a day 1 day
Level of pain experienced	Low Moderate Severe
Number of days of bleeding after treatment	3 days 8 days 14 days
Time taken to return to normal activities after treatment	1–2 days 3–4 days 5–6 days 7 days or more
Cost of treatment to women	£50 £150 £250
Chance of complications requiring more time or readmission to hospital	Very unlikely (about 5 in 100) Quite unlikely (about 10 in 100) Unlikely (about 20 in 100)

**Table 2** Pretrial scenarios for surgical, medical, and expectant management of miscarriage based on trial attributes and levels

Attributes	Surgical scenario	Medical scenario	Expectant scenario
Time spent at hospital receiving treatment	1 day	0.5 day	0.5 day
Level of pain experienced	Low	Moderate	Moderate
Number of days bleeding after treatment	3 days	8 days	14 days
Time taken to return to normal activities after treatment	3–4 days	3–4 days	3–4 days
Chance of complications requiring more time or readmission to hospital	5%	10%	5%

for each questionnaire. Each type of questionnaire had a constant comparator for one of the labeled alternative-specific options (surgical management for questionnaires 1 and 2 and medical management for questionnaire 3). The constant comparator scenario attributes and levels were devised from the SPDCE attributes and levels and modeled as closely as possible to scenarios representing surgical, medical, and expectant management based on evidence from the literature and expert advice at the outset of the trial (see Table 2). This design gave rise to a total of 25 choice sets for each questionnaire. Twenty-five choice sets were considered to be too burdensome for women; consequently, each questionnaire was blocked into two questionnaires (1a, 1b, 2a, 2b, 3a, and 3b), with either 12 or 13 choice sets. For the purposes of analysis and to treat the questionnaires statistically appropriately as a complete block, however, individual “a” and “b” blocks for each of questionnaires 1, 2, and 3 were combined and analyzed as one questionnaire. The alternative scenarios were generated through an orthogonal design using SPEED statistical software (version 2.1, Hague Consulting Group, Hague, The Netherlands) and set against the chosen constant comparator in the resulting choice sets. This was a somewhat unusual design because it was not perfectly orthogonal. Nevertheless, our experimental design did satisfy the main criteria at the time for efficient DCE design: near orthogonal-in-differences, minimum overlap, level balance, plausible, and realistic (Zwerina et al. 1996, unpublished). It should be noted that the most recent design literature recommends using more statistically sound fold-over designs. Moreover, the criteria for efficient SPDCE designs have been developed in recent years and, as such, additional criteria such as zero correlation and maximizing D-optimality are now employed [29]. For each choice set, women were asked which option they preferred. An example choice set is shown in Figure 1.

## Data Analysis

The sociodemographic and health status characteristics of women who did and did not return a completed DCE questionnaire were compared using the Student's *t* test for continuous variables and the chi-square test for categorical variables. The discrete-choice responses were analyzed using a random effects probit model available in LIMDEP. In this model, there is an overall intercept and an error term with two components:  $\varepsilon_{it}$  and  $\mu_i$ . The  $\varepsilon_{it}$  is the traditional error term unique to each observation, and the  $\mu_i$  is an error term representing the extent to which the intercept of the *i*th unit differs from the overall intercept [30]. This type of model essentially accounts for the repeated nature of the data (i.e., the multiple choices per individual). Because the design of the SPDCE was a labeled experiment, otherwise known as an “alternative

Scenario 2	Surgical Treatment	Expectant Treatment
Time spent at the hospital receiving treatment	1 day	½ day
Level of pain experienced	Low	Moderate
Number of days of bleeding following treatment	3 days	8 days
Time taken to return to normal activities after treatment	3-4 days	5-6 days
Cost to you of treatment (if you were paying)	£150	£50
Chance of complications requiring more time or readmission to hospital	Very unlikely (about 5 in 100)	Quite unlikely (about 10 in 100)

For scenario 2, which treatment would you prefer? ☐ Prefer Surgical ☐ Prefer Expectant

**Figure 1** An example choice set included in discrete-choice experiment.

specific” discrete-choice experiment as opposed to a “generic” or unlabeled design, a constant term was also included to allow for testing of inherent preferences for the labeled, i.e., alternative specific, options when assuming that the attributes and levels are equivalent. Such a design allows the “label” or name of the option to convey information to the decision-maker beyond the included attributes and levels. Such a design matters in some choice experiments because 1) subjects may use labels to infer missing (omitted) information; and 2) these inferences may be correlated with the random component of the error term. Incorporating alternative-specific constant terms in such a labeled design allows testing for the effect of preferences on attributes beyond those included in the design and interpreted by the respondent as inherent in the choice “label.”

WTP values were obtained by estimating the MRS between the noncost attribute coefficients and the cost coefficient. Confidence intervals (CI) around the WTP values were obtained using the variance–covariance matrix of the noncost attribute coefficients and the cost coefficient [31]. The theoretical validity of the valuations was assessed by determining whether the estimated parameters for each coefficient were of the appropriate algebraic sign, i.e., whether increased levels of time spent in hospital receiving treatment, pain, number of days of bleeding after treatment,

time taken to return to normal activities after treatment, cost to women, and chance of complications decreased utility (led to a negative coefficient). The internal consistency of a woman’s responses was investigated by including between two and four choice sets within each questionnaire in which one option was superior to the other across some attributes and no worse than the other across any remaining attributes. Finally, overall synthesized monetary estimates of welfare shifts between management options were derived using both hypothetical data for each attribute generated by the pretrial-designed SPDCE questionnaires, as well as actual trial data for each attribute observed in the MIST trial. Differences between the WTP values were considered statistically significant if the 95% CI generated were not overlapping.

## Results

A total of 1200 women participated in the MIST trial, two of whom were subsequently found to have a viable pregnancy. The clinical and sociodemographic characteristics at trial entry of the remaining 1198 women are presented in Table 3. Of these 1198 women, 648 returned the SPDCE questionnaires, a response rate of 54.1% that reflects positively in comparison with other

**Table 3** Clinical and sociodemographic characteristics at trial entry of women who participated in the MIST trial

Characteristic	Expectant		Medical		Surgical	
	398	(%)	398	(%)	402	(%)
Age						
Mean [SD]	31.3	[5.8]	31.2	[5.9]	31.5	[5.8]
Gestational age (days)						
<56	26	(7)	18	(5)	25	(6)
56–76	168	(42)	168	(42)	173	(43)
77 or more	147	(37)	155	(39)	147	(37)
Not known	57	(14)	57	(14)	57	(14)
Parity						
Nulliparous	170	(43)	172	(43)	175	(44)
Parous	228	(57)	226	(57)	227	(56)
Type of miscarriage						
Missed	306	(77)	308	(78)	310	(77)
Incomplete	92	(23)	90	(23)	92	(23)
Bleeding at entry	340	(85)	331	(83)	335	(83)
Pain at entry	213	(54)	206	(52)	205	(51)
Ultrasound findings						
AP diameter						
Mean [SD]	23.2	[11.6]	23.5	[13.0]	22.4	[11.6]
Median {IQR}	21.0	{14–30}	21.0	{14–30}	21.0	{14–29}
In employment	292	(73.4)	301	(75.6)	280	(69.7)

MIST, miscarriage treatment; SD, standard deviation; AP, anterior posterior; IQR, interquartile range.

**Table 4** Random effects probit, baseline model for women allocated to expectant management

Variable	Attribute unit	Coefficient	SE	P-value	WTP (£) per unit decrement (95% CI)
Constant	—	0.299	0.1692	0.08	—
Time spent at hospital receiving treatment	Days	−0.0436	0.0056	<0.001	£13.74 (£13.66, £13.81)
Number of days of bleeding after treatment	Days	−0.0549	0.0103	<0.001	£17.30 (£17.12, £17.48)
Time taken to return to normal activities after treatment	Days	−0.166	0.0210	<0.001	£52.25 (£51.15, £53.35)
Cost to woman of treatment	£	−0.00318	0.0006	<0.001	—
Chance of complications requiring more time or readmission to hospital	%	−0.0586	0.0092	<0.001	£18.46 (£18.29, £18.63)
Level of pain experienced ( <i>ref</i> = low)					
Moderate	Category	−0.581	0.1215	<0.001	£182.89 (£160.67, £205.11)
Severe	Category	−1.743	0.1272	<0.001	£548.51 (£478.75, £618.26)

Number of observations: 2331  
 Unbalanced panel: 189 individuals  
 Log-likelihood function: −703.09  
 Restricted log-likelihood: −1217.7  
 Chi-square: 186.7  
 Significance level: <0.001  
 Hosmer-Lemeshow chi-square: 6.22  
 % Correct predictions: 76%  
 Choice probabilities: Surgery: 75%; Medical: 25%

SE, standard error; WTP, willingness to pay; CI, confidence interval.

SPDCE postal surveys [22,23]. There were no significant differences between women who did and did not return the questionnaire in terms of their age, gestational age at miscarriage, parity, type of miscarriage, and management method of allocation, although nonresponders were less likely to be in paid employment. Of the 398 women allocated to expectant management, 198 (49.6%) returned the DCE questionnaire. The response rates were 228 out of 398 (57.3%) and 222 out of 402 (55.1%) among women allocated to medical and surgical management, respectively. There were no significant differences in terms of clinical and sociodemographic characteristics between women allocated to the three management methods who returned the SPDCE questionnaire. After the removal of missing values (entire respondents were only removed where all variables were missing), analyzable responses were available for 189 women (47.5%) (2331 observations) allocated to expectant management, 223 women (56.0%) (2771 observations) allocated to

medical management, and 218 women (54.2%) (2711 observations) allocated to surgical management. The checks for internal consistency of responses revealed consistency rates of 77.1%, 84.5%, and 93.1% among women allocated to expectant, medical, and surgical management, respectively, and an overall consistency rate of 83.6%. There were no significant differences in terms of clinical and sociodemographic characteristics between women allocated to the three management methods who provided consistent responses.

Tables 4–6 present the results from the random effects probit models for women allocated to expectant, medical, and surgical management, respectively. The models appear to fit the data well, with more than 75% of observations correctly predicted. The statistical significance of  $P < 0.001$  in all three models supports the use of this approach. The estimated coefficients for the attributes included in the SPDCE design are all of the theoretically anticipated sign and are all statistically significant. Women

**Table 5** Random effects probit, baseline model for women allocated to medical management

Variable	Attribute unit	Coefficient	SE	P-value	WTP (£) per unit decrement (95% CI)
Constant	—	0.198	0.154	0.199	—
Time spent at hospital receiving treatment	Days	−0.037	0.0059	<0.001	£14.64 (£14.56, £14.73)
Number of days of bleeding after treatment	Days	−0.071	0.0094	<0.001	£27.61 (£27.35, £27.87)
Time taken to return to normal activities after treatment	Days	−0.186	0.0214	<0.001	£72.34 (£70.79, £73.89)
Cost to woman of treatment	£	−0.0025	0.0005	<0.001	—
Chance of complications requiring more time or readmission to hospital	%	−0.0291	0.0084	<0.001	£11.34 (£11.24, £11.43)
Level of pain experienced ( <i>ref</i> = low)					
Moderate	Category	−0.486	0.114	<0.001	£189.39 (£167.80, £210.99)
Severe	Category	−1.963	0.106	0.001	£763.40 (£682.25, £844.55)

Number of observations: 2771  
 Unbalanced panel: 223 individuals  
 Log-likelihood function: −824.15  
 Restricted log-likelihood: −1446.6  
 Chi-square: 256.32  
 Significance level: <0.001  
 Hosmer-Lemeshow chi-square: 2.97  
 % Correct predictions: 75%  
 Choice probabilities: Surgery: 74.4%; Expectant: 25.6%

SE, standard error; WTP, willingness to pay; CI, confidence interval.



**Table 6** Random effects probit, baseline model for women allocated to surgical management

Variable	Attribute unit	Coefficient	SE	P-value	WTP (£) per unit decrement (95% CI)
Constant	—	0.0021	0.1228	0.98	—
Time spent at hospital receiving treatment	Days	−0.033	0.0047	<0.001	£14.02 (£13.95, £14.08)
Number of days of bleeding after treatment	Days	−0.0957	0.0089	<0.001	£40.62 (£40.26, £40.99)
Time taken to return to normal activities after treatment	Days	−0.211	0.0179	<0.001	£89.74 (£88.13, £91.34)
Cost to woman of treatment	£	−0.0023	0.0004	<0.001	—
Chance of complications requiring more time or readmission to hospital	%	−0.062	0.0073	<0.001	£26.52 (£26.32, £26.71)
Level of pain experienced ( <i>ref</i> = low)					
Moderate	Category	−0.463	0.0975	<0.001	£196.89 (£177.69, £216.09)
Severe	Category	−1.869	0.107	<0.001	£793.50 (£707.94, £879.06)

Number of observations: 2711  
 Unbalanced panel: 218 individuals  
 Log-likelihood function: −967.03  
 Restricted log-likelihood: −1247.86  
 Chi-square: 524.9  
 Significance level: <0.001  
 Hosmer-Lemeshow chi-square: 9.44  
 % Correct predictions: 79%  
 Choice probabilities: Medical: 75.5%; Expectant: 24.5%

SE, standard error; WTP, willingness to pay; CI, confidence interval.

in all three arms of the trial, therefore, expressed a clear preference for decreased levels of time spent in hospital receiving treatment, pain, number of days of bleeding after treatment, time taken to return to normal activities after treatment, personal cost, and chance of complications. These results support the theoretical validity of the study design. The effects are broadly similar across the three management methods of allocation. In none of the random effects probit models was the alternative-specific constant term a significant predictor of choice at the 5% significance level. This latter result implies that women's preferences were a function of the attributes and levels provided and not driven by underlying preferences for attributes excluded from the study.

Table 7 shows estimates of women's WTP for unit decreases in the noncost attributes segmented by each management method of allocation. The WTP estimates are derived by taking the ratio of the estimated coefficient for each noncost attribute to that of the cost coefficient [22]. These results help to assess the relative valuation of different attributes depending upon which arm of the trial the respondents were allocated to and, by implication, the management options being offered for preference elicitation in the SPDCE. The highest WTP estimate is for a reduction in the pain experienced, estimated at £182.89 (95% CI: £160.67, £205.11), £189.39 (95% CI: £167.80, £210.99), and £196.89

(95% CI: £177.69, £216.09) for a reduction from moderate to low pain among women allocated to expectant, medical, and surgical management, respectively, and at £548.51 (95% CI: £478.75, £618.26), £763.40 (95% CI: £682.25, £844.55), and £793.50 (95% CI: £707.94, £879.06) for a reduction from severe to low pain among women allocated to expectant, medical, and surgical management, respectively. The second most important attribute, as imputed by women's WTP, is time taken to return to normal activities after treatment, followed by number of days of bleeding after treatment, chance of complications requiring more time or readmission to hospital, and time spent at hospital receiving treatment. The WTP values for unit changes in the synthesized WTP analysis shown in Table 7 differed significantly between women allocated to the three management methods. The WTP values were highest among women allocated to surgical management for the attributes related to the number of days of bleeding, time taken to return to normal activities, chance of complications and level of pain, and highest among women allocated to medical management for the "time spent at hospital" attribute.

Finally, synthesizing the marginal WTP values summarized in Table 7 with the descriptions of the management options in the pretrial-designed SPDCE scenarios generated overall monetary estimates of welfare shifts between alternative sets of attributes

**Table 7** Comparison of WTP values across the three management methods of allocation

Attribute	Unit	WTP (£) per unit decrement (95% CI*)		
		Women allocated to expectant management	Women allocated to medical management	Women allocated to surgical management
Time spent at hospital receiving treatment	Days	£13.74 (£13.66, £13.81)	£14.64 (£14.56, £14.73)	£14.02 (£13.95, £14.08)
Number of days of bleeding after treatment	Days	£17.30 (£17.12, £17.48)	£27.61 (£27.35, £27.87)	£40.62 (£40.26, £40.99)
Time taken to return to normal activities after treatment	Days	£52.25 (£51.15, £53.35)	£72.34 (£70.79, £73.89)	£89.74 (£88.13, £91.34)
Chance of complications requiring more time or readmission to hospital	%	£18.46 (£18.29, £18.63)	£11.34 (£11.24, £11.43)	£26.52 (£26.32, £26.71)
Level of pain experienced ( <i>ref</i> = low)				
Moderate	Category	£182.89 (£160.67, £205.11)	£189.39 (£167.80, £210.99)	£196.89 (£177.69, £216.09)
Severe	Category	£548.51 (£478.75, £618.26)	£763.40 (£682.25, £844.55)	£793.50 (£707.94, £879.06)

\*Derived from the variance covariance matrix.  
WTP, willingness to pay.

**Table 8** Post-trial scenarios for surgical, medical, and expectant management of miscarriage based on actual MIST trial data

Attributes	Surgical scenario	Medical scenario	Expectant scenario
Time spent at hospital receiving treatment	1 day	1.2 days	0 days
Level of pain experienced	Low	Low	Low
Number of days bleeding after treatment	8 days	11 days	12 days
Time taken to return to normal activities after treatment	6.7 days	6.7 days	12 days
Chance of complications requiring more time or readmission to hospital	3%	2%	3%

MIST, miscarriage treatment.

representing management options. These WTP values were calculated by management method of allocation. Hence, they represent the values of women allocated to each management method for welfare shifts between the management methods they were not allocated to. These were estimated at £354.82 (95% CI: £330.89–£378.76) for a shift from medical to surgical management (values of women allocated to expectant management), £485.76 (95% CI: £461.37–£510.20) for a shift from expectant to surgical management (values of women allocated to medical management), and £111.15 (95% CI: £109.96–£112.39) for a shift from expectant to medical management (values of women allocated to surgical management). The overall monetary estimates of welfare shifts that were calculated using actual mean MIST trial data for each attribute observed, as shown in Table 8, were more conservative however at £36.31 (95% CI: £35.94–£36.71) for a shift from medical to surgical management (values of women allocated to expectant management), £161.04 (95% CI: £158.70–£163.40) for a shift from expectant to surgical management (values of women allocated to medical management), and £131.08 (95% CI: £129.16–£133.01) for a shift from expectant to medical management (values of women allocated to surgical management).

## Discussion and Conclusions

The results presented in this article provide new information about women's preferences for attributes of alternative management options for first-trimester miscarriage. The results suggest that the level of pain experienced by women is the most important determinant of their preferences (as indicated by the highest WTP per unit decrement). Time taken to return to normal activities after treatment, number of days of bleeding after treatment, chance of complications requiring more time or readmission to hospital, and time spent at hospital receiving treatment are also statistically significant determinants.

The results are broadly in line with evidence from qualitative studies that highlight the levels of pain and bleeding as critical in women's perceptions of their miscarriage experiences [32–34]. Furthermore, the results of this study concur with the only other SPDCE of women's preferences for attributes of first-trimester miscarriage, the study by Ryan and Hughes [21], which identified a general preference for surgical over medical management. In the study by Ryan and Hughes [21], "complications following treatment" was the primary determinant of women's preferences followed by "level of pain experienced." In addition, this study highlighted that preferences, in terms of WTP values for attribute shifts, varied significantly between women allocated to differing arms of the trial. This implies that preferences for the attribute shifts may be a function of the care women actually received. In

the absence of data mining, such a result could possibly be explained in terms of women's management experiences influencing their perception of attributes. Nevertheless, it is recommended that future studies incorporate appropriate qualitative research to explore this result in a more systematic fashion.

The study presented here also imputed monetary benefits of shifts between management options. On aggregate, surgical management was valued more highly than expectant and medical management by women allocated to medical and expectant management, respectively, while medical management was valued more highly than expectant management by women allocated to surgical management. These results were replicated regardless of the application of either hypothetical data for each attribute generated by the pretrial-designed DCE questionnaires or actual data for each attribute observed in the MIST trial. When these overall monetary estimates are considered in conjunction with the clinical and cost-effectiveness results from the MIST trial, however, there appears to be a divergence of results. The cost-effectiveness analysis based on the MIST trial revealed that expectant management was in fact the most cost-effective option [18]. Future research planned by the authors will integrate the preference data presented in this article with the clinical and cost-effectiveness data generated by the MIST trial within a formal CBA framework.

Although the study design adhered to appropriate methodological practice on application of DCEs within health care [35] at the time of conduct and produced results that can be considered theoretically valid and of relevance to clinicians and decision-makers, there are a number of caveats that should be borne in mind by readers. First, there have been a number of improvements to SPDCE design theory since the design and inception of this study, and thus further work in this area should consider these improvements in methodology [36]. In relation to the estimation of WTP values using SPDCEs, recent work by Lancsar and Savage has recommended that welfare estimates must also take account of the probability of choosing a good, suggesting that the welfare values must be implicitly weighted by the probability of choosing each alternative in the choice set [37]. Nevertheless, Ryan has also shown that when using state of the world models (as in this study where the choice is binary), the formula advocated by Lancsar and Savage reduces to the method traditionally used by health economists (and used in this analysis) [38]. Nevertheless, further consideration may need to be given on how best to reconcile the DCE-generated welfare estimates and binary choice probabilities. Future studies that offer women all three management options to choose from and allow for the probability of choice as recommended by Lancsar [37] may find these impacts the WTP values for the alternative management options. Second, and also with regard to the design of the DCE, the alternative options were generated through an orthogonal design and set against the constant comparator in the resulting choice sets. Nevertheless, it is now accepted that this is not the most statistically robust technique and future studies should model the constant comparator as a function of the attributes and levels of the main orthogonal, fold-over design. Third, the analyses presented here are all at the aggregate level. Ongoing further research will assess whether and how preferences vary according to the characteristics of respondents, e.g., whether women with different types of miscarriage, who differed in their clinical outcomes in the MIST trial [16], have different preference structures, or whether women from different socioeconomic groups differ in their WTP values. Fourth, we were unable to conduct formal pretesting of our research instruments or follow-up debriefing with respondents about their experience of completing the DCE questionnaire. Synergistic application of

qualitative and quantitative research in our study methods could have provided insight into the respondents' understanding of the experiment, the validity of the choice sets, and their cognitive processes when selecting between choice sets [39]. Fifth, while the survey could have benefited from further reminders to improve the response rate [40], it was felt that because of the unpleasant nature of the women's recent health circumstances, it was important for the survey not to be overly burdensome. Finally, if this study were to be repeated, it is recommended that future SPDCEs in this area use the same questionnaire for all respondents and simply control for their level of experience at the analysis stage as opposed to controlling for their experience at the design stage as in our study. Using the same questionnaire would allow the results to be more comparable across women.

In conclusion, this study provides new evidence of women's preferences for attributes of alternative management options for first-trimester miscarriage, as well as overall monetary estimates of welfare shifts between alternative management options. The results from this study reveal that many women undergoing management of first-trimester miscarriage would value being offered alternatives to expectant management as defined by the attributes in our survey. Data from this study should however be considered by decision-makers, in conjunction with the clinical and cost-effectiveness evidence base in this area, as well as consideration of the budgets available to them for such services. Further research that establishes the validity of our results would aid decision-makers in their deliberations.

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