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Willingness-to-pay to prevent hospital medication administration errors: views from the UK public

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Abstract

Medication errors are common in hospitals. These errors can result in adverse drug events (ADEs), which can reduce the health and wellbeing of patients', and their relatives and caregivers. Interventions have been developed to reduce medication errors, including those that occur at the administration stage.

Objective: We aimed to estimate willingness-to-pay (WTP) values to prevent hospital medication administration errors.

Design and setting: An online, contingent valuation (CV) survey was conducted, using the random card-sort elicitation method, to estimate WTP to prevent medication errors.

Participants: A representative sample of the UK public.

Methods: Seven medication error scenarios, varying in the potential for harm and the severity of harm, were valued. Scenarios were developed with input from: clinical experts, focus groups with members of the public, and piloting. Mean and median WTP values were calculated, excluding protest responses or those that failed a logic test. A two-part model regression analysis was conducted to explore predictive characteristics of WTP.

Results: Responses were collected from 1,001 individuals. The proportion of respondents willing to pay to prevent a medication error increased as the severity of the ADE increased and was highest for scenarios that described actual harm occurring. Mean WTP across the scenarios ranged from £45 (95% CI: £36 - £54) to £278 (95% CI: £200 - £355). Several factors influenced both the value and likelihood of WTP, such as: income, known experience of medication errors, gender, field of work, marriage status, education level, and employment status. Predictors of WTP were not, however, consistent across scenarios.

Conclusions: This CV study highlights how the UK public value preventing medication errors. The findings from this study could be used to carry out a cost-benefit analysis which could inform

implementation decisions on the use of technology to reduce medication administration errors in UK hospitals.

Article Summary

Strengths and Limitations of this study

- First study to obtain UK public preferences for the prevention of hospital medication administration errors.
- Preferences obtained from a representative sample of the UK public which aligns with the interest of policymakers who seek to represent the general public.
- The CV survey design and development adhered to internationally recognised methodological standards.
- Preference results may be subject to biases introduced from respondents' interpretation of scenarios.
- The online format of the survey may introduce bias to the results from a "digital divide".

1. Introduction

Medication errors are common, with a recent review estimating that 237 million medication errors occurred across primary and secondary care settings and care homes every year in England[1]. Over a quarter of these errors had the potential to cause moderate or severe harm[1]. A review of internationally published studies of medication administration errors in hospitals and long-term care facilities reported a median error rate of 21.7% of administered medication doses in the UK (5.5% when wrong time errors were excluded)[2]. Medication errors may result in harm or no harm to the patient (e.g., if a medication was given a little late).

Harm caused as a result of medication use is known as an adverse drug event (ADE) and is formally defined as 'injury resulting from medical interventions related to a drug'[3]. Potential ADEs are defined as medication errors that had the potential to cause harm but this did not occur (e.g., a patient received a drug which they had a documented allergy to but no reaction occurred)[4]. The administration of medication may also result in an unexpected adverse reaction (e.g., a rash caused by a previously unknown allergic reaction) known as a non-preventable ADE. ADEs can result in patient morbidity and mortality in addition to significant distress for their relatives and care providers[5]. Furthermore, there is a substantial cost associated with preventable medication errors. This has been estimated to be over £111 million (2015/16 prices) annually for errors made in primary and secondary care in the UK[1].

Interventions have been developed and implemented to reduce medication administration errors in hospitals. These include the use of health information technology, such as barcode medication administration systems to identify both the patient and the medication is correct at the administration stage[6-8]. A systematic review reported a reduction in medication errors following implementation of a barcode administration system[9]. There is, however, a lack of evidence around the impact of alternative tools to prevent medication administration errors, particularly in a UK setting.

The UK MedEye study[10] was conducted to explore the impact of implementing a novel bedside medication verification system on medication administration errors in hospitals and value the benefit that individuals associated with avoiding such errors. These include patient health benefits, like maintaining their quality of life and non-health benefits, such as maintaining their trust in hospital systems and devices[11].

One approach to measuring the value that patients place on preventing medication errors is by using stated preference techniques[12]; these are so called because individuals are asked to state their preferences regarding their willingness-to-pay (WTP) for the good or outcome under investigation (in this case, preventing medication error and resulting ADEs). Contingent valuation (CV) is a stated preference technique that involves the creation of a hypothetical market in which individuals are asked the maximum amount they would be willing to pay for a good[13,14]. The stated monetary amount is considered to represent the economic value placed on the good by the individual[15]. Benefits valued using CV are not limited to direct health benefits, therefore, the CV method can also be appropriate when valuing health technologies incorporating non-health benefits. No previous studies have obtained stated preference valuations for preventing medication errors; however, the CV method has previously been used to value the benefit of avoiding adverse events associated with specific health conditions, such as anaemia[16] and whooping cough[17]. Given the gap in the current literature, we conducted a WTP study using the CV method to obtain a monetary value for the holistic benefit from the prevention of hospital medication administration errors.

2. Methods

An online CV survey was developed with Dynata Ltd, a company who have considerable experience in survey development, distribution, and data collection from the UK public.

2.1. Survey development

The survey was developed in five steps. Step 1: Seven hypothetical scenarios were developed for the survey by researchers at Newcastle University (SH and LV) drawing on information from ADE literature[18-20] (see Supplementary material A for descriptions of all scenarios). These were reviewed by two pharmacists, from Newcastle-upon-Tyne hospitals and Newcastle University, to ensure clinical accuracy of descriptions with different levels of harm: (Scenario 1) errors which have no potential to cause harm to the patient, (Scenarios 2-4) errors which have the potential to cause harm to the patient, and (Scenarios 5-7) errors which cause actual harm to the patient. Scenario 1 was included to explore whether people value preventing medication errors in hospital independent of clinical harm caused.

The potential to cause harm and actual harm scenario categories were each then further divided into three scenarios representing the severity of harm associated with each ADE: mild harm, moderate harm, and severe harm (see Figure 1). These were determined to reflect the severity distinctions of both potential and actual ADEs avoided by preventing medication administration errors provided in the literature[18-20]. As medication errors which fall within the "potential to cause harm" category occur more commonly than those in the "actual harm" category[6], there remained an empirical question of whether people would value preventing medication errors which would have only the potential to cause harm differently to those which would cause actual harm.

INSERT FIGURE 1 HERE

Step 2: Two patient and public involvement (PPI) sessions were held; the first (n=3) to help refine the wording of the survey instructions and scenarios and the second (n=4) to identify the most appropriate type of payment to use (i.e., the payment vehicle)[14 21] and identify the most appropriate way to ask the CV question (i.e., the elicitation method)[14 21]. The PPI members suggested that a "*donation to your local hospital trust*" was the preferable payment vehicle compared with additional tax contributions or a one-off payment. When exploring different elicitation methods, the PPI members found that asking an open-ended question, e.g. "*How much would you be willing to pay to* *prevent the medication error?*", was difficult to consider. Alternative approaches were presented, such as a payment card method[22] (i.e. a list of monetary amounts is presented and respondents select the amounts they are WTP) and an iterative bidding technique[22 23] (i.e. respondents are offered an initial monetary amount and, subject to the respondent's WTP response, a follow-up amount is offered which is either lower or higher than the initial monetary amount[21]). There was no strong preference from the PPI members for either method, thus, a version of the payment card method (the random card sort technique[24]) was chosen for the survey.

Step 3: The survey was then tested on a range of volunteers (n=14) with different occupations (e.g., postgraduate students, pharmacists, clinicians, and professional services staff) to ensure that the range of values presented in the random card sort was appropriate for the good being valued. The final range of values used in the survey was: £1, £5, £10, £25, £50, £75, £100, £150, £200, £300, £500, £750, £1000.

Step 4: The survey was further refined by adding a logic test[i] after each scenario to ensure respondents understood whether actual harm was caused because of the medication error in each case. Respondents were then asked whether they would be willing to pay to prevent each medication error. Respondents who were unwilling to pay were asked to select their reason from a list of five possible options (see Box 1) and had an opportunity to provide a free text response under "other". The justifications selected for unwillingness to pay were used to categorise responses as either a protest response (i.e., the respondent valued preventing the medication error but was unwilling to pay for another reason[25]) or a true zero valuation (i.e., a reason indicating that a respondent truly did not value the intervention). The options *"Avoiding the medication mistake is valuable to me but it should be funded by existing government budgets"* and *"I do not think*

[i] The logic test comprised of one question after each scenario was presented which asked respondents whether any harm is caused because of the medication error described in the scenario. Correct answers which passed the logic test were "no harm" for scenarios 1-4, and "yes, harm caused" for scenarios 5-7.

donations to my local hospital trust should fund this" were considered protests against the method of payment. The free text responses were examined independently by two members of the research team (SH and LV) who categorised each response as either a protest or a true zero. Where opinions differed for response categorisation, a final decision was made via discussion between the two researchers and no third-party input was required.

Respondents who indicated WTP to prevent the medication error completed a random card sort in which monetary amounts were displayed randomly and respondents would indicate whether they "would pay", "would maybe pay", or "would not pay" each amount in turn. The random card sort was introduced to allow respondents to think through how they value preventing each medication error before being asked an open-ended question: *"What is the MAXIMUM value you would be willing to pay as a one-off donation to your local hospital trust to avoid the medication mistake?".* The respondent's choices of monetary values that they were willing/not willing-to-pay during the random card sort were displayed when asking the open-ended question, to help guide the respondent to state their maximum WTP. The open-ended question allowed for greater sensitivity to individual WTP and provided continuous rather than interval data for analysis.

Step 5: An online pilot of the survey was conducted by Dynata to their UK panel in February 2020, which obtained responses from 166 respondents. Small changes were made to the scenario descriptions (i.e. emphasising some text in bold and adding a clarification of the harm associated with each error in the scenario title) in response to the pilot, predominantly to improve the proportion of respondents passing the logic test. The fully developed survey was then finalised.

2.2. Patient and Public Involvement

As described above, two PPI sessions were held to inform the design of the CV survey.

2.3. Data Collection

Dynata distributed the online survey to their UK panel on 2nd March 2020 and received all responses on 18th March 2020. The sample collected was representative of the adult UK public according to age, gender, and occupational group. In addition to the WTP questions, demographic characteristics were also collected (see Table 1 for all characteristics collected). A required sample size of 502 was calculated following the sample size calculation recommended by Mitchell & Carson[22] (see Supplementary material B for full details of the sample size calculation). The sample size was inflated to account for the proportion of data that would not count towards analysis, using data on failed logic responses and protests from the soft launch, resulting in a desired sample size of 996.

2.4. Data analysis

Survey data were analysed using statistical software STATA 15[26]. Descriptive statistics were conducted to estimate mean and median WTP. Protest responses were removed from the sample prior to analysis following conventional practice[27], so as not to downwardly bias WTP estimates. Base-case analysis also excluded responses which failed the logic test for each scenario. Sensitivity analyses were conducted to explore the impact on mean WTP from trimming the highest 1% of values and from including responses that failed the logic test.

Regression analysis was conducted to identify predictors of WTP. Due to a large proportion of zero values and a skewed data distribution, standard ordinary least squares estimators would have provided biased and inconsistent estimates[28]. Limited dependent variable models (such as two-part, Tobit, or selectivity) have been recommended for open-ended data including zero values[29]; therefore, a two-part model was employed in order to take account of the zero WTP values in the regression analysis[30]. A sensitivity analysis was conducted which included respondents who failed the logic test for scenarios 1-4[ii] but also reported personal experience of a medication error. This sensitivity analysis was prompted in response to an analysis of respondent characteristics based on responses to the logic test. This analysis showed that those failing the logic tests for scenarios 1-4[iii] were more likely to report known experience of prior error. Therefore, the base-case analysis for these scenarios was potentially biased towards individuals who had no known experience of a medication error.

3. Results

In total, 1,001 responses were received to the survey. Table 1 outlines the demographic characteristics of the full sample survey participants (see Table S1 in Supplementary material C for characteristics of the sample included in analysis for each scenario separately). Most of the sample had no known personal or familial experience of medication errors.

INSERT TABLE 1 HERE

Across the scenarios, 56%-88% of respondents passed the logic test and were included in the base-case analysis (see Table 2). Fewer respondents passed the logic test for the potential harm scenarios than for the actual harm scenarios. Table 2 describes the number and type of response for each scenario. There was a similar proportion of protest responses across all scenarios in the base-case analysis (~45% of the sample); however, the proportion of respondents willing to pay to prevent the medication error increased between the potential and actual harm scenarios and increased as the severity of the ADE and medication error increased.

INSERT TABLE 2 HERE

[ii] i.e. respondents who believed harm was caused by the medication errors which had no potential to cause harm and potential to cause harm

[iii] There was no difference in medication error experience between those who passed and failed the logic test for scenarios 5-7

Both mean and median WTP were positive for all scenarios. The lower bound of the 95% confidence intervals (95% CIs) around mean WTP were substantially greater than zero for all scenarios, which suggests with confidence that true mean WTP is positive. Both mean and median WTP increase as severity of ADE increases and between potential and actual harm scenarios. Mean WTP ranged from £45 (95% CI: £36 - £54) to prevent a medication error which causes no harm, to £278 (95% CI: £200 - £355) to prevent a medication error which causes life-threatening actual harm (see Table 3).

The 95% CIs were widest for the larger mean WTP values, which suggests the presence of outlier WTP values for the most severe actual ADE scenarios. The comparable 95% CIs when the top 1% of WTP values were trimmed are substantially narrower, validating the theory that a few, large outliers in the base-case sample skewed the results. However, for the trimmed WTP sample, there is evidence that both mean and median WTP remain greater than zero (see Table 3).

Including failed logic responses increased estimates of mean and median WTP for the no-harm and potential harm scenarios and reduced estimates for the actual harm scenarios (see Table 3). This result is expected given that incorrect logic responses to the potential ADE scenarios anticipated harm from the medication error, and vice versa for the actual harm ADE. It is logical that respondents anticipating harm from the medication error in the potential harm scenarios may have been willing to pay more than those correctly anticipating no harm occurring. The converse would be true for the actual harm ADEs.

INSERT TABLE 3 HERE

Regression analysis

The base-case regression analysis results are reported in Table 4. In the base-case analysis, there is evidence that having a family member who had experienced a medication error had an impact on both respondents' decision to pay to prevent the medication error (part 1 of the model) and the amount respondents offered (part 2 of the model). The logit columns of Table 4 report the odds of demonstrating a positive WTP to prevent the medication error in each scenario. For each of the potential harm scenarios, there is evidence that the odds of WTP are 2.5 to 3 times greater for respondents who have familial experience of a medication error (p<0.05).

Factors predicting likelihood of WTP

Table 4 also demonstrates evidence that having an annual household income greater than £40,000 (p<0.05), being male (p<0.01), working in a non-health sector field (p<0.05), being married (p<0.05), and having higher education (p<0.01) all increased the odds of being willing to pay to prevent a medication error and, thus, an ADE. However, evidence is not consistent across all scenarios. There is also evidence that having an annual household income of less than £20,000 decreased the odds of WTP a positive amount (OR:0.49-0.53, p<0.05).

Factors predicting a lower WTP amount

When it comes to WTP values, Table 4 also shows evidence that respondents under the age of 35 (p<0.05) and those who are unemployed (p<0.05) or unpaid workers (p<0.01) offered lower WTP amounts than their comparative respondents (see Table 4 for details of base factors).

Factors predicting a higher WTP amount

Respondents with higher education (p<0.01) and annual household incomes above £40,000 (p<0.01) were willing to pay higher amounts than their comparative respondents. For most of the scenarios, there is no evidence that respondents with the lowest household incomes offered different WTP amounts to respondents in the mid-range household income category (£20,000-£40,000).

INSERT TABLE 4 HERE

Sensitivity Analysis

The sensitivity analysis is reported in Table S2 in supplementary material C. This analysis includes respondents who failed the logic test for the first four scenarios (in which failure was characterised by participants believing harm is caused in the four scenarios in which no ADE occurs) but reported personal experience of a medication error. The results of this sensitivity analysis closely mirror those of the base-case analysis, apart from the impact of personal medication error experience and familial medication error experience. Table S2 shows that in the no potential to cause harm, potential for mild harm, and potential for moderate harm scenarios, known personal medication error experience increased the odds of stating WTP to prevent the medication error substantially (OR: 2.65-3.67; p<0.01).

The evidence of impact of known familial experience of a medication error is, however, reduced in the sensitivity analysis compared to the base-case; there is only evidence of an increase in odds of WTP for one scenario (potential for mild harm scenario) compared to all three potential harm scenarios in the base-case.

4. Discussion

The results from this CV study suggest that the UK public value preventing medication errors, even in situations where no ADE occurred. However, a smaller proportion of respondents valued preventing medication errors which have no potential to cause an ADE (Scenario 1: 54%) compared with preventing errors which cause actual harm (Scenarios 5-7: ~80%) and errors with potential to cause harm (Scenarios 2-4: ~65%). This provides a degree of face validity to the study as it was expected that more respondents would value the prevention of errors that could cause harm than errors that are not associated with any harm to patients. Despite the lower proportion of respondents valuing errors causing no harm compared to preventing those resulting in ADEs, over half of the analytic sample did value the prevention of errors which had little to no likelihood of resulting in harm. This suggests that the UK public attribute, and positively value, non-health benefits from the prevention of medication errors, such as increased trust in healthcare provision. Thus, low cost interventions that can prevent medication administration errors, regardless of the potential for harm prevented as a result, may still be efficient from a UK societal perspective due to the value placed on non-health benefits associated with preventing medication errors.

The sensitivity regression analysis results further substantiate this conclusion. This analysis was conducted after identifying evidence of a difference in known personal medication error experience between respondents who passed and those who failed the logic test for the first four scenarios (i.e. those in which no ADE occurs as a results of the medication error). It is assumed that individuals who have experienced a medication error personally are more informed about the impacts of such errors than individuals who have no personal experience. The failures in the logic test could be due to misunderstanding the question or misreading the scenarios, however, the significant difference between passes and failures characterised by individuals with experience in medication errors suggests that these respondents are aware of harms caused to patients from medication errors, regardless of whether an ADE occurs. One explanation could be that respondents who have experienced medication errors personally encountered non-health-related harms as a result. To explore this theory, respondents who failed the logic test for the first four scenarios and reported personal experience of a medication error were included in a sensitivity regression analysis (all other logic failures remained excluded). This sensitivity analysis demonstrated that personal medication error experience increased the likelihood of a respondent being willing to pay to prevent medication errors in the scenarios in which no actual ADE occurs as a result. These results further support a theory that those with personal medication error experience perceive non-health-related benefits from preventing medication errors as those individuals are more likely to value error prevention than individuals without similar experience in situations where errors do not result in an ADE.

Several other predictors of WTP were identified from the regression analysis; however, these were not consistent across all scenarios, suggesting that the respondent characteristics examined in our analysis did not largely drive decisions on WTP. There may be other respondent characteristics that predict WTP to prevent medication administration errors that were not analysed in this study due to limitations in our data collection, such as participants’ medication regimes, however, it was beyond the scope of our survey to collect this information. One consistent predictor of WTP was household income; there was evidence that respondents in the highest household income group (over £40,000 annually) were consistently either more willing to pay to prevent medication errors or offer a higher WTP value. Conversely, respondents in the lowest household income group (less than £20,000 annually) were less likely to be willing to pay to prevent the medication errors. The link between ability to pay and WTP is expected in CV studies as the greater an individual's ability to pay, the greater their position is to offer a positive WTP value and the higher that value can be. Therefore, this finding indicates theoretical validity of the survey[31-33].

Although the survey produced skewed data, which is common in CV surveys[34], with a substantial proportion of zeros, mean and median WTP were consistently and confidently positive across all scenarios. Trimming the top 1% of values to remove any potential outliers had no impact on median WTP and mean WTP, suggesting that the findings of this study, with regards to the UK public valuing the prevention of medication errors, are robust.

The CV survey design and development adhered to internationally recognised methodological standards[14,35] and the study sought to seek the views of a representative sample of the UK public. Thorough pilot testing allowed us to refine and simplify the survey. Furthermore, recent literature has reported that the random card sort technique, which was used in this survey, may produce more valid responses than the standard payment card method[36]. Thus, the choice of this elicitation method over the standard payment card method adds to the validity of the results. In addition, asking open-ended questions without any context has been demonstrated to be cognitively burdensome[12] and has potential to result in large proportions of non-responses, zero responses and outliers[22]. Therefore, conducting the random card sort task prior to asking the open-ended question was intended to minimise some of these biases whilst enabling more granular WTP responses from the open-ended question compared to responses from the random card sort task alone. However, the findings of our study should be interpreted in the light of some limitations.

Potential biases may have been introduced from respondents' interpretation of scenarios relating to details that were not included in the scenarios such as the duration of symptoms or likelihood of ADE occurrence. The heterogeneity of WTP responses could be explained by different interpretations of how long symptoms would last or the probability of symptoms occurring, and the extent of the negative impact the medication errors could have on patient wellbeing. Additionally, the construction of the survey itself may have introduced bias from the order in which scenarios were presented[37] and the payment vehicle used[22 38]. The scenarios were presented in the same order to each participant (no potential for harm, potential harm increasing in severity, then actual harm increasing in severity) and there were some objections to the payment vehicle from respondents, although these responses were removed from the analysis as protest zeros. Both the order of the scenarios presented, and the payment vehicle, were tested in PPI sessions and the final decisions based on feedback from the public representatives' feedback. The use of online survey panels may have limited the findings of our study by excluding members of the public who have not joined the market research panel used by Dynata Ltd to recruit respondents. In addition, the survey was not available to individuals without access to the internet. There may be differences in the characteristics of individuals on either side of the *digital divide*, thus, potentially biasing the results against those unable to participate due to access limitations.

4.1. Conclusion

This study has identified that the UK public value preventing medication errors, even in instances where no harm occurs. The value placed on preventing medication errors increases as the level of harm occurring because of the error increases. Individuals with higher household income are more likely to be willing-to-pay to prevent a medication error and will offer greater amounts than individuals with lower incomes and known personal experience of a medication error had an impact on respondents' WTP to prevent medication errors in a sensitivity analysis. Other factors predict WTP (e.g. higher education, being male, working in a non-health sector field, and being married), however, these are not consistent across all scenarios. The mean WTP results were robust to several sensitivity analyses; therefore, the WTP estimates elicited in this study provide reliable information on the value to the UK public of preventing medication errors.

This study has potential to impact future practice in medication administration in hospitals in the UK as the WTP findings from this study can be used to carry-out a cost-benefit analysis[34] to explore the net monetary benefits of interventions to prevent medication errors in hospitals. The cost-benefit analysis could inform policymakers' decisions regarding implementation of medication-error prevention interventions.

Declarations

Funding

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Competing interests

No competing interests for any of the authors.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

Ethical approval to conduct the contingent valuation study was obtained from Newcastle University Ethics Committee on 18/07/2019 (Ref: 14156/2018). Survey respondents were informed at the start of the survey that completion of the survey constituted consent to take party in the study. No identifiable data were collected.

Author contributions

SH contributed to the design of the study, data collection, data analysis and write-up of the paper. NB contributed to the design of the study and write-up of the paper. CB contributed to the design of the study and the write-up of the paper. SS contributed to the design of the study and write-up of the paper. LV contributed to the design of the study, data analysis, write-up of the paper and general oversight of the study.

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Box 1 Reasons for unwillingness to pay

1. Avoiding the medication mistake is not valuable to me
2. Avoiding the medication mistake is valuable to me but I can't afford it
3. I do not think donations to my local hospital trust should fund this
4. Avoiding the medication mistake is valuable to me but it should be funded by existing government budgets
5. Other

Table 1 Characteristics of full initial sample

Respondent characteristic	Initial sample (N=1,001) Frequency (%)		UK national proportions+, %
Sex			
Male	498	(49.8%)	48.7
Female	502	(50.1%)	51.3
Prefer not to say	1	(0.1%)	-
Age			
18-24	153	(15.3%)	14.8
25-34	161	(16.1%)	16.6
35-44	170	(17.0%)	17.3
45-54	175	(17.5%)	17.2
55-64	156	(15.6%)	14.6
65+	186	(18.6%)	19.5
Region			
England	852	(85.1%)	84
Scotland	82	(8.2%)	8.1
Wales	48	(4.8%)	4.7
Northern Ireland	19	(1.9%)	2.7
Occupational group †			
A	56	(5.6%)	4
B	223	(22.3%)	23
C1	288	(28.8%)	28
C2	191	(19.1%)	20
D	125	(12.5%)	15
E	118	(11.8%)	10
Marriage status			
Married/cohabiting	539	(53.8%)	51.2
Single	340	(34.0%)	34.4
Divorced/widowed	121	(12.1%)	14.4
Prefer not to say	1	(0.1%)	-
Employment status			
Full time	378	(37.8%)	-
Part time	131	(13.1%)	-
Self employed	73	(7.3%)	-
Unemployed	117	(11.7%)	-
Retired	200	(20.0%)	-
Full time student	58	(5.8%)	-
Part time student	2	(0.2%)	-
Other	42	(4.2%)	-
Working in the health sector			
Yes	113	(11.3%)	-
No	669	(66.8%)	-
Not applicable	219	(21.9%)	-

Studying a health-related field			
Yes	8	(0.8%)	-
No	52	(5.2%)	-
Not applicable	941	(94.0%)	-
Education			
Degree	363	(36.3%)	-
Higher education below degree	114	(11.4%)	-
A-level	220	(22.0%)	-
GCSE A*-C	221	(22.1%)	-
GCSE D-G	47	(4.7%)	-
Foreign qual	2	(0.2%)	-
No formal qualifications	34	(3.4%)	-
Annual household income (£)			
0 - 12K	110	(11.0%)	-
12K-20K	167	(16.7%)	-
20K - 30K	220	(22.0%)	-
30K - 40K	166	(16.6%)	-
40K - 50K	116	(11.6%)	-
50K - 70K	89	(8.9%)	-
70K - 100K	64	(6.4%)	-
100K +	16	(1.6%)	-
Prefer not to say	40	(4.0%)	-
Unknown	13	(1.3%)	-
Known personal experience of a medication mistake			
Experience	74	(7.4%)	-
No experience	880	(87.9%)	-
Unsure	47	(4.7%)	-
Harm suffered from the mistake			
Harm	29	(39.2%)*	-
No harm	41	(55.4%)*	-
Unsure	4	(5.4%)*	-
Friend or family member known experience of a medication mistake			
Experience	174	(17.4%)	-
No experience	729	(72.8%)	-
Unsure	98	(9.8%)	-
Harm suffered from the mistake			
Harm	102	(58.6%)*	-
No harm	51	(29.3%)*	-
Unsure	21	(12.1%)*	-

[+]National proportions reported where available. Marriage status for England and Wales only

[†] Occupational groups: A=Higher managerial, administrative and professional, B=Intermediate managerial, administrative and professional, C1=Supervisory, clerical and junior managerial, administrative and professional, C2=Skilled manual workers, D=Semi-skilled and unskilled manual workers, E=State pensioners, casual and lowest grade workers, unemployed with state benefits only.

*% of those reporting personal/familial experience of medication mistake

Table 2. Initial sample and unwillingness to pay responses

Scenarios	No potential for harm	Potential harm (mild)	Potential harm (moderate)	Potential harm (severe)	Actual harm (mild)	Actual harm (moderate)	Actual harm (severe)
Initial sample (N)	1,001	1,001	1,001	1,001	1,001	1,001	1,001
Number passing logic test (%)	867 (86.6)	616 (61.5)	568 (56.7)	565 (56.4)	787 (78.6)	865 (86.4)	885 (88.4)
Number of protest-zero WTP responses*	344	277	274	266	358	383	379
Number of positive WTP responses*	284	199	192	209	336	387	422
Number of true zero WTP responses*	239	140	102	90	93	95	84
Number excluded for other reasons, e.g. clear misunderstanding of WTP question or scenario description	10	8	6	6	8	14	0
Reasons for unwillingness to pay (N)**							
Avoiding the medication mistake is not valuable to me	120	46	23	20	17	9	6
Avoiding the medication mistake is valuable to me but I can't afford it	92	84	73	64	68	77	66
I do not think donations to my local hospital trust should fund this	89	64	64	71	63	63	60
Avoiding the medication mistake is valuable to me but it should be funded by existing government budgets	243	198	194	181	277	296	292
Other	39	25	22	20	26	33	39

*Only respondents who pass logic test included in numbers
**Includes both protest-zero and true-zero responses of respondents who passed the logic test

Table 3 Mean and median WTP for base-case and sensitivity analyses, GBP£

Scenarios	No harm	Potential harm (significant)	Potential harm (serious)	Potential harm (life threatening)	Actual harm (significant)	Actual harm (Serious)	Actual harm (life threatening)
Base-case							
Mean	45	53	72	96	115	153	278
(95% CI)	(36 - 54)	(37 - 69)	(49 - 95)	(70 - 123)	(87 - 144)	(121 - 185)	(200 - 355)
Median	5	10	15	25	35	50	63
(IQR)	0-50	0-50	0-75	0-100	0-100	0-150	0-200
Trimmed values							
Mean	37	40	56	79	82	126	195
(95% CI)	(31 - 44)	(32 - 47)	(43 - 69)	(61 - 96)	(70 - 95)	(107 - 145)	(163 - 227)
Median	5	10	15	25	30	50	55
(IQR)	0-50	0-50	0-75	0-100	5-100	10-125	10-200
Including failed logic responses							
Mean	70	80	90	120	103	142	259
(95% CI)	(57 - 82)	(65 - 96)	(74 106)	(99 - 141)	(80 - 127)	(114 - 169)	(188 - 330)
Median	10	20	25	35	25	50	50
(IQR)	0-75	0-75	0-100	1-100	0-100	0-123	0-200

95% CI: 95% Confidence interval, IQR: Interquartile range

Table 4 Results of two-part model regression analysis with dependent variable WTP

Covariates	No potential for harm		Potential harm (significant)		Potential harm (serious)		Potential harm (life threatening)		Actual harm (significant)		Actual harm (Serious)		Actual harm (life threatening)	
	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)
	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*
Female	**0.577****	-0.107	0.764	-0.063	0.972	-0.239	0.741	-0.043	**0.590***	-0.206	0.798	-0.300	1.036	**-0.586****
	(0.110)	*(0.177)*	*(0.186)*	*(0.277)*	*(0.271)*	*(0.260)*	*(0.212)*	*(0.255)*	*(0.153)*	*(0.194)*	*(0.199)*	*(0.170)*	*(0.268)*	*(0.189)*
UK resident outside England	1.002	0.042	0.783	0.735	0.740	-0.178	1.427	-0.320	1.190	0.357	1.404	0.368	1.318	0.064
	(0.262)	*(0.245)*	*(0.266)*	*(0.400)*	*(0.276)*	*(0.38)1*	*(0.558)*	*(0.324)*	*(0.443)*	*(0.257)*	*(0.538)*	*(0.228)*	*(0.510)*	*(0.257)*
Married	1.156	-0.122	1.233	-0.021	1.051	0.237	0.891	-0.375	1.070	0.121	1.373	0.127	**1.942***	-0.055
	(0.247)	*(0.209)*	*(0.336)*	*(0.283)*	*(0.318)*	*(0.286)*	*(0.283)*	*(0.277)*	*(0.320)*	*(0.22)1*	*(0.38)7*	*(0.187)*	*(0.574)*	*(0.212)*
Age														
Under 35	1.202	**0.486***	0.944	0.416	1.624	**0.651***	1.658	0.189	1.325	0.122	1.053	0.177	0.999	0.079
	(0.284)	*(0.228)*	*(0.278)*	*(0.370)*	*(0.567)*	*(0.314)*	*(0.617)*	*(0.331)*	*(0.441)*	*(0.233)*	*(0.335)*	*(0.206)*	*(0.332)*	*(0.230)*
Over 65	1.497	0.241	1.060	-0.079	2.442	0.147	0.985	0.114	0.701	-0.047	0.941	-0.142	1.273	0.319
	(0.659)	*(0.341)*	*(0.618)*	*(0.651)*	*(1.637)*	*(0.610)*	*(0.674)*	*(0.556)*	*(0.417)*	*(0.403)*	*(0.547)*	*(0.342)*	*(0.711)*	*(0.374)*
Employment status														
Unemployed	0.827	0.110	1.248	0.182	1.169	0.049	2.610	-0.331	1.539	-0.033	0.887	0.014	0.385	**-0.739***
	(0.361)	*(0.336)*	*(0.714)*	*(0.636)*	*(0.766)*	*(0.604)*	*(1.793)*	*(0.534)*	*(0.919)*	*(0.385)*	*(0.503)*	*(0.330)*	*(0.209)*	*(0.327)*
Student	1.332	0.031	4.344	0.161	-	-	-	-	-	-	-	-	-	-
	(0.833)	*(0.580)*	*(3.771)*	*(0.863)*										
Disabled	2.226	-0.020	6.093	0.036	5.634	0.640	12.669	-0.221	3.231	-0.228	0.877	-0.001	0.619	-1.129
	(2.013)	*(0.867)*	*(6.390)*	*(0.983)*	*(7.524)*	*(0.971)*	*(17.116)*	*(0.932)*	*(3.386)*	*(0.710)*	*(0.824)*	*(0.646)*	*(0.626)*	*(0.631)*
Unpaid worker	0.958	-0.882	2.471	-1.187	0.680	-0.938	6.061	-0.866	1.436	**-2.194***	1.030	**-1.977****	0.169	**-1.670***
	(0.796)	*(0.861)*	*(2.773)*	*(1.143)*	*(0.708)*	*(1.008)*	*(6.915)*	*(0.894)*	*(1.581)*	*(0.875)*	*(1.321)*	*(0.753)*	*(0.164)*	*(0.747)*
Education level														
Higher education	1.018	-0.019	1.067	0.292	1.472	0.308	1.379	0.303	1.420	0.169	1.339	**0.431***	**2.231****	**0.598****
	(0.201)	*(0.195)*	*(0.275)*	*(0.282)*	*(0.430)*	*(0.264)*	*(0.411)*	*(0.253)*	*(0.389)*	*(0.201)*	*(0.354)*	*(0.172)*	*(0.625)*	*(0.185)*
No formal qualifications	2.742	-0.463	1.948	0.129	1.189	0.037	0.921	-0.304	0.558	-0.042	0.668	0.148	0.958	0.411
	(1.675)	*(0.492)*	*(1.395)*	*(0.700)*	*(0.805)*	*(0.626)*	*(0.622)*	*(0.629)*	*(0.317)*	*(0.615)*	*(0.371)*	*(0.491)*	*(0.557)*	*(0.565)*

Covariates	No harm		Potential harm (significant)		Potential harm (serious)		Potential harm (life threatening)		Actual harm (significant)		Actual harm (Serious)		Actual harm (life threatening)	
	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)
	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*
Household income														
Under £20-40k	**0.533***	-0.344	0.582	-0.117	**0.493***	-0.209	0.563	0.068	0.623	0.353	0.620	**0.652****	0.698	0.486
	(0.132)	*(0.247)*	*(0.183)*	*(0.406)*	*(0.177)*	*(0.386)*	*(0.210)*	*(0.363)*	*(0.207)*	*(0.280)*	*(0.190)*	*(0.243)*	*(0.224)*	*(0.265)*
Over £40K	0.908	0.223	**1.995***	0.116	**2.197***	0.319	**2.176***	0.387	1.779	**0.778***	1.966	**0.960****	1.368	**0.847****
	(0.218)	*(0.222)*	*(0.645)*	*(0.328)*	*(0.831)*	*(0.310)*	*(0.856)*	*(0.301)*	*(0.614)*	*(0.223)*	*(0.702)*	*(0.195)*	*(0.478)*	*(0.218)*
Personal medication error experience														
Yes	1.651	0.077	1.253	-0.020	3.621	-0.574	2.203	-0.103	2.791	0.223	1.588	0.241	1.264	-0.284
	(0.695)	*(0.374)*	*(0.813)*	*(0.658)*	*(3.089)*	*(0.568)*	*(1.716)*	*(0.696)*	*(1.843)*	*(0.347)*	*(0.878)*	*(0.317)*	*(0.611)*	*(0.378)*
Unsure	1.135	-0.132	0.665	0.333	0.569	0.207	2.207	-0.658	1.494	-0.095	0.687	-0.495	2.429	**-0.915***
	(0.519)	*(0.445)*	*(0.463)*	*(0.740)*	*(0.401)*	*(0.658)*	*(1.987)*	*(0.584)*	*(1.056)*	*(0.473)*	*(0.424)*	*(0.462)*	*(1.975)*	*(0.455)*
Family medication error experience														
Yes	1.629	-0.315	**2.569***	-0.519	**2.627***	-0.178	**3.030***	-0.109	0.794	-0.214	1.666	0.110	0.688	**0.497***
	(0.450)	*(0.249)*	*(0.976)*	*(0.356)*	*(1.128)*	*(0.335)*	*(1.528)*	*(0.355)*	*(0.284)*	*(0.263)*	*(0.664)*	*(0.232)*	*(0.238)*	*(0.244)*
Unsure	1.012	-0.051	**3.660***	-0.499	2.202	0.344	1.825	0.366	1.709	-0.450	0.908	-0.281	1.244	-0.063
	(0.371)	*(0.388)*	*(2.149)*	*(0.498)*	*(1.507)*	*(0.554)*	*(1.282)*	*(0.520)*	*(0.945)*	*(0.341)*	*(0.403)*	*(0.321)*	*(0.640)*	*(0.325)*
Health sector work														
Yes	0.803	-0.231	1.129	-0.019	**0.271***	-0.460	**0.258***	0.462	2.060	0.102	1.035	0.001	0.684	0.011
	(0.258)	*(0.305)*	*(0.507)*	*(0.534)*	*(0.155)*	*(0.605)*	*(0.145)*	*(0.635)*	*(1.097)*	*(0.312)*	*(0.446)*	*(0.269)*	*(0.279)*	*(0.328)*
Health field study														
Yes	1.293	-1.702	0.444	**-2.971***	-	-2.256	-	-1.355	0.222	-1.236	0.336	-0.221	**0.095***	0.333
	(1.414)	*(1.094)*	*(0.637)*	*(1.335)*		*(1.190)*		*(1.017)*	*(0.238)*	*(1.023)*	*(0.436)*	*(0.946)*	*(0.108)*	*(1.103)*
Constant	1.665	**4.435****	1.013	**4.286****	1.468	**3.883****	3.029	**4.785****	**8.307***	**4.241****	4.542	**4.629****	3.910	**4.938****
	(0.463)	*(0.262)*	*(0.357)*	*(0.438)*	*(1.445)*	*(0.926)*	*(3.130)*	*(0.868)*	*(8.102)*	*(0.649)*	*(3.975)*	*(0.562)*	*(3.674)*	*(0.601)*
Observations	515		335		288		293		424		474		506	

Base factors: Male, Resident in England, Aged 35-65, Unmarried, Employed, School-level qualifications, annual household income £20,000-£40,000, No personal experience of medication error, No familial experience of medication error, working in a non-health sector role, Studying in a non-health field

**p<0.05, **p<0.01*

Coeff.: coefficient, GLM: Generalised linear model, S.E.: Standard error

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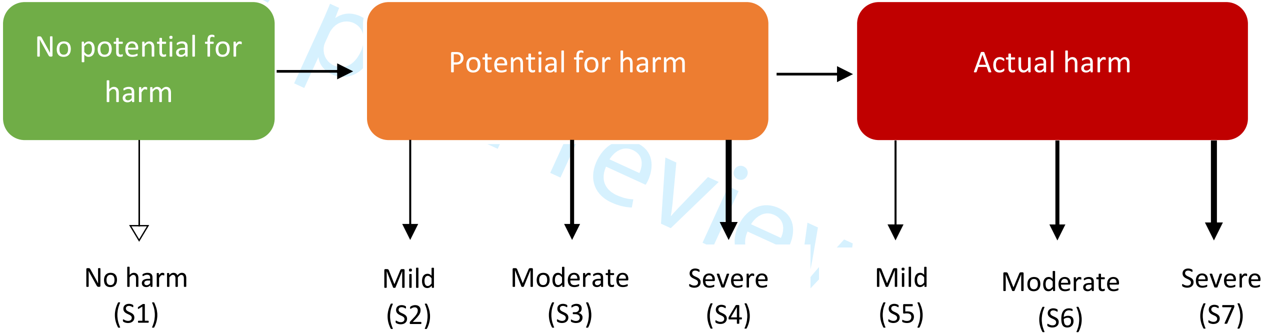
No potential for harm
Potential for harm
Actual harm
No harm (S1)
Mild (S2)
Moderate (S3)
Severe (S4)
Mild (S5)
Moderate (S6)
Severe (S7)

*S=Scenario

Supplementary material A

The seven descriptions of ADEs presented in the survey for each of the hypothetical scenarios are displayed below.

Medication error with no harm

Non-harmful mistake – no actual harm is caused

You are in hospital as a result of a serious illness and you have to take medication in order to get better. A mistake is made in the timing of your medication but the mistake is **not serious enough to cause you any harm**. Although your medication is not given at the exact time you should have had it, it is still effective and **your recovery from illness is not affected**.

Medication errors with potential ADEs

Potential mild harm – no actual harm is caused

You are in hospital as a result of a serious illness and you have to take medication in order to get better. A mistake is made when you are given your medication which has the **potential** to cause you harm. For example, the wrong medication is given to you, which means you do not get the medication you need to get better. However, the mistake is noticed quickly and you are soon given the correct medication you need to treat your illness, so that your **recovery is not affected** by the mistake. Luckily, you are also **not harmed** by the medication mistake, but the wrong medication that you were given had the **potential** to cause some new, short-term symptoms, which could have included any of the following:

- Dizziness
- Fatigue
- Constipation or diarrhoea
- Headaches
- Skin rash
- Nausea (feeling sick)

The symptoms could have been harmful and unpleasant to you but would not have posed any threat to your life. However, luckily you did not suffer any of these symptoms and **no actual harm was caused by the mistake.**

Potential moderate harm – no actual harm is caused

You are in hospital as a result of a serious illness and you have to take medication in order to get better. A mistake is made when you are given your medication which has the **potential** to cause you harm. For example, the wrong medication is given to you, which means you do not get the medication you need to get better. However, the mistake is noticed quickly and you are soon given the correct medication you need to treat your illness, so that your **recovery is not affected** by the mistake. Luckily, you are also **not harmed** by the medication mistake, but the wrong medication that you were given had the **potential** to cause some complications, which could have included any of the following:

- Internal bleeding (bleeding inside your body)
- Drop in blood pressure causing light-headedness
- Fever and chills
- Problems with your liver or kidneys

The harm could have been significant enough to make you need to stay in hospital longer for further medical treatment. You may also have needed to take additional medications to fix the complications. The complications could have been harmful to you and may have affected the way your body works but would not have been life-threatening. However, luckily you did not suffer any of these symptoms and **no actual harm was caused by the mistake.**

Potential severe harm – no actual harm is caused

You are in hospital as a result of a serious illness and you have to take medication in order to get better. A mistake is made when you are given your medication which has the **potential** to cause you harm. For example, the wrong medication is given to you, which means you do not get the medication you need to get better. However, the mistake is noticed quickly and you are soon given the correct medication you need to treat your illness, so that your **recovery is not affected** by the mistake. Luckily, you are also **not harmed** by the medication mistake, but the wrong medication that you were given had the **potential** to cause some complications, which could have included any of the following:

- Severe allergic reaction
- Cardiac arrest (heart stops beating)
- Being unable to breathe

You could have had to stay in hospital for longer and be moved to the intensive care area of the hospital. If the complications were not immediately treated then they would have **put you at risk of death or permanent disability**.

However, luckily you did not suffer any of these symptoms and **no actual harm was caused by the mistake.**

Medication errors with actual ADEs

Mild harm – actual harm is caused

You are in hospital as a result of a serious illness and you have to take medication in order to get better. A mistake is made when you are given your medication which **causes you harm**. For example, the wrong medication is given to you so you do not get the medication you need to get better. The medication mistake means that your recovery from the illness is delayed. The wrong medication also causes some new, short-term symptoms, which could include any of the following:

- Dizziness
- Fatigue
- Constipation or diarrhoea
- Headaches
- Skin rash
- Nausea (feeling sick)

The symptoms are harmful and unpleasant to you but do not pose any threat to your life.

Moderate harm – actual harm is caused

You are in hospital as a result of a serious illness and you have to take medication in order to get better. A mistake is made when you are given your medication which **causes you harm**. For example, the wrong medication is given to you so you do not get the medication you need to get better. The medication mistake means that you stop recovering from your illness. The wrong medication also causes some complications, which could include any of the following:

- Internal bleeding (bleeding inside your body)
- Drop in blood pressure causing light-headedness
- Fever and chills
- Problems with your liver or kidneys

The harm is significant enough to make you need to stay in hospital longer for further medical treatment. You may also need to take additional medications to fix the complications.

The complications are harmful to you and affect the way your body works but are not life-threatening.

Severe harm – actual harm is caused

You are in hospital as a result of a serious illness and you have to take medication in order to get better. A mistake is made when you are given your medication which **causes you harm**. For example, the wrong medication is given to you so you do not get the medication you need to get better. The medication mistake means that you stop recovering from your illness. The wrong medication also causes some complications, which could include any of the following:

- Severe allergic reaction
- Cardiac arrest (heart stops beating)
- Being unable to breathe

You would have to stay in hospital for longer and be moved to the intensive care area of the hospital. If the complications were not immediately treated then they would **put you at risk of death or permanent disability**.

Supplementary material B

Mitchell & Carson (2013) set out an approach to determine sample size in contingent valuation studies. Their approach is based on three factors: deviation from true WTP (Δ), relative error (V) and confidence levels (1-α). Equation 1 outlines the sample size calculation where Z represents the Z-score from a standard normal distribution Z~N (0,1) for a given confidence level (1-α). If no prior evidence is available, the Mitchell & Carson recommend assuming a value of 2 for relative error (V).

(Equation 1) $$\left[\frac{Z\hat{V}}{\Delta}\right]^2$$

Sample size was calculated based on a confidence level of 0.05% (z-score = 1.96), relative error of 2 (as no prior evidence was available to direct relative error, Mitchell & Carson's (2013) recommended value was used) and deviation from true WTP of 0.175 (chosen based on a midpoint value of recommended values offered by Mitchell & Carson (2013)). Populating equation 1 with the above values resulted in a sample size of 502 (see equation 2).

(Equation 2) $$\left[\frac{1.96*2}{0.175}\right]^2 = 502$$

Reference

MITCHELL, R. C. & CARSON, R. T. 2013. Using Surveys to Value Public Goods: The Contingent Valuation Method, Taylor & Francis.

Supplementary Material C

Table S1 Characteristics of sample included in base case analysis for each scenario (protest responses and failed logic test responses excluded)

Respondent characteristic	No Harm (N=515)		Potential harm (significant) (N=335)		Potential harm (serious) (N=290)		Potential harm (life-threatening) (N=296)		Actual harm (significant) (N=424)		Actual harm (serious) (N=475)		Actual harm (life-threatening) (N=506)	
	Frequency (%)		Frequency (%)		Frequency (%)		Frequency (%)		Frequency (%)		Frequency (%)		Frequency (%)	
Sex														
Male	248	(48.2%)	162	(48.4%)	135	(46.6%)	139	(47.0%)	213	(50.2%)	226	(47.6%)	241	(47.6%)
Female	267	(51.8%)	173	(51.6%)	155	(53.4%)	157	(53.0%)	211	(49.8%)	248	(52.2%)	265	(52.4%)
Prefer not to say	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	1	(0.2%)	0	(0.0%)
Age														
18-24	87	(16.9%)	60	(17.9%)	57	(19.7%)	50	(16.9%)	77	(18.2%)	90	(18.9%)	91	(18.0%)
25-34	79	(15.3%)	53	(15.8%)	41	(14.1%)	43	(14.5%)	73	(17.2%)	73	(15.4%)	81	(16.0%)
35-44	90	(17.5%)	53	(15.8%)	48	(16.6%)	46	(15.5%)	73	(17.2%)	84	(17.7%)	84	(16.6%)
45-54	93	(18.1%)	61	(18.2%)	44	(15.2%)	54	(18.2%)	77	(18.2%)	85	(17.9%)	87	(17.2%)
55-64	72	(14.0%)	48	(14.3%)	49	(16.9%)	47	(15.9%)	57	(13.4%)	60	(12.6%)	71	(14.0%)
65+	94	(18.3%)	60	(17.9%)	51	(17.6%)	56	(18.9%)	67	(15.8%)	83	(17.5%)	92	(18.2%)
Region														
England	435	(84.5%)	285	(85.1%)	242	(83.4%)	247	(83.4%)	359	(84.7%)	406	(85.5%)	434	(85.8%)
Wales	44	(8.5%)	27	(8.1%)	29	(10.0%)	30	(10.1%)	34	(8.0%)	35	(7.4%)	37	(7.3%)
Scotland	26	(5.0%)	17	(5.1%)	13	(4.5%)	12	(4.1%)	20	(4.7%)	22	(4.6%)	24	(4.7%)
Northern Ireland	10	(1.9%)	6	(1.8%)	6	(2.1%)	7	(2.4%)	11	(2.6%)	12	(2.5%)	11	(2.2%)
Occupational group														
A	27	(5.2%)	15	(4.5%)	13	(4.5%)	13	(4.4%)	24	(5.7%)	32	(6.7%)	30	(5.9%)
B	117	(22.7%)	82	(24.5%)	69	(23.8%)	75	(25.3%)	106	(25.0%)	113	(23.8%)	127	(25.1%)
C1	146	(28.3%)	82	(24.5%)	73	(25.2%)	71	(24.0%)	116	(27.4%)	131	(27.6%)	136	(26.9%)
C2	89	(17.3%)	62	(18.5%)	52	(17.9%)	56	(18.9%)	77	(18.2%)	84	(17.7%)	98	(19.4%)
D	74	(14.4%)	47	(14.0%)	39	(13.4%)	36	(12.2%)	54	(12.7%)	62	(13.1%)	61	(12.1%)
E	62	(12.0%)	47	(14.0%)	44	(15.2%)	45	(15.2%)	47	(11.1%)	53	(11.2%)	54	(10.7%)

Respondent characteristic	No Harm (N=515)	Potential harm (significant) (N=335)	Potential harm (serious) (N=290)	Potential harm (life-threatening) (N=296)	Actual harm (significant) (N=424)	Actual harm (serious) (N=475)	Actual harm (life-threatening) (N=506)
Marriage status							
Married/cohabiting	267 (51.8%)	175 (52.2%)	142 (49.0%)	150 (50.7%)	230 (54.2%)	249 (52.4%)	277 (54.7%)
Single	192 (37.3%)	120 (35.8%)	113 (39.0%)	114 (38.5%)	149 (35.1%)	176 (37.1%)	173 (34.2%)
Divorced/widowed	56 (10.9%)	40 (11.9%)	35 (12.1%)	32 (10.8%)	45 (10.6%)	50 (10.5%)	56 (11.1%)
Employment status							
Full time	182 (35.3%)	116 (34.6%)	96 (33.1%)	96 (32.4%)	169 (39.9%)	182 (38.3%)	187 (37.0%)
Part time	81 (15.7%)	55 (16.4%)	43 (14.8%)	42 (14.2%)	57 (13.4%)	62 (13.1%)	63 (12.5%)
Self employed	41 (8.0%)	23 (6.9%)	21 (7.2%)	23 (7.8%)	31 (7.3%)	34 (7.2%)	36 (7.1%)
Unemployed	64 (12.4%)	45 (13.4%)	42 (14.5%)	42 (14.2%)	47 (11.1%)	56 (11.8%)	59 (11.7%)
Retired	91 (17.7%)	57 (17.0%)	45 (15.5%)	50 (16.9%)	65 (15.3%)	81 (17.1%)	90 (17.8%)
FT student	35 (6.8%)	22 (6.6%)	25 (8.6%)	25 (8.4%)	35 (8.3%)	39 (8.2%)	44 (8.7%)
PT student	1 (0.2%)	1 (0.3%)	1 (0.3%)	1 (0.3%)	1 (0.2%)	1 (0.2%)	1 (0.2%)
Other	20 (3.9%)	16 (4.8%)	17 (5.9%)	17 (5.7%)	19 (4.5%)	20 (4.2%)	26 (5.1%)
Working in the health sector							
Yes	51 (9.9%)	29 (8.7%)	19 (6.6%)	22 (7.4%)	50 (11.8%)	64 (13.5%)	65 (12.8%)
No	344 (66.8%)	222 (66.3%)	186 (64.1%)	189 (63.9%)	272 (64.2%)	295 (62.1%)	311 (61.5%)
Not applicable	120 (23.3%)	84 (25.1%)	85 (29.3%)	85 (28.7%)	102 (24.1%)	116 (24.4%)	130 (25.7%)
Studying a health-related field							
Yes	4 (0.8%)	3 (0.9%)	2 (0.7%)	3 (1.0%)	5 (1.2%)	4 (0.8%)	5 (1.0%)
No	32 (6.2%)	20 (6.0%)	24 (8.3%)	23 (7.8%)	31 (7.3%)	36 (7.6%)	40 (7.9%)
Not applicable	479 (93.0%)	312 (93.1%)	264 (91.0%)	270 (91.2%)	388 (91.5%)	435 (91.6%)	461 (91.1%)
Education							
Degree	188 (36.5%)	117 (34.9%)	105 (36.2%)	108 (36.5%)	172 (40.6%)	189 (39.8%)	198 (39.1%)
Higher education below degree	52 (10.1%)	29 (8.7%)	27 (9.3%)	27 (9.1%)	43 (10.1%)	47 (9.9%)	43 (8.5%)
A-level	126 (24.5%)	84 (25.1%)	66 (22.8%)	73 (24.7%)	84 (19.8%)	94 (19.8%)	112 (22.1%)
GCSE A*-C	106 (20.6%)	75 (22.4%)	63 (21.7%)	58 (19.6%)	84 (19.8%)	99 (20.8%)	108 (21.3%)
GCSE D-G	26 (5.0%)	19 (5.7%)	16 (5.5%)	17 (5.7%)	23 (5.4%)	26 (5.5%)	25 (4.9%)
Foreign qualifications	1 (0.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.2%)	1 (0.2%)	2 (0.4%)
No formal qualifications	16 (3.1%)	11 (3.3%)	13 (4.5%)	13 (4.4%)	17 (4.0%)	19 (4.0%)	18 (3.6%)

Respondent characteristic	No Harm (N=515)		Potential harm (significant) (N=335)		Potential harm (serious) (N=290)		Potential harm (life-threatening) (N=296)		Actual harm (significant) (N=424)		Actual harm (serious) (N=475)		Actual harm (life-threatening) (N=506)	
Annual household income (£)														
0 - 12K	63	(12.2%)	49	(14.6%)	41	(14.1%)	45	(15.2%)	45	(10.6%)	52	(10.9%)	55	(10.9%)
12K-20K	99	(19.2%)	57	(17.0%)	51	(17.6%)	47	(15.9%)	70	(16.5%)	82	(17.3%)	83	(16.4%)
20K - 30K	108	(21.0%)	70	(20.9%)	53	(18.3%)	53	(17.9%)	86	(20.3%)	110	(23.2%)	112	(22.1%)
30K - 40K	77	(15.0%)	51	(15.2%)	46	(15.9%)	44	(14.9%)	65	(15.3%)	62	(13.1%)	71	(14.0%)
40K - 50K	58	(11.3%)	43	(12.8%)	37	(12.8%)	33	(11.1%)	54	(12.7%)	56	(11.8%)	58	(11.5%)
50K - 70K	49	(9.5%)	33	(9.9%)	26	(9.0%)	34	(11.5%)	45	(10.6%)	46	(9.7%)	53	(10.5%)
70K - 100K	28	(5.4%)	14	(4.2%)	17	(5.9%)	18	(6.1%)	35	(8.3%)	39	(8.2%)	43	(8.5%)
100K +	8	(1.6%)	2	(0.6%)	3	(1.0%)	4	(1.4%)	7	(1.7%)	8	(1.7%)	10	(2.0%)
Prefer not to say	20	(3.9%)	14	(4.2%)	13	(4.5%)	14	(4.7%)	13	(3.1%)	16	(3.4%)	17	(3.4%)
Unknown	5	(1.0%)	2	(0.6%)	3	(1.0%)	4	(1.4%)	4	(0.9%)	4	(0.8%)	4	(0.8%)
Personal experience of a medication mistake														
Experience	32	(6.2%)	14	(4.2%)	12	(4.1%)	14	(4.7%)	39	(9.2%)	46	(9.7%)	48	(9.5%)
No experience	458	(88.9%)	308	(91.9%)	264	(91.0%)	269	(90.9%)	367	(86.6%)	411	(86.5%)	438	(86.6%)
Unsure	25	(4.9%)	13	(3.9%)	14	(4.8%)	13	(4.4%)	18	(4.2%)	18	(3.8%)	20	(4.0%)
Harm suffered from the mistake														
Harm	7	(21.9%)	3	(21.4%)	3	(25.0%)	6	(42.9%)	14	(35.9%)	19	(41.3%)	21	(43.8%)
No harm	22	(68.8%)	11	(78.6%)	9	(75.0%)	8	(57.1%)	22	(56.4%)	23	(50.0%)	23	(47.9%)
Unsure	3	(9.4%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	3	(7.7%)	4	(8.7%)	4	(8.3%)
Friend or family member experience of a medication mistake														
Experience	87	(16.9%)	55	(16.4%)	47	(16.2%)	46	(15.5%)	81	(19.1%)	89	(18.7%)	101	(20.0%)
No experience	390	(75.7%)	257	(76.7%)	226	(77.9%)	233	(78.7%)	309	(72.9%)	347	(73.1%)	363	(71.7%)
Unsure	38	(7.4%)	23	(6.9%)	17	(5.9%)	17	(5.7%)	34	(8.0%)	39	(8.2%)	42	(8.3%)
Harm suffered from the mistake														
Harm	46	(52.9%)	33	(60.0%)	26	(55.3%)	26	(56.5%)	48	(59.3%)	52	(58.4%)	57	(56.4%)
No harm	30	(34.5%)	15	(27.3%)	13	(27.7%)	12	(26.1%)	21	(25.9%)	23	(25.8%)	30	(29.7%)
Unsure	11	(12.6%)	7	(12.7%)	8	(17.0%)	8	(17.4%)	12	(14.8%)	14	(15.7%)	14	(13.9%)

[†] Occupational groups: A=Higher managerial, administrative and professional, B=Intermediate managerial, administrative and professional, C1=Supervisory, clerical and junior managerial, administrative and professional, C2=Skilled manual workers, D=Semi-skilled and unskilled manual workers, E=State pensioners, casual and lowest grade workers, unemployed with state benefits only.

Table S2 Sensitivity regression analysis for Scenarios 1-4, including failed logic responses for respondents with experience of a medication error

Covariates	No potential for harm		Potential harm (mild)		Potential harm (moderate)		Potential harm (severe)	
	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)
	Odds Ratio *(S.E)*	Coeff. *(S.E)*	Odds Ratio *(S.E)*	Coeff. *(S.E)*	Odds Ratio *(S.E)*	Coeff. *(S.E)*	Odds Ratio *(S.E)*	Coeff. *(S.E)*
Female	**0.588**** *(0.111)*	-0.152 *(0.166)*	0.724 *(0.171)*	-0.161 *(0.245)*	0.942 *(0.250)*	-0.384 *(0.246)*	0.710 *(0.194)*	-0.113 *(0.218)*
UK resident outside of England	0.995 *(0.258)*	0.125 *(0.228)*	0.876 *(0.289)*	0.574 *(0.338)*	0.746 *(0.264)*	-0.405 *(0.343)*	1.501 *(0.572)*	-0.392 *(0.277)*
Married	1.187 *(0.250)*	-0.209 *(0.199)*	1.200 *(0.316)*	-0.184 *(0.246)*	1.027 *(0.295)*	0.201 *(0.264)*	0.872 *(0.264)*	-0.239 *(0.239)*
Age								
Under 35	1.243 *(0.287)*	**0.573**** *(0.202)*	1.000 *(0.285)*	0.010 *(0.304)*	1.440 *(0.471)*	0.395 *(0.275)*	1.498 *(0.516)*	0.147 *(0.267)*
Over 65	1.476 *(0.655)*	0.163 *(0.343)*	0.948 *(0.543)*	-0.178 *(0.612)*	1.910 *(1.266)*	-0.109 *(0.589)*	0.726 *(0.486)*	0.056 *(0.502)*
Employment status								
Unemployed	0.801 *(0.352)*	0.161 *(0.337)*	1.333 *(0.746)*	-0.022 *(0.610)*	1.149 *(0.748)*	0.051 *(0.593)*	2.670 *(1.797)*	-0.394 *(0.491)*
Student	1.346 *(0.845)*	0.001 *(0.575)*	4.823 *(4.126)*	0.364 *(0.820)*	-	-	-	-
Disabled	1.964 *(1.793)*	-0.181 *(0.853)*	6.721 *(6.967)*	-0.081 *(0.928)*	6.527 *(8.620)*	0.456 *(0.917)*	**14.388*** *(19.141)*	-0.176 *(0.833)*
Unpaid worker	0.924 *(0.773)*	-0.756 *(0.854)*	2.949 *(3.273)*	-1.140 *(1.112)*	0.804 *(0.827)*	-0.782 *(0.999)*	6.81 *(7.663)*	-0.966 *(0.831)*
Educational level								
Higher education	1.012 *(0.197)*	0.011 *(0.177)*	1.098 *(0.272)*	0.057 *(0.239)*	1.353 *(0.370)*	0.245 *(0.230)*	1.286 *(0.362)*	0.193 *(0.210)*
No formal qualifications	2.752 *(1.677)*	-0.513 *(0.482)*	2.108 *(1.497)*	0.072 *(0.683)*	1.298 *(0.862)*	-0.002 *(0.628)*	1.030 *(0.680)*	-0.287 *(0.584)*

Covariates	No potential for harm		Potential harm (mild)		Potential harm (moderate)		Potential harm (severe)	
	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)
	Odds Ratio *(S.E)*	Coeff. *(S.E)*	Odds Ratio *(S.E)*	Coeff. *(S.E)*	Odds Ratio *(S.E)*	Coeff. *(S.E)*	Odds Ratio *(S.E)*	Coeff. *(S.E)*
Household income								
Under £20K	**0.563*** *(0.137)*	-0.139 *(0.228)*	0.606 *(0.183)*	-0.069 *(0.334)*	0.543 *(0.182)*	-0.133 *(0.336)*	0.629 *(0.219)*	-0.018 *(0.298)*
Over £40K	0.899 *(0.213)*	0.344 *(0.209)*	**1.985*** *(0.630)*	0.221 *(0.291)*	**2.380*** *(0.867)*	0.283 *(0.284)*	**2.497*** *(0.947)*	0.312 *(0.255)*
Personal medication error experience								
Yes	**2.652**** *(0.987)*	**0.844**** *(0.307)*	**2.844*** *(1.313)*	0.682 *(0.402)*	**3.667*** *(1.908)*	0.294 *(0.403)*	2.823 *(1.554)*	0.071 *(0.388)*
Unsure	1.125 *(0.515)*	-0.121 *(0.442)*	0.690 *(0.472)*	0.589 *(0.718)*	0.553 *(0.374)*	0.255 *(0.667)*	2.225 *(1.942)*	-0.524 *(0.547)*
Family medication error experience								
Yes	1.58 *(0.427)*	-0.414 *(0.232)*	**2.133*** *(0.753)*	-0.551 *(0.315)*	2.071 *(0.785)*	-0.192 *(0.308)*	1.889 *(0.805)*	-0.181 *(0.286)*
Unsure	1.023 *(0.373)*	-0.239 *(0.372)*	**3.681*** *(2.113)*	-0.647 *(0.460)*	2.426 *(1.627)*	0.279 *(0.530)*	1.947 *(1.349)*	0.262 *(0.459)*
Health sector work								
Yes	0.965 *(0.297)*	0.150 *(0.287)*	1.510 *(0.638)*	0.506 *(0.431)*	0.559 *(0.274)*	0.572 *(0.468)*	0.488 *(0.245)*	0.74 *(0.424)*
Health sector study								
Yes	0.616 *(0.640)*	-1.655 *(1.080)*	0.441 *(0.626)*	**-2.851*** *(1.295)*	-	-2.157 *(1.191)*	-	-1.392 *(0.951)*
Constant	1.612 *(0.439)*	**4.366**** *(0.242)*	1.011 *(0.346)*	**4.712**** *(0.374)*	2.084 *(2.010)*	**4.485**** *(0.869)*	4.258 *(4.247)*	**4.907**** *(0.761)*
Observations	541		373		326		329	

Base factors: Male, Resident in England, Aged 35-65, Unmarried, Employed, School-level qualifications, annual household income £20,000-£40,000, No personal experience of medication error, No familial experience of medication error, working in a non-health sector role, Studying in a non-health field

*p<0.05, **p<0.01

Coeff.: coefficient, GLM: Generalised linear model, S.E.: Standard error

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Eliciting willingness-to-pay to prevent hospital medication administration errors in the UK: a contingent valuation survey

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Abstract

Medication errors are common in hospitals. These errors can result in adverse drug events (ADEs), which can reduce the health and wellbeing of patients', and their relatives and caregivers. Interventions have been developed to reduce medication errors, including those that occur at the administration stage.

Objective: We aimed to elicit willingness-to-pay (WTP) values to prevent hospital medication administration errors.

Design and setting: An online, contingent valuation (CV) survey was conducted, using the random card-sort elicitation method, to elicit WTP to prevent medication errors.

Participants: A representative sample of the UK public.

Methods: Seven medication error scenarios, varying in the potential for harm and the severity of harm, were valued. Scenarios were developed with input from: clinical experts, focus groups with members of the public, and piloting. Mean and median WTP values were calculated, excluding protest responses or those that failed a logic test. A two-part model (logit, GLM) regression analysis was conducted to explore predictive characteristics of WTP.

Results: Responses were collected from 1,001 individuals. The proportion of respondents willing to pay to prevent a medication error increased as the severity of the ADE increased and was highest for scenarios that described actual harm occurring. Mean WTP across the scenarios ranged from £45 (95% CI: £36 - £54) to £278 (95% CI: £200 - £355). Several factors influenced both the value and likelihood of WTP, such as: income, known experience of medication errors, gender, field of work, marriage status, education level, and employment status. Predictors of WTP were not, however, consistent across scenarios.

Conclusions: This CV study highlights how the UK public value preventing medication errors. The findings from this study could be used to carry out a cost-benefit analysis which could inform

implementation decisions on the use of technology to reduce medication administration errors in UK hospitals.

Article Summary

Strengths and Limitations of this study

- First study to obtain UK public preferences for the prevention of hospital medication administration errors.
- Preferences obtained from a representative sample of the UK public which aligns with the interest of policymakers who seek to represent the general public.
- The CV survey design and development adhered to internationally recognised methodological standards.
- Preference results may be subject to biases introduced from respondents' interpretation of scenarios.
- The online format of the survey may introduce bias to the results from a "digital divide".

1. Introduction

Medication errors are common, with a recent review estimating that 237 million medication errors occurred across primary and secondary care settings and care homes every year in England[1]. Over a quarter of these errors had the potential to cause moderate or severe harm[1]. A review of internationally published studies of medication administration errors in hospitals and long-term care facilities reported a median error rate of 21.7% of administered medication doses in the UK (5.5% when wrong time errors were excluded)[2]. Medication errors may result in harm or no harm to the patient (e.g., if a medication was given a little late).

Harm caused because of medication use is known as an adverse drug event (ADE) and is formally defined as 'injury resulting from medical interventions related to a drug'[3]. Potential ADEs are defined as medication errors that had the potential to cause harm but this did not occur (e.g., a patient received a drug which they had a documented allergy to but no reaction occurred)[4]. The administration of medication may also result in an unexpected adverse reaction (e.g., a rash caused by a previously unknown allergic reaction) known as a non-preventable ADE. ADEs can result in patient morbidity and mortality[5] in addition to significant distress for their relatives and care providers[6]. Furthermore, there is a substantial cost associated with preventable medication errors. This has been estimated to be over £111 million (2015/16 prices) annually for errors made in primary and secondary care in the UK[1].

Interventions have been developed and implemented to reduce medication administration errors in hospitals. These include the use of health information technology, such as barcode medication administration systems to identify both the patient and the medication is correct at the administration stage[7-9]. A systematic review reported a reduction in medication errors following implementation of a barcode administration system[10]. There is, however, a lack of evidence around the impact of alternative tools to prevent medication administration errors, particularly in a UK setting.

The UK MedEye study[11] was conducted to explore the impact of implementing a novel bedside medication verification system on medication administration errors in hospitals and value the benefit that individuals associated with avoiding such errors. These include patient health benefits, like maintaining their quality of life and non-health benefits, such as maintaining their trust in hospital systems and devices[12].

One approach to measuring the value that patients place on preventing medication errors is by using stated preference techniques[13]; these are so called because individuals are asked to state their preferences regarding their willingness-to-pay (WTP) for the good or outcome under investigation (in this case, preventing medication error and resulting ADEs). Contingent valuation (CV) is a stated preference technique that involves the creation of a hypothetical market in which individuals are asked the maximum amount they would be willing to pay for a good[14 15]. The stated monetary amount is considered to represent the economic value placed on the good by the individual[16]. Benefits valued using CV are not limited to direct health benefits, therefore, the CV method can also be appropriate when valuing health technologies incorporating non-health benefits. No previous studies have obtained stated preference valuations for preventing medication errors; however, the CV method has previously been used to value the benefit of avoiding adverse events associated with specific health conditions, such as anaemia[17] and whooping cough[18]. Given the gap in the current literature, we conducted a WTP study using the CV method to obtain a monetary value for the holistic benefit from the prevention of hospital medication administration errors.

2. Methods

An online CV survey was developed with Dynata Ltd, a company who have considerable experience in survey development, distribution, and data collection from the UK public.

2.1. Survey development

The survey was developed in five steps. Step 1: Seven hypothetical scenarios were developed for the survey by researchers at Newcastle University (SH and LV) drawing on information from ADE literature[19-21] (see Supplementary material A for descriptions of all scenarios). These were reviewed by two pharmacists, from Newcastle-upon-Tyne hospitals and Newcastle University, to ensure clinical accuracy of descriptions with different levels of harm: (Scenario 1) errors which have no potential to cause harm to the patient, (Scenarios 2-4) errors which have the potential to cause harm to the patient, and (Scenarios 5-7) errors which cause actual harm to the patient. Scenario 1 was included to explore whether people value preventing medication errors in hospital independent of clinical harm caused.

The potential to cause harm and actual harm scenario categories were each then further divided into three scenarios representing the severity of harm associated with each ADE: mild harm, moderate harm, and severe harm (see Figure 1). These were determined to reflect the severity distinctions of both potential and actual ADEs avoided by preventing medication administration errors provided in the literature[19-21]. As medication errors which fall within the "potential to cause harm" category occur more commonly than those in the "actual harm" category[7], there remained an empirical question of whether people would value preventing medication errors which would have only the potential to cause harm differently to those which would cause actual harm.

INSERT FIGURE 1 HERE

Step 2: Two patient and public involvement (PPI) sessions were held; the first (n=3) to help refine the wording of the survey instructions and scenarios and the second (n=4) to identify the most appropriate type of payment to use (i.e., the payment vehicle)[15 22] and identify the most appropriate way to ask the CV question (i.e., the elicitation method)[15 22]. The PPI members suggested that a "*donation to your local hospital trust*" was the preferable payment vehicle compared with additional tax contributions or a one-off payment. When exploring different elicitation methods, the PPI members found that asking an open-ended question, e.g., "*How much would you be willing to pay to* *prevent the medication error?*", was difficult to consider. Alternative approaches were presented, such as a payment card method[23] (i.e. a list of monetary amounts is presented and respondents select the amounts they are WTP) and an iterative bidding technique[15 23] (i.e., respondents are offered an initial monetary amount and, subject to the respondent's WTP response, a follow-up amount is offered which is either lower or higher than the initial monetary amount[22]). There was no strong preference from the PPI members for either method, thus, a version of the payment card method (the random card sort technique[24]) was chosen for the survey.

Step 3: The survey was then tested on a range of volunteers (n=14) with different occupations (e.g., postgraduate students, pharmacists, clinicians, and professional services staff) to ensure that the range of values presented in the random card sort was appropriate for the good being valued. The final range of values used in the survey was: £1, £5, £10, £25, £50, £75, £100, £150, £200, £300, £500, £750, £1000.

Step 4: The survey was further refined by adding a logic test[i] after each scenario to ensure respondents understood whether actual harm was caused because of the medication error in each case. Respondents were then asked whether they would be willing to pay to prevent each medication error. Respondents who were unwilling to pay were asked to select their reason from a list of five possible options (see Box 1) and had an opportunity to provide a free text response under "other". The justifications selected for unwillingness to pay were used to categorise responses as either a protest response (i.e., the respondent valued preventing the medication error but was unwilling to pay for another reason[25]) or a true zero valuation (i.e., a reason indicating that a respondent truly did not value the intervention). The options *"Avoiding the medication mistake is valuable to me but it should be funded by existing government budgets"* and *"I do not think*

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[i] The logic test comprised of one question after each scenario was presented which asked respondents whether any harm is caused because of the medication error described in the scenario. Correct answers which passed the logic test were "no harm" for scenarios 1-4, and "yes, harm caused" for scenarios 5-7.

donations to my local hospital trust should fund this" were considered protests against the method of payment. The free text responses were examined independently by two members of the research team (SH and LV) who categorised each response as either a protest or a true zero. Where opinions differed for response categorisation, a final decision was made via discussion between the two researchers and no third-party input was required.

Respondents who indicated WTP to prevent the medication error completed a random card sort in which monetary amounts were displayed randomly and respondents would indicate whether they "would pay", "would maybe pay", or "would not pay" each amount in turn. The random card sort was introduced to allow respondents to think through how they value preventing each medication error before being asked an open-ended question: *"What is the MAXIMUM value you would be willing to pay as a one-off donation to your local hospital trust to avoid the medication mistake?".* The respondent's choices of monetary values that they were willing/not willing-to-pay during the random card sort were displayed when asking the open-ended question, to help guide the respondent to state their maximum WTP. The open-ended question allowed for greater sensitivity to individual WTP and provided continuous rather than interval data for analysis.

Step 5: An online pilot of the survey was conducted by Dynata to their UK panel in February 2020, which obtained responses from 166 respondents. Small changes were made to the scenario descriptions (i.e., emphasising some text in bold and adding a clarification of the harm associated with each error in the scenario title) in response to the pilot, predominantly to improve the proportion of respondents passing the logic test. The fully developed survey was then finalised.

2.2. Patient and Public Involvement

As described above, two PPI sessions were held to inform the design of the CV survey.

2.3. Data Collection

Dynata distributed the online survey to their UK panel on 2nd March 2020 and received all responses on 18th March 2020. The sample collected was representative of the adult UK public according to age, gender, and occupational group. In addition to the WTP questions, demographic characteristics were also collected (see Table 1 for all characteristics collected). A required sample size of 502 was calculated following the sample size calculation recommended by Mitchell & Carson[23] (see Supplementary material B for full details of the sample size calculation). The sample size was inflated to account for the proportion of data that would not count towards analysis, using data on failed logic responses and protests from the soft launch, resulting in a desired sample size of 996.

2.4. Data analysis

Survey data were analysed using statistical software STATA 15[26]. Descriptive statistics were conducted to calculate mean and median WTP. Protest responses were removed from the sample prior to analysis following conventional practice[27], so as not to downwardly bias WTP estimates. Base-case analysis also excluded responses which failed the logic test for each scenario. Sensitivity analyses were conducted to explore the impact on mean WTP from trimming the highest 1% of values and from including responses that failed the logic test.

Regression analysis was conducted to identify predictors of WTP. Due to a large proportion of zero values (from respondents who state unwillingness to pay) and a skewed data distribution, standard ordinary least squares estimators would have provided biased and inconsistent estimates[28]. Two-part models have been recommended for continuous data with a spike at zero[29]. A two-part model was employed in order to take account of the zero WTP values in the regression analysis[30]. The two-part model used respondents' WTP value for each scenario as the dependent variable (see Supplementary material C for details of predictor variables); logistic regression first modelled the probability of a respondent being willing to pay to avoid the medication error (i.e., those unwilling to pay are allocated a WTP value of £0) and a linear regression (GLM) modelled WTP value conditional on the respondent being willing to pay (i.e., having a WTP value >£0).

A subgroup analysis was conducted which included respondents who failed the logic test for scenarios 1-4[ii] but also reported personal experience of a medication error. This subgroup analysis was prompted because a comparison of characteristics between respondents who passed and failed logic tests showed that respondents failing the logic tests for scenarios 1-4[iii] were more likely to report known experience of prior error. Therefore, the base-case analysis for these scenarios was potentially biased towards individuals who had no known experience of a medication error.

3. Results

In total, 1,001 responses were received to the survey. Table 1 outlines the demographic characteristics of the full sample survey participants (see Table S1 in Supplementary material D for characteristics of the sample included in analysis for each scenario separately). Most of the sample had no known personal or familial experience of medication errors and did not work in the health sector. Similar proportions of respondents reported household incomes of less than £20,000 (28%) or greater than £40,000 (29%) and the largest proportion reported household incomes between £20,000 and £40,000 (39%).

INSERT TABLE 1 HERE

Across the scenarios, 56%-88% of respondents passed the logic test and were included in the base-case analysis (see Table 2). Fewer respondents passed the logic test for the potential harm scenarios than for the actual harm scenarios. Table 2 describes the number and type of response for each scenario. There was a similar proportion of protest responses across all scenarios in the base-

[ii] i.e., respondents who believed harm was caused by the medication errors which had no potential to cause harm and potential to cause harm

[iii] There was no difference in medication error experience between those who passed and failed the logic test for scenarios 5-7

case analysis (~45% of the sample); however, the proportion of respondents willing to pay to prevent the medication error increased between the potential and actual harm scenarios and increased as the severity of the ADE and medication error increased.

INSERT TABLE 2 HERE

Both mean and median WTP were greater than zero (henceforth, “positive”) for all scenarios. The lower bound of the 95% confidence intervals (95% CIs) around mean WTP were substantially greater than zero for all scenarios, which suggests with confidence that true mean WTP is positive. Both mean and median WTP increase as severity of ADE increases and between potential and actual harm scenarios. Mean WTP ranged from £45 (95% CI: £36 - £54) to prevent a medication error which causes no harm, to £278 (95% CI: £200 - £355) to prevent a medication error which causes life-threatening actual harm (see Table 3).

The 95% CIs were widest for the larger mean WTP values, which suggests the presence of outlier WTP values for the most severe actual ADE scenarios. The comparable 95% CIs when the top 1% of WTP values were trimmed are substantially narrower, validating the theory that a few, large outliers in the base-case sample skewed the results. However, for the trimmed WTP sample, there is evidence that both mean and median WTP remain greater than zero (see Table 3).

Including failed logic responses increased estimates of mean and median WTP for the no-harm and potential harm scenarios and reduced estimates for the actual harm scenarios (see Table 3). This result is expected given that incorrect logic responses to the potential ADE scenarios anticipated harm from the medication error, and vice versa for the actual harm ADE. It is logical that respondents anticipating harm from the medication error in the potential harm scenarios may have been willing to pay more than those correctly anticipating no harm occurring. The converse would be true for the actual harm ADEs.

INSERT TABLE 3 HERE

<u>Regression analysis</u>

The base-case regression analysis results are reported in Table 4. The logit columns of Table 4 report the odds of a respondent being willing to pay to prevent the medication error in each scenario and the GLM columns report the impact of each predictor variable on the WTP amount offered, conditional on the respondent being willing to pay to prevent the medication error.

Factors predicting likelihood of WTP

In the base-case analysis, there is evidence that having a family member who had experienced a medication error increased respondents' likelihood of paying to prevent a potentially harmful medication error (OR:2.5-3, $p<0.05$), as did having an annual household income greater than £40,000 compared with between £20,000 and £40,000 (OR: 2, $p<0.05$). Table 4 also demonstrates evidence that being male ($p<0.01$), working or studying in a non-health sector field ($p<0.05$), being married ($p<0.05$), and having higher education compared with standard qualifications ($p<0.01$) all increased the odds of being willing to pay to prevent a medication error for at least one scenario. However, evidence is not consistent across all scenarios. There is also evidence that having an annual household income of less than £20,000 compared with between £20,000 and £40,000 decreased the odds of WTP a positive amount (OR:0.49-0.53, $p<0.05$).

Factors predicting a lower WTP amount

Respondents who are unemployed ($p<0.05$), unpaid workers ($p<0.01$), female ($p<0.01$) or unsure about their medication error experience ($p<0.05$) offered lower WTP amounts than their comparative respondents to prevent actual harmful errors (see Table 4 for base factors). Those studying in a health-related field also offered less to prevent a mild, potentially harmful error ($p<0.05$).

Factors predicting a higher WTP amount

Having a family member who had experienced a medication error increased the WTP amount to prevent severely harmful errors ($p<0.05$) whilst young respondents (compared with those aged 35-65) offered more to prevent errors which cause no, or potentially moderate, harm ($p<0.05$).

Respondents with higher education (p<0.01) and annual household incomes above £40,000 (p<0.01) were willing to pay higher amounts than their comparative respondents to prevent actual harmful errors. For most of the scenarios, there is no evidence that respondents with the lowest household incomes offered different WTP amounts to respondents in the mid-range household income category (£20,000-£40,000), except for preventing moderately harmful errors in which this group offered a higher WTP amount.

INSERT TABLE 4 HERE

Subgroup Analysis

The subgroup analysis is reported in Table S2 in supplementary material D. This analysis includes respondents who failed the logic test for the first four scenarios (in which failure was characterised by participants believing harm is caused in the four scenarios in which no ADE occurs) but reported personal experience of a medication error. There are very few changes to variables identified as predictors of likelihood or value of WTP between the base-case and subgroup analyses, apart from the impact of personal medication error experience and familial medication error experience. Table S2 shows that in the no potential to cause harm and both potential for mild and moderate harm scenarios, known personal medication error experience increased the odds of WTP to prevent the medication error substantially (OR: 2.65-3.67; p<0.01).

The evidence of impact of known familial experience of a medication error is, however, reduced in the subgroup analysis compared to the base-case; there is only evidence of an increase in odds of WTP for one scenario (potential for mild harm) compared to all three potential harm scenarios in the base-case.

4. Discussion

The results from this CV study suggest that the UK public value preventing medication errors, even in situations where no ADE occurred. However, a smaller proportion of respondents valued preventing medication errors which have no potential to cause an ADE (Scenario 1: 54%) compared with preventing errors which cause actual harm (Scenarios 5-7: ~80%) and errors with potential to cause harm (Scenarios 2-4: ~65%). This provides a degree of face validity to the study as it was expected that more respondents would value the prevention of errors that could cause harm than errors that are not associated with any harm to patients. Despite the lower proportion of respondents valuing errors causing no harm compared to preventing those resulting in ADEs, over half of the analytic sample did value the prevention of errors which had little to no likelihood of resulting in harm. This suggests that the UK public attribute, and positively value, non-health benefits from the prevention of medication errors, such as increased trust in healthcare provision. Thus, low cost interventions that can prevent medication administration errors, regardless of the potential for harm prevented as a result, may still be efficient from a UK societal perspective due to the value placed on non-health benefits associated with preventing medication errors.

The subgroup analysis results further substantiate this conclusion. This analysis was conducted after identifying evidence of a difference in known personal medication error experience between respondents who passed and those who failed the logic test for the first four scenarios (i.e., those in which no ADE occurs as a results of the medication error). It is assumed that individuals who have experienced a medication error personally are more informed about the impacts of such errors than individuals who have no personal experience. The failures in the logic test could be due to misunderstanding the question or misreading the scenarios, however, the significant difference between passes and failures characterised by individuals with experience in medication errors suggests that these respondents are aware of harms caused to patients from medication errors, regardless of whether an ADE occurs. One explanation could be that respondents who have experienced medication errors personally encountered non-health-related harms as a result. To explore this theory, respondents who failed the logic test for the first four scenarios and reported personal experience of a medication error were included in an additional regression analysis (all other logic failures remained excluded). This additional analysis demonstrated that personal medication error experience increased the likelihood of a respondent being willing to pay to prevent medication errors in the scenarios in which no actual ADE occurs as a result. These results further support a theory that those with personal medication error experience perceive non-health-related benefits from preventing medication errors as those individuals are more likely to value error prevention than individuals without similar experience in situations where errors do not result in an ADE.

Several other predictors of WTP were identified in the base-case regression analysis; however, these were not consistent across all scenarios, suggesting that the respondent characteristics examined in our analysis did not largely drive decisions on WTP. There may be other respondent characteristics that predict WTP to prevent medication administration errors that were not analysed in this study due to limitations in our data collection, such as participants' medication regimes, however, it was beyond the scope of our survey to collect this information. One consistent predictor of WTP was household income; there was evidence that respondents in the highest household income group (over £40,000 annually) were consistently either more willing to pay to prevent medication errors or offer a higher WTP value for all scenarios except the "no harm" scenario. Conversely, respondents in the lowest household income group (less than £20,000 annually) were less likely to pay to prevent the medication errors, although the evidence for this was inconsistent (only scenarios 1 and 3). The link between ability to pay and WTP is expected in CV studies as the greater an individual's ability to pay, the greater both their likelihood of WTP and the value offered can be. Therefore, this finding indicates theoretical validity of the survey[31-33].

Although the survey produced skewed data, which is common in CV surveys[34], with a substantial proportion of zeros, mean and median WTP were consistently and confidently positive across all scenarios. Trimming the top 1% of values to remove any potential outliers did not impact median WTP and mean WTP was reduced slightly, however, confidence intervals remained substantially greater than zero. The findings of this study, with regards to the UK public valuing the prevention of medication errors, are considered robust.

The CV survey design and development adhered to internationally recognised methodological standards[35 36] and the study sought to seek the views of a representative sample of the UK public. Thorough pilot testing allowed us to refine and simplify the survey. Furthermore, recent literature has reported that the random card sort technique, which was used in this survey, may produce more valid responses than the standard payment card method[37]. Thus, the choice of this elicitation method over the standard payment card method adds to the validity of the results. In addition, asking open-ended questions without any context has been demonstrated to be cognitively burdensome[15] and has potential to result in large proportions of non-responses, zero responses and outliers[23]. Therefore, conducting the random card sort task prior to asking the open-ended question was intended to minimise some of these biases whilst enabling more granular WTP responses from the open-ended question compared to responses from the random card sort task alone. However, the findings of our study should be interpreted in the light of some limitations.

Potential biases may have been introduced from respondents' interpretation of scenarios relating to details that were not included in the scenarios such as the duration of symptoms or likelihood of ADE occurrence. The heterogeneity of WTP responses could be explained by different interpretations of how long symptoms would last or the probability of symptoms occurring, and the extent of the negative impact the medication errors could have on patient wellbeing. Additionally, the construction of the survey itself may have introduced bias from the order in which scenarios were presented[38] and the payment vehicle used[23 39]. The scenarios were presented in the same order to each participant (no potential for harm, potential harm increasing in severity, then actual harm increasing in severity) and there were some objections to the payment vehicle from respondents, although these responses were removed from the analysis as protest zeros. Both the order of the scenarios presented, and the payment vehicle, were tested in PPI sessions and the final decisions based on feedback from the public representatives' feedback. The use of online survey panels may have limited the findings of our study by excluding members of the public who have not joined the market research panel used by Dynata Ltd to recruit respondents. In addition, the survey was not available to individuals without access to the internet. There may be differences in the characteristics of individuals on either side of the *digital divide*, thus, potentially biasing the results against those unable to participate due to access limitations.

4.1. Conclusion

This study has identified that the UK public value preventing medication errors, even in instances where no harm occurs. The value placed on preventing medication errors increases as the level of harm occurring due to error increases. Individuals with higher household income are more likely to be willing-to-pay to prevent a medication error and will offer greater amounts than individuals with lower incomes and known personal experience of a medication error had an impact on respondents' WTP to prevent medication errors in a sensitivity analysis. Other factors predict both the likelihood and/or value of WTP (e.g., higher education, being male, working in a non-health sector field, and being married), however, these are not consistent across all scenarios. Sensitivity analysis did not alter mean or median WTP substantially, therefore, our conclusions regarding the value placed on preventing medication errors remain robust and the findings of this study provide reliable information on the value to the UK public of preventing medication errors.

This study has potential to impact future practice in medication administration in hospitals in the UK as the WTP findings from this study can be used to carry-out a cost-benefit analysis[34] to explore the net monetary benefits of interventions to prevent medication errors in hospitals. The cost-benefit analysis could inform policymakers' decisions regarding implementation of medication-error prevention interventions.

Declarations

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Competing interests

No competing interests for any of the authors.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

Ethical approval to conduct the contingent valuation study was obtained from Newcastle University Ethics Committee on 18/07/2019 (Ref: 14156/2018). Survey respondents were informed at the start of the survey that completion of the survey constituted consent to take party in the study. No identifiable data were collected.

Author contributions

SH contributed to the design of the study, data collection, data analysis and write-up of the paper. NB contributed to the design of the study and write-up of the paper. CT contributed to the design of the study and the write-up of the paper. SS contributed to the design of the study and write-up of the paper. LV contributed to the design of the study, data analysis, write-up of the paper and general oversight of the study.

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Box 1 Reasons for unwillingness to pay

1. Avoiding the medication mistake is not valuable to me
2. Avoiding the medication mistake is valuable to me but I can't afford it
3. I do not think donations to my local hospital trust should fund this
4. Avoiding the medication mistake is valuable to me but it should be funded by existing government budgets
5. Other

Table 1 Characteristics of full initial sample

Respondent characteristic	Initial sample (N=1,001) Frequency (%)		UK national proportions⁺, %
Sex			
Male	498	(49.8%)	48.7
Female	502	(50.1%)	51.3
Prefer not to say	1	(0.1%)	-
Age			
18-24	153	(15.3%)	14.8
25-34	161	(16.1%)	16.6
35-44	170	(17.0%)	17.3
45-54	175	(17.5%)	17.2
55-64	156	(15.6%)	14.6
65+	186	(18.6%)	19.5
Region			
England	852	(85.1%)	84
Scotland	82	(8.2%)	8.1
Wales	48	(4.8%)	4.7
Northern Ireland	19	(1.9%)	2.7
Occupational group †			
A	56	(5.6%)	4
B	223	(22.3%)	23
C1	288	(28.8%)	28
C2	191	(19.1%)	20
D	125	(12.5%)	15
E	118	(11.8%)	10
Marriage status			
Married/cohabiting	539	(53.8%)	51.2
Single	340	(34.0%)	34.4
Divorced/widowed	121	(12.1%)	14.4
Prefer not to say	1	(0.1%)	-
Employment status			
Full time	378	(37.8%)	-
Part time	131	(13.1%)	-
Self employed	73	(7.3%)	-
Unemployed	117	(11.7%)	-
Retired	200	(20.0%)	-
Full time student	58	(5.8%)	-
Part time student	2	(0.2%)	-
Other	42	(4.2%)	-
Working in the health sector			
Yes	113	(11.3%)	-
No	669	(66.8%)	-
Not applicable	219	(21.9%)	-

Studying a health-related field			
Yes	8	(0.8%)	-
No	52	(5.2%)	-
Not applicable	941	(94.0%)	-
Education			
Degree	363	(36.3%)	-
Higher education below degree	114	(11.4%)	-
A-level	220	(22.0%)	-
GCSE A*-C	221	(22.1%)	-
GCSE D-G	47	(4.7%)	-
Foreign qual	2	(0.2%)	-
No formal qualifications	34	(3.4%)	-
Annual household income (£)			
0 - 12K	110	(11.0%)	-
12K-20K	167	(16.7%)	-
20K - 30K	220	(22.0%)	-
30K - 40K	166	(16.6%)	-
40K - 50K	116	(11.6%)	-
50K - 70K	89	(8.9%)	-
70K - 100K	64	(6.4%)	-
100K +	16	(1.6%)	-
Prefer not to say	40	(4.0%)	-
Unknown	13	(1.3%)	-
Known personal experience of a medication mistake			
Experience	74	(7.4%)	-
No experience	880	(87.9%)	-
Unsure	47	(4.7%)	-
Harm suffered from the mistake			
Harm	29	(39.2%)*	-
No harm	41	(55.4%)*	-
Unsure	4	(5.4%)*	-
Friend or family member known experience of a medication mistake			
Experience	174	(17.4%)	-
No experience	729	(72.8%)	-
Unsure	98	(9.8%)	-
Harm suffered from the mistake			
Harm	102	(58.6%)*	-
No harm	51	(29.3%)*	-
Unsure	21	(12.1%)*	-

[+]National proportions reported where available. Marriage status for England and Wales only

[†] Occupational groups: A=Higher managerial, administrative and professional, B=Intermediate managerial, administrative and professional, C1=Supervisory, clerical and junior managerial, administrative and professional, C2=Skilled manual workers, D=Semi-skilled and unskilled manual workers, E=State pensioners, casual and lowest grade workers, unemployed with state benefits only.

*% of those reporting personal/familial experience of medication mistake

Table 2. Initial sample and unwillingness to pay responses

Scenarios	No potential for harm	Potential harm (mild)	Potential harm (moderate)	Potential harm (severe)	Actual harm (mild)	Actual harm (moderate)	Actual harm (severe)
Initial sample (N)	1,001	1,001	1,001	1,001	1,001	1,001	1,001
Number passing logic test (%)	867 (86.6)	616 (61.5)	568 (56.7)	565 (56.4)	787 (78.6)	865 (86.4)	885 (88.4)
Number of protest-zero WTP responses*	344	277	274	266	358	383	379
Number of positive WTP responses*	284	199	192	209	336	387	422
Number of true zero WTP responses*	239	140	102	90	93	95	84
Number excluded for other reasons, e.g. clear misunderstanding of WTP question or scenario description	10	8	6	6	8	14	0
Reasons for unwillingness to pay (N)**							
Avoiding the medication mistake is not valuable to me	120	46	23	20	17	9	6
Avoiding the medication mistake is valuable to me but I can't afford it	92	84	73	64	68	77	66
I do not think donations to my local hospital trust should fund this	89	64	64	71	63	63	60
Avoiding the medication mistake is valuable to me but it should be funded by existing government budgets	243	198	194	181	277	296	292
Other	39	25	22	20	26	33	39

*Only respondents who pass logic test included in numbers
**Includes both protest-zero and true-zero responses of respondents who passed the logic test
Total number of participants included in the base case analysis for each scenario is calculated as the number passing the logic test minus the number of protest zero WTP responses, since protesters are removed from the sample prior to analysis

Table 3 Mean and median WTP for base-case and sensitivity analyses, GBP£

Scenarios	No harm	Potential harm (mild)	Potential harm (moderate)	Potential harm (severe)	Actual harm (mild)	Actual harm (moderate)	Actual harm (severe)
Base-case							
Mean (95% CI)	45 (36 - 54)	53 (37 - 69)	72 (49 - 95)	96 (70 - 123)	115 (87 - 144)	153 (121 - 185)	278 (200 - 355)
Median (IQR)	5 0-50	10 0-50	15 0-75	25 0-100	35 0-100	50 0-150	63 0-200
Trimmed values							
Mean (95% CI)	37 (31 - 44)	40 (32 - 47)	56 (43 - 69)	79 (61 - 96)	82 (70 - 95)	126 (107 - 145)	195 (163 - 227)
Median (IQR)	5 0-50	10 0-50	15 0-75	25 0-100	30 5-100	50 10-125	55 10-200
Including failed logic responses							
Mean (95% CI)	70 (57 - 82)	80 (65 - 96)	90 (74 106)	120 (99 - 141)	103 (80 - 127)	142 (114 - 169)	259 (188 - 330)
Median (IQR)	10 0-75	20 0-75	25 0-100	35 1-100	25 0-100	50 0-123	50 0-200

95% CI: 95% Confidence interval, IQR: Interquartile range

Table 4 Results of two-part model regression analysis with dependent variable WTP

Covariates	No potential for harm		Potential harm (mild)		Potential harm (moderate)		Potential harm (severe)		Actual harm (mild)		Actual harm (moderate)		Actual harm (severe)	
	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)
	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*
Female	**0.577****	-0.107	0.764	-0.063	0.972	-0.239	0.741	-0.043	**0.590***	-0.206	0.798	-0.300	1.036	**-0.586****
	(0.110)	*(0.177)*	*(0.186)*	*(0.277)*	*(0.271)*	*(0.260)*	*(0.212)*	*(0.255)*	*(0.153)*	*(0.194)*	*(0.199)*	*(0.170)*	*(0.268)*	*(0.189)*
UK resident outside England	1.002	0.042	0.783	0.735	0.740	-0.178	1.427	-0.320	1.190	0.357	1.404	0.368	1.318	0.064
	(0.262)	*(0.245)*	*(0.266)*	*(0.400)*	*(0.276)*	*(0.38)1*	*(0.558)*	*(0.324)*	*(0.443)*	*(0.257)*	*(0.538)*	*(0.228)*	*(0.510)*	*(0.257)*
Married	1.156	-0.122	1.233	-0.021	1.051	0.237	0.891	-0.375	1.070	0.121	1.373	0.127	**1.942***	-0.055
	(0.247)	*(0.209)*	*(0.336)*	*(0.283)*	*(0.318)*	*(0.286)*	*(0.283)*	*(0.277)*	*(0.320)*	*(0.221)*	*(0.38)7*	*(0.187)*	*(0.574)*	*(0.212)*
Age														
Under 35	1.202	**0.486***	0.944	0.416	1.624	**0.651***	1.658	0.189	1.325	0.122	1.053	0.177	0.999	0.079
	(0.284)	*(0.228)*	*(0.278)*	*(0.370)*	*(0.567)*	*(0.314)*	*(0.617)*	*(0.331)*	*(0.441)*	*(0.233)*	*(0.335)*	*(0.206)*	*(0.332)*	*(0.230)*
Over 65	1.497	0.241	1.060	-0.079	2.442	0.147	0.985	0.114	0.701	-0.047	0.941	-0.142	1.273	0.319
	(0.659)	*(0.341)*	*(0.618)*	*(0.651)*	*(1.637)*	*(0.610)*	*(0.674)*	*(0.556)*	*(0.417)*	*(0.403)*	*(0.547)*	*(0.342)*	*(0.711)*	*(0.374)*
Employment status														
Unemployed	0.827	0.110	1.248	0.182	1.169	0.049	2.610	-0.331	1.539	-0.033	0.887	0.014	0.385	**-0.739***
	(0.361)	*(0.336)*	*(0.714)*	*(0.636)*	*(0.766)*	*(0.604)*	*(1.793)*	*(0.534)*	*(0.919)*	*(0.385)*	*(0.503)*	*(0.330)*	*(0.209)*	*(0.327)*
Student	1.332	0.031	4.344	0.161	-	-	-	-	-	-	-	-	-	-
	(0.833)	*(0.580)*	*(3.771)*	*(0.863)*										
Disabled	2.226	-0.020	6.093	0.036	5.634	0.640	12.669	-0.221	3.231	-0.228	0.877	-0.001	0.619	-1.129
	(2.013)	*(0.867)*	*(6.390)*	*(0.983)*	*(7.524)*	*(0.971)*	*(17.116)*	*(0.932)*	*(3.386)*	*(0.710)*	*(0.824)*	*(0.646)*	*(0.626)*	*(0.631)*
Unpaid worker	0.958	-0.882	2.471	-1.187	0.680	-0.938	6.061	-0.866	1.436	**-2.194***	1.030	**-1.977****	0.169	**-1.670***
	(0.796)	*(0.861)*	*(2.773)*	*(1.143)*	*(0.708)*	*(1.008)*	*(6.915)*	*(0.894)*	*(1.581)*	*(0.875)*	*(1.321)*	*(0.753)*	*(0.164)*	*(0.747)*
Education level														
Higher education	1.018	-0.019	1.067	0.292	1.472	0.308	1.379	0.303	1.420	0.169	1.339	**0.431***	**2.231****	**0.598****
	(0.201)	*(0.195)*	*(0.275)*	*(0.282)*	*(0.430)*	*(0.264)*	*(0.411)*	*(0.253)*	*(0.389)*	*(0.201)*	*(0.354)*	*(0.172)*	*(0.625)*	*(0.185)*
No formal qualifications	2.742	-0.463	1.948	0.129	1.189	0.037	0.921	-0.304	0.558	-0.042	0.668	0.148	0.958	0.411
	(1.675)	*(0.492)*	*(1.395)*	*(0.700)*	*(0.805)*	*(0.626)*	*(0.622)*	*(0.629)*	*(0.317)*	*(0.615)*	*(0.371)*	*(0.491)*	*(0.557)*	*(0.565)*

Covariates	No harm		Potential harm (mild)		Potential harm (moderate)		Potential harm (severe)		Actual harm (mild)		Actual harm (moderate)		Actual harm (severe)	
	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)
	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*
Household income														
Under £20	**0.533***	-0.344	0.582	-0.117	**0.493***	-0.209	0.563	0.068	0.623	0.353	0.620	**0.652****	0.698	0.486
	(0.132)	*(0.247)*	*(0.183)*	*(0.406)*	*(0.177)*	*(0.386)*	*(0.210)*	*(0.363)*	*(0.207)*	*(0.280)*	*(0.190)*	*(0.243)*	*(0.224)*	*(0.265)*
Over £40K	0.908	0.223	**1.995***	0.116	**2.197***	0.319	**2.176***	0.387	1.779	**0.778****	1.966	**0.960****	1.368	**0.847****
	(0.218)	*(0.222)*	*(0.645)*	*(0.328)*	*(0.831)*	*(0.310)*	*(0.856)*	*(0.301)*	*(0.614)*	*(0.223)*	*(0.702)*	*(0.195)*	*(0.478)*	*(0.218)*
Personal medication error experience														
Yes	1.651	0.077	1.253	-0.020	3.621	-0.574	2.203	-0.103	2.791	0.223	1.588	0.241	1.264	-0.284
	(0.695)	*(0.374)*	*(0.813)*	*(0.658)*	*(3.089)*	*(0.568)*	*(1.716)*	*(0.696)*	*(1.843)*	*(0.347)*	*(0.878)*	*(0.317)*	*(0.611)*	*(0.378)*
Unsure	1.135	-0.132	0.665	0.333	0.569	0.207	2.207	-0.658	1.494	-0.095	0.687	-0.495	2.429	**-0.915***
	(0.519)	*(0.445)*	*(0.463)*	*(0.740)*	*(0.401)*	*(0.658)*	*(1.987)*	*(0.584)*	*(1.056)*	*(0.473)*	*(0.424)*	*(0.462)*	*(1.975)*	*(0.455)*
Family medication error experience														
Yes	1.629	-0.315	**2.569***	-0.519	**2.627***	-0.178	**3.030***	-0.109	0.794	-0.214	1.666	0.110	0.688	**0.497***
	(0.450)	*(0.249)*	*(0.976)*	*(0.356)*	*(1.128)*	*(0.335)*	*(1.528)*	*(0.355)*	*(0.284)*	*(0.263)*	*(0.664)*	*(0.232)*	*(0.238)*	*(0.244)*
Unsure	1.012	-0.051	**3.660***	-0.499	2.202	0.344	1.825	0.366	1.709	-0.450	0.908	-0.281	1.244	-0.063
	(0.371)	*(0.388)*	*(2.149)*	*(0.498)*	*(1.507)*	*(0.554)*	*(1.282)*	*(0.520)*	*(0.945)*	*(0.341)*	*(0.403)*	*(0.321)*	*(0.640)*	*(0.325)*
Health sector work														
Yes	0.803	-0.231	1.129	-0.019	**0.271***	-0.460	**0.258***	0.462	2.060	0.102	1.035	0.001	0.684	0.011
	(0.258)	*(0.305)*	*(0.507)*	*(0.534)*	*(0.155)*	*(0.605)*	*(0.145)*	*(0.635)*	*(1.097)*	*(0.312)*	*(0.446)*	*(0.269)*	*(0.279)*	*(0.328)*
Health field study														
Yes	1.293	-1.702	0.444	**-2.971***	-	-2.256	-	-1.355	0.222	-1.236	0.336	-0.221	**0.095***	0.333
	(1.414)	*(1.094)*	*(0.637)*	*(1.335)*		*(1.190)*		*(1.017)*	*(0.238)*	*(1.023)*	*(0.436)*	*(0.946)*	*(0.108)*	*(1.103)*
Constant	1.665	**4.435****	1.013	**4.286****	1.468	**3.883****	3.029	**4.785****	**8.307***	**4.241****	4.542	**4.629****	3.910	**4.938****
	(0.463)	*(0.262)*	*(0.357)*	*(0.438)*	*(1.445)*	*(0.926)*	*(3.130)*	*(0.868)*	*(8.102)*	*(0.649)*	*(3.975)*	*(0.562)*	*(3.674)*	*(0.601)*
Observations	515		335		288		293		424		474		506	

Base factors: Male, Resident in England, Aged 35-65, Unmarried, Employed, School-level qualifications, annual household income £20,000-£40,000, No personal experience of medication error, No familial experience of medication error, working in a non-health sector role, Studying in a non-health field

**p<0.05, **p<0.01*

Coeff.: coefficient, GLM: Generalised linear model, S.E.: Standard error

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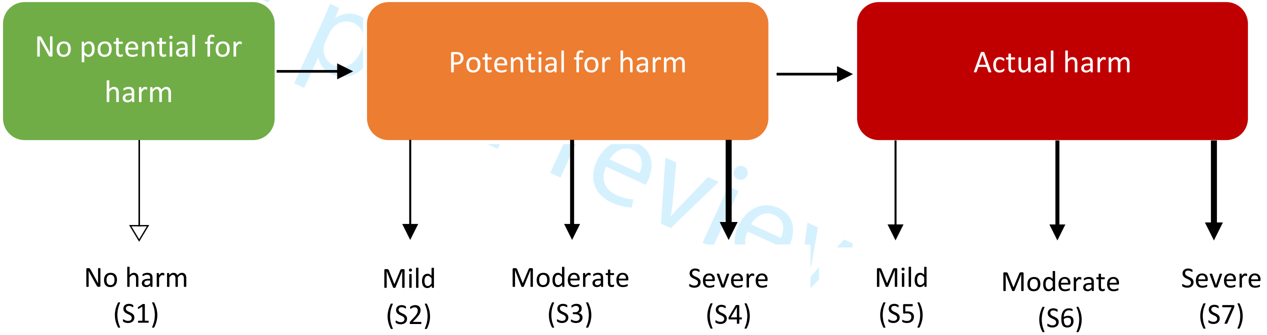
No potential for harm
Potential for harm
Actual harm
No harm (S1)
Mild (S2)
Moderate (S3)
Severe (S4)
Mild (S5)
Moderate (S6)
Severe (S7)

*S=Scenario

Supplementary material A

The seven descriptions of ADEs presented in the survey for each of the hypothetical scenarios are displayed below.

Medication error with no harm

Non-harmful mistake – no actual harm is caused

You are in hospital as a result of a serious illness and you have to take medication in order to get better. A mistake is made in the timing of your medication but the mistake is not serious enough to cause you any harm. Although your medication is not given at the exact time you should have had it, it is still effective and your recovery from illness is not affected.

Medication errors with potential ADEs

Potential mild harm – no actual harm is caused

You are in hospital as a result of a serious illness and you have to take medication in order to get better. A mistake is made when you are given your medication which has the **potential** to cause you harm. For example, the wrong medication is given to you, which means you do not get the medication you need to get better. However, the mistake is noticed quickly and you are soon given the correct medication you need to treat your illness, so that your **recovery is not affected** by the mistake. Luckily, you are also **not harmed** by the medication mistake, but the wrong medication that you were given had the **potential** to cause some new, short-term symptoms, which could have included any of the following:

- Dizziness
- Fatigue
- Constipation or diarrhoea
- Headaches
- Skin rash
- Nausea (feeling sick)

The symptoms could have been harmful and unpleasant to you but would not have posed any threat to your life. However, luckily you did not suffer any of these symptoms and **no actual harm was caused by the mistake.**

Potential moderate harm – no actual harm is caused

You are in hospital as a result of a serious illness and you have to take medication in order to get better. A mistake is made when you are given your medication which has the **potential** to cause you harm. For example, the wrong medication is given to you, which means you do not get the medication you need to get better. However, the mistake is noticed quickly and you are soon given the correct medication you need to treat your illness, so that your **recovery is not affected** by the mistake. Luckily, you are also **not harmed** by the medication mistake, but the wrong medication that you were given had the **potential** to cause some complications, which could have included any of the following:

- Internal bleeding (bleeding inside your body)
- Drop in blood pressure causing light-headedness
- Fever and chills
- Problems with your liver or kidneys

The harm could have been significant enough to make you need to stay in hospital longer for further medical treatment. You may also have needed to take additional medications to fix the complications. The complications could have been harmful to you and may have affected the way your body works but would not have been life-threatening. However, luckily you did not suffer any of these symptoms and **no actual harm was caused by the mistake.**

Potential severe harm – no actual harm is caused

You are in hospital as a result of a serious illness and you have to take medication in order to get better. A mistake is made when you are given your medication which has the **potential** to cause you harm. For example, the wrong medication is given to you, which means you do not get the medication you need to get better. However, the mistake is noticed quickly and you are soon given the correct medication you need to treat your illness, so that your **recovery is not affected** by the mistake. Luckily, you are also **not harmed** by the medication mistake, but the wrong medication that you were given had the **potential** to cause some complications, which could have included any of the following:

- Severe allergic reaction
- Cardiac arrest (heart stops beating)
- Being unable to breathe

You could have had to stay in hospital for longer and be moved to the intensive care area of the hospital. If the complications were not immediately treated then they would have **put you at risk of death or permanent disability**.

However, luckily you did not suffer any of these symptoms and **no actual harm was caused by the mistake.**

Medication errors with actual ADEs

Mild harm – actual harm is caused

You are in hospital as a result of a serious illness and you have to take medication in order to get better. A mistake is made when you are given your medication which **causes you harm**. For example, the wrong medication is given to you so you do not get the medication you need to get better. The medication mistake means that your recovery from the illness is delayed. The wrong medication also causes some new, short-term symptoms, which could include any of the following:

- Dizziness
- Fatigue
- Constipation or diarrhoea
- Headaches
- Skin rash
- Nausea (feeling sick)

The symptoms are harmful and unpleasant to you but do not pose any threat to your life.

Moderate harm – actual harm is caused

You are in hospital as a result of a serious illness and you have to take medication in order to get better. A mistake is made when you are given your medication which **causes you harm**. For example, the wrong medication is given to you so you do not get the medication you need to get better. The medication mistake means that you stop recovering from your illness. The wrong medication also causes some complications, which could include any of the following:

- Internal bleeding (bleeding inside your body)
- Drop in blood pressure causing light-headedness
- Fever and chills
- Problems with your liver or kidneys

The harm is significant enough to make you need to stay in hospital longer for further medical treatment. You may also need to take additional medications to fix the complications.

The complications are harmful to you and affect the way your body works but are not lifethreatening.

<u>Severe harm – actual harm is caused</u>

You are in hospital as a result of a serious illness and you have to take medication in order to get better. A mistake is made when you are given your medication which **causes you harm**. For example, the wrong medication is given to you so you do not get the medication you need to get better. The medication mistake means that you stop recovering from your illness. The wrong medication also causes some complications, which could include any of the following:

- Severe allergic reaction
- Cardiac arrest (heart stops beating)
- Being unable to breathe

You would have to stay in hospital for longer and be moved to the intensive care area of the hospital. If the complications were not immediately treated then they would **put you at risk of death or permanent disability**.

Supplementary material B

Mitchell & Carson (2013) set out an approach to determine sample size in contingent valuation studies. Their approach is based on three factors: deviation from true WTP (Δ), relative error (V) and confidence levels (1-α). Equation 1 outlines the sample size calculation where Z represents the Z-score from a standard normal distribution Z~N (0,1) for a given confidence level (1-α). If no prior evidence is available, the Mitchell & Carson recommend assuming a value of 2 for relative error (V).

(Equation 1) $$\left[\frac{Z\widehat{V}}{\Delta}\right]^2$$

Sample size was calculated based on a confidence level of 95% (z-score = 1.96), relative error of 2 (as no prior evidence was available to direct relative error, Mitchell & Carson's (2013) recommended value was used) and deviation from true WTP of 0.175 (chosen based on a midpoint value of recommended values offered by Mitchell & Carson (2013)). Populating equation 1 with the above values resulted in a sample size of 502 (see equation 2).

(Equation 2) $$\left[\frac{1.96*2}{0.175}\right]^2 = 502$$

Reference

MITCHELL, R. C. & CARSON, R. T. 2013. Using Surveys to Value Public Goods: The Contingent Valuation Method, Taylor & Francis.

Supplementary Material C

The two-part model used to estimate the impact of predictor variables on WTP included the same set of predictor variables for both parts of the model (logit followed by GLM). Details of the predictor variables and the base factor used in are given in Box 1 below.

Box 1 Coding of predictor variables for two-part model

Dummy variables		**Base factor in regression**
FEMALE	Sex; 1 for females, 0 for males	Male
UK RESIDENT OUTSIDE OF UK	UK location; 1 for Scotland, Wales or Northern Ireland, 0 for England	Resident in England
MARRIED	Marital status; 1 for married/cohabiting, 0 for not married (i.e., single/divorced/widowed)	Not married
HEALTH SECTOR WORK	Working in the health sector; 1 for working in relevant sector, 0 for not working in relevant sector	Working in a non-health sector
HEALTH FIELD STUDY	Currently studying in a health-related field; 1 for studying in relevant field, 0 for not working in relevant field	Studying a non-health-related field
Ordinal variables		
AGE	Age; 0 for under 35, 1 for 35-65, 2 for over 65	Age 35-65
EMPLOYMENT STATUS	Employment status; 0 for employed (full or part-time), 1 for unemployed (including retired), 2 for student, 3 for disabled, 4 for unpaid worker	Employed
EDUCATION	Highest level of education; 0 for no formal qualifications, 1 for school level qualifications (GCSE or equivalent, A-Level or equivalent, foreign qualification), 2 for higher education qualification	School level qualifications
INCOME	Household income; 0 for less than £20,000, 1 for £20,000-£40,000, 2 for over £40,000	Annual household income £20,000-£40,000
PERSONAL MEDICATION EXPERIENCE	Personal known experience of a medication error; 0 for no known experience, 1 for known experience, 2 for unsure	No known experience
FAMILIAL MEDICATION ERROR EXPERIENCE	Known family member experience of medication error; 0 for no known experience, 1 for known experience, 2 for unsure	No known experience

Supplementary Material D

Table S1 Characteristics of sample included in base case analysis for each scenario (protest responses and failed logic test responses excluded)

Respondent characteristic	No Harm (N=515)	Potential harm (mild) (N=335)	Potential harm (moderate) (N=290)	Potential harm (severe) (N=296)	Actual harm (mild) (N=424)	Actual harm (moderate) (N=475)	Actual harm (severe) (N=506)
	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)
Sex							
Male	248 (48.2%)	162 (48.4%)	135 (46.6%)	139 (47.0%)	213 (50.2%)	226 (47.6%)	241 (47.6%)
Female	267 (51.8%)	173 (51.6%)	155 (53.4%)	157 (53.0%)	211 (49.8%)	248 (52.2%)	265 (52.4%)
Prefer not to say	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.2%)	0 (0.0%)
Age							
18-24	87 (16.9%)	60 (17.9%)	57 (19.7%)	50 (16.9%)	77 (18.2%)	90 (18.9%)	91 (18.0%)
25-34	79 (15.3%)	53 (15.8%)	41 (14.1%)	43 (14.5%)	73 (17.2%)	73 (15.4%)	81 (16.0%)
35-44	90 (17.5%)	53 (15.8%)	48 (16.6%)	46 (15.5%)	73 (17.2%)	84 (17.7%)	84 (16.6%)
45-54	93 (18.1%)	61 (18.2%)	44 (15.2%)	54 (18.2%)	77 (18.2%)	85 (17.9%)	87 (17.2%)
55-64	72 (14.0%)	48 (14.3%)	49 (16.9%)	47 (15.9%)	57 (13.4%)	60 (12.6%)	71 (14.0%)
65+	94 (18.3%)	60 (17.9%)	51 (17.6%)	56 (18.9%)	67 (15.8%)	83 (17.5%)	92 (18.2%)
Region							
England	435 (84.5%)	285 (85.1%)	242 (83.4%)	247 (83.4%)	359 (84.7%)	406 (85.5%)	434 (85.8%)
Wales	44 (8.5%)	27 (8.1%)	29 (10.0%)	30 (10.1%)	34 (8.0%)	35 (7.4%)	37 (7.3%)
Scotland	26 (5.0%)	17 (5.1%)	13 (4.5%)	12 (4.1%)	20 (4.7%)	22 (4.6%)	24 (4.7%)
Northern Ireland	10 (1.9%)	6 (1.8%)	6 (2.1%)	7 (2.4%)	11 (2.6%)	12 (2.5%)	11 (2.2%)
Occupational group							
A	27 (5.2%)	15 (4.5%)	13 (4.5%)	13 (4.4%)	24 (5.7%)	32 (6.7%)	30 (5.9%)
B	117 (22.7%)	82 (24.5%)	69 (23.8%)	75 (25.3%)	106 (25.0%)	113 (23.8%)	127 (25.1%)
C1	146 (28.3%)	82 (24.5%)	73 (25.2%)	71 (24.0%)	116 (27.4%)	131 (27.6%)	136 (26.9%)
C2	89 (17.3%)	62 (18.5%)	52 (17.9%)	56 (18.9%)	77 (18.2%)	84 (17.7%)	98 (19.4%)
D	74 (14.4%)	47 (14.0%)	39 (13.4%)	36 (12.2%)	54 (12.7%)	62 (13.1%)	61 (12.1%)
E	62 (12.0%)	47 (14.0%)	44 (15.2%)	45 (15.2%)	47 (11.1%)	53 (11.2%)	54 (10.7%)

Respondent characteristic	No Harm (N=515)		Potential harm (mild) (N=335)		Potential harm (moderate) (N=290)		Potential harm (severe) (N=296)		Actual harm (mild) (N=424)		Actual harm (moderate) (N=475)		Actual harm (severe) (N=506)	
Marriage status														
Married/cohabiting	267	(51.8%)	175	(52.2%)	142	(49.0%)	150	(50.7%)	230	(54.2%)	249	(52.4%)	277	(54.7%)
Single	192	(37.3%)	120	(35.8%)	113	(39.0%)	114	(38.5%)	149	(35.1%)	176	(37.1%)	173	(34.2%)
Divorced/widowed	56	(10.9%)	40	(11.9%)	35	(12.1%)	32	(10.8%)	45	(10.6%)	50	(10.5%)	56	(11.1%)
Employment status														
Full time	182	(35.3%)	116	(34.6%)	96	(33.1%)	96	(32.4%)	169	(39.9%)	182	(38.3%)	187	(37.0%)
Part time	81	(15.7%)	55	(16.4%)	43	(14.8%)	42	(14.2%)	57	(13.4%)	62	(13.1%)	63	(12.5%)
Self employed	41	(8.0%)	23	(6.9%)	21	(7.2%)	23	(7.8%)	31	(7.3%)	34	(7.2%)	36	(7.1%)
Unemployed	64	(12.4%)	45	(13.4%)	42	(14.5%)	42	(14.2%)	47	(11.1%)	56	(11.8%)	59	(11.7%)
Retired	91	(17.7%)	57	(17.0%)	45	(15.5%)	50	(16.9%)	65	(15.3%)	81	(17.1%)	90	(17.8%)
FT student	35	(6.8%)	22	(6.6%)	25	(8.6%)	25	(8.4%)	35	(8.3%)	39	(8.2%)	44	(8.7%)
PT student	1	(0.2%)	1	(0.3%)	1	(0.3%)	1	(0.3%)	1	(0.2%)	1	(0.2%)	1	(0.2%)
Other	20	(3.9%)	16	(4.8%)	17	(5.9%)	17	(5.7%)	19	(4.5%)	20	(4.2%)	26	(5.1%)
Working in the health sector														
Yes	51	(9.9%)	29	(8.7%)	19	(6.6%)	22	(7.4%)	50	(11.8%)	64	(13.5%)	65	(12.8%)
No	344	(66.8%)	222	(66.3%)	186	(64.1%)	189	(63.9%)	272	(64.2%)	295	(62.1%)	311	(61.5%)
Not applicable	120	(23.3%)	84	(25.1%)	85	(29.3%)	85	(28.7%)	102	(24.1%)	116	(24.4%)	130	(25.7%)
Studying a health-related field														
Yes	4	(0.8%)	3	(0.9%)	2	(0.7%)	3	(1.0%)	5	(1.2%)	4	(0.8%)	5	(1.0%)
No	32	(6.2%)	20	(6.0%)	24	(8.3%)	23	(7.8%)	31	(7.3%)	36	(7.6%)	40	(7.9%)
Not applicable	479	(93.0%)	312	(93.1%)	264	(91.0%)	270	(91.2%)	388	(91.5%)	435	(91.6%)	461	(91.1%)
Education														
Degree	188	(36.5%)	117	(34.9%)	105	(36.2%)	108	(36.5%)	172	(40.6%)	189	(39.8%)	198	(39.1%)
Higher education below degree	52	(10.1%)	29	(8.7%)	27	(9.3%)	27	(9.1%)	43	(10.1%)	47	(9.9%)	43	(8.5%)
A-level	126	(24.5%)	84	(25.1%)	66	(22.8%)	73	(24.7%)	84	(19.8%)	94	(19.8%)	112	(22.1%)
GCSE A*-C	106	(20.6%)	75	(22.4%)	63	(21.7%)	58	(19.6%)	84	(19.8%)	99	(20.8%)	108	(21.3%)
GCSE D-G	26	(5.0%)	19	(5.7%)	16	(5.5%)	17	(5.7%)	23	(5.4%)	26	(5.5%)	25	(4.9%)
Foreign qualifications	1	(0.2%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	1	(0.2%)	1	(0.2%)	2	(0.4%)
No formal qualifications	16	(3.1%)	11	(3.3%)	13	(4.5%)	13	(4.4%)	17	(4.0%)	19	(4.0%)	18	(3.6%)

Respondent characteristic	No Harm (N=515)		Potential harm (mild) (N=335)		Potential harm (moderate) (N=290)		Potential harm (severe) (N=296)		Actual harm (mild) (N=424)		Actual harm (moderate) (N=475)		Actual harm (severe) (N=506)	
Annual household income (£)														
0 - 12K	63	(12.2%)	49	(14.6%)	41	(14.1%)	45	(15.2%)	45	(10.6%)	52	(10.9%)	55	(10.9%)
12K-20K	99	(19.2%)	57	(17.0%)	51	(17.6%)	47	(15.9%)	70	(16.5%)	82	(17.3%)	83	(16.4%)
20K - 30K	108	(21.0%)	70	(20.9%)	53	(18.3%)	53	(17.9%)	86	(20.3%)	110	(23.2%)	112	(22.1%)
30K - 40K	77	(15.0%)	51	(15.2%)	46	(15.9%)	44	(14.9%)	65	(15.3%)	62	(13.1%)	71	(14.0%)
40K - 50K	58	(11.3%)	43	(12.8%)	37	(12.8%)	33	(11.1%)	54	(12.7%)	56	(11.8%)	58	(11.5%)
50K - 70K	49	(9.5%)	33	(9.9%)	26	(9.0%)	34	(11.5%)	45	(10.6%)	46	(9.7%)	53	(10.5%)
70K - 100K	28	(5.4%)	14	(4.2%)	17	(5.9%)	18	(6.1%)	35	(8.3%)	39	(8.2%)	43	(8.5%)
100K +	8	(1.6%)	2	(0.6%)	3	(1.0%)	4	(1.4%)	7	(1.7%)	8	(1.7%)	10	(2.0%)
Prefer not to say	20	(3.9%)	14	(4.2%)	13	(4.5%)	14	(4.7%)	13	(3.1%)	16	(3.4%)	17	(3.4%)
Unknown	5	(1.0%)	2	(0.6%)	3	(1.0%)	4	(1.4%)	4	(0.9%)	4	(0.8%)	4	(0.8%)
Personal experience of medication mistake														
Experience	32	(6.2%)	14	(4.2%)	12	(4.1%)	14	(4.7%)	39	(9.2%)	46	(9.7%)	48	(9.5%)
No experience	458	(88.9%)	308	(91.9%)	264	(91.0%)	269	(90.9%)	367	(86.6%)	411	(86.5%)	438	(86.6%)
Unsure	25	(4.9%)	13	(3.9%)	14	(4.8%)	13	(4.4%)	18	(4.2%)	18	(3.8%)	20	(4.0%)
Harm suffered from the mistake														
Harm	7	(21.9%)	3	(21.4%)	3	(25.0%)	6	(42.9%)	14	(35.9%)	19	(41.3%)	21	(43.8%)
No harm	22	(68.8%)	11	(78.6%)	9	(75.0%)	8	(57.1%)	22	(56.4%)	23	(50.0%)	23	(47.9%)
Unsure	3	(9.4%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	3	(7.7%)	4	(8.7%)	4	(8.3%)
Friend or family member experience of medication mistake														
Experience	87	(16.9%)	55	(16.4%)	47	(16.2%)	46	(15.5%)	81	(19.1%)	89	(18.7%)	101	(20.0%)
No experience	390	(75.7%)	257	(76.7%)	226	(77.9%)	233	(78.7%)	309	(72.9%)	347	(73.1%)	363	(71.7%)
Unsure	38	(7.4%)	23	(6.9%)	17	(5.9%)	17	(5.7%)	34	(8.0%)	39	(8.2%)	42	(8.3%)
Harm suffered from the mistake														
Harm	46	(52.9%)	33	(60.0%)	26	(55.3%)	26	(56.5%)	48	(59.3%)	52	(58.4%)	57	(56.4%)
No harm	30	(34.5%)	15	(27.3%)	13	(27.7%)	12	(26.1%)	21	(25.9%)	23	(25.8%)	30	(29.7%)
Unsure	11	(12.6%)	7	(12.7%)	8	(17.0%)	8	(17.4%)	12	(14.8%)	14	(15.7%)	14	(13.9%)

[†]Occupational groups: A=Higher managerial, administrative and professional, B=Intermediate managerial, administrative and professional, C1=Supervisory, clerical and junior managerial, administrative and professional, C2=Skilled manual workers, D=Semi-skilled and unskilled manual workers, E=State pensioners, casual and lowest grade workers, unemployed with state benefits only.

Table S2 Sensitivity regression analysis for Scenarios 1-4, including failed logic responses for respondents with experience of a medication error

Covariates	No potential for harm		Potential harm (mild)		Potential harm (moderate)		Potential harm (severe)	
	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)
	Odds Ratio *(S.E)*	Coeff. *(S.E)*	Odds Ratio *(S.E)*	Coeff. *(S.E)*	Odds Ratio *(S.E)*	Coeff. *(S.E)*	Odds Ratio *(S.E)*	Coeff. *(S.E)*
Female	**0.588**** *(0.111)*	-0.152 *(0.166)*	0.724 *(0.171)*	-0.161 *(0.245)*	0.942 *(0.250)*	-0.384 *(0.246)*	0.710 *(0.198)*	-0.113 *(0.218)*
UK resident outside of England	0.995 *(0.258)*	0.125 *(0.228)*	0.876 *(0.289)*	0.574 *(0.338)*	0.746 *(0.264)*	-0.405 *(0.343)*	1.503 *(0.572)*	-0.392 *(0.277)*
Married	1.187 *(0.250)*	-0.209 *(0.199)*	1.200 *(0.316)*	-0.184 *(0.246)*	1.027 *(0.295)*	0.201 *(0.264)*	0.872 *(0.263)*	-0.239 *(0.239)*
Age								
Under 35	1.243 *(0.287)*	**0.573**** *(0.202)*	1.000 *(0.285)*	0.010 *(0.304)*	1.440 *(0.471)*	0.395 *(0.275)*	1.495 *(0.516)*	0.147 *(0.267)*
Over 65	1.476 *(0.655)*	0.163 *(0.343)*	0.948 *(0.543)*	-0.178 *(0.612)*	1.910 *(1.266)*	-0.109 *(0.589)*	0.725 *(0.485)*	0.056 *(0.502)*
Employment status								
Unemployed	0.801 *(0.352)*	0.161 *(0.337)*	1.333 *(0.746)*	-0.022 *(0.610)*	1.149 *(0.748)*	0.051 *(0.593)*	2.670 *(1.797)*	-0.394 *(0.491)*
Student	1.346 *(0.845)*	0.001 *(0.575)*	4.823 *(4.126)*	0.364 *(0.820)*	-	-	-	-
Disabled	1.964 *(1.793)*	-0.181 *(0.853)*	6.721 *(6.967)*	-0.081 *(0.928)*	6.527 *(8.620)*	0.456 *(0.917)*	**14.388*** *(19.141)*	-0.176 *(0.833)*
Unpaid worker	0.924 *(0.773)*	-0.756 *(0.854)*	2.949 *(3.273)*	-1.140 *(1.112)*	0.804 *(0.827)*	-0.782 *(0.999)*	6.811 *(7.665)*	-0.966 *(0.831)*
Educational level								
Higher education	1.012 *(0.197)*	0.011 *(0.177)*	1.098 *(0.272)*	0.057 *(0.239)*	1.353 *(0.370)*	0.245 *(0.230)*	1.285 *(0.362)*	0.193 *(0.210)*
No formal qualifications	2.752 *(1.677)*	-0.513 *(0.482)*	2.108 *(1.497)*	0.072 *(0.683)*	1.298 *(0.862)*	-0.002 *(0.628)*	1.036 *(0.688)*	-0.287 *(0.584)*

Covariates	No potential for harm		Potential harm (mild)		Potential harm (moderate)		Potential harm (severe)	
	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)
	Odds Ratio *(S.E)*	Coeff. *(S.E)*	Odds Ratio *(S.E)*	Coeff. *(S.E)*	Odds Ratio *(S.E)*	Coeff. *(S.E)*	Odds Ratio *(S.E)*	Coeff. *(S.E)*
Household income								
Under £20K	**0.563*** *(0.137)*	-0.139 *(0.228)*	0.606 *(0.183)*	-0.069 *(0.334)*	0.543 *(0.182)*	-0.133 *(0.336)*	0.629 *(0.213)*	-0.018 *(0.298)*
Over £40K	0.899 *(0.213)*	0.344 *(0.209)*	**1.985*** *(0.630)*	0.221 *(0.291)*	**2.380*** *(0.867)*	0.283 *(0.284)*	**2.497*** *(0.947)*	0.312 *(0.255)*
Personal medication error experience								
Yes	**2.652**** *(0.987)*	**0.844**** *(0.307)*	**2.844*** *(1.313)*	0.682 *(0.402)*	**3.667*** *(1.908)*	0.294 *(0.403)*	2.828 *(1.554)*	0.071 *(0.388)*
Unsure	1.125 *(0.515)*	-0.121 *(0.442)*	0.690 *(0.472)*	0.589 *(0.718)*	0.553 *(0.374)*	0.255 *(0.667)*	2.225 *(1.943)*	-0.524 *(0.547)*
Family medication error experience								
Yes	1.58 *(0.427)*	-0.414 *(0.232)*	**2.133*** *(0.753)*	-0.551 *(0.315)*	2.071 *(0.785)*	-0.192 *(0.308)*	1.889 *(0.805)*	-0.181 *(0.286)*
Unsure	1.023 *(0.373)*	-0.239 *(0.372)*	**3.681*** *(2.113)*	-0.647 *(0.460)*	2.426 *(1.627)*	0.279 *(0.530)*	1.947 *(1.349)*	0.262 *(0.459)*
Health sector work								
Yes	0.965 *(0.297)*	0.150 *(0.287)*	1.510 *(0.638)*	0.506 *(0.431)*	0.559 *(0.274)*	0.572 *(0.468)*	0.488 *(0.245)*	0.74 *(0.424)*
Health sector study								
Yes	0.616 *(0.640)*	-1.655 *(1.080)*	0.441 *(0.626)*	**-2.851*** *(1.295)*	-	-2.157 *(1.191)*	-	-1.392 *(0.951)*
Constant	1.612 *(0.439)*	**4.366**** *(0.242)*	1.011 *(0.346)*	**4.712**** *(0.374)*	2.084 *(2.010)*	**4.485**** *(0.869)*	4.252 *(4.247)*	**4.907**** *(0.761)*
Observations	541		373		326		329	

Base factors: Male, Resident in England, Aged 35-65, Unmarried, Employed, School-level qualifications, annual household income £20,000£40,000, No personal experience of medication error, No familial experience of medication error, working in a non-health sector role, Studying in a non-health field
*p<0.05, **p<0.01
Coeff.: coefficient, GLM: Generalised linear model, S.E.: Standard error

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Eliciting willingness-to-pay to prevent hospital medication administration errors in the UK: a contingent valuation survey

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Abstract

Medication errors are common in hospitals. These errors can result in adverse drug events (ADEs), which can reduce the health and wellbeing of patients', and their relatives and caregivers. Interventions have been developed to reduce medication errors, including those that occur at the administration stage.

Objective: We aimed to elicit willingness-to-pay (WTP) values to prevent hospital medication administration errors.

Design and setting: An online, contingent valuation (CV) survey was conducted, using the random card-sort elicitation method, to elicit WTP to prevent medication errors.

Participants: A representative sample of the UK public.

Methods: Seven medication error scenarios, varying in the potential for harm and the severity of harm, were valued. Scenarios were developed with input from: clinical experts, focus groups with members of the public, and piloting. Mean and median WTP values were calculated, excluding protest responses or those that failed a logic test. A two-part model (logit, GLM) regression analysis was conducted to explore predictive characteristics of WTP.

Results: Responses were collected from 1,001 individuals. The proportion of respondents willing to pay to prevent a medication error increased as the severity of the ADE increased and was highest for scenarios that described actual harm occurring. Mean WTP across the scenarios ranged from £45 (95% CI: £36 - £54) to £278 (95% CI: £200 - £355). Several factors influenced both the value and likelihood of WTP, such as: income, known experience of medication errors, gender, field of work, marriage status, education level, and employment status. Predictors of WTP were not, however, consistent across scenarios.

Conclusions: This CV study highlights how the UK public value preventing medication errors. The findings from this study could be used to carry out a cost-benefit analysis which could inform

implementation decisions on the use of technology to reduce medication administration errors in UK hospitals.

Article Summary

Strengths and Limitations of this study

- First study to obtain UK public preferences for the prevention of hospital medication administration errors.
- Preferences obtained from a representative sample of the UK public which aligns with the interest of policymakers who seek to represent the general public.
- The CV survey design and development adhered to internationally recognised methodological standards.
- Preference results may be subject to biases introduced from respondents' interpretation of scenarios.
- The online format of the survey may introduce bias to the results from a "digital divide".

1. Introduction

Medication errors are common, with a recent review estimating that 237 million medication errors occurred across primary and secondary care settings and care homes every year in England[1]. Over a quarter of these errors had the potential to cause moderate or severe harm[1]. A review of internationally published studies of medication administration errors in hospitals and long-term care facilities reported a median error rate of 21.7% of administered medication doses in the UK (5.5% when wrong time errors were excluded)[2]. Medication errors may result in harm or no harm to the patient (e.g., if a medication was given a little late).

Harm caused because of medication use is known as an adverse drug event (ADE) and is formally defined as 'injury resulting from medical interventions related to a drug'[3]. Potential ADEs are defined as medication errors that had the potential to cause harm but this did not occur (e.g., a patient received a drug which they had a documented allergy to but no reaction occurred)[4]. The administration of medication may also result in an unexpected adverse reaction (e.g., a rash caused by a previously unknown allergic reaction) known as a non-preventable ADE. ADEs can result in patient morbidity and mortality[5] in addition to significant distress for their relatives and care providers[6]. Furthermore, there is a substantial cost associated with preventable medication errors. This has been estimated to be over £111 million (2015/16 prices) annually for errors made in primary and secondary care in the UK[1].

Interventions have been developed and implemented to reduce medication administration errors in hospitals. These include the use of health information technology, such as barcode medication administration systems to identify both the patient and the medication is correct at the administration stage[7-9]. A systematic review reported a reduction in medication errors following implementation of a barcode administration system[10]. There is, however, a lack of evidence around the impact of alternative tools to prevent medication administration errors, particularly in a UK setting.

The UK MedEye study[11] was conducted to explore the impact of implementing a novel bedside medication verification system on medication administration errors in hospitals and value the benefit that individuals associated with avoiding such errors. These include patient health benefits, like maintaining their quality of life and non-health benefits, such as maintaining their trust in hospital systems and devices[12].

One approach to measuring the value that patients place on preventing medication errors is by using stated preference techniques[13]; these are so called because individuals are asked to state their preferences regarding their willingness-to-pay (WTP) for the good or outcome under investigation (in this case, preventing medication error and resulting ADEs). Contingent valuation (CV) is a stated preference technique that involves the creation of a hypothetical market in which individuals are asked the maximum amount they would be willing to pay for a good[14 15]. The stated monetary amount is considered to represent the economic value placed on the good by the individual[16]. Benefits valued using CV are not limited to direct health benefits, therefore, the CV method can also be appropriate when valuing health technologies incorporating non-health benefits. No previous studies have obtained stated preference valuations for preventing medication errors; however, the CV method has previously been used to value the benefit of avoiding adverse events associated with specific health conditions, such as anaemia[17] and whooping cough[18]. Given the gap in the current literature, we conducted a WTP study using the CV method to obtain a monetary value for the holistic benefit from the prevention of hospital medication administration errors.

2. Methods

An online CV survey was developed with Dynata Ltd, a company who have considerable experience in survey development, distribution, and data collection from the UK public.

2.1. Survey development

The survey was developed in five steps. Step 1: Seven hypothetical scenarios were developed for the survey by researchers at Newcastle University (SH and LV) drawing on information from ADE literature[19-21] (see Supplementary material A for descriptions of all scenarios). These were reviewed by two pharmacists, from Newcastle-upon-Tyne hospitals and Newcastle University, to ensure clinical accuracy of descriptions with different levels of harm: (Scenario 1) errors which have no potential to cause harm to the patient, (Scenarios 2-4) errors which have the potential to cause harm to the patient, and (Scenarios 5-7) errors which cause actual harm to the patient. Scenario 1 was included to explore whether people value preventing medication errors in hospital independent of clinical harm caused.

The potential to cause harm and actual harm scenario categories were each then further divided into three scenarios representing the severity of harm associated with each ADE: mild harm, moderate harm, and severe harm (see Figure 1). These were determined to reflect the severity distinctions of both potential and actual ADEs avoided by preventing medication administration errors provided in the literature[19-21]. As medication errors which fall within the "potential to cause harm" category occur more commonly than those in the "actual harm" category[7], there remained an empirical question of whether people would value preventing medication errors which would have only the potential to cause harm differently to those which would cause actual harm.

INSERT FIGURE 1 HERE

Step 2: Two patient and public involvement (PPI) sessions were held; the first (n=3) to help refine the wording of the survey instructions and scenarios and the second (n=4) to identify the most appropriate type of payment to use (i.e., the payment vehicle)[15 22] and identify the most appropriate way to ask the CV question (i.e., the elicitation method)[15 22]. The PPI members suggested that a "*donation to your local hospital trust*" was the preferable payment vehicle compared with additional tax contributions or a one-off payment. When exploring different elicitation methods, the PPI members found that asking an open-ended question, e.g., "*How much would you be willing to pay to* *prevent the medication error?*", was difficult to consider. Alternative approaches were presented, such as a payment card method[23] (i.e. a list of monetary amounts is presented and respondents select the amounts they are WTP) and an iterative bidding technique[15 23] (i.e., respondents are offered an initial monetary amount and, subject to the respondent's WTP response, a follow-up amount is offered which is either lower or higher than the initial monetary amount[22]). There was no strong preference from the PPI members for either method, thus, a version of the payment card method (the random card sort technique[24]) was chosen for the survey.

Step 3: The survey was then tested on a range of volunteers (n=14) with different occupations (e.g., postgraduate students, pharmacists, clinicians, and professional services staff) to ensure that the range of values presented in the random card sort was appropriate for the good being valued. The final range of values used in the survey was: £1, £5, £10, £25, £50, £75, £100, £150, £200, £300, £500, £750, £1000.

Step 4: The survey was further refined by adding a logic test[i] after each scenario to ensure respondents understood whether actual harm was caused because of the medication error in each case. Respondents were then asked whether they would be willing to pay to prevent each medication error. Respondents who were unwilling to pay were asked to select their reason from a list of five possible options (see Box 1) and had an opportunity to provide a free text response under "other". The justifications selected for unwillingness to pay were used to categorise responses as either a protest response (i.e., the respondent valued preventing the medication error but was unwilling to pay for another reason[25]) or a true zero valuation (i.e., a reason indicating that a respondent truly did not value the intervention). The options *"Avoiding the medication mistake is valuable to me but it should be funded by existing government budgets"* and *"I do not think*

[i] The logic test comprised of one question after each scenario was presented which asked respondents whether any harm is caused because of the medication error described in the scenario. Correct answers which passed the logic test were "no harm" for scenarios 1-4, and "yes, harm caused" for scenarios 5-7.

donations to my local hospital trust should fund this" were considered protests against the method of payment. The free text responses were examined independently by two members of the research team (SH and LV) who categorised each response as either a protest or a true zero. Where opinions differed for response categorisation, a final decision was made via discussion between the two researchers and no third-party input was required.

Respondents who indicated WTP to prevent the medication error completed a random card sort in which monetary amounts were displayed randomly and respondents would indicate whether they "would pay", "would maybe pay", or "would not pay" each amount in turn. The random card sort was introduced to allow respondents to think through how they value preventing each medication error before being asked an open-ended question: *"What is the MAXIMUM value you would be willing to pay as a one-off donation to your local hospital trust to avoid the medication mistake?".* The respondent's choices of monetary values that they were willing/not willing-to-pay during the random card sort were displayed when asking the open-ended question, to help guide the respondent to state their maximum WTP. The open-ended question allowed for greater sensitivity to individual WTP and provided continuous rather than interval data for analysis.

Step 5: An online pilot of the survey was conducted by Dynata to their UK panel in February 2020, which obtained responses from 166 respondents. Small changes were made to the scenario descriptions (i.e., emphasising some text in bold and adding a clarification of the harm associated with each error in the scenario title) in response to the pilot, predominantly to improve the proportion of respondents passing the logic test. The fully developed survey was then finalised.

2.2. Patient and Public Involvement

As described above, two PPI sessions were held to inform the design of the CV survey.

2.3. Data Collection

Dynata distributed the online survey to their UK panel on 2nd March 2020 and received all responses on 18th March 2020. The sample collected was representative of the adult UK public according to age, gender, and occupational group. In addition to the WTP questions, demographic characteristics were also collected (see Table 1 for all characteristics collected). A required sample size of 502 was calculated following the sample size calculation recommended by Mitchell & Carson[23] (see Supplementary material B for full details of the sample size calculation). The sample size was inflated to account for the proportion of data that would not count towards analysis, using data on failed logic responses and protests from the soft launch, resulting in a desired sample size of 996.

2.4. Data analysis

Survey data were analysed using statistical software STATA 15[26]. Descriptive statistics were conducted to calculate mean and median WTP. Protest responses were removed from the sample prior to analysis following conventional practice[27], so as not to downwardly bias WTP estimates. Base-case analysis also excluded responses which failed the logic test for each scenario. Sensitivity analyses were conducted to explore the impact on mean WTP from trimming the highest 1% of values and from including responses that failed the logic test.

Regression analysis was conducted to identify predictors of WTP. Due to a large proportion of zero values (from respondents who state unwillingness to pay) and a skewed data distribution, standard ordinary least squares estimators would have provided biased and inconsistent estimates[28]. Two-part models have been recommended for continuous data with a spike at zero[29]. A two-part model was employed in order to take account of the zero WTP values in the regression analysis[30]. The two-part model used respondents' WTP value for each scenario as the dependent variable (see Supplementary material C for details of predictor variables); logistic regression first modelled the probability of a respondent being willing to pay to avoid the medication error (i.e., those unwilling to pay are allocated a WTP value of £0) and a linear regression (GLM) modelled WTP value conditional on the respondent being willing to pay (i.e., having a WTP value >£0).

A subgroup analysis was conducted which included respondents who failed the logic test for scenarios 1-4[ii] but also reported personal experience of a medication error. This subgroup analysis was prompted because a comparison of characteristics between respondents who passed and failed logic tests showed that respondents failing the logic tests for scenarios 1-4[iii] were more likely to report known experience of prior error. Therefore, the base-case analysis for these scenarios was potentially biased towards individuals who had no known experience of a medication error.

3. Results

In total, 1,001 responses were received to the survey. Table 1 outlines the demographic characteristics of the full sample survey participants (see Table S1 in Supplementary material D for characteristics of the sample included in analysis for each scenario separately). Most of the sample had no known personal or familial experience of medication errors and did not work in the health sector. Similar proportions of respondents reported household incomes of less than £20,000 (28%) or greater than £40,000 (29%) and the largest proportion reported household incomes between £20,000 and £40,000 (39%).

INSERT TABLE 1 HERE

Across the scenarios, 56%-88% of respondents passed the logic test and were included in the base-case analysis (see Table 2). Fewer respondents passed the logic test for the potential harm scenarios than for the actual harm scenarios. Table 2 describes the number and type of response for each scenario. There was a similar proportion of protest responses across all scenarios in the base-

[ii] i.e., respondents who believed harm was caused by the medication errors which had no potential to cause harm and potential to cause harm

[iii] There was no difference in medication error experience between those who passed and failed the logic test for scenarios 5-7

case analysis (~45% of the sample); however, the proportion of respondents willing to pay to prevent the medication error increased between the potential and actual harm scenarios and increased as the severity of the ADE and medication error increased.

INSERT TABLE 2 HERE

Both mean and median WTP were greater than zero (henceforth, "positive") for all scenarios. The lower bound of the 95% confidence intervals (95% CIs) around mean WTP were substantially greater than zero for all scenarios, which suggests with confidence that true mean WTP is positive. Both mean and median WTP increase as severity of ADE increases and between potential and actual harm scenarios. Mean WTP ranged from £45 (95% CI: £36 - £54) to prevent a medication error which causes no harm, to £278 (95% CI: £200 - £355) to prevent a medication error which causes life-threatening actual harm (see Table 3).

The 95% CIs were widest for the larger mean WTP values, which suggests the presence of outlier WTP values for the most severe actual ADE scenarios. The comparable 95% CIs when the top 1% of WTP values were trimmed are substantially narrower, validating the theory that a few, large outliers in the base-case sample skewed the results. However, for the trimmed WTP sample, there is evidence that both mean and median WTP remain greater than zero (see Table 3).

Including failed logic responses increased estimates of mean and median WTP for the no-harm and potential harm scenarios and reduced estimates for the actual harm scenarios (see Table 3). This result is expected given that incorrect logic responses to the potential ADE scenarios anticipated harm from the medication error, and vice versa for the actual harm ADE. It is logical that respondents anticipating harm from the medication error in the potential harm scenarios may have been willing to pay more than those correctly anticipating no harm occurring. The converse would be true for the actual harm ADEs.

INSERT TABLE 3 HERE

<u>Regression analysis</u>

The base-case regression analysis results are reported in Table 4. The logit columns of Table 4 report the odds of a respondent being willing to pay to prevent the medication error in each scenario and the GLM columns report the impact of each predictor variable on the WTP amount offered, conditional on the respondent being willing to pay to prevent the medication error.

Factors predicting likelihood of WTP

In the base-case analysis, there is evidence that having a family member who had experienced a medication error increased respondents' likelihood of paying to prevent a potentially harmful medication error (OR:2.5-3, $p<0.05$), as did having an annual household income greater than £40,000 compared with between £20,000 and £40,000 (OR: 2, $p<0.05$). Table 4 also demonstrates evidence that being male ($p<0.01$), working or studying in a non-health sector field ($p<0.05$), being married ($p<0.05$), and having higher education compared with standard qualifications ($p<0.01$) all increased the odds of being willing to pay to prevent a medication error for at least one scenario. However, evidence is not consistent across all scenarios. There is also evidence that having an annual household income of less than £20,000 compared with between £20,000 and £40,000 decreased the odds of WTP a positive amount (OR:0.49-0.53, $p<0.05$).

Factors predicting a lower WTP amount

Respondents who are unemployed ($p<0.05$), unpaid workers ($p<0.01$), female ($p<0.01$) or unsure about their medication error experience ($p<0.05$) offered lower WTP amounts than their comparative respondents to prevent actual harmful errors (see Table 4 for base factors). Those studying in a health-related field also offered less to prevent a mild, potentially harmful error ($p<0.05$).

Factors predicting a higher WTP amount

Having a family member who had experienced a medication error increased the WTP amount to prevent severely harmful errors ($p<0.05$) whilst young respondents (compared with those aged 35-65) offered more to prevent errors which cause no, or potentially moderate, harm ($p<0.05$).

Respondents with higher education (p<0.01) and annual household incomes above £40,000 (p<0.01) were willing to pay higher amounts than their comparative respondents to prevent actual harmful errors. For most of the scenarios, there is no evidence that respondents with the lowest household incomes offered different WTP amounts to respondents in the mid-range household income category (£20,000-£40,000), except for preventing moderately harmful errors in which this group offered a higher WTP amount.

INSERT TABLE 4 HERE

Subgroup Analysis

The subgroup analysis is reported in Table S2 in supplementary material D. This analysis includes respondents who failed the logic test for the first four scenarios (in which failure was characterised by participants believing harm is caused in the four scenarios in which no ADE occurs) but reported personal experience of a medication error. There are very few changes to variables identified as predictors of likelihood or value of WTP between the base-case and subgroup analyses, apart from the impact of personal medication error experience and familial medication error experience. Table S2 shows that in the no potential to cause harm and both potential for mild and moderate harm scenarios, known personal medication error experience increased the odds of WTP to prevent the medication error substantially (OR: 2.65-3.67; p<0.01).

The evidence of impact of known familial experience of a medication error is, however, reduced in the subgroup analysis compared to the base-case; there is only evidence of an increase in odds of WTP for one scenario (potential for mild harm) compared to all three potential harm scenarios in the base-case.

4. Discussion

The results from this CV study suggest that the UK public value preventing medication errors, even in situations where no ADE occurred. However, a smaller proportion of respondents valued preventing medication errors which have no potential to cause an ADE (Scenario 1: 54%) compared with preventing errors which cause actual harm (Scenarios 5-7: ~80%) and errors with potential to cause harm (Scenarios 2-4: ~65%). This provides a degree of face validity to the study as it was expected that more respondents would value the prevention of errors that could cause harm than errors that are not associated with any harm to patients. Despite the lower proportion of respondents valuing errors causing no harm compared to preventing those resulting in ADEs, over half of the analytic sample did value the prevention of errors which had little to no likelihood of resulting in harm. This suggests that the UK public attribute, and positively value, non-health benefits from the prevention of medication errors, such as increased trust in healthcare provision. Thus, low-cost interventions that can prevent medication administration errors, regardless of the potential for harm prevented as a result, may still be efficient from a UK societal perspective due to the value placed on non-health benefits associated with preventing medication errors.

The subgroup analysis results further substantiate this conclusion. This analysis was conducted after identifying evidence of a difference in known personal medication error experience between respondents who passed and those who failed the logic test for the first four scenarios (i.e., those in which no ADE occurs as a results of the medication error). It is assumed that individuals who have experienced a medication error personally are more informed about the impacts of such errors than individuals who have no personal experience. The failures in the logic test could be due to misunderstanding the question or misreading the scenarios, however, the significant difference between passes and failures characterised by individuals with experience in medication errors suggests that these respondents are aware of harms caused to patients from medication errors, regardless of whether an ADE occurs. One explanation could be that respondents who have experienced medication errors personally encountered non-health-related harms as a result. To explore this theory, respondents who failed the logic test for the first four scenarios and reported personal experience of a medication error were included in an additional regression analysis (all other logic failures remained excluded). This additional analysis demonstrated that personal medication error experience increased the likelihood of a respondent being willing to pay to prevent medication errors in the scenarios in which no actual ADE occurs as a result. These results further support a theory that those with personal medication error experience perceive non-health-related benefits from preventing medication errors as those individuals are more likely to value error prevention than individuals without similar experience in situations where errors do not result in an ADE.

Several other predictors of WTP were identified in the base-case regression analysis; however, these were not consistent across all scenarios, suggesting that the respondent characteristics examined in our analysis did not largely drive decisions on WTP. There may be other respondent characteristics that predict WTP to prevent medication administration errors that were not analysed in this study due to limitations in our data collection, such as participants' medication regimes, however, it was beyond the scope of our survey to collect this information. One consistent predictor of WTP was household income; there was evidence that respondents in the highest household income group (over £40,000 annually) were consistently either more willing to pay to prevent medication errors or offer a higher WTP value for all scenarios except the "no harm" scenario. Conversely, respondents in the lowest household income group (less than £20,000 annually) were less likely to pay to prevent the medication errors, although the evidence for this was inconsistent (only scenarios 1 and 3). The link between ability to pay and WTP is expected in CV studies as the greater an individual's ability to pay, the greater both their likelihood of WTP and the value offered can be. Therefore, this finding indicates theoretical validity of the survey[31-33].

Although the survey produced skewed data, which is common in CV surveys[34], with a substantial proportion of zeros, mean and median WTP were consistently and confidently positive across all scenarios. Trimming the top 1% of values to remove any potential outliers did not impact median WTP and mean WTP was reduced slightly, however, confidence intervals remained substantially greater than zero. The findings of this study, with regards to the UK public valuing the prevention of medication errors, are considered robust.

The CV survey design and development adhered to internationally recognised methodological standards[35 36] and the study sought to seek the views of a representative sample of the UK public. Thorough pilot testing allowed us to refine and simplify the survey. Furthermore, recent literature has reported that the random card sort technique, which was used in this survey, may produce more valid responses than the standard payment card method[37]. Thus, the choice of this elicitation method over the standard payment card method adds to the validity of the results. In addition, asking open-ended questions without any context has been demonstrated to be cognitively burdensome[15] and has potential to result in large proportions of non-responses, zero responses and outliers[23]. Therefore, conducting the random card sort task prior to asking the open-ended question was intended to minimise some of these biases whilst enabling more granular WTP responses from the open-ended question compared to responses from the random card sort task alone. However, the findings of our study should be interpreted in the light of some limitations.

Potential biases may have been introduced from respondents' interpretation of scenarios relating to details that were not included in the scenarios such as the duration of symptoms or likelihood of ADE occurrence. The heterogeneity of WTP responses could be explained by different interpretations of how long symptoms would last or the probability of symptoms occurring, and the extent of the negative impact the medication errors could have on patient wellbeing. Additionally, the construction of the survey itself may have introduced bias from the order in which scenarios were presented[38] and the payment vehicle used[23 39]. The scenarios were presented in the same order to each participant (no potential for harm, potential harm increasing in severity, then actual harm increasing in severity) and there were some objections to the payment vehicle from respondents, although these responses were removed from the analysis as protest zeros. Both the order of the scenarios presented, and the payment vehicle, were tested in PPI sessions and the final decisions based on feedback from the public representatives' feedback. The use of online survey panels may have limited the findings of our study by excluding members of the public who have not joined the market research panel used by Dynata Ltd to recruit respondents. In addition, the survey was not available to individuals without access to the internet. There may be differences in the characteristics of individuals on either side of the *digital divide*, thus, potentially biasing the results against those unable to participate due to access limitations.

4.1. Conclusion

This study has identified that the UK public value preventing medication errors, even in instances where no harm occurs. The value placed on preventing medication errors increases as the level of harm occurring due to error increases. Individuals with higher household income are more likely to be willing-to-pay to prevent a medication error and will offer greater amounts than individuals with lower incomes and known personal experience of a medication error had an impact on respondents' WTP to prevent medication errors in a subgroup analysis. Other factors predict increased likelihood and/or higher value of WTP (i.e., higher education, being male, working or studying in a non-health sector field, being married, having family medication error experience, and being aged <35 years) however, these are not consistent across all scenarios. Alternatively, several factors predicted lower WTP offers, i.e., unemployment or being in unpaid work, being female, studying in a health-related field and being unsure about medication error experience. Similarly, these factors were inconsistent predictors across all scenarios. Sensitivity analysis did not alter median WTP substantially and mean values were reduced when data were trimmed and outliers removed. Mean WTP and 95% CIs remained substantially greater than zero in all sensitivity analyses, therefore, our conclusions regarding the value placed on preventing medication errors remain and the findings of this study provide reliable information on the value to the UK public of preventing medication errors.

This study has potential to impact future practice in medication administration in hospitals in the UK as the WTP findings from this study can be used to carry-out a cost-benefit analysis[34] to explore the net monetary benefits of interventions to prevent medication errors in hospitals. The cost-benefit analysis could inform policymakers' decisions regarding implementation of medication-error prevention interventions.

Declarations

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Competing interests

No competing interests for any of the authors.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

Ethical approval to conduct the contingent valuation study was obtained from Newcastle University Ethics Committee on 18/07/2019 (Ref: 14156/2018). Survey respondents were informed at the start of the survey that completion of the survey constituted consent to take party in the study. No identifiable data were collected.

Author contributions

SH contributed to the design of the study, data collection, data analysis and write-up of the paper. NB contributed to the design of the study and write-up of the paper. CT contributed to the design of the study and the write-up of the paper. SS contributed to the design of the study and write-up of the paper. LV contributed to the design of the study, data analysis, write-up of the paper and general oversight of the study.

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Box 1 Reasons for unwillingness to pay

1. Avoiding the medication mistake is not valuable to me
2. Avoiding the medication mistake is valuable to me but I can't afford it
3. I do not think donations to my local hospital trust should fund this
4. Avoiding the medication mistake is valuable to me but it should be funded by existing government budgets
5. Other

Table 1 Characteristics of full initial sample

Respondent characteristic	Initial sample (N=1,001) Frequency	(%)	UK national proportions[+], %
Sex			
Male	498	(49.8%)	48.7
Female	502	(50.1%)	51.3
Prefer not to say	1	(0.1%)	-
Age			
18-24	153	(15.3%)	14.8
25-34	161	(16.1%)	16.6
35-44	170	(17.0%)	17.3
45-54	175	(17.5%)	17.2
55-64	156	(15.6%)	14.6
65+	186	(18.6%)	19.5
Region			
England	852	(85.1%)	84
Scotland	82	(8.2%)	8.1
Wales	48	(4.8%)	4.7
Northern Ireland	19	(1.9%)	2.7
Occupational group [†]			
A	56	(5.6%)	4
B	223	(22.3%)	23
C1	288	(28.8%)	28
C2	191	(19.1%)	20
D	125	(12.5%)	15
E	118	(11.8%)	10
Marriage status			
Married/cohabiting	539	(53.8%)	51.2
Single	340	(34.0%)	34.4
Divorced/widowed	121	(12.1%)	14.4
Prefer not to say	1	(0.1%)	-
Employment status			
Full time	378	(37.8%)	-
Part time	131	(13.1%)	-
Self employed	73	(7.3%)	-
Unemployed	117	(11.7%)	-
Retired	200	(20.0%)	-
Full time student	58	(5.8%)	-
Part time student	2	(0.2%)	-
Other	42	(4.2%)	-
Working in the health sector			
Yes	113	(11.3%)	-
No	669	(66.8%)	-
Not applicable	219	(21.9%)	-

Studying a health-related field			
Yes	8	(0.8%)	-
No	52	(5.2%)	-
Not applicable	941	(94.0%)	-
Education			
Degree	363	(36.3%)	-
Higher education below degree	114	(11.4%)	-
A-level	220	(22.0%)	-
GCSE A*-C	221	(22.1%)	-
GCSE D-G	47	(4.7%)	-
Foreign qual	2	(0.2%)	-
No formal qualifications	34	(3.4%)	-
Annual household income (£)			
0 - 12K	110	(11.0%)	-
12K-20K	167	(16.7%)	-
20K - 30K	220	(22.0%)	-
30K - 40K	166	(16.6%)	-
40K - 50K	116	(11.6%)	-
50K - 70K	89	(8.9%)	-
70K - 100K	64	(6.4%)	-
100K +	16	(1.6%)	-
Prefer not to say	40	(4.0%)	-
Unknown	13	(1.3%)	-
Known personal experience of a medication mistake			
Experience	74	(7.4%)	-
No experience	880	(87.9%)	-
Unsure	47	(4.7%)	-
Harm suffered from the mistake			
Harm	29	(39.2%)*	-
No harm	41	(55.4%)*	-
Unsure	4	(5.4%)*	-
Friend or family member known experience of a medication mistake			
Experience	174	(17.4%)	-
No experience	729	(72.8%)	-
Unsure	98	(9.8%)	-
Harm suffered from the mistake			
Harm	102	(58.6%)*	-
No harm	51	(29.3%)*	-
Unsure	21	(12.1%)*	-

[+]National proportions reported where available. Marriage status for England and Wales only

[†] Occupational groups: A=Higher managerial, administrative and professional, B=Intermediate managerial, administrative and professional, C1=Supervisory, clerical and junior managerial, administrative and professional, C2=Skilled manual workers, D=Semi-skilled and unskilled manual workers, E=State pensioners, casual and lowest grade workers, unemployed with state benefits only.

*% of those reporting personal/familial experience of medication mistake

Table 2. Initial sample and unwillingness to pay responses

Scenarios	No potential for harm	Potential harm (mild)	Potential harm (moderate)	Potential harm (severe)	Actual harm (mild)	Actual harm (moderate)	Actual harm (severe)
Initial sample (N)	1,001	1,001	1,001	1,001	1,001	1,001	1,001
Number passing logic test (%)	867 (86.6)	616 (61.5)	568 (56.7)	565 (56.4)	787 (78.6)	865 (86.4)	885 (88.4)
Number of protest-zero WTP responses*	344	277	274	266	358	383	379
Number of positive WTP responses*	284	199	192	209	336	387	422
Number of true zero WTP responses*	239	140	102	90	93	95	84
Number excluded for other reasons, e.g. clear misunderstanding of WTP question or scenario description	10	8	6	6	8	14	0
Reasons for unwillingness to pay (N)**							
Avoiding the medication mistake is not valuable to me	120	46	23	20	17	9	6
Avoiding the medication mistake is valuable to me but I can't afford it	92	84	73	64	68	77	66
I do not think donations to my local hospital trust should fund this	89	64	64	71	63	63	60
Avoiding the medication mistake is valuable to me but it should be funded by existing government budgets	243	198	194	181	277	296	292
Other	39	25	22	20	26	33	39

*Only respondents who pass logic test included in numbers
**Includes both protest-zero and true-zero responses of respondents who passed the logic test
Total number of participants included in the base case analysis for each scenario is calculated as the number passing the logic test minus the number of protest zero WTP responses, since protesters are removed from the sample prior to analysis

Table 3 Mean and median WTP for base-case and sensitivity analyses, GBP£

Scenarios	No harm	Potential harm (mild)	Potential harm (moderate)	Potential harm (severe)	Actual harm (mild)	Actual harm (moderate)	Actual harm (severe)
Base-case							
Mean	45	53	72	96	115	153	278
(95% CI)	(36 - 54)	(37 - 69)	(49 - 95)	(70 - 123)	(87 - 144)	(121 - 185)	(200 - 355)
Median	5	10	15	25	35	50	63
(IQR)	0-50	0-50	0-75	0-100	0-100	0-150	0-200
Trimmed values							
Mean	37	40	56	79	82	126	195
(95% CI)	(31 - 44)	(32 - 47)	(43 - 69)	(61 - 96)	(70 - 95)	(107 - 145)	(163 - 227)
Median	5	10	15	25	30	50	55
(IQR)	0-50	0-50	0-75	0-100	5-100	10-125	10-200
Including failed logic responses							
Mean	70	80	90	120	103	142	259
(95% CI)	(57 - 82)	(65 - 96)	(74 - 106)	(99 - 141)	(80 - 127)	(114 - 169)	(188 - 330)
Median	10	20	25	35	25	50	50
(IQR)	0-75	0-75	0-100	1-100	0-100	0-123	0-200

95% CI: 95% Confidence interval, IQR: Interquartile range

Table 4 Results of two-part model regression analysis with dependent variable WTP

Covariates	No potential for harm		Potential harm (mild)		Potential harm (moderate)		Potential harm (severe)		Actual harm (mild)		Actual harm (moderate)		Actual harm (severe)	
	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)
	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*
Female	**0.577****	-0.107	0.764	-0.063	0.972	-0.239	0.741	-0.043	**0.590***	-0.206	0.798	-0.300	1.036	**-0.586****
	(0.110)	*(0.177)*	*(0.186)*	*(0.277)*	*(0.271)*	*(0.260)*	*(0.212)*	*(0.255)*	*(0.153)*	*(0.194)*	*(0.199)*	*(0.170)*	*(0.268)*	*(0.189)*
UK resident outside England	1.002	0.042	0.783	0.735	0.740	-0.178	1.427	-0.320	1.190	0.357	1.404	0.368	1.318	0.064
	(0.262)	*(0.245)*	*(0.266)*	*(0.400)*	*(0.276)*	*(0.38)1*	*(0.558)*	*(0.324)*	*(0.443)*	*(0.257)*	*(0.538)*	*(0.228)*	*(0.510)*	*(0.257)*
Married	1.156	-0.122	1.233	-0.021	1.051	0.237	0.891	-0.375	1.070	0.121	1.373	0.127	**1.942***	-0.055
	(0.247)	*(0.209)*	*(0.336)*	*(0.283)*	*(0.318)*	*(0.286)*	*(0.283)*	*(0.277)*	*(0.320)*	*(0.22)1*	*(0.38)7*	*(0.187)*	*(0.574)*	*(0.212)*
Age														
Under 35	1.202	**0.486***	0.944	0.416	1.624	**0.651***	1.658	0.189	1.325	0.122	1.053	0.177	0.999	0.079
	(0.284)	*(0.228)*	*(0.278)*	*(0.370)*	*(0.567)*	*(0.314)*	*(0.617)*	*(0.331)*	*(0.441)*	*(0.233)*	*(0.335)*	*(0.206)*	*(0.332)*	*(0.230)*
Over 65	1.497	0.241	1.060	-0.079	2.442	0.147	0.985	0.114	0.701	-0.047	0.941	-0.142	1.273	0.319
	(0.659)	*(0.341)*	*(0.618)*	*(0.651)*	*(1.637)*	*(0.610)*	*(0.674)*	*(0.556)*	*(0.417)*	*(0.403)*	*(0.547)*	*(0.342)*	*(0.711)*	*(0.374)*
Employment status														
Unemployed	0.827	0.110	1.248	0.182	1.169	0.049	2.610	-0.331	1.539	-0.033	0.887	0.014	0.385	**-0.739***
	(0.361)	*(0.336)*	*(0.714)*	*(0.636)*	*(0.766)*	*(0.604)*	*(1.793)*	*(0.534)*	*(0.919)*	*(0.385)*	*(0.503)*	*(0.330)*	*(0.209)*	*(0.327)*
Student	1.332	0.031	4.344	0.161	-	-	-	-	-	-	-	-	-	-
	(0.833)	*(0.580)*	*(3.771)*	*(0.863)*										
Disabled	2.226	-0.020	6.093	0.036	5.634	0.640	12.669	-0.221	3.231	-0.228	0.877	-0.001	0.619	-1.129
	(2.013)	*(0.867)*	*(6.390)*	*(0.983)*	*(7.524)*	*(0.971)*	*(17.116)*	*(0.932)*	*(3.386)*	*(0.710)*	*(0.824)*	*(0.646)*	*(0.626)*	*(0.631)*
Unpaid worker	0.958	-0.882	2.471	-1.187	0.680	-0.938	6.061	-0.866	1.436	**-2.194***	1.030	**-1.977****	0.169	**-1.670***
	(0.796)	*(0.861)*	*(2.773)*	*(1.143)*	*(0.708)*	*(1.008)*	*(6.915)*	*(0.894)*	*(1.581)*	*(0.875)*	*(1.321)*	*(0.753)*	*(0.164)*	*(0.747)*
Education level														
Higher education	1.018	-0.019	1.067	0.292	1.472	0.308	1.379	0.303	1.420	0.169	1.339	**0.431***	**2.231****	**0.598****
	(0.201)	*(0.195)*	*(0.275)*	*(0.282)*	*(0.430)*	*(0.264)*	*(0.411)*	*(0.253)*	*(0.389)*	*(0.201)*	*(0.354)*	*(0.172)*	*(0.625)*	*(0.185)*
No formal qualifications	2.742	-0.463	1.948	0.129	1.189	0.037	0.921	-0.304	0.558	-0.042	0.668	0.148	0.958	0.411
	(1.675)	*(0.492)*	*(1.395)*	*(0.700)*	*(0.805)*	*(0.626)*	*(0.622)*	*(0.629)*	*(0.317)*	*(0.615)*	*(0.371)*	*(0.491)*	*(0.557)*	*(0.565)*

Covariates	No harm		Potential harm (mild)		Potential harm (moderate)		Potential harm (severe)		Actual harm (mild)		Actual harm (moderate)		Actual harm (severe)	
	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)
	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*	Odds ratio *(S.E)*	Coeff. *(S.E)*
Household income														
Under £20	**0.533*** *(0.132)*	-0.344 *(0.247)*	0.582 *(0.183)*	-0.117 *(0.406)*	**0.493*** *(0.177)*	-0.209 *(0.386)*	0.563 *(0.210)*	0.068 *(0.363)*	0.623 *(0.207)*	0.353 *(0.280)*	0.620 *(0.190)*	**0.652**** *(0.243)*	0.698 *(0.224)*	0.486 *(0.265)*
Over £40K	0.908 *(0.218)*	0.223 *(0.222)*	**1.995*** *(0.645)*	0.116 *(0.328)*	**2.197*** *(0.831)*	0.319 *(0.310)*	**2.176*** *(0.856)*	0.387 *(0.301)*	1.779 *(0.614)*	**0.778*** *(0.223)*	1.966 *(0.702)*	**0.960**** *(0.195)*	1.368 *(0.478)*	**0.847**** *(0.218)*
Personal medication error experience														
Yes	1.651 *(0.695)*	0.077 *(0.374)*	1.253 *(0.813)*	-0.020 *(0.658)*	3.621 *(3.089)*	-0.574 *(0.568)*	2.203 *(1.716)*	-0.103 *(0.696)*	2.791 *(1.843)*	0.223 *(0.347)*	1.588 *(0.878)*	0.241 *(0.317)*	1.264 *(0.611)*	-0.284 *(0.378)*
Unsure	1.135 *(0.519)*	-0.132 *(0.445)*	0.665 *(0.463)*	0.333 *(0.740)*	0.569 *(0.401)*	0.207 *(0.658)*	2.207 *(1.987)*	-0.658 *(0.584)*	1.494 *(1.056)*	-0.095 *(0.473)*	0.687 *(0.424)*	-0.495 *(0.462)*	2.429 *(1.975)*	**-0.915*** *(0.455)*
Family medication error experience														
Yes	1.629 *(0.450)*	-0.315 *(0.249)*	**2.569*** *(0.976)*	-0.519 *(0.356)*	**2.627*** *(1.128)*	-0.178 *(0.335)*	**3.030*** *(1.528)*	-0.109 *(0.355)*	0.794 *(0.284)*	-0.214 *(0.263)*	1.666 *(0.664)*	0.110 *(0.232)*	0.688 *(0.238)*	**0.497*** *(0.244)*
Unsure	1.012 *(0.371)*	-0.051 *(0.388)*	**3.660*** *(2.149)*	-0.499 *(0.498)*	2.202 *(1.507)*	0.344 *(0.554)*	1.825 *(1.282)*	0.366 *(0.520)*	1.709 *(0.945)*	-0.450 *(0.341)*	0.908 *(0.403)*	-0.281 *(0.321)*	1.244 *(0.640)*	-0.063 *(0.325)*
Health sector work														
Yes	0.803 *(0.258)*	-0.231 *(0.305)*	1.129 *(0.507)*	-0.019 *(0.534)*	**0.271*** *(0.155)*	-0.460 *(0.605)*	**0.258*** *(0.145)*	0.462 *(0.635)*	2.060 *(1.097)*	0.102 *(0.312)*	1.035 *(0.446)*	0.001 *(0.269)*	0.684 *(0.279)*	0.011 *(0.328)*
Health field study														
Yes	1.293 *(1.414)*	-1.702 *(1.094)*	0.444 *(0.637)*	**-2.971*** *(1.335)*	-	-2.256 *(1.190)*	-	-1.355 *(1.017)*	0.222 *(0.238)*	-1.236 *(1.023)*	0.336 *(0.436)*	-0.221 *(0.946)*	**0.095*** *(0.108)*	0.333 *(1.103)*
Constant	1.665 *(0.463)*	**4.435**** *(0.262)*	1.013 *(0.357)*	**4.286**** *(0.438)*	1.468 *(1.445)*	**3.883**** *(0.926)*	3.029 *(3.130)*	**4.785**** *(0.868)*	**8.307*** *(8.102)*	**4.241**** *(0.649)*	4.542 *(3.975)*	**4.629**** *(0.562)*	3.910 *(3.674)*	**4.938**** *(0.601)*
Observations	515		335		288		293		424		474		506	

Base factors: Male, Resident in England, Aged 35-65, Unmarried, Employed, School-level qualifications, annual household income £20,000-£40,000, No personal experience of medication error, No familial experience of medication error, working in a non-health sector role, Studying in a non-health field

**p<0.05, **p<0.01*

Coeff.: coefficient, GLM: Generalised linear model, S.E.: Standard error

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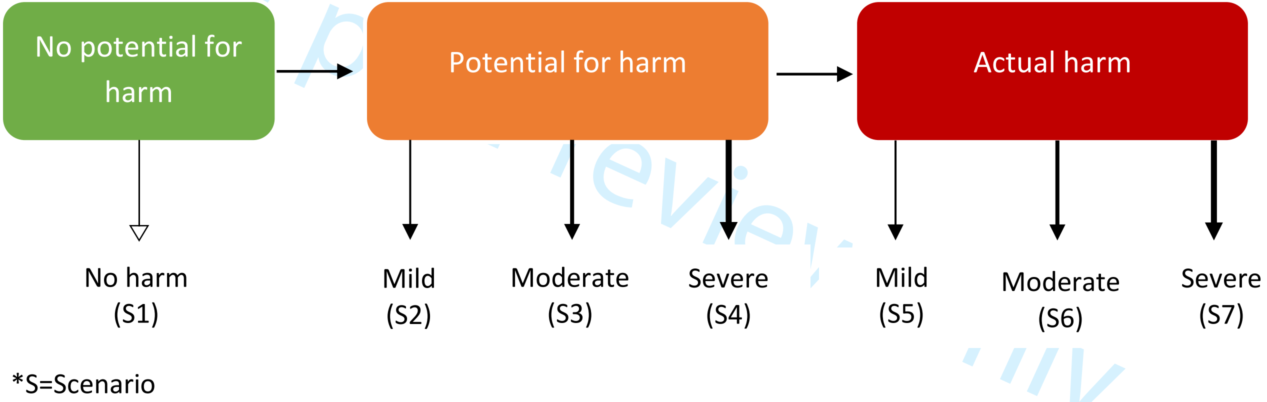
No potential for harm
Potential for harm
Actual harm
No harm (S1)
Mild (S2)
Moderate (S3)
Severe (S4)
Mild (S5)
Moderate (S6)
Severe (S7)
*S=Scenario

Supplementary material A

The seven descriptions of ADEs presented in the survey for each of the hypothetical scenarios are displayed below.

Medication error with no harm

Non-harmful mistake – no actual harm is caused

You are in hospital as a result of a serious illness and you have to take medication in order to get better. A mistake is made in the timing of your medication but the mistake is not serious enough to cause you any harm. Although your medication is not given at the exact time you should have had it, it is still effective and your recovery from illness is not affected.

Medication errors with potential ADEs

Potential mild harm – no actual harm is caused

You are in hospital as a result of a serious illness and you have to take medication in order to get better. A mistake is made when you are given your medication which has the **potential** to cause you harm. For example, the wrong medication is given to you, which means you do not get the medication you need to get better. However, the mistake is noticed quickly and you are soon given the correct medication you need to treat your illness, so that your **recovery is not affected** by the mistake. Luckily, you are also **not harmed** by the medication mistake, but the wrong medication that you were given had the **potential** to cause some new, short-term symptoms, which could have included any of the following:

- Dizziness
- Fatigue
- Constipation or diarrhoea
- Headaches
- Skin rash
- Nausea (feeling sick)

The symptoms could have been harmful and unpleasant to you but would not have posed any threat to your life. However, luckily you did not suffer any of these symptoms and **no actual harm was caused by the mistake.**

Potential moderate harm – no actual harm is caused

You are in hospital as a result of a serious illness and you have to take medication in order to get better. A mistake is made when you are given your medication which has the **potential** to cause you harm. For example, the wrong medication is given to you, which means you do not get the medication you need to get better. However, the mistake is noticed quickly and you are soon given the correct medication you need to treat your illness, so that your **recovery is not affected** by the mistake. Luckily, you are also **not harmed** by the medication mistake, but the wrong medication that you were given had the **potential** to cause some complications, which could have included any of the following:

- Internal bleeding (bleeding inside your body)
- Drop in blood pressure causing light-headedness
- Fever and chills
- Problems with your liver or kidneys

The harm could have been significant enough to make you need to stay in hospital longer for further medical treatment. You may also have needed to take additional medications to fix the complications. The complications could have been harmful to you and may have affected the way your body works but would not have been life-threatening. However, luckily you did not suffer any of these symptoms and **no actual harm was caused by the mistake.**

Potential severe harm – no actual harm is caused

You are in hospital as a result of a serious illness and you have to take medication in order to get better. A mistake is made when you are given your medication which has the **potential** to cause you harm. For example, the wrong medication is given to you, which means you do not get the medication you need to get better. However, the mistake is noticed quickly and you are soon given the correct medication you need to treat your illness, so that your **recovery is not affected** by the mistake. Luckily, you are also **not harmed** by the medication mistake, but the wrong medication that you were given had the **potential** to cause some complications, which could have included any of the following:

- Severe allergic reaction
- Cardiac arrest (heart stops beating)
- Being unable to breathe

You could have had to stay in hospital for longer and be moved to the intensive care area of the hospital. If the complications were not immediately treated then they would have **put you at risk of death or permanent disability**.
However, luckily you did not suffer any of these symptoms and **no actual harm was caused by the mistake.**

Medication errors with actual ADEs

Mild harm – actual harm is caused

You are in hospital as a result of a serious illness and you have to take medication in order to get better. A mistake is made when you are given your medication which **causes you harm**. For example, the wrong medication is given to you so you do not get the medication you need to get better. The medication mistake means that your recovery from the illness is delayed. The wrong medication also causes some new, short-term symptoms, which could include any of the following:

- Dizziness
- Fatigue
- Constipation or diarrhoea
- Headaches
- Skin rash
- Nausea (feeling sick)

The symptoms are harmful and unpleasant to you but do not pose any threat to your life.

Moderate harm – actual harm is caused

You are in hospital as a result of a serious illness and you have to take medication in order to get better. A mistake is made when you are given your medication which **causes you harm**. For example, the wrong medication is given to you so you do not get the medication you need to get better. The medication mistake means that you stop recovering from your illness. The wrong medication also causes some complications, which could include any of the following:

- Internal bleeding (bleeding inside your body)
- Drop in blood pressure causing light-headedness
- Fever and chills
- Problems with your liver or kidneys

The harm is significant enough to make you need to stay in hospital longer for further medical treatment. You may also need to take additional medications to fix the complications.

The complications are harmful to you and affect the way your body works but are not lifethreatening.

Severe harm – actual harm is caused

You are in hospital as a result of a serious illness and you have to take medication in order to get better. A mistake is made when you are given your medication which **causes you harm**. For example, the wrong medication is given to you so you do not get the medication you need to get better. The medication mistake means that you stop recovering from your illness. The wrong medication also causes some complications, which could include any of the following:

- Severe allergic reaction
- Cardiac arrest (heart stops beating)
- Being unable to breathe

You would have to stay in hospital for longer and be moved to the intensive care area of the hospital. If the complications were not immediately treated then they would **put you at risk of death or permanent disability**.

Supplementary material B

Mitchell & Carson (2013) set out an approach to determine sample size in contingent valuation studies. Their approach is based on three factors: deviation from true WTP (Δ), relative error (V) and confidence levels (1-α). Equation 1 outlines the sample size calculation where Z represents the Z-score from a standard normal distribution Z∼N (0,1) for a given confidence level (1-α). If no prior evidence is available, the Mitchell & Carson recommend assuming a value of 2 for relative error (V).

(Equation 1) $$\left[\frac{Z\hat{V}}{\Delta}\right]^2$$

Sample size was calculated based on a confidence level of 95% (z-score = 1.96), relative error of 2 (as no prior evidence was available to direct relative error, Mitchell & Carson's (2013) recommended value was used) and deviation from true WTP of 0.175 (chosen based on a midpoint value of recommended values offered by Mitchell & Carson (2013)). Populating equation 1 with the above values resulted in a sample size of 502 (see equation 2).

(Equation 2) $$\left[\frac{1.96*2}{0.175}\right]^2 = 502$$

Reference

MITCHELL, R. C. & CARSON, R. T. 2013. Using Surveys to Value Public Goods: The Contingent Valuation Method, Taylor & Francis.

Supplementary Material C

The two-part model used to estimate the impact of predictor variables on WTP included the same set of predictor variables for both parts of the model (logit followed by GLM). Details of the predictor variables and the base factor used in are given in Box 1 below.

Box 1 Coding of predictor variables for two-part model

Dummy variables		**Base factor in regression**
FEMALE	Sex; 1 for females, 0 for males	Male
UK RESIDENT OUTSIDE OF UK	UK location; 1 for Scotland, Wales or Northern Ireland, 0 for England	Resident in England
MARRIED	Marital status; 1 for married/cohabiting, 0 for not married (i.e., single/divorced/widowed)	Not married
HEALTH SECTOR WORK	Working in the health sector; 1 for working in relevant sector, 0 for not working in relevant sector	Working in a non-health sector
HEALTH FIELD STUDY	Currently studying in a health-related field; 1 for studying in relevant field, 0 for not working in relevant field	Studying a non-health-related field
Ordinal variables		
AGE	Age; 0 for under 35, 1 for 35-65, 2 for over 65	Age 35-65
EMPLOYMENT STATUS	Employment status; 0 for employed (full or part-time), 1 for unemployed (including retired), 2 for student, 3 for disabled, 4 for unpaid worker	Employed
EDUCATION	Highest level of education; 0 for no formal qualifications, 1 for school level qualifications (GCSE or equivalent, A-Level or equivalent, foreign qualification), 2 for higher education qualification	School level qualifications
INCOME	Household income; 0 for less than £20,000, 1 for £20,000-£40,000, 2 for over £40,000	Annual household income £20,000-£40,000
PERSONAL MEDICATION EXPERIENCE	Personal known experience of a medication error; 0 for no known experience, 1 for known experience, 2 for unsure	No known experience
FAMILIAL MEDICATION ERROR EXPERIENCE	Known family member experience of medication error; 0 for no known experience, 1 for known experience, 2 for unsure	No known experience

Supplementary Material D

Table S1 Characteristics of sample included in base case analysis for each scenario (protest responses and failed logic test responses excluded)

Respondent characteristic	No Harm (N=515)	Potential harm (mild) (N=335)	Potential harm (moderate) (N=290)	Potential harm (severe) (N=296)	Actual harm (mild) (N=424)	Actual harm (moderate) (N=475)	Actual harm (severe) (N=506)
	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)
Sex							
Male	248 (48.2%)	162 (48.4%)	135 (46.6%)	139 (47.0%)	213 (50.2%)	226 (47.6%)	241 (47.6%)
Female	267 (51.8%)	173 (51.6%)	155 (53.4%)	157 (53.0%)	211 (49.8%)	248 (52.2%)	265 (52.4%)
Prefer not to say	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.2%)	0 (0.0%)
Age							
18-24	87 (16.9%)	60 (17.9%)	57 (19.7%)	50 (16.9%)	77 (18.2%)	90 (18.9%)	91 (18.0%)
25-34	79 (15.3%)	53 (15.8%)	41 (14.1%)	43 (14.5%)	73 (17.2%)	73 (15.4%)	81 (16.0%)
35-44	90 (17.5%)	53 (15.8%)	48 (16.6%)	46 (15.5%)	73 (17.2%)	84 (17.7%)	84 (16.6%)
45-54	93 (18.1%)	61 (18.2%)	44 (15.2%)	54 (18.2%)	77 (18.2%)	85 (17.9%)	87 (17.2%)
55-64	72 (14.0%)	48 (14.3%)	49 (16.9%)	47 (15.9%)	57 (13.4%)	60 (12.6%)	71 (14.0%)
65+	94 (18.3%)	60 (17.9%)	51 (17.6%)	56 (18.9%)	67 (15.8%)	83 (17.5%)	92 (18.2%)
Region							
England	435 (84.5%)	285 (85.1%)	242 (83.4%)	247 (83.4%)	359 (84.7%)	406 (85.5%)	434 (85.8%)
Wales	44 (8.5%)	27 (8.1%)	29 (10.0%)	30 (10.1%)	34 (8.0%)	35 (7.4%)	37 (7.3%)
Scotland	26 (5.0%)	17 (5.1%)	13 (4.5%)	12 (4.1%)	20 (4.7%)	22 (4.6%)	24 (4.7%)
Northern Ireland	10 (1.9%)	6 (1.8%)	6 (2.1%)	7 (2.4%)	11 (2.6%)	12 (2.5%)	11 (2.2%)
Occupational group							
A	27 (5.2%)	15 (4.5%)	13 (4.5%)	13 (4.4%)	24 (5.7%)	32 (6.7%)	30 (5.9%)
B	117 (22.7%)	82 (24.5%)	69 (23.8%)	75 (25.3%)	106 (25.0%)	113 (23.8%)	127 (25.1%)
C1	146 (28.3%)	82 (24.5%)	73 (25.2%)	71 (24.0%)	116 (27.4%)	131 (27.6%)	136 (26.9%)
C2	89 (17.3%)	62 (18.5%)	52 (17.9%)	56 (18.9%)	77 (18.2%)	84 (17.7%)	98 (19.4%)
D	74 (14.4%)	47 (14.0%)	39 (13.4%)	36 (12.2%)	54 (12.7%)	62 (13.1%)	61 (12.1%)
E	62 (12.0%)	47 (14.0%)	44 (15.2%)	45 (15.2%)	47 (11.1%)	53 (11.2%)	54 (10.7%)

Respondent characteristic	No Harm (N=515)		Potential harm (mild) (N=335)		Potential harm (moderate) (N=290)		Potential harm (severe) (N=296)		Actual harm (mild) (N=424)		Actual harm (moderate) (N=475)		Actual harm (severe) (N=506)	
Marriage status														
Married/cohabiting	267	(51.8%)	175	(52.2%)	142	(49.0%)	150	(50.7%)	230	(54.2%)	249	(52.4%)	277	(54.7%)
Single	192	(37.3%)	120	(35.8%)	113	(39.0%)	114	(38.5%)	149	(35.1%)	176	(37.1%)	173	(34.2%)
Divorced/widowed	56	(10.9%)	40	(11.9%)	35	(12.1%)	32	(10.8%)	45	(10.6%)	50	(10.5%)	56	(11.1%)
Employment status														
Full time	182	(35.3%)	116	(34.6%)	96	(33.1%)	96	(32.4%)	169	(39.9%)	182	(38.3%)	187	(37.0%)
Part time	81	(15.7%)	55	(16.4%)	43	(14.8%)	42	(14.2%)	57	(13.4%)	62	(13.1%)	63	(12.5%)
Self employed	41	(8.0%)	23	(6.9%)	21	(7.2%)	23	(7.8%)	31	(7.3%)	34	(7.2%)	36	(7.1%)
Unemployed	64	(12.4%)	45	(13.4%)	42	(14.5%)	42	(14.2%)	47	(11.1%)	56	(11.8%)	59	(11.7%)
Retired	91	(17.7%)	57	(17.0%)	45	(15.5%)	50	(16.9%)	65	(15.3%)	81	(17.1%)	90	(17.8%)
FT student	35	(6.8%)	22	(6.6%)	25	(8.6%)	25	(8.4%)	35	(8.3%)	39	(8.2%)	44	(8.7%)
PT student	1	(0.2%)	1	(0.3%)	1	(0.3%)	1	(0.3%)	1	(0.2%)	1	(0.2%)	1	(0.2%)
Other	20	(3.9%)	16	(4.8%)	17	(5.9%)	17	(5.7%)	19	(4.5%)	20	(4.2%)	26	(5.1%)
Working in the health sector														
Yes	51	(9.9%)	29	(8.7%)	19	(6.6%)	22	(7.4%)	50	(11.8%)	64	(13.5%)	65	(12.8%)
No	344	(66.8%)	222	(66.3%)	186	(64.1%)	189	(63.9%)	272	(64.2%)	295	(62.1%)	311	(61.5%)
Not applicable	120	(23.3%)	84	(25.1%)	85	(29.3%)	85	(28.7%)	102	(24.1%)	116	(24.4%)	130	(25.7%)
Studying a health-related field														
Yes	4	(0.8%)	3	(0.9%)	2	(0.7%)	3	(1.0%)	5	(1.2%)	4	(0.8%)	5	(1.0%)
No	32	(6.2%)	20	(6.0%)	24	(8.3%)	23	(7.8%)	31	(7.3%)	36	(7.6%)	40	(7.9%)
Not applicable	479	(93.0%)	312	(93.1%)	264	(91.0%)	270	(91.2%)	388	(91.5%)	435	(91.6%)	461	(91.1%)
Education														
Degree	188	(36.5%)	117	(34.9%)	105	(36.2%)	108	(36.5%)	172	(40.6%)	189	(39.8%)	198	(39.1%)
Higher education below degree	52	(10.1%)	29	(8.7%)	27	(9.3%)	27	(9.1%)	43	(10.1%)	47	(9.9%)	43	(8.5%)
A-level	126	(24.5%)	84	(25.1%)	66	(22.8%)	73	(24.7%)	84	(19.8%)	94	(19.8%)	112	(22.1%)
GCSE A*-C	106	(20.6%)	75	(22.4%)	63	(21.7%)	58	(19.6%)	84	(19.8%)	99	(20.8%)	108	(21.3%)
GCSE D-G	26	(5.0%)	19	(5.7%)	16	(5.5%)	17	(5.7%)	23	(5.4%)	26	(5.5%)	25	(4.9%)
Foreign qualifications	1	(0.2%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	1	(0.2%)	1	(0.2%)	2	(0.4%)
No formal qualifications	16	(3.1%)	11	(3.3%)	13	(4.5%)	13	(4.4%)	17	(4.0%)	19	(4.0%)	18	(3.6%)

Respondent characteristic	No Harm (N=515)	Potential harm (mild) (N=335)	Potential harm (moderate) (N=290)	Potential harm (severe) (N=296)	Actual harm (mild) (N=424)	Actual harm (moderate) (N=475)	Actual harm (severe) (N=506)
Annual household income (£)							
0 - 12K	63 (12.2%)	49 (14.6%)	41 (14.1%)	45 (15.2%)	45 (10.6%)	52 (10.9%)	55 (10.9%)
12K-20K	99 (19.2%)	57 (17.0%)	51 (17.6%)	47 (15.9%)	70 (16.5%)	82 (17.3%)	83 (16.4%)
20K - 30K	108 (21.0%)	70 (20.9%)	53 (18.3%)	53 (17.9%)	86 (20.3%)	110 (23.2%)	112 (22.1%)
30K - 40K	77 (15.0%)	51 (15.2%)	46 (15.9%)	44 (14.9%)	65 (15.3%)	62 (13.1%)	71 (14.0%)
40K - 50K	58 (11.3%)	43 (12.8%)	37 (12.8%)	33 (11.1%)	54 (12.7%)	56 (11.8%)	58 (11.5%)
50K - 70K	49 (9.5%)	33 (9.9%)	26 (9.0%)	34 (11.5%)	45 (10.6%)	46 (9.7%)	53 (10.5%)
70K - 100K	28 (5.4%)	14 (4.2%)	17 (5.9%)	18 (6.1%)	35 (8.3%)	39 (8.2%)	43 (8.5%)
100K +	8 (1.6%)	2 (0.6%)	3 (1.0%)	4 (1.4%)	7 (1.7%)	8 (1.7%)	10 (2.0%)
Prefer not to say	20 (3.9%)	14 (4.2%)	13 (4.5%)	14 (4.7%)	13 (3.1%)	16 (3.4%)	17 (3.4%)
Unknown	5 (1.0%)	2 (0.6%)	3 (1.0%)	4 (1.4%)	4 (0.9%)	4 (0.8%)	4 (0.8%)
Personal experience of medication mistake							
Experience	32 (6.2%)	14 (4.2%)	12 (4.1%)	14 (4.7%)	39 (9.2%)	46 (9.7%)	48 (9.5%)
No experience	458 (88.9%)	308 (91.9%)	264 (91.0%)	269 (90.9%)	367 (86.6%)	411 (86.5%)	438 (86.6%)
Unsure	25 (4.9%)	13 (3.9%)	14 (4.8%)	13 (4.4%)	18 (4.2%)	18 (3.8%)	20 (4.0%)
Harm suffered from the mistake							
Harm	7 (21.9%)	3 (21.4%)	3 (25.0%)	6 (42.9%)	14 (35.9%)	19 (41.3%)	21 (43.8%)
No harm	22 (68.8%)	11 (78.6%)	9 (75.0%)	8 (57.1%)	22 (56.4%)	23 (50.0%)	23 (47.9%)
Unsure	3 (9.4%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (7.7%)	4 (8.7%)	4 (8.3%)
Friend or family member experience of medication mistake							
Experience	87 (16.9%)	55 (16.4%)	47 (16.2%)	46 (15.5%)	81 (19.1%)	89 (18.7%)	101 (20.0%)
No experience	390 (75.7%)	257 (76.7%)	226 (77.9%)	233 (78.7%)	309 (72.9%)	347 (73.1%)	363 (71.7%)
Unsure	38 (7.4%)	23 (6.9%)	17 (5.9%)	17 (5.7%)	34 (8.0%)	39 (8.2%)	42 (8.3%)
Harm suffered from the mistake							
Harm	46 (52.9%)	33 (60.0%)	26 (55.3%)	26 (56.5%)	48 (59.3%)	52 (58.4%)	57 (56.4%)
No harm	30 (34.5%)	15 (27.3%)	13 (27.7%)	12 (26.1%)	21 (25.9%)	23 (25.8%)	30 (29.7%)
Unsure	11 (12.6%)	7 (12.7%)	8 (17.0%)	8 (17.4%)	12 (14.8%)	14 (15.7%)	14 (13.9%)

[†]Occupational groups: A=Higher managerial, administrative and professional, B=Intermediate managerial, administrative and professional, C1=Supervisory, clerical and junior managerial, administrative and professional, C2=Skilled manual workers, D=Semi-skilled and unskilled manual workers, E=State pensioners, casual and lowest grade workers, unemployed with state benefits only.

Table S2 Sensitivity regression analysis for Scenarios 1-4, including failed logic responses for respondents with experience of a medication error

Covariates	No potential for harm		Potential harm (mild)		Potential harm (moderate)		Potential harm (severe)	
	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)
	Odds Ratio *(S.E)*	Coeff. *(S.E)*	Odds Ratio *(S.E)*	Coeff. *(S.E)*	Odds Ratio *(S.E)*	Coeff. *(S.E)*	Odds Ratio *(S.E)*	Coeff. *(S.E)*
Female	**0.588**** *(0.111)*	-0.152 *(0.166)*	0.724 *(0.171)*	-0.161 *(0.245)*	0.942 *(0.250)*	-0.384 *(0.246)*	0.710 *(0.193)*	-0.113 *(0.218)*
UK resident outside of England	0.995 *(0.258)*	0.125 *(0.228)*	0.876 *(0.289)*	0.574 *(0.338)*	0.746 *(0.264)*	-0.405 *(0.343)*	1.500 *(0.572)*	-0.392 *(0.277)*
Married	1.187 *(0.250)*	-0.209 *(0.199)*	1.200 *(0.316)*	-0.184 *(0.246)*	1.027 *(0.295)*	0.201 *(0.264)*	0.872 *(0.263)*	-0.239 *(0.239)*
Age								
Under 35	1.243 *(0.287)*	**0.573**** *(0.202)*	1.000 *(0.285)*	0.010 *(0.304)*	1.440 *(0.471)*	0.395 *(0.275)*	1.499 *(0.510)*	0.147 *(0.267)*
Over 65	1.476 *(0.655)*	0.163 *(0.343)*	0.948 *(0.543)*	-0.178 *(0.612)*	1.910 *(1.266)*	-0.109 *(0.589)*	0.725 *(0.485)*	0.056 *(0.502)*
Employment status								
Unemployed	0.801 *(0.352)*	0.161 *(0.337)*	1.333 *(0.746)*	-0.022 *(0.610)*	1.149 *(0.748)*	0.051 *(0.593)*	2.670 *(1.797)*	-0.394 *(0.491)*
Student	1.346 *(0.845)*	0.001 *(0.575)*	4.823 *(4.126)*	0.364 *(0.820)*	-	-	-	-
Disabled	1.964 *(1.793)*	-0.181 *(0.853)*	6.721 *(6.967)*	-0.081 *(0.928)*	6.527 *(8.620)*	0.456 *(0.917)*	**14.388*** *(19.141)*	-0.176 *(0.833)*
Unpaid worker	0.924 *(0.773)*	-0.756 *(0.854)*	2.949 *(3.273)*	-1.140 *(1.112)*	0.804 *(0.827)*	-0.782 *(0.999)*	6.810 *(7.665)*	-0.966 *(0.831)*
Educational level								
Higher education	1.012 *(0.197)*	0.011 *(0.177)*	1.098 *(0.272)*	0.057 *(0.239)*	1.353 *(0.370)*	0.245 *(0.230)*	1.283 *(0.362)*	0.193 *(0.210)*
No formal qualifications	2.752 *(1.677)*	-0.513 *(0.482)*	2.108 *(1.497)*	0.072 *(0.683)*	1.298 *(0.862)*	-0.002 *(0.628)*	1.030 *(0.683)*	-0.287 *(0.584)*

Covariates	No potential for harm		Potential harm (mild)		Potential harm (moderate)		Potential harm (severe)	
	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)	Logit (Part 1)	GLM (Part 2)
	Odds Ratio *(S.E)*	Coeff. *(S.E)*	Odds Ratio *(S.E)*	Coeff. *(S.E)*	Odds Ratio *(S.E)*	Coeff. *(S.E)*	Odds Ratio *(S.E)*	Coeff. *(S.E)*
Household income								
Under £20K	**0.563*** *(0.137)*	-0.139 *(0.228)*	0.606 *(0.183)*	-0.069 *(0.334)*	0.543 *(0.182)*	-0.133 *(0.336)*	0.629 *(0.213)*	-0.018 *(0.298)*
Over £40K	0.899 *(0.213)*	0.344 *(0.209)*	**1.985*** *(0.630)*	0.221 *(0.291)*	**2.380*** *(0.867)*	0.283 *(0.284)*	**2.497*** *(0.947)*	0.312 *(0.255)*
Personal medication error experience								
Yes	**2.652**** *(0.987)*	**0.844**** *(0.307)*	**2.844*** *(1.313)*	0.682 *(0.402)*	**3.667*** *(1.908)*	0.294 *(0.403)*	2.828 *(1.554)*	0.071 *(0.388)*
Unsure	1.125 *(0.515)*	-0.121 *(0.442)*	0.690 *(0.472)*	0.589 *(0.718)*	0.553 *(0.374)*	0.255 *(0.667)*	2.225 *(1.942)*	-0.524 *(0.547)*
Family medication error experience								
Yes	1.58 *(0.427)*	-0.414 *(0.232)*	**2.133*** *(0.753)*	-0.551 *(0.315)*	2.071 *(0.785)*	-0.192 *(0.308)*	1.889 *(0.805)*	-0.181 *(0.286)*
Unsure	1.023 *(0.373)*	-0.239 *(0.372)*	**3.681*** *(2.113)*	-0.647 *(0.460)*	2.426 *(1.627)*	0.279 *(0.530)*	1.947 *(1.349)*	0.262 *(0.459)*
Health sector work								
Yes	0.965 *(0.297)*	0.150 *(0.287)*	1.510 *(0.638)*	0.506 *(0.431)*	0.559 *(0.274)*	0.572 *(0.468)*	0.488 *(0.245)*	0.74 *(0.424)*
Health sector study								
Yes	0.616 *(0.640)*	-1.655 *(1.080)*	0.441 *(0.626)*	**-2.851*** *(1.295)*	-	-2.157 *(1.191)*	-	-1.392 *(0.951)*
Constant	1.612 *(0.439)*	**4.366**** *(0.242)*	1.011 *(0.346)*	**4.712**** *(0.374)*	2.084 *(2.010)*	**4.485**** *(0.869)*	4.253 *(4.247)*	**4.907**** *(0.761)*
Observations	541		373		326		329	

Base factors: Male, Resident in England, Aged 35-65, Unmarried, Employed, School-level qualifications, annual household income £20,000£40,000, No personal experience of medication error, No familial experience of medication error, working in a non-health sector role, Studying in a non-health field
*p<0.05, **p<0.01

Coeff.: coefficient, GLM: Generalised linear model, S.E.: Standard error