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Determinants of influenza and pertussis vaccination uptake in pregnancy: a multi-centre questionnaire study of pregnant women and healthcare professionals

Wilcox, C.R., Calvert, A., Metz, J., Kilich, E., MacLeod, R., Beadon, K., Heath, P.T., Khalil, A., Finn, A., Snape, M.D., Vandrevalla, T., Nadarzynski, T., Coleman, M.A. and Jones, C.E.

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1 **Determinants of influenza and pertussis vaccination uptake in**
2 **pregnancy: a multi-centre questionnaire study of pregnant women and**
3 **healthcare professionals**
4

5 Christopher R Wilcox MBBCh ¹, Anna Calvert MRCPH ², Jane Metz MBBS ³, Eliz Kilich BM
6 BCh ², Rachael MacLeod MBChB ³, Kirsten Beadon BSc ⁴, Paul T Heath MRCPH ², Asma
7 Khalil MD ^{5,6}, Adam Finn PhD ³, Matthew D Snape MD ⁴, Tushna Vandrevalla PhD ⁷, Tom
8 Nadarzynski PhD ⁸, Matthew A Coleman MD ⁹, Christine E Jones PhD ¹⁰
9

10 1: NIHR Clinical Research Facility, University Hospital Southampton NHS Foundation Trust,
11 Southampton, UK
12

13 2: Vaccine Institute, St George's, University of London, London, UK
14

15 3: Bristol Children's Vaccine Centre, University of Bristol, Bristol, UK
16

17 4: Oxford Vaccine Group, Department of Paediatrics, University of Oxford and the NIHR
18 Oxford Biomedical Research Centre, Oxford, UK
19

20 5: Fetal Medicine Unit, Department of Obstetrics and Gynaecology, St George's University
21 Hospitals NHS Foundation Trust, London, UK
22

23 6: Vascular Biology Research Centre, Molecular and Clinical Sciences Research Institute,
24 St George's, University of London, London, UK
25

26 7: School of Social and Behavioural Sciences, Faculty of Business & Social Sciences,
27 Kingston University, Kingston, London, UK
28

29 8: Department of Psychology, University of Westminster, London, UK
30

31 9: Department of Fetal Medicine, Princess Anne Hospital, University Hospital Southampton
32 NHS Foundation Trust, Southampton, UK
33

34 10: Faculty of Medicine and Institute for Life Sciences, University of Southampton and
35 University Hospital Southampton NHS Foundation Trust, Southampton, UK
36

37 **Abbreviated title**

38 Improving uptake of maternal vaccination: questionnaire study
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40 **Running title**

41 Questionnaire study of maternal vaccination
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43 **Corresponding author**

- 44 - Dr Christopher Wilcox
45 - NIHR Clinical Research Facility, Southampton Centre for Biomedical Research, C Level
46 West Wing, Mailpoint 218, Southampton General Hospital, Tremona Road,
47 Southampton, SO16 6DY
48 - Email: christopher.wilcox@soton.ac.uk
49 - Telephone: 02381204956

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Keywords - Vaccination; Pregnancy; Influenza; Pertussis; Vaccine confidence

Abstract

Introduction

Uptake rates of antenatal vaccination remain suboptimal. Our aims were to determine: (1) the acceptability of routine vaccination among pregnant women, (2) the confidence of maternity healthcare professionals (HCPs) discussing vaccination and (3) HCP opinion regarding the optimum healthcare site for vaccine administration.

Methods

Separate questionnaires for pregnant women and HCPs were distributed within four NHS trusts in South England (July 2017-January 2018).

Results

Responses from 314 pregnant women and 204 HCPs (18% obstetricians, 75% midwives, 7% unidentified) were analysed. Previous/intended uptake of influenza and pertussis vaccination was 78% and 92%, respectively. The commonest reason for declining vaccination was feared side-effects for their child. White British women (79%) were significantly more accepting of influenza (85% vs. 61%, OR 3.25, 95% CI: 1.67-6.32) and pertussis vaccination (96% vs. 83%, OR 4.83, 95% CI: 1.77-13.19) compared with non-white-British women. Among HCPs, 25% were slightly or not-at-all confident discussing vaccination. Obstetricians felt significantly more confident discussing pertussis vaccination than midwives (68% vs. 55% were very/moderately confident, OR 2.05, 95% CI: 1.02-4.12). Among HCPs, 53%, 25% and 16% thought vaccines should be administered in primary care (general practice), community midwifery and in hospital, respectively.

Conclusion

Misconceptions exist regarding safety/efficacy of antenatal vaccination, and framing information towards the child's safety may increase uptake. Education of HCPs is essential, and vaccine promotion should be incorporated into routine antenatal care, with an emphasis on women from ethnic minorities. Administration of vaccines in primary care presents logistical barriers however support for alternative sites appears low among HCPs.

87 Introduction

88

89 Both influenza and pertussis result in severe outcomes for pregnant women and their
90 infants (including respiratory illness and death)^{1 2}, and vaccination in pregnancy is an
91 effective means of protection until the period of greatest susceptibility has passed³⁻⁶. In
92 the UK, influenza and pertussis vaccination have been routinely recommended for use in
93 pregnancy since 2010 and 2012, respectively⁷.

94

95 Unfortunately, achieving vaccine acceptance among pregnant women and healthcare
96 professionals (HCPs) remains a global challenge⁸. The World Health Organization (WHO)
97 Strategic Advisory Group of Experts on Immunization have called for improved monitoring
98 of vaccine acceptance, and research into the socio-economic determinants of attitudes
99 towards vaccines⁹. The uptake of influenza and pertussis vaccination during pregnancy in
100 England over the September 2016 - January 2017 period was 44.9% and 74.2%,
101 respectively^{10 11}. Pertussis vaccination uptake in the UK has gradually climbed from
102 around 50% since its introduction in 2012, yet influenza vaccine uptake has been relatively
103 static, and remains well below the WHO target of 75%¹⁰. Furthermore, coverage varies
104 significantly between different regions of the UK, with average uptake approximately 10%
105 and 20% lower in London than in northern England for influenza and pertussis, respectively
106^{9 11}.

107

108 Uptake of vaccination could be significantly improved if we are able to fully understand the
109 decision-making processes to acceptance. Furthermore, it is well-acknowledged that
110 encouragement from a familiar HCP significantly improves vaccine acceptance^{12 13}, yet
111 few studies have considered the extent to which HCPs feel confident discussing
112 vaccinations with pregnant women, and the associated factors which might influence this.
113 Optimizing the healthcare site of vaccine administration is also an important issue that may
114 have a considerable impact on vaccine uptake, yet few studies have considered the support
115 of HCPs for alternative approaches. In the UK, vaccination is free-of-charge, and is usually
116 provided within primary care (general practice), and is less commonly available within
117 secondary (hospital-based) care. This may present a logistical barrier if it requires women
118 to arrange extra appointments, and more convenient approach might be to routinely
119 administer vaccination at the time of antenatal appointments.

120

121 Ours aims were therefore: (1) to identify factors associated with the acceptance of influenza
122 and pertussis vaccinations in pregnancy, (2) to establish the level of confidence among
123 HCPs in discussing vaccination with pregnant women, as well as the factors which might
124 affect this, and (3) to establish the opinion of HCPs as to the optimum healthcare site for
125 vaccine administration.

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130 **Methods**

131

132 **Questionnaire design and development**

133 Two separate anonymized questionnaires were developed for pregnant women and
134 maternity HCPs. These were developed with input from a multi-disciplinary study team
135 including obstetricians, pediatricians, health psychologists, and clinical academic trainees.
136 The questionnaires consisted of closed questions and a single free-text box in which
137 participants could add further comments.

138

139 The questions analyzed here (see supplementary file) were nested within a larger
140 questionnaire focussing on the attitudes of pregnant women and HCPs to both routine
141 vaccination in pregnancy and to clinical trials of vaccines in pregnancy. The current paper
142 focuses only on the questions relating to routinely recommended vaccines. Pregnant
143 women were asked whether 1) they had/planned to receive influenza and pertussis
144 vaccination and 2) the motivating reasons for accepting or declining these vaccines.
145 Maternity HCPs were asked whether 1) they felt confident providing advice regarding these
146 two vaccines and 2) their opinion regarding the optimal healthcare site of vaccine
147 administration. Ethical approval was granted (reference 17/LO/0537) and the study was
148 registered on ClinicalTrials.gov prior to recruitment (NCT03096574).

149

150 **Study population and recruitment**

151 The questionnaire for pregnant women was administered to women (aged ≥ 16 years at the
152 time of completing the questionnaire) attending for routine antenatal care at four study sites
153 in southern England: University Hospital Southampton NHS Foundation Trust, University
154 Hospitals Bristol NHS Foundation Trust, Oxford University Hospitals NHS Foundation Trust,
155 and St George's University Hospitals NHS Foundation Trust, London. These sites were
156 selected because of their high birth rates (all > 4000 births/year)¹⁴, and by distributing our
157 questionnaire across four hospitals, we attempted to increase the demographic diversity of
158 our study population.

159

160 The HCP questionnaire was administered to those working in either midwifery or obstetrics
161 at the same four study sites. It should be noted that routine antenatal care in the UK is
162 usually midwife-led (unless a pregnancy is deemed high-risk), and therefore the majority of
163 potential respondents to our questionnaire were midwives, rather than obstetricians.
164 Recruitment of participants took place from July 2017 to January 2018. Pregnant women
165 were recruited in person via opportunistic sampling at antenatal clinics or wards, and given
166 paper questionnaires to complete. Maternity HCPs were either recruited via email
167 (containing a link to an online questionnaire) or face-to-face by opportunistic sampling, in
168 which case they were also given paper questionnaires. The initial response rate from HCPs
169 was promoted by up to two further email reminders. Participation was voluntary and no
170 financial or other incentive was offered. All participants gave informed consent.

171

172 **Questionnaire data analysis**

173 Questionnaire data was entered at the lead site (Southampton) into iSurvey
174 (www.isurvey.soton.ac.uk). Statistical analysis was performed using IBM SPSS Version 25.
175 Logistic and ordinal regression analyses were performed for pregnant women and HCP
176 responses, respectively, and adjusted odds ratios (ORs) were calculated. P-values < 0.05
177 were considered as statistically significant. Multicollinearity was examined using the
178 tolerance test and the Variance Inflation Factor (VIF) to ensure variables with a VIF value
179 exceeding 2.5 were not entered into the multivariate regression analysis.

181 **Results**

182
183 A total of 525 participants completed the questionnaires: 321 pregnant women and 204
184 HCPs (18% obstetricians, 75% midwives, and 7% unidentified). The numbers of
185 respondents were relatively equally distributed between the four study sites. Eight
186 questionnaires from pregnant women, and five from HCPs, were excluded due to largely
187 incomplete or illegible responses, therefore 513 questionnaires (98%) were included in the
188 analysis. The full characteristics of respondents, including demographic details, are
189 displayed in Table 1.

191 **Responses from pregnant women**

192 Regarding influenza vaccination: of 310 responses, 38% had been vaccinated, 40% were
193 intending to be vaccinated, and 22% were not intending to be vaccinated. Regarding
194 pertussis vaccination: of 302 responses, 56% had been vaccinated, 36% were intending to
195 be vaccinated, and 8% were not intending to be vaccinated. The reasons for declining
196 vaccination are displayed in Figure 1. A similar trend in responses was observed for both
197 vaccines. The most commonly cited reason for declining was concern about possible side
198 effects for their child.

199
200 Binary logistic regression analysis (Table 2, supplementary information) demonstrated that
201 women identifying themselves as White British (79% of respondents) were significantly
202 more likely to accept influenza (85% vs. 61%, OR 3.25, 95% confidence interval [CI] 1.67-
203 6.32) and pertussis (96% vs. 83%, OR 4.83, 95% CI 1.77-13.19) vaccination compared to
204 those identifying in all other ethnic groups. In the case of influenza vaccination, study site
205 also had a significant effect, and participants at site B were significantly more likely to
206 accept influenza vaccination than those at site D (91% vs. 64%, OR 4.20, 95% CI 1.47-
207 11.95). Participants' age and whether they had previous children had no significant effect
208 on vaccine uptake. In the qualitative analysis of the free text comments, pregnant women
209 identified further concerns regarding vaccination in pregnancy, including damage to their
210 unborn baby, vaccination being offered too late and insufficient information provided (see
211 supplementary information).

213 **Responses from maternity healthcare professionals**

214 Out of 199 HCPs who responded, they were: extremely (25%), moderately (34%),
215 somewhat (17%), slightly (16%) and not at all (8%) confident providing advice regarding
216 influenza vaccination. For pertussis vaccination, they were: extremely (25%), moderately
217 (32%), somewhat (16%), slightly (15%) and not at all confident (12%). See Figure 2.

218
219 Ordinal regression analysis (Table 3, supplementary information) demonstrated that
220 obstetricians were significantly more likely than midwives to feel confident giving advice
221 about the pertussis vaccine (68% vs. 55% were very/moderately confident, OR 2.05, 95%
222 CI 1.02-4.12), however there was no significant difference between either profession for the
223 influenza vaccine. On the other hand, longer experience in maternity care was associated
224 with greater confidence giving advice regarding influenza vaccination, but not pertussis
225 vaccination. Study site was also significantly associated with confidence providing advice
226 for both vaccines, with HCPs from sites B and C being significantly more likely to feel
227 confident than those in site D. Finally, health professional's age and whether or not they
228 had children of their own were not associated with greater confidence in discussing
229 vaccination. No free-text comments from staff relating to influenza/pertussis vaccination
230 were provided for analysis.

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With regards to the optimal healthcare site for vaccine administration during pregnancy (Figure 3), approximately one-half (53%) of HCP respondents thought that vaccines should be delivered in the primary care setting as part of general practice, 25% thought vaccines should be delivered in by midwives in the community, and 16% thought vaccines should be delivered in secondary care (at the time of antenatal appointments). The remaining 8% either thought that vaccination should be administered in both general practice and community midwifery services (4%) or in all three locations (4%).

248 **Discussion**

249

250 Vaccination in pregnancy remains a national and international priority for improving
251 healthcare outcomes. Understanding women's and HCP's opinions and attitudes to vaccine
252 acceptance are important in explaining current vaccination attainment levels. Our aims
253 were to identify factors associated with vaccine acceptance and hesitancy among pregnant
254 women, to establish whether HCPs feel confident discussing vaccination with these women,
255 and to establish where HCPs thought these vaccines should be administered.

256

257 **Uptake of vaccination among pregnant women**

258 Encouragingly, the acceptance of influenza and pertussis vaccination was high among
259 pregnant women in this study. The most common reasons for vaccine hesitancy were
260 concerns about side effects, and doubts regarding the effectiveness and need for
261 vaccination. Perception of possible harm is commonly cited as the primary reason for
262 vaccine refusal among previous studies^{12 15}, and women are usually more concerned
263 about potential risks to their child's health than their own¹⁶. Clearly, important
264 misconceptions still exist regarding the safety of vaccines, including the presence of 'toxins'
265 such as thimerosal (a mercury-containing preservative removed from childhood vaccines in
266 2001) that was proposed in 2005 to be associated with neurologic conditions, including
267 autism¹⁷. We recommend that vaccine advocacy should emphasise the safety and efficacy
268 of vaccination, specifically towards protection of the baby. Furthermore, accessible
269 alternatives to face-to-face counseling that been successfully used in the past have
270 included social media and webcasts^{18 19}, mobile phone text messages (such as
271 Text4baby)^{20 21} and smart phone apps (such as MatImms²²).

272

273 Another important finding was that pregnant women of ethnic minorities were significantly
274 less likely to accept vaccination than those identifying as 'White British'. Previous research
275 has similarly demonstrated lower vaccine acceptance among these groups²³⁻²⁵, and these
276 findings highlight the importance of taking into account possible cultural/religious and
277 language barriers when counselling these women and producing educational materials. The
278 underlying reasons for the difference in vaccine attitudes between ethnic groups remains a
279 significant gap in our knowledge, and future studies in this specific area are needed.
280 Interestingly, we did not find any significant effect of age or having children already in our
281 study, however younger age has been shown to be associated with lower uptake in some
282 previous studies^{23 26}. Study site had no effect on pertussis vaccine acceptance however
283 there was significantly higher influenza vaccine acceptance among pregnant women at site
284 B. These results may be skewed by the recruitment season of this site, however, as
285 recruitment here was all undertaken entirely during the influenza vaccination season (which
286 runs from September to February).

287

288 **Confidence of healthcare professionals and optimal healthcare site for vaccine**
289 **administration**

290 Very few previous studies²⁷ have investigated to what extent HCPs feel confident
291 discussing vaccination with pregnant women. This is despite the fact that pregnant women
292 consider their HCP their most trusted source of information, and encouragement from them
293 has been shown to increase intention to receive vaccination by up to 20 times^{13 12}.
294 Conversely, a lack of knowledge of the indications and benefits of vaccination among HCPs
295 has been identified as a barrier to implementation of vaccination recommendations²⁸.
296 Among HCPs in our study, a significant proportion were not confident providing advice to

297 pregnant women. Confidence also varied significantly by study site, suggesting that there is
298 a potential risk of health inequalities based on differing levels of vaccine confidence and
299 recommendations across the South of England. Further education of multidisciplinary HCPs
300 is essential, and individual barriers to active promotion of these vaccines need to be
301 identified and reduced. Individual sites should aim to establish areas of low confidence
302 within their own working body and push to incorporate active promotion of vaccination into
303 routine antenatal care. Also, while it should be noted that obstetricians, and those with more
304 experience in maternity care, felt more confident giving advice about the pertussis and
305 influenza vaccines, respectively, we suggest that education should not be aimed solely at a
306 particular profession, or those new to maternity care.

307
308 Finally, optimizing the healthcare site for vaccine administration is an important and topical
309 issue which may have a considerable impact on vaccine uptake. In the UK, vaccination in
310 pregnancy is usually provided in the primary care setting (within general practice), yet this
311 presents a logistical barrier as it normally requires women to arrange extra primary care
312 appointments. A more convenient and efficient approach might be to routinely offer and
313 administer vaccination at the time of hospital antenatal appointments (such as the fetal
314 anomaly scan at around 20 week's gestation), either by incorporating vaccination directly
315 into these clinics, or providing adjacent vaccination clinics, which women are invited to visit
316 immediately before or after their regular antenatal appointment^{29–31}. Previous studies have
317 demonstrated that vaccinating in secondary care may indeed improve uptake^{29–31}, yet
318 support for this approach appeared to be low (16%) among HCPs surveyed in this study. A
319 lack of staff, lack of a suitable setting and resources, concerns regarding appropriate
320 financial reimbursement, and lack of confidence with vaccine discussion, have all been
321 identified as potential barriers to this approach by HCPs in previous studies^{30–33}. Potential
322 solutions include employing dedicated vaccination staff (including vaccination specialist
323 midwives) and improving vaccine education (as discussed above). Further pragmatic and/or
324 qualitative research is also required to establish the feasibility and effectiveness of this
325 approach, and to establish facilitators and barriers to its acceptance among both pregnant
326 women and HCPs.

327

328 **Strengths and limitations**

329 This study had significant numbers of respondents, and by distributing our questionnaire at
330 four hospitals in southern England we attempted to maximize the demographic diversity of
331 our study population. That said, the responses to the questionnaire cannot be taken as
332 representative of all pregnant women and maternity HCPs. Reported actual/intended
333 vaccine uptake was higher among our questionnaire respondents than national reports of
334 vaccine uptake, and this may limit the generalisability of our study findings. All of our
335 respondents were recruited from antenatal clinics at tertiary hospitals, and therefore it is
336 possible that our sample was missing subsets of the population that tend to be more anti-
337 vaccination. Future studies would therefore benefit from including a greater number of study
338 sites over a wider geographic area, and recruiting from different types of sites (including
339 smaller non-tertiary hospitals and primary care) and perhaps utilizing online recruitment via
340 popular websites and social media.

341

342 Another limitation is that we relied upon self-reported vaccination status/intention, and there
343 is therefore potential reporting bias in our estimations, which may have been improved by
344 verification of women's medical records following delivery; however recent evidence does
345 suggest that self-reported intention correlates well with actual uptake of vaccination^{34 35}.
346 Finally, the number of pregnant women/HCPs approached, and the number who declined

347 participation (as well as their reasons for doing so) was not recorded, and we are therefore
348 unable to report this.

349

350 **Conclusions**

351 Whilst the high acceptance of vaccination among respondents in this study was
352 encouraging, misconceptions still exist regarding vaccine safety and efficacy. Further
353 education of multidisciplinary HCPs is essential, and active vaccine promotion needs to be
354 incorporated into routine antenatal care, with a particular emphasis on women from ethnic
355 minorities.

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358

360 **Figures**

361 Figure 1: Reasons why the surveyed pregnant women did not intend to receive influenza or
362 pertussis vaccination in pregnancy

363
364 Figure 2: Healthcare professionals' confidence providing advice to pregnant women
365 regarding influenza (A) and pertussis (B) vaccination in pregnancy

366
367 Figure 3: Healthcare professionals' opinions regarding the optimal healthcare site at which
368 vaccines in pregnancy should be delivered

369
370 **Tables**

371 Table 1: Characteristics of the respondents to questionnaires (pregnant women and
372 healthcare professionals)

373
374 Table 2 [Supplementary information]: Logistic regression analysis of factors predicting
375 pregnant women's intention to receive vaccination

376
377 Table 3 [Supplementary information]: Ordinal regression analysis of factors predicting
378 healthcare professionals' confidence in providing advice regarding vaccination in pregnancy

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385 Southampton, and all of the non-study staff that helped facilitate recruitment in the
386 participating sites.

387
388 **Author Contributions**

389 CW drafted the manuscript. All authors contributed to questionnaire design and critically
390 revised the manuscript. CW, AC, JM, EK, RM, KB, PH, AK, AF, MS, TV, TN, MC and CJ
391 were involved in study set up and data collection at the participating sites. CW, TN and CJ
392 performed the data analysis. CJ conceived the study and was the chief investigator. All
393 authors approved the final version of the manuscript.

394

395 **Conflict of Interests Statement**

396 CW, AC, JM, KB, PH, AK, AF, MS and CJ are investigators for clinical trials done on behalf
397 of their respective institutions, sponsored by various vaccine manufacturers, but receive no
398 personal funding for these activities. All other authors report no potential conflicts of
399 interest.

400

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404 analysis/interpretation, report writing, or the decision to submit the manuscript for
405 publication.

406

407 **Clinical trial registration**

408 The questionnaire study was registered on ClinicalTrials.gov prior to recruitment
409 (NCT03096574).

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411 **Ethical approval**

412 Ethical approval was granted from the West London & GTAC NHS Research Ethics
413 Committee (reference 17/LO/0537) on 6th April 2017.

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Characteristic	Pregnant women, n=314	Healthcare professionals, n=199
Age		
16-24	34 (11%)	
25-30	107 (34%)	
31-35	92 (29%)	
36-40	58 (19%)	
41-45	13 (4%)	
46+	0 (0%)	
Gestation (weeks)		
<12	8 (2%)	
12-16	37 (12%)	
17-20	31 (10%)	
21-30	55 (18%)	
31-36	93 (30%)	
>37	76 (24%)	
Study site		
A	88 (28%)	43 (22%)
B	77 (25%)	53 (27%)
C	79 (25%)	61 (31%)
D	70 (22%)	42 (21%)
Ethnicity		
Asian (British, Indian, Pakistani, Bangladeshi, Chinese, other)	25 (8%)	4 (2%)
Black (British, African, Caribbean, other)	17 (5%)	4 (2%)
White (British, Irish, other)	248 (79%)	175 (88%)
Mixed (Caribbean, African, Asian, other)	11 (4%)	6 (3%)
Other ethnic group (Arab, other)	3 (1%)	0 (0%)
Did not want to say	1 (0.3%)	1 (1%)
No response	10 (3%)	9 (5%)
Has children		
No	142 (45%)	72 (36%)
Yes	172 (55%)	127 (64%)
Profession		
Obstetrics		37 (19%)
Midwifery		151 (76%)
No response		11 (6%)
Midwifery seniority		
Band 5 (newly-qualified midwife)		8 (4%)
Band 6 (junior midwife)		84 (42%)
Band 7 (senior midwife)		46 (23%)
Band 8 (midwifery manager)		8 (4%)
No response		5 (3%)
Obstetrician seniority		
Specialty training years 1-3 (or equivalent)		8 (22%)
Specialty training years 4-6 (or equivalent)		6 (16%)
Specialty training years 7-8 (or equivalent)		6 (16%)
Consultant		17 (46%)
Time spent working in maternity care (years)		
<2		17 (9%)
2-5		29 (15%)
6-10		37 (19%)
11-15		20 (10%)
16-20		26 (13%)
>21		62 (31%)
No response		8 (4%)

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548 **Table 1:** Characteristics of the respondents to questionnaires (pregnant women and maternity
549 healthcare professionals)

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551

Variable	Number who had previously received/were intending to receive influenza vaccination (%)	Adjusted odds ratio (95% Confidence interval)	Number who had previously received/were intending to receive pertussis vaccination (%)	Adjusted odds ratio (95% Confidence interval)
Ethnicity				
White British	182/213 (85%)	3.25 (1.67-6.32) ***	203/212 (96%)	4.83 (1.77-13.19) **
Non-White British	51/84 (61%)	1.00 for reference	70/84 (83%)	1.00 for reference
Study site				
Site A	67/85 (79%)	1.36 (0.61-3.04)	73/81 (90%)	0.47 (0.14-1.62)
Site B	68/75 (91%)	4.20 (1.47-11.95) **	67/72 (93%)	0.91 (0.21-3.89)
Site C	58/74 (78%)	1.38 (0.58-3.30)	72/76 (95%)	1.22 (0.26-5.67)
Site D	40/63 (64%)	1.00 for reference	61/67 (91%)	1.00 for reference
Age				
16-24	26/32 (81%)	1.19 (0.40-3.58)	28/29 (97%)	1.96 (0.22-17.66)
25-35	152/188 (81%)	1.24 (0.62-2.49)	173/186 (93%)	1.12 (0.40-3.14)
36-45	49/68 (72%)	1.00 for reference	64/71 (90%)	1.00 for reference
Previous children				
Yes	127/163 (78%)	0.82 (0.44-1.53)	145/160 (91%)	0.47 (0.17-1.32)
No	106/134 (79%)	1.00 for reference	128/136 (94%)	1.00 for reference

*= p<0.05; **= p<0.01; ***= p<0.001;

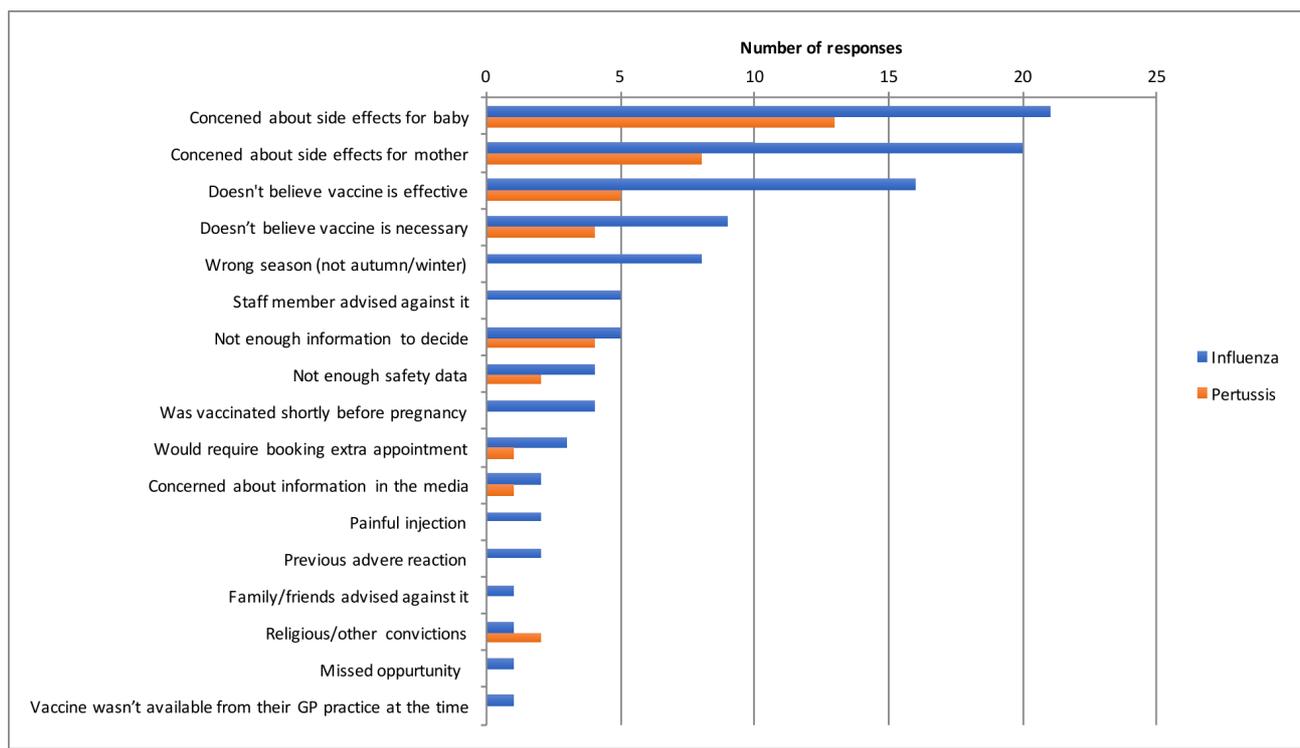
Table 2: Logistic regression analysis of factors predicting pregnant women's intention to receive/previous receipt of vaccination

Variable	Number who were very or moderately confident providing advice about influenza vaccination (%)	Adjusted odds ratio (95% Confidence interval)	Number who were very or moderately confident providing advice about pertussis vaccination (%)	Adjusted odds ratio (95% Confidence interval)
Professional group				
Obstetrics	24/37 (65%)	2.00 (0.90-4.03)	25/37 (68%)	2.05 (1.02-4.12) *
Midwifery	90/151 (60%)	1.00 for reference	83/151 (55%)	1.00 for reference
Time working in maternity care				
21+ years	42/62 (68%)	3.88 (1.29-11.68) *	36/62 (58%)	1.72 (0.58-5.09)
11-20 years	32/46 (70%)	4.02 (1.33-12.15) *	30/46 (65%)	1.98 (0.67-5.87)
2-10 years	34/66 (52%)	2.83 (1.05-7.66) *	36/66 (55%)	2.22 (0.83-5.95)
<2 years	6/17 (35%)	1.00 for reference	7/17 (41%)	1.00 for reference
Study site				
A	24/43 (56%)	1.27 (0.54-2.99)	20/43 (47%)	1.09 (0.47-2.57)
B	39/53 (74%)	5.05 (2.12-12.01) ***	26/53 (49%)	4.68 (1.98-11.05) ***
C	41/61 (67%)	2.44 (1.13-5.29) *	42/61 (69%)	2.46 (1.14-5.30) *
D	15/42 (36%)	1.00 for reference	16/42 (38%)	1.00 for reference
Has their own children				
Yes	84/127 (66%)	1.23 (0.62-2.42)	76/127 (60%)	1.21 (0.52-3.63)
No	35/72 (49%)	1.00 for reference	38/72 (53%)	1.00 for reference
Ethnicity				
White British	108/175 (62%)	1.75 (0.66-4.66)	101/175 (58%)	1.37 (0.52-3.63)
Non-White British	11/24 (46%)	1.00 for reference	13/24 (54%)	1.00 for reference

*= p<0.05; **= p<0.01; ***= p<0.001

Table 3: Ordinal regression analysis of factors predicting healthcare professionals' confidence in providing advice regarding vaccination in pregnancy

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Figure 1: Reasons why the surveyed pregnant women did not intend to receive influenza or pertussis vaccination in pregnancy

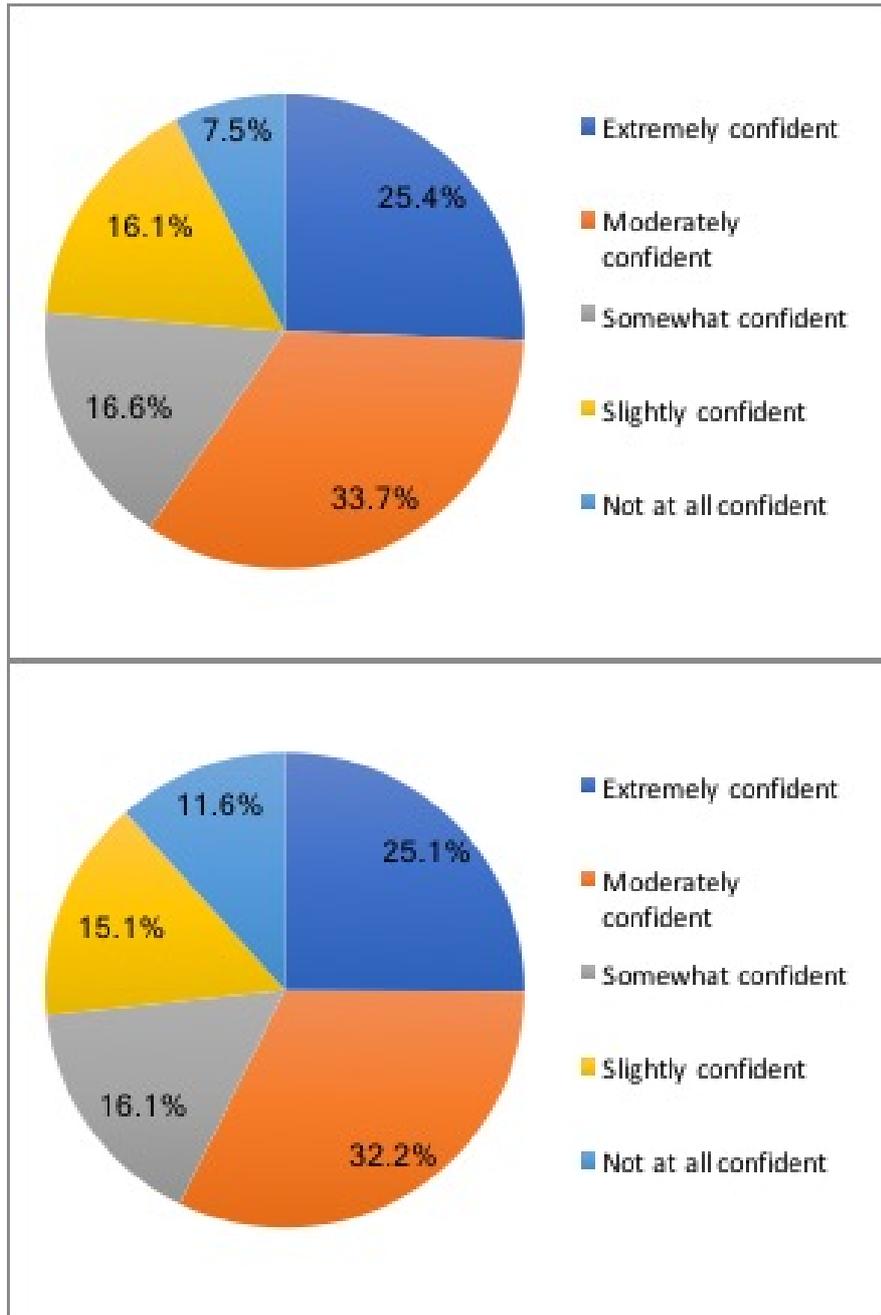


Figure 2: Healthcare professionals' confidence providing advice to pregnant women regarding influenza (A) and pertussis (B) vaccination in pregnancy

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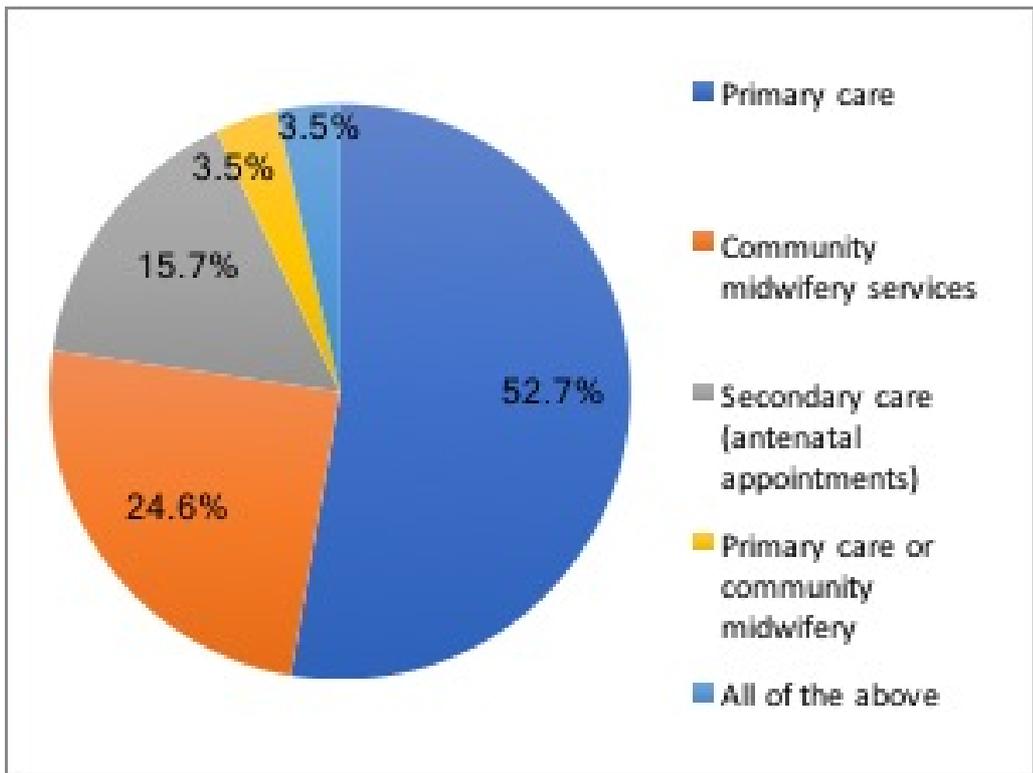


Figure 3: Healthcare professionals' opinions regarding the optimal healthcare site at which vaccines in pregnancy should be delivered

Supplementary information

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1. Questions for pregnant women analyzed in this study

(1) Have you received either of the following vaccines in this pregnancy?

- Flu (influenza) Yes No
 Whooping cough (pertussis) Yes No

(1a) If no, why have you not yet received these vaccines?

- | | For flu (influenza)? | For whooping cough(pertussis)? |
|--|--------------------------|--------------------------------|
| I don't intend to receive the vaccine | <input type="checkbox"/> | <input type="checkbox"/> |
| I haven't been offered the vaccine yet | <input type="checkbox"/> | <input type="checkbox"/> |
| I haven't got round to getting the vaccine yet | <input type="checkbox"/> | <input type="checkbox"/> |
| Other (please specify)..... | | |

(1b) If you don't intend to receive these vaccines in this pregnancy, please specify the reasons why. Tick as many apply:

- | | For flu (influenza)? | For pertussis (whooping cough)? |
|--|--------------------------|---------------------------------|
| I worry that the injection might be painful | <input type="checkbox"/> | <input type="checkbox"/> |
| My midwife did not advise it | <input type="checkbox"/> | <input type="checkbox"/> |
| My obstetrician did not advise it | <input type="checkbox"/> | <input type="checkbox"/> |
| My GP did not advise it | <input type="checkbox"/> | <input type="checkbox"/> |
| My family/friends advised against it | <input type="checkbox"/> | <input type="checkbox"/> |
| I don't believe the vaccine is effective | <input type="checkbox"/> | <input type="checkbox"/> |
| I worry about potential side effects for my baby | <input type="checkbox"/> | <input type="checkbox"/> |
| I worry about potential side effects for me | <input type="checkbox"/> | <input type="checkbox"/> |
| Vaccination was not offered to me | <input type="checkbox"/> | <input type="checkbox"/> |
| There is not enough safety data | <input type="checkbox"/> | <input type="checkbox"/> |
| I don't have enough information to decide | <input type="checkbox"/> | <input type="checkbox"/> |
| I am concerned about information in the media | <input type="checkbox"/> | <input type="checkbox"/> |
| I don't want to attend extra hospital/GP visits | <input type="checkbox"/> | <input type="checkbox"/> |
| Religious or other convictions | <input type="checkbox"/> | <input type="checkbox"/> |
| Other (please specify):
..... | | |

(2) How old are you in years?

- 16-24 25-30 31-35 36-40 41-45 46+

(3) How many weeks pregnant are you?

- Less than 12 12-16 17-20 21-30 31-36 37+

(4) To what ethnic group do you feel you belong? (Please circle)

- | White | Black / African / Caribbean / Black British |
|---|---|
| - English / Welsh / Scottish / Northern Irish | - African |
| - British Irish | - Caribbean |
| - Gypsy or Irish Traveller | - Other (please specify)..... |
| - Other (please specify) | |

- 704
- 705 **Mixed/Multiple ethnic groups** **Other ethnic group**
- 706 - White and Black Caribbean - Arab
- 707 - White and Black African - Other (please specify).....
- 708 - White and Asian
- 709 - Other (please specify)

- 710
- 711 **Asian / Asian British** **I'd prefer not to say**
- 712 - Indian
- 713 - Pakistani
- 714 - Bangladeshi
- 715 - Chinese
- 716 - Other (please specify)

- 717
- 718
- 719 **(5) Have you had any children before?**
- 720 Yes.
- 721 If yes, how many?.....
- 722 What are their ages?
- 723 Child 1: Less than 1 1-5 6-10 11-16 17+
- 724 Child 2: Less than 1 1-5 6-10 11-16 17+
- 725 Child 3: Less than 1 1-5 6-10 11-16 17+
- 726 No

- 727
- 728
- 729
- 730 **(6) Optional: Do you have any comments or concerns about any of the issues raised in the questionnaire?**
- 731
- 732
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2. Questions for maternity healthcare professionals analyzed in this study

- 739
- 740
- 741
- 742 **(1) How confident would you feel about providing advice regarding the flu (influenza) vaccine to women during pregnancy?**
- 743 **pregnancy?**
- 744 Not at all confident
- 745 Slightly confident
- 746 Somewhat confident
- 747 Moderately confident
- 748 Extremely confident
- 749

- 750
- 751 **(2) How confident would you feel about providing advice regarding the whooping cough (pertussis) vaccine to women during pregnancy?**
- 752 **women during pregnancy?**
- 753 Not at all confident
- 754 Slightly confident
- 755 Somewhat confident
- 756 Moderately confident
- 757 Extremely confident
- 758

- 759 **(3) In your opinion, where should these vaccines be delivered to pregnant women?**
- 760
- 761 Primary care (GP practice)
- 762 Midwifery services (Community services)

- 763 Secondary care at time of antenatal scans or appointments
 764 Other (please specify).....

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 766 **(4) Which healthcare professional group do you belong to?**

- 767 Obstetrics
 768 Midwifery
 769 Other (please state)

770
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 772 **(5) How long have you worked in maternity care?**

- 773 Under 2 years
 774 2-5 years
 775 6-10 years
 776 11-15 years
 777 16-20 years
 778 21+ years

779
 780 **(6) What is your grade?**

781 *1. Midwifery/nursing staff*

- 782 Band 4 Band 5 Band 6 Band 7 Band 8 Band 9

783 *2. Obstetricians*

- 784 ST 1-3 (or equivalent) ST 4-6 (or equivalent) ST 7-8 (or equivalent) Consultant

785
 786 **(7) Have you had any children before?**

- 787 Yes.
 788 If yes, how many?.....
 789 What are their ages?

- 790 Child 1: Less than 1 1-5 6-10 11-16 17+
 791 Child 2: Less than 1 1-5 6-10 11-16 17+
 792 Child 3: Less than 1 1-5 6-10 11-16 17+
 793 Child 4: Less than 1 1-5 6-10 11-16 17+

- 794
 795 No

796
 797 **(8) To what ethnic group do you feel you belong? (Please circle)**

- 798
 799 **White** **Black / African / Caribbean / Black British**
 800 - English / Welsh / Scottish / Northern Irish - African
 801 / British Irish - Caribbean
 802 - Gypsy or Irish Traveller - Other (please specify).....
 803 - Other (please specify)

- 804
 805 **Mixed/Multiple ethnic groups** **Other ethnic group**
 806 - White and Black Caribbean - Arab
 807 - White and Black African - Other (please specify).....
 808 - White and Asian
 809 - Other (please specify)

- 810
 811 **Asian / Asian British** **I'd prefer not to say**
 812 - Indian
 813 - Pakistani
 814 - Bangladeshi
 815 - Chinese
 816 - Other (please specify)

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 819 **(9) Optional: Do you have any comments or concerns about vaccination or vaccine research studies during pregnancy?**

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829 **3. Free text comments (all received from pregnant women)**

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831 *“Many vaccines contain unsafe levels of mercury, in some cases are produced on human*
832 *tissue (DNA) and contain various other toxins. I believe a baby is born with a perfect*
833 *immune system which takes up to three years to fully develop and it’s not healthy injecting*
834 *a perfectly healthy child with chemicals and toxins (mercury)”*

835

836 *“We were not offered the whooping cough [vaccine] until much later on in the pregnancy –*
837 *close to it being too late. No flu jab offered – we would have done so otherwise.”*

838

839 *“I would like the opportunity to ask more questions and have more information before*
840 *agreeing to vaccination”*

841