Why do parents not re-vaccinate their child for influenza? A prospective cohort study

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Journal: Vaccine
Acceptance date: 12th April 2020

FUNDING SOURCES
LS was funded by the Economic and Social Research Council through a Doctoral Training Centre Studentship. The research was funded by the National Institute for Health Research Health Protection Research Unit (NIHR HPRU) in Emergency Preparedness and Response at King’s College London in partnership with Public Health England (PHE), in collaboration with the University of East Anglia and Newcastle University. The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR, the Department of Health or Public Health England.
HIGHLIGHTS

- There are no publicly available data on re-vaccination rates for the child influenza vaccine.

- 17.7% (n=41) children vaccinated for influenza in 2016/17 were not re-vaccinated in 2017/18.

- Increased severity of, and worry about, side-effects were associated with not re-vaccinating.

- However, restricted sample sizes reduced the statistical power of these analyses.
ABSTRACT
Child influenza vaccination rates for the UK are published annually, however there are no publicly available data on how many children are re-vaccinated the following year. This prospective cohort study aimed to identify factors associated with not re-vaccinating one’s child. Participants (n=270) completed a questionnaire before their child was vaccinated for influenza in the 2016/17 season, and follow-up questionnaires three days and one month after their child’s vaccination. Re-vaccination data were collected at the end of the 2017/18 influenza season (n=232, response rate 85.9%). Forty-one children (17.7%) were not re-vaccinated for influenza in 2017/18. Parental report of severe side-effects three days after vaccination ($p=.04$) and worry about side-effects one month after vaccination ($p=.05$) were associated with not re-vaccinating. However, the restricted sample size reduced the statistical power of these analyses. Decreasing parental worry about side-effects may help improve re-vaccination rates.

Clinical trial registration: The study was registered on ClinicalTrials.gov (NCT02909855).

Key words: side-effects, child vaccination, psychological factors
Since its introduction to the vaccine schedule in England in 2013, uptake of the child influenza vaccine has been low, between 30% and 62% [1-5]. Due to the constant mutation of the influenza virus, vaccination is recommended yearly. While factors associated with uptake of the child influenza vaccine have been researched [6], there are no available data on re-vaccination rates or analyses investigating why parents who vaccinate their child against influenza one year, do not to do so in a subsequent year.

Concern about side-effects is a common reason for declining vaccination [7]. Around 40% to 50% of children vaccinated against influenza (nasal spray) experience side-effects [8, 9]. Parental report of side-effects in the child, and perception of more severe side-effects, is associated with decreased intention to re-vaccinate one’s child in the next influenza season [6, 10].

In this study, we investigated the rate of influenza re-vaccination in 2017/18 in children who were vaccinated for influenza in 2016/17. We also investigated whether re-vaccination refusal was associated with: reporting side-effects from vaccination; perceived severity of side-effects; worry about side-effects; re-vaccination intention; healthcare worker suggestion that the vaccine causes side-effects; change in how sensitive parents perceived their child to be to medicines; and change in parents’ trust in healthcare workers.

**MATERIAL AND METHODS**

**Design**
In this prospective cohort study, participants completed a baseline questionnaire immediately before their child received the influenza vaccine (a nasal spray) in the 2016/17 season (T1). All children were vaccinated for influenza at their primary care practice in the 2016/17 season; this was not necessarily the child’s first influenza vaccination. Parents then completed follow-up questionnaires three days (T2) and one month after (T3) vaccination. Re-vaccination was assessed at the end of the 2017/18 influenza season (T4).
This original study also investigated psychological factors associated with parental report of side-effects and re-vaccination intention [10].

**Participants**
Participants were eligible for the study if they: had a child aged two to four on 31st August 2016; intended to vaccinate that child for influenza in the 2016/17 influenza season; were eighteen years or over; and spoke fluent English. If parents had two children who were eligible to receive the child influenza vaccine through their primary care practice, parents were asked to complete the study with one child in mind.

Most participants were recruited from eleven primary care practices in South London (n=259); other participants from different surgeries participated online (n=11).

**Study materials**

*Outcome measure*

Vaccination in the 2017/18 influenza season was ascertained where possible from primary care vaccination records. If this was not possible, or if children were eligible to be vaccinated at school, parents were contacted directly and asked if their child had been “vaccinated in the 2017/18 flu season.” Possible answers were “yes,” “no,” and “don’t know.”

*Side-effects from previous vaccination*

We asked parents three days and again one month after vaccination if their child had “experienced side-effects…because of their latest child flu vaccine” using a list of 23 symptoms [6, 10].

Parents who indicated that their child had experienced one or more side-effects were asked how severe the side-effects were “from their [child’s] latest flu vaccine” using a five-point response format of “very mild” (1) to “very severe” (5). Parents were also asked how worried they had been “about the overall side-effects that [their child] experienced from their
latest flu vaccine” using a four-point response format of “not at all worried” (1) to “very worried” (4).

Factors which may have changed since vaccination in 2016/17

Three days after their vaccination appointment (T2), parents were asked if the healthcare worker had suggested “that the flu vaccine might cause side-effects” in their child’s influenza vaccination appointment (2016/17). We hypothesised that the suggestion of symptoms from the healthcare worker may have been stronger if parents trusted the healthcare worker. We therefore measured if parents thought healthcare workers could “be trusted as a source of information about the flu vaccine.”

Parents indicated how sensitive they believed their child to be to medicines by completing an adapted parent-report version of the Perceived Sensitivity to Medicines questionnaire [11] at T1 and T3. Participants’ trust in healthcare workers was also measured at T1 and T3 using an adapted form of the Meyer Credibility Scale [12].

Personal and clinical characteristics

Participants were asked for their age and gender; their child’s age, gender and whether they were the parent’s first child; whether they or their child had a long-term health condition1; and whether there were any people “at risk” from influenza in the child’s household. We also asked parents whether the child was up-to-date for other routine vaccines at T1, however, due to lack of cases who were not up-to-date at T4 we were unable to analyse these data (see Table 1).

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1 Parents were said to have a “long term health condition” if they had ever been diagnosed by a medical doctor as having: breathing complaints (e.g. asthma, bronchitis, pulmonary disease, emphysema); cancer; diabetes; heart disease (e.g. heart failure, high blood pressure); kidney disease (e.g. renal failure, kidney transplant); liver disease (e.g. hepatitis, cirrhosis); mental health (i.e. depression, anxiety, stress); neurological condition (i.e. caused by disease or damage to the brain, spinal cord or other parts of the nervous system); stroke (or transient ischaemic attack; TIA); or substance misuse (i.e. alcohol, drugs). For children, this list was identical, but did not include substance misuse.
**Procedure**

Ethical approval for the study was granted by the NHS Research Ethics Committee (Reference: IRAS ID: 192325, REC reference: 16/LO/1003).

Potential participants were identified through their child’s primary care practice.

Participants were recruited between 1st October 2016 and 16th December 2016. Before completing questionnaire materials, consent was obtained from all parents.

Participants completed T1 materials before their child’s influenza vaccination, at the primary care practice or online (link sent to parents of children in an information letter about the study, via the primary care practice). T2 and T3 materials were emailed to parents and completed online. If parents did not have access to email, materials were completed by telephone (n=13).

At the end of the T2 questionnaire we asked parents for consent to access their child’s vaccination records for 2017/18. If consent was granted, we accessed vaccination records at the end of the 2017/18 vaccination campaign at each primary care practice. Where needed, we also contacted parents via email or telephone at this point.

**Power**

The original study was powered to detect small odds ratios (OR=1.6 [13]) between parents who did and did not report side-effects from vaccination [10].

Power for the current study was determined using post-hoc power calculations. We calculated achieved power for each analysis using the a-priori parameter of a two-tailed logistic regression, based on small (OR=1.68) and medium (OR=3.47) effect sizes [13] (see Tables 1 and 2).

**Protocol registration**

The protocol for the study was registered in advance on clinicaltrials.gov (identifier: NCT02909855).
**Analysis**

We coded re-vaccination status in 2017/18 into a binary variable (not re-vaccinated in 2017/18, re-vaccinated); “don’t know” was coded as missing data (n=3, 1.3%). We coded report of a side-effect (reported at least one side-effect, no side-effects reported) and re-vaccination intention (did not definitely intend to re-vaccinate, definitely intend to re-vaccinate; see [10]) as binary variables.

We created a composite measure of symptom suggestion by multiplying the suggestion of symptoms from the healthcare worker vaccinating the child by trust in the healthcare worker.

We used logistic regression analyses to identify whether re-vaccination of the child in 2017/18 was associated with: report of a side-effect at T2 or T3; perceived severity of and worry about side-effects; suggestion that the child would experience side-effects by the healthcare worker; suggestion that the child would experience side-effects by trust in the healthcare worker; changes in the parents’ perception of how sensitive the child was to medicines; changes in trust in healthcare workers; and personal and clinical characteristics.

Analyses controlled for all parent and child personal and clinical characteristics, apart from up-to-date status with routine vaccinations (due to lack of cases not up-to-date) and were run in SPSS version 22 [14]. We did not adjust for multiple comparisons.

**RESULTS**

270 parents (221 mothers) completed the initial questionnaire (259 in the primary care practice, eleven online). 233 participants initiated T2 follow-up, with 202 participants completing all T2 items (response rate 74.8%; 185 mothers, see Figure 1). 200 participants initiated T3 follow-up, with 195 completing all T3 items (response rate 72.2%; 164 mothers). Re-vaccination status in 2017/18 was ascertained for 232 participants (response rate 85.9%; 190 mothers). 104 parents gave consent for us to access their child’s vaccination records at T4. Those for whom re-vaccination status was not ascertained did not give permission for the
child’s vaccination records to be accessed and were lost to follow up. There were no differences in personal or clinical characteristics between those who did and did not complete the T4 follow-up (see supplementary materials).

Forty-one children (17.7%, 95% CI [12.7, 22.6]) had not been re-vaccinated; 188 children (81.0%, 95% CI [76.0, 86.1]) had been re-vaccinated; and three parents (1.3%) did not know if their child had been re-vaccinated.

Associations between personal characteristics, predictor variables and re-vaccination status can be found in Tables 1 and 2.

Parents who were aged 35 to 44 were less likely to re-vaccinate their child compared to those aged 18 to 34. No other personal characteristics were associated with re-vaccination status.

Parents who reported that their child experienced more severe side-effects three days after vaccination were less likely to re-vaccinate their child. Parents who reported being more worried about their child’s side-effects one month after vaccination were also less likely to re-vaccinate their child. No other variables showed an association with re-vaccination status.2

**DISCUSSION**

This is the first study to investigate re-vaccination rates for the child influenza vaccine in England, with results indicating that almost 18% of children who were vaccinated in the 2016/17 influenza season were not re-vaccinated in 2017/18, despite previous vaccination being one of the strongest predictors of uptake [15]. High rates of children being up-to-date with routine vaccinations in the sample and high response rates for the study indicate that this may be a motivated sample of parents. Thus, re-vaccination rates across the whole population (England or UK) are likely to be lower (upper bound of 95% confidence interval 22.6%).

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2 We ran a chi squared analysis to investigate whether there was an association between previous vaccination (before 31st August 2016) and re-vaccination in 2017/18, finding no evidence for an association (p=.37). There was also no evidence for an association when using an adjusted logistic regression (p=.41).
This highlights the need to identify factors associated with re-vaccination and to incorporate these into communications with parents whose children have just been vaccinated.

Although research indicates that parental report of side-effects was associated with decreased vaccination intention [10], we found no association with actual re-vaccination. Parental worry about, and perceived severity of, side-effects were associated with not re-vaccinating one’s child. However, our results should be taken with caution due to the restricted sample included in these analyses (only those who reported a side-effect in their child), resulting in reduced power. Providing reassurance to parents about the typically transitory and non-harmful nature of side-effects [16] may be a useful strategy to reduce long-term attrition among parents who have previously vaccinated their child.

Contrary to previous research [17], we found no association between re-vaccination intention and later re-vaccination. This may be due to the year-long delay between completion of the two measures. Practical considerations – such as the child being ill on the day of vaccination or vaccine shortages, and the tendency for children to be re-vaccinated at school in 2017/18 – may have had a greater influence on re-vaccination rates than parental intention to re-vaccinate, possibly explaining the lack of a significant association. This latter issue was partly the result of children reaching school age at follow-up and partly because of changes to official recommendations for the 2017/18 influenza season [5]. Uptake of the influenza vaccine is higher in school-aged children [1-5], presumably due to the relative ease of vaccination for parents, so this is unlikely to have artificially lowered the rate of re-vaccination. Our findings may also be a manifestation of the intention-behaviour gap commonly found in studies of health behaviours [18].

Strengths of this study include its prospective longitudinal design. Although we used two ways to ascertain re-vaccination status (primary care records and self-report), research indicates that parent-report of a child’s influenza vaccine status is a robust measure [19].
Limitations of the study include that outcome data were skewed, with most children being re-vaccinated, causing decreased power. Analyses of perceived severity and worry about side-effects lacked power due to restricted samples. Multiple analyses were used increasing the risk of Type I errors. Due to space limitations in our questionnaire, we did not measure potential barriers affecting re-vaccination such as access to the primary care practice, nor did we ask parents who did not report side-effects whether they were worried about potential vaccine side-effects. Our findings may not be generalisable to other vaccinations with different side-effect profiles, including the injected influenza vaccination, or to other populations. Notably, 95% of our sample indicated that their child was fully up-to-date with other routine vaccines. This is slightly higher than the general population, with uptake of routine vaccines in two-year olds in London ranging between 84.2% and 91.6% by vaccine in 2016/17 [20].

This is the first study to investigate the proportion of children re-vaccinated for influenza. Findings indicated that about one in six children were not re-vaccinated in the 2017/18 season in a motivated sample, therefore the true proportion may be lower. While results should be taken with caution due to limited power, there was some evidence that parental perception of severe side-effects from vaccination and worry about side-effects was negatively associated with re-vaccination. These findings should be investigated further. Interventions aimed at minimising parental perception of, and worry about, vaccination side-effects may help to maintain vaccine rates. As side-effects from the child influenza vaccine are common, research into how best to reassure parents about their typically mild and short-term nature may be beneficial.
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Table 1. Participants’ personal characteristics and associations with intention to vaccinate and vaccination status in 2017/18

| Participant characteristics | Level | Re-vaccination in 2017/18 influenza season | Odds ratio (95% CI) | p | Adjusted odds ratio (95% CI)* | p | Power to detect small effect (OR=1.68) | Power to detect medium effect (OR=3.47) |
|-----------------------------|-------|------------------------------------------|---------------------|---|-------------------------------|---|-----------------------------|-------------------------------------|
|                            |       | Not re-vaccinated (total n=41, n (%)   | Re-vaccinated (total n=188, n (%) |     |                               |     |                            |                                      |
| Parent gender              | Female| 34 (17.9)                                | 156 (82.1)          | 1.00 (0.41 to 2.45) | .99 | 0.50 (0.15 to 1.74)          | .28 | 86.8%                      | 100%                                |
|                            | Male  | 7 (17.9)                                 | 32 (82.1)           | 0.43 (0.09 to 2.16) | .31 | 0.46 (0.08 to 2.66)          | .39 | 73.6%                      | 99.9%                               |
| Parent age                 | 45+   | 2 (12.5)                                 | 14 (87.5)           | 0.29 (0.11 to 0.76) | .01 | 0.30 (0.09 to 0.96)          | .04 |                            |                                      |
|                            | 35-44 | 9 (8.9)                                  | 92 (91.1)           | Reference          |     | Reference                    |     |                            |                                      |
|                            | 18-34 | 12 (25.0)                                | 36 (75.0)           | Reference          |     | Reference                    |     |                            |                                      |
| Parent chronic illness     | Present| 6 (13.3)                                 | 39 (86.7)           | 0.83 (0.32 to 2.17) | .70 | 1.21 (0.33 to 4.41)          | .77 | 81.3%                      | 99.9%                               |
|                            | None  | 24 (15.7)                                | 129 (84.3)          | Reference          |     | Reference                    |     |                            |                                      |
| Other “at risk” people in | Yes   | 9 (12.0)                                 | 66 (88.0)           | 0.74 (0.31 to 1.78) | .50 | 0.35 (0.10 to 1.20)          | .10 | 76.9%                      | 99.9%                               |
| child’s household          | No    | 16 (15.5)                                | 87 (84.5)           | Reference          |     | Reference                    |     |                            |                                      |
| Child gender               | Female| 24 (19.5)                                | 99 (80.5)           | 1.26 (0.63 to 2.49) | .52 | 1.66 (0.58 to 4.77)          | .35 | 86.6%                      | 100%                                |
|                            | Male  | 17 (16.2)                                | 88 (83.8)           | Reference          |     | Reference                    |     |                            |                                      |
| First-born child           | Yes   | 19 (15.6)                                | 103 (84.4)          | 1.09 (0.49 to 2.44) | .83 | 0.60 (0.20 to 1.86)          | .38 | 81.3%                      | 99.9%                               |
|                            | No    | 11 (14.5)                                | 65 (85.5)           | Reference          |     | Reference                    |     |                            |                                      |
| Child age                  | Range 1-5 | N=40, M=3.03, SD=0.92 | N=186, M=3.10, SD=0.92 | 0.91 (0.63 to 1.33) | .63 | 0.86 (0.48 to 1.55)          | .61 | 86.3%                      | 100%                                |
| Child chronic illness      | Present| 3 (16.7)                                 | 15 (83.3)           | 1.13 (0.31 to 4.18) | .85 | 1.92 (0.35 to 10.57)         | .45 | 81.3%                      | 99.9%                               |
|                            | None  | 27 (15.0)                                | 153 (85.0)          | Reference          |     | Reference                    |     |                            |                                      |
| Child up-to-date (UTD)     | Not fully UTD | 0 (0.0)                  | 9 (100.0)        | †                    | †   | †                            | †   | †                          | †                                    |
| with other routine vaccines| UTD   | 29 (15.7)                                | 159 (84.6)          | Reference          |     | Reference                    |     |                            |                                      |

*a Adjusting for all other personal characteristics (both parent and child, apart from child up-to-date status with routine vaccinations)

*p≤.05

† Analyses unable to be run due to small cell count
Table 2. Associations between side-effects, intention and changes with re-vaccination status in 2017/18

| Category                                      | Perception statement | Level               | Re-vaccination in 2017/18 influenza season | 2017/18 influenza season | Odds ratio (95% CI) | p       | Adjusted odds ratio (95% CI) | p       | Power to detect small effect (OR=1.68) | Power to detect medium effect (OR=3.47) |
|-----------------------------------------------|----------------------|---------------------|-------------------------------------------|--------------------------|---------------------|--------|-------------------------------|--------|--------------------------------------|--------------------------------------|
| Symptoms following vaccination                |                      |                     |                                            |                          |                     |        |                               |        |                                      |                                      |
| Report of side-effects as assessed at T2      | Yes                  | 13 (15.7)           | 70 (84.3)                                 | 1.18 (0.54 to 2.62)      | .68                 |        | 2.21 (0.72 to 6.82)           | .17    | 81.9%                               | 99.9%                               |
|                                              | No                   | 16 (13.6)           | 102 (86.4)                                | 1.24 (0.60 to 2.56)      | .57                 |        | 1.35 (0.44 to 4.18)           | .60    | 44.5%                               | 98.8%                               |
| Worry about side-effects as assessed at T2    | Four-point Likert    | N=15, M=1.73, SD=1.03 | N=70, M=1.61, SD=0.67                     | 1.12 (0.58 to 2.19)      | .73                 |        | 2.83 (1.05 to 7.63)           | .04*   | 44.5%                               | 98.8%                               |
|                                              | Five-point Likert    | N=15, M=1.87, SD=1.06 | N=70, M=1.79, SD=0.78                     |                           |                     |        |                               |        |                                      |                                      |
| Severity of side-effects as assessed at T2    | Four-point Likert    | N=11, M=1.82, SD=0.98 | N=53, M=1.58, SD=0.66                     | 1.522 (0.65 to 3.56)     | .33                |        | 4.57 (1.01 to 20.58)          | .05*   | 34.6%                               | 94.3%                               |
|                                              | Five-point Likert    | N=10, M=2.50, SD=0.71 | N=50, M=1.76, SD=0.82                     | 2.83 (1.19 to 6.73)      | .02*               |        | 8.17 (0.83 to 80.24)          | .07    | 32.6%                               | 92.6%                               |
| Report of side-effects as recalled at T3      | Yes                  | 11 (16.7)           | 55 (83.3)                                 | 0.89 (0.40 to 1.97)      | .78                 |        | 1.50 (0.50 to 4.49)           | .47    | 78.8%                               | 99.9%                               |
|                                              | No                   | 22 (18.3)           | 98 (81.7)                                 |                           |                     |        |                               |        |                                      |                                      |
| Worry about side-effects as recalled at T3    | Four-point Likert    | N=11, M=1.82, SD=0.98 | N=53, M=1.58, SD=0.66                     | 1.522 (0.65 to 3.56)     | .33                |        | 4.57 (1.01 to 20.58)          | .05*   | 34.6%                               | 94.3%                               |
|                                              | Five-point Likert    | N=10, M=2.50, SD=0.71 | N=50, M=1.76, SD=0.82                     | 2.83 (1.19 to 6.73)      | .02*               |        | 8.17 (0.83 to 80.24)          | .07    | 32.6%                               | 92.6%                               |
| Re-vaccination intention                      | Re-vaccination intention | 31 (17.4)           | 147 (82.6)                                | 1.31 (0.47 to 3.63)      | .61                 |        | 0.49 (0.13 to 1.90)           | .30    | 84.3%                               | 99.9%                               |
|                                              | No                   | 5 (13.9)            | 31 (86.1)                                 |                           |                     |        |                               |        |                                      |                                      |
| Factors which may have changed since vaccination in 2016/17 | Healthcare worker suggestion in vaccine appointment | Four-point Likert | N=14, M=2.64, SD=0.63 | 1.47 (0.62 to 3.48) | .38 | 1.64 (0.52 to 5.18) | .40 | 58.7% | 99.9% |
|                                              | Healthcare worker suggestion in vaccine appointment | Suggestion by Trust (higher score indicates more trust), range 1 to 20 | N=14, M=10.43, SD=4.80 | 0.98 (0.85 to 1.14) | .82 | 1.02 (0.83 to 1.25) | .87 | 58.7% | 99.9% |
| Change in perceived sensitivity to medicines | Range -20 to 8       | N=32, M=0.31, SD=3.27 | N=148, M=0.18, SD=3.38 | 0.99 (0.88 to 1.11) | .83 | 1.03 (0.89 to 1.20) | .66 | 77.4% | 99.9% |
| Change in trust in healthcare workers | Range -20 to 10      | N=31, M=0.26, SD=3.93 | N=146, M=0.67, SD=3.67 | 1.08 (0.96 to 1.23) | .21 | 1.07 (0.89 to 1.27) | .47 | 76.7% | 99.9% |

a Adjusting for all personal characteristics (both parent and child, apart from child up-to-date status with routine vaccinations)

* p≤.05
Figure 1. Flowchart showing the number of participants who completed materials at each stage of the study. Please note that not all participants who completed study materials at T2 also completed materials at T3, and vice versa.

T1, before child’s influenza vaccination (2016/17).
$n=270$ parents completed.

T2, three days after child’s influenza vaccination.
$n=202$ completed (233 initiated follow-up).

T3, one month after child’s influenza vaccination.
$n=195$ completed (200 initiated follow-up).

T4, after end of 2017/18 influenza season.
$n=232$ re-vaccination status ascertained.