

# Assessing determinants of the intention to accept a pertussis cocooning vaccination

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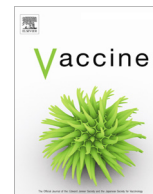
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# Assessing determinants of the intention to accept a pertussis cocooning vaccination: A survey among healthcare workers in maternity and paediatric care

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## ABSTRACT

**Objective:** To assess the intention to accept a pertussis cocooning vaccination and to examine the determinants that influence this intention among healthcare workers (HCWs) in maternity and paediatric care.  
**Design:** Cross-sectional survey.

**Setting:** Maternity assistants, midwives, and paediatric nurses in the Netherlands.

**Methods:** We developed a 123-item questionnaire based on a literature review and the Reasoned Action Approach (a social cognitive model of behaviour). We used the questionnaire to explore the determinants of intention to accept pertussis cocooning vaccination among the HCW groups. We also assessed the behavioural beliefs underlying HCWs' attitudes towards pertussis cocooning. We used correlation and regression analyses to assess univariate and multivariate associations in the study variables.

**Results:** Altogether, 486 maternity assistants, 320 midwives, and 200 paediatric nurses completed the questionnaire; 45%–63% reported their intentions to accept pertussis vaccination. Attitude, anticipated affect regarding non-acceptance, and decisional uncertainty were uniquely associated with the intention to accept a pertussis vaccination. The respondents' attitude towards pertussis cocooning vaccination was further explained by their general vaccination beliefs, agreement with a policy advice to vaccinate HCWs, the perceived cost-benefit ratio, and the perceived personal responsibility to prevent pertussis in patients.

**Conclusion:** About half of the participating HCWs reported their intentions to accept a pertussis cocooning vaccination. Attitude, anticipated affect regarding non-acceptance, and decisional uncertainty came forward as the most important determinants of intention. This study helps build the evidence base describing the determinants of the intention to accept a pertussis cocooning vaccination among HCWs.

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## 1. Introduction

Many countries have reported a resurgence of pertussis in recent decades, despite high coverage of the inactivated pertussis

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vaccine in childhood [1,2]. The reason seems to be a mixture of more awareness, better diagnostics, waning immunity, bacterial changes in the circulating pertussis strains [3,4], and more frequent vaccine hesitancy [5]. Such resurgence particularly threatens young infants, who are vulnerable to severe pertussis complications and who only receive adequate protection after completing the primary series of vaccinations at the age of 6 months [6].

The increased pertussis incidence has led to pertussis outbreaks in healthcare settings (including neonatal care) [7–9] in which healthcare workers (HCWs) are apparently either the introductory source or part of the transmission chain. Apart from the morbidity and mortality among infants who contract pertussis during

hospitalization, nosocomial pertussis outbreaks generate considerable costs for containment strategies, antibiotic prophylaxis or therapy, and sometimes ad hoc vaccination strategies [9–11]. In high-income countries, a pertussis booster vaccination for HCWs has been recommended, as part of a cocooning strategy aiming to prevent transmission to patients, particularly young infants [1,12,13]. Introducing such a strategy might also reduce costs [10,11,14]. The USA, Australia, and nine European countries have adopted these recommendations and have introduced pertussis booster vaccination for HCWs and other close contacts in a cocooning strategy to prevent pertussis transmission to infants [15].

However, HCWs' uptake of pertussis vaccination in high-income countries is reportedly a problematic 11%–85% [16–26]. A vaccination program designed to carefully target the barriers and facilitators of acceptance could ensure optimal uptake. This program would use a coherent theory- and evidence-based approach [27–30]. Insight into the determinants influencing HCWs' acceptance of pertussis vaccination is crucial here. Therefore, the aims of this study were to assess HCWs' intention to accept a pertussis cocooning vaccination and to examine and quantify the determinants that influence this intention.

## 2. Methods

### 2.1. Study design and population

In our cross-sectional questionnaire study among Dutch HCWs we targeted maternity assistants, midwives, and paediatric nurses specifically. A possible future program of pertussis cocooning vaccination would most likely include these professionals because they care for infants in the vulnerable first half year of their lives.

### 2.2. Questionnaire and variables

Our Dutch questionnaire with 123 items is based on a theoretical framework (Fig. 1). The framework, which describes the various determinants of accepting pertussis vaccination, originated

from the results of a literature review, our previous qualitative study [31], and the Reasoned Action Approach [32]. We developed the questionnaire in parallel with a study of parental intention to accept pertussis vaccination (published elsewhere) [33].

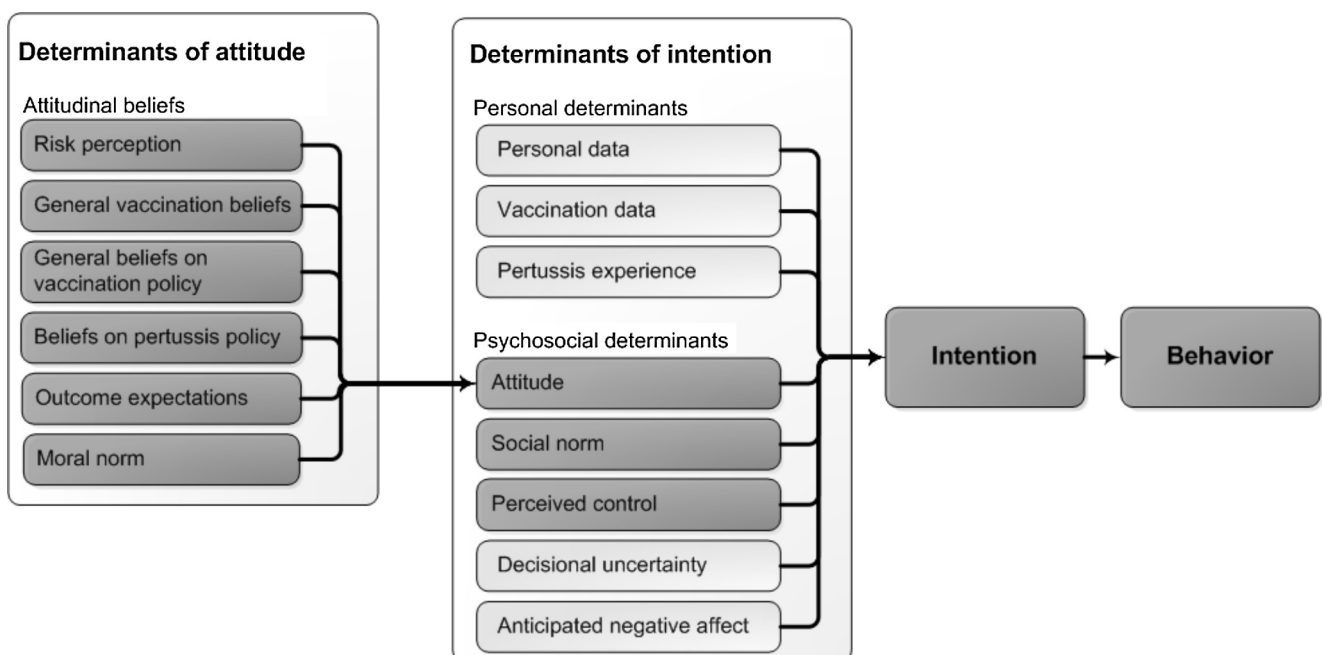
The primary outcome measure of the questionnaire was the HCWs' intention of accepting a pertussis vaccination if it were offered in a cocooning strategy. We measured both personal and psychosocial determinants that potentially influence the intention to accept vaccination and potential determinants of attitude (behavioural beliefs). The personal determinants of intention included personal characteristics, vaccination history, and pertussis experience.

The psychosocial determinants included attitude, social norm, perceived behavioural control, anticipated negative affect, and decisional uncertainty. The first three are main psychosocial determinants of behaviour derived from the Reasoned Action Approach. The remaining two determinants were relevant in the qualitative study. The behavioural beliefs underlying attitude were selected from the qualitative study findings and the literature review. Table 1 and Appendix 1 show the psychosocial measures and behavioural beliefs.

We used a seven-point Likert scale to measure the primary outcome (intention), the psychosocial determinants of intention, and the behavioural beliefs underlying attitude. We combined items that were theoretically linked, but only when there was enough internal consistency (Cronbach's Alpha  $\alpha > 0.70$  or Pearson correlation  $r > 0.60$ ). Items for each participant were then averaged into one single measure.

### 2.3. Data collection

In November and December of 2012, we invited maternity assistants, midwives, and paediatric nurses to participate. We used a pragmatic approach to data collection for each population. Potential participants had a month to complete the questionnaire. Based on a power calculation, we needed at least 200 respondents in each group. To increase the response rates, the eligible populations were



**Fig. 1.** Theoretical framework for accepting a pertussis cocooning vaccination. Dark grey – based on Reasoned Action Approach. Light grey – based on previous qualitative research, and a literature search.

**Table 1**  
Overview of determinants within intention, psychosocial determinants, and attitudinal beliefs.

Determinant in theoretical model	Determinant measured	Number of items <sup>a</sup>
<b>Intention</b>	Intention	3
<b>Psychosocial determinants</b>		
Attitude	Attitude	5
Social norm	Social norm	8
Perceived control	Perceived capacity	2
	Perceived autonomy	1
Decisional uncertainty	Decisional uncertainty	3
Anticipated negative affect	Non-acceptance	3
	Acceptance	4
<b>Attitudinal beliefs</b>		
Risk perception	Susceptibility of child to pertussis	1
	Severity of pertussis for child	1
	Susceptibility of pertussis to oneself	1
	Susceptibility of professionals to pertussis	1
	Severity of pertussis for oneself	1
	Susceptibility to transmission	1
	Perceived impact of hygiene on transmission	1
	Perceived impact of work stop on transmission	1
	Severity of transmission	1
	Susceptibility to side effects of vaccination	5
	Severity of vaccination side effects	2
General beliefs about vaccination	Consideration, naturalistic beliefs and fear	6
General beliefs about vaccination policy	Too many vaccinations for professionals	1
	Importance of following governmental advice	1
	Financial influence of pharmaceutical companies	1
Beliefs about pertussis policy	Agreement with national policy	5
	Goal of policy: to diminish health costs	1
	Goal of policy: to diminish sick leave	1
Outcome expectations	Perceived efficacy for oneself	2
	Perceived efficacy for patients	5
	Perceived cost-benefit	3
	Perceived impact on employability	1
	Perceived fear of blame	1
Moral norm	Justice	1
	Responsibility	7

<sup>a</sup> Within the measured determinant.

informed that every 20th participant would receive a small gift voucher.

Maternity assistants care for 95% of mothers and children in their own homes after delivery [34]. A branch organization representing 70% of the Dutch maternity-care organizations invited their 35 members to participate. Of the ten maternity care organizations interested in participating, seven were selected in an even distribution over the Netherlands. These organizations e-mailed an invitation with a link to the online questionnaire to their 2180 maternity assistants. No reminders were sent because enough respondents replied in the given time.

Community midwives work autonomously in private practices and take care of low-risk births at home or in the hospital. Clinical midwives working in hospitals are supervised by gynaecologists. Their professional association provided the addresses of 525 community midwife practices and 317 clinical midwives. Each received a request to complete the questionnaire, either online or on paper. Midwives in private practices were asked to appoint one affiliated

midwife to complete the questionnaire. No reminders were needed; enough respondents replied in the given time.

We selected university and general hospitals, evenly distributed among the 91 Dutch hospitals in 2012 [35] to participate. We asked their managers of paediatric wards and neonatal intensive care units to e-mail invitations with a link to our online questionnaire to all their nurses who work with children aged 0–6 months. Twenty of the 21 hospitals we approached agreed to participate. Approximately 900 nurses were invited. The managers were asked to send reminders 3 weeks later.

We used the predictive analytic computer software SPSS (Statistical Product and Service Solutions, IBM, New York, version 22) to process and analyze the data. No items were missing in the completed online questionnaires since this was required for completion. We excluded unfinished paper questionnaires from the analysis. Incomplete items were entered as “missing”.

#### 2.4. Data analysis

First, we descriptively analyzed the personal and psychosocial measures (frequencies). We dichotomized determinants ( $\geq 5.0$  was positive;  $< 5.0$  was negative) for descriptive purposes, where relevant. Those measures for which more than 90% of the respondents gave the same answer were excluded from further analysis because of low variability. Since the intention data showed a non-normal distribution for each group, we dichotomized the intention measure ( $\geq 5.0$  for intention,  $< 5.0$  for no intention) for further analysis. We used univariate and multivariate logistic regression analysis to assess the association between intention and its personal and psychosocial determinants. We chose the Nagelkerke index to express a pseudo  $R^2$  to approximate the explained variance of the multivariate logistic model. To assess the contribution of the beliefs in explaining attitude, we used a univariate and multivariate linear regression analysis. We used the  $R^2$  to express the explained variance in the multivariate linear model. Those determinants correlating ( $r > 0.3$ ) with the outcome variable (intention or attitude) in the univariate analyses were entered simultaneously in the multivariate model to assess their unique contribution to explaining the outcome variable. We built a final multivariate regression model by backwardly eliminating the non-significant determinants until only significant determinants ( $p < 0.05$ ) remained.

#### 2.5. Ethical review

The Medical Ethics Committee of the District of Arnhem – Nijmegen assessed the study and concluded that it was exempt from their approval (reference number: 2010/475).

### 3. Results

#### 3.1. Population

Altogether, 486 maternity assistants, 320 midwives, and 200 paediatric nurses completed the questionnaire (Table 2). Most were women. All the groups had equally high vaccination coverage of their own childhood vaccinations, which is comparable to the total Dutch vaccination coverage of 92%–95% [36]. However, their children's vaccination coverage differed: less midwives vaccinated their children than maternity assistants and paediatric nurses. The rates for participants influenced by a specific philosophical background (e.g. religion, homeopathy, natural cure, or anthroposophy) were slightly high compared to the 8.2% in the general population [37]. The rates of experience with pertussis in children differed among the groups, as expected due to the nature of their profession.

**Table 2**  
Personal determinants for maternity assistants, midwives, and paediatric nurses.

	Maternity assistants		Midwives		Paediatric nurses	
	%	n/N	%	n/N	%	n/N
<b>Personal data</b>						
Women	99.6	484/486	96.9	310/320	97.0	194/200
Mean age in years (SD)	45.1 (10.8)	483	39.2 (10.7)	317	43.2 (10.9)	196
High educational level <sup>a</sup>	4.3	21/486	99.7	319/320	64.5	127/197
Medium or high household income <sup>b</sup>	14.1	43/305	52.5	128/244	31.4	44/140
Philosophical background <sup>c</sup>	11.7	57/486	16.3	51/313	13	26/200
Perceived good personal health	45.9	223/486	22.9	72/314	35.5	71/200
Mean total of people in household (SD)	3.3 (1.7)	486	3.1 (1.5)	318	3.2 (1.5)	200
Mean work experience in healthcare in years (SD)	18.2 (11.3)	486	16.6 (11.1)	316	23.1 (11.3)	200
Mean working hours per week (SD)	20.7 (8.2)	486	38.5 (14.0)	312	26.6 (7.0)	200
<b>Vaccination data</b>						
Vaccination of own children	95.6	395/413	78.6	158/201	96.5	138/143
Vaccinated according to NIP themselves	96.8	455/470	96.7	297/307	94.8	181/191
Previous influenza vaccination						
Accepted	64.2	217/338	55.3	130/235	46.9	90/192
Not offered	23.4	103/441	23.9	74/309	3.5	7/199
<b>Pertussis experience</b>						
Experience with pertussis in adults	22.1	101/457	29.0	90/310	43.9	86/196
Experience with pertussis in children	9.1	42/464	15.9	49/309	72.7	144/198
Experience with own pertussis infection	6.2	30/486	6.4	20/314	8	16/200
<b>Intention</b>						
To accept pertussis cocooning vaccination	67.3	327/486	53.1	170/320	44.5	89/200

Note: SD, standard deviation; NIP, National Immunization Program.

<sup>a</sup> Higher vocational education or university.

<sup>b</sup> More than €3050 for monthly household income.

<sup>c</sup> Philosophical backgrounds include religion, homeopathy, natural cure, and anthroposophy.

### 3.2. Intention

Sixty-seven percent of the maternity assistants, 53% of the midwives, and 45% of the paediatric nurses intended to accept pertussis vaccination (Table 2). The mean scores on the intention scale (range 1–7) were 5.3 (SD 1.8), 4.5 (SD 2.0), and 4.0 (SD 2.0), respectively.

### 3.3. Determinants of intention

Most participating HCWs considered it their autonomous choice to accept or decline pertussis vaccination (89.5%, 93.4%, and 95.0%, respectively) and said they could get vaccinated if they wanted to (82.9%, 86.4%, and 76%, respectively). However, considerably fewer HCWs had a positive attitude towards pertussis vaccination (55.6%, 28.6%, and 31%, respectively) or thought important others would value the vaccination positively (66.6%, 48.6%, and 41.2%, respectively). Part of the participant HCWs were uncertain about vaccination (24.1%, 28%, and 35%, respectively) and anticipated regret (negative affect) for refusing vaccination if one of their patients contracted pertussis (59.5%, 47.3%, and 36%, respectively).

Univariate logistic regression of the personal determinants showed that acceptance of a previously offered influenza vaccination was associated with the intention to accept pertussis vaccination in the three HCW groups presented here. All the psychosocial determinants, except perceived control–autonomy for the paediatric nurses, were significantly associated with intention (Table 3).

In the multivariate analyses, the attitude of the maternity assistants, midwives, and paediatric nurses, the anticipated affect regarding non-acceptance and decisional uncertainty were uniquely associated with the intention to accept a pertussis vaccination in the three target groups. Previous influenza vaccination, social norm, perceived capacity, and anticipated affect regarding acceptance showed a unique association only for one or two specific groups (Table 4).

### 3.4. Determinants of attitude

Most maternity assistants, midwives, and paediatric nurses classified pertussis in infants as severe (97.9%, 95.6%, and 92%, respectively) and said they would feel very bad if they had infected an infant patient (98.8%, 97.5%, and 98%, respectively). Only some HCWs felt susceptible to pertussis themselves (15.8%, 5.9%, and 8.5%, respectively), although they believed that there was a higher susceptibility for HCWs in their profession in general (25.1%, 29.1%, and 32%, respectively). About half the maternity assistants (46.9%) and midwives (44.9%) felt that hygienic measures would reduce the chance of their transmitting pertussis to an infant versus 25.5% of the paediatric nurses. While 54.4% of the midwives and 51.0% of the paediatric nurses agreed with a policy advising the pertussis vaccination of HCWs with infant contact, 76.1% of the maternity assistants agreed. The participants who felt morally responsible to help prevent patients from contracting pertussis included 71.2% of the maternity assistants, 60.9% of the midwives, and 48.5% of the paediatric nurses.

Univariate linear regression of the determinants of attitude showed that most of these determinants were significantly associated with the attitude towards pertussis cocooning vaccination ( $p < 0.001$  and  $r > 0.3$ ; Appendix 2). In the multivariate analysis, general vaccination beliefs, agreement with policy advice to vaccinate HCWs, perceived cost–benefit ratio, and perceived personal responsibility to prevent pertussis were uniquely associated with the attitude towards pertussis cocooning vaccination of all target groups. Several risk perception determinants, beliefs about general vaccination policy, and the perceived efficacy of cocooning showed a unique association only for one or two of the target groups (Table 5).

## 4. Discussion

The number of HCWs who intended to accept pertussis cocooning vaccination differed among the three target groups in our



**Table 3**  
Univariate logistic regression and Pearson correlation of personal and psychosocial determinants of HCWs' intentions to accept a pertussis cocooning vaccination, including maternity assistants, midwives, and paediatric nurses.

Determinants	Maternity assistants (n = 486)			Midwives (n = 320)			Paediatric nurses (n = 200)		
	OR (95% CI)	p	r	OR (95% CI)	p	r	OR (95% CI)	p	r
<b>Personal determinants</b>									
Age	1.01 (0.99–1.03)	0.410	0.038	1.00 (0.98–1.02)	0.806	−0.014	1.00 (0.97–1.02)	0.729	−0.025
High education	0.78 (0.32–1.93)	0.592	−0.024	n.a. <sup>b</sup>	0.060		0.99 (0.55–1.79)	0.979	−0.002
High income	1.22 (0.60–2.49)	0.587	0.031	1.41 (0.85–2.34)	0.182	0.086	1.23 (0.60–2.52)	0.566	0.048
Years of work experience in healthcare	1.00 (0.98–1.02)	0.896	0.006	1.00 (0.99–1.01)	0.977	−0.027	1.00 (0.97–1.02)	0.858	−0.013
Working > mean hours per week <sup>a</sup>	1.35 (0.91–1.98)	0.133	0.068	0.69 (0.44–1.08)	0.104	−0.092	1.20 (0.69–2.10)	0.516	0.046
Excellent health status	1.64 (1.11–2.42)	0.012	0.114	1.63 (0.94–2.77)	0.083	0.098	1.76 (0.98–3.16)	0.058	0.135
Previous influenza vaccination <sup>c</sup>		<0.001	0.294		<0.001	0.362		<0.001	0.365
Accepted	4.42 (2.71–7.18)			5.78 (3.29–10.16)			4.79 (2.60–8.84)		
Not offered	2.00 (1.17–3.43)			3.31 (1.78–6.18)			1.98 (0.42–9.42)		
Experience with pertussis in adults	1.99 (1.18–3.35)	0.009	0.123	1.45 (0.88–2.38)	0.146	0.083	1.71 (0.97–3.03)	0.065	0.132
Experience with pertussis in children	0.96 (0.49–1.89)	0.909	−0.005	0.92 (0.50–1.70)	0.791	−0.015	0.60 (0.32–1.12)	0.110	−0.114
<b>Psychosocial determinants</b>									
Attitude	16.30 (9.39–28.29)	<0.001	0.746	17.92 (9.31–34.50)	<0.001	0.729	17.74 (7.85–40.09)	<0.001	0.755
Social norm	3.53 (2.63–4.75)	<0.001	0.599	5.07 (3.43–7.50)	<0.001	0.655	4.06 (2.62–6.28)	<0.001	0.580
Perceived capacity	2.20 (1.83–2.65)	<0.001	0.439	2.56 (1.94–3.38)	<0.001	0.415	1.63 (1.29–2.08)	<0.001	0.294
Perceived autonomy	0.41 (0.19–0.86)	0.018	−0.110	0.25 (0.08–0.75)	0.013	−0.149	0.33 (0.08–1.30)	0.111	−0.118
Anticipated effect									
Non-acceptance	2.19 (1.85–2.58)	<0.001	0.477	2.22 (1.83–2.68)	<0.001	0.517	2.20 (1.73–2.80)	<0.001	0.510
Acceptance	0.21 (0.16–0.28)	<0.001	−0.652	0.09 (0.05–0.16)	<0.001	−0.665	0.19 (0.12–0.30)	<0.001	−0.625
Decisional uncertainty	0.41 (0.34–0.48)	<0.001	−0.589	0.50 (0.42–0.59)	<0.001	−0.507	0.60 (0.50–0.73)	<0.001	−0.386

<sup>a</sup> Mean working hours per week for maternity assistants was 20 h; midwives, 36 h; paediatric nurses, 26 h.

<sup>b</sup> All midwives were highly educated as this is required for their profession.

<sup>c</sup> Categorical variable, therefore correlation was measured with Cramer's V. Non-acceptance is the control variable.

**Table 4**  
Multivariate logistic regression of personal and psychosocial determinants of HCWs' intention to accept a pertussis cocooning vaccination, including maternity assistants, midwives, and paediatric nurses.

Determinants in the final model	Maternity assistants <sup>a</sup>		Midwives <sup>b</sup>		Paediatric nurses <sup>c</sup>	
	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
<b>Personal determinants</b>						
Previous influenza vaccination <sup>d</sup>				0.008		
Accepted			5.08 (1.65–15.67)			
Not offered			4.85 (1.45–16.22)			
<b>Psychosocial determinants</b>						
Attitude	7.37 (3.70–14.67)	<0.001	5.48 (2.56–11.73)	<0.001	9.19 (3.80–22.23)	<0.001
Social norm	1.62 (1.07–2.47)	0.023			1.66 (1.01–2.75)	0.046
Perceived capacity	1.55 (1.04–2.33)	0.032	2.04 (1.18–3.51)	0.011		
Anticipated effect						
Non-acceptance	1.64 (1.14–2.37)	0.008	1.52 (1.08–2.14)	0.017	1.64 (1.02–2.63)	0.042
Acceptance			0.28 (0.13–0.57)	0.001		
Decisional uncertainty	0.35 (0.23–0.52)	<0.001	0.48 (0.33–0.71)	<0.001	0.42 (0.23–0.75)	0.004

<sup>a</sup> n = 401 (85 missing), pseudo R<sup>2</sup> = 0.84.

<sup>b</sup> n = 301 (19 missing), pseudo R<sup>2</sup> = 0.82.

<sup>c</sup> n = 182 (18 missing), pseudo R<sup>2</sup> = 0.82.

<sup>d</sup> Categorical variable, non-acceptance is a control variable.

study. The determinants influencing the intentions of all groups to accept vaccination include attitude, anticipated affect regarding non-acceptance, and decisional uncertainty. Social norm, perceived capacity, anticipated negative affect regarding acceptance, and previous acceptance of influenza vaccination influenced the intentions in one or two groups. The HCWs' attitude toward pertussis cocooning vaccination in all groups was further explained by general vaccination beliefs, agreement with policy advice to vaccinate HCWs, perceived cost-benefit ratio, and perceived personal responsibility to prevent pertussis.

#### 4.1. Intention

The intention rates in this study might be considered low. Considering the well-known intention-behaviour gap would make the actual uptake in this population even lower [38].

Only a few previous studies describe HCWs' intention to accept a pertussis vaccination. The results range from 15% to 76% [39–41]. The intention to accept a pertussis vaccination in this study is comparable to the reported actual acceptance in most studies coming from countries where a HCW pertussis booster is recommended and voluntary (range 46%–75%) [17,20–22,25,26]. Few studies report a lower vaccination uptake (range 11%–30%) [23,24]. However, one has recently reported a high uptake over 85% [18], which could be credited to the specific timing of the pertussis campaign: it took place during a local pertussis outbreak.

Previous studies of pertussis cocooning acceptance report differences in vaccination uptake among HCWs. These studies show that the acceptance rate of pertussis cocooning vaccination is generally lower among nurses than other HCWs [17,24,26,42]. This correlates with our data. To our knowledge, only Guthmann's study [24] reports the pertussis vaccination coverage among midwives; namely, 43.8%, comparable to the 53% in this study.

**Table 5**

Multivariate linear regression analysis of the determinants of HCWs' attitudes to pertussis cocooning vaccination including maternity assistants, midwives, and paediatric nurses.

Determinants in the final model	Maternity assistants <sup>a</sup>		Midwives <sup>b</sup>		Paediatric nurses <sup>c</sup>	
	$\beta$ (95% CI)	p	$\beta$ (95% CI)	p	$\beta$ (95% CI)	p
<b>Risk perception</b>						
Susceptibility of child	0.76 (0.36–0.116)	<0.001	0.07 (0.01–0.13)	0.029		
Susceptibility of professionals					0.12 (0.06–0.17)	<0.001
Susceptibility to side effects	–0.11 (–0.18 to –0.04)	0.002				
Severity of side effects	–0.05 (–0.09 to –0.01)	0.026			–0.09 (–0.17 to –0.01)	0.023
General vaccination beliefs	0.18 (0.11–0.25)	<0.001	0.25 (0.18–0.32)	<0.001	0.30 (0.20–0.40)	<0.001
<b>Beliefs about vaccination policy</b>						
Importance of following governmental advice	0.16 (0.10–0.21)	<0.001			0.15 (0.08–0.23)	<0.001
<b>Beliefs about pertussis policy</b>						
Agreement with pertussis policy	0.22 (0.13–0.31)	<0.001	0.38 (0.25–0.51)	<0.001	0.22 (0.08–0.36)	0.002
<b>Outcome expectations</b>						
Perceived efficacy for patients	0.08 (0.01–0.15)	0.035				
Perceived cost-benefit	0.10 (0.05–0.16)	<0.001	0.18 (0.11–0.26)	<0.001	0.16 (0.07–0.25)	<0.001
<b>Moral norm</b>						
Responsibility	0.29 (0.21–0.37)	<0.001	0.16 (0.06–0.25)	0.001	0.15 (0.05–0.25)	0.004

<sup>a</sup> n = 486 (0 missing), R<sup>2</sup> = 0.82.<sup>b</sup> n = 317 (3 missing), R<sup>2</sup> = 0.79.<sup>c</sup> n = 200 (0 missing), R<sup>2</sup> = 0.78.

Notably, HCWs' acceptance of pertussis cocooning has only been described for HCWs who work in hospitals, whereas most maternity assistants and midwives in our study work outside the hospital.

#### 4.2. Determinants of intention

Several vaccination acceptance studies in different settings for various vaccines show that attitude, social norm, and perceived capacity (or self-efficacy) are important predictors of the intention to accept vaccination [43–46]. This agrees with our findings. In studies of HCWs' acceptance of pertussis cocooning, previous acceptance of influenza vaccination and perceived recommendation (by national or local authorities) are apparently common determinants that are also reflected in our potential determinants of intention [18,21,23,25]. In our study, the association between previous influenza vaccination and intention was only significant for the midwives. Perceived recommendation can be understood as part of the social norm, which correlates with our study.

Anticipated regret or negative affect (especially regarding non-acceptance) has been considered a determinant of vaccination behaviour [47,48]. The additional value of anticipated negative affect these studies suggested agrees with our study.

We added decisional uncertainty as a determinant because of the profound influence it showed in our previous qualitative research. To our knowledge, no other studies have considered decisional uncertainty as a determinant, but the difficulty of deciding whether to accept vaccination has been described previously [49]. Peadon et al. [26] state that non-acceptors of pertussis vaccination need more information for their decision. The finding that decisional uncertainty is uniquely associated with the intention to accept in this study matches our previous study [33]. This aligns with studies assessing the effect of decision aids on vaccination, which showed a reduction of decisional conflict and an increase in uptake. [50,51] The decisional uncertainty in HCWs regarding their own vaccinations raises concerns on how this possibly impacts their role in promoting vaccination among their patients, such as new parents making vaccination decisions for their children.

In all our target groups, attitude, anticipated negative affect regarding non-acceptance (regret), and decisional uncertainty were significantly associated with intention. Social norm, per-

ceived capacity, and anticipated affect regarding acceptance were only significantly associated with intention in a specific target group. First, social norm only showed a significant association for maternity assistants and paediatric nurses, not for midwives. It could be argued that the autonomous practice of independent midwives contributed to this finding. Second, perceived capacity did not influence the paediatric nurses. These nurses might be used to the organization of work-related vaccinations in their hospitals and therefore see fewer constraints in this respect. Third, anticipated negative affect regarding acceptance only appeared for midwives. This matches and is potentially explained by our finding that midwives were more likely to have a specific philosophical background.

#### 4.3. Determinants of attitude

The risk perception (or fear) of side effects and professionals' perceived susceptibility to pertussis are frequently described regarding HCWs' acceptance of pertussis cocooning vaccination [18,19,26,52]. This correlates with our study, where these aspects of risk perception showed a unique association with the attitudes of maternity assistants and paediatric nurses. The perceived susceptibility of a child to pertussis significantly influenced midwives' attitude toward pertussis cocooning vaccination. Paranthaman also recently described this aspect of risk perception as a determinant of acceptance [18].

In our study, "general vaccination beliefs" consist of items about critical vaccination beliefs, consideration, and naturalistic beliefs. Studies in other vaccination settings have described parts of this determinant. Harmsen [53] describes the influence of deliberate choice and disease beliefs on the acceptance of the National Immunization Program. These items seem identical to our items about consideration and naturalistic beliefs.

In our study, trust in government was reflected in the general beliefs about vaccination policy and showed an independent association with the attitudes of maternity assistants and paediatric nurses. Trust issues were previously presented as determinants of pertussis cocooning acceptance [22,42], and they are important in the broader literature about vaccination acceptance [54–56].

To our knowledge, agreement with vaccination policy and perceived cost-benefit have neither been described as determinants of pertussis vaccination acceptance nor as determinants of accep-

tance in other vaccination settings. In our study, these factors are uniquely associated with attitude in the three target groups. The perceived efficacy of pertussis cocooning was previously described as a determinant of parents' and HCWs' acceptance of pertussis cocooning [25]. However, this shows significant association only with attitude for the maternity assistants here.

Responsibility reflects the beliefs that express a moral responsibility towards patients to accept a vaccination for preventing pertussis transmission and a notion that acceptance of pertussis cocooning vaccination is part of their professional role. Previously, ethicists presented this line of thinking as an argument in the discussion of mandatory-versus-voluntary vaccination [57,58]. Such responsibility has not been described in the literature about determinants of vaccination acceptance. However, some studies indicate that a key reason for HCWs to accept a pertussis cocooning vaccination is to protect their patients [18,19,25,59]. This resembles the responsibility described here.

#### 4.4. Strengths and limitations

This article presents a complete set of determinants within a robust theoretical framework and is based on the questionnaire results of a high number of respondents (1006 in total). Similarly to our previous study of determinants of parents' acceptance of pertussis cocooning, we used an extensive questionnaire based on our previous qualitative study, the literature, and theory [31,33]. Although our HCW groups showed some result variance, the theoretical framework again shows a good fit.

This study has some limitations. We note that some determinants were measured with one item, which could have reduced measurement specificity. At the time of the study, pertussis cocooning vaccination for HCWs was under review for regular care and was not being recommended. Our choice to include specific HCW target groups was not extensive. Given the differences among our HCW groups, this might limit the representativeness for other specific HCW groups who work with infants, such as paediatricians. Furthermore, this study is performed in the Dutch healthcare system, which might limit the generalisability of the findings to other healthcare systems where especially maternity assistants and midwives have different professional roles.

Another limitation is a potential response bias. The HCWs who returned the questionnaire were possibly the HCWs with the most distinct opinions about vaccination. An indication for some selection might be that the midwives who declined vaccination in the National Immunization Program for their own children were over-represented (21.4% versus around 5% in the general Dutch population [36]) and that a relatively high number of HCWs indicated to be influenced by a specific philosophical background (11.7% for the maternity assistants, 16.3% for the midwives, and 13% for the paediatric nurses, compared to 8.2% in the general population [37]). This potential response bias might influence the generalisability of the presented frequencies. However, it should not have any effect on the relation between determinants and outcome measures, which was the main aim of our study, particularly because of the high number of total participants (1006) in this study.

## 5. Conclusion

We conclude that about half our HCWs intended to accept a pertussis cocooning vaccination, but the intention rate varied among the HCW groups. Attitude, anticipated affect regarding non-acceptance, and decisional uncertainty were the most important determinants of intention. Attitude was further explained by their general vaccination beliefs, agreement with a policy advice to vaccinate HCWs, the perceived cost-benefit ratio, and the per-

ceived personal responsibility to prevent pertussis in patients. This study helps build the evidence base describing determinants of HCWs' intention to accept a pertussis cocooning vaccination. Along with country-specific factors, such as costs and logistical barriers, this is essential information for designing an effective vaccination program. Furthermore, it provides a robust framework for these determinants, which could also apply in other vaccination contexts.

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## Conflict of interest

All authors state that there are no known conflicts of interest associated with this publication.

## Authorship and manuscript preparation

OV, JH, MH and KV conceptualized and designed the study. OV and LK designed the questionnaire, collected the data and started with data analysis. OV further analyzed the data and drafted and revised the manuscript. RA was the statistical expert who supervised and approved the analyses. RR was the expert on behavioural theories who supervised and approved the theoretical framework and advised on the analyses. KV, MH and JH coordinated and supervised data collection and analysis. All authors critically revised the manuscript and approved the final manuscript as submitted.

## Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.vaccine.2017.12.021>.

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