Maternal Immunization – implementation challenges, Canadian solutions

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THE UNIVERSITY OF BRITISH COLUMBIA

Faculty of Medicine

Vaccine Evaluation Center

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CAIRE
Canadian Association for Immunization Research, Evaluation and Education
Association Canadienne pour la recherche, l'évaluation et l'éducation en immunisation

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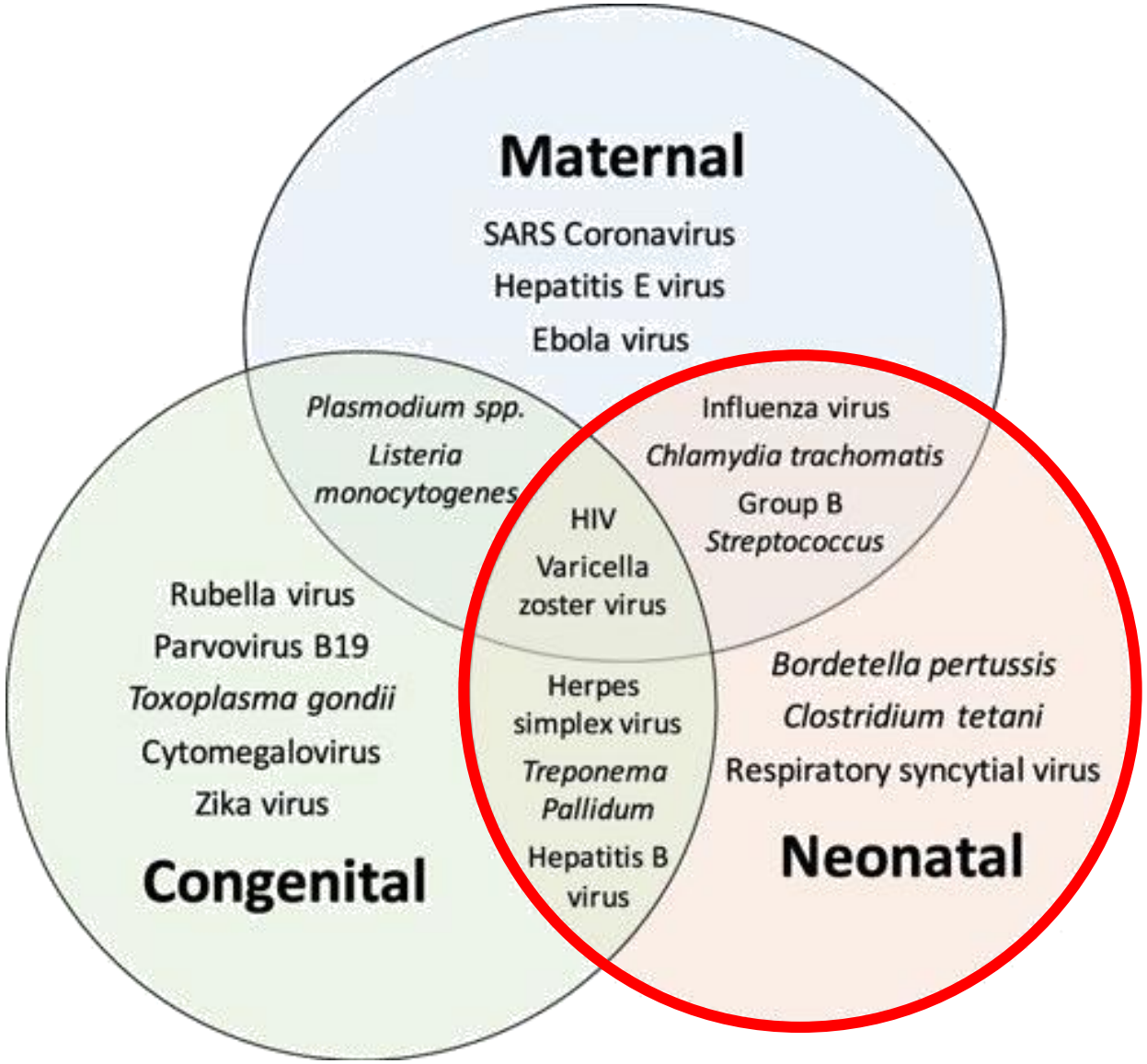
Objectives

- Know which vaccines are/will be available for immunization in pregnancy
- Be familiar with existing data for safety and effectiveness of immunization in pregnancy
- Understand the current gaps in safety and/or effectiveness data, and how these create implementation challenges
- Appreciate issues around acceptability and feasibility of maternal immunization programs for patients and healthcare professionals

Outline

- Overview of immunization in pregnancy
- Influenza
- Pertussis
- Acceptability and feasibility
- Current gaps and implementation challenges

The scope of maternal immunization

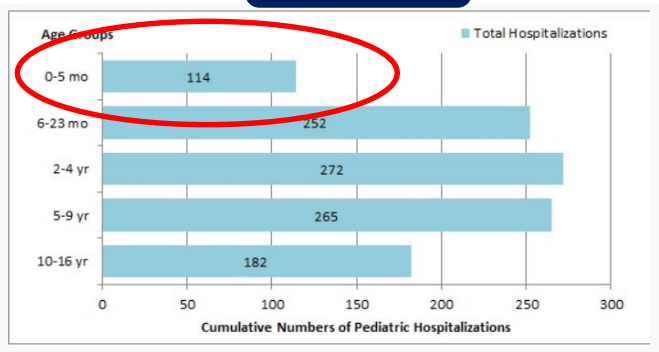


Pathogen Category	Goal of Vaccination	Optimal Timing of Vaccination
Maternal	Prevent maternal infection/disease	PRIOR to or DURING pregnancy
Congenital	Prevent fetal infection/disease	PRIOR to pregnancy
Neonatal	Prevent neonatal infection/disease	DURING pregnancy

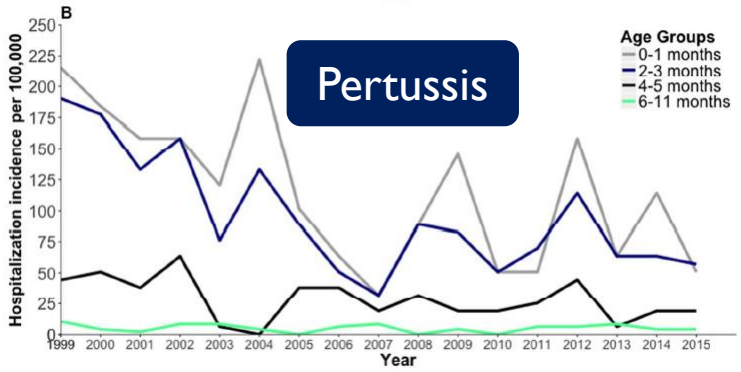
Vermillion & Klein. npj Vaccines 2018

The challenge of protecting infants

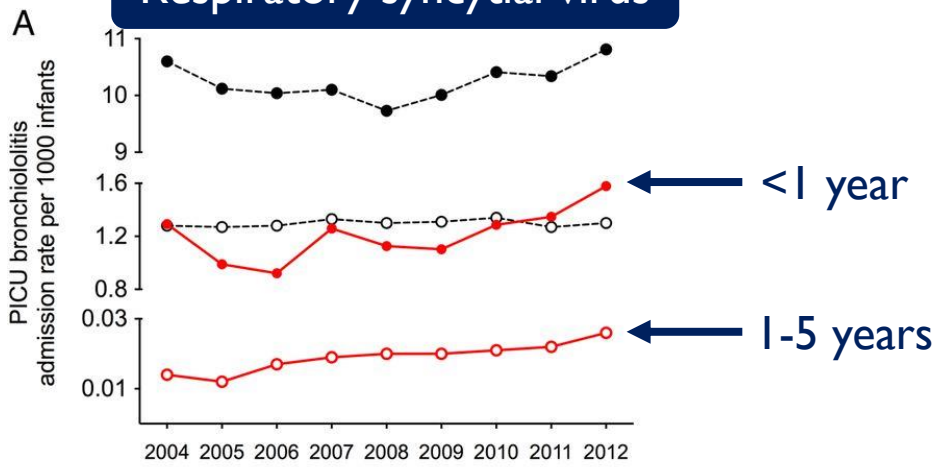
Influenza



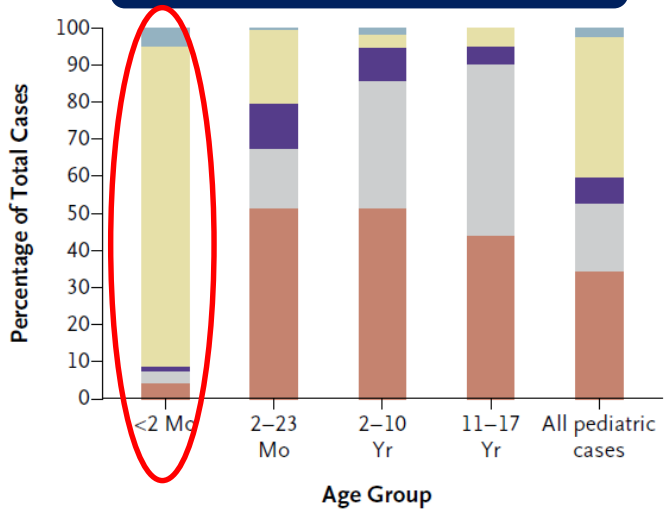
Pertussis



Respiratory syncytial virus



Group B Streptococcus



Green et al. Arch Dis Child 2016; Thigpen et al. NEJM 2011
PHAC FluWatch Report
Abu Raya et al. JPIDS 2018 in press

Every pathogen is different

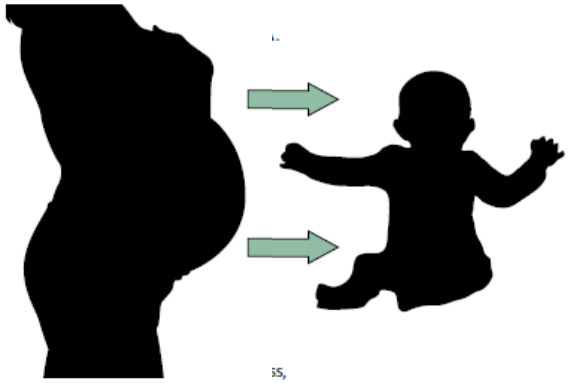
	Pertussis	Influenza	Group B streptococcus	Respiratory syncytial virus
Maternal disease risk	+	+++	++	+
Infant mortality	++	+	+++	++
Infant disease frequency	+ (cyclic*)	++	+	+++
Disease seasonality	✓	✓	×	✓
Microbial diversity	+	++	++	+
Licensed vaccine available	✓	✓	×	×
Maternal booster response expected†	✓	Partial‡	Not assumed	✓
Passive protection of infant	✓	✓	✓	✓
Maternal to cord antibody ratio	1·1–1·9	0·7–1·0	0·7–0·8	1·0
Antibody half-life (days)	36–40	40–50	30–44	36–79
Infant vaccination	✓	≥6 months	×	(✓)§
Correlate of protection	×	Partial¶	×	×
Functional immunoassay	×	✓	||	✓
Competing control option	×	×	✓**	✓††

+=low. ++=medium. +++=high. *Increased disease incidence usually occurs every 3–4 years. †Via previous vaccination or infection. ‡Previous vaccination or infection will lead to partial protection due to virus evolution. §Monoclonal antibody administered to high-risk infants during respiratory syncytial virus season. ¶Correlates of protection based on haemagglutinin inhibition assay or microneutralisation titres have not been validated in young infants and are not based on maternal immunisation. ||Bacterial killing in an opsonophagocytic assay has been suggested as a possible correlate of protection. **Intrapartum antibiotic prophylaxis has reduced the incidence of early onset group B streptococcus neonatal sepsis. ††Monoclonal antibodies administered to high risk infants during respiratory syncytial virus season reduces rates of hospital admission.

Table: Targets of maternal immunisation

Marchant, Sadarangani et al.
Lancet Inf Dis 2017

Goals of immunization in pregnancy



Heath et al. Lancet Inf Dis 2017

- Temporary protection of the young infant against
  - Severe illness and death
- Via
  - Passive transplacental transfer of maternal IgG
  - Transfer of breast milk immune factors
  - Reduction of carriage/disease in the mother
  - ?Induction of immune responses in the fetus
- Until
  - High risk period has elapsed (e.g. Group B Streptococcus) and/or
  - Infant immunization provides protection (e.g. pertussis)
- Without adverse effect on infant immunity

Which vaccines?

- Specifically recommended during pregnancy
  - Influenza
  - Tetanus-diphtheria-acellular pertussis (Tdap)

- Consider if indicated
  - Hepatitis B
  - Hepatitis A (post-exposure prophylaxis, travel)
  - Meningococcal conjugate (post-exposure prophylaxis, travel)
  - Pneumoccoccal conjugate or polysaccharide

Influenza is worse in pregnancy

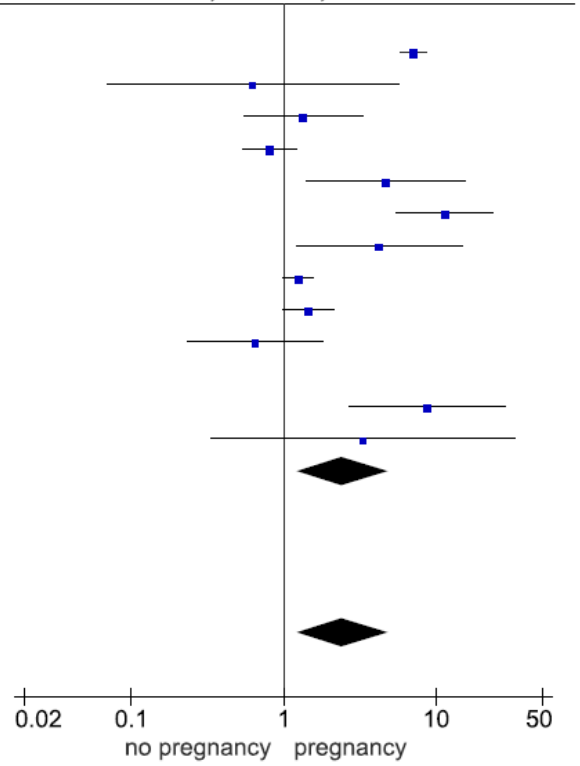
- 152 studies
- Individual level data on >300,000 subjects

Pregnancy as a risk factor for severe outcomes from influenza virus infection: A systematic review and meta-analysis of observational studies

Dominik Mertz [a,b,c,d], Johanna Geraci [e], Judi Winkup [b], Bradford D. Gessner [f], Justin R. Ortiz [g], Mark Loeb [b,c,d,*]

- ↑ hospitalization in pregnant women with influenza

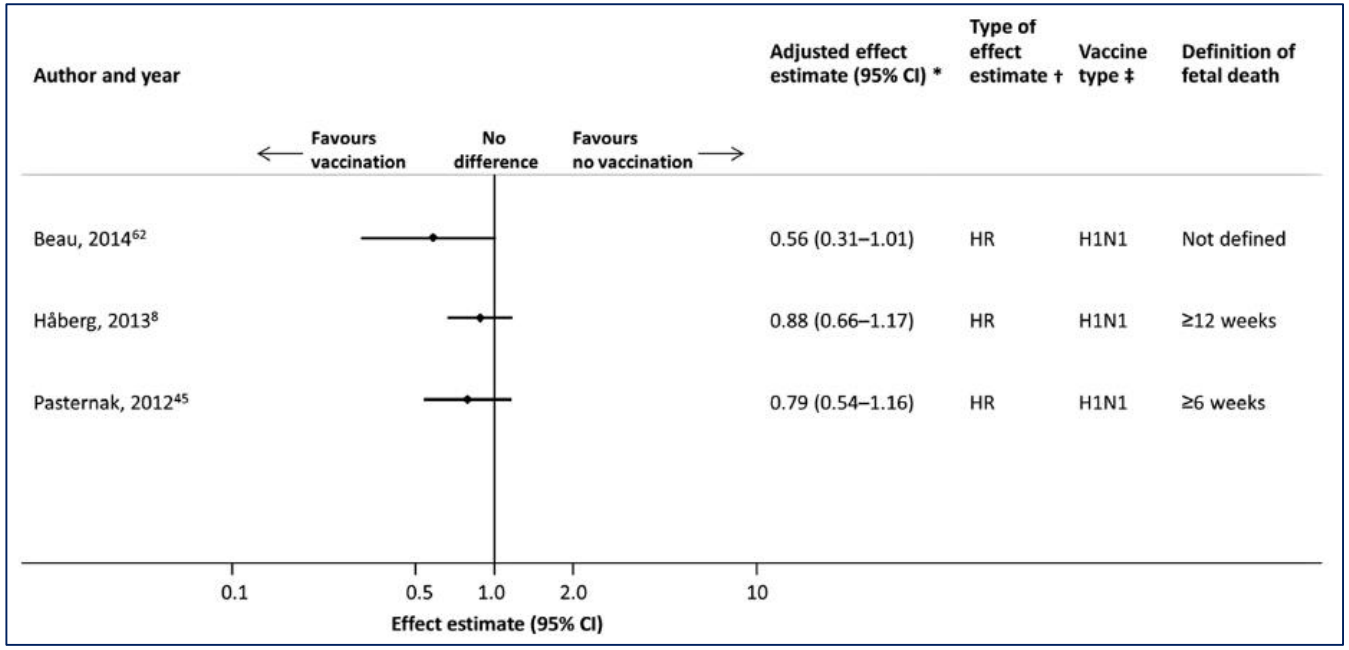
Study or Subgroup	pregnancy Events	Total	no pregnancy Events	Total	Weight	Odds Ratio M-H, Random, 95% CI
46.3.1 Community						
Buda 2010	138	514	5933	120030	10.2%	7.06 [5.80, 8.59]
Echavarria 2010	1	5	77	270	5.0%	0.63 [0.07, 5.70]
Gilca 2011	10	20	157	367	8.8%	1.34 [0.54, 3.29]
Gonzales-Candelas 2011	46	102	653	1300	9.9%	0.81 [0.54, 1.22]
Harris 2010	9	14	22	79	7.9%	4.66 [1.41, 15.47]
Jamieson 2009	11	34	218	5435	9.2%	11.45 [5.51, 23.78]
Kwan-Gett 2009	4	11	66	554	7.7%	4.23 [1.20, 14.82]
Lenzi 2012a	162	352	884	2175	10.2%	1.25 [0.99, 1.56]
Orellano 2010	87	124	4171	6742	10.0%	1.45 [0.98, 2.14]
Poeppl 2011	8	15	335	525	8.4%	0.65 [0.23, 1.82]
Poggensee 2010	25	160	527	16957		Not estimable
Sevencan 2011	12	18	11	59	7.9%	8.73 [2.68, 28.37]
Vasoo 2010	3	4	45	95	4.8%	3.33 [0.33, 33.20]
Subtotal (95% CI)		**1213**		**137631**	**100.0%**	**2.44 [1.22, 4.87]**
Total events	491		12572			
Heterogeneity: Tau² = 1.21; Chi² = 229.19, df = 11 (P < 0.00001); I² = 95%						
Test for overall effect: Z = 2.52 (P = 0.01)						
Total (95% CI)		**1213**		**137631**	**100.0%**	**2.44 [1.22, 4.87]**
Total events	491		12572			
Heterogeneity: Tau² = 1.21; Chi² = 229.19, df = 11 (P < 0.00001); I² = 95%						
Test for overall effect: Z = 2.52 (P = 0.01)						
Test for subgroup differences: Not applicable						



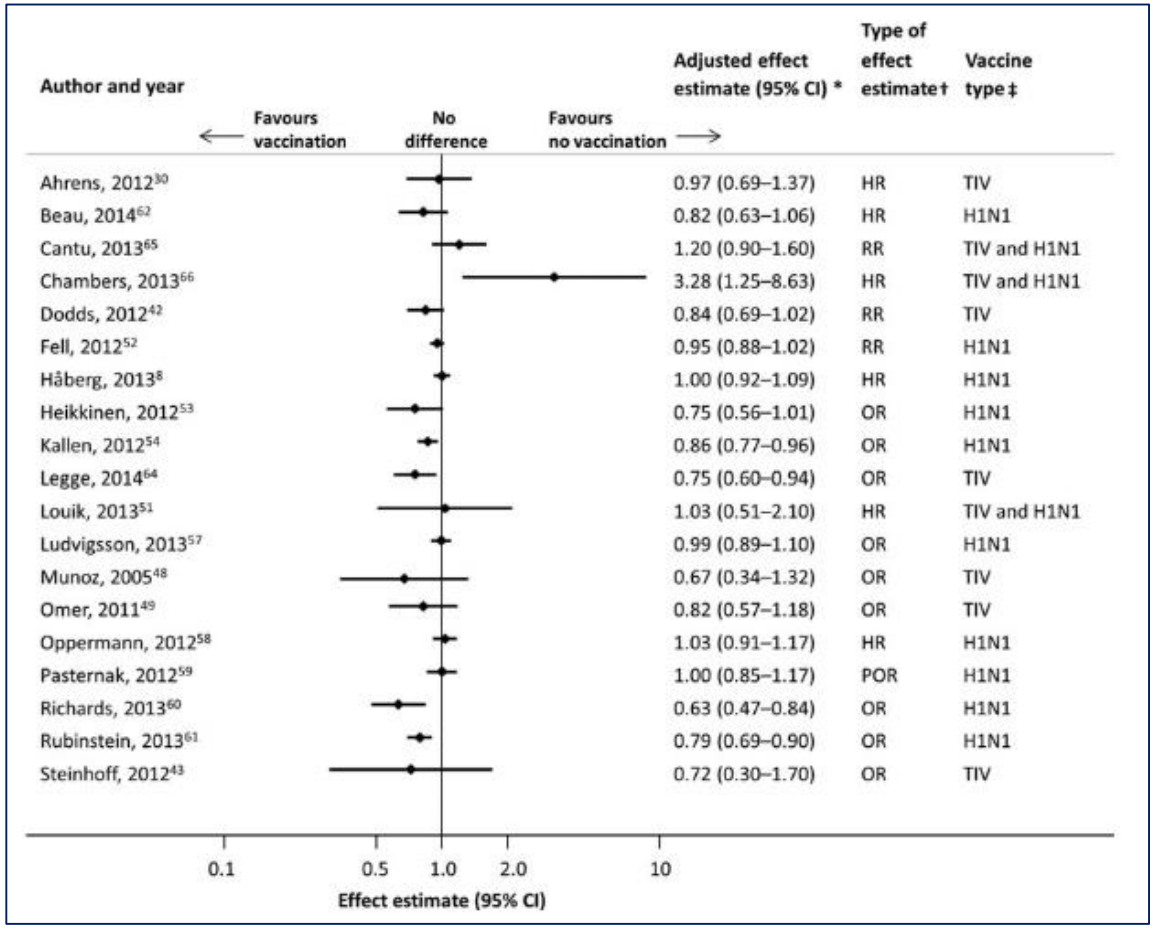
Is influenza vaccine in pregnancy safe?

- Fell et al. BJOG 2015
  - 1 RCT, 26 observational studies

Fetal death



Preterm birth



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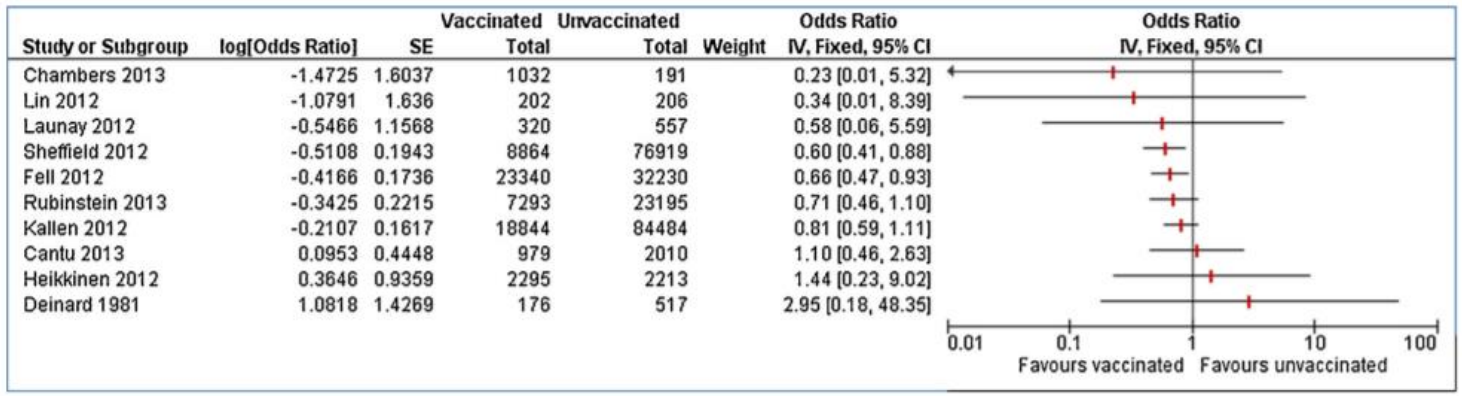
- McMillan et al. Vaccine 2015
  - 19 observational studies

Congenital malformations

Study	Design	Composition	Adjuvant	Type	Vaccine group	Control group	Effect estimate subtotals (95% CI)
All malformation							
Opperman et al. [10]	Prospective	Mono H1N1	Non-adj or AS03	Split-virion	321	1198	OR 0.92 (0.58 to 1.46)
Heikkinen et al. [12]	Mixed	Mono H1N1	MF-59	Subunit	2295	2213	OR 1.33 (0.88 to 2.00)
Mackenzie et al. [27]	Prospective	Mono H1N1	AS03	Split-virion	97	13	OR 1.60 (0.08 to 30.70)†
Rubinstein et al. [21]	Cross section	Mono H1N1	MF-59	Subunit	7293	23195	OR 0.81 (0.55 to 1.19)⌘†
Deinard [9]	Prospective	Mono Hsw1N1	Unspecified	Split or whole	176	517	OR 0.58 (0.32 to 1.06)¤†
Munoz et al. [25]	Retrospective	TIV	Unspecified	Unspecified	225	825	OR 0.12 (0.01 to 1.95)¤†
Major malformation							
Opperman et al. [10]	Prospective	Mono H1N1	Non-adj or AS03	Split-virion	321	1198	OR 1.11 (0.51 to 2.42)
Launay et al. [24]	Prospective	Mono H1N1	Non-adjuvant	Split-virion	320	557	OR 2.34 (0.52 to 10.51)†
Sheffield et al. [19]	Retrospective	TIV	Unspecified	Unspecified	8425	76919	OR 1.01 (0.84 to 1.22)¶¥

Fetal death



Is influenza vaccine in pregnancy safe?

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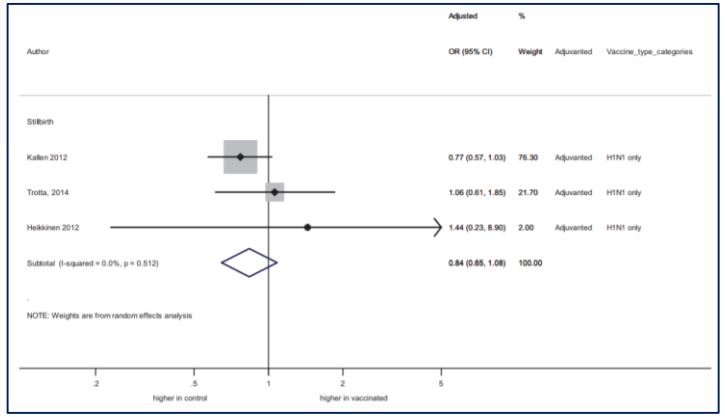
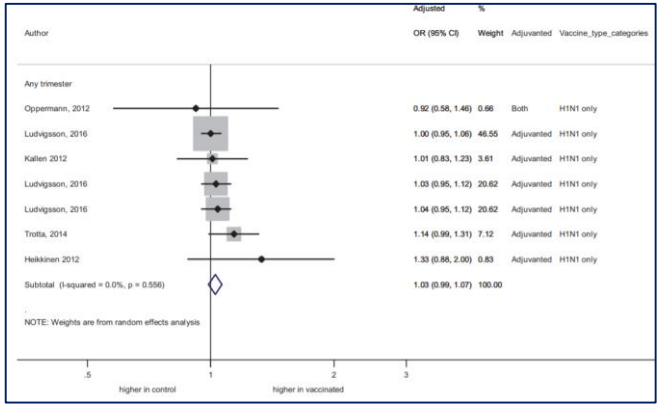
- Giles et al. Human Vacc Immunother 2018
  - 40 studies

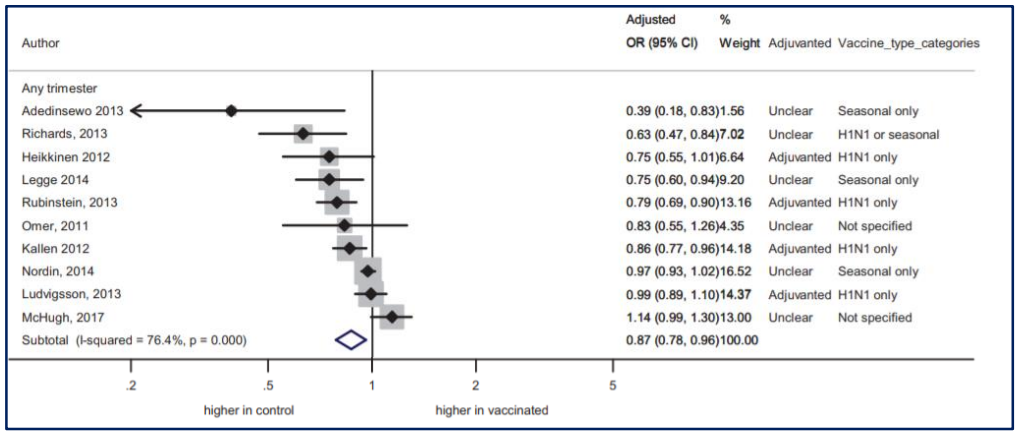
Fetal death



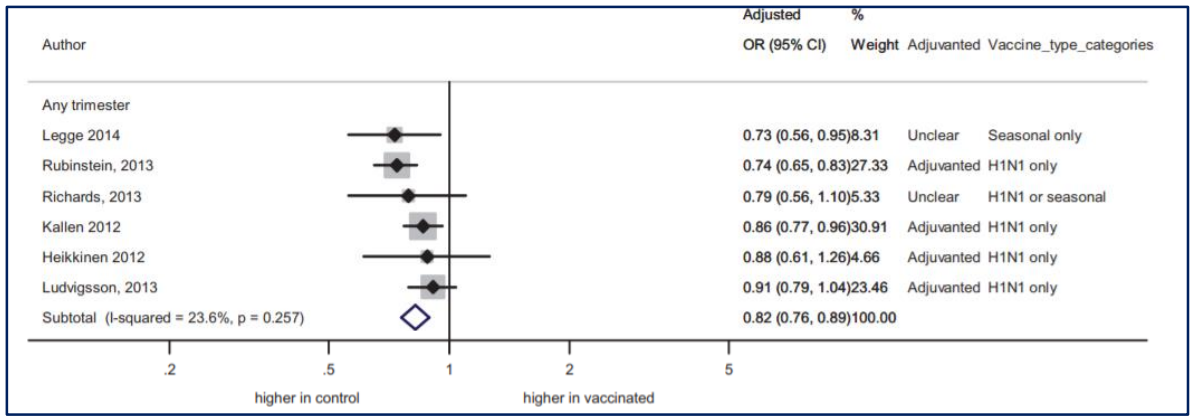
Congenital malformations



Preterm birth



Low birth weight



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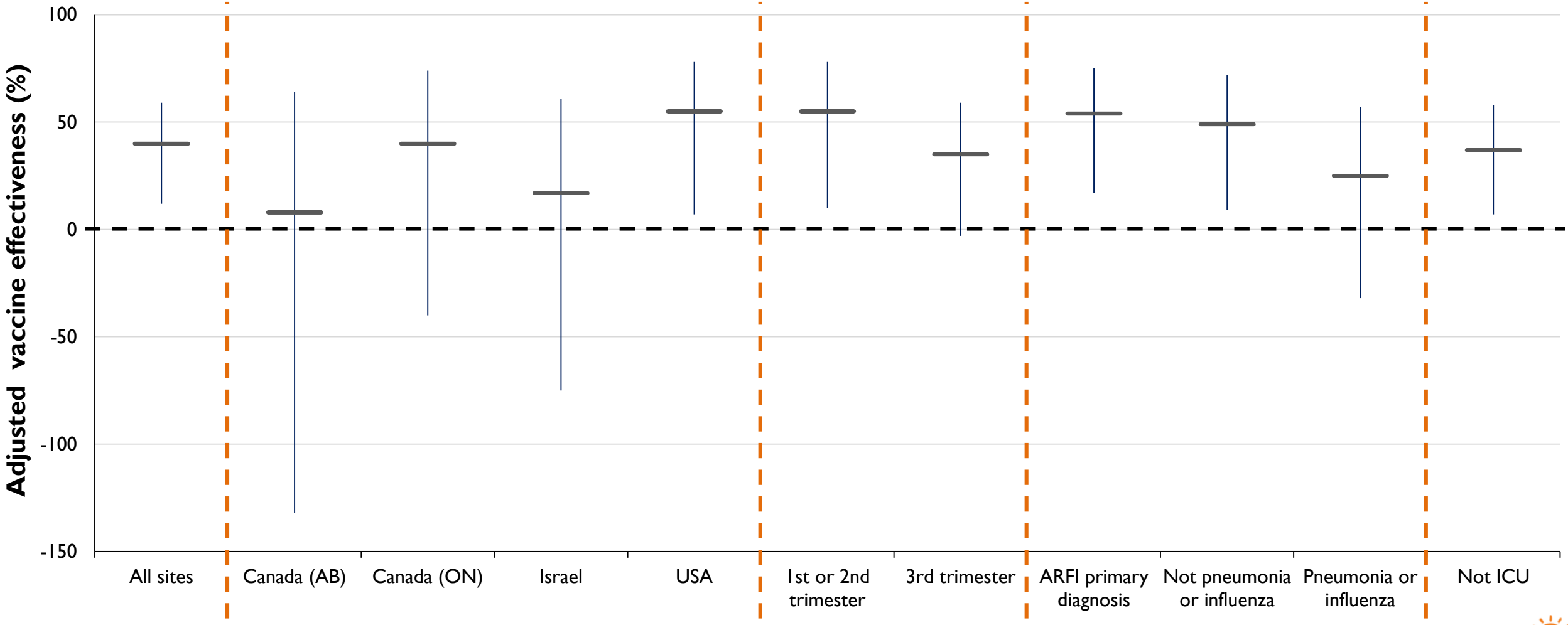
- Giles et al. Human Vacc Immunother 2018
  - 40 studies
- Fell et al. Vaccine 2015
  - Mixed evidence suggesting reduced risk of adverse birth outcomes
  - Mainly retrospective observational studies
  - No evidence of harm

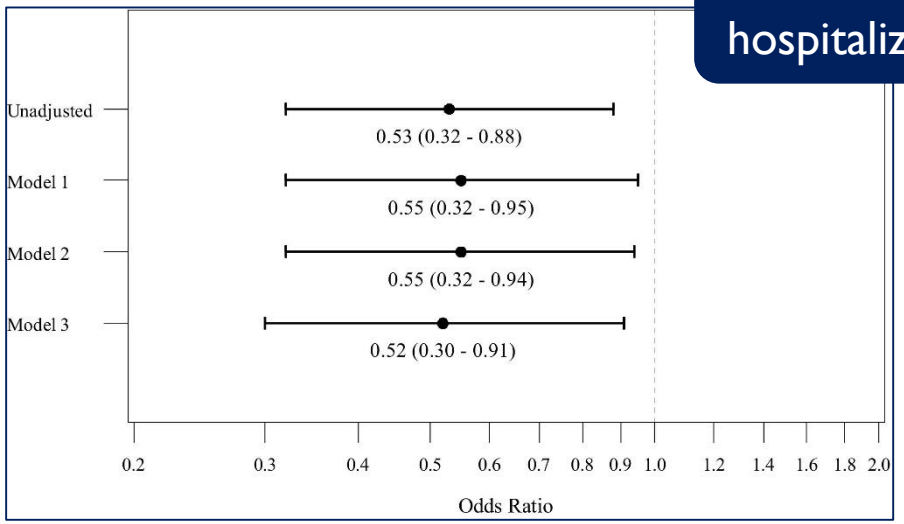
Does influenza vaccine work in pregnancy?



Thompson et al. Clin Inf Dis 2018

What about the infants?

Lab-confirmed hospitalizations



Poehlling et al. Am J Obst Gyn 2011

Measure	Subjects aged <6 months	Subjects aged ⩾6 months
No. (%) of case infants; no. (%) of control infants		
Mother was vaccinated	2 (2.2); 31 (19.9)	1 (4.6); 2 (5.6)
Mother was not vaccinated	89 (97.8); 125 (80.1)	21 (95.5); 34 (94.4)
Vaccine effectiveness (95% CI), %		
Unadjusted	90.7 (59.9–97.8)[a]	−41.4 (−2257.3 to 91.5)[b]
Adjusted[c]	91.5 (61.7–98.1)[a]	…

NOTE. CI, confidence interval.

[a] $P = .001$.

[b] $P = .809$.

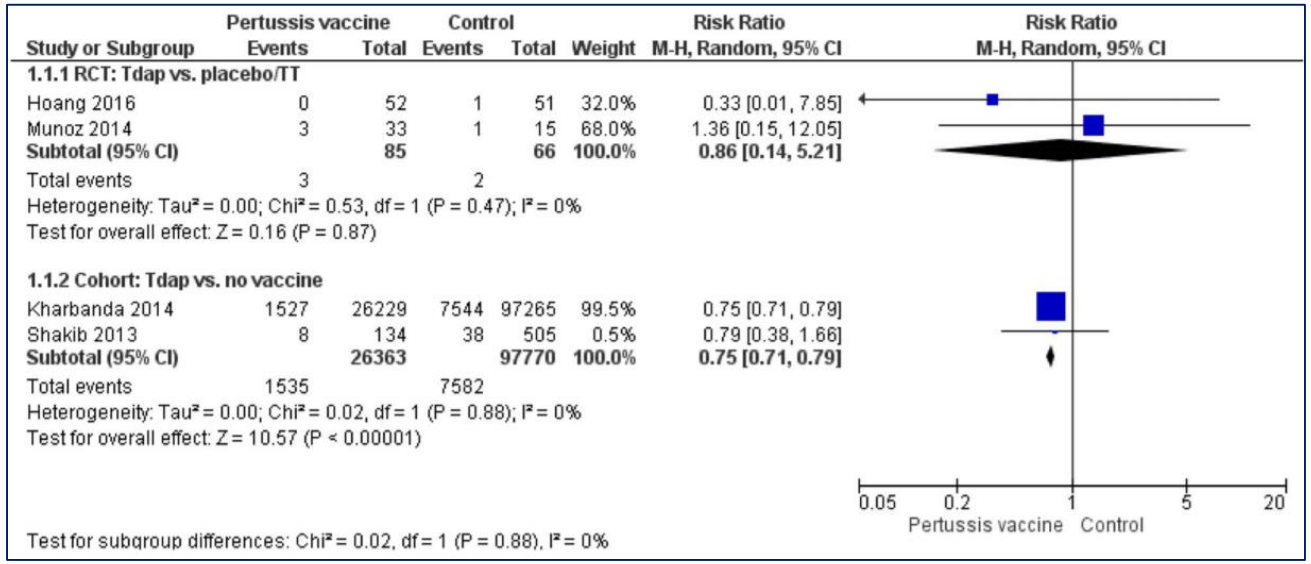
[c] The adjusted model for subjects aged <6 months retained vaccination of household contacts and prematurity.

Benowitz et al. Clin Inf Dis 2010

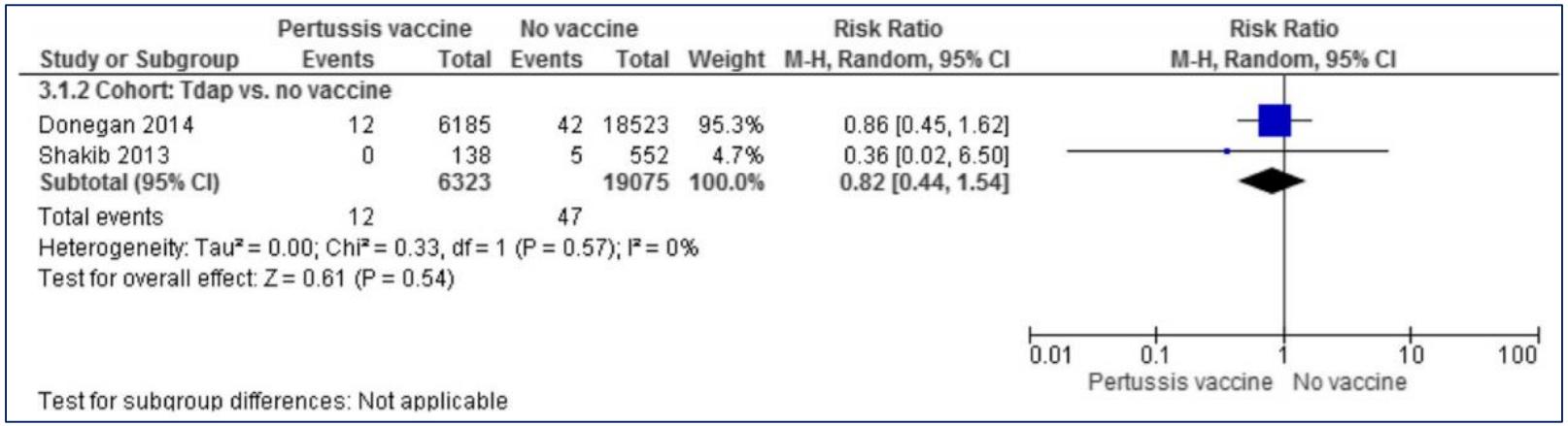
Pertussis in pregnancy - safety

- Furuta et al. BMC Preg Childbirth 2017
  - 15 studies

Preterm birth



Stillbirth



Pertussis immunization in pregnancy works

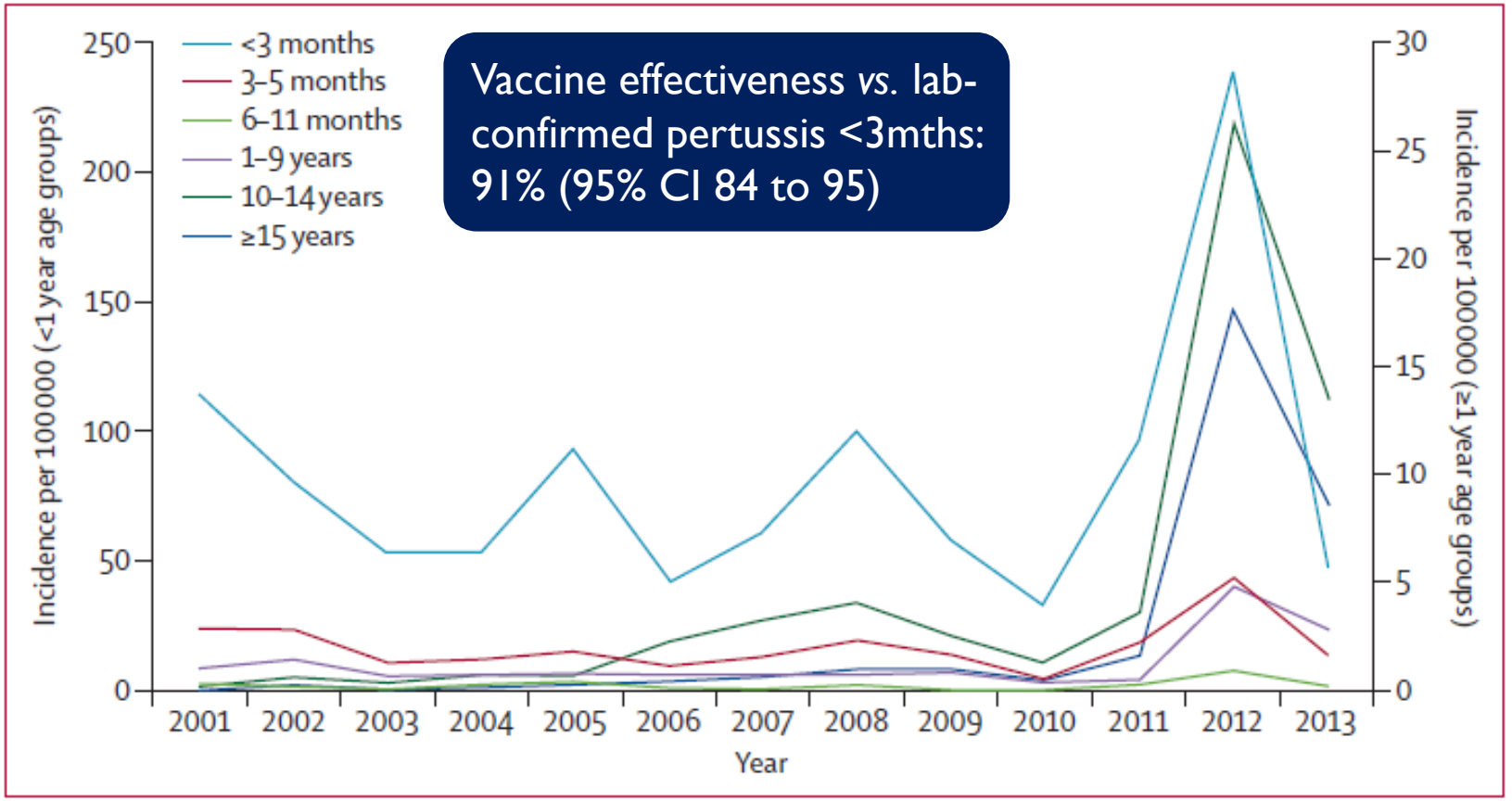


Figure 2: **Annual incidence of laboratory-confirmed cases of pertussis by age group**
Figure shows incidence from 2001 to 2013 in England only.

Amirthalingam et al. Lancet (2014)

Pertussis immunization in pregnancy works

Table 3. Maternal Pertussis Vaccine Effectiveness Estimates, by Timing of Vaccination

Timing of Vaccination	Cases Vaccinated/Total	Average Matched Coverage	VE (95% CI)
28 d before delivery	31/229	64.1%	91% (88–94)
7–27 d before delivery	4/213	16.2%	91% (80–96)
0–6 d before or 1–13 d after delivery	3/179	2.7%	43% (–35 to 76)

Abbreviations: CI, confidence interval; VE, vaccine effectiveness.

Table 4. Maternal Pertussis Vaccine Effectiveness, by Vaccine Product

Vaccine	Cases Vaccinated/ Total	Average Matched Coverage	VE (95% CI)	VE Reducing Coverage by Relative 20% (95% CI)
dT5aP-IPV	20/172	63.1%	93% (89–95)	87% (80–92)
dT3aP-IPV	15/71	69.3%	88% (79–93)	78% (62–88)

Abbreviations: CI, confidence interval; dT3aP, diphtheria–tetanus–3-component acellular pertussis vaccine; dT5aP, diphtheria–tetanus–5-component acellular pertussis vaccine; IPV, inactivated polio vaccine; VE, vaccine effectiveness.

Amirthalingam et al. Clin Inf Dis (2016)

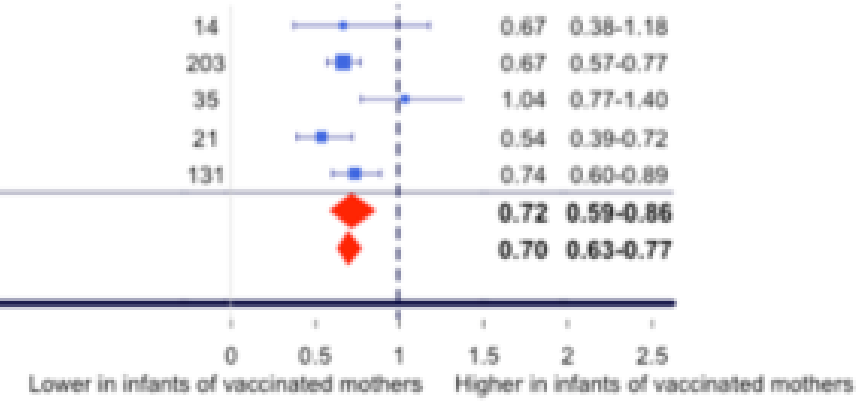
Pertussis immunization in pregnancy works

	12-mo Follow-up (Total Pertussis Cases = 103)			
	No. of Pertussis Cases (Rate per 100 000 Person-Years)		VE, % (95% CI)	*P*
	No Maternal Tdap	Maternal Tdap		
Maternal Tdap during pregnancy (8+ days before birth)[a]				
0 DTaP doses (birth until day 7 after the first DTaPdose)	31 (177.2)	2 (14.8)	87.9 (41.4 to 97.5)	.009
Protected by 1 DTaP dose[b]	23 (170.3)	5 (43.2)	81.4 (42.5 to 94.0)	.004
Protected by 2 DTaP doses[b]	12 (88.5)	8 (72.8)	6.4 (−165.1 to 66.9)	.901
Protected by 3 DTaP doses[b]	14 (48.7)	7 (32.1)	65.9 (4.5 to 87.8)	.041
Maternal Tdap before pregnancy	89 (89.4)	14 (42.4)	55.6 (20.1 to 75.4)	.007
Maternal Tdap after pregnancy	80 (72.1)	23 (106.2)	24.1 (−28.5 to 55.1)	.305

Baxter et al. Pediatrics (2018)

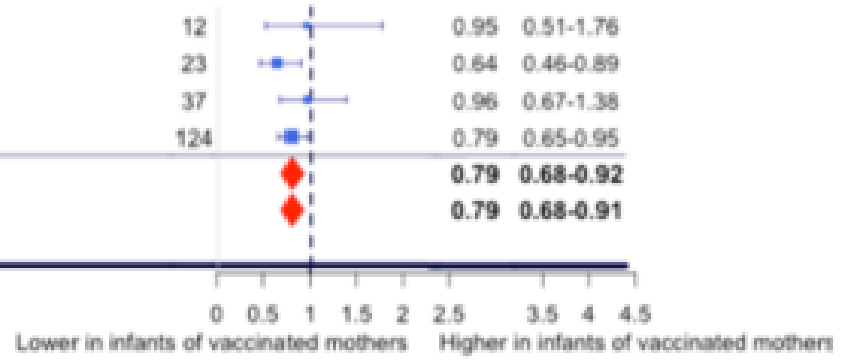
What about the infants?

Study	Infants of vaccinated mothers GMC	n	Infants of unvaccinated mothers GMC	n	RoGM	95% CI
Munoz et al; JAMA 2014	64.9	26	96.6	14	0.67	0.38-1.18
Ladhani et al; CID 2014	28.8	129	43.2	203	0.67	0.57-0.77
Hoang et al; Vaccine 2016	70	35	67	35	1.04	0.77-1.40
Maertens et al; Vaccine 2016	29	49	54	21	0.54	0.39-0.72
Halperin et al; CID 2018	56.9	118	77.3	131	0.74	0.60-0.89
Summary (Random effects model, P=0.0005)					**0.72**	**0.59-0.86**
Summary (Fixed effect model, P<0.0001)					**0.70**	**0.63-0.77**
Chi-Square=10.75, df=4 (P=0.029); I-Square=62.8%						



A) Meta-analysis of infants' anti-PT IgG levels post primary vaccination

Study	Infants of vaccinated mothers GMC	n	Infants of unvaccinated mothers GMC	n	RoGM	95% CI
Munoz et al; JAMA 2014	80.1	27	83.9	12	0.95	0.51-1.76
Maertens et al; Vaccine 2016	36.29	45	56.6	23	0.64	0.46-0.89
Maertens et al; CID 2016	129	30	133.7	37	0.96	0.67-1.38
Halperin et al; CID 2018	55.6	115	70.2	124	0.79	0.65-0.95
Summary (Random effects model, P=0.0025)					**0.79**	**0.68-0.92**
Summary (Fixed effect model, P=0.0019)					**0.79**	**0.68-0.91**
Chi-Square=3.07, df=3 (P=0.3807); I-Square=2.3%						



B) Meta-analysis of infants' anti-PT IgG levels post booster vaccination

Abu Raya et al. Unpublished data

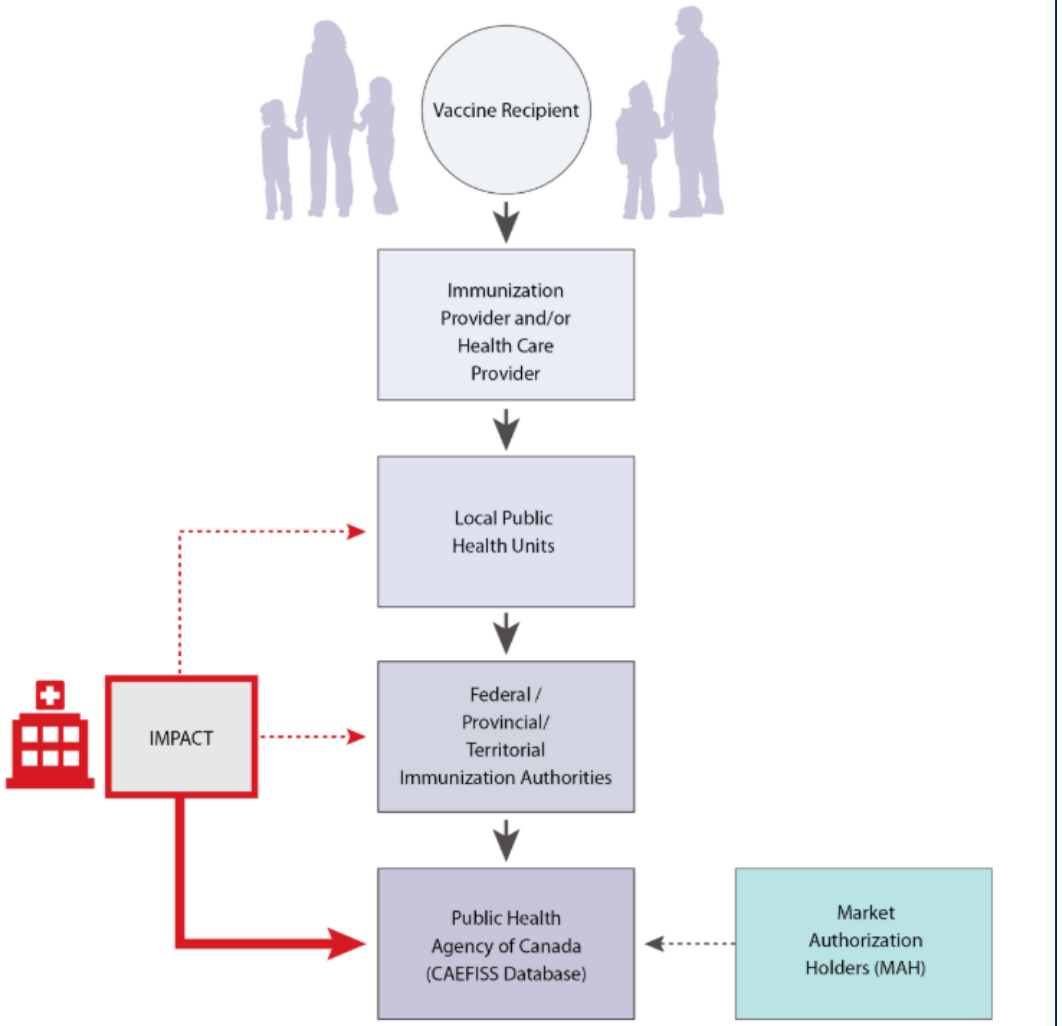
Current Canadian (NACI) recommendations

- Influenza
  - All pregnant women
  - Any stage of pregnancy
  - Inactivated vaccine
  - If not given, as early as possible post-partum, preferably before hospital discharge

- Pertussis (Tdap)
  - All pregnant women
  - Every pregnancy
  - Ideally 27-32 weeks gestation, consider 13-26 weeks gestation, any time until delivery

Gaps in safety data

Figure 1: Public Health Reporting Pathway for Adverse Events Following Immunization (AEFIs) to CAEFISS



Complication	~Baseline rate	10% increase	~Study sample size
Small for gestational age	9%	10%	33,000
Preterm births	8%	9%	38,000
Low birth weight (<2.5 kg)	6%	6.6%	52,000
Congenital malformations	4%	4.4%	80,000
Stillbirths	1%	1.1%	326,000

Statistics Canada
Public Health Agency of Canada

Components of safety surveillance

- Global AEFI surveillance for pregnant women and infants
  - 47 countries, including 19 high-income countries (HICs)

	Total		HICs	
	n	(%)	n	(%)
National maternal immunization policy	30	(64%)	12	(63%)
Active AEFI surveillance - maternal	9	(19%)	2	(11%)
Active AEFI surveillance – infant	7	(15%)	3	(16%)
Passive AEFI surveillance	40	(85%)	17	(89%)
Passive: ascertains pregnancy status	17	(36%)	5	(26%)
Registry for unintentional immunization	4	(9%)	2	(11%)

Cassidy et al. Human Vacc Immunother 2016

Components of safety surveillance

- Global AEFI surveillance for pregnant women and infants
  - 47 countries, including 19 high-income countries (HICs)

	Total		HICs		Canada?
	n	(%)	n	(%)	
National maternal immunization policy	30	(64%)	12	(63%)	No
Active AEFI surveillance - maternal	9	(19%)	2	(11%)	No
Active AEFI surveillance – infant	7	(15%)	3	(16%)	No
Passive AEFI surveillance	40	(85%)	17	(89%)	Yes
Passive: ascertains pregnancy status	17	(36%)	5	(26%)	No
Registry for unintentional immunization	4	(9%)	2	(11%)	No

Cassidy et al. Human Vacc Immunother 2016

Components of safety surveillance

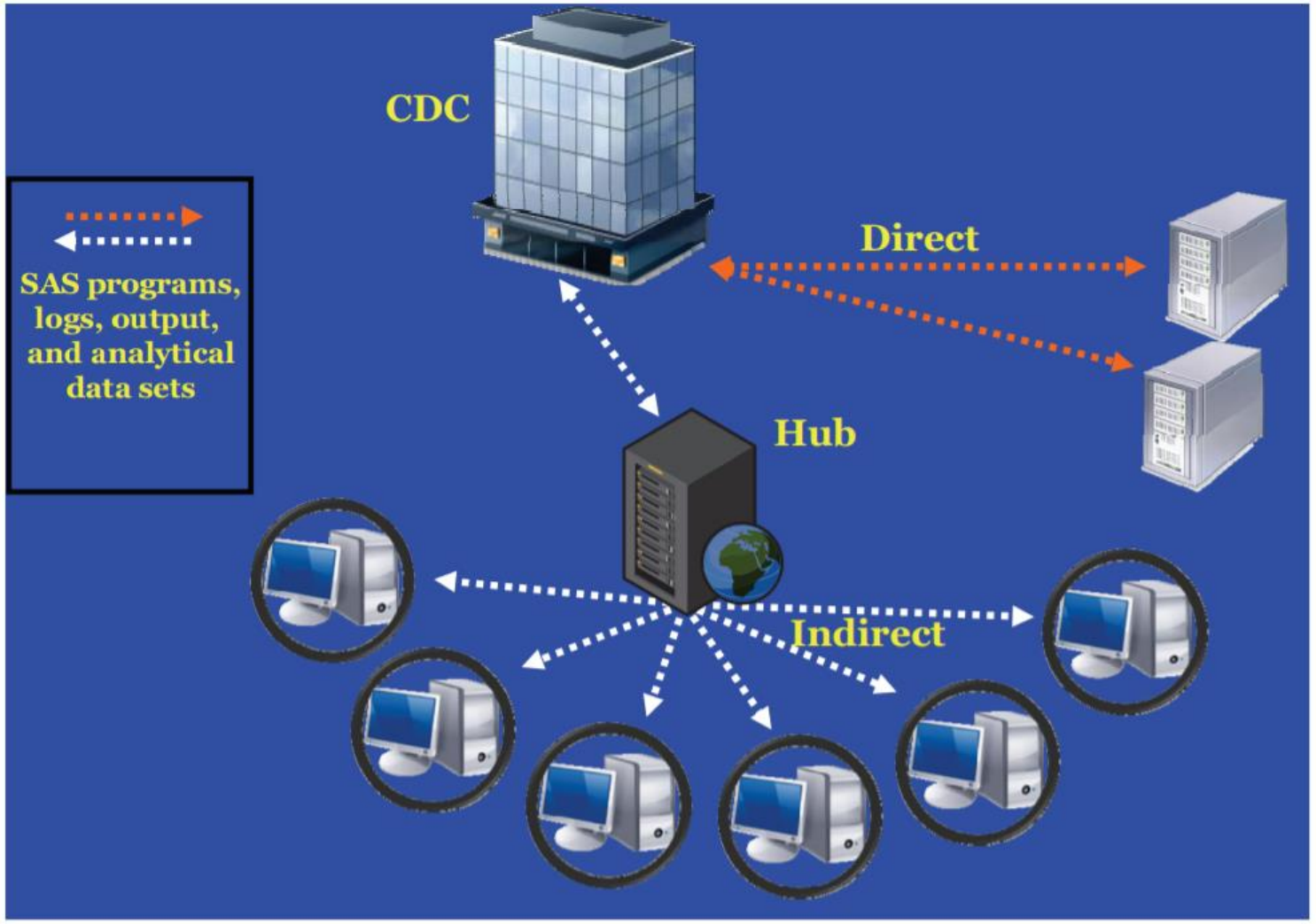
- Global AEFI surveillance for pregnant women and infants
  - 47 countries, including 19 high-income countries (HICs)

	Total		HICs		Canada?	Australia	USA	UK	Sudan Mexico
	n	(%)	n	(%)					
National maternal immunization policy	30	(64%)	12	(63%)	No	Yes	Yes	Yes	Yes
Active AEFI surveillance - maternal	9	(19%)	2	(11%)	No	Yes	Yes	Yes	Yes
Active AEFI surveillance – infant	7	(15%)	3	(16%)	No	No	Yes	Yes	Yes
Passive AEFI surveillance	40	(85%)	17	(89%)	Yes	Yes	Yes	Yes	Yes
Passive: ascertains pregnancy status	17	(36%)	5	(26%)	No	No	No	Yes	Yes
Registry for unintentional immunization	4	(9%)	2	(11%)	No	No	Yes	Yes	No

Cassidy et al. Human Vacc Immunother 2016

The US model?

- Vaccine Safety Datalink
  - 69 publications, 1995-2018



Baggs et al. Pediatrics 2011

We need more data

PHARMACOEPIDEMIOLOGY AND DRUG SAFETY 2015; **24**: 361–367
Published online 12 February 2015 in Wiley Online Library (wileyonlinelibrary.com) **DOI**: 10.1002/pds.3754

ORIGINAL REPORT

Adverse event following immunization surveillance systems for pregnant women and their infants: a systematic review

Christine Cassidy[1], Noni E. MacDonald[2,3], Audrey Steenbeek[1,3] and Karina A. Top[2,3,4]*

[1] *School of Nursing, Faculty of Health Professions, Dalhousie University, Halifax, Nova Scotia, Canada*
[2] *Department of Paediatrics, Dalhousie University, Halifax, Nova Scotia, Canada*
[3] *Canadian Center for Vaccinology, IWK Health Centre, Halifax, Nova Scotia, Canada*
[4] *Department of Community Health and Epidemiology, Dalhousie University, Halifax, Nova Scotia, Canada*

Vaccine 34 (2016) 6038–6046
Contents lists available at ScienceDirect
Vaccine
journal homepage: www.elsevier.com/locate/vaccine

Neonatal infections: Case definition and guidelines for data collection, analysis, and presentation of immunisation safety data☆

Stefania Vergnano[a], Jim Buttery[b], Ben Cailes[a], Ravichandran Chandrasekaran[c], Elena Chiappini[d], Ebiere Clark[e], Clare Cutland[f], Solange Dourado de Andrade[g], Alejandra Esteves-Jaramillo[h], Javier Ruiz Guinazu[i], Chrissie Jones[a], Beate Kampmann[j,k], Jay King[h], Sonali Kochhar[l], Noni Macdonald[m], Alexandra Mangili[n], Reinaldo de Menezes Martins[o], César Velasco Muñoz[p], Michael Padula[q], Flor M. Muñoz[r], James Oleske[s], Melvin Sanicas[t], Elizabeth Schlaudecker[u], Hans Spiegel[v], Maja Subelj[w], Lakshmi Sukumaran[x], Beckie N. Tagbo[y], Karina A. Top[m], Dat Tran[z], Paul T. Heath[a,*], The Brighton Collaboration Neonatal Infections Working Group[1]

Estimating vaccine effectiveness

- Characteristics of vaccine recipient
  - Link pregnancy & immunization status
  - Link mother & infant
- High quality individual level vaccine data
  - Timing, product
- Environment & exposure to pathogen
- Measure outcome of interest
  - Lab confirmation, hospitalization, etc
- Number of methodologic considerations
  - Case-control studies, Test negative design, Cohort studies, Screening method
- Infant's immune response to vaccination should be measured

Vaccine 36 (2018) 7286–7293

Contents lists available at ScienceDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine

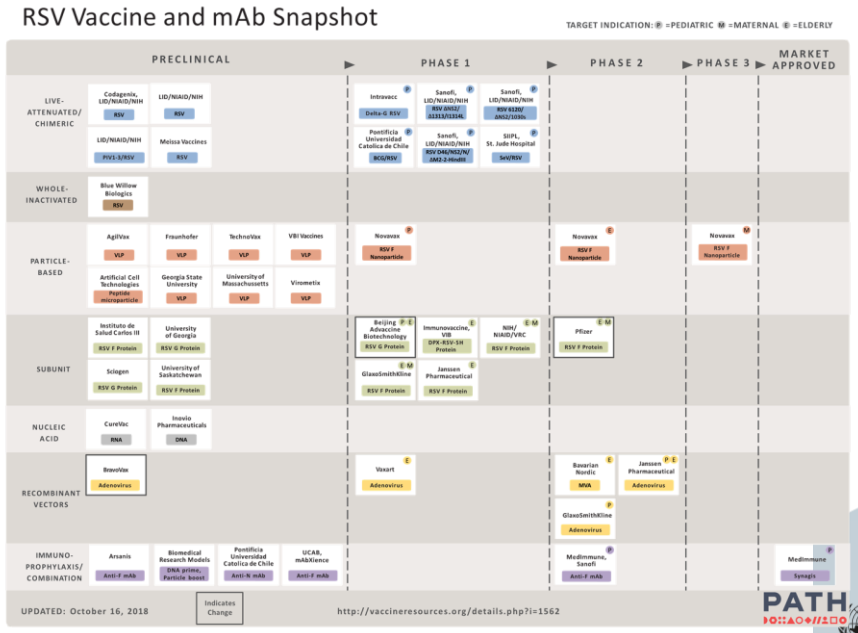
Review

A framework for research on vaccine effectiveness

Natasha S. Crowcroft [a,b,*], Nicola P. Klein [c]

What's in the pipeline?

- Universal influenza
- Monovalent/novel antigen pertussis
- RSV
- GBS
- CMV
- clintrials.gov: 343 trials



NIH National Institute of Allergy and Infectious Diseases

HUMAN VACCINES PROJECT

A universal flu vaccine should

- Be at least 75% effective
- Protect against group I and II influenza A viruses
- Have durable protection that lasts at least 1 year
- Be suitable for all age groups

Universal Influenza Vaccine Initiative

A genetically inactivated two-component acellular pertussis vaccine, alone or combined with tetanus and reduced-dose diphtheria vaccines, in adolescents: a phase 2/3, randomised controlled non-inferiority trial

Sirintip Sricharoenchai, Chukiat Sirivichayakul*, Kulkanya Chokephaibulkit, Punnee Pitisuttithum, Jittima Dhitavat, Arom Pitisuthitham, Wanatpreeya Phongsamart, Kobporn Boonnak, Keswadee Lapphra, Yupa Sabmee, Orasri Wittawatmongkol, Pailinrut Chinwangso, Indrajeet Kumar Poredi, Jean Petre, Pham Hong Thai, Simonetta Viviani*

Lancet Infect Dis 2018; 18: 58–67

PATH World Health Organization

GROUP B STREPTOCOCCUS VACCINE TECHNOLOGY ROADMAP

AMERICAN SOCIETY FOR MICROBIOLOGY | Clinical and Vaccine Immunology®

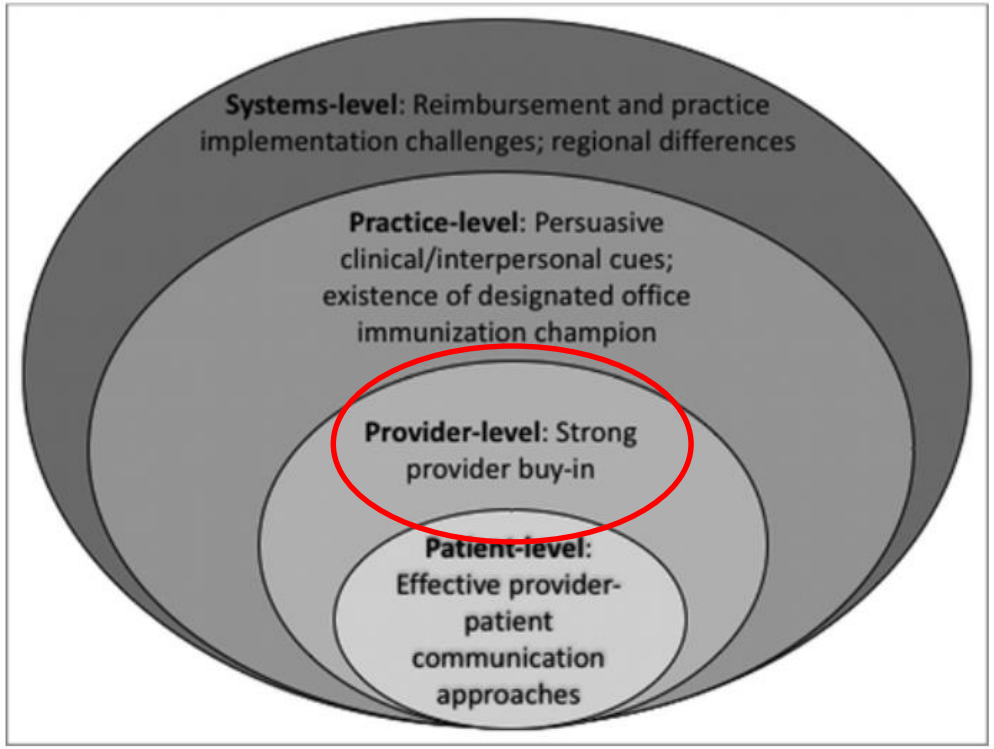
Progress toward Development of a Vaccine against Congenital Cytomegalovirus Infection

Mark R. Schleiss,[a] Sallie R. Permar,[b] Stanley A. Plotkin[c]

UBC BC Children's Hospital Research Institute

Who should deliver maternal immunization programs?

- Public health clinics
- Pharmacists
  - Immunization expertise
  - Additional visits
- Midwives
- Obstetricians
  - Regular contact with pregnant women
  - Philosophy to avoid all unnecessary medications
  - Multiple barriers to administering vaccines
- Family physicians?



Frew et al. Hum Vac Imm 2018

Knowledge, attitudes, perceptions

Qualitative Meta-Analysis: General Article

"Nature Does Things Well, Why Should We Interfere?": Vaccine Hesitancy Among Mothers

Qualitative Health Research
2016, Vol. 26(3) 411–425

DOI: 10.1177/1049732315573207
qhr.sagepub.com
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Eve Dubé[1], Maryline Vivion[2], Chantal Sauvageau[2], Arnaud Gagneur[3], Raymonde Gagnon[4], and Maryse Guay[5]

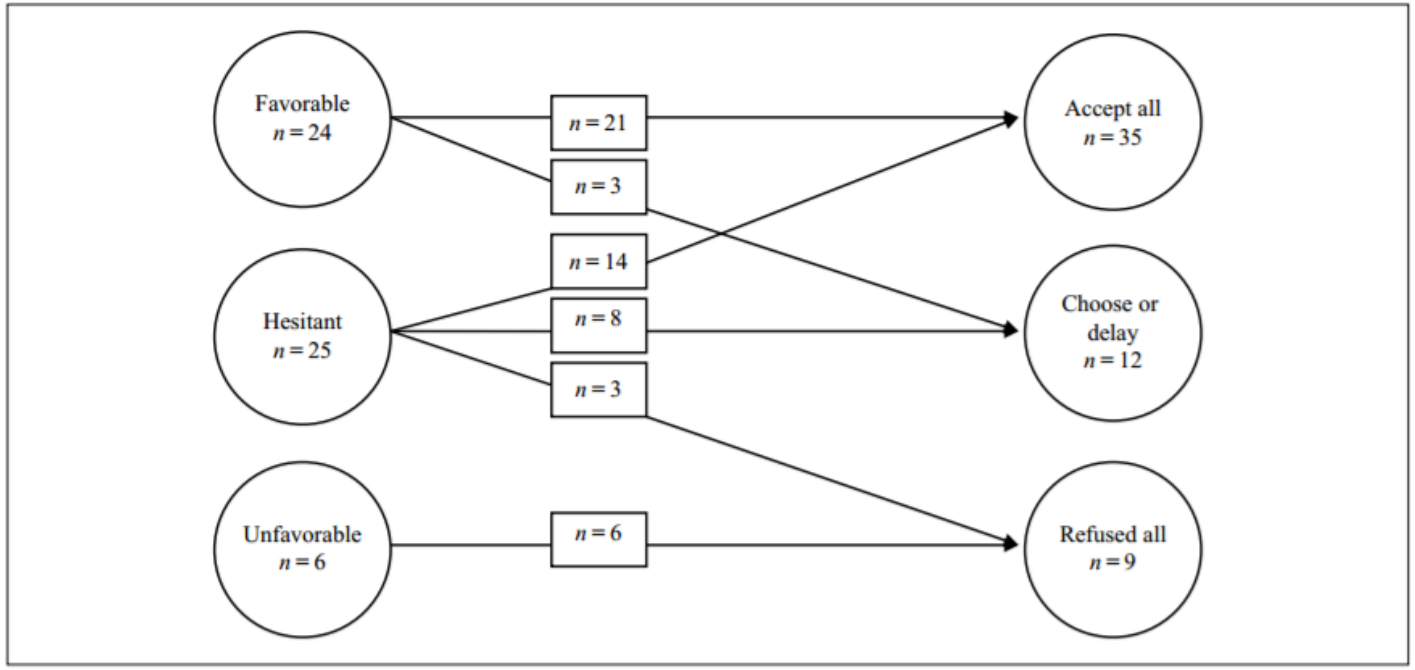

Figure 1. Mothers' attitudes at first interview and mothers' decision at second interview.

Knowledge, attitudes, perceptions

Qualitative Meta-Analysis: General Article

Qualitative Health Research
2016, Vol. 26(3) 411–425
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DOI: 10.1177/1049732315573207
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"Nature Does Things Well, Why Should We Interfere?": Vaccine Hesitancy Among Mothers

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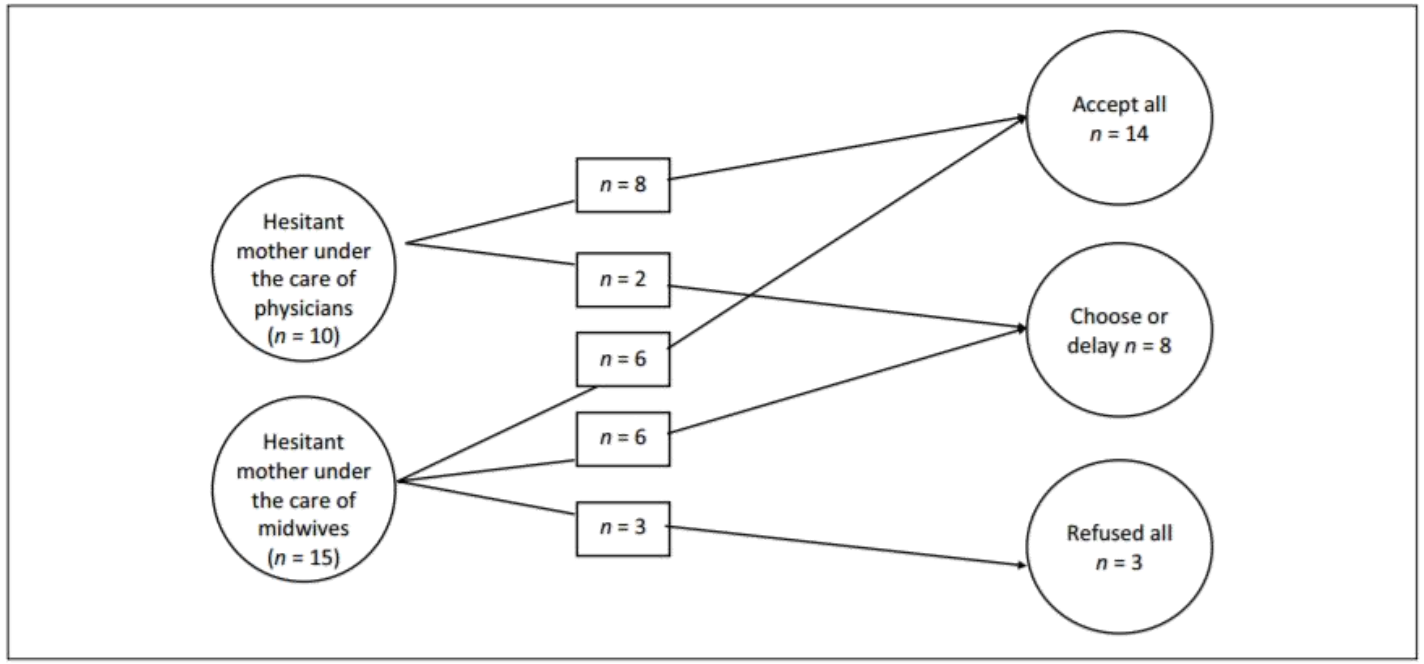

Figure 2. Vaccine-hesitant mothers' decisions and type of care.

Knowledge, attitudes, perceptions

Qualitative Meta-Analysis: General Article

Qualitative Health Research
2016, Vol. 26(3) 411–425

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"Nature Does Things Well, Why Should We Interfere?": Vaccine Hesitancy Among Mothers

Eve Dubé[1], Maryline Vivion[2], Chantal Sauvageau[2], Arnaud Gagneur[3], Raymonde Gagnon[4], and Maryse Guay[5]

Table 2. Main Factors Influencing Mothers' Decision About Vaccination.

To accept all vaccines following the recommended schedule	• To protect the child from catching VPD, fear of VPD • Anticipated regret if the child catches a VPD • Because it is the "normal thing to do," vaccination as a social norm • Pressure to vaccinate (from family, spouse, friends, etc.) • Trust in health professionals' recommendation • Because the child is at particular risk of VPD (i.e., older siblings, will go to day care, etc.) • To protect others, to prevent the spread of VPD in the community
To refuse one or more vaccines and/or to delay vaccination	• As a "trade-off" position between refusing all and accepting all vaccines • Disease perceived as mild (mostly for rotavirus vaccine) • Fear of adverse events (to refuse some vaccines)/fear of diseases (to accept some vaccines) • Because it is a new vaccine (mostly for rotavirus vaccine) • Feeling of guilt/pressure to vaccinate (to accept some—all vaccines with a delayed schedule or not) • Bad experience with vaccination for the child/for others in the social network • Fear of multiple injections at the same visit • Advice/information on "alternative vaccination schedule"
To refuse all vaccines	• Perception that vaccines are unsafe and ineffective • Preference for natural immunity • Perception that risk associated with vaccination is higher than risk of VPD • Preference for other modes of protection (e.g., homeopathic vaccines)

Note. VPD = vaccine-preventable diseases.

UBC BC Children's Hospital Research Institute

Maternity care provider barriers

- Lack of knowledge
- Misconceptions about disease risk
- Concerns about vaccine safety & efficacy
- Need for vaccination during pregnancy
- Lack of studies done in pregnant women
- Patient refusal
- Lack of time
- Concern about liability & blame
- Ambiguous guidelines
- Uncertainty about who bears responsibility
- Inability to track vaccination status
- Vaccination not part of typical practice

HUMAN VACCINES & IMMUNOTHERAPEUTICS
2016, VOL. 12, NO. 4, 857–865
http://dx.doi.org/10.1080/21645515.2015.1101524

REVIEW

Improving rates of maternal immunization: Challenges and opportunities

Donna M. MacDougall[a,b] and Scott A. Halperin[a]

Maternity care provider facilitators

- Positive attitude toward vaccination
- Concern about seriousness of influenza
- Belief in safety and efficacy of vaccines
- Older providers
- Vaccinated providers
- Multispecialty groups
- Engaged with influenza program
- Existence of national recommendations

HUMAN VACCINES & IMMUNOTHERAPEUTICS
2016, VOL. 12, NO. 4, 857–865
http://dx.doi.org/10.1080/21645515.2015.1101524

REVIEW

Improving rates of maternal immunization: Challenges and opportunities

Donna M. MacDougall[a,b] and Scott A. Halperin[a]

Moving forward – likely a mixed model

- Enhanced communication strategy
- Understanding factors contributing to hesitancy
- Timely updates to maternity care providers
- Immunization needs to be integrated into standard maternity care
- Formal maternal immunization strategy
  - Evidence-based guidelines
- Support for maternity care providers
  - Education and training
  - Immunization competency
- Avoiding missed opportunities

Highest research priorities in Canada

- Relating to pertussis immunization in pregnancy

- Maternity care providers
  - Behaviour and intentions around Tdap recommendations
  - Opinions on how to optimize Tdap acceptance
  - Opinions on how to best integrate immunization into routine prenatal care

- Front line immunization providers
  - Behaviour and intentions around Tdap recommendations
  - Behaviour and intentions around Tdap delivery
  - Opinions on how to best integrate immunization into routine prenatal care

How does this lead to implementation challenges?

Criteria
Disease characteristics and burden
Vaccine characteristics
Immunization strategies
Social and economic costs and benefits
Feasibility and acceptability
Ability to evaluate
Research questions
Other considerations including equity, politics and legal issues
Overall, this program should be publicly-funded

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Vaccine 23 (2005) 2470–2476

Vaccine
www.elsevier.com/locate/vaccine

An analytical framework for immunization programs in Canada

L.J. Erickson[a,b,*], P. De Wals[c,d], L. Farand[a]

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[b] *Agence d'évaluation des technologies et des modes d'intervention en santé du Québec (AETMIS), 2021 Avenue Union, Bureau 1040, Montreal, Que., Canada H3A 2S9*
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Received 29 July 2004; received in revised form 12 September 2004; accepted 24 October 2004
Available online 24 November 2004

Avoiding the Dutch situation

"The Dutch National Institute for Public Health is currently investigating how to arrange this vaccination for pregnant women."

"Women can be vaccinated by their family doctor…not all practices offer the vaccination…or go to the Public Health Service"

The PIPER Group

WEDNESDAY, DECEMBER 5

14:00 – 15:30 CONCURRENT SESSIONS

ROOM 210 SUCCESSFUL IMPLEMENTATION OF MATERNAL VACCINATION PROGRAMS: HOW TO GET THERE?

- Progressing Immunization in Pregnancy Evaluation in Research

5th International Neonatal & Maternal Immunization Symposium (INMIS 2019)
September 15-17, 2019 in Vancouver, Canada
www.inmis.org

Hear up-to-date information in maternal and neonatal immunization from vaccinology research laboratory science and clinical trials through to implementation and social science of immunization programs.

Thank you

http://vaccineevaluationcenter.ca/, https://bcchr.ca/

Twitter: @manishs_ @VEC_ubc

THE UNIVERSITY OF BRITISH COLUMBIA
Faculty of Medicine

Vaccine Evaluation Center

BC Children's Hospital Research Institute