Changing epidemiology of vaccine preventable diseases in New Zealand

Sarah Radke PhD, MSPH 17 February 2015



Te Whare Wānanga o Tāmaki Makaurau

Why vaccines?

"Only clean water and antibiotics have had an impact on childhood death and disease that is equal to that of vaccines"

-World Health Organization







Smallpox



Source: BBC.co.uk

Smallpox

- Since 10,000 BC
- Killed approx 400,000 Europeans annually during 18th Century
- 1/3 of all blindness, 20-80% fatality rate
- 20th century around 300-500 million deaths
- Last case in NZ in 1925
- Last 2 cases in the world in 1978
- Global eradication declared in 1980

Polio





Global Polio Eradication Initiative

- 1988 41th World Health Assembly 166 Member States
- Resolution for worldwide eradication of polio



World Health Organization



CENTERS FOR DISEASE CONTROL AND PREVENTION





nunisation Advisory Centre

Polio in 2008



The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement. Data Source: World Health Organization Map Production: Public Health Information and Geographic Information Systems (GIS) World Health Organization



© WHO 2008. All rights reserved

Polio in 2014



Excludes vaccine derived polioviruses and viruses detected from environmental surveillance.

Data in HQ as of 09 September 2014



Polio cases in New Zealand 1915-1962



Year

Poliomyelitis cases in New Zealand 1962-1999



Polio deaths in New Zealand 1946-2009



Source: ESR

Tetanus





Tetanus hospitalisations (1970-2013), notifications (1980-2013) and deaths (2000-2011) in NZ



Source: Immunisation Handbook 2014

13

Tetanus deaths in New Zealand, 1945-2012



Recipe for vaccine-control of infectious diseases



©The Immunisation Advisory Centre

Pertussis



Source: Anusha Ganeshalingham, Paediatric Intensive Care Specialist, Starship Hospital

Number of pertussis notifications and hospitalisations by calendar month-year, New Zealand, 1998-2014



Note: Includes confirmed, probable, suspect cases and notifications still under investigation.

Source: ESR 2014

Rate of pertussis notification (cases per 100 000 population) by age group, 1997-2014



Note: Includes confirmed, probable and suspect cases only. Rate of pertussis cases per 100 000 population calculated using mid-year population estimates.

Pertussis hospitalisations by age group 2000 – 2013, NZ



Source: Radke S et al, IMAC 2013

©The Immunisation Advisory Centre

Pertussis Hospitalisations 2006 - 2012 birth cohorts

Characteristic	Ν	(%)
Median age in months (IQR)	2.3	(1.4, 4.4)
Gender		
Male	329	(49)
Female	345	(51)
Ethnicity		
Māori	285	(42)
Pacific	116	(17)
Asian	18	(3)
European	241	(36)
Other	13	(2)

Radke S, et al. IMAC 2013



Radke S, et al., IMAC 2013

The New Zealand Herald

Wednesday Feb 26, 2014

Baby girl's death from whooping cough was preventable – coroner

Baby girl dies in growing whooping cough outbreak.



©The Immunisation Advisory Centre



Note: Includes confirmed, probable, suspect cases and notifications still under investigation.

©The Immunisation Advisory Centre

Basic reproduction number of infection (infectiousness)

Pertussis infectiousness

 R_0 = the expected number of secondary cases produced by a single (typical) infection in a completely susceptible population

R₀ for pertussis is between 12 and 17

Pertussis is <u>extremely</u> infectious



Source: Plotkin. Vaccines. 5th Edition

Duration of immunity from disease

Pertussis infection induces imperfect immunity

TABLE 1. Selected Articles Describing Duration of Protection Acquired by Natural Infection With Bordetella pertu	issis
--	-------

Author	Year	Participants (n)	Data Source	Estimate of Protection (y	Country of Study
Laing and Hay ¹⁰ Gordon and Hood ⁸ Wirsing von König et al ¹¹ Miller and Gay ¹² Versteegh et al ⁷	Laing and Hay10190220,405CohorGordon and Hood81951Not applicableReviewWirsing von König et al111995 369 ProspMiller and Gay121997Not applicableReviewVersteegh et al7 2002 4Case applicable		Cohort Review Prospective household contact Review/modeling Case series	Near lifelong Near lifelong 20 7–10 3.5–12	U.S. Not applicable Germany U.K. The Netherlands

- Immunity not life long
- Average adult probably experiences 2.6 cases of mild pertussis in lifetime

Duration of immunity from vaccine

Pertussis vaccines induce even less perfect immunity

TABLE 2. Selected Articles Describing Duration of Protection Acquired by wP Vaccine							
Author	Year	Participants (n)	Data Source	Estimate of Protection (yr)	Country of Study		
Lambert ¹³	1965	474	Outbreak	12	U.S. (Michigan)		
Jenkinson ¹⁷	1988	436	Clinic population	4	U.K.		
CDC ¹⁸	1993	225	Outbreak	4-6	U.S. (Massachusetts)		
Ramsay et al ¹⁹	1993	3150	Surveillance data	8	U.K.		
Nielsen and Larsen ¹⁴	1994	Unknown	Surveillance data	10	Denmark		
He et al ²⁰	1996	3794	Surveillance data	5-10	Finland and Switzerland		
Van Buynder et al ⁶		15.286	Surveillance data	5-14	U.K.		
Torvaldsen and McIntyre ⁵ 2003		Unknown Surveillance data		6-9	Australia		
CDC indicates Centers for Disease C	ontrol and P	revention.					

TABLE 3. Selected Articles Describing Duration of Protection Acquired by aP Vaccine

Author	Year	Vaccine Type	Participants (n)	Data Source	Duration of Follow-up	Estimate of Protection (yr)	Country of Study
Simondon et al ²⁴	1997	Pasteur Mérieux Serums and Vaccines (4-component)	4181	Nested case-contact	Up to 4.25 yr	Protection after vP onger than aP	Senegal
Tindberg et al ²⁵	1999	2-component	207	Follow-up of vaccine efficacy trial	10 yr	5.5	Sweden
Salmaso et al ⁴	2001	SmithKlineBeecham and Chiron Biocine (both 3-component)	8432	Vaccine efficacy trial	3 yr	6	Italy
Lugauer et al ²⁶	2002	4-component	10271	Longitudinal cohort	6 yr	6	Germany

Wendelboe A, Van Rie A, Salmaso S, Englund J. Duration of immunity against pertussis after natural infection of vaccination. Pediatr Infect Dis J 2005;24: S58–S61



Pertussis vaccine efficacy

- Current aP vaccine provides around 81-85% efficacy after 3 infant doses¹
- Number and schedule of doses has changed over time in New Zealand²



Pertussis vaccine efficacy - timeliness

• Room for improvement in timeliness of vaccination

Efficacy



And delays are more common in the highest risk groups





% fully immunised at 6 months of age by deprivation June 2009 to March 2014

→ Dep 1-2 → Dep 3-4 → Dep 5-6 → Dep 7-8 → Dep 9-10



Indirect protection?

Indirect protection?



- Antibody against PT prevents clinical illness
- Natural infection prevents re-colonisation for some years
- aP vaccine does not prevent colonisation
 Vaccinated baboons exposed to pertussis infect unvaccinated baboons and make them sick





Measles

Source: American Academy of Pediatrics, Red Book Online Visual Library

Global progress on measles



Figure 1. Routine first measles vaccination coverage (WHO-UNICEF estimates) and measles case reports. 1980 - 2011.

WHO. Status report on progress towards measles and rubella elimination. 22 Oct 2012



	Western Pacific Region										
♠	Health topics	Data and statistics	Media centre	Publications	Programmes and projects	s Countri	es and areas	WHO in the Wester	rn Pacific		
		Q,					Search		Advanced search		
Me Nev Fea	Media centre Four Western Pacific countries and areas are the first in their Region to be measles-free News releases Features Features Steady progress on several fronts as the Region moves closer towards						the wards	Share 🖶 Print			
Mu	Itimedia ntact	News rel	elimination of the disease, although significant challenges remain News release SEOUL, 20 March 2014 - The World Health Organization Western Pacific Region celebrates a milestone today with the announcement of measles						Related links Health topic: Measles and rubella Global Vaccine Action Plan 2011– 2020 ☐ Global Measles & Rubella Strategic Plan 2012–2020 Measles Verification Q&A pdf, 29kb		
		SEOUL, The Wo Organiz Pacific I milestor annound									
		eliminat Macao (and the They ar or areas receive	ion by Australia (China), Mongol Republic of Kor e the first count in the Region this distinction.	, rea. ries							
		Measles 330 peo a truly s Region	s kills approxima ple worldwide e ignificant achie work towards th	ately every day, mos vement as WH ne elimination o	tly children under the age O Member States in the V of measles.	of five, mal Vestern Pac	who king this cific				
		"The eli reduce t	mination of mea the high burden	sles must rem of mortality an	ain a priority in order to pr d morbidity caused by thi	omote equi s disease o	ty and to n the				

world's most vulnorable, not only in our Pagion but also around the world " said Dr.

Measles hospitalisations, notifications and lab confirmations, New Zealand, 1970-2012



Source: Ministry of Health and the Institute of Environmental Science and Research

©The Immunisation Advisory Centre

2014 Surveillance Year Measles Age Specific Rates Confirmed and Probable Cases with 95% Confidence Intervals

(approx. <1 and 1-4 age group denominators)



2014 Surveillance Year Measles Cases by Ethnic Group



Slide content courtesy of Richard Hoskins, Medical Officer of Health. 8th April 2014 Immunisation Advisory Centre

Auckland's experience Dec 2013 – Mar 2014

Measles cases notified in Auckland from Dec 2013



Measles



38

The gaps have closed by the two year milestone

% Fully immunised at 2 years of age by deprivation June 2009 to March 2014 → Dep 1-2 → Dep 3-4 → Dep 5-6 → Dep 7-8 → Dep 9-10 95% **5% Fully immunised at 2 years** 80% 22% 22% 70% JULI SED DEC War, JULI SED DEC War, JULI SED DEC War, J



Key messages

- Measles
 - We need to get the cohort with low immunisation coverage vaccinated
 - We need to reach our 95% coverage target for infants and maintain it.
- Pertussis
 - Very challenging
 - Protecting youngest infants with maternal immunisation
 - Ultimately, we need a better vaccine