Fact File

The Royal College of Pathologists of Australasia

Immunisation

Medicine is Pathology

Contents

Fact File on Immunisations

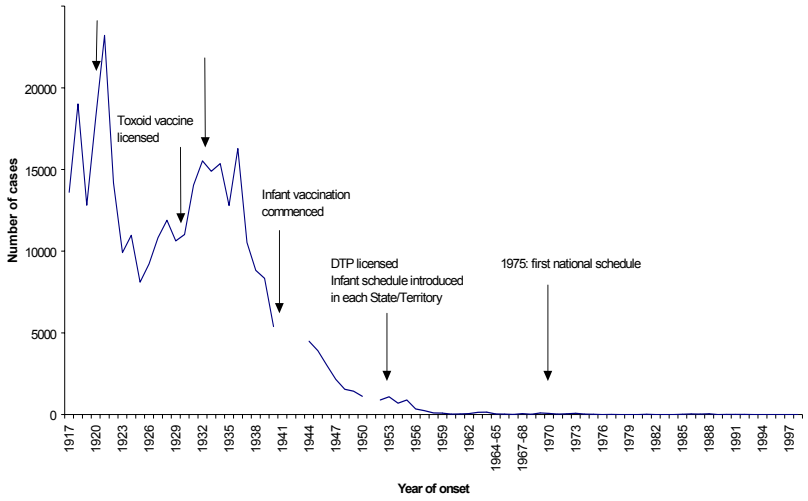
1. Background

In the 19th and the first half of the 20th centuries, childhood deaths from measles, diphtheria, tetanus and poliomyelitis were commonplace in Australia and other industrialised countries. They are now very rare in Australasia, North America and Western Europe, and their incidence has fallen sharply in many developing countries over the past 10 - 20 years because of successful immunisation programs.

Nevertheless, there are still 2 - 3 million childhood deaths each year, worldwide, from diseases that are preventable by the common childhood vaccines.

1.1 Diphtheria

In Australia, the first fall in the incidence of an infectious disease, that was attributable to immunisation, began with the production of diphtheria toxoid by the Commonwealth Serum Laboratories in the 1920s. Following the introduction of school-based immunisation programs in the 1930s and infant vaccination in the early 1940s, deaths from diphtheria fell from about 4000 during 1926 – 1935, to only 44 between 1956 and 1965; there have been none in Australia in the last decade (Figure 1;Table 1).



gure 1. Relationship between diphtheria notifications and the use of diphtheria toxin-antitoxin and toxoid vaccines in Australia.

(*from Hall R. Notifiable disease surveillance, 1917 to 1991. Commun Dis Intell1993;17: 226-36)*

1.2 Pertussis

Similarly, after pertussis vaccination was introduced, deaths from pertussis fell progressively from nearly 1700 between 1936 and 1945, to fewer than one per year on average for the past 20 years[1]. (Table 1).

1.3 Polio

Salk (injected) and Sabin (oral) polio vaccines were introduced in 1956 and 1966 respectively. Catastrophic polio epidemics had caused more than 1000 deaths, between 1946 and 1955, and left thousands of survivors handicapped from paralysis, including some who were ventilator-dependent for the rest of their lives. Since the mid-1960s there have been only 4 deaths from polio in Australia and the global polio eradication program is nearing completion (due 2005), with fewer than 500 cases, worldwide in 2001. Assuming the program remains on track, polio will be the second communicable disease, after smallpox, to have been eliminated, globally, because of the availability of safe and effective, albeit imperfect, vaccines.

1.4 Measles

Measles vaccination of infants, which began in Australia in 1969, gradually led to disappearance of the regular 2-3 yearly measles epidemics during which virtually every

susceptible child was infected, many were admitted to hospital with severe disease, encephalitis or secondary bacterial complications - such as pneumonia - and a significant number died.

1.5 *Haemophilus influenzae* type b (Hib)

The incidence of invasive disease due to *Haemophilus influenzae* type b (Hib) - the commonest cause of childhood meningitis - fell from about 500-600 per annum before the introduction of the first Hib conjugate vaccine, in 1993, to fewer than 50 per annum since 1995.

Based on these data, it is estimated that tens of thousands of deaths of Australian children have been prevented, over the past 60 years, by immunisation[1]. (Table 1)

Table 1

Deaths from diseases commonly vaccinated against, Australia 1926-2000*.
Reprinted from McIntyre et al[1]

Period	Diphtheria	Pertussis	Tetanus	Poliomyelitis	Measles†	Population estimate
1926–1935	4073	2808	879	430	1102	6 600 000
1936–1945	2791	1693	655	618	822	7 200 000
1946–1955	624	429	625	1013	495	8 600 000
1956–1965	44	58	280	123	210	11 000 000
1966–1975	11	22	82	2	146	13 750 000
1976–1985	2	14	31	2	62	14 900 000
1986–1995	2	9	21	0	32	17 300 000
1996–2000	0	9	5	0	0	18 734 000

* Sources: Feery B. One hundred years of vaccination. *Public Health Bulletin* 1997; 8:61-63; Feery B. Impact of immunization on disease patterns in Australia. *Med J Aust* 1981;2:172-176. Deaths recorded for 1966–1975 and 1996–2000 updated with data provided by ABS and the Australian Institute of Health and Welfare Mortality Database.

† Excludes deaths from subacute sclerosing panencephalitis.

Indicates decade in which community vaccination started for the disease.

2. Re-emergence of Vaccine Preventable Diseases

As the incidence of vaccine preventable diseases falls, there is a risk of complacency.

2.1. Measles

In the 1980s and '90s, measles outbreaks, with some deaths, occurred intermittently because vaccine uptake had plateaued at a level that provided insufficient herd immunity to prevent spread of such a highly contagious disease among susceptible individuals.

A national serosurvey in 1997-8 showed that up to 15% of children and young adults were susceptible to measles, suggesting that the risk of a major epidemic was high[2]. During the Australian Measles Control Campaign, in 1998, more than 90% of primary school children had been given measles, mumps and rubella (MMR) vaccine. Parents of preschool children, identified by the newly established Australian Childhood

Immunisation Register (ACIR) as being behind with scheduled immunisations, were sent reminders and immunisation rates in this group increased[3].

A second serosurvey after the campaign, showed that fewer than 2% of children in the age-groups targeted, were susceptible. Since then, infections in these age-groups have been uncommon[2].

However, several outbreaks among young adults, originating from index cases acquired overseas, emphasise the need for continued vigilance to achieve and maintain high levels of protection[4].

2.2. Pertussis

There have been other examples of re-emergence of vaccine preventable diseases, when immunisation rates fall. In the United Kingdom, in the 1970s, public concern about reports (which have never been substantiated) of an association between pertussis vaccine and various neurological diseases led to a fall in pertussis immunisation rates, followed by significant increases in the number of cases and deaths from pertussis[5] (Figure 2).

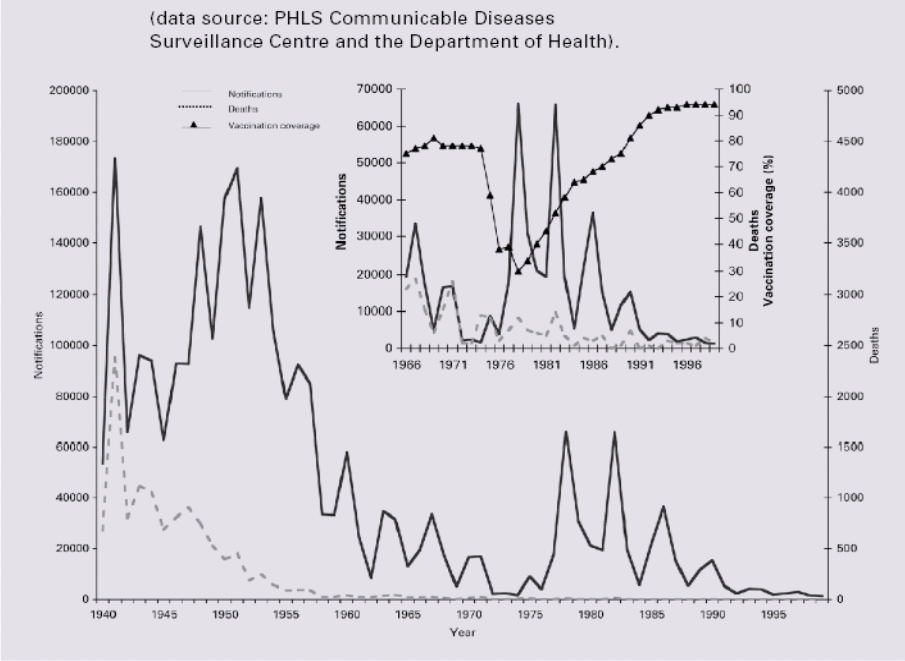


Figure 2. Inverse relationship between pertussis notifications and pertussis vaccination coverage in the United Kingdom, 1965-96.

2.3 Diphtheria

Even more dramatically, there was a massive diphtheria epidemic, in the 1990s, in Russia and the Newly Independent States, following the break up of the Soviet Union, where immunisation rates, previously, had been high.

Vaccine supplies failed when workers were unpaid and access to basic medical services was hindered by social disruption caused by conflict and mass migration. Diphtheria spread from unimmunised children to adults with waning vaccine-induced immunity, including soldiers, who often carried it from one region to another. Between 1990 and 1997, there were 150,000 cases and 5000 deaths[6].

3. Immunise Australia Program

Parents whose children are not fully immunised are more likely to be too busy, forgetful, socially disadvantaged or to have difficulty accessing health services, than to seriously object to immunisation.

Over the past 5-6 years, the *Immunise Australia Program* has introduced a number of incentives designed to remove barriers and improve the uptake of routine childhood vaccination, while still allowing conscientious objection. They include legislation, in most jurisdictions, requiring parents to provide evidence of their child's immunisation status before school entry and to exclude unimmunised children during epidemics.

Nationally, the establishment of the Australian childhood Immunization Register (ACIR) ensures that parents are reminded when their child's immunisation is overdue. Parents must provide evidence of age-appropriate vaccination of their child (or approved medical or philosophical exemption) to receive certain government funded allowances. General practitioner incentive payments are designed to encourage providers to reach immunisation targets for children in their practices and notify the ACIR when immunisations are completed. These initiatives have resulted in Australia's immunisation uptake reaching the highest ever recorded – 94% at 12 months and 90% at 2 years - with, correspondingly, record low rates of measles, rubella and Hib disease[7].

4. Benefit to Risk Relationship

4.1. Anti-immunisation lobby

Despite the well-documented and highly favourable benefit-to-risk ratio of childhood immunisation, small but influential anti-immunisation lobby groups attempt to undermine immunisation programs[8].

Their arguments often appear plausible to a generation of parents who have no experience of the frightening illnesses that have been all but eliminated by immunisation. They focus on the predictable, but rare side-effects of some vaccines.

For example there are rare cases of paralysis caused by oral polio vaccine - about 1 per 2.5 million doses and occasionally in a contact of the vaccinee. There have been 2 cases of vaccine-associated polio, in Australia in the past 13 years[5]. Other side-effects include fever, which can precipitate the first febrile convulsion, local or generalised allergic reactions and the hypotonic-hyporesponsive ("floppy baby") syndrome, which can occur after triple antigen. With few exceptions these effects are transient and relatively trivial compared with the potential complications of the diseases they prevent[5].

It is true that, in a highly immunised population, the chances of a child being exposed to a vaccine preventable disease (and so of being affected by its complications) are relatively small. Thus, individual unimmunised children are generally well protected by herd immunity, so long as they are a small minority. However, the risk remains, especially for diseases in which herd immunity is irrelevant, such as tetanus. That the parents' refusal to allow their child to be immunised can have serious consequences, is shown by a recently reported case of tetanus in an unimmunised 2-year old[9].

4.2 Serious adverse effects

Claims that vaccines are or could be causally related to serious childhood conditions, such as sudden infant death syndrome (SIDS), attention deficit disorder or autism[8] also seem plausible, since there may be a temporal relationship between a vaccine dose and

the onset of the condition. However, experience over many years and many millions of vaccine doses, and well planned prospective and case-control studies, have not only failed to confirm but have convincingly refuted any causal relationship between immunisation and serious disease[5].

Indeed, the incidence of SIDS has decreased significantly in Australia, despite increasing immunisation rates in infancy[10]. While there is less experience with newer vaccines, well-planned follow-up studies are designed to identify rare adverse effects that have not been detected in pre-registration trials. Recently, the withdrawal of a rotavirus vaccine because of an increased risk (1 in 10,000) of intussusception in immunised children, illustrates both the commitment of vaccine manufacturers to post-registration surveillance and their willingness to acknowledge unforeseen side-effects when they occur[11].

4.3 The Outcome of Benefit to Risk Analysis on Immunization Program

Clearly it is in the interests of the industry, the medical profession and governments, as well as vaccine recipients and their parents, to recognise adverse vaccine events – and respond appropriately - if only because of the potential for costly litigation if they fail to do so. However, claims of conspiracy, cover-up and accusations of conflicts of interest are integral components of the anti-immunisation case[10]. Fear, distrust and firmly held beliefs, no matter how irrational, are difficult to counter with logic and evidence, which may, paradoxically, reinforce the philosophical opposition to immunisation. Fortunately the influence of anti-immunisation groups is minimal – fewer that 1% of >1000 children surveyed in Melbourne, recently, had had no immunisation. Most parents who are sincerely concerned about the risks and benefits of immunisation can be reassured by honest, factual presentation of the facts[12].

Nevertheless, successful immunisation policies can be, paradoxically, compromised by their success. When the perceived risk of the disease is remote, even the transient pain and minor side-effects of immunisation, in a small infant, may seem unacceptable to some parents. However, when children are believed to be at risk from potentially serious diseases, parents expect access to immunisation. Recently, media reports of deaths from meningococcal disease (apparently encouraged by vaccine manufacturers[13]), fuelled public demand for meningococcal group C conjugate vaccine and prompted government acquiescence, despite the relatively high cost and the fact that only a third of cases are vaccine-preventable.

5. Issues for the Future

The benefit-to-risk ratio of some newer vaccines - against pneumococcal disease and varicella, for example – will be lower than that of many older vaccines. Although they are safe and effective, they are many times more expensive and deaths from the diseases they prevent are less common or confined to high risk groups. Decisions about whether a vaccine should be in the routine infant schedule, limited to high risk groups or given to school children or adults – generally more expensive, complicated and less successful than infant immunisation - and whether they should fully funded by government will

become more complex and difficult in future. They will be influenced by expert opinion, based on sophisticated epidemiological modelling, cost-effectiveness and risk assessments and health economics. There will be (often contradictory) pressures from vaccine manufacturers, practitioners, lobby groups, the media and the public, but ultimately, politicians make decisions about the allocation of major public resources. It is crucial that controversy about new vaccines does not undermine existing, successful, immunisation programs. A well-informed public, provided with impartial, honest and accessible evidence about the benefits, risks and costs of immunisation, is the best way to prevent inappropriate political decisions influenced by vested interests and maintain public support for this highly successful public health program.

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