

Recent Improvements in Polio and Pertussis Vaccination Policy in Israel, 2005

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Abstract

For children born after 1 January 2005, use of the Sabin oral polio vaccine in combination with the enhanced-potency Salk inactivated polio vaccine as part of the routine vaccination schedule was discontinued. The schedule now includes only IPV. In September 2005, a fifth dose of pertussis vaccine was added for pupils in their second year of elementary school. This article describes the reasons for these changes, which have rendered Israel's routine vaccination program one of the most effective in the world.

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Changing to IPV-only polio immunization program

Israel's polio vaccination program began in 1957 using the Salk inactivated polio vaccine. This eliminated most of the polio outbreaks and lowered the polio incidence about tenfold. Because the immunogenicity of IPV was low, it was decided in 1962 to switch from IPV to the Sabin oral polio vaccine (four doses in the first year of life). This further lowered the polio incidence to only tens of patients a year, but control and elimination of this dreadful disease, which was easily achieved by western countries soon after introducing either IPV or OPV, proved to be impossible in Israel using OPV alone.

During the 1970s, the enhanced-potency IPV was developed, which was much more immunogenic than OPV and IPV. It was assumed that this was the vaccine of choice for Israel. From 1982 it replaced OPV in the Hadera and Ramle subdistricts as a first step for replacing OPV with IPV throughout the country. The 1988 outbreak of polio type 1 virus, in which 12 of the 15 cases came from the Hadera subdistrict, led to the next change in the state's polio vaccination policy [1,2].

Opinions regarding the causes of this unexpected outbreak were divided [3]. One opinion held that the epidemic strain differed from the wild Mahoney and Sabin type 1 OPV vaccine strains, causing lower immunity to the 1988 epidemic strains. IPV-vaccinated children were highly protected against the epidemic strain of poliovirus. According to this view the outbreak demonstrated the superiority in Israel of the enhanced-potency IPV and the ability of this vaccine to achieve effective control of poliomyelitis in Israel.

Others considered the likely causes of the outbreak to be the greater susceptibility of young adults previously vaccinated with OPV, as well as oral-fecal transmission of wild poliovirus to susceptible people by children with low gut immunity against poliovirus after vaccination with IPV. According to this view, a vaccination program combining IPV with OPV was the best option for Israel. This approach, which emphasizes the gut immunity gained through immunization with OPV, was adopted by the Ministry of Health. A combination program of IPV-OPV was implemented on 1 January 1990 and remained in practice until 31 December 2004. Since this program was instituted, no polio cases – neither wild type nor vaccine-associated – occurred in Israel.

The World Health Organization declared Israel free of polio on 21 June 2002 [4]. This program was thus a success and the only one – as part of the WHO's polio eradication program – to achieve the goal of eliminating polio from Israel. If such a resounding success, then why was this program changed in 2005? The most important reasons for omitting OPV from the vaccination program are discussed below:

- Recent studies in Israel demonstrated that contrary to former belief, OPV when administered together with IPV, may not confer significant "gut immunity" against infection by polio virus (T. Swartz, personal communication, 2004). According to the results of recent studies, the addition of OPV to IPV does not confer a significant benefit over the IPV-only program, but it does have definitive risks (see below).
- In the last 3–5 years, outbreaks of circulating vaccine-associated paralytic polio have been reported in Haiti, the Dominican Republic and Madagascar, and have since been recognized as responsible for outbreaks that occurred in Egypt in the 1960s [5].
- Revertant OPV type 2 with mutations developing over time and differing from the vaccine strain by 9–14.2% have been repeatedly isolated from the sewage of the Tel Aviv area since 1998. These revertant vaccine-derived viruses have been shown to be invasive and neurovirulent in mice [6, and L. Shulman, personal communication, 2004].
- The WHO has decided to implement simultaneous global cessation of OPV vaccination soon after global polio eradi-

IPV = inactivated polio vaccine (Salk)

OPV = oral polio vaccine (Sabin)

WHO = World Health Organization

cation in order to prevent vaccine-associated outbreaks [7]. OPV is not safe in a world where vaccination coverage is not high and where the number of immunocompromised patients continues to increase as a result of cancer treatment, organ transplantations and AIDS.

When weighing the unproven benefits of adding OPV to the IPV program with the definitive and proven risk of OPV, the Israel Ministry of Health has decided to discontinue administration of OPV. This decision is a costly one: IPV is 15–20 times more expensive than OPV.

Children born after 1 January 2005 receive four doses of IPV in their first year of life (at ages 2, 4, 6 and 12 months), and a fifth dose in their second year of elementary school.

Adding a fifth dose of pertussis vaccine

Since the introduction of routine childhood vaccination, pertussis has been considered preventable and pertussis-associated illness and deaths have dropped by 98% [8]. Despite record high vaccination coverage rates against pertussis in western countries, significant increases in the incidence rates of pertussis have occurred in most of these countries during the last decade. In Israel the incidence rate has risen about tenfold since 1999. It is estimated that in Israel, each year, thousands of people suffer from pertussis (Department of Epidemiology, Ministry of Health, personal communication, 2004). The highest incidence rates are in infants, followed by 10–14 year olds, with over 50% of reported cases occurring in persons 10 years of age and older. Seventy percent of infants with pertussis are hospitalized. Pertussis is one of the commonest causes of prolonged coughing among young adults in Israel [9].

There are two main reasons for the rising rates of pertussis in western countries:

- Increased diagnosis and reporting following the introduction of polymerase chain reaction testing, which is much more sensitive than the traditional throat culture or serology testing, and increased awareness of pertussis among family physicians [10].
- Optimal protection against pertussis after vaccination and after natural infection, which lasts for only 5–10 years [11]. The last (fourth) dose of pertussis vaccine in Israel is administered at age 12 months. School-age children and young adults are thus not well protected against this disease [12]. When infected by *Bordetella pertussis* bacterium, they may be asymptomatic or suffer prolonged coughing without the typical whooping coughs, apnea spells and vomiting that characterize pertussis in infants. Infants and toddlers are infected by adolescents and adults whose immunity against pertussis has waned [13]. A few years ago there were no pertussis vaccines licensed for people over age 7 years. In recent years however, acellular pertussis vaccines have been licensed for infants, toddlers and adults. The acellular vaccine contains only three to five antigens as opposed to tens of antigens that are included in the former whole-cell pertussis vaccine.

Approximately sixty countries have already added a fifth dose of pertussis vaccine to schoolchildren during the last decade. In Israel, beginning with the 2005–2006 school year, this fifth dose has been introduced to the routine vaccination schedule of children in their second year of elementary school. In this grade the tetanus-diphtheria vaccine (Td) was replaced by the quadruple combination vaccine Tdap-IPV. This change combines the two aforementioned changes: replacing the OPV dose given in first grade with IPV, and the addition of the fifth pertussis vaccine dose. This change will cost some 2 million dollars a year.

The addition of the fifth dose, however, is not sufficient to stop the rising incidence of pertussis. In June 2005 the Advisory Committee on Immunization Practice to the Centers for Disease Control and Prevention in the United States voted to recommend the routine use of a sixth dose of pertussis vaccine (as dTap) in persons aged 11–18 [14]. This recommendation was implemented in the USA on 1 January 2006. The only way to adequately control pertussis in the future may be by adding pertussis immunization as Tdap in every situation where diphtheria-tetanus vaccine is administered today: namely, routinely for schoolchildren and as part of tetanus post-exposure prophylaxis after injury in emergency wards and community clinics.

Conclusion

These two improvements in the routine vaccination program of Israel make it one of the best in the world. The program in the U.S. also includes varicella vaccine and conjugated pneumococcal vaccine for toddlers and infants respectively, and conjugated meningococcal vaccine and a sixth pertussis vaccine dose for 11–12 year olds. The addition of varicella vaccine for toddlers and a pertussis vaccine booster dose for pupils in the eighth grade has already been recommended by the Advisory Committee of the Ministry of Health's Department of Epidemiology. It awaits the appropriate funding.

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