Global control of infectious diseases by vaccination programs

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Abstract

In both industrialized and developing countries, childhood immunization has become one of the most important and cost-effective public health interventions. National immunization programs have prevented millions of deaths since WHO initiated the ‘Expanded Program on Immunization’ in 1974. Smallpox was eradicated in 1979, poliomyelitis is on the verge of eradication, and two thirds of developing countries have eliminated neonatal tetanus. Global immunization coverage was at 78% in 2005. Through their impact on childhood morbidity and mortality, immunization programs are contributing to reaching the ‘Millennium Development Goal 4’ – a two-thirds reduction of under-five mortality by 2015. However, the failure to reach more than 20% of the world’s children with existing vaccines was responsible for at least 2.5 million of an estimated 10.5 million deaths of children under 5 years, mainly in developing countries. Of these deaths, 1.4 million could have been prevented by vaccines currently recommended by WHO. Rapid progress in our understanding of the pathogenesis of infectious diseases, immunology, and biotechnology has increased the number of candidate vaccine antigens available. Pressures are growing on public health decision makers to establish evidence-based ways to decide which new vaccines should be introduced on a large scale into national immunization programs. The gap in access to new vaccines between the developing and industrialized worlds is still wide, and wealthy countries are still the first to introduce and use new vaccines. Interest from countries and partner agencies in vaccination, as one of the most cost-effective public health interventions, continues to be strong, also due to rapid progress in biotechnology and vaccine development and the emergence of global infectious disease threats, including HIV/AIDS, SARS, and influenza. The establishment of the Global Alliance for Vaccines and Immunization has focused global activities to support vaccination programs through raising considerable funds, and to assist especially poorer countries in improving and expanding their vaccination programs. Global efforts concentrate on further reducing the gap in the access to all existing vaccines between industrialized and developing countries.
Introduction

In both industrialized and developing countries, child immunization has become one of the most important and cost-effective public health interventions [1, 2]. National immunization programs have prevented millions of deaths since WHO initiated the ‘Expanded Program on Immunization (EPI)’ in 1974 [3]. Smallpox was eradicated in 1979 [4], poliomyelitis is on the verge of eradication [5], and two thirds of developing countries have eliminated neonatal tetanus (NT).\(^1\) Global immunization coverage, as measured by the reported infant coverage with the third dose of diphtheria–tetanus–pertussis (DTP) vaccine (DTP3), was at 78% worldwide in 2005 [6] (Fig. 1), as compared to 20% in 1980. By the end of 2004, 153 of 192 WHO Member States had introduced hepatitis B (HepB) vaccine and 92 countries had introduced *Haemophilus influenzae* type b vaccine (Hib) into routine infant vaccination programs [7, 8], even though both vaccines are still under-used in developing countries. The estimated number of deaths (from measles, pertussis and NT) prevented through childhood immunization in 2003 was more than 2 million. Infant HepB vaccination in 2003 was estimated to prevent a future 600 000 adult deaths, which would have occurred without vaccination, due to chronic liver disease and liver cancer. However, the failure to reach >20% of the world’s children with existing vaccines was responsible for at least 2.5 million of an estimated 10.5 million deaths of children <5 years in 2002 (Fig. 2), mainly in developing countries. Of these deaths, 1.4 million could have been prevented by vaccines currently recommended by WHO: >500 000 due to measles, nearly 400 000 due to Hib, nearly 300 000 due to pertussis, and 180 000 NT deaths [9, 10]. An additional 1.1 million children <5 years are estimated to have died worldwide in 2003 from rotavirus and pneumococcal disease, against which effective vaccines exist,\(^2\) but are not yet used in developing countries [10]. Through their impact on childhood morbidity and mortality, immunization programs are already contributing considerably to reaching the ‘Millennium Development Goal 4’ – a two-third reduction of <5 mortality by 2015 [11]. It was estimated that improving coverage with the basic six EPI vaccines could potentially reduce <5 mortality by 13%, with another 10% mortality reduction possible following the introduction and more widespread use of Hib, pneumococcal, rotavirus and meningococcal vaccines.

In industrialized countries, mortality reduction is not the main driving force of national vaccine programs. Programs in wealthy countries recognize and mostly adhere to global vaccination goals set by WHO, and address


\(^2\) See the chapter by Dr. Steele of this volume on rotavirus and section on pneumococcal vaccines later in this chapter