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Review

Pediatric disease burden and vaccination recommendations: understanding local differences☆

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ABSTRACT

Background: Diphtheria (D), tetanus (T), pertussis (P), hepatitis B (HepB), invasive *Haemophilus influenzae* type b (Hib) disease, and measles cause substantial global morbidity and mortality.
Methods: This unique review highlights geographic differences in disease burden across certain countries in the African, Americas, Mediterranean, South-East Asian, and Western Pacific World Health Organization (WHO) regions, and relates this to vaccination coverage and local vaccine recommendations using the authors' countries as illustrations.
Results: Substantial differences were observed in the incidence of these diseases and in vaccination coverage between the countries studied. Disease incidence often reflected inadequate surveillance, but also variable or poor vaccination coverage. Vaccination coverage against HepB was particularly low in the African and South-East Asian WHO regions; vaccination coverage against invasive Hib disease was low in these regions and in the Eastern Mediterranean and Western Pacific WHO regions. Vaccination schedules within some countries in these regions do not include, or have only recently included, vaccinations against HepB and Hib disease. The use of DTwP–HepB–Hib (diphtheria, tetanus, whole-cell pertussis, HepB, Hib) combination vaccines has now been adopted by some countries to help increase vaccination coverage.
Conclusions: Vaccination coverage and vaccination schedules vary markedly between the countries studied, often according to the resources available. DTwP–HepB–Hib combination vaccines represent a cost-effective option, with the potential to substantially reduce the burden associated with these diseases by increasing coverage and compliance.

1. Introduction

Diphtheria, tetanus, pertussis, hepatitis B (HepB), invasive *Haemophilus influenzae* type b (Hib) disease, and measles are all serious childhood diseases that are associated with significant levels of morbidity and mortality. The reported incidence of these diseases varies across countries and regions, as does the proportion of cases reported to result in death (Table 1).[1–14] It is believed that there is a large amount of under-reporting of these diseases, partly

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Table 1
Global reported incidence, estimated actual global incidence and prevalence, and mortality of diphtheria, tetanus, pertussis, hepatitis B, *Haemophilus influenzae* type b (Hib) disease, and measles[1–14]

Disease	Global reported incidence (cases/year)	Estimated actual global incidence/prevalence	Mortality	Data sources
Diphtheria	7088	Unknown	5–10% (20% in those <5 years of age)	CDC 2008[1] WHO 2010[2]
Tetanus	16 628	Incidence: 1 million	~11%	Bleck 2005[3] CDC 2008[4] WHO 2010[5]
Pertussis	152 535	Incidence: 17.6 million	~1.6%	WHO 2005[6] WHO 2008[7]
Hepatitis B	914 000	Prevalence: 350–360 million	600 000/year[a]	WHO 2004[8] WHO 2008[9] WHO 2008[10]
Hib disease	3 million	Unknown	386 000/year	WHO 2005[11] WHO 2006[12]
Measles	281 972	Unknown	1–5% (developed countries); up to 25% in certain countries	WHO 2009[13] WHO 2008[14]

Data relate to 2007 or latest available data, unless otherwise stated. CDC, Centers for Disease Control and Prevention; WHO, World Health Organization.
[a] Includes chronic consequences of hepatitis B.

due to the poor access to healthcare for many individuals in developing countries. There is also a lack of surveillance, or weak surveillance programs. For example, although the documented global annual incidence of tetanus was 16 628 cases in 2008,[5] the actual incidence is believed to be closer to 1 million cases per year.[3] This is also the case with pertussis, for which the reported annual incidence is 151 586,[7] whereas it has been estimated that approximately 17.6 million cases occur each year.[6] Difficulty in detection may also affect disease reporting. Although millions of people are known to develop invasive Hib disease every year (2 200 000 estimated cases with 325 000–500 000 deaths per year worldwide),[15] it is difficult to diagnose as it causes a range of illnesses, sometimes with non-specific symptoms, and confirmation by laboratory testing may be expensive and can be challenging, requiring special agar and sera, and staff trained in and equipped for diagnosis. It is likely, therefore, that the estimated incidence of invasive Hib disease and the numbers of cases and mortalities are underestimates, and many of those infected die without the disease being diagnosed or reported.

Together, these vaccine-preventable diseases cause a substantial disease burden affecting populations worldwide, particularly in developing countries. Once any of these diseases is contracted, treatment options can be extremely limited, particularly for measles, pertussis, and HepB, with most treatments focused on providing symptomatic relief. Therefore, the most effective strategy to combat these diseases is disease prevention, particularly through vaccination. Vaccination has been shown to be one of the most effective public health interventions worldwide,[16] through which a number of serious childhood diseases have been successfully eradicated. For example, as a result of vaccination, polio has now been eradicated from the Americas (in 1994), the Western Pacific (in 2000), and the European World Health Organization (WHO) regions (in 2002).[17]

The WHO recommends vaccination against a number of serious infectious diseases, including diphtheria,[18] tetanus,[19] pertussis,[6] HepB,[8] invasive Hib disease,[12] and measles[20] for all children, and against pneumococcal disease, yellow fever, and rotavirus disease for children in some areas as part of their Expanded Program on Immunization (EPI). However, many infants and children still die every year from diseases that could be prevented by implementing the WHO vaccination recommendations.[21] It has been shown that approximately 27 million infants are not vaccinated against common childhood diseases, such as measles or tetanus. As a result, 2–3 million children will die annually from easily preventable diseases, and many more will fall ill.[22]

Developing countries can find the implementation of vaccination programs challenging and may not have the financial resources available to incorporate new vaccines into their schedules. The availability of cost-effective combination vaccines could make the implementation of complex schedules more achievable, through a number of economic and logistical benefits, including time gains in administration and throughout the supply chain,[23] as well as through enhancing timeliness and compliance in schedule completion.[24] Vaccination has the additional benefit of decreasing the inequity brought about by inaccessibility of medical care to the poor. For the local communities, providing vaccination brings benefits in terms of reduced morbidity, greater productivity, and improved economic savings and gains.[25]

The aim of this review is to provide an insight into disease burden, vaccination recommendations, and vaccination coverage across a range of geographical regions. The review is based on discussions from an experts' meeting of pediatricians from several different countries and regions. The broad geographical and socioeconomic spread of the countries that are represented allows a balanced analysis of the current situation; this may be particular to the country of origin of the meeting attendees rather than to the WHO region.

It is our hope that this unique review will help to facilitate implementation of vaccination support that is tailored to local needs, and will play a part in increasing vaccination coverage by promoting greater awareness of current challenges. Such improvements in vaccination coverage are essential to control disease outbreaks, and reduce the morbidity and mortality associated with vaccine-preventable childhood diseases.

2. Regional variation in disease burden

While global statistics provide a useful overview of disease burden, examination of regional variations across the countries studied reveals clear differences in geographical distributions for diphtheria, tetanus, pertussis, HepB, and measles (Figure 1).[8,26–33] The vast majority of diphtheria cases occur in the South-East Asian WHO region; this region also has the greatest proportion of tetanus, pertussis, and HepB cases. The greatest proportion of measles cases are found in the Western Pacific WHO region.

The distribution of cases appears much clearer when countries are classified as developed or developing, with the vast majority of cases of diphtheria (99.0%), tetanus (99.2%), pertussis (71.5%), and measles (98.8%) occurring in developing countries.[34] Indeed, more than 95% of measles cases occur in countries that have both a per