

Do Vaccines Save Lives? Yes They Do!



As Vacinas Salvam Vidas? Sim, Salvam!

Tinne LERNOUT¹, Heidi THEETEN¹, Elke LEURIDAN¹, Pierre VAN DAMME¹
Acta Med Port 2014 Mar-Apr;27(2):160-162

ABSTRACT

Since their introduction and widespread use, vaccines have been very successful in reducing morbidity and mortality of the diseases they target, at an individual level and through herd immunity. The impact on the mortality has been rapid and easy to measure for some diseases, such as diphtheria, pertussis and measles. For other diseases, including hepatitis B and human papillomavirus infections, deaths averted occur many years after vaccination, and it takes years until the full potential of the vaccine can be established. Finally, in middle and high income countries, the impact of vaccination against some diseases, like invasive pneumococcal disease and rotavirus gastro-enteritis, is measured by decrease in incidence of the disease and reduction in hospitalization rather than impact on mortality. But in the countries with the highest incidence of these diseases, mortality remains high due to low availability of these vaccines, and millions of deaths could be averted by optimal use of vaccines in these regions. Major challenges for vaccination programmes are to maintain and strengthen trust in the benefits of vaccination and adapt immunization schedules according to the changing epidemiological landscape.

Keywords: Vaccination; Vaccines; Communicable Diseases.

RESUMO

Desde a sua introdução e aplicação universal, as vacinas têm sido utilizadas com sucesso reduzindo a morbilidade e mortalidade das doenças às quais se destinam, ao nível individual e através da imunidade de rebanho (imunidade colectiva). O impacto sobre a mortalidade foi rápido e de fácil avaliação no que se refere a algumas doenças, tal como a difteria, tosse convulsa e sarampo. Noutras doenças, incluindo a hepatite B e as infecções por papilomavírus humano (HPV), as mortes evitadas ocorrem muitos anos após a vacinação, tardando alguns anos até que todo o potencial da vacina possa ser estabelecido. Finalmente, em países de médios e elevados recursos, o impacto da vacina em algumas doenças, tal como na doença pneumocócica e na gastroenterite a rotavírus, é medido pela redução da incidência da doença e dos internamentos a ela associados, mais do que pelo impacto sobre a mortalidade. Contudo, nos países com uma elevada incidência destas doenças, a mortalidade permanece elevada devido à escassa disponibilidade destas vacinas e milhões de mortes poderiam ser evitadas através de uma utilização eficiente das vacinas nestas regiões. Os principais desafios dos programas de vacinação consistem em manter e fortalecer a confiança nos benefícios da vacinação e em adaptar os calendários de imunização ao contexto epidemiológico em constante evolução.

Palavras-chave: Doenças Transmissíveis; Vacinas; Vacinação.

Vaccination is one of the most cost-effective health interventions available, saving millions of people from illness and death each year.

The first vaccine was developed in 1796, against smallpox, but there was no widespread use until the 20th century.¹ Since then, highly effective vaccines for primary prevention have been developed against at least 26 diseases.¹ Using these vaccines in universal programs, targeting the susceptible (childhood) population as a whole, enables to gain maximal effects on disease reduction. For transmittable pathogens that circulate in humans only, universal vaccination programs have the potential to reduce or even stop transmission and thus eliminate the infection, through direct and indirect (herd immunity) protection. Herd immunity occurs when the vaccination of a significant portion of a population provides protection for non-immune, unvaccinated individuals, with less circulation of the disease and reduced risk of transmission between infected and susceptible subjects. Among the greatest success stories are the eradication of smallpox in 1979, and the polio eradication programme. Global efforts result for the latter

in a 99% decrease of cases since 1988, from an estimated 350 000 cases worldwide then, to 223 reported cases in 2012.²

The impact on the mortality related to vaccine preventable diseases has been rapid and easy to measure for some, such as diphtheria, pertussis and measles. In the early 1900s, 7 575 deaths were attributed to measles in the United States (US) (year 1920), 13 170 to diphtheria (year 1920) and 5 099 to pertussis (year 1922).¹ One century later, there are no more diphtheria cases (and related deaths) recorded, 18 pertussis-related deaths have been reported in 2012, but mainly among infants younger than 3 months of age, too young to be vaccinated and measles is (almost) eliminated, with an estimated 13.8 million deaths prevented by measles vaccination during 2000 – 2012 in the US.^{3,4}

For other diseases, deaths averted occur many years after vaccination. This is the case for hepatitis B and human papillomavirus (HPV) infections. Hepatitis B virus (HBV) infection may be acute or chronic, depending on the age at infection; 90% of infected infants and 30% of infected

1. Centre for the Evaluation of Vaccination. Vaccine and Infectious Disease Institute. University of Antwerp. Antwerp. Belgium.

Recebido: 06 de Março de 2014 - Aceite: 06 de Março de 2014 | Copyright © Ordem dos Médicos 2014



children aged < 5 years become chronically infected, with a risk for premature death from cirrhosis or hepatocellular carcinoma of 15%–25%. Universal vaccination programmes (newborn/infant and/or adolescents) protect the entire population before exposure to infection, thus preventing death in chronically infected persons at older age. After implementation of the national vaccination program in 1995, HBV prevalence in Korea declined from 6~8% to 2~3%, with a significant impact on liver cancer mortality rate compared to the period before vaccination (1991 - 1994).⁵

Vaccines against HPV were progressively introduced into national immunization programmes in European countries after their approval in 2006 and 2007. Although it is too soon to show the impact of the vaccine on cervical cancer mortality, vaccine efficacy against CIN3+ and adenocarcinoma in situ has been demonstrated.⁶ Modeling studies predict that it takes about 15 years after start of the HPV vaccination programme until vaccine induced effects can be seen and about 60 years until the full potential of the vaccine is established.⁷

Finally, the impact of vaccination against some other diseases (including invasive pneumococcal disease/IPD and rotavirus gastro-enteritis) in middle and high income countries is mainly measured by decrease in the incidence of the disease and reduction in hospitalization (and related reduction in economic costs) rather than impact on mortality. But in the countries with the highest incidence of these diseases, mortality remains high due to suboptimal use and/or low availability of these vaccines. An estimated 4% of global child deaths (approximately 300 000 deaths) in 2010 were attributed to rotavirus.⁸ The large majority of these deaths among under-fives were in low-income populations of Africa and Asia.⁸ Mathematical modeling conducted in 73 countries supported by the GAVI Alliance estimated that the projected use of vaccines for hepatitis B, yellow fever, *Haemophilus influenzae* type B (Hib), *Streptococcus pneumoniae*, rotavirus, *N. meningitidis* serogroup A, live attenuated Japanese encephalitis, human papillomavirus types 16 and 18, rubella, and measles-containing vaccines during 2011 – 2020 in these countries is expected to avert more than 23 million deaths, with the highest contribution by measles-containing vaccines.⁹

Besides impact on incidence and mortality of diseases, vaccination can have wider benefits. A review of the effect of immunization programs on antimicrobial utilization showed that vaccination against pneumococcal disease reduces the use of antibiotics by reducing the morbidity related to pneumococcal pneumonia and otitis media, and vaccination against influenza reduces the use of antibiotics to treat bacterial complications of influenza or prescribed

prophylactically in the fear of such complications.¹⁰

However, the success of vaccination programs also became its greatest enemy. With the decreasing incidence and related deaths following vaccination, some vaccine-preventable diseases are now considered as 'harmless childhood diseases', underestimating the benefits of vaccination. Alongside with increased attention for potential side effects, adverse media publicity and religious beliefs, vaccination coverage persists at a suboptimal level or can dramatically fall. Suboptimal coverage may result in flare up of diseases, such as measles and mumps in the United Kingdom after concerns about MMR vaccine and autism, or in delays in achieving elimination and eradication objectives. The latter was illustrated by the resurgence of poliomyelitis in Nigeria after Islamic community leaders claimed that the polio vaccines were unsafe and might cause infertility. And repeated measles outbreaks occurred in religious communities in the Netherlands, within the so-called bible belt, where religion forbids vaccination.

Furthermore, dynamics of vaccine-preventable diseases change over time, and immunization schedules need to be adapted according to the changing epidemiological landscape. Resurgence of pertussis has been described in several countries using pertussis vaccine, including the United Kingdom (UK), Belgium and the US. This increase of incidence might be related to inadequate coverage, use of imperfect (whole-cell) vaccines in the past, enhanced disease surveillance and early waning of immunity after vaccination with the current acellular pertussis vaccines.¹¹ In response to the increasing number of cases among infants, too young to be (completely) vaccinated, some countries recommend vaccination with a pertussis-containing vaccine of pregnant women (and other individuals who come into close contact with infants). In the UK, where a pregnancy vaccination programme was set up in October 2012, only two infants died from pertussis in 2013 (compared to 14 in 2012), whose mothers had not been vaccinated during pregnancy.¹²

In summary, since their introduction and widespread use, vaccines have been very successful in reducing morbidity and mortality of the diseases they target, at an individual level and through herd immunity. But the battle is not over. The major challenge for vaccination programmes is to maintain and strengthen trust in the benefits of vaccination.

CONFLICTS OF INTEREST

The authors declared no conflicts of interest.

FUNDING SOURCES

None stated.

REFERENCES

- Centers for Disease Control and Prevention. Impact of vaccines universally recommended for children — United States, 1900–1998. MMWR Morb Mortal Wkly Rep. 1999;48:243-8.
- World Health Organization. Fact sheet poliomyelitis. [Consulted 2014 Feb 11]. Available at <http://www.who.int/mediacentre/factsheets/fs114/en/>.
- Centers for Disease Control and Prevention. Fact sheets pertussis and diphtheria. [Consulted 2014 Feb 11]. Available at <http://www.cdc.gov>.
- Perry RT, Gacic-Dobo M, Dabbagh A, Mulders MN, Strebel PM, Okwo-Bele JM, et al. Global control and regional elimination of measles, 2000–2012. MMWR Morb Mortal Wkly Rep. 2014;63:103-7.
- Gwack J, Park SK, Lee EH, Park B, Choi Y, Yoo KY. Hepatitis B

- vaccination and liver cancer mortality reduction in Korean children and adolescents. *Asian Pac J Cancer Prev*. 2011;12:2205-8.
6. Lehtinen M, Paavonen J, Wheeler CM, Jaisamram U, Garland SM, Castellsagué X, et al. Overall efficacy of HPV-16/18 AS04-adjuvanted vaccine against grade 3 or greater cervical intraepithelial neoplasia: 4-year end-of-study analysis of the randomised, double-blind PATRICIA trial. *Lancet Oncol*. 2012;13:89-99.
 7. Horn J, Damm O, Kretzschmar ME, Deléré Y, Wichmann O, Kaufmann AM, et al. Estimating the long-term effects of HPV vaccination in Germany. *Vaccine*. 2013;31:2372-80.
 8. Liu L, Johnson HL, Cousens S, Perin J, Scott S, Lawn JE, et al. Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. *Lancet*. 2012;379:2151-61.
 9. Lee LA, Franzel L, Atwell J, Datta SD, Friberg IK, Goldie SJ, et al. The estimated mortality impact of vaccinations forecast to be administered during 2011-2020 in 73 countries supported by the GAVI Alliance. *Vaccine*. 2013;31:B61-72.
 10. Wilby KJ, Werry D. A review of the effect of immunization programs on antimicrobial utilization. *Vaccine*. 2012;30:6509-14.
 11. Guiso N. Bordetella pertussis: why is it still circulating? *J Infect*. 2014;68:S119-24.
 12. Public Health England. Vaccine Update. Issue 211, January 2014. [Consulted 2014 Feb 11]. Available at <https://www.gov.uk/government/publications/vaccine-update-issue-211-january-2014>.

Tinne LERNOUT, Heidi THEETEN, Elke LEURIDAN, Pierre VAN DAMME

Do Vaccines Save Lives? Yes They Do!

Acta Med Port 2014;27:160-162

Publicado pela **Acta Médica Portuguesa**, a Revista Científica da Ordem dos Médicos

Av. Almirante Gago Coutinho, 151

1749-084 Lisboa, Portugal.

Tel: +351 218 428 215

E-mail: submissao@actamedicaportuguesa.com

www.actamedicaportuguesa.com

ISSN:0870-399X | e-ISSN: 1646-0758



ACTA MÉDICA
PORTUGUESA

