Vaccine 30S (2012) B26–B36

Contents lists available at SciVerse ScienceDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine

The changing and dynamic epidemiology of meningococcal disease☆

Scott A. Halperin[a,*], Julie A. Bettinger[b], Brian Greenwood[c], Lee H. Harrison[d], Jane Jelfs[e], Shamez N. Ladhani[f], Peter McIntyre[e], Mary E. Ramsay[f], Marco A.P. Sáfadi[g]

[a] Canadian Center for Vaccinology, Dalhousie University, the IWK Health Centre, and Capital Health, Halifax, Canada
[b] Vaccine Evaluation Center, British Columbia Children's Hospital and the University of British Columbia, Vancouver, Canada
[c] London School of Hygiene & Tropical Medicine, London, UK
[d] Infectious Diseases Epidemiology Research Unit, University of Pittsburgh, Pittsburgh, USA
[e] National Centre for Immunisation Research & Surveillance, Westmead, Australia
[f] Health Protection Agency, London, UK
[g] Faculdade de Medicina da Santa Casa de São Paulo, São Paulo, Brazil

ARTICLE INFO

Article history:
Received 24 October 2011
Received in revised form 4 December 2011
Accepted 5 December 2011
Available online 15 December 2011

Keywords:
Neisseria meningitidis
Meningococcus
Epidemiology
Surveillance

ABSTRACT

The epidemiology of invasive meningococcal disease continues to change rapidly, even in the three years since the first Meningococcal Exchange Meeting in 2008. Control of disease caused by serogroup C has been achieved in countries that have implemented meningococcal C or quadrivalent meningococcal ACWY conjugate vaccines. Initiation of mass immunization programs with meningococcal A conjugate vaccines across the meningitis belt of Africa may lead to the interruption of cyclical meningococcal epidemics. A meningococcal B vaccination program in New Zealand has led to a decreased incidence of high rates of endemic serogroup B disease. Increases in serogroup Y disease have been observed in certain Nordic countries which, if they persist, may require consideration of use of a multiple serogroup vaccine. The imminent availability of recombinant broadly protective serogroup B vaccines may provide the tools for further control of invasive meningococcal disease in areas where serogroup B disease predominates. Continued surveillance of meningococcal disease is essential; ongoing global efforts to improve the completeness of reporting are required.

1. Introduction

In 2008, at the first Meningococcus Scientific Exchange Meeting in Siena, Italy, Harrison et al. reviewed the global epidemiology of meningococcal disease [1]. In that review, it was stressed that the nature and quality of the surveillance undertaken in a region has a direct bearing on the reported incidence of invasive meningococcal disease (IMD). The ideal of population-based, active surveillance with clinical cases confirmed by laboratory testing and strain characterization is still not attainable in most places in the world. Instead, combinations of syndromic surveillance, active and passive surveillance, sentinel surveillance, and laboratory-based surveillance are used, making comparison between jurisdictions difficult and calculation of true incidence impossible. Changes in the epidemiology of IMD over time can be described with some accuracy in regions where surveillance methodology has remained consistent. The purpose of this review is to provide an update on the global epidemiology of IMD in the 3 years since the first Meningococcus Scientific Exchange Meeting. The effects of implementation of universal meningococcal C (MenC) or quadrivalent meningococcal ACWY (MenACWY) conjugate vaccines in various regions will be described, as will the long-awaited implementation of the meningococcal A conjugate vaccine (MenA) program in the African meningitis belt. Additional details related to the epidemiology of meningococcal B strains will also be provided in anticipation of the licensure of meningococcal B vaccines (MenB) in the near future.

2. Description of the pathogen

Neisseria meningitidis is a gram-negative diplococcus which colonizes the pharynx and upper respiratory tract. Thirteen serogroups have been identified based on unique capsular polysaccharides; 6 serogroups cause virtually all human disease (A, B, C, W, X, Y) [2]. The reported incidence of IMD varies by region, ranging from less than 0.5 cases per 100,000 in North America and just under 1 case per 100,000 in Europe up to 10–1000 cases per 100,000 during epidemic years in Africa (Table 1). The serogroups causing IMD also vary geographically, with serogroup A disease occurring

☆ Presented in part at the Meningococcus Scientific Exchange Meeting "Towards a meningitis free world", July 2–3, 2011, Siena Italy, sponsored by Novartis Vaccines.

* Corresponding author at: Canadian Center for Vaccinology, Dalhousie University, IWK Health Centre, 5850/5980 University Avenue, Halifax NS B3K 6R8, Canada. Tel.: +1 902 470 8141; fax: +1 902 470 7232.
E-mail address: scott.halperin@dal.ca (S.A. Halperin).

0264-410X/$ – see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.vaccine.2011.12.032

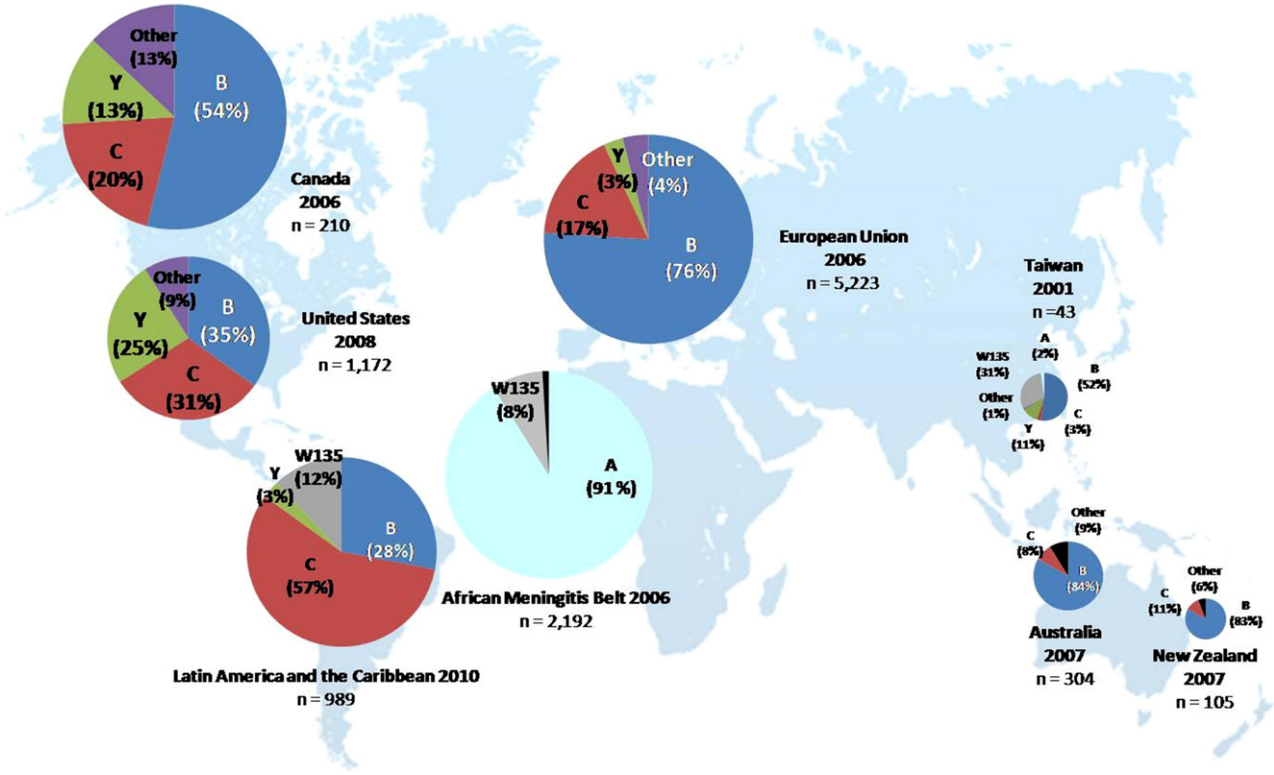

Fig. 1. Proportion of meningococcal disease by serogroup by geographic region.

in Africa and areas of Asia and B and C disease predominating in many other regions (Fig. 1).

3. Meningococcal epidemiology, by region

3.1. Africa and Asia

3.1.1. Africa

The geography of Africa varies from desert to tropical rain forest and so it is not surprising that the epidemiology of IMD, strongly influenced by climate, varies markedly across the continent. Different patterns of IMD are seen in North Africa, the Sahel and sub-Sahel, and in Africa south of the sub-Sahel.

3.1.1.1. North Africa. The epidemiology of IMD in North Africa was systematically reviewed in 2005 by the Middle East & North Africa (MENA) Vaccine-Preventable Diseases Regional Advisory Group [3]. Few recent reports were found. However, it appears that the epidemiology of IMD in North Africa is similar to that seen in the Middle East, with a low level of endemic infection punctuated by occasional outbreaks. There has been no report of a major epidemic of meningococcal disease in North Africa since this review was undertaken. The incidence of meningococcal disease in Egypt, where large epidemics of serogroup A disease occurred in the past [4], is now low with an increased proportion of cases due to serogroup B infections, perhaps a consequence of the introduction of routine immunization of schoolchildren with serogroup A + C polysaccharide vaccines [5].

Table 1
Invasive meningococcal incidence by country or region.

Country/region	Incidence/100,000	Year
African meningitis belt	10–1000 (during epidemics)[a]	Not applicable
New Zealand	2.4	2010
Australia	1.2	2009
Europe	0.92	2009
Chile	0.5	2010
Argentina	0.6	2008
Canada	0.47	2008
United States	0.28	2009

[a] The annual incidence during serogroup A epidemics in the meningitis belt can exceed 1000 cases per 100,000 population.

3.1.1.2. The Sahel and sub-Sahel. Information on the incidence of meningitis in 13 countries in the African meningitis belt is now collected on a weekly basis by the WHO Multi-Disease Surveillance Centre (MDSC), Ougadougou, Burkina Faso [6]. Although etiology is known for only a proportion of these cases and there is likely to be bias in the selection of the cases that are investigated, weekly MDSC reports provide a very valuable, up-to-date picture of the evolution of meningococcal disease within the African meningitis belt. There has been sustained disease activity within the belt during the past five years (Fig. 2). Serogroup A meningococci were responsible for the majority of cases in 2007–2009, including an outbreak with 26,878 cases in Burkina Faso in 2007 (Table 2). In 2010 and 2011, serogroup W135 has predominated, especially in Niger, where the epidemic W135 strains isolated belonged to clonal complex ST-11 [7]. Few serogroup A infections have been detected during the past two years except in Chad and neighboring northern Cameroon [6] suggesting a low level of circulation of serogroup A meningococci within the African meningitis belt at the present time. This view is supported by results from a series of carriage studies conducted across the meningitis belt by partners in the African Meningococcal Carriage Consortium in 2010 which identified serogroup A carriage only in Chad, while another study in Burkina Faso also found few serogroup A carriers (Greenwood, personal communication).

The low level of circulation of serogroup A meningococci across the meningitis belt has come at the time of the introduction of a new MenA conjugate vaccine (MenAfriVac™) developed by the Meningitis Vaccine Project (MVP) with support from the Bill & Melinda