Journal of Infection and Public Health (2016) xxx, xxx—xxx

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Streptococcus pneumoniae carriage among healthy and sick pediatric patients before the generalized implementation of the 13-valent pneumococcal vaccine in Morocco from 2010 to 2011

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Received 3 September 2015; received in revised form 17 February 2016; accepted 24 February 2016

KEYWORDS
Streptococcus pneumoniae;
Nasopharyngeal carriage;

Summary Nasopharyngeal carriage studies provide insights into the local prevalence of circulating pneumococcal serotypes. These data are critical to vaccination monitoring, as they allow for the prediction and assessment of impact. Very little data are available on the carriage of pneumococcal serotypes in Morocco. Here, we describe the prevalence of *Streptococcus pneumoniae* carriage and serotype distribution among 697 pediatric patients with ages ranging from 2 to 59 months who were admitted to a Moroccan hospital with severe pneumonia, as well as 195

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http://dx.doi.org/10.1016/j.jiph.2016.02.012

Please cite this article in press as: Jroundi I, et al. *Streptococcus pneumoniae* carriage among healthy and sick pediatric patients before the generalized implementation of the 13-valent pneumococcal vaccine in Morocco from 2010 to 2011. J Infect Public Health (2016), http://dx.doi.org/10.1016/j.jiph.2016.02.012

Children;
Serotypes;
Pneumococcal conjugate vaccines

healthy infants and young children who were recruited at a vaccination clinic. Carriage rates were 40.5% (79/195) for healthy children and 22.8% (159/697) for sick children. The most commonly observed circulating serotypes included 6A, 6B and 19F, all of which are included in the current 13-valent anti-pneumococcal conjugate vaccine that was recently introduced in Morocco. Monitoring of circulating serotypes remains necessary after vaccine introduction to assess whether serotype replacement is occurring.

Background

Pneumococcal disease is the leading cause of vaccine preventable deaths, and *Streptococcus pneumoniae* is estimated to be responsible for 11% of all deaths in children less than five years of age worldwide, mostly due to community-acquired pneumonia [1]. Nasopharyngeal colonization is known to play an important role in the development and transmission of pneumococcal disease. Infants and young children are considered to be the main carriers of this pathogen [2]. Studies show that it is essential to prospectively monitor circulating pneumococcal serotypes to predict and assess the impact of the vaccine introduction in a given community and also determine whether serotype replacement may be occurring [3].

Pediatric pneumonia remains a major public health challenge in Morocco; a middle-income country in Northern Africa. A recent study conducted in 2010 in a tertiary hospital that involved admitted children less than five years of age with clinically severe pneumonia reported that the etiologies of pneumonia were mostly viral. Additionally, the bacterial pathogens were rarely isolated, affecting only 3.5% of the patients [4]. In 2010, the Moroccan Ministry of Health introduced the pneumococcal (13-valent) conjugate vaccine into its expanded program of immunization (EPI) [5]. Due to the lack of available data in Morocco [6], we aimed to investigate pneumococcal carriage and serotype distribution among healthy infants recruited at vaccination clinics and sick children admitted with a diagnosis of severe pneumonia at a hospital in Morocco.

Material and methods

Study region and population

The study was conducted at the *Hôpitald'Enfants de Rabat* (HER), the only public hospital dedicated to children in the region, and at four heath centers located in the region of Rabat-Salé-Zemmour-Zair (RSZZ Rabat province). The proportion of children under five in the region of RSZZ has been estimated to be 5.66% [5].

Study design

The study population was recruited from HER and consisted of patients admitted for severe clinical pneumonia according to WHO definition [7] during a one-year survey from November 2010 to December 2011. These subjects were recruited as part of a wider research protocol attempting to define the epidemiology and etiology of respiratory distress at HER [4]. Healthy children who were visiting primary health care centers in the province of Rabat for routine vaccination were also recruited from February to March of 2011. These sites were selected randomly from a list of primary health care providers in the region RSZZ. The sample size for the community study ($n = 200$) was calculated based on the preliminary carriage rates observed at HER in children with WHO-defined severe clinical pneumonia [4].

Data collection

Children were recruited only after the parents or legal guardians signed an informed consent form. The study team then administered standardized questionnaires and obtained nasopharyngeal samples from the children using a mini culturette extra-thin flexible wire swab, in addition to other procedures explained elsewhere [4].

Laboratory methods

The nasopharyngeal cultures were added to tubes containing Stuart Transport Medium. Samples were processed (homogenized, aliquoted and frozen at $-70^{\circ}C$) on a daily basis. Nasal samples were cultured using conventional methods and bacterial

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