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Using pneumococcal and rotavirus surveillance in vaccine decision-making: A series of case studies in Bangladesh, Armenia and the Gambia

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ABSTRACT

Pneumonia and diarrhea are the leading causes of child morbidity and mortality globally and are vaccine preventable. The WHO-coordinated Global Rotavirus and Invasive Bacterial Vaccine-Preventable Disease Surveillance Networks support surveillance systems across WHO regions to provide burden of disease data for countries to make evidence-based decisions about introducing vaccines and to demonstrate the impact of vaccines on disease burden. These surveillance networks help fill the gaps in data in low and middle-income countries where disease burden and risk are high but support to sustain surveillance activities and generate data is low. Through a series of country case studies, this paper reviews the successful use of surveillance data for disease caused by pneumococcus and rotavirus in informing national vaccine policy in Bangladesh, Armenia and The Gambia. The case studies delve into ways in which countries are leveraging and building capacity in existing surveillance infrastructure to monitor other diseases of concern in the country. Local institutions have been identified to play a critical role in making surveillance data available to policymakers. We recommend that countries review local or regional surveillance data in making vaccine policy decisions. Documenting use of surveillance activities can be used as advocacy tools to convince governments and external funders to invest in surveillance and make it a priority immunization activity.

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1. Introduction

Pneumonia and diarrhea are leading causes of childhood death, accounting for 24% (1.4 million) of global under-five deaths in 2015 [1]. A large proportion of pneumonia cases are caused by *Streptococcus pneumoniae* (pneumococcus) and diarrhea cases by rotavirus [2]. Pneumococcus, along with other pathogens like

Haemophilus influenzae type b (Hib) can lead to other clinical diseases such as meningitis and sepsis [3]. Disease caused by pneumococcus, Hib and rotavirus are vaccine-preventable [2].

The World Health Organization (WHO)-coordinated Global Invasive Bacterial Vaccine-Preventable Disease (IB-VPD) Surveillance Network (GISN) and the Global Rotavirus Surveillance Network (GRSN) were established in 2008 building on existing surveillance systems across all WHO regions [4]. The main objectives of surveillance for IB-VPD (which includes conditions like pneumonia, meningitis and sepsis) and pediatric diarrhea are to provide burden of disease data for countries to make evidence-based decisions about introducing vaccines and to demonstrate the impact of vaccines on disease burden. Each surveillance network includes a laboratory component that contains national,

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regional and global laboratories that identify the cause of disease and help characterize prevalent strains or serotypes/serogroups/g enotypes of strains of disease. The WHO has played a key role in advocating, establishing and sustaining VPD surveillance globally. WHO has advocated for and provided technical input for the creation of National Immunization Technical Advisory Groups (NITAGs) which use disease burden data generated from VPD surveillance and cost-effectiveness data in vaccine policy decision-making [5,6]. Gavi, the Vaccine Alliance has also helped support disease surveillance in low and middle-income countries (LMICs) and in recent years has provided financial support for components of the WHO-coordinated surveillance networks. Participation in the global surveillance networks is voluntary. As of 2016, 58 countries and 123 sentinel sites report data to GISN and 59 countries and 134 sentinel sites report data to GRSN [7]. Availability of disease burden and vaccine impact data is essential in making evidence-based vaccine policy decisions especially in LMICs where there is high disease burden but multiple competing health priorities limit resources [8].

The primary objective of this paper is to demonstrate the importance of the country-based IB-VPD and rotavirus surveillance in informing country level vaccine policy and also how the existing network infrastructure can be leveraged for surveillance of other diseases.

2. Materials and methods

Three case studies were conducted to evaluate the importance of the GISN and GRSN in vaccine decision-making in selected countries: Bangladesh, Armenia and The Gambia (see Table 1). These countries were included in this study because all conduct high quality surveillance as they meet highest performance criteria as determined by WHO [9]. These countries also represent countries with different income levels, Gavi funding eligibility status and regional locations (see Table 1).

Published literature and Gavi country applications were reviewed to map out how surveillance data were used in the decision-making. Published literature included studies from case study countries that reported use of IB-VPD or rotavirus surveillance data in informing vaccine introduction decisions and Hib, pneumococcal conjugate vaccine (PCV) or rotavirus vaccine impact and cost-effectiveness. Gavi country documents included country application forms for support for Hib vaccine, PCV and rotavirus vaccines and joint appraisal reports for each country [10].

Discussions with key country, regional and global stakeholders were conducted to report their perspective on how WHO sentinel surveillance networks have been used in the country to inform vaccine policy and how existing surveillance infrastructure is being leveraged.

3. Results

These country case studies showed how pneumococcal and rotavirus surveillance have been used for vaccine decision-making and how surveillance platforms have been leveraged to build surveillance capacity for other VPDs.

Table 1
Case study countries by income level, Gavi eligibility status, and WHO Region.

Country	World bank income level	Gavi eligibility status	WHO Region
Bangladesh	Low-income	Eligible (Preparatory transition phase)	South East Asia
Armenia	Lower middle-income	Eligible until end of 2017 (Accelerated transition phase)	European
The Gambia	Low-income	Eligible	African

3.1. Bangladesh

Bangladesh is a lower-middle income country in the WHO South East Asian Region [11]. In Bangladesh, there were about 15% deaths due to pneumonia, 15% deaths due to sepsis or meningitis and 6% deaths due diarrheal disease among children under five years in 2015 [1].

Bangladesh is a Gavi-eligible country and has entered the preparatory transition phase as of 2017. The country will next enter the accelerated transition phase and in 5 years should reach fully self-financing status and lose Gavi support. Bangladesh has received Gavi support for the introduction of the pentavalent vaccine (which contains Hib, diphtheria, pertussis, tetanus and Hepatitis B) (in 2009) and PCV (in 2015) among other vaccines. The country has already applied for Gavi support for the rotavirus vaccine and is expected to introduce the vaccine in 2018 [12].

Bangladesh currently has 4 sentinel sites that participate in GISN and has been a part of the GISN since 2008. The country had conducted pneumococcal surveillance prior to joining the GISN. To support laboratory assisted sentinel surveillance, Bangladesh has one of the best performing laboratories in the GISN as per the external quality assessment program conducted by the WHO laboratory network and site visits made by external experts (Fatima Serhan, personal communication). The country conducts sentinel surveillance for rotavirus using the WHO-recommended methodology but does not currently report data to WHO [13].

3.1.1. Using surveillance data in vaccine policy decision-making

Asia has major gaps in knowledge of the burden of Hib and pneumococcal disease and Hib vaccine and PCV impact data [9]. However, Bangladesh is an exception in the region. Surveillance was used to show the dramatic impact of Hib vaccine, which was introduced in the country in 2009. A study using data from 2 surveillance hospitals in Dhaka showed reduction in confirmed Hib meningitis cases from 92 to 12 cases per 100,000 within 1 year of vaccine introduction [14]. This study suggested that the Hib vaccine prevented about 14,000 cases of Hib meningitis among infants in the country one year after Hib introduction.

Bangladesh has also used surveillance data to inform decisions regarding selection of the most appropriate pneumococcal vaccines. Bangladesh's Gavi application for PCV10 cited results from surveillance data, which showed high invasive pneumococcal disease (IPD) burden in young age groups and that a large proportion of disease was caused by the serotypes in PCV10. The application also highlighted how these results informed the National Committee for Immunization Practice to make PCV10 introduction a priority in reducing child mortality in the country [15].

A facility-based surveillance study in Bangladesh found serotype 2, a serotype not covered by PCV10 or 13, to be a major cause of childhood meningitis [16]. The authors of this study acknowledge that recent IPD reports do not report high prevalence of this serotype, which in part may have to do with the challenges in detection of the serotype. This finding suggests that ongoing surveillance after PCV10 introduction in the country is important to track shifts in prevalence of vaccine and non-vaccine serotypes like serotype 2 and help inform future pneumococcal vaccine formulation and introduction decisions.

Bangladesh has also developed a population-based surveillance site in Mirzapur for IB-VPD surveillance. There are very few population-based IB-VPD surveillance sites in Asia, and this site is one of the 2 population-based surveillance sites in the GISN. Since the population under surveillance is known, this approach allows

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