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Health Related to Pneumococcal Carriage among the Pediatric Population of Jordan

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One of the most important developmental challenges identified in Jordan is the poor quality of primary healthcare services. The constraints to Jordan's future development include large family sizes, lack of sufficient high quality maternal and child healthcare services, a significant unmet demand for high quality maternal and child health services, and a significant increase in the prevalence of chronic diseases such as diabetes, hypertension, obesity and the increase of infectious diseases with the related bacterial agents which shows high resistance to many antibiotics. The described research was conducted by the German Jordanian University, together with the assistance of the National Reference Center for Streptococcus in Aachen/Germany.

In Jordan, 49% of the total population are children below 19 years of age. Pneumonia, a lung infection caused by many types of organisms, caused death of one third of pneumonia cases before the discovery of antibiotics. Streptococcus pneumoniae, an infectious agent causing meningitis, pneumonia, and bacteremia especially in young children

and mainly in low income countries where pneumococcal conjugate vaccines (PCVs) are still underused. In countries where PCVs have been introduced, much of their efficacy has resulted from their impact on nasopharyngeal (NP) carriage in vaccinated children, so that understanding the epidemiology of carriage for *S. pneumoniae* and other

common respiratory bacteria in developing countries is crucial for implementing appropriate vaccination strategies and evaluating their impact. Nasopharyngeal (NP) colonization of *Streptococcus pneumoniae* (*S. pneumoniae*) in infants is generally acquired at approximately four to six months of age. It is considered as a prerequisite for a disease, but unlike children, carriage in elderly is rarely detected.

S. pneumoniae is a common colonizing agent of the respiratory tract, mostly symptomless, however, it can progress to other body sites causing pneumonia or systemic disease. An important feature is that pneumococcal disease will not occur without preceding nasopharyngeal colonization with the homologous strain, therefore pneumococcal carriage is believed to be an important source of horizontal spread of this pathogen within the community. Increased prevalence of *S. pneumoniae* in healthy children's nasopharynx reflects a potential risk to develop more frequently respiratory infections in the community.

Streptococcus pneumoniae was given the name as the forgotten killer in children in 2006 by the WHO, which

accounts for more than one third of acute bacterial sinusitis and more than one half of community-acquired bacterial pneumonia. It remains a major cause of childhood morbidity and mortality, where at least 1.2 million children die of pneumococcal infections each year as stated by the WHO in 2007, 70% of them in Africa and southeast Asia respectively mostly in developing countries.

In general, resistance of *S. pneumoniae* to antibiotics made the treatment more difficult, particularly for young children attending the day care. On the other hand, emergence of penicillin- and cephalosporin-resistant strains have created an urgent need for pneumococcal vaccines that are effective in infants. Pneumococcal vaccines containing capsular polysaccharides of five (6B, 14, 19F, 18C, 23F) and seven (4, 6B, 9V, 14, 19F, 18C, 23F) serotypes have been shown to be safe and immunogenic in children. Despite the fact that this bacteria is found as normal flora in the environment, it resides in the nasopharynx of healthy carriers. When presented in small densities it is considered to be non-pathogenic, but if the densities increase significantly, it turns to be pathogenic and causes a lot of diseases, due to the fact



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that it disseminates to other body parts. The parts that get infected in the host body are usually, the respiratory tract, sinuses, and nasal cavity. The diseases that can be caused by *S. pneumoniae* are: pneumonia, septicaemia, bacteraemia, otitis media, acute sinusitis, and meningitis. All these are associated with high morbidity and mortality. Pneumococcal infections are particularly common in younger children and in older adults and may be divided broadly into invasive and non-invasive disease. Pneumonia is one of the most common clinical presentations of pneumococcal infection and may itself be invasive or non-invasive. It can be transmitted by sneezing, coughing, and direct contact with an infected person.

Although there are differences in the prevalence and rank order of serotypes obtained from NP specimens and from those with invasive diseases, pneumococcal nasopharyngeal isolates may reflect the strains circulating in the community and may be used as a marker to predict serotype prevalence of invasive disease and resistance patterns. The information about pneumococcal strains found in Jordanian children and NP carriage of infants is limited and does not include children living in rural regions. Monitoring serotype distribution is essential for the appropriate application of vaccination. Vaccine use in infants proves to be highly efficacious in the prevention of invasive pneumococcal disease as well as in decreasing the carriage of vaccine

serotypes in the nasopharynx of infants which impacted significantly in the long run on Otitis media infection and helped decrease the infection rates among contacts of these infants. The result has been a decrease in the pneumococcal infection rate among elderly contacts of these infants and decrease colonization with pneumococci.

Objectives

Although the 13-valent pneumococcal conjugate vaccine (PCV13) is available in the market since 2010, research on *S. pneumoniae* showed that more than 70-85% of all *S. pneumoniae* cases in the United States of America and Europe can be covered and prevented by the 7-valent pneumococcal conjugate vaccine Prevenar (PCV7). This coverage is different according to the country. In Jordan, PCV was introduced without any previous studies and without any preliminary clinical studies of the serotypes or capsular types found. Furthermore, there are no published data about the infections caused by *Streptococcus pneumoniae* from Jordan. Moreover, data from the statistical department of the Ministry of Health showed that only non-meningococcal meningitis in Jordan is registered without indicating the exact cause, knowing the fact that pneumococci is a major causative agent which covers about 20% of these cases. Based on these facts, the main aim of the following study, is to determine the rate of carriage, the prevalence

of antimicrobial resistance among isolates of streptococcus pneumoniae, and find out the serotypes circulating in the community which are responsible for the majority of the diseases caused by this infectious agent, then find out the coverage of the vaccines available.

Methods

The GJU found out that 847 nasopharyngeal swabs were taken from healthy Jordanian children. Swabs were cultivated on sheep blood agar. Suspected alpha hemolytic isolates were tested from the GJU for optochin sensitivity and bile solubility for identification. Isolates were analyzed for antimicrobial susceptibility and the serotyping was performed using the Neufeld Quellung method with serotypes obtained from the Satens Serum Institute in Copenhagen, Denmark.

Results

We found out that the total pneumococcal carriage was 36.7%. The total coverage of PCV7, PCV10 and PCV13 was 37.6%, 37.9%, 52.4%, respectively. The coverage of multiresistant isolates by PCV7, PCV10 and PCV13 was 54.7%, 54.7% and 72.3%. Rate of carriage for cases below six months of age was 39.9%, so that 52.8% can be covered by the PCV13. The carriage was highest in the age group

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7 to 12 (52.6%). Resistance rates were as follows: penicillin (88.7%), clarithromycin (57.6%), clindamycin (32.8%), trimethoprim-sulfamethoxazole (48.6%), tetracycline (49.2%). Multiresistance was 51.1% in all samples. 180 isolates were macrolide resistant, where 78 isolates (42.1%) were M-phenotype and 55.6% were cMLSB, one isolate was iMLSB (0.6%). Predominant serotypes were 19F (14.7%), 6B (9.7%), 6A (9.0%), 23F (8.7%), 11A (8.0%).

Conclusions

The GJU together with the National Reference Center for Streptococcus can conclude that there was a significant difference in carriage of pneumococci in all cities. But the resistance is relatively high. Localizing specific serotypes among specific areas is recommended for a better control with the available PCVs.



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