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Nasopharyngeal swabs of school children, useful in rapid assessment of community antimicrobial resistance patterns in *Streptococcus pneumoniae* and *Haemophilus influenzae*

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Abstract

Objectives: The present study evaluates the feasibility of rapid surveillance of community antimicrobial resistance (AMR) patterns of *Streptococcus pneumoniae* and *Haemophilus influenzae* in India using nasopharyngeal swabs (NPSs) of school children. It compares the AMR data obtained with that of invasive and nasopharyngeal (NP) isolates studied previously. No one has done such surveillance since our study so we decided to publish and more clearly demonstrate the feasibility of the methodology we did.

Study Design and Setting: This community-based, cross-sectional, cluster sample study had seven centers; each had two sites distant to them. Two hundred sixty school children per center were enrolled. NP swabbing was performed and isolates identified as *S. pneumoniae* and *H. influenzae* at each center were sent to reference laboratories.

Results: From January to December 2004, 1,988 NP swabs were processed; 776 *S. pneumoniae* and 64 *H. influenzae* were isolated. The AMR patterns for *S. pneumoniae* to co-trimoxazole varied, with sensitivity as low as 6% in Mumbai, 29% in Chennai and Vellore, and 100% in Delhi and Lucknow. For *H. influenzae*, sensitivity rates to co-trimoxazole ranged from 22% to 62%. The AMR patterns for both bacteria in the present study with data from invasive and NP isolates studied earlier were similar.

Conclusion: The study demonstrates that it is practical and feasible to rapidly assess the AMR patterns of both *S. pneumoniae* and *H. influenzae* in NPSs of school children in different geographic locations all over India.

Keywords: Antimicrobial resistance; Rapid; *Streptococcus pneumoniae*; *Haemophilus influenzae*; Community; Surveillance; Nasopharyngeal

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1. Introduction

Streptococcus pneumoniae and *Haemophilus influenzae* are two of the most common bacterial pathogens causing respiratory infections especially among children in developing countries [1]. Drug-resistant *S. pneumoniae* has emerged as a problem of global concern, with some European and Southeast Asian countries having very high levels of resistance [2,3]. Surveillance of antimicrobial resistance (AMR) helps to develop rational evidence-based antimicrobial policy [1]. However, isolation of invasive infection for surveillance is difficult and costly over long periods; conventional AMR surveillance using invasive isolates takes 3 years to get 150 isolates of *S. pneumoniae* [4−10]. Clearly there is a need for a more rapid and efficient system of determining community AMR patterns in resource poor setting. Given the geographic diversity of India, documenting potential differences in AMR patterns for these bacteria is very important.

The use of nasopharyngeal swabs (NPSs) has been documented in animal and human studies [11]. They have been found better than pharyngeal swabs [12] and are relatively easier, have a higher yield than detecting invasive infection [13].

A study by Lieberman et al. [36] compared the isolation rates of *S. pneumoniae* and *H. influenzae* in adults using NPSs, NP washing, and oropharyngeal swabs (OPSs). The NPS was able to detect 89% of the *S. pneumoniae* when compared with 30% by the OPS, whereas it was able to pick up 64% of the *H. influenzae* when compared with 49% by the OPS. Both the NPS and OPS performed equally well.

The uses of NPSwabs include screening healthy children (colonization rates 15−50% [2,16−19]), assessing the risk factors for pneumonia [20,21], epidemiological tools in sick hospitalized patients [2,22,23] including the effect of antibiotic cycling [24], in community studies to follow the antibiograms of bacteria following changes in antibiotic policy [25], to compare antibiograms of healthy children, and children with infections [26−28,34] who are in contact with screening [29].

A study [17] in Vellore when looking at the dynamics of colonization in the nasopharynx of children aged 18 months found that 81% had pneumococcal colonization.

The IndiaCLEN network has a study group—Invasive Bacterial Infection Study Group (IBIS)—that has previously studied the antibiograms of invasive *S. pneumoniae* and *H. influenzae* [1,4]. These were IBIS phase 1 from 1993 to 1998 and IBIS phase 2 from 1998 to 2002. The invasive isolates of these two bacteria from children in six tertiary care centers around India were studied. The group also studied the antibiograms of these two bacteria from children attending the medical centers from 1998 to 2002, from their NPSs (IBIS NP).

The group also studied the antibiograms of these bacteria from NPSs of school children in the community living close to large tertiary care center—the Community Antimicrobial Resistance Study (CAMR)—from 1999 to 2002 (personnel communication). The correlation of the antibiograms of these studies is seen in Figs. 1 and 2.

As India is a large country with relatively few tertiary care centers, the need for regular surveillance of AMR of these two important pathogens in a cost-effective and timely manner arose.

The aim of the present study was to evaluate the feasibility of rapidly assessing community AMR pattern surveillance of *S. pneumoniae* and *H. influenzae* using the NPSs, and an existing network (IndiaCLEN) working in collaboration with other smaller medical centers distant from the centers and geographically distributed all over India. This study was called the CAMR extension study as we were now looking at a rapid method of getting isolates from rural and urban sites from all over India, distant from the original tertiary care centers. During this study, it was not feasible to get data on invasive isolates of these bacteria concurrently. (However, data from IBIS NP and CAMR are concurrent and have been shown in the figures.)

These data were then compared with the data obtained from invasive isolate (IBIS) and NP isolates (CAMR) of *S. pneumoniae* and *H. influenzae* identified in earlier surveillance studies by the IndiaCLEN network. No one has done surveillance since our study so we decided to publish and more clearly demonstrate the feasibility of the methodology we did. The study is of relevance today, as quick, efficient, cost-effective surveillance mechanisms are the need of the hour and surveillance systems in India are evolving.

2. Subjects and methods

Seven tertiary teaching hospitals in India were selected based on an existing partnership on IndiaCLEN IBIS network [1]. They are 1) Christian Medical College, Vellore; 2) King George Medical College, Lucknow; 3) All India Institute of Medical Sciences, New Delhi; 4) Government Medical College, Nagpur; 5) MGR University, Chennai; 6) Trivandrum Medical college, Thiruvananthapuram, and the 7) Lokmania Tilak Memorial Hospital, Mumbai. The study was cleared by the ethics committees of all the participating centers and by the institutional review board setup by International Clinical Epidemiology Network (INCLEN). Permission was also obtained from appropriate community leaders and education department officials at each center. Informed consent was obtained from parents of children participating in the study.

2.1. Study design

The study was a community-based cross-sectional, cluster sample design conducted between January to December 2004.

2.2. Sample size

To detect 10% penicillin resistance, the sample size required per participating center was estimated to be 130.