# Defeating Meningitis in Northern Nigeria: *Streptococcus pneumoniae* Jigsaw

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## A. Background

- *Streptococcus pneumoniae* (pneumoococcus) is among the leading cause of meningitis in all age and risk groups in Northern Nigeria
- Though, the 10-valent pneumococcal conjugate vaccine (PCV10;Synflorix™) is offered routinely nationwide (PCV10 protects against 10 invasive *S. pneumoniae* serotypes), the prevalence of invasive pneumococcal diseases (IPDs) such as meningitis remain high.
- Exacerbating the challenge are: 1. PCV10 vaccine coverage remain sub-optimal (≤54.5% vaccine ,coverage) 2.The region (Northern Nigeria) is populated by above national average of vulnerable groups to invasive pneumococcal diseases (IPDs) including meningitis such as sickle cell diseases-, malnourished-, paediatric/adult HIV/AIDS-patients, internally displaced persons and 3. Lack of national surveillance system to meningitis aetiologies

Figure : Map of Study Area located within Africa Meningitis Belt

## B. Aims

- To generate data for the optimization of PCV use in risk groups as well as healthy control in Northern Nigeria
- Antibiotic susceptibilities data for *S. pneumoniae* serotypes
- Archive s of samples/isolates for further study

## C. Hypothesis

- Vulnerable groups lacking robust immune systems are susceptible to carriage and IPDs such as meningitis with diverse, invasive, non-invasive and multidrug-resistant *S. pneumoniae* serotypes compared to healthy cohort

## D. Methodology

- Study Design/Period: Cross –sectional/ October,,2023 – July,2024.
- Study Area: Federal Teaching Hospital (FTH) Gombe Gombe State , Abubakar Tafawa Balewa University Teaching Hospital (ATBUTH)Bauchi Bauchi State , Federal Medical Centre (FMC) Nguru Yobe State and Jos University Teaching Hospital (JUTH) , Jos Plateau State. (Fig. 1)
- Study Participant: Children ≤5 years ( for nasopharyngeal (NP) carriage study) and all age groups ( for IPDs study)
- Study Ethics: Informed consent of participants/ parents/ guardians and ethical approval from participating institutions
- Sample Size: 600 NP samples and 1350 IPDs ( blood, cerebrospinal fluid and broncho-alveolar lavage) clinical specimens
- Sample collection: WHO protocol for NP carriage and IPDs specimens
- Epidemiological Study: Socio-demographic and medical history of study participants
- Microbiological Study: Isolation/ identification of pneumococcus serotypes, biofilm study for dominant serotypes , Vitek-2 ID/ AST of *S. pneumoniae* isolates
- Genomic Study:: Molecular serotyping for *S. pneumoniae* from minimally processed samples; BOS-PCR for dominant serotypes ; NGS Illumina Miseq (Wellcome Sanger) for detail genomic data and clustering to national, regional and worldwide isolates

## E. Expected Results

- Molecular *S. pneumoniae* serotypes (40 serotypes)
- Antibiotic susceptibilities including minimum inhibitory concentration of invasive serotypes
- Biofilm-forming capacity of dominant serotypes
- BOX-PCR genetic relatedness of dominant serotypes
- NGS Illumina sequence data for strain/capsular type, MLST, antibiotic resistance genes, invasive/virulence genes, global pneumococcal sequence cluster (GPSC)

## F. Collaborations On-going/Needed

- Molecular epidemiology of *S. pneumoniae*/NGS- Prof Stephen D. Bentley Wellcome Sanger Institute UK ( On going)
- Biofilm/ Growth Kinetic Experiments( Collaborators needed)
- Colonization factors expression and regulation ( Collaborators needed)
- Mechanisms of resistance in pneumococcus (Collaborators needed)
- Serotype-dependent and –independent pneumococcal vaccine (Collaborators needed)

## G. Acknowledgements

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