National Multi-pathogen Diagnostics Program (NMPDP)

Supporting Patient-centered Care through Strengthening Microbiology and Molecular Techniques in Zambia:

AN OVERVIEW

ASLM ECHO SESSION

PEPFAR
U.S. President's Emergency Plan for AIDS Relief

CDC

CIDRZ

ZNPHI

Introduction

Sub-Saharan Africa is vulnerable to infectious disease epidemics due to

Favorable climate and ecological conditions for vectors and pathogens

Also high human to animal interactions enhancing the spread of infectious diseases.

Low capacity to manage epidemics due to inadequate resources for early detection, identification and prompt response *Rugarabamu S et al(2020)*

Only 55 percent of 2nd level hospitals and 23% of third level and above hospitals are able to perform culture and sensitivity tests *National Health Strategic Plan (2022-2026*)

Clinicians are forced to treat using empiric therapy; this contributes to poor treatment outcomes, and antimicrobial resistance

Program approach

Initial focus is on respiratory conditions and conditions affecting PLHIV (CNS, STIs)

NMPDP to improve diagnostic capacity and scale up surveillance systems to improve patient management and outcomes

Open PCR testing implemented in 6 sites

L/Stone, TDRC, UTH, Mansa, Kabwe and Chinsali

Cascade to other facilities

Key definition

Multiplex testing - refers to diagnostic approaches that simultaneously detect multiple pathogens or diseases from a single specimen using platforms like multiplex PCR.

Rationale: resource efficiency, improved diagnostic accuracy, faster patient management.

Current Diagnostic Limitations And Opportunities For The NMPDP

Syndrome	Routine	Opportunities
Respiratory	diagnosis is limited to TB/SARS-CoV-2	Test for other pathogens causing respiratory disease as well as co-infections (i.e., Influenza H1N1, Influenza B,Pnemocystis Jirovecci fungus, Strepcoccus Pneumoniae Bacteria, Hemophilus Influenzae)
STIs	HIV, Syphilis	CTNG, HPV, Hep B, Herpes
CNS	Limited to Culture, India ink stain, cryptococcal antigen (CrAg)	Capacity for screening for viral pathogen and others that are difficult to culture

NMPDP Objectives

1. Strengthen microbiology diagnostic capacity in public health laboratories.
    - Increase laboratory staff complement and competency
    - supplement provision of reagents
    - Provision of equipment
    - Improve Lab Infrastructure

2. Set up open PCR testing platforms for the detection of multiple pathogens causing infectious disease/conditions including but not limited to
    - Respiratory
    - STIs
    - Neurological

3. Establish an algorithm for:
    - Microbiology/molecular testing, and
    - pathogen genomic sequencing.

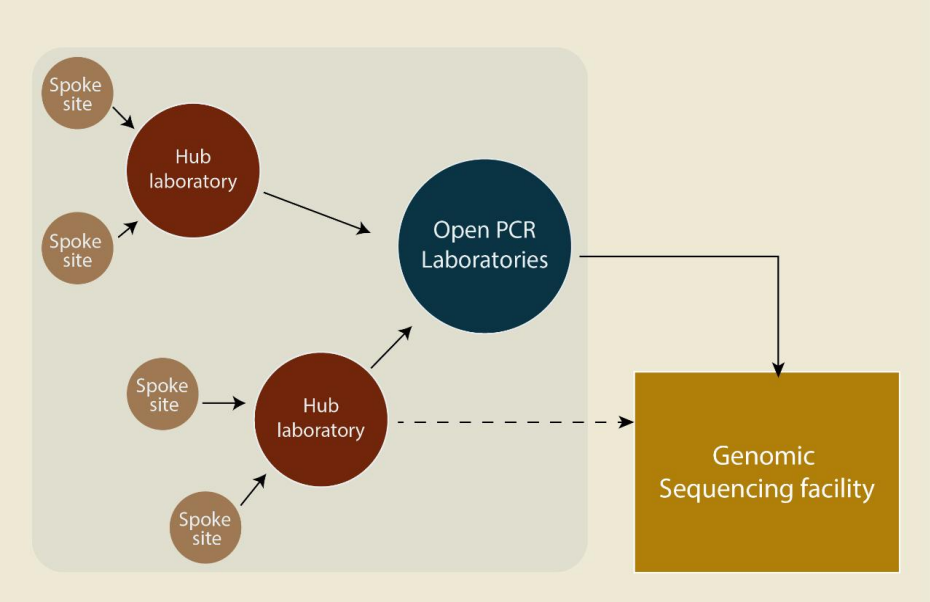
4. Strengthen public health surveillance systems for infectious diseases in Zambia.


Provinces of Zambia
N
W
E
S
Northern
Luapula
Muchinga
North-Western
Copperbelt
Eastern
Central
Lusaka
Western
Southern
0
100
200
400 Kilometers

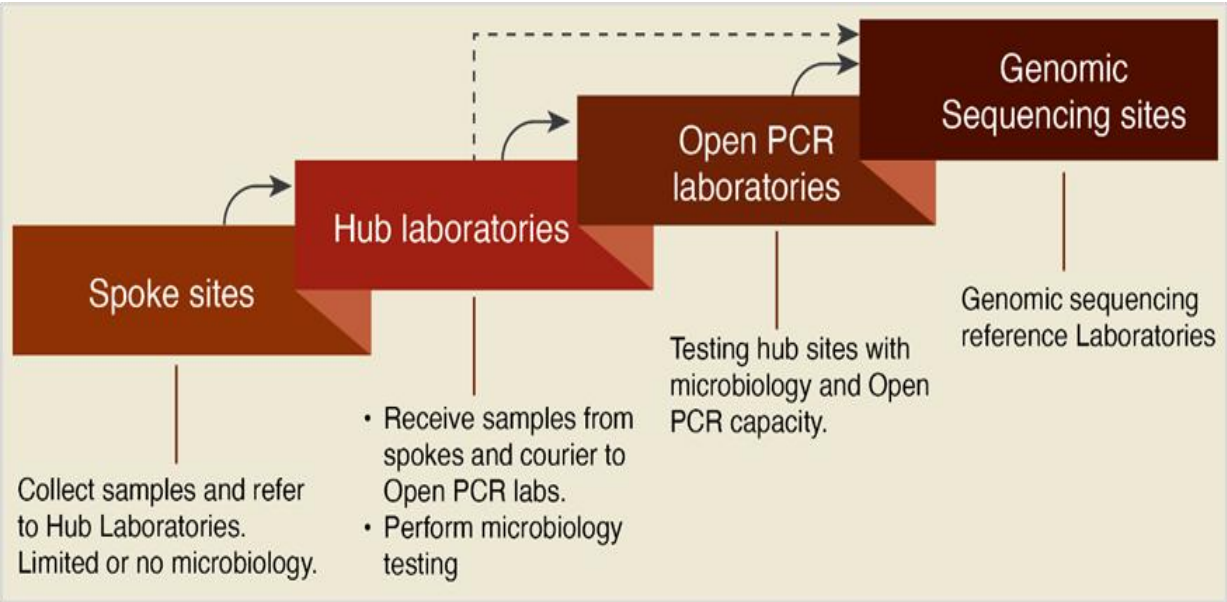
Facilities being supported

SN	Province	Facility Name
1	**Southern***	Livingstone Teaching Hospital
2	**Lusaka***	University Teaching Hospitals
3	Eastern	Chipata Central Hospital
4	**Central***	Kabwe Central Hospital
5	**Copperbelt***	Ndola Teaching Hospital
6	Northwestern	Solwezi General Hospital
7	**Muchinga***	Chinsali General Hospital
8	Northern	Kasama General Hospital
9	**Luapula***	Mansa General Hospital
10	Western	Lewanika General Hospital

Laboratory network and tier functions



NMPDP Laboratory network



Overview of the functions of each tier in the NMPDP laboratory network.

Spoke and hub model

Clinical workflow

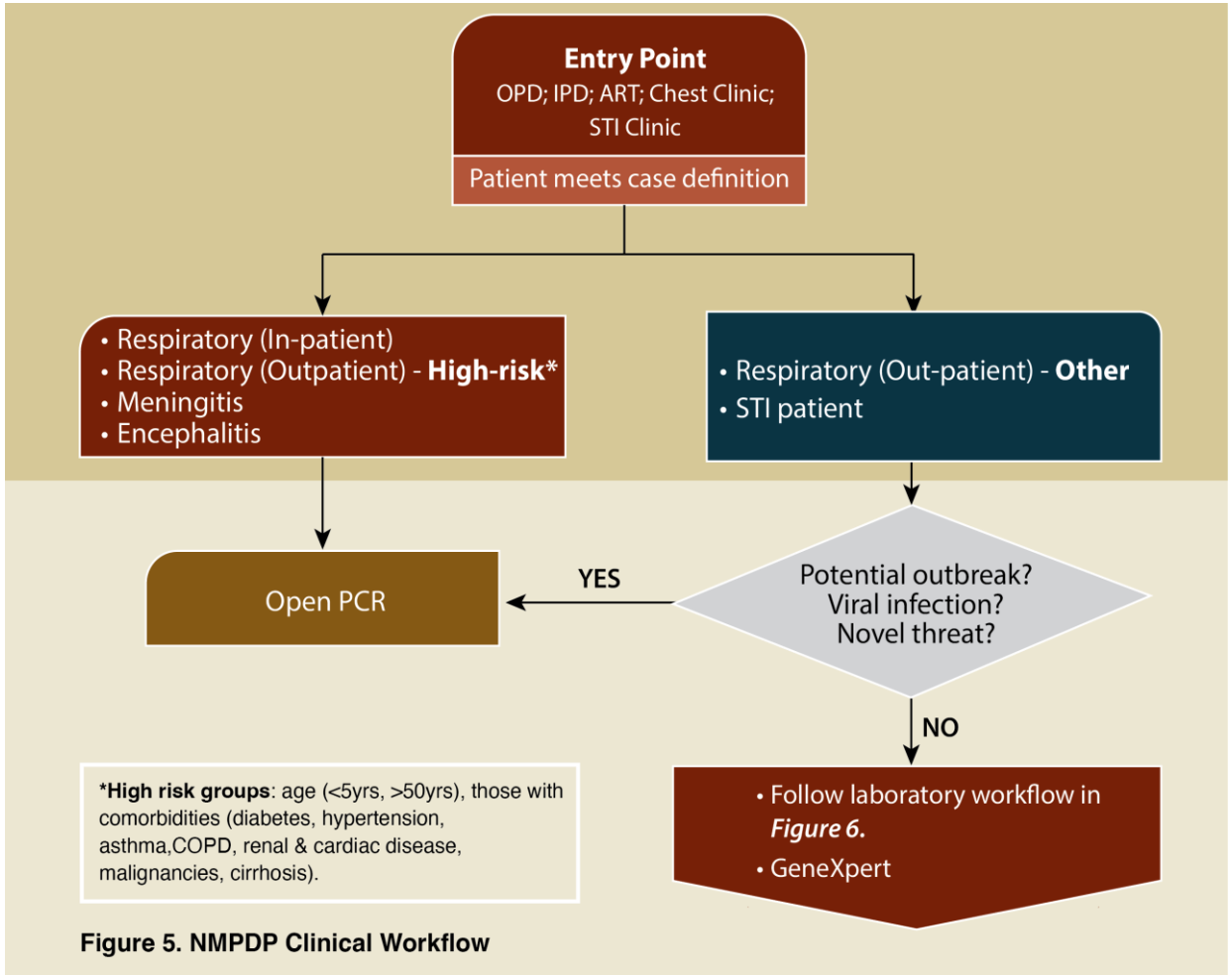


Figure 5. NMPDP Clinical Workflow

Clinicians will initiate the diagnostic process

Program case investigation forms will be used to capture patient data in real-time or transcribed into digital records

Notifiable diseases

Clinicians will ensure that the case definition is met before samples are collected for laboratory testing

Open PCR platform

Specimen types

System	Sample type	Container type	Quantity
Respiratory	Swabs (nasal, nasopharyngeal, throat)	Container with transport media	2 swabs
	Sputum/ Broncho alveolar lavage	Sputum container	3-5ml
	Tracheal aspirates	Sterile plain container	Minimum 1ml
	Pleural fluid	Sterile plain container	2 tubes 5-10 ml
CNS	Cerebral spinal fluid	Plain vacutainers (red top) or CSF bottle	5 -10ml (min)
	Pus aspirate	Plain vacutainers	Minimum 2ml
	Blood culture	Blood culture bottles	8-10ml adults 1-3ml children
Genitourinary	Swabs (Genital, pharyngeal, rectal)	Container with transport media	2 swabs
	Urine	Sterile plain container	3-5 ml
	Scrapings	Slide	NA

Respiratory Pathogen Panel targets (Multiplex PCR)

Adenovirus	*Bocavirus*	*Bordetella pertussis*	*Chlamydia pneumoniae*	*Cytomegalovirus*	*Coronavirus 43*	*Coronavirus 63*
Coronavirus 229	*Coronavirus HKU1*	*Enterovirus*	*Haemophilus influenzae*	*Haemophilus influenzae*	*Human metapneumovirus A*	*Human metapneumovirus B*
Influenza A	*Influenza B*	*Influenza C*	*Klebsiella pneumoniae*	*Legionella species*	*Moraxella catarrhalis*	*Mycoplasma pneumoniae*
Parainfluenza 1	*Parainfluenza 2*	*Parainfluenza 3*	*Parainfluenza 4*	*Parechovirus*	*Pneumocystis jiroveci*	*Respiratory syncytial virus A*
	Respiratory syncytial virus B	*Rhinovirus*	*Salmonella*	*Streptococcus pneumoniae*	*Staphylococcus aureus*	

Genomic Sequencing

Sequencing laboratories will be the highest tier in the network

The criteria for pathogens to be sequenced will be based on the National Genomic Strategic Plan and the Zambia Genomics Consortium

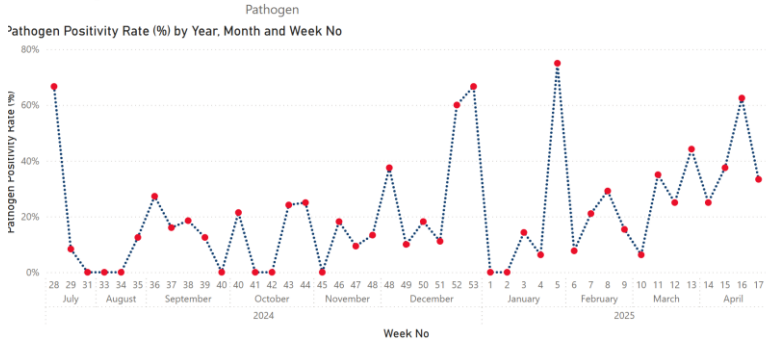
Which aims to:

- Identify and understand the genetic makeup of pathogens to aid public health
- Provide information regarding tracking and controlling disease outbreaks

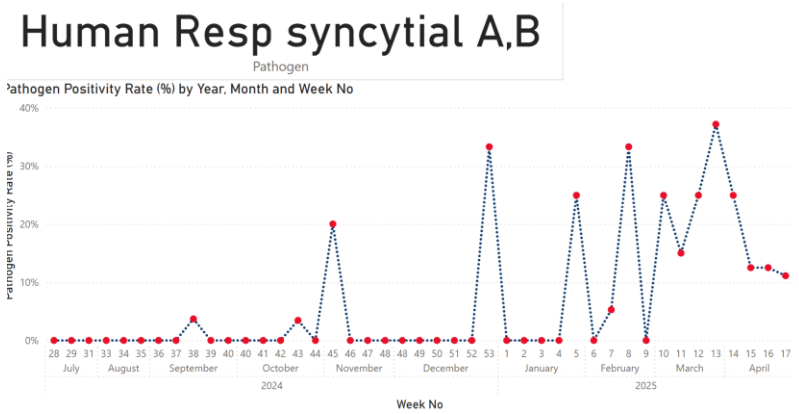
Table : Total samples tested in the facility and percentage of those from PLWHIV from sites

Site	Total Patients Tested	HIV Positive Patients	% HIV Positive
Chinsali General Hospital	177	6	3.4%
Kabwe Central Hospital	68	13	19.1%
Livingstone Teaching Hospital	427	88	20.6%
University Teaching Hospital (Lusaka)	466	-	-
TDRC (Copperbelt)	19	-	-
Mansa General Hospital	28	-	-
Levy Mwanawasa Teaching hospital	23	3	13.4%
Total for facilities reporting PLWHIV	1208	110	~9.1% (data from **UTH, Mansa, TDRC** not factored in)

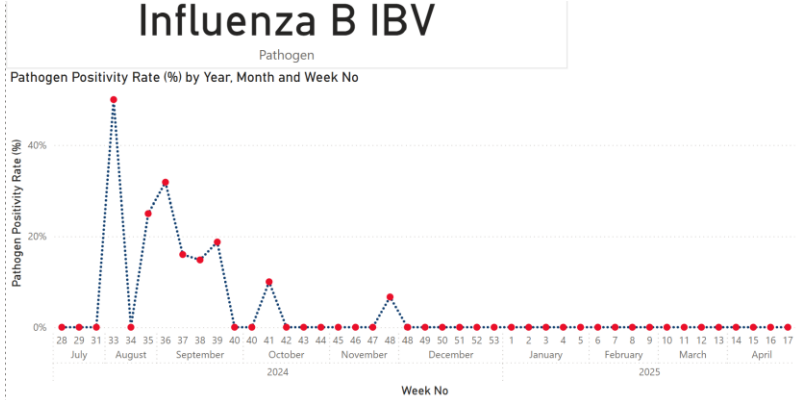
Streptococcus Pneumoniae



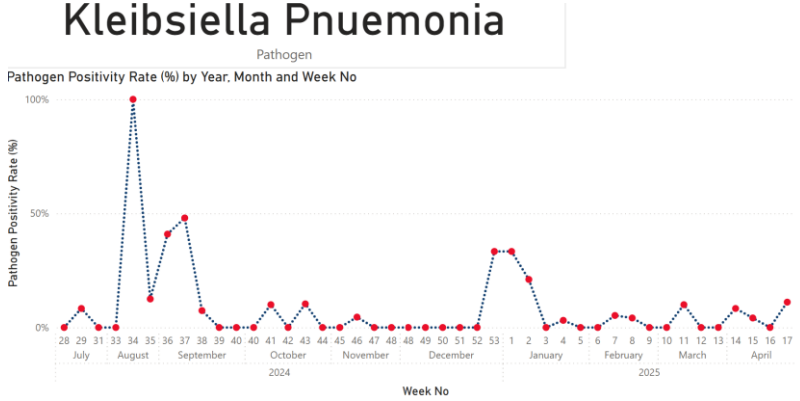
Human Resp syncytial A,B



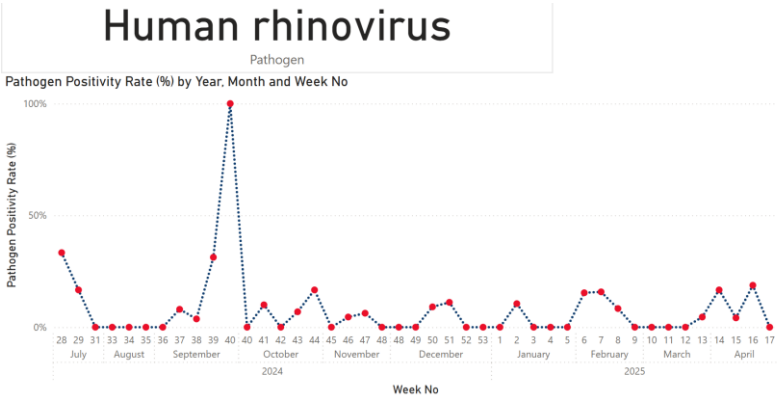
Influenza B IBV



Kleibsiella Pnuemonia



Human rhinovirus



Trends – Pathogens Isolated (Top 5 Pathogens)

Impact of Open PCR Molecular Diagnostics

Enhanced Disease Management for PLHIV through advanced diagnostic capabilities

Accurate Detection and tracking of Diverse Pathogens, including hard-to-culture and slow-growing organisms

Rapid Identification of Opportunistic Infections (e.g., PCP, viral co-infections), enabling timely interventions

Improved Patient Outcomes via early diagnosis and prompt treatment initiation

Reduced Morbidity and Better Prognosis for individuals living with HIV

Decreased Use of Unnecessary Treatments, promoting targeted, effective care

Challenges/Limitations

Sustaining reagent and equipment supply

Ensuring consistent staff training across tiers

Data management and integration with clinical LIS systems (Smartcare)

NMPDP Accomplishments

Established a national framework for multi-pathogen testing to support data-driven policymaking.

Facilitated the development of the national genomic strategic plan

Enabled real-time tracking of seasonal respiratory pathogens, improving outbreak response.

During Zambia’s 2024 flu season, open PCR platforms confirmed Influenza A (H1N1) as the main cause—ruling out a COVID-19 resurgence.

Accurate pathogen identification improved patient care and reduced use of unnecessary COVID-19 treatments.

Enhanced resource allocation and cost-effectiveness through targeted diagnostics.

Acknowledgement