



A GUIDE TO STEPWISE IMPLEMENTATION OF DNO

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A GUIDE TO STEPWISE IMPLEMENTATION OF DIAGNOSTIC NETWORK OPTIMIZATION



OUTLINE

- Overview of DNO
- Stepwise Guide to DNO
- Case Studies

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WHAT IS DNO?

DIAGNOSTIC NETWORK OPTIMIZATION

DEFINITION

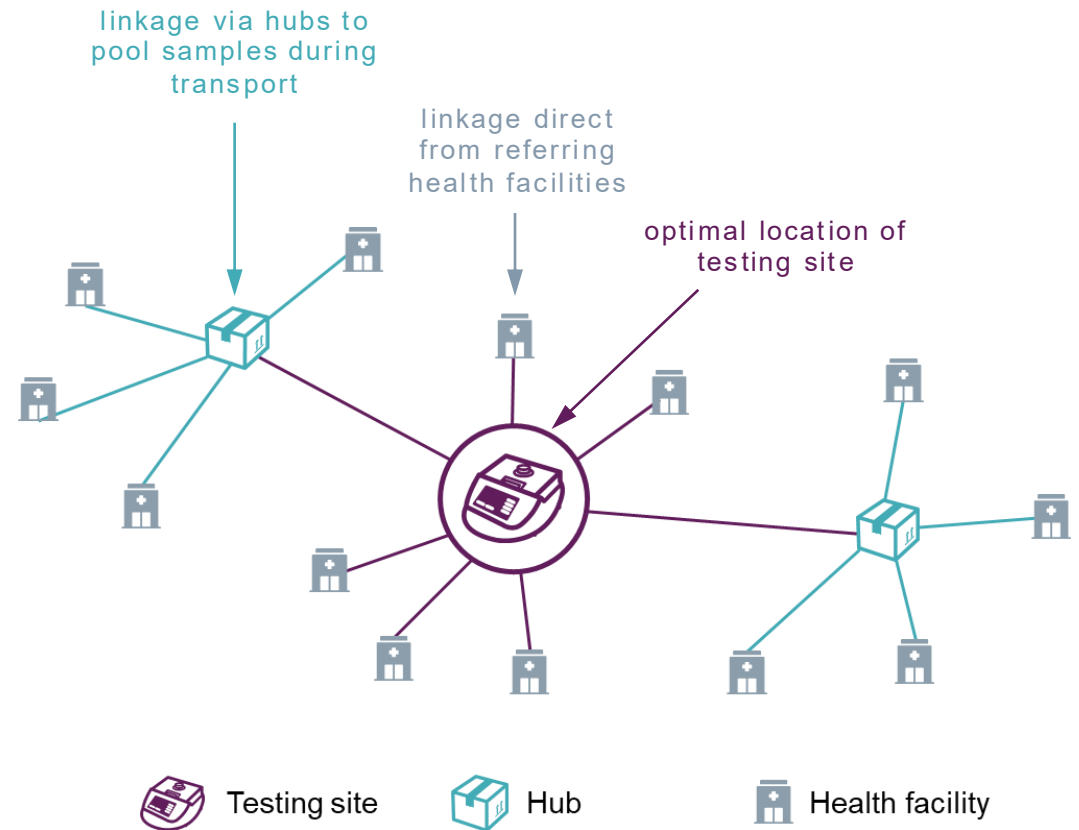
Diagnostic network optimization (DNO) is a geospatial analytics approach to

- analyse the current diagnostic network
- recommend the optimal type, number and location of diagnostics and associated sample referral network to achieve national health goals
- minimize overall network costs subject to applied (access) constraints

BENEFITS

- Generates insights around testing demand, capacity and utilization, cost efficiency and access to services
- Enables evaluation of trade-offs across multiple elements simultaneously
- Informs interventions that maximize impact of available investments

Graphical representation of DNO-recommended diagnostic network design



DIAGNOSTIC NETWORKS

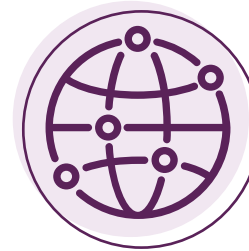
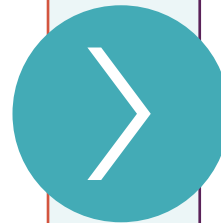
**COMPLEX CONTEXTS & CONSTRAINED RESOURCES HINDER
EQUITABLE ACCESS TO QUALITY DIAGNOSIS**



Aims of diagnostic networks

- ✓ the **right amount** of the **right testing**
- ✓ at the **right time**
- ✓ in the **right place**
- ✓ at an affordable and **sustainable cost**

...to guide patient care and public health decision-making



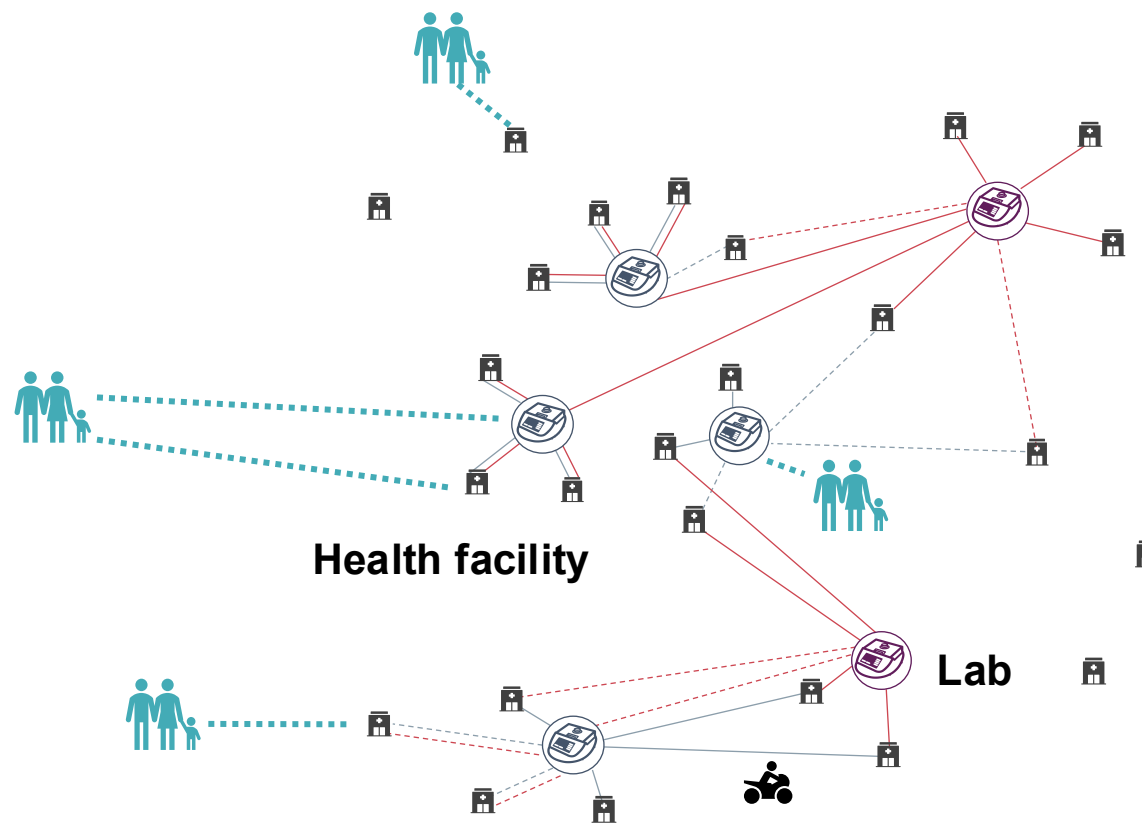
Current reality

- Diagnostic systems are complex; **varying epidemiological, geographical & health system contexts**
- Inefficient, **siloed systems & constrained resources** limit access to diagnosis. Major diagnostic gaps exist, especially at primary care level.
- Patients frequently **travel long distances and incur significant out of pocket expenditure** to access services; **accessibility is inequitable**

DIAGNOSTIC NETWORK OPTIMIZATION: A TRADE-OFF



PEOPLE & HEALTH SYSTEM PERSPECTIVES



People access services at nearby health facility (samples collected and referred for testing) or by traveling direct to laboratory

Samples are tested on-site or are transported from health facilities to labs/testing sites within the network

Population Accessibility focus

Diagnostic Network configuration focus

“Diagnostic network optimization (DNO)”

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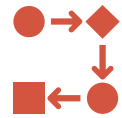


IMPLEMENTATION
GUIDE

OBJECTIVES OF THE DNO IMPLEMENTATION GUIDE



How to use **data** for improving diagnostic networks



Identify and **understand** each phase of conducting a DNO



Suitable **tool(s)** for addressing common DNO problems



Identifying the **types of data required** for different DNO analyses



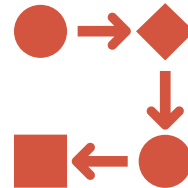
Enhancing the **impact** of DNO analyses

WHO IS THE GUIDE FOR?



Countries

MoH, NTP & other programs
 Understand the processes
 and best practices for
 conducting and implementing
 DNO



Donors & Funders

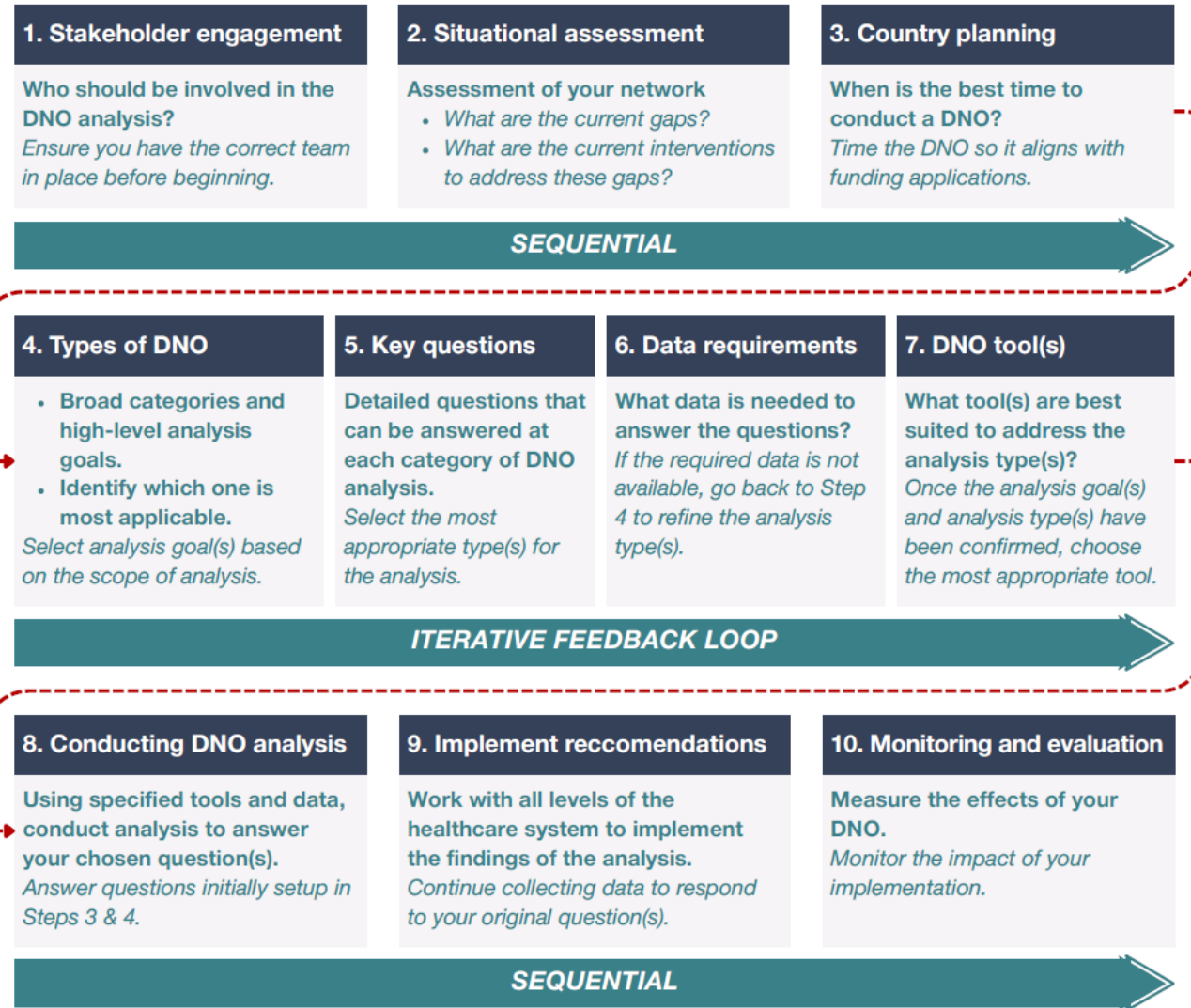
How DNO outputs inform
 impactful investment
 decisions



Implementing partners

Structured guidance to better
 align with national health
 objectives

IMPLEMENTING DNO ANALYSES



SETTING UP YOUR DNO FOR SUCCESS



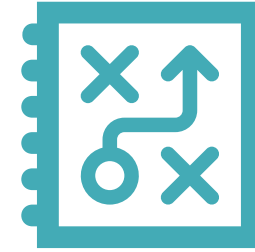
1. Stakeholder Engagement

- MoH Leadership is Essential
- Multi-sectoral collaboration



2. Situational assessment

- Establish a team at national level
- Gather documentation & DNO history
- Establish the goal

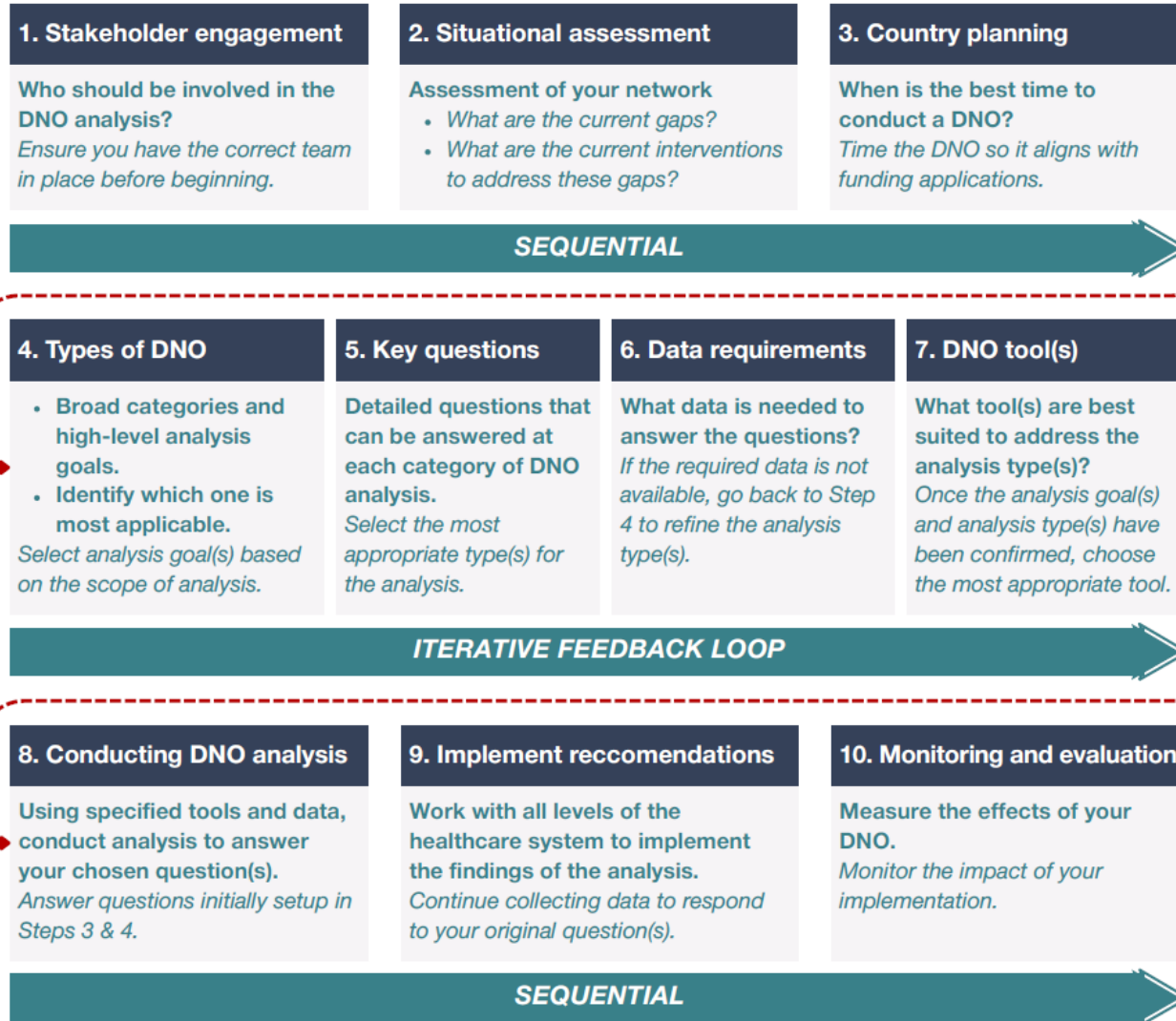


3. Country Planning

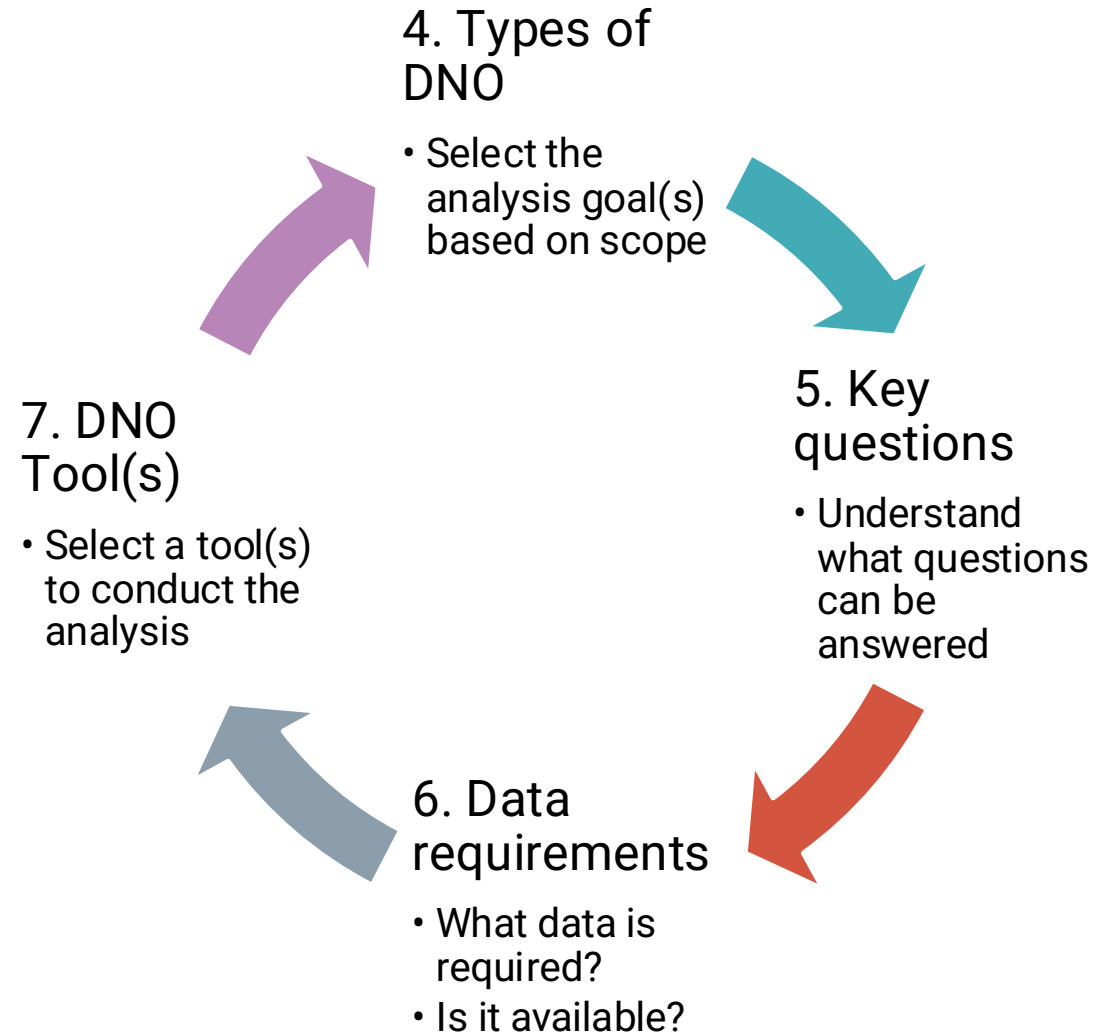
- Ensure the timing is right
- Define feasibility

The timing of DNO analysis is critical to ensuring that outputs are available at the right time to inform planning for funding applications.

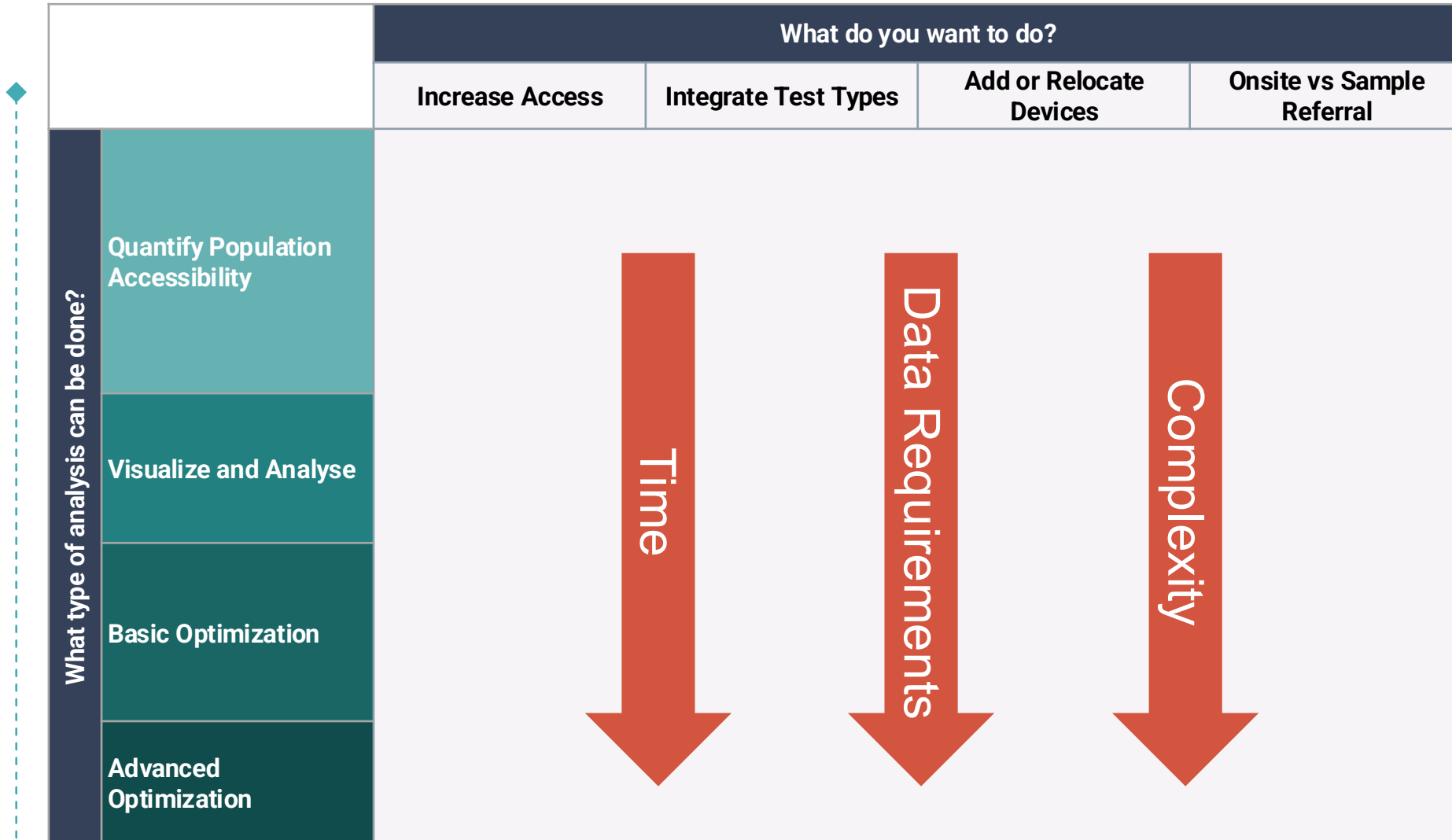
IMPLEMENTING DNO ANALYSES



HOW TO CONDUCT A DNO ANALYSIS



4. TYPES OF DNO ANALYSES



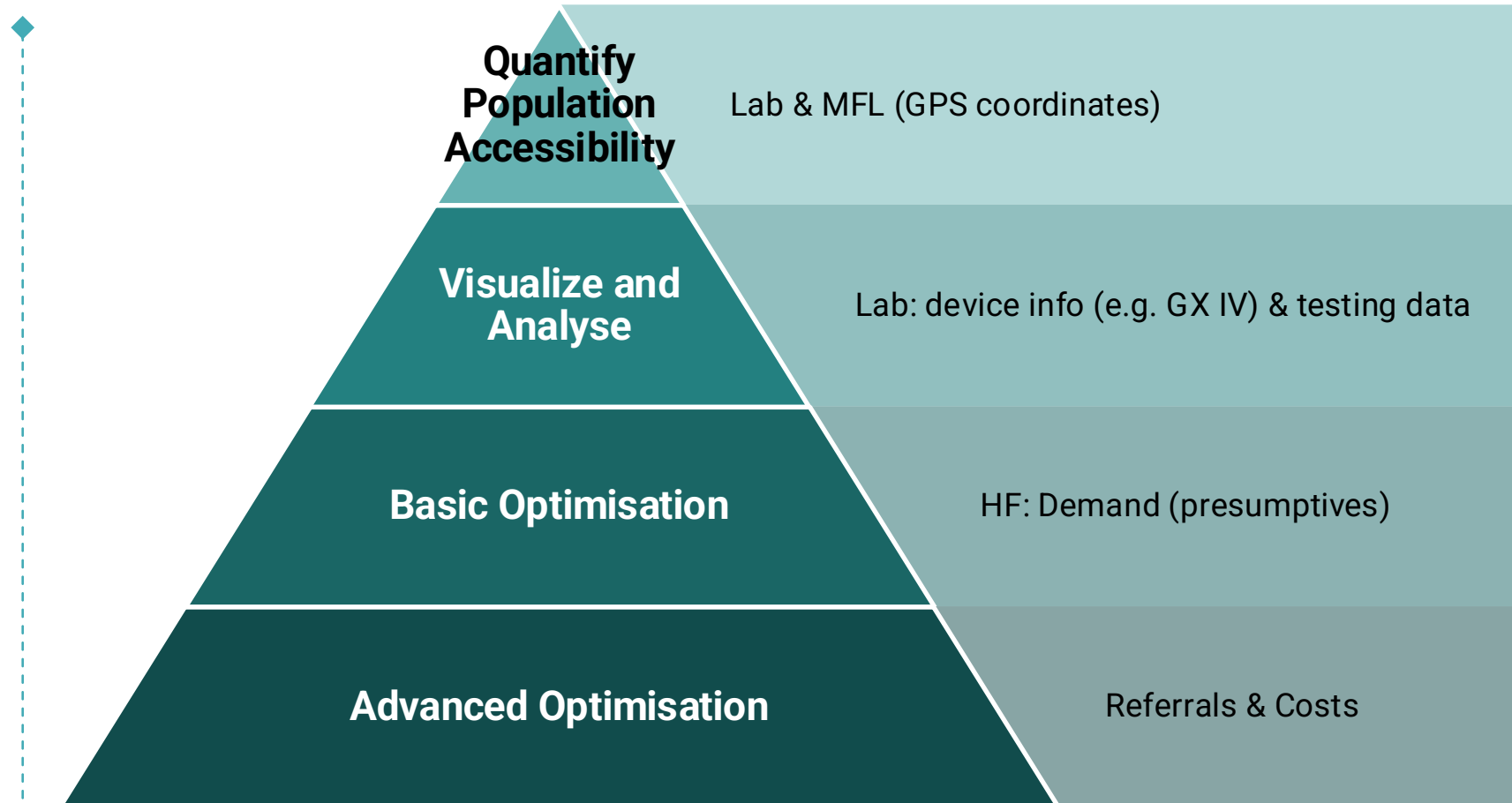
4. TYPES OF DNO ANALYSES

	What do you want to do?				Estimated Timeline	
	Increase Access	Integrate Test Types	Add or Relocate Devices	Onsite vs Sample Referral		
What type of analysis can be done?	Quantify Population Accessibility	Measure change in population accessibility	Quantify increased population that can access devices after integration	Add: quantify increase in population coverage; compare between different scenarios Relocate: compare reduction in access in one area to increase in access in another area	What % of population has access to onsite vs. via referral. Does the referral network cover all the population?	0-2 months
	Visualize and Analyse	Analyse capacity and utilization across the network to identify gaps in testing	Understand impact on capacity & utilization. Where is it possible to integrate?	Understand increase in testing & impact on utilization. Which devices are over/under utilized?	Quantify onsite utilization versus referral utilization	2-3 months
	Basic Optimization	Understand impact on utilization from increased sample collection sites	Optimize referrals for all test types	Understand impact on capacity & utilization across the network	Make recommendations on optimal locations based on distances between labs and facilities	3-6 months
	Advanced Optimization	Identify areas with long TAT and referral pathways	Identify optimal mix of devices and sample referral across disease programme	Identify optimal mix of devices and sample referral across disease programmes	Identify optimal mix of devices and sample referral across disease programmes	3-12 months

5. KEY QUESTIONS THAT DNO CAN ANSWER

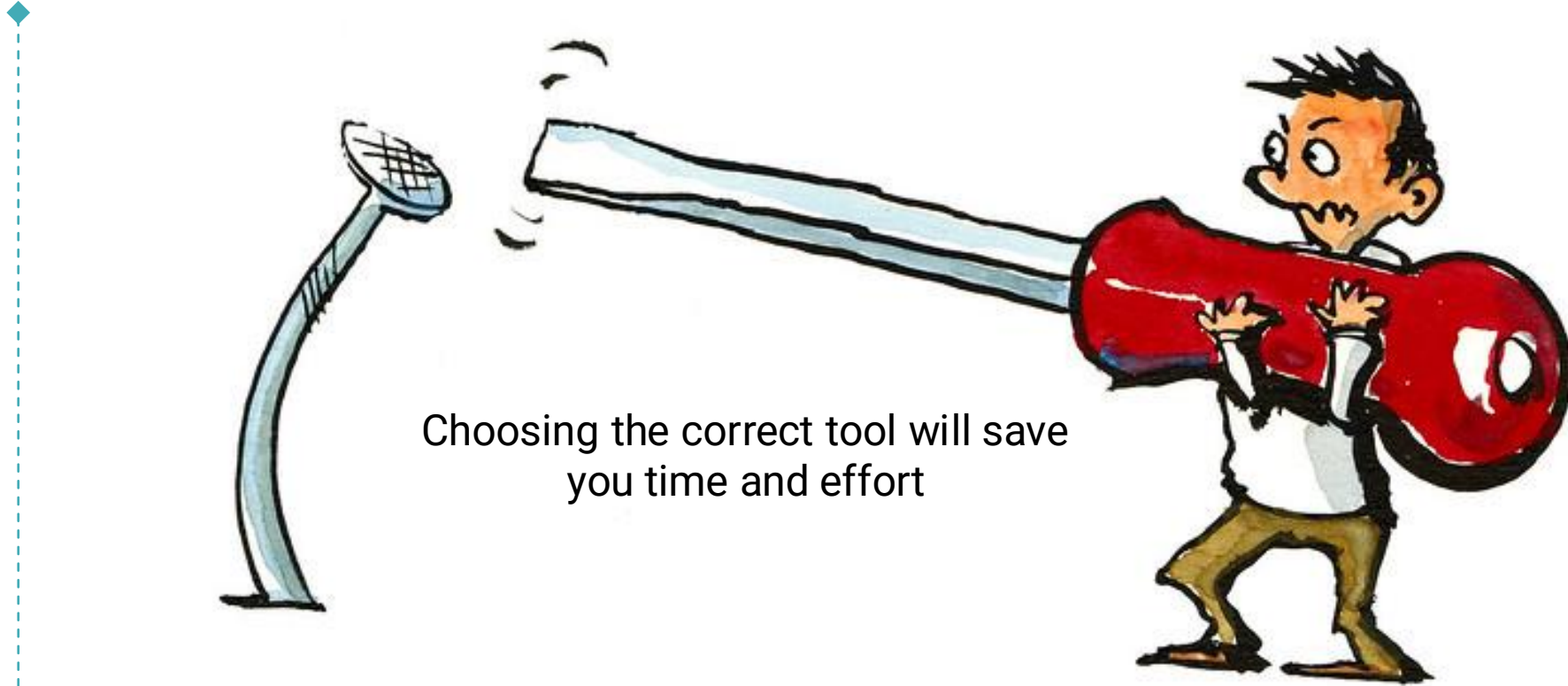
		What do you want to do?				
		Increase Access	Integrate Test Types	Add or Relocate Devices	Onsite vs Sample Referral	
What type of analysis can be done?	Quantify Population Accessibility	Possible analysis	A country wants to determine which provinces/districts currently have the lowest population accessibility to TB testing.	A country wants to integrate TB and HIV testing on all GeneXperts across the country and understand the increase in population accessibility.	Add devices: Measure the change in population accessibility when adding 5 new devices across the country at specified labs. Relocate devices: Move an mWRD from a central lab with multiple devices to a rural lab with no devices and measure the increase in population accessibility.	How accessible are current mWRDs to the population (travel time/distance)? Via onsite testing and/or sample referral.
		Not included	Understanding the diagnostic capacity & utilization across the network to measure and estimate capacity for integration.		Add devices: Which types of devices could be selected based on device capacity and test demand (volumes).	Understand the length of sample referrals (direct to lab or via hub), and the costs of the system.
	Visualize and Analyse	Possible analysis	To what extent is capacity utilized across different districts? Which districts have the lowest/highest utilization in the country?	Are any devices under-utilized that could be good candidates for testing integration, e.g., TB, HIV, HPV, among others?	Add: Which mWRDs are over utilized and may need an additional module or different type/size of device? Relocate: For laboratories with low utilization, is there sufficient capacity to relocate a device to another laboratory with high utilization?	Is there enough diagnostic capacity for devices to start receiving samples from the surrounding health facilities?
		Not included	Understand the length of sample referrals, and the costs of the system which is useful for reducing turnaround times at a lower cost.		It is not possible to determine the optimal location for adding or removing devices, however the outputs would provide directional guidance.	Understand the length of sample referrals (direct to lab or via hub), and the costs of the system.
	Basic Optimization	Possible analysis	What is the required number & locations of mWRDs to ensure good access for all health facilities, especially in remote areas?	What is the reduction in average referral distance if devices integrate test types?	If testing was to be increased by 50% next year to meet NSP targets for patient notification, given the current diagnostic footprint, what are the optimal locations to add 5 new devices to enable the greatest improvement in population accessibility to services?	Where should new devices be placed so that the average referral distance is reduced?
		Not included	Compare the cost of the diagnostic network between scenarios and mapping the existing sample referral system versus an optimized one. To analyse costs, this must be done separately and requires additional data.			
	Advance Optimization	Possible analysis	In the current referral system, which facilities are sending samples further than a given threshold? How can we change the network to reduce sample referral distances?	What is the estimated cost savings if testing and sample referral was integrated across disease programmes?	Should more devices be purchased to add to the network, or should more spending on sample transportation be considered? What combination gives the best access with the lowest cost based on sub-national contexts?	What is the estimated cost of a sample referral system for the optimized network? How does that compare to the current costs?
		Not included	Dynamic and live tracking of all diagnostic devices, tests, referrals, and TATs. Possible to link to a live sample tracking system.			

6. DATA REQUIREMENTS AND DATA SOURCES



If you don't have the data required, go back, and revise the analysis type.

7. SELECTING APPROPRIATE DNO TOOL(S)



7. SELECTING APPROPRIATE DNO TOOL(S)

Data Elements	DxGeo Map*	LabMap*	PlanWise*	BI (PowerBI, Tableau)	R / Python	Access Mod*	ArcGIS / QGIS	OptiDx*	Commercial Supply Chain Optimization Tools++
Lab Data	X	X	X	X	X	X	X	X	X
Master Facility List	X	X	X	X	X	X	X	X	X
Lab Device Info			X	X	X	X	X	X	X
Testing Data		X	X	X	X	X	X	X	X
HF Demand			X		X	X	X	X	X
Land Cover						X			
Barriers						X			
Roads						X			
Historical Referrals		X			X			X	X
Costs			X					X	X
Analysis Type	Quantify Population Accessibility		Visualize & Analyse			Basic Optimization		Advanced Optimization	

There are custom tools (software) available for DNO depending on what type of analysis best fits your needs.

* Tools are specifically designed for DNO

+ Business Intelligence

++ Examples of Commercial supply chain optimization tools: Coupa, OptiLogic, AIMMS

NEWER TOOLS AND AI

FIND



FIND
Diagnosis for all

AI-DNO Agent

Diagnostic Network Optimization - Pune

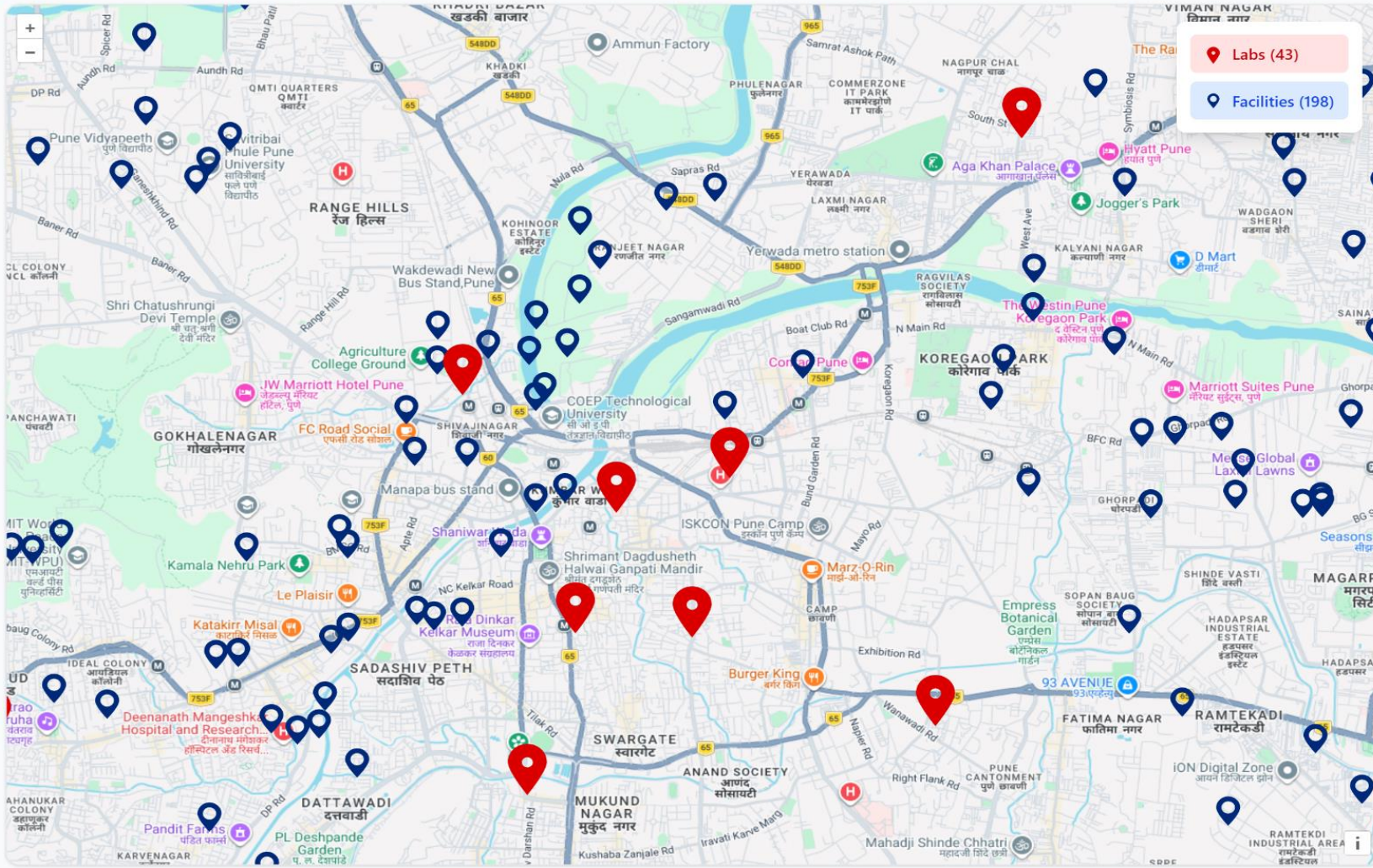
Home

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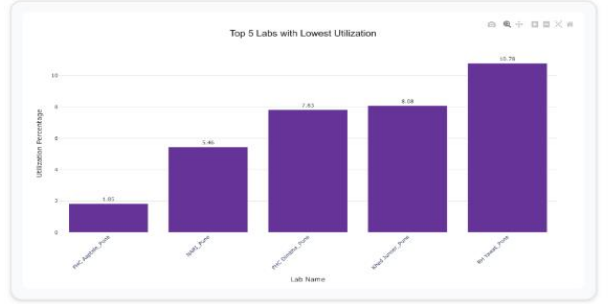
Local Mode (Offline)



Chat with AI-DNO Agent
Ask questions about the diagnostic network

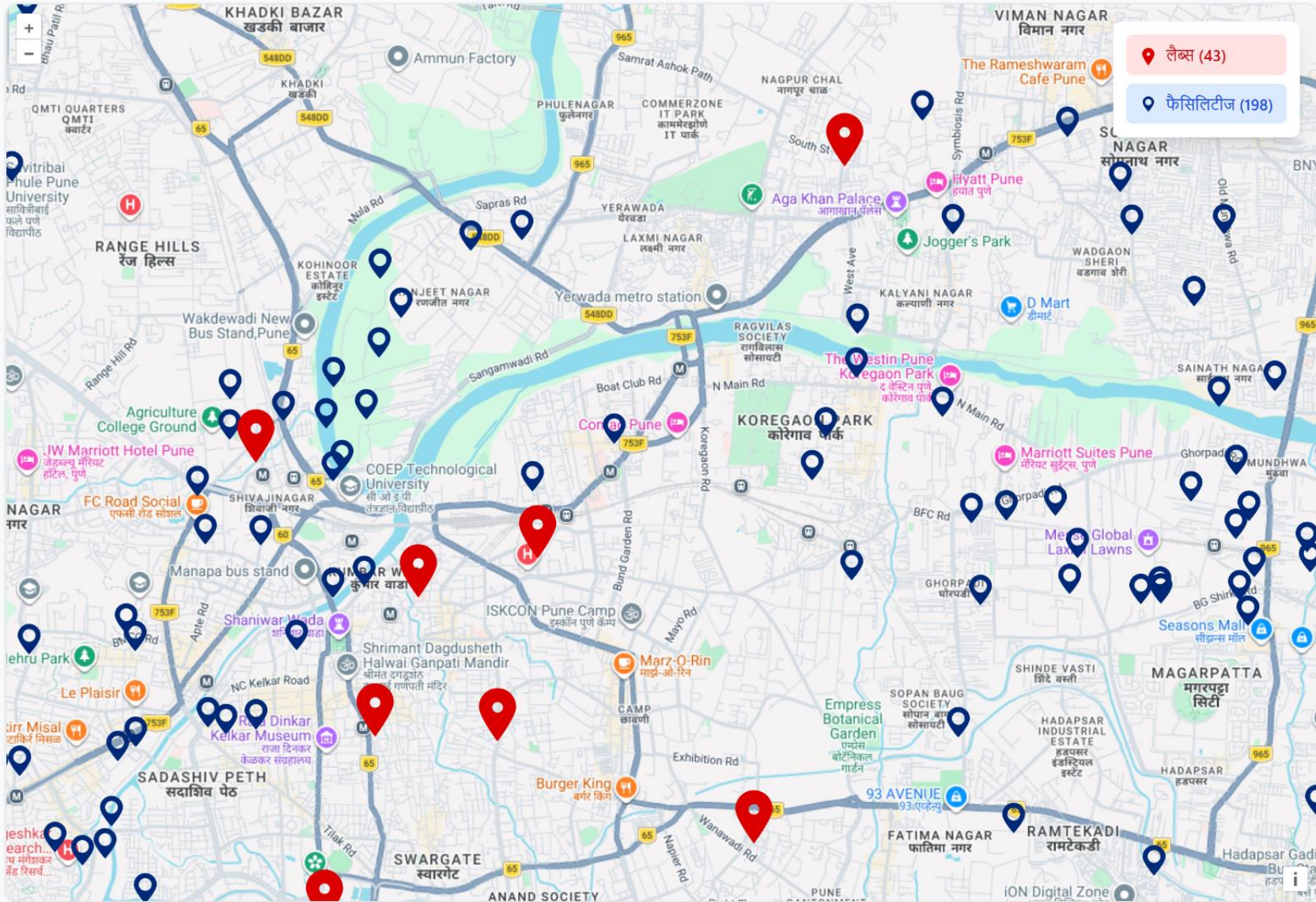
Show me the top 5 labs with lowest utilization rate
01:02 PM

Here are the top 5 labs with the lowest utilization rates: Aundh Community Health Center at 30.26%, Hadapsar Community Health Center (LAB0005) at 36.72%, Hadapsar Community Health Center (LAB0006) at 37.39%, Viman Nagar Community Health Center at 40.71%, and Hadapsar Medical Center Lab at 45.75%. These labs have significant spare capacity that could be better utilized.



01:02 PM
0:03 0:38

Type your message... Send



📍 लैब्स (43)

📍 फैसिलिटीज (198)

Chat with AI-NETRA V4
Ask questions about the diagnostic network

इन पांच प्रयोगशालाओं में उपयोग में सुधार के लिए मैं क्या कर सकता हूँ

01:03 PM

जिन पांच पुणे प्रयोगशालाओं पर आप ध्यान केंद्रित कर रहे हैं, उनमें उपयोग दर 30% से 46% तक है, जो महत्वपूर्ण अतिरिक्त क्षमता के साथ मध्यम से कम उपयोग को इंगित करता है। प्रदर्शन को बेहतर बनाने के लिए, मैं अनुशंसा करता हूँ: (1) निकटतम उच्च-मांग वाली सुविधाओं का मानचित्रण करना और इन कम उपयोग की जाने वाली प्रयोगशालाओं के लिए अधिक विश्वसनीय नमूना-परिवहन मार्ग स्थापित करना, (2) यह सुनिश्चित करने के लिए रेफरल समझौतों की समीक्षा करना कि इन प्रयोगशालाओं को आसपास की स्वास्थ्य सुविधाओं से नमूनों का एक स्थिर प्रवाह प्राप्त हो, (3) इन स्थानों पर टीबी परीक्षण की उपलब्धता के बारे में जागरूकता बढ़ाने के लिए सामुदायिक आउटरीच कार्यक्रम आयोजित करना, (4) उपकरण प्लेसमेंट का मूल्यांकन करना - विचार करें कि क्या सेवाओं को समीकित करने या उपकरणों को उच्च-मांग वाले क्षेत्रों में पुनर्वितरित करने से समग्र नेटवर्क दक्षता में सुधार होगा, और (5) पीक मांग के समय का विश्लेषण करना और सामुदायिक आवश्यकताओं से बेहतर मिलान करने के लिए परिचालन घंटे या स्टाफिंग को समायोजित करना। इन चरणों को लागू करने से उपयोग को अधिक कुशल सीमा (60-80%) की ओर बढ़ाना चाहिए और मौजूदा निवेश का बेहतर उपयोग करना चाहिए।

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अपना संदेश टाइप करें...

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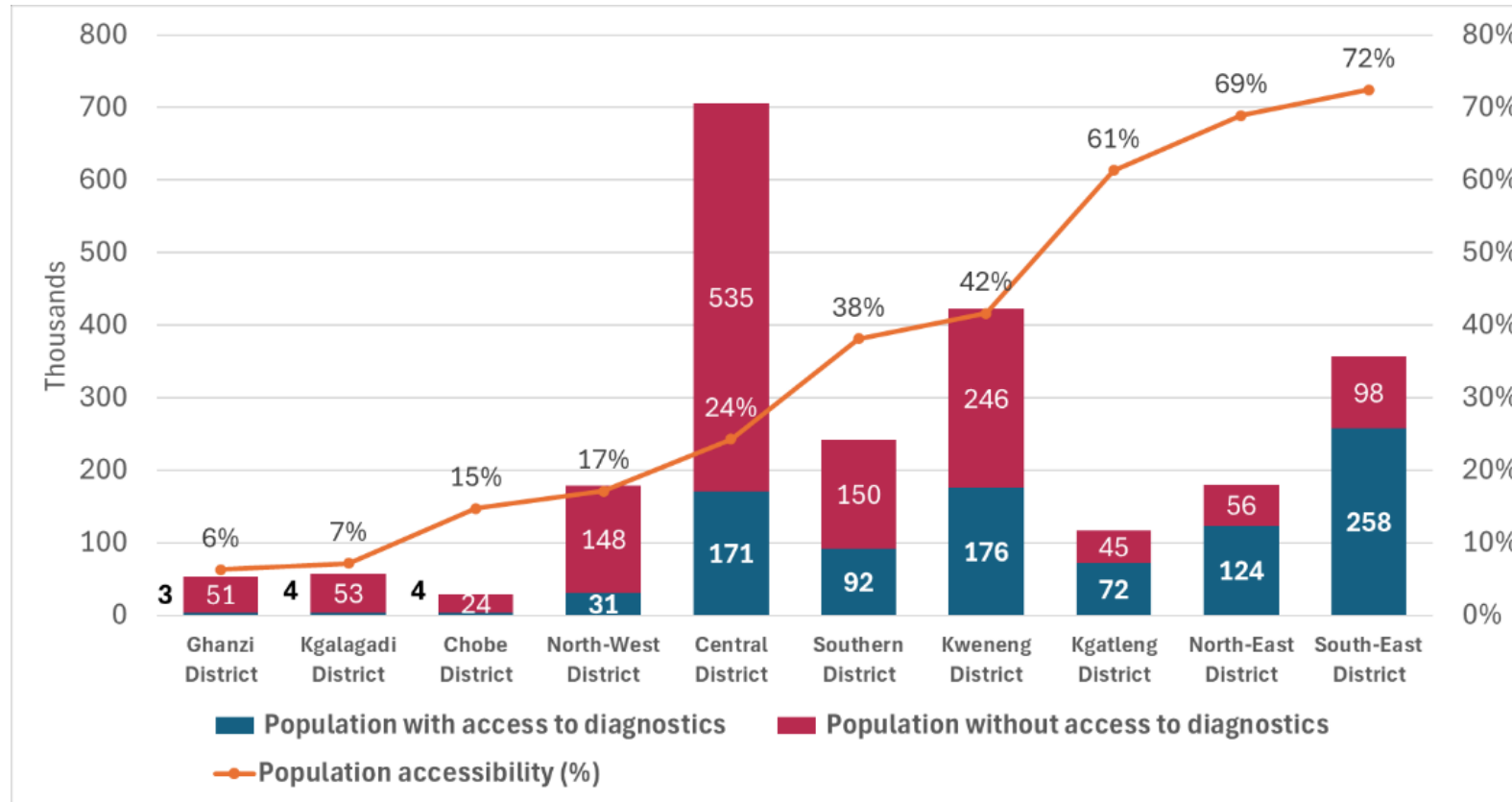
BEFORE PROCEEDING: CHECKLIST FOR ANALYSIS PLAN

Stakeholders									
Type(s) of DNO	Increase access	Integrate test types	Add/relocate devices	Onsite vs sample referral					
Objective(s)									
Analysis Type(s)	Quantify Population Accessibility		Visualize & Analyse			Basic Optimization		Advanced Optimization	
Data available	Labs	MFL	Device info	Testing data		HF demand		Referrals	Costs
Tool(s)	DxGeo Map	LabMap	PlanWise	BI (PowerBI, Tableau)	R / Python	Access Mod	ArcGIS QGIS	OptiDx	Supply Chain
Timeline	0-2 months	1-4 months	2-5 months			3-6 months		3-12 months	

CASE STUDY 1: INCREASING ACCESSIBILITY TO DIAGNOSTIC TESTING

Identifying gaps in population accessibility to TB services to inform the placement of TB diagnostics in Botswana										
Stakeholders	Botswana National Tuberculosis Program (BNTP); FIND									
Type(s) of DNO	Increase access	Integrate test types			Add/relocate devices		Onsite vs sample referral			
Objective(s)	Assess accessibility to TB services at a national and sub-national level.									
Analysis Type(s)	Quantify Population Accessibility		Visualize & Analyse			Basic Optimization		Advanced Optimization		
Data available	Labs	MFL	Device info		Testing data		HF demand		Referrals	Costs
Tool(s)	DxGeo Map	LabMap	PlanWise	BI (PowerBI, Tableau)		R Python	Access Mod	ArcGIS QGIS	OptiDx	Supply Chain
Timeline	2 weeks		2-5 months			3-6 months		11 months		

CASE STUDY 1: INCREASING ACCESSIBILITY TO DIAGNOSTIC TESTING



Botswana district population accessibility within 30 minutes driving

Tool: DxGeoMap

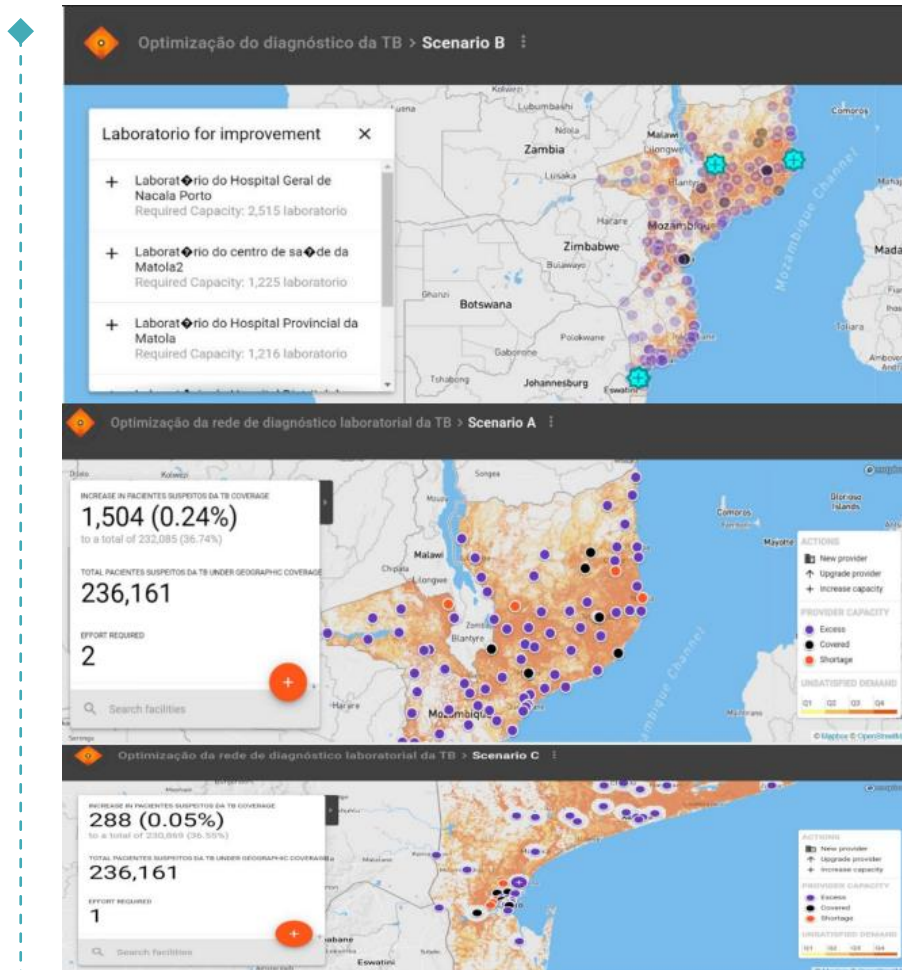
Results:

- Identify sub-districts with current gaps in population access to TB services
- Areas where the new GeneXpert devices should be prioritized for placement to improve equitable population coverage to TB services.
- This evidence was used to support the countries' TGF funding request.

CASE STUDY 2: EXPANDING EQUITABLE ACCESS TO TB, HIV, AND OTHER PRIORITY DISEASES

Mapping laboratory access and test integration in Mozambique									
Stakeholders	República De Moçambique Ministério Da Saúde - Direcção Nacional de Assistência Médica; ASLM; Africa Centre for Disease Control (CDC)								
Type(s) of DNO	Increase access	Integrate test types		Add/relocate devices		Onsite vs sample referral			
Objective(s)	Analyse access, capacity, and implications of test integration.								
Analysis Type(s)	Quantify Population Accessibility		Visualize & Analyse			Basic Optimization		Advanced Optimization	
Data available	Labs	MFL	Device info	Testing data		HF demand		Referrals	Costs
Tool(s)	DxGeo Map	LabMap	PlanWise	BI (PowerBI, Tableau)	R Python	Access Mod	ArcGIS QGIS	OptiDx	Supply Chain
Timeline	0-2 months	1-4 months	2-5 months			3-6 months		3-12 months	

CASE STUDY 2: EXPANDING EQUITABLE ACCESS TO TB, HIV, AND OTHER PRIORITY DISEASES



Tools: LabMap & PlanWise

Results:

- Only 36.5% of the population had access to TB diagnostic services within the recommended 10 km radius
- Increase from current 175 Labs to 203 (add 28 more GeneXpert Labs) by 2026;
- Optimize the number of GeneXpert modules (add 72 more modules) in laboratories based on TB testing demand by 2026;
- Add 40 GeneXpert modules for other tests such as: COVID-19, Viral Load/HIV, hepatitis among others by 2026;
- Findings used to inform funding application to TGF

CASE STUDY 3: ASSESSING CAPACITY WITHIN THE NETWORK TO INTEGRATE MULTIPLE TEST TYPES ON THE SAME PLATFORM

Using DNO to inform the design of integrated diagnostic testing services and sample referral networks for greater access to TB, HIV, and HPV services in Côte d'Ivoire									
Stakeholders	Programme National de Lutte contre le Cancer (PNLCa); Programme National de Lutte contre le Sida (PNLS); Programme National de Lutte contre la Tuberculose (PNLT); I-TECH; CDC; UNIGE; FIND								
Type(s) of DNO	Increase access	Integrate test types	Add/relocate devices			Onsite vs sample referral			
Objective(s)	Integrate testing services to improve accessibility.								
Analysis Type(s)	Quantify Population Accessibility		Visualize & Analyse			Basic Optimization		Advanced Optimization	
Data available	Labs	MFL	Device info	Testing data		HF demand		Referrals	Costs
Tool(s)	DxGeo Map	LabMap	PlanWise	BI (PowerBI, Tableau)	R Python	Access Mod	ArcGIS QGIS	OptiDx	Supply Chain
Timeline	0-2 months	1-4 months	2-5 months			3-6 months		11 months	

CASE STUDY 3: ASSESSING CAPACITY WITHIN THE NETWORK TO INTEGRATE MULTIPLE TEST TYPES ON THE SAME PLATFORM

◆ Tool: OptiDx

Results:

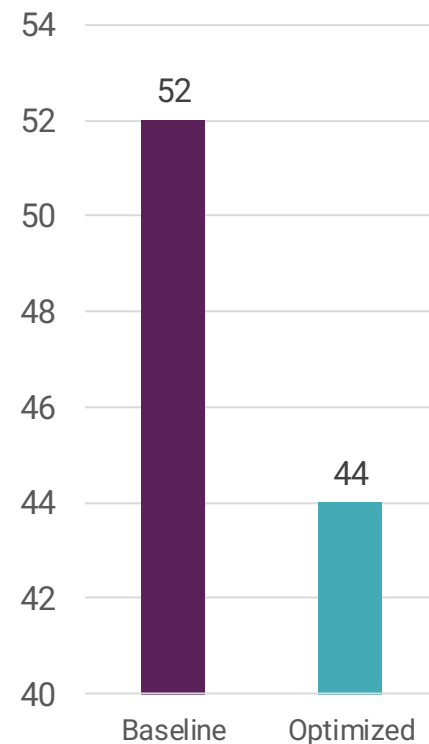
- Optimization of referral linkages reduces service distance, cost and utilization

Implementation:

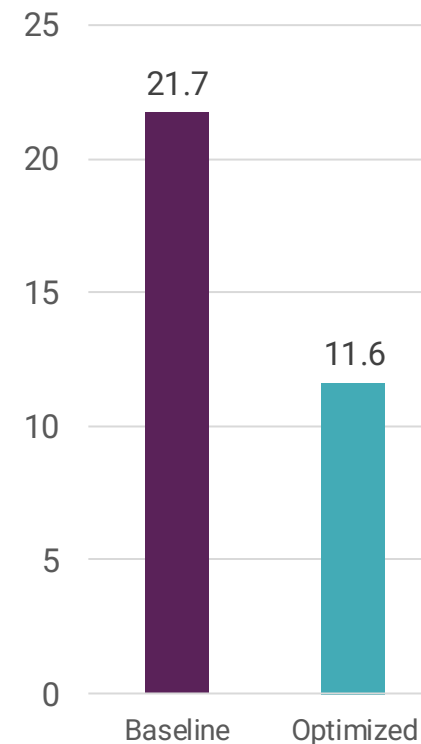
- Informed NSP
- Pilot of integrated SRS for TB, HIV, HPV
- Used in funding applications for TGF, UNICEF, PEPFAR

RESULTS

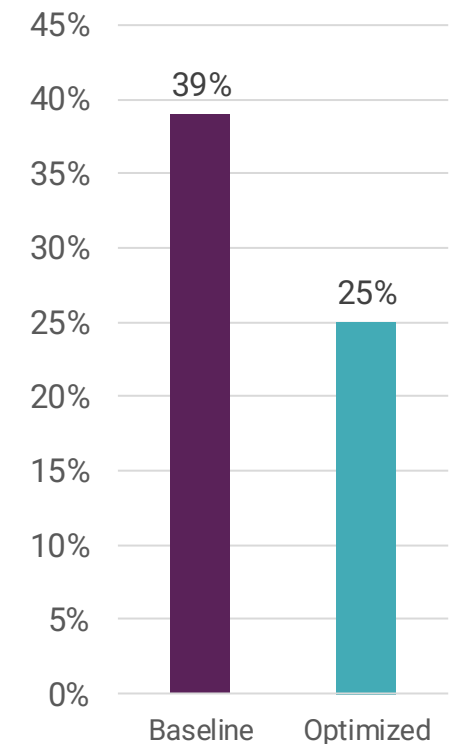
Avg. service distance (km)



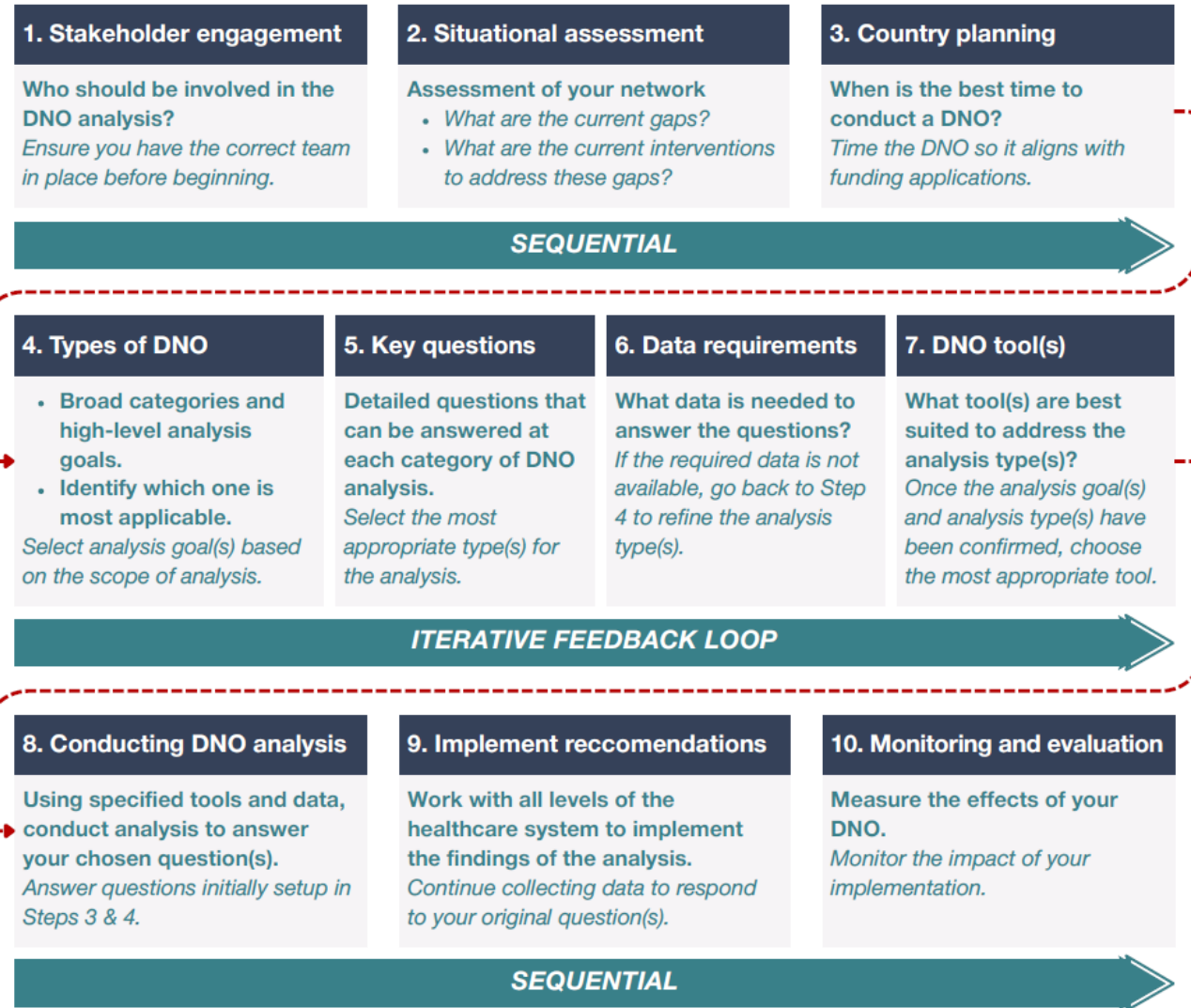
Est. Cost (USD mil.)



Device utilization



IMPLEMENTING DNO ANALYSES



PERFORMING AND IMPLEMENTING FINDINGS



8. Conducting DNO analysis

Use an analysis framework:

- baseline
- scenario comparison
- interpret outputs
- compare costs



9. Implement recommendations


- Direct policy impact
- Phased approach
- Inform NSP



10. M&E

- Use M&E framework
- Track KPIs (utilization, TAT etc.)

COMMON THINGS TO AVOID



Starting DNO too late in funding cycle

Excluding key stakeholders

Waiting for all of the data

Ignoring implementation feasibility

Not validating assumptions with country teams

Failing to establish M&E from the start

ACKNOWLEDGEMENTS



Ministries of Health:

- Botswana,
- Mozambique,
- Kenya,
- Cote d'Ivoire, and
- India

for providing examples for the guide

Stop  Partnership

MORE INFORMATION



[A guide to stepwise implementation of DNO - Stop TB](#)

USEFUL LINKS

◆ [DNO Data Guidance Tool](#) – determine what data is required for what analysis

DNO Specific Tools

1. [LabMap](#) (ASLM) – Open Access
2. [DxGeoMap](#) (FIND) – Open Access
3. [PlanWise](#) (ASLM) – Open Source
4. [AccessMod](#) (UNIGE) – Open Source
5. [DxPulse](#) (FIND) – Open Source
6. [OptiDx](#) (FIND) – Open Access

Commercial Tools that can be adapted for DNO

1. ArcGIS Network Analyst (ESRI)

Further reading: [Landscape Review of Diagnostic Network and Route Optimization Tools](#)