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GIS FOR DIAGNOSTIC NETWORKS

DNO SubCop ECHO session

◆ 2024-07-25



GIS FOR DIAGNOSTIC NETWORKS
SESSION OBJECTIVES



Introduce basic concepts and outputs of GIS analyses



Describe how a range of GIS based analyses can be applied to diagnostic network planning



Provide examples of GIS based mapping and analysis

DIAGNOSTIC NETWORKS

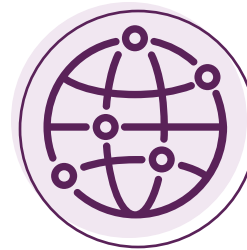
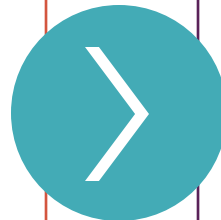
COMPLEX CONTEXTS & CONSTRAINED RESOURCES HINDER EQUITABLE ACCESS TO QUALITY DIAGNOSIS



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**

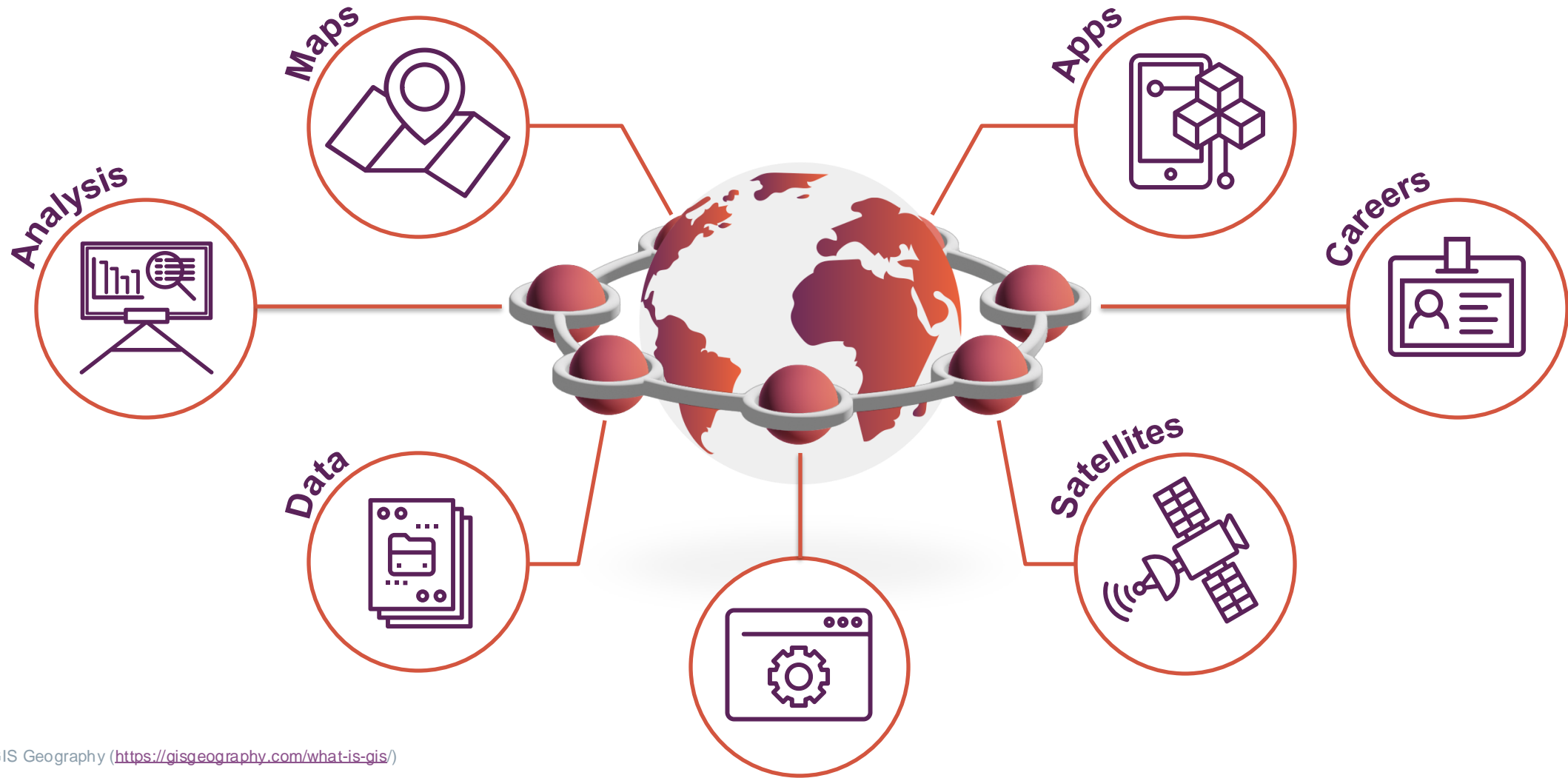


Current reality

- 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**

GEOGRAPHIC INFORMATION SYSTEMS

WHAT IS GIS?



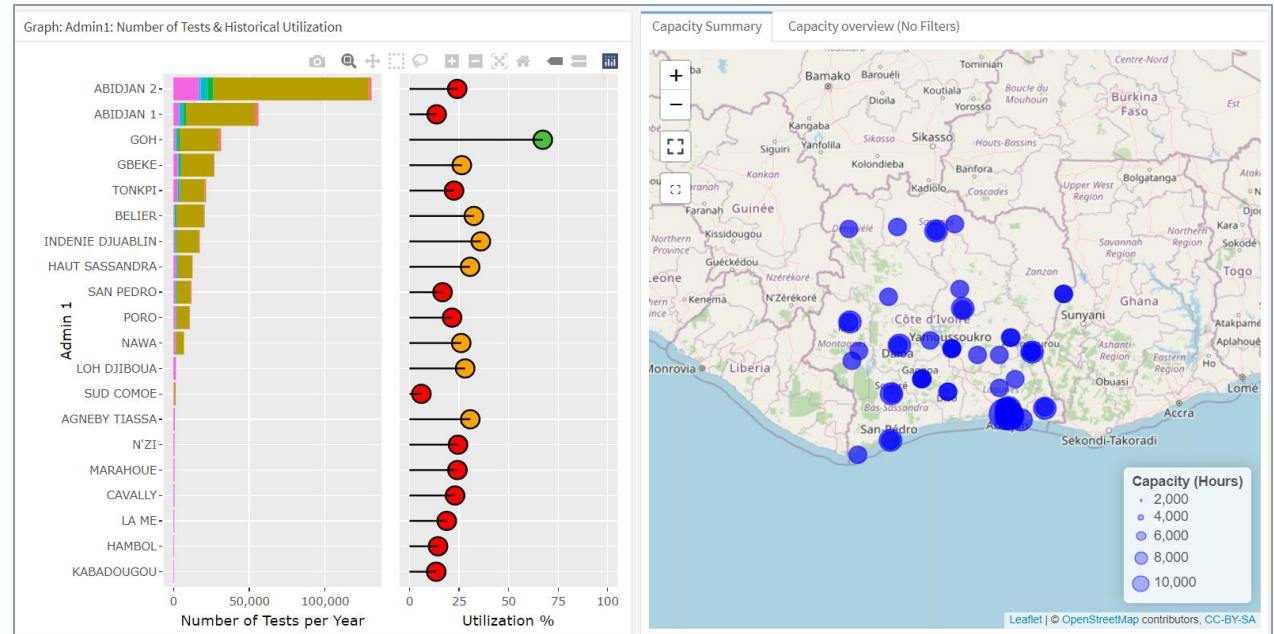
Source: GIS Geography (<https://gisgeography.com/what-is-gis/>)

GEOSPATIAL NETWORK ANALYTICS & OPTIMIZATION

DIAGNOSTIC SYSTEMS PLANNING

Geospatially-powered visualization, analysis and optimization approaches that:

- analyze a country's current diagnostic network to identify **gaps and opportunities** for systems strengthening
- recommend** changes to the type, number & location of diagnostics and associated sample referral system to achieve national health goals
- Model introduction of new diagnostic** tools and approaches



- Gain detailed insights into spatial **patterns & trends**
- Model the **real world** more accurately
- Examine trade-offs** & improve decision making

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**GIS
VISUALIZATIONS**



WHAT DOES GIS DATA LOOK LIKE?

GIS DATA

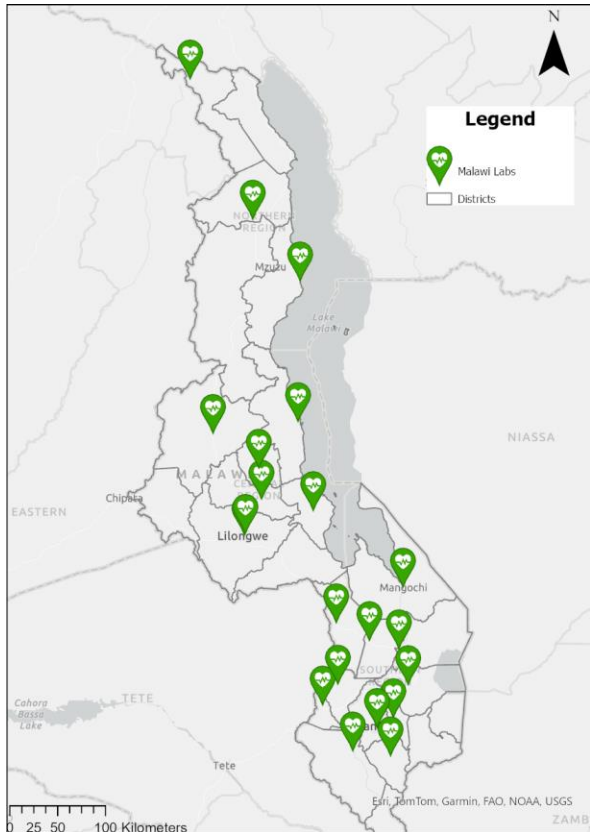
LOCATION

ATTRIBUTES

NAME	LOCATION		ATTRIBUTES				
	LONGITUDE	LATITUDE	CAPACITY	TEST_HIV	TEST_TB	TEST_TOTAL	UTILIZATION
Balaka District Hospital	34.94959	-14.98498	1000	343	97	440	44
Bwaila Hospital	33.77561	-13.99164	1000	92	59	150	15
Chikwawa District Hospital	34.79346	-16.0231	3000	1097	673	1770	59
Chiradzulu District Hospital	35.17419	-15.71072	2500	1224	251	1475	59
Chitipa District Hospital	33.26590	-9.70159	1000	264	66	330	33
Dowa District Hospital	33.93625	-13.65432	3500	2002	1848	3850	110
Kamuzu Central Hospital	33.78512	-13.97639	5000	564	4136	4700	94
Kasungu District Hospital	33.48041	-13.03579	1000	446	365	810	81
Machinga District Hospital	35.22630	-15.06229	3000	1053	1287	2340	78
Mangochi District Hospital	35.26527	-14.48191	1500	231	99	330	22
Mwanza District Hospital	34.50998	-15.59118	3500	391	869	1260	36
Neno District Hospital	34.65349	-15.39524	1500	248	97	345	23
Nkhata Bay District Hospital	34.29872	-11.60159	2500	631	1894	2525	101
Nkhotakota District Hospital	34.27939	-12.92508	3500	512	153	665	19
Ntcheu District Hospital	34.63823	-14.81698	2000	1066	234	1300	65

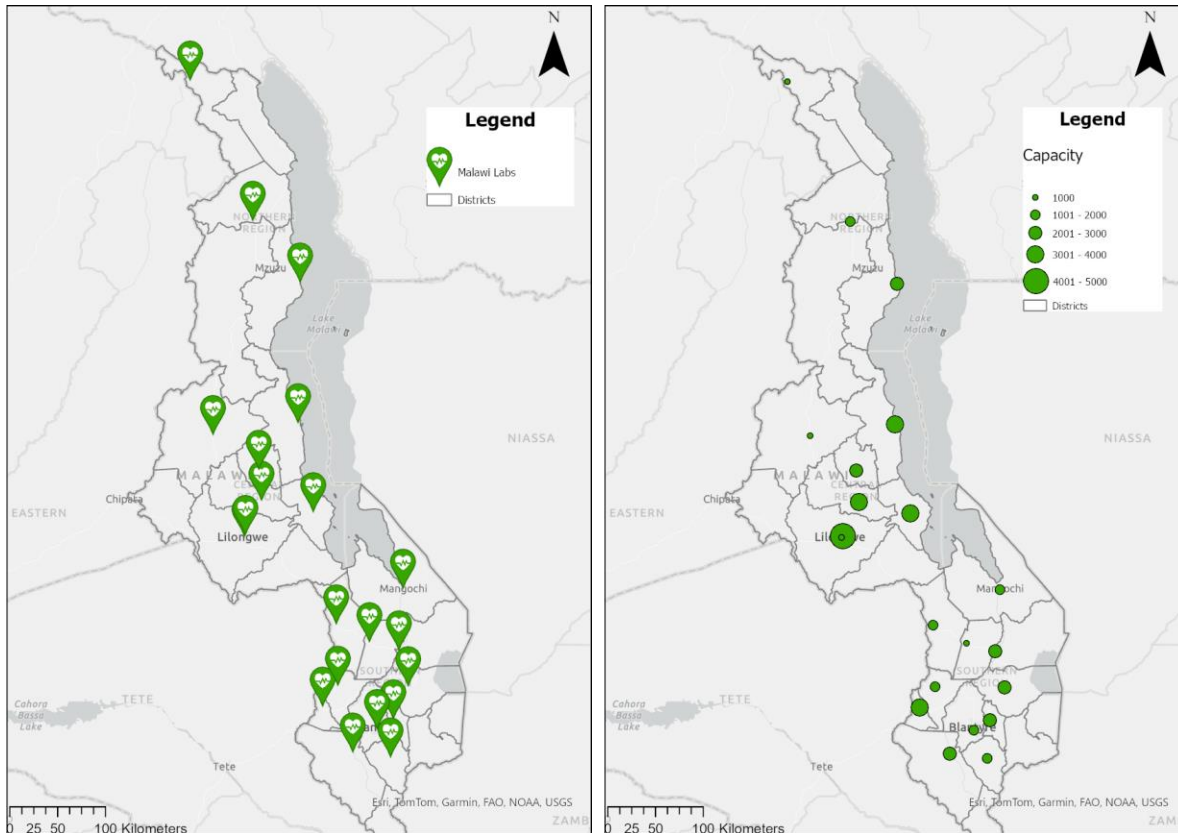
VISUALIZATION TECHNIQUES

GIS MAPPING



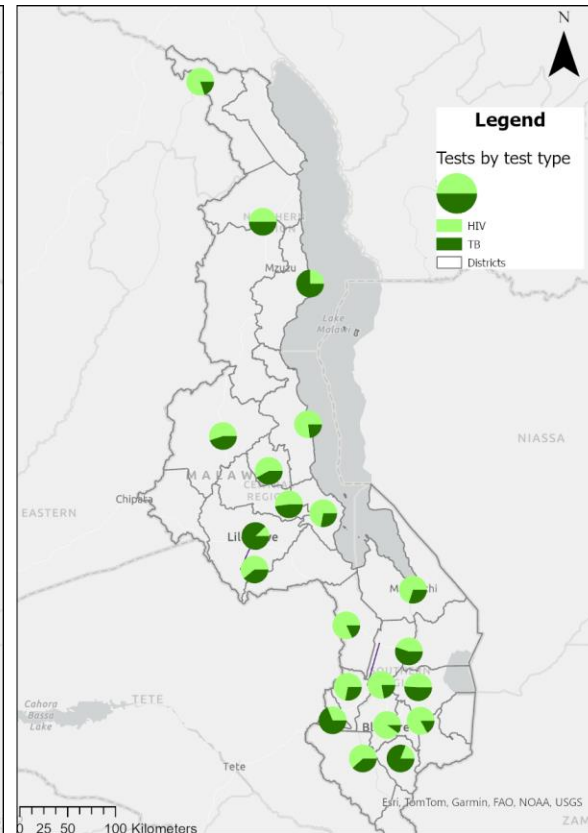
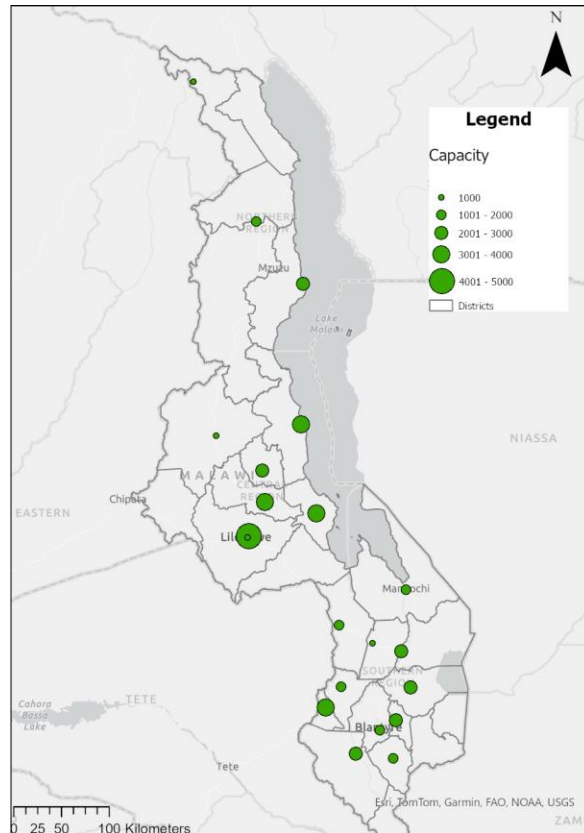
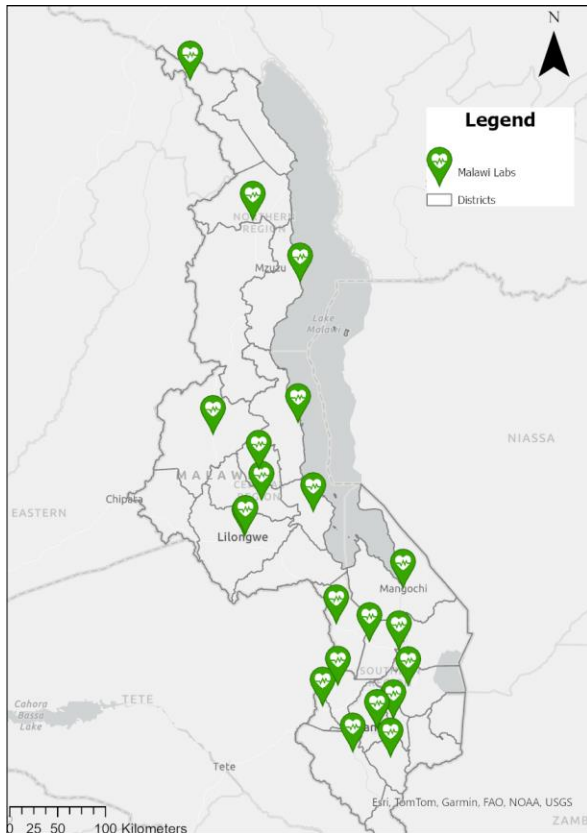
VISUALIZATION TECHNIQUES

GIS MAPPING

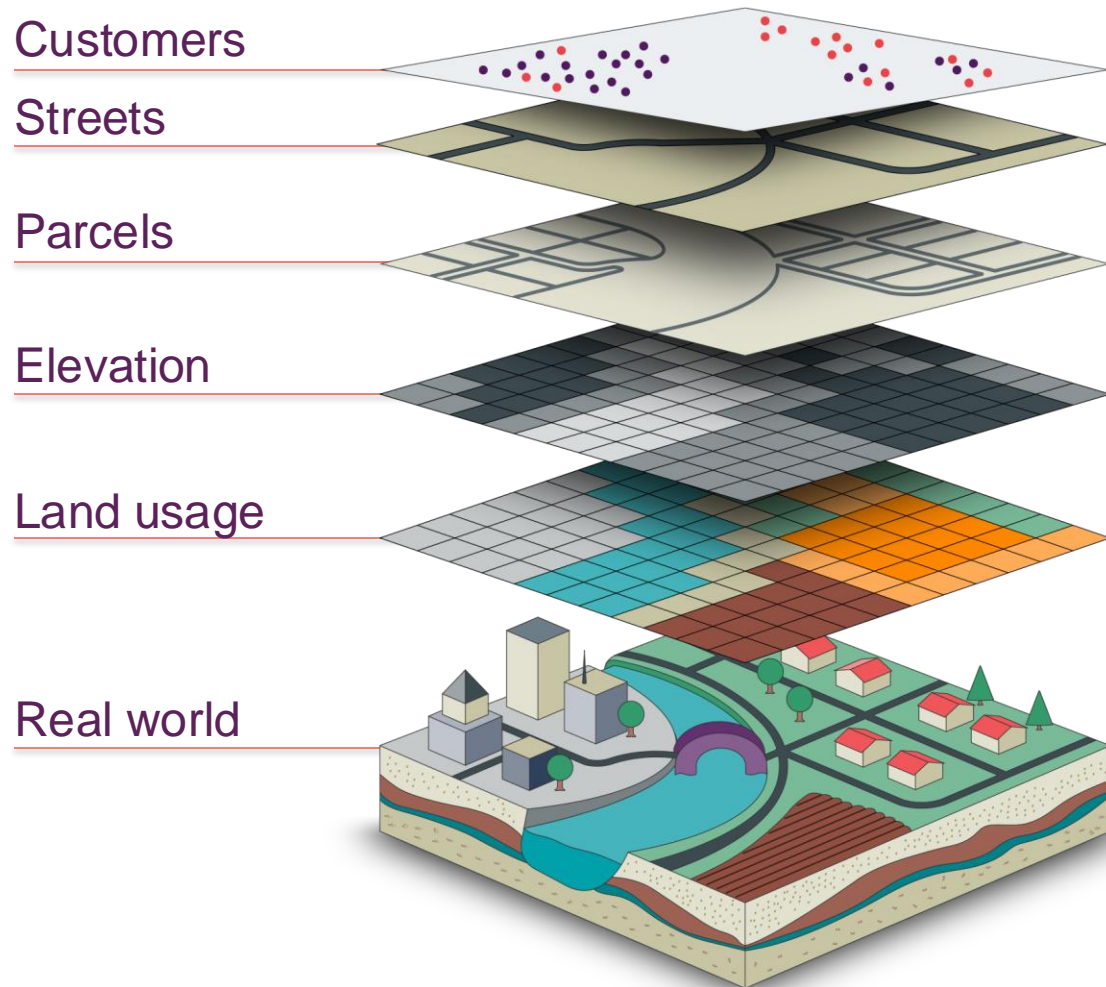


VISUALIZATION TECHNIQUES

GIS MAPPING

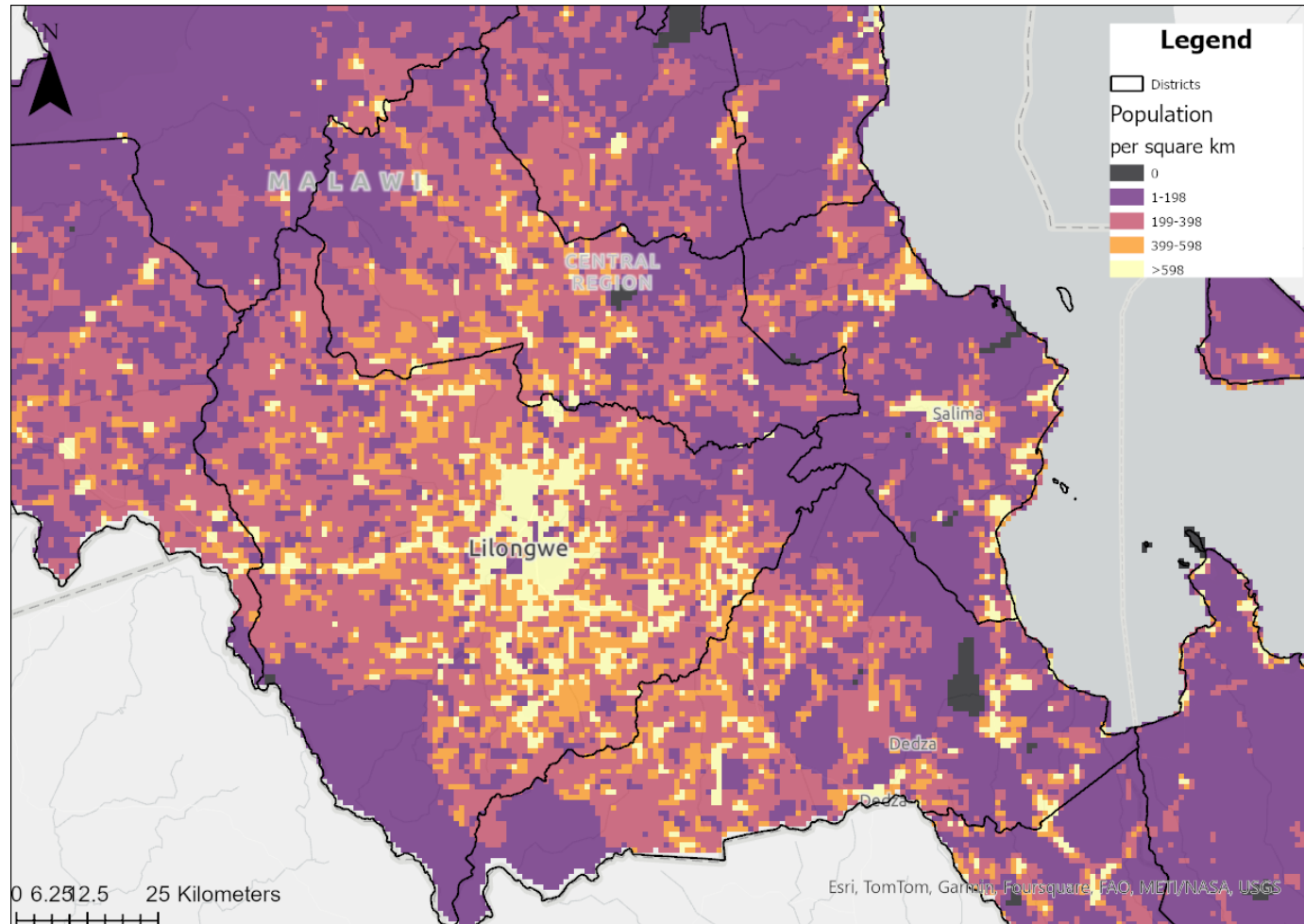


GIS DATA
A LAYERED APPROACH

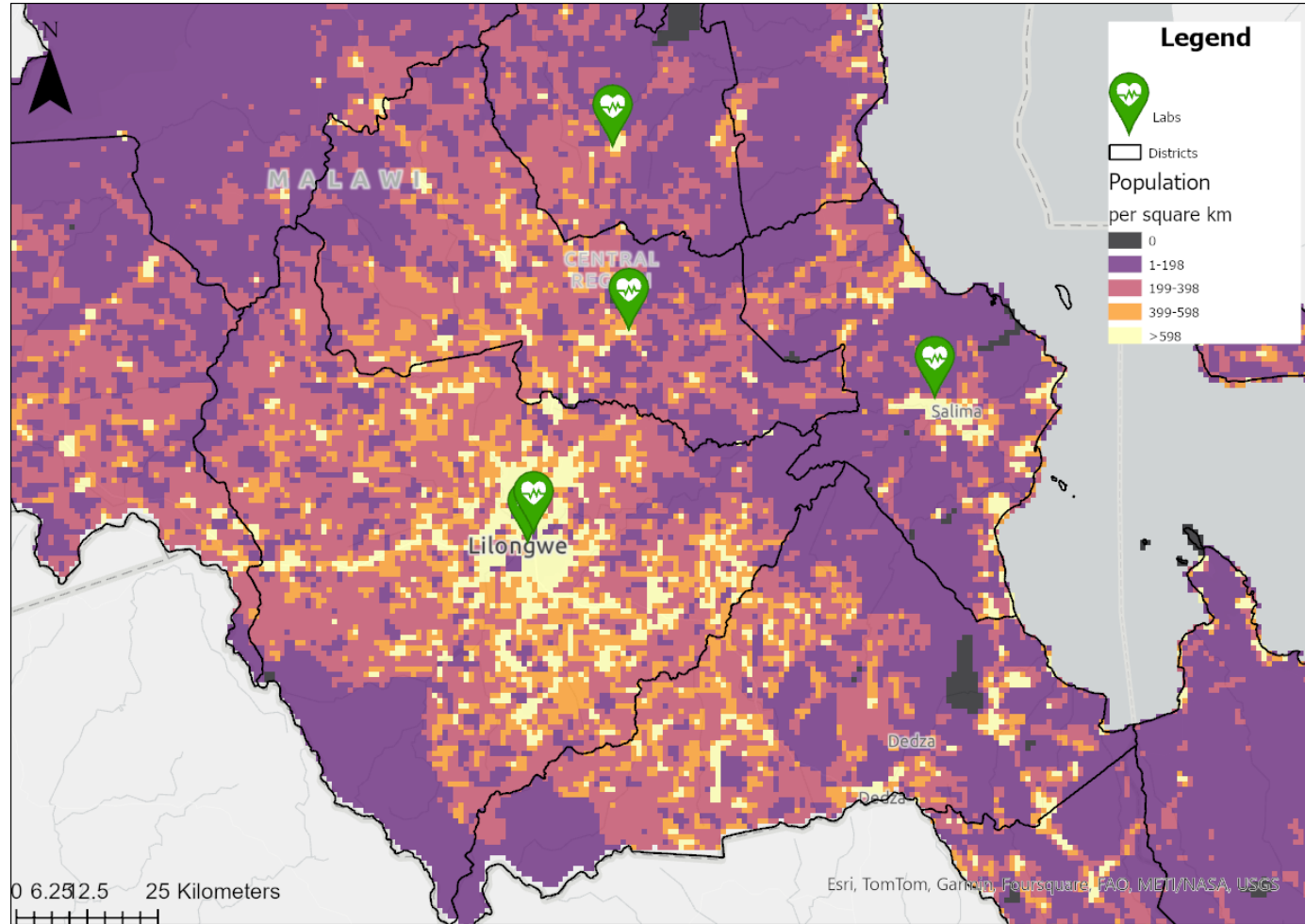


Geographic Information Systems use layers of spatial data to help us reflect what is happening in the real world.

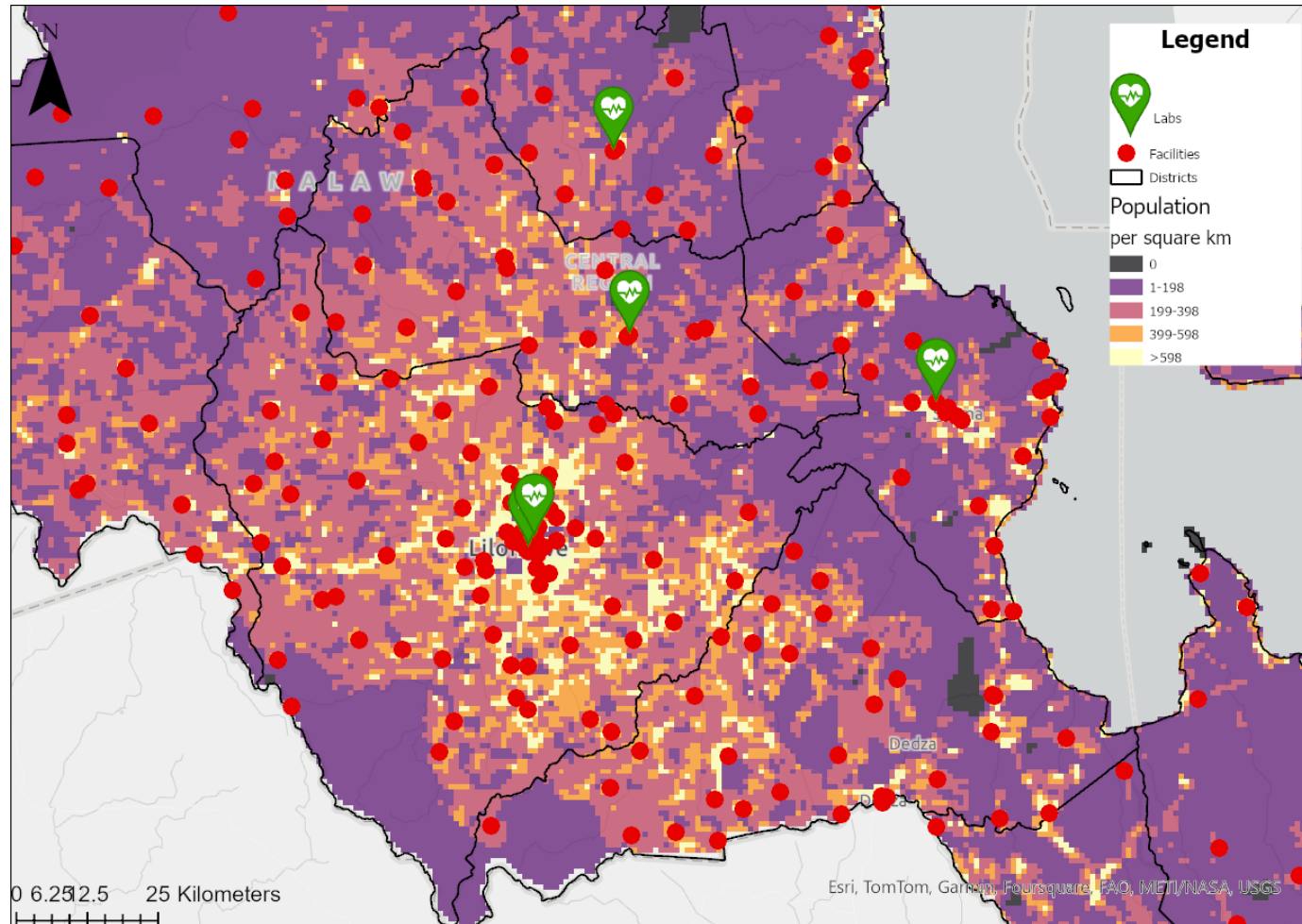
LAYERS OF DIAGNOSTIC NETWORK INFORMATION GIS MAPPING



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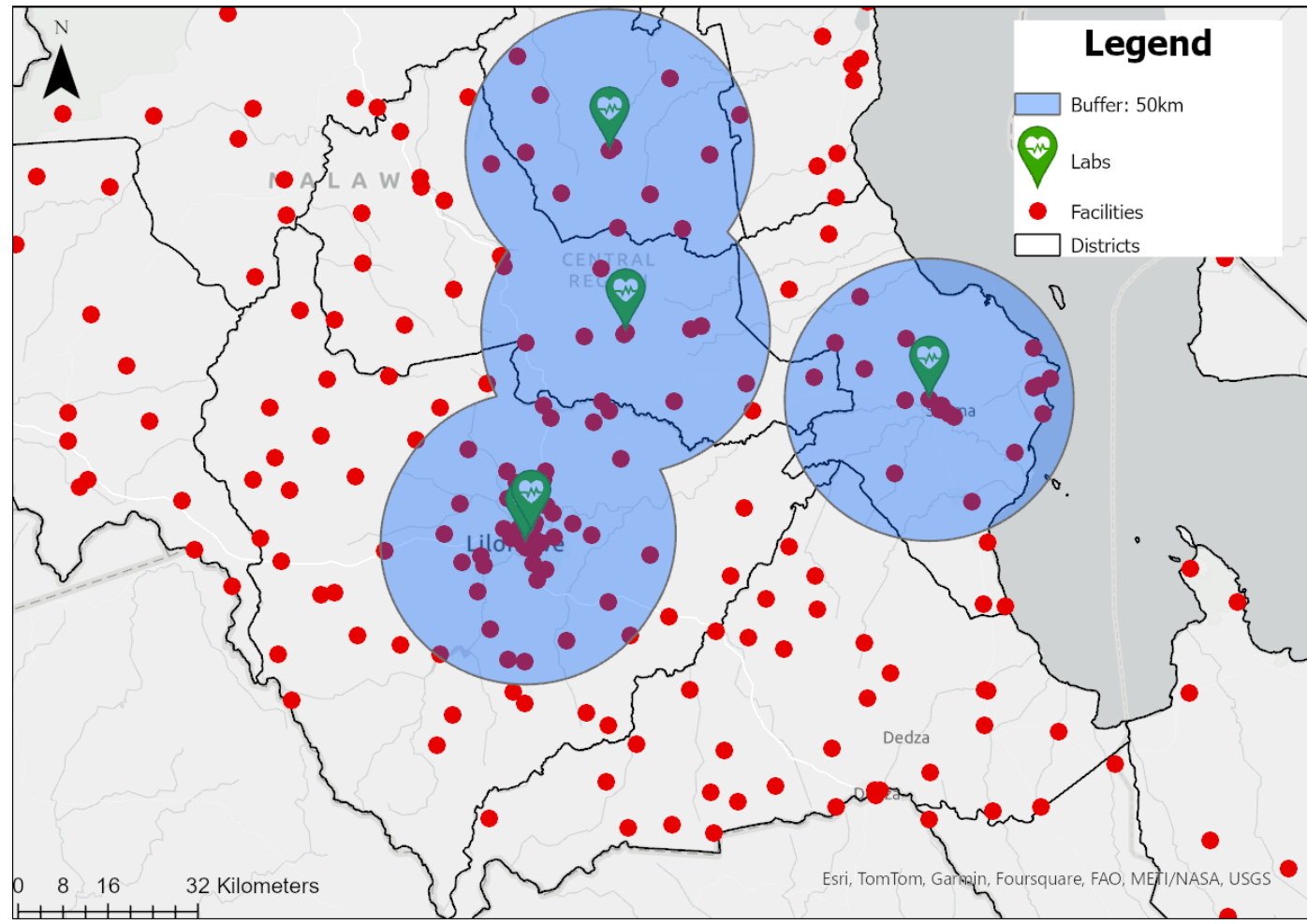
FIND 



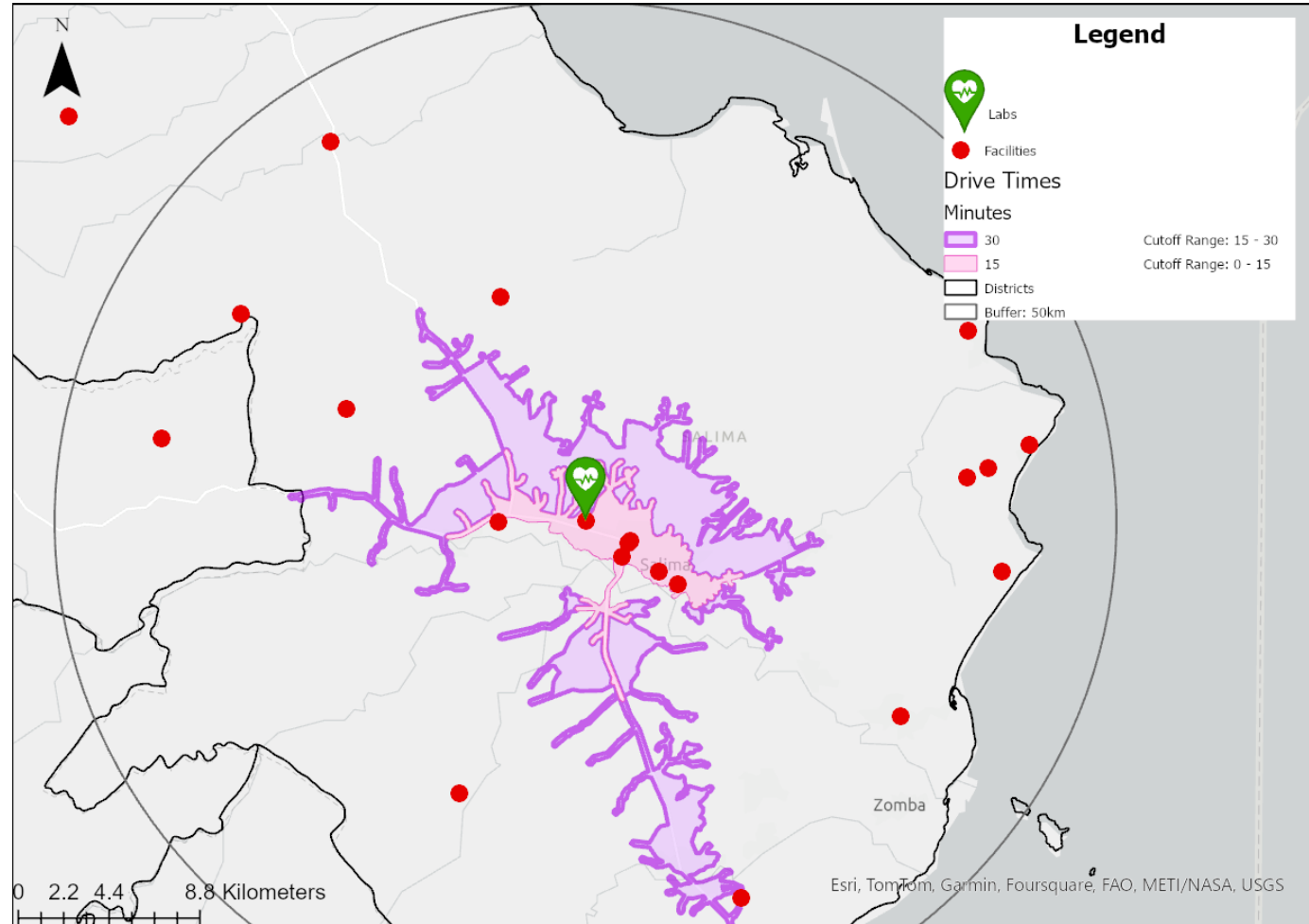
**GIS ANALYSES TYPES
FOR DIAGNOSTIC
NETWORKS**



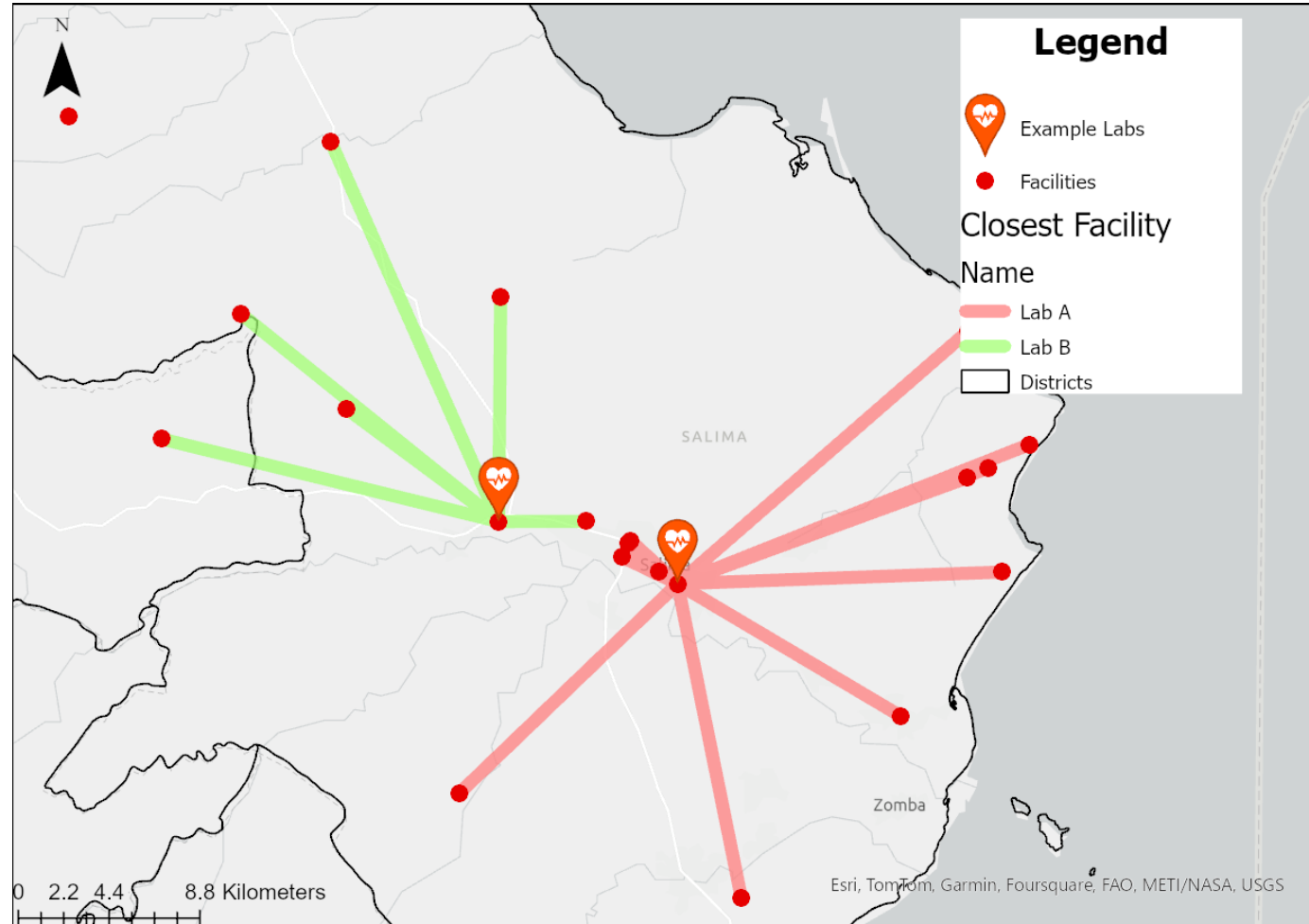
BUFFER GIS ANALYSIS TYPES FOR DNO



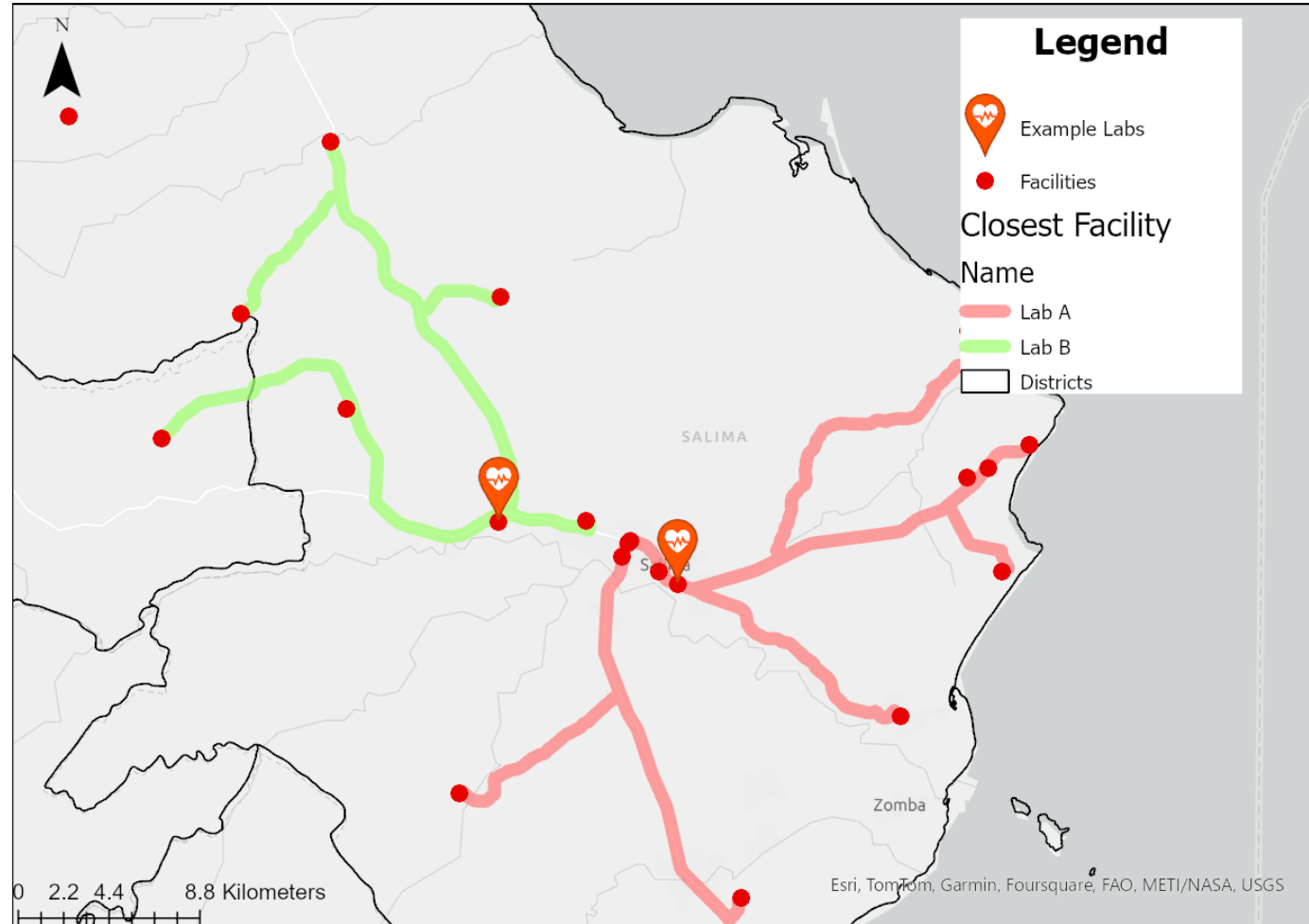
TRAVEL TIME GIS ANALYSIS TYPES FOR DNO



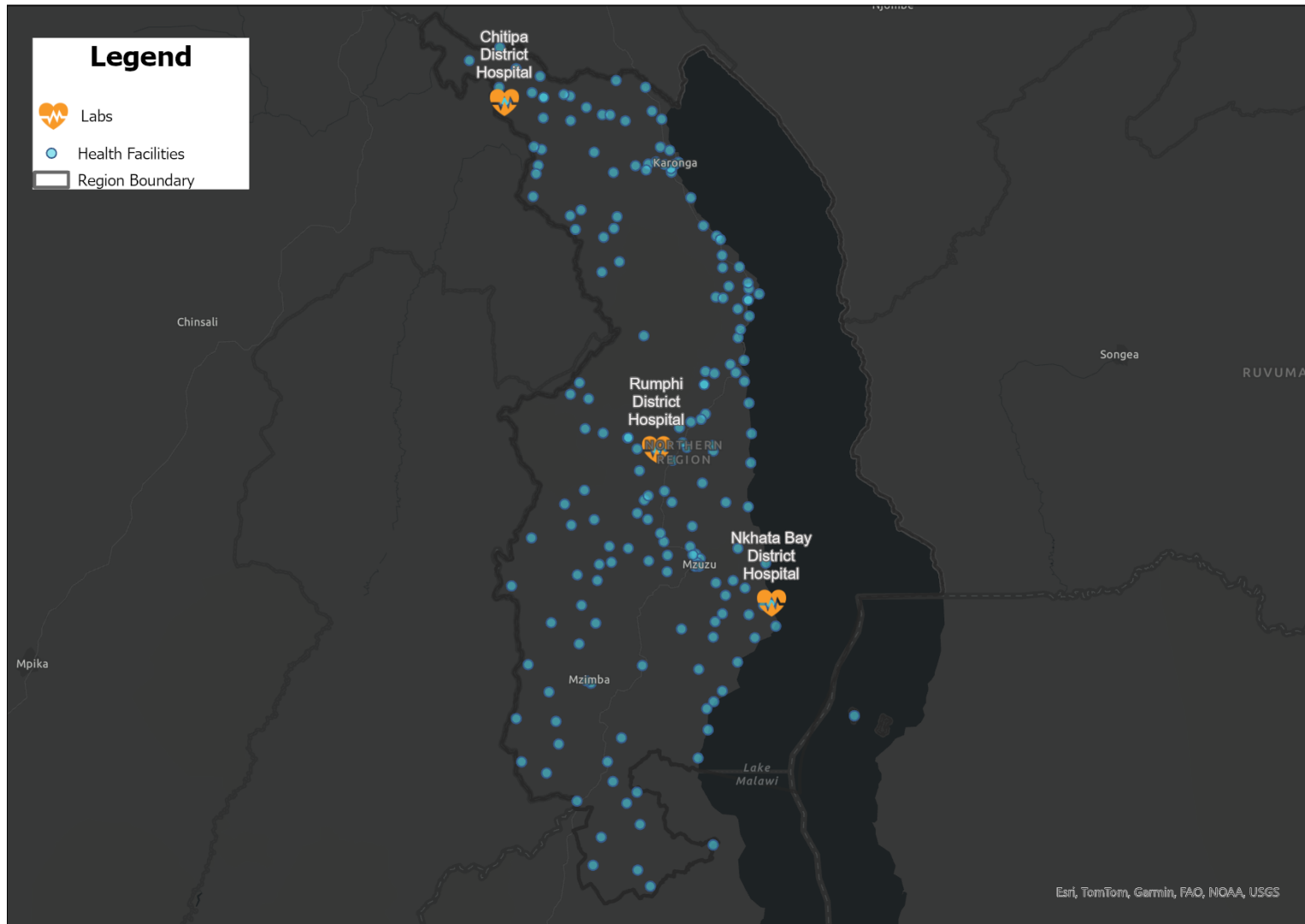
NEAR-STRAIGHT LINE
GIS ANALYSIS TYPES FOR DNO



NEAR-ROAD DISTANCE
GIS ANALYSIS TYPES FOR DNO



DEVICE PLACEMENT EXAMPLE
GIS ANALYSIS TYPES FOR DNO

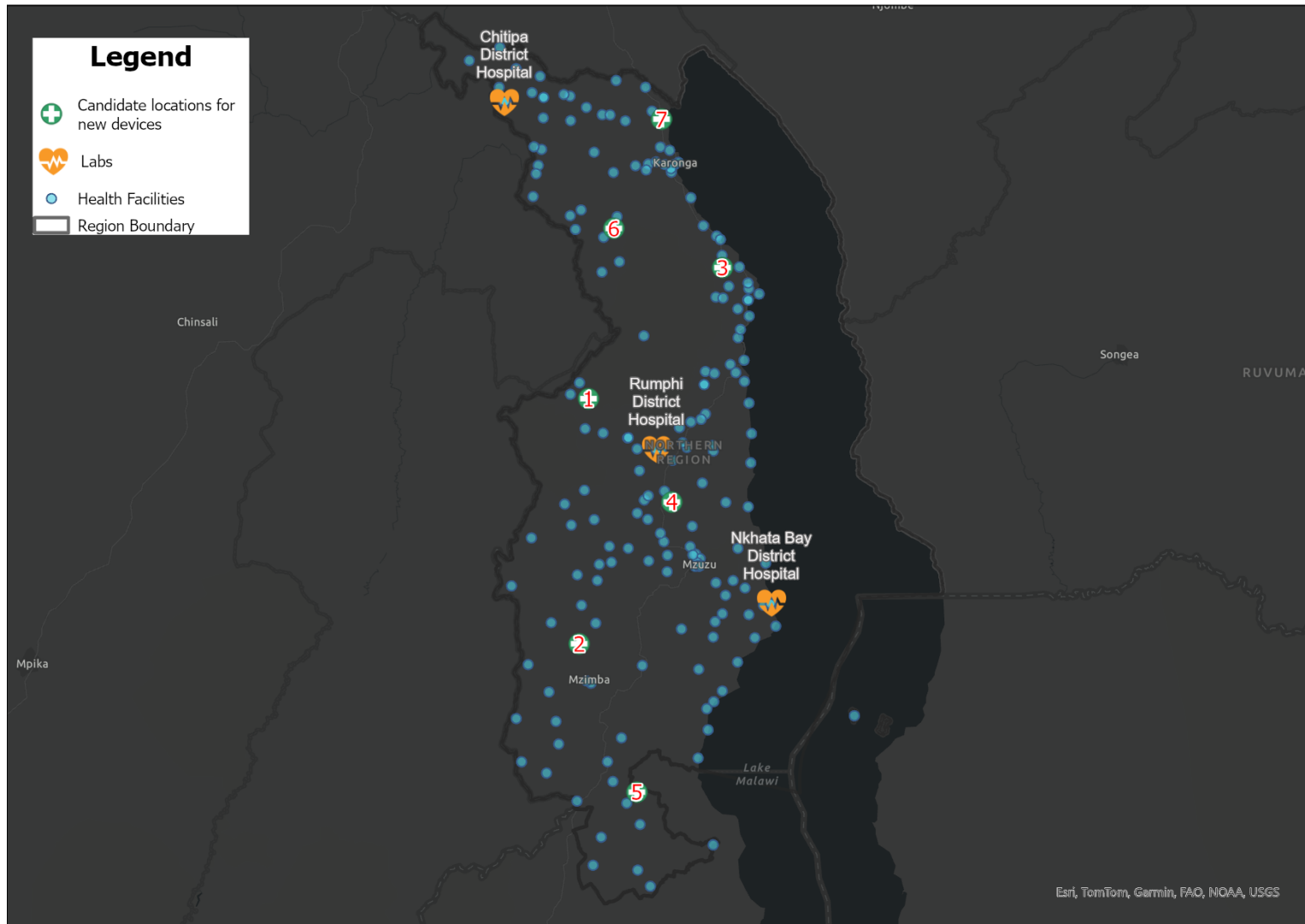


Our current diagnostic network has three laboratories and many health facilities.

We want to add devices to three new locations.

DEVICE PLACEMENT EXAMPLE

GIS ANALYSIS TYPES FOR DNO

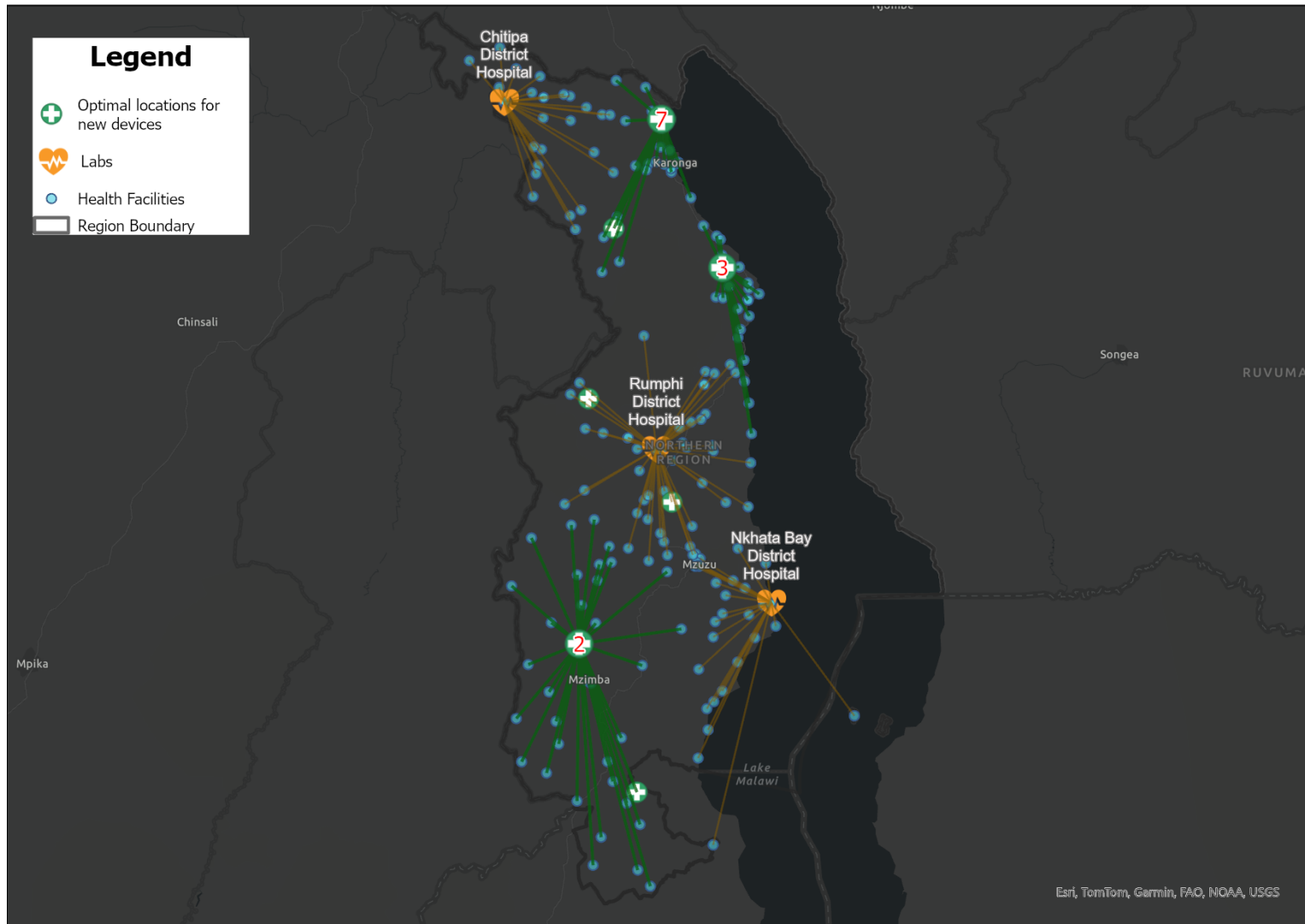


In country experts have identified seven potential sites for the three new devices.

Question: Where would you place three new devices so that you could improve access to testing?

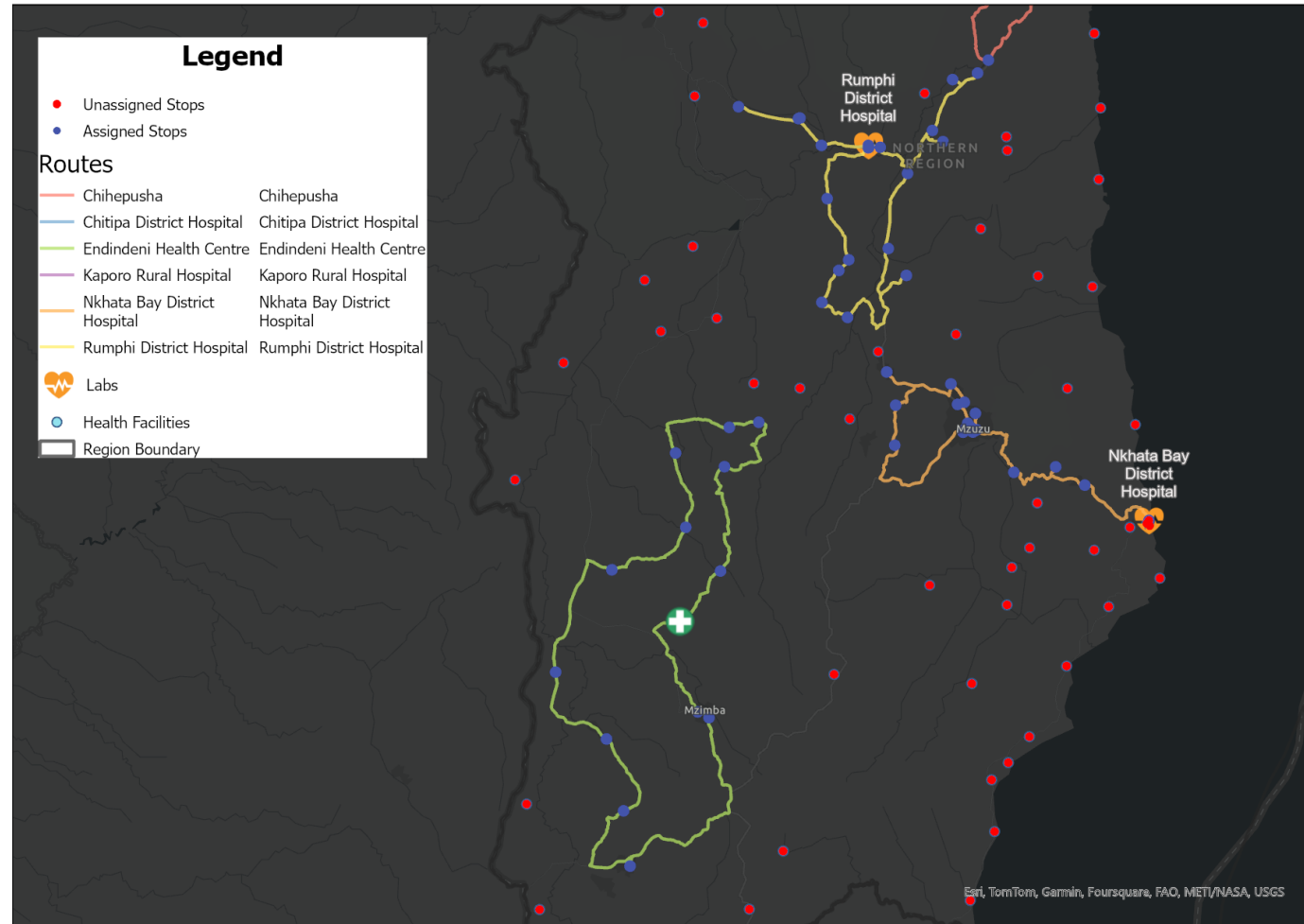
Place your answer in the chat. E.g. 1, 2, 3.

DEVICE PLACEMENT EXAMPLE GIS ANALYSIS TYPES FOR DNO



GIS software can help us find the optimal locations based on travel time.

SAMPLE TRANSPORT GIS ANALYSIS TYPES FOR DNO



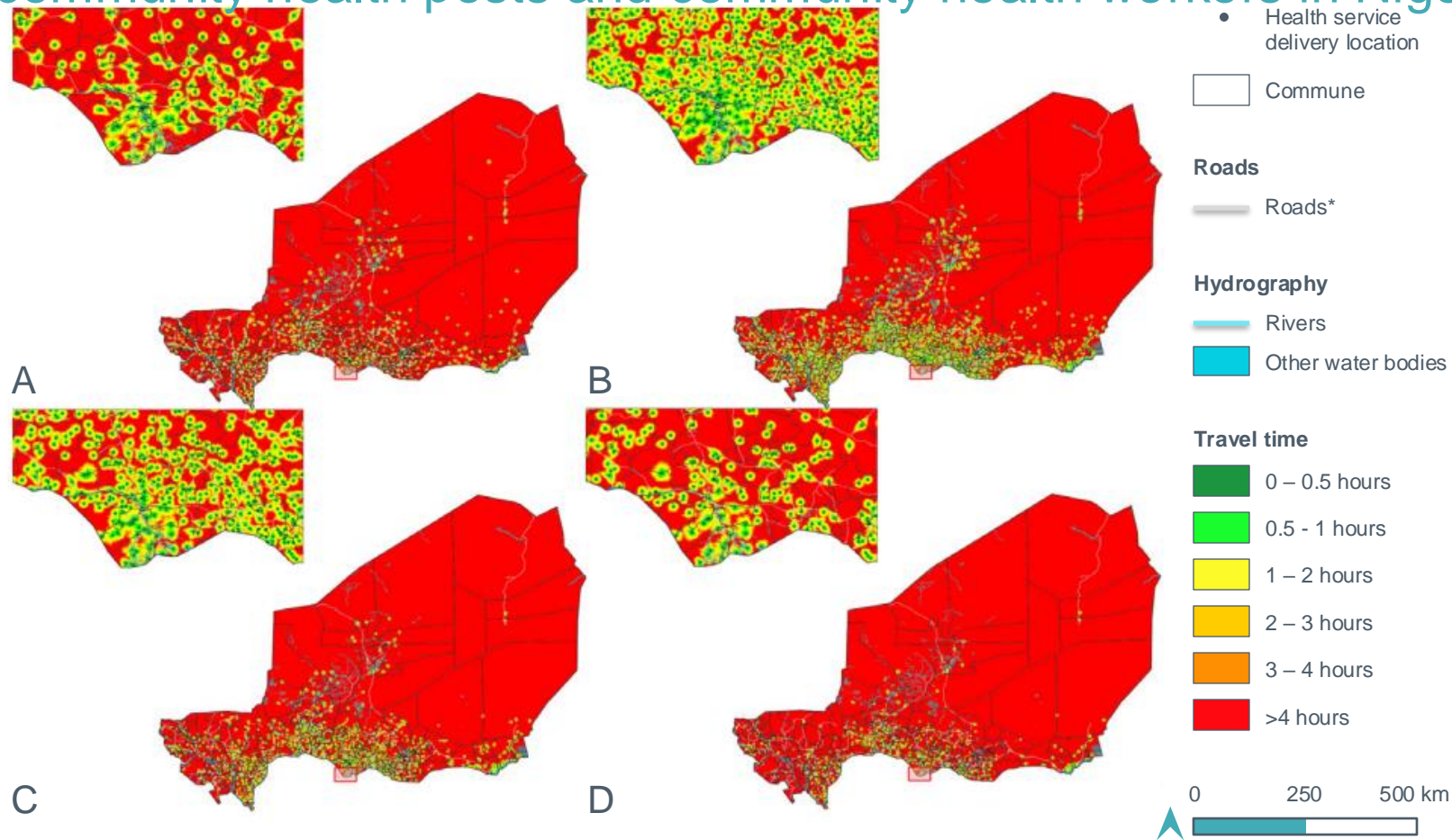


**REAL WORLD
EXAMPLES**



REAL WORLD EXAMPLES
NIGER

Optimising geographical accessibility to primary health care: a geospatial analysis of community health posts and community health workers in Niger



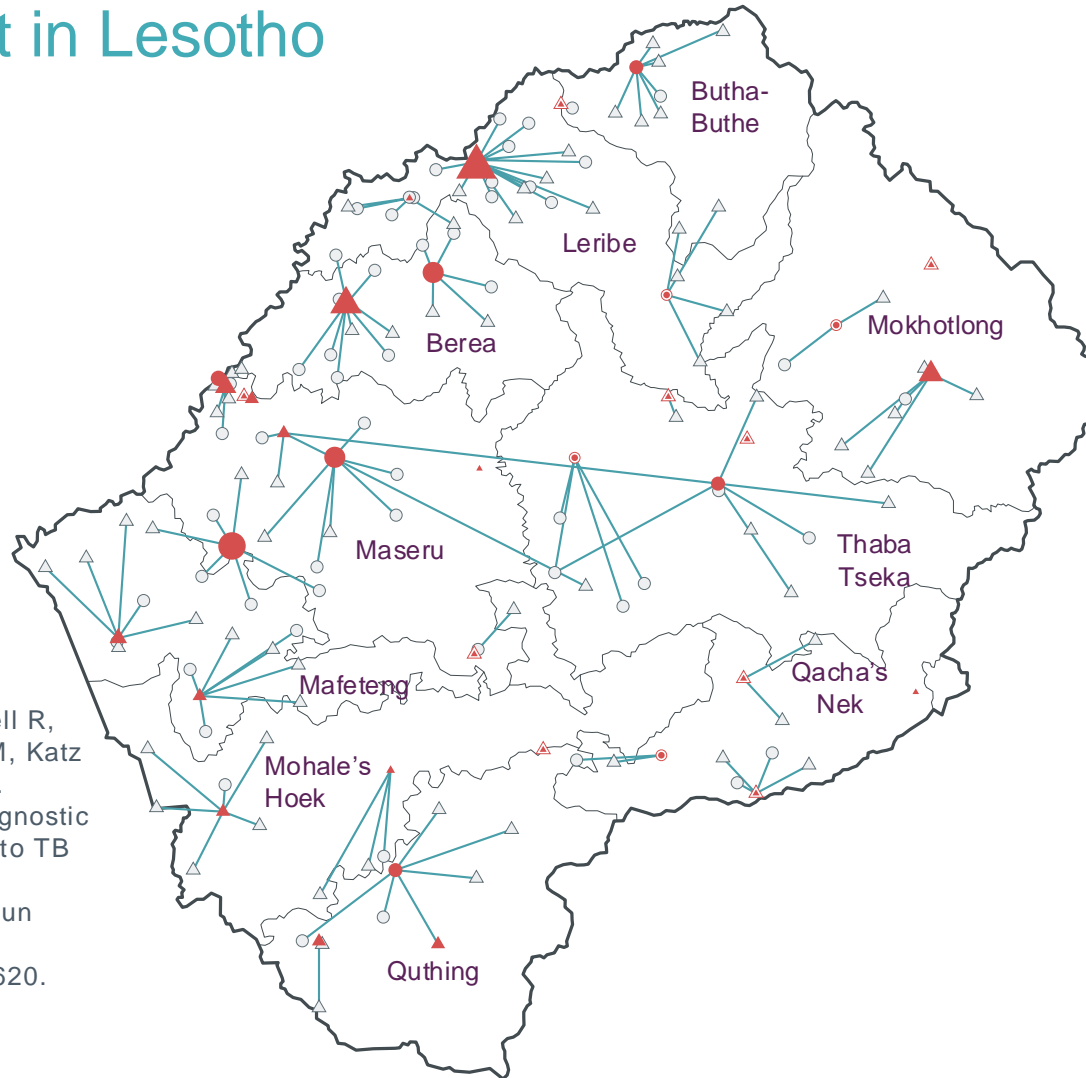
- Accessibility analysis to primary healthcare
- Green areas of maps are closer to primary health care facilities
- Data driven approach to locating new primary health care facilities

Reference: Oliphant NP, Ray N, Bensaid K, Ouedraogo A, Gali AY, Habi O, Maazou I, Panciera R, Muñiz M, Sy Z, Manda S, Jackson D, Doherty T. Optimising geographical accessibility to primary health care: a geospatial analysis of community health posts and community health workers in Niger. *BMJ Glob Health.* 2021 Jun;6(6):e005238. doi: 10.1136/bmjgh-2021-005238. PMID: 34099482; PMCID: PMC8186743.

REAL WORLD EXAMPLES

LESOTHO

Designing an optimized diagnostic network to improve access to TB diagnosis and treatment in Lesotho

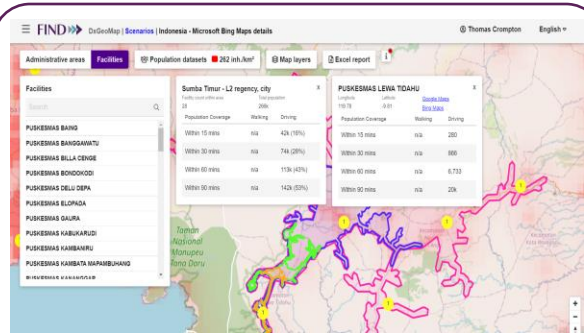


- Improved access to TB diagnosis
- Number and placement of different devices

Reference: Albert H, Purcell R, Wang YY, Kao K, Mareka M, Katz Z, Maama BL, Mots'oane T. Designing an optimized diagnostic network to improve access to TB diagnosis and treatment in Lesotho. PLoS One. 2020 Jun 3;15(6):e0233620. doi: 10.1371/journal.pone.0233620. PMID: 32492022; PMCID: PMC7269260.

STEPWISE APPROACH TO GIS BASED DIAGNOSTIC NETWORK ANALYTICS

1. POPULATION ACCESSIBILITY ANALYSIS

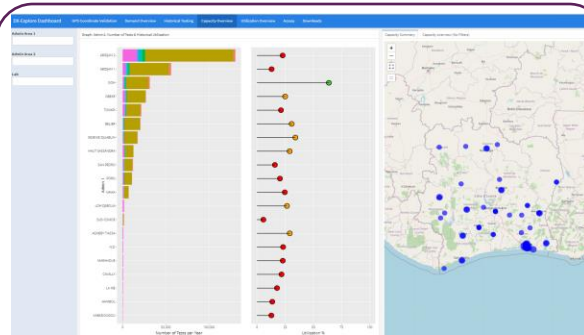


How accessible are Dx services to the population (travel time/distance)?

How can Dx coverage be improved?

Data requirement: **LOW**

2. DIAGNOSTICS CAPACITY MAPPING



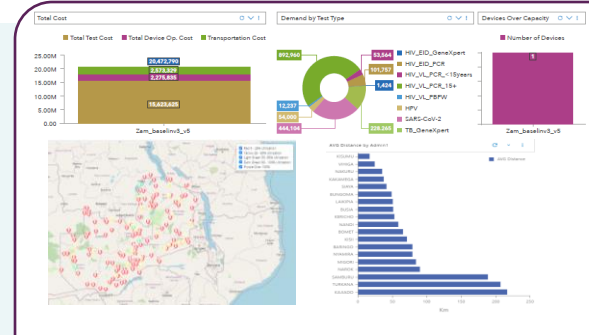
Are Dx equitably distributed or are there gaps?

To what extent is capacity utilized?

Could the current network support higher testing volumes?

Data requirement: **MEDIUM**

3. ADVANCED DNO ANALYSIS (OPTIDX)



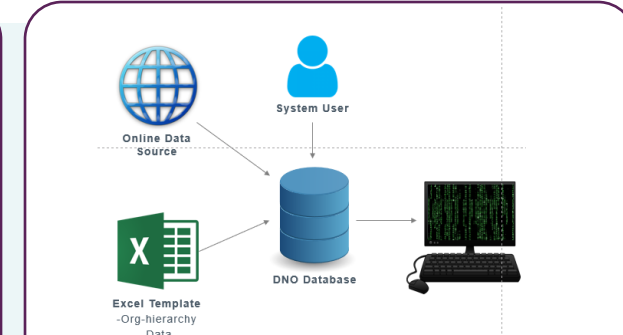
What is the optimal mix and placement of devices for current & future needs?

How can integration work best?

What is the best balance between adding more devices & sample transport?

Data requirement: **HIGH**

4. DYNAMIC DNO APPLICATION (DHIS-2)



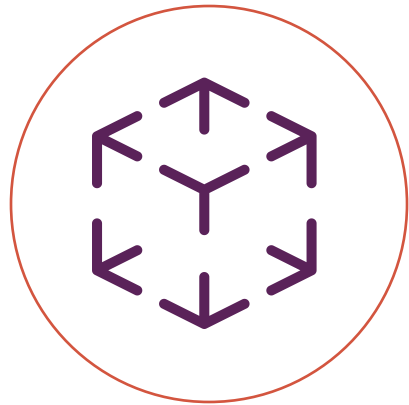
Tracking network performance over time, incl. addition of new tests/devices

Simple “what if?” scenarios

Web-based and country-installed versions (under development)

Data requirement: **MEDIUM -HIGH**

SUMMARY OF GIS FOR DIAGNOSTIC NETWORKS



Visualize

data with a spatial component



Layer

information for a more detailed view



Analyze

quantify access



Optimize

find nearest and optimal locations

SUMMARY OF ANALYSIS TYPES

QUESTIONS THAT CAN BE ANSWERED



Mapping

Which areas do not have diagnostic testing services?



Service Areas

How accessible are current services to the population (travel time/distance)?

Could coverage be improved with service expansion or introduction of new Dx?



Device Placement

What is the optimal location of Dx capacity to meet current & future needs?



Sample Transport

What is the best balance between adding more devices & sample transport?

What is the optimal route for a specimen courier?

TO LEARN MORE



INTRODUCTION TO DIAGNOSTIC NETWORK OPTIMIZATION 2.0

STARTING 5 AUGUST 2024

Join us to learn about diagnostic network optimisation (DNO) a geospatial analytics approach to achieve patient centric and cost-efficient diagnostic systems

- Free **self-learning, self-paced** online course
- Approximately 10-12 learning hours over 2 weeks

Updated course content:
Wider range of DNO analyses, additional resources and country examples

Register here

Security code: 099926

FIND Diagnosis for all **ASLM**
Integrated Diagnostics Consortium **World Health Organization**
 South-East Asia

Updated self-learning DNO course, free of cost.

Starts 5th August. Registrations open now.

Link to register:

dxacademy.finddx.org/groupSelfRegistration/65ba03b6dee0e859dcc280b4

Security code: 099926

Contact:

dno.community@finddx.org

THANK YOU

For more information:

[DNO Sub-CoP - African Society for Laboratory Medicine \(aslm.org\)](http://aslm.org)

[Diagnostic network design and optimization - FIND \(finddx.org\)](http://finddx.org)