Integrating Administrative Databases to Improve Resource Allocation in the Zambian Health Sector

An Application to the Spatial Distribution of Health Workers

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Health remains a major concern in Zambia

According to the Zambian Demographic and Health Survey 2013-2014:

- 1 in every 22 Zambian children dies before reaching age one, and 1 in every 13 does not survive to his or her fifth birthday
- 36% of deliveries are not performed by a skilled health care provider
- 24% of children in urban areas are not fully immunised and this number is 35% in rural areas

Making the most of the available resources

- Lack of health resources in Zambia
  - Shortage of health workers is a particular concern
  - 0.98 health workers per 1000 population while WHO recommends 4.45
- How can the available resources be used most effectively?
- Data can help allocate resources efficiently and support evidence-based policy-making

Data is available, but not integrated

The Ministry of Health (MoH) and its partners collect a wide variety on health services, for example:

- Health Management Information System (HMIS)
- Human Resource Information System (HRIS)
- MoH Health Facility Census
- EQUIP Health Facility Census

But these databases are not linked

This study

- Integrate the previously mentioned databases
- Demonstrate the power of the integrated data
- Provide two examples:
    1. Analysis of the spatial distribution of health workers
    2. Analysis of population access to laboratories

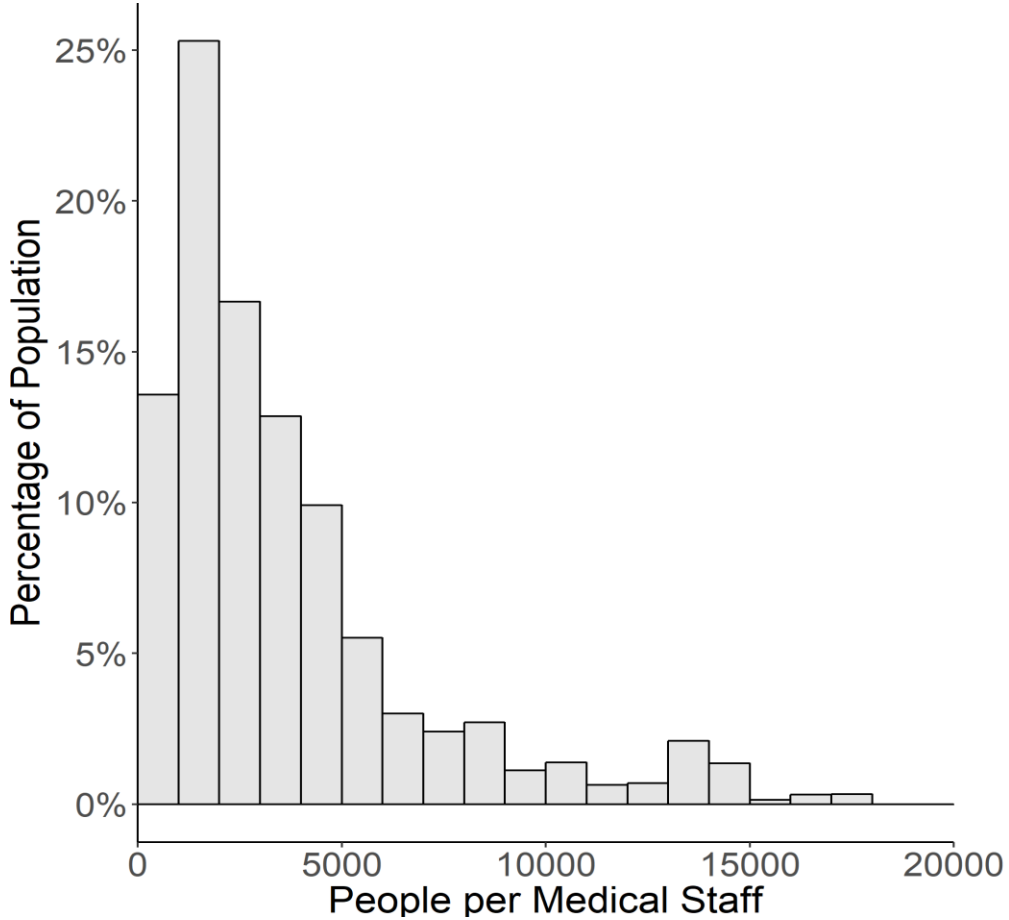
Database integration

- All datasets were merged together by facility name
- Match rates vary across datasets
  - 26% of all facilities in EQUIP are not in HRIS
  - 17% of HRIS facilities are not in EQUIP
- Reasons for unmatched facilities include:
  - Different target populations
    - For example, HRIS contains only facilities with MoH employees while EQUIP also contains private facilities
  - Time lag
    - EQUIP is from 11/2016-05/2017
    - HRIS is from 01/2018
  - Missing facilities, especially small health posts

The spatial distribution of medical staff

- Focus on health centres and health posts
- Define medical staff as nurses, midwives, clinical officers, environmental and community health workers, pharmaceutical staff, and doctors
  - Results are similar when different staffing definitions are considered
- Data:
  - Health facility staffing (HRIS)
  - Catchment populations (EQUIP)
  - Facility location (EQUIP)
- Data available for 1,420 facilities providing primary care for 14.3 million people

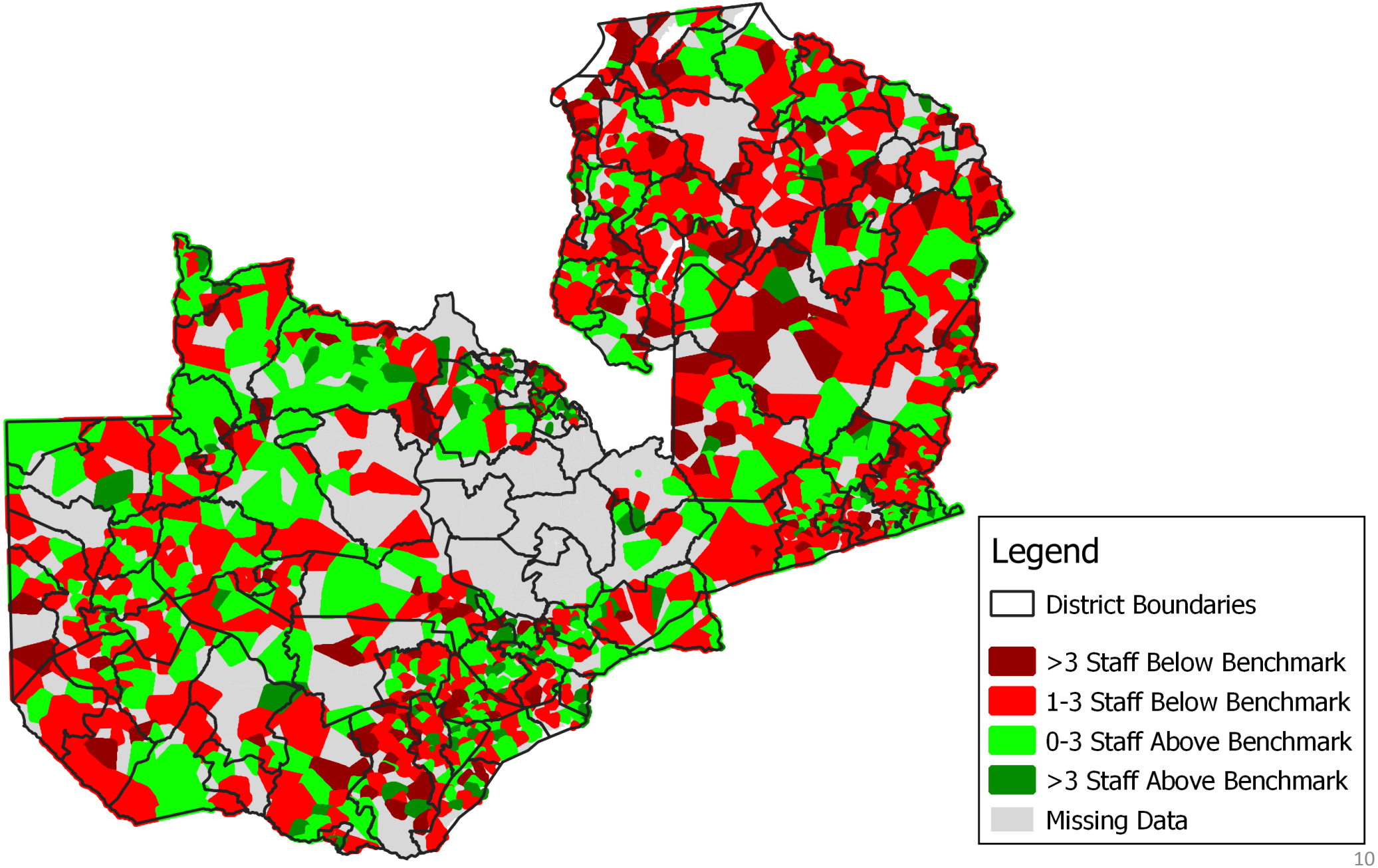
Distribution of population per medical staff



- On average there are 3,695 people per medical staff
- 10% of population live in areas with staffing ratios below 850 people per medical staff
- 10% of population live in areas with staffing ratios above 8,133 people per medical staff

Comparing relative staffing levels

- Imagine a rule-based allocation of staff: For no facility the ratio of population to medical staff should exceed x.
- Compute the lowest achievable staffing threshold (x) given the current stock of health workers and population.
  - This amounts to 2,054.
- Use the number of staff implied by this rule as a benchmark to assess relative staffing at each facility.


Legend
District Boundaries
>3 Staff Below Benchmark
1-3 Staff Below Benchmark
0-3 Staff Above Benchmark
>3 Staff Above Benchmark
Missing Data

Large local variation in staffing levels

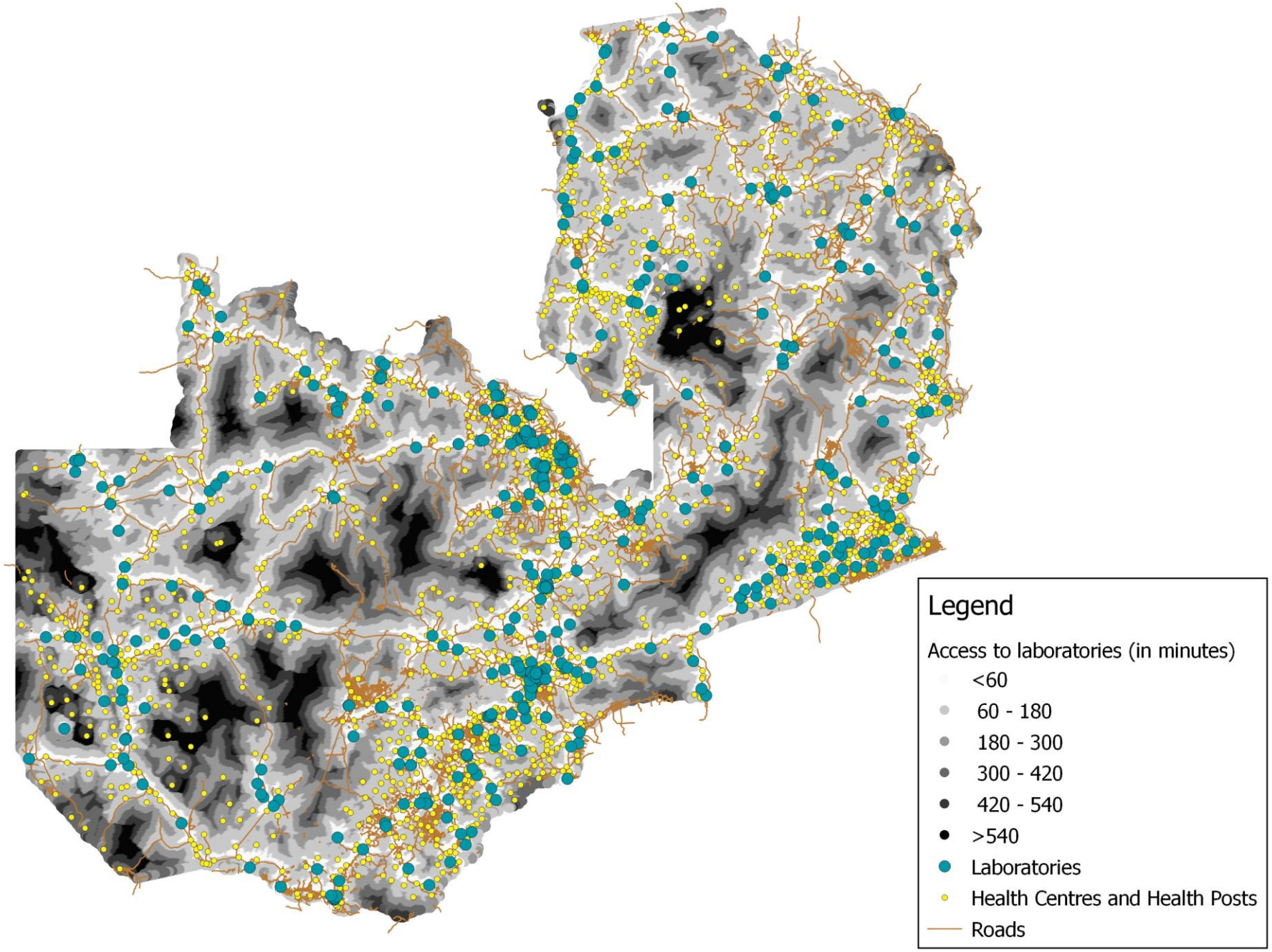
- Differences between average relative staffing between districts are small compared to differences in relative staffing between facilities within the same district
- Based on this approach, nearly every district has facilities that are under- and over-staffed

Food for thought

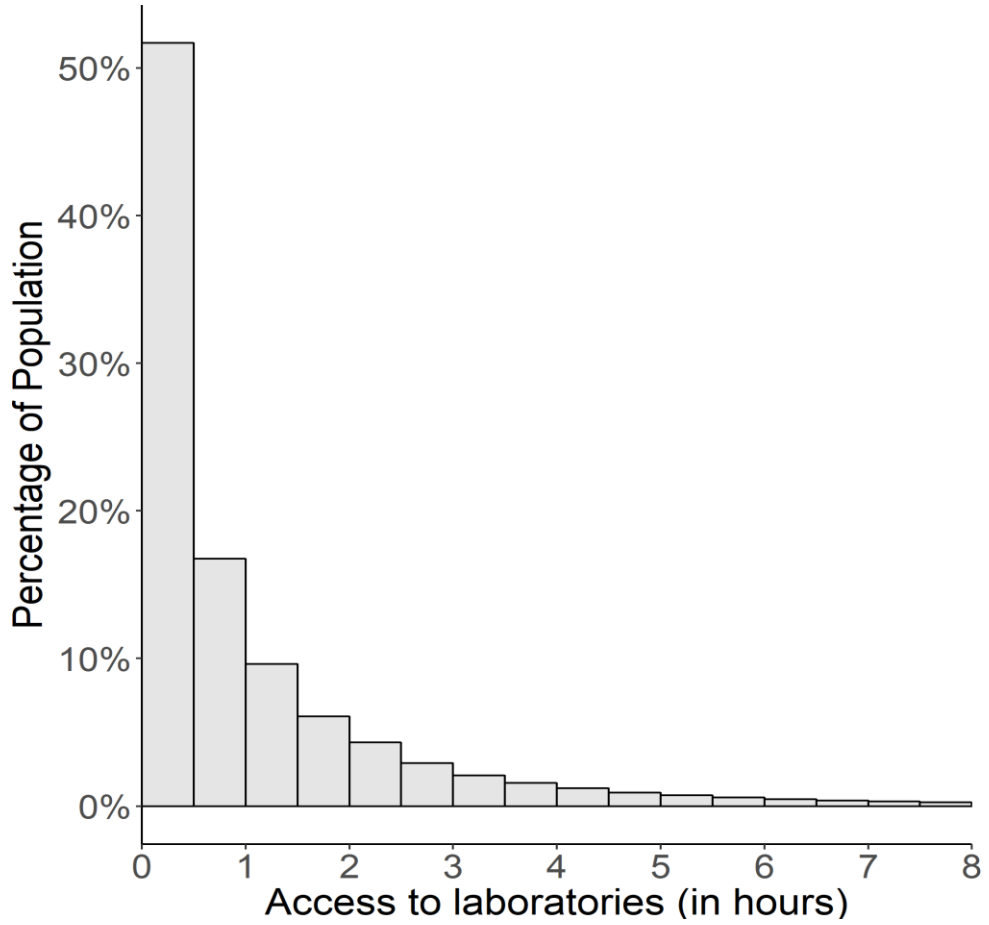
- Should medical staff be re-allocated across facilities to reach a more equitable distribution?
- Would such a re-allocation improve aggregate health outcomes?
- What other factors should be considered in the staffing analysis?
- Why are some facilities understaffed while others are relatively well staffed?

Additional application: access to laboratories

- Compare access to laboratories across population
- Measure access to laboratories as the sum of
  - Travel time from place of residence to closest primary care facility
  - Travel time from this primary care facility to the nearest laboratory
- Data:
  - Location of laboratories (EQUIP)
  - Population distribution (WorldPop)
  - Travel time (Malaria Atlas Project)


Legend
Access to laboratories (in minutes)
<60
60 - 180
180 - 300
300 - 420
420 - 540
>540
Laboratories
Health Centres and Health Posts
Roads

Distribution of access to laboratories



- Approximately half of Zambians have an access time below 30 minutes
- For 10% of the population, this time is greater than 2.8 hours

Food for thought

- Where should the next laboratory be built?
- What other factors should be considered in this decision?
- What available data could provide information about those factors?

Further applications

There are many other potential applications for an integrated database, including:

- Location choice for the construction of new health facilities
- Monitoring spatial disease patterns and coordinating countermeasures
- Supply management

Conclusion

- A large amount of health data is collected at substantial expense
- Integrating existing datasets is comparatively cheap but benefits seem large
- An integrated data system facilitates:
  - Situational analysis
  - Identification of problems
  - Design of solutions

Roadmap towards an integrated data system

1. Identify key datasets to serve as the foundation of a comprehensive database
2. Introduce common facility identifiers across datasets and ensure completeness
3. Launch integrated data system
4. Expand data system to include additional information as needed

Appendix

Match rates across datasets

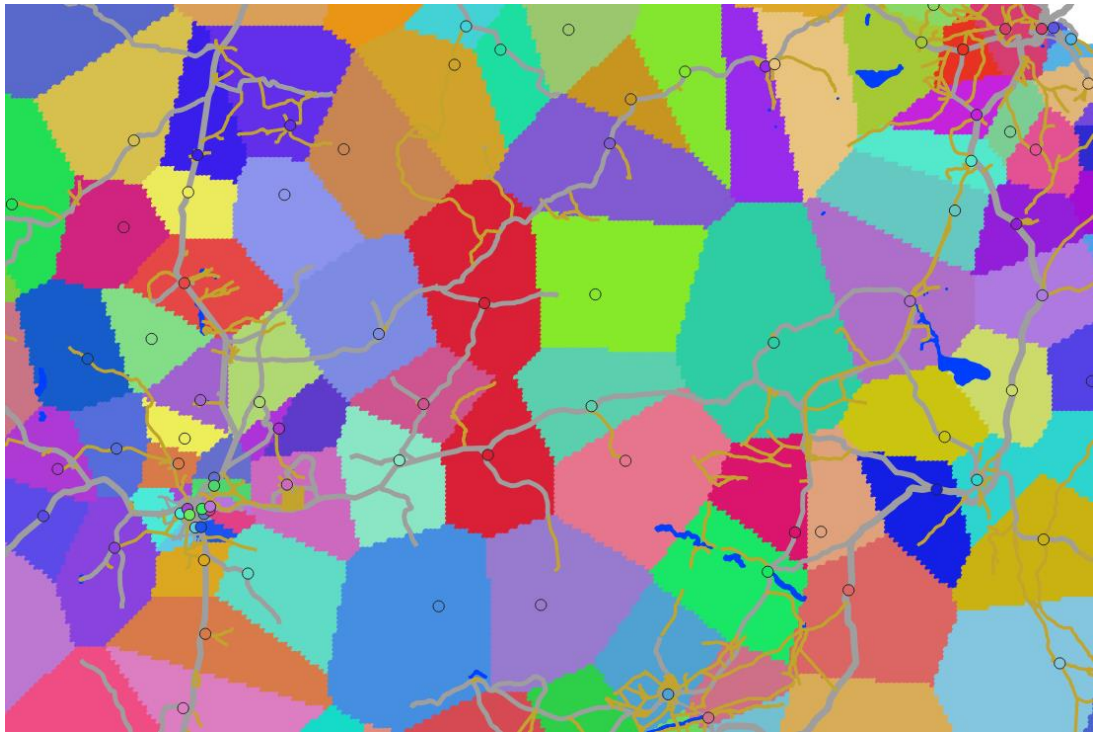
Reference Dataset	Merged Dataset				
		EQUIP Census	MoH Census	HRIS*	HMIS
	EQUIP Census	2,650 (100%)	1,729 (65%)	2,010 (74%)	2,306 (87%)
	MoH Census	1,729 (88%)	1,956 (100%)	1,501 (77%)	1,770 (90%)
	HRIS*	2,010 (83%)	1,501 (64%)	2,329 (100%)	1,897 (82%)
	HMIS	2,306 (93%)	1,770 (71%)	1,897 (76%)	2,483 (100%)

* HRIS excludes administrative offices and facilities without a meaningful name

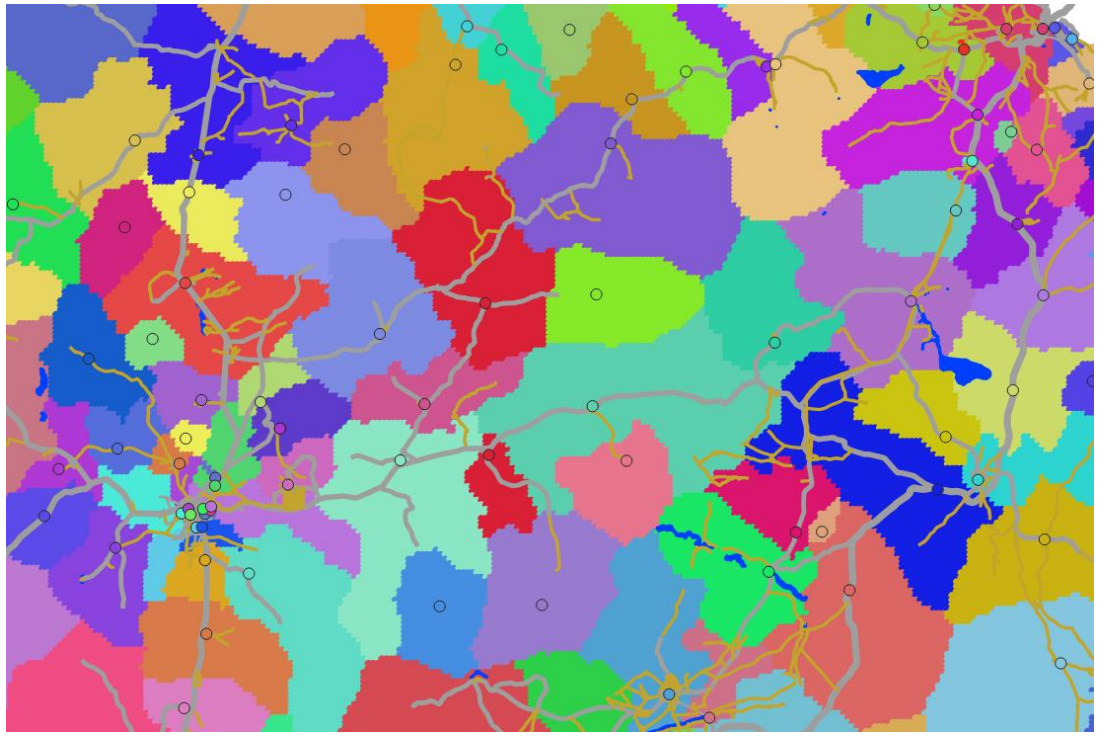
Missing catchment population data

- Data on catchment population missing for 655 primary care facilities
- Estimate catchment population for these facilities by integrating additional publicly available data on population distribution
- Satellite-based high-resolution population estimates from
  - WorldPop (100x100 m^2)
  - The Gridded Population of the World (~900x900 m^2 at centre of Zambia)
- Assign grid cells to facilities by straight-line distance or travel time
  - Facility coordinates from EQUIP

Construction of catchment areas

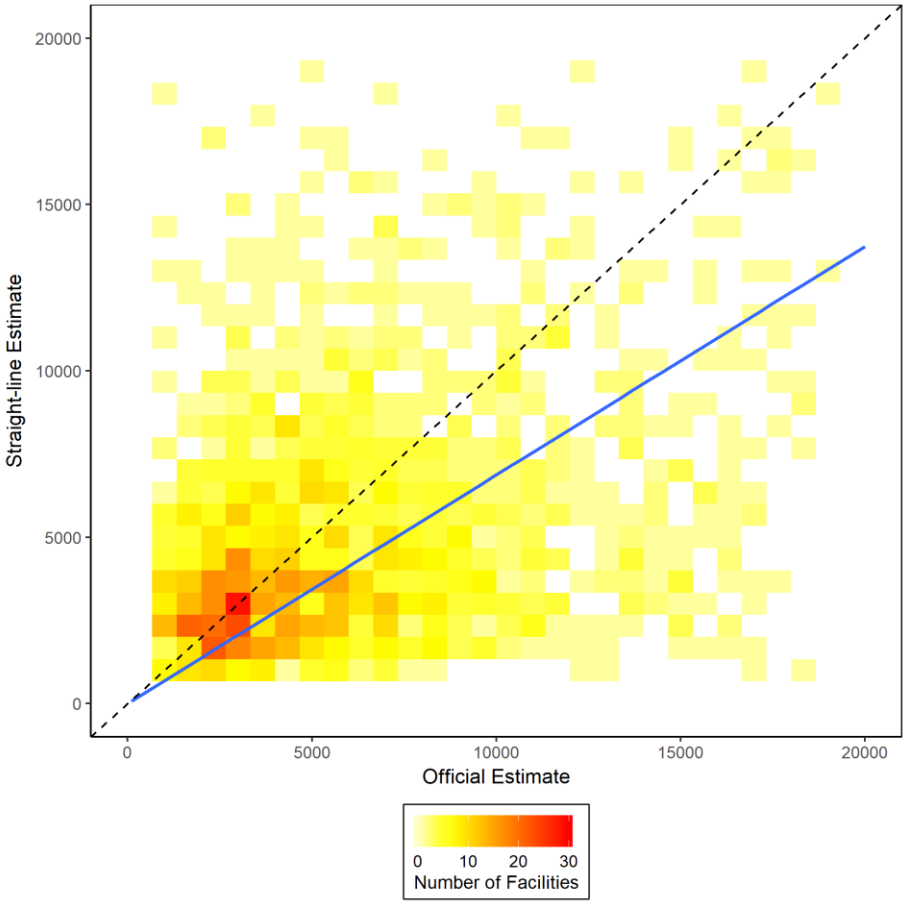


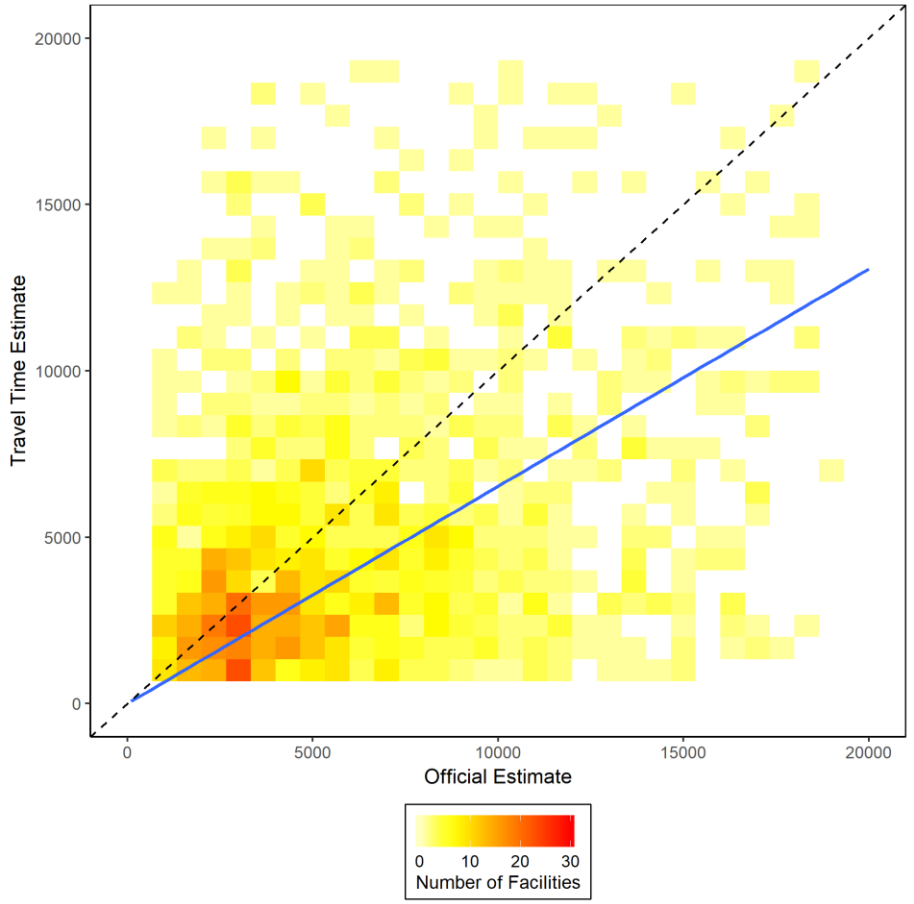
Straight-line Distance

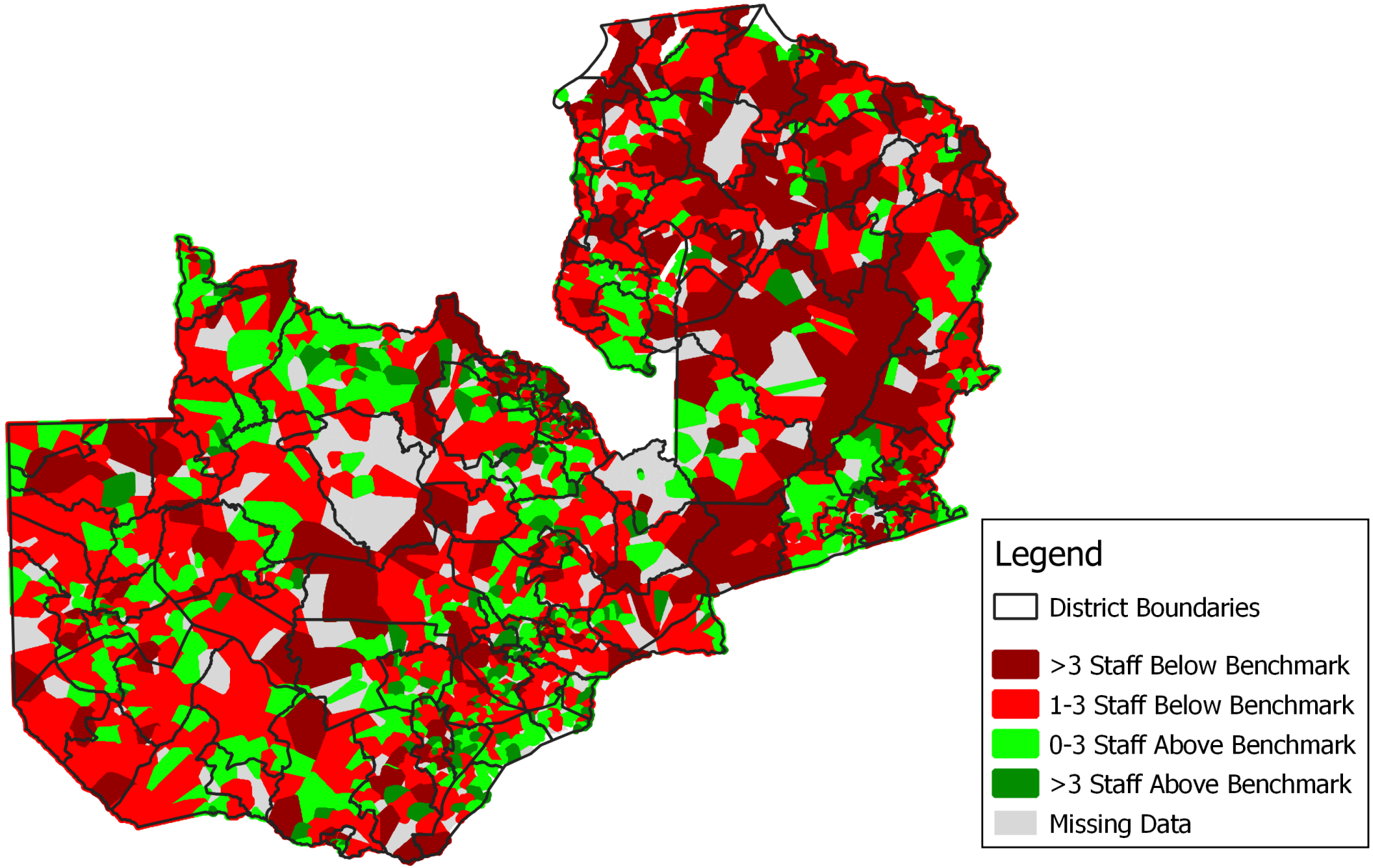


Travel Time

Estimated catchment populations



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