Policy brief
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Integrating administrative databases to improve resource allocation in the Zambian health sector

An application to the spatial distribution of health workers

In brief

- The Zambian Ministry of Health (MoH) and its partners collect a wide variety of data on health services. However, this information is generally recorded in separate, unlinked datasets that can only be used in isolation from each other.
- This brief illustrates how the integration of administrative datasets into a single health database can support efficient resource allocation. The spatial distribution of health workers is examined as a concrete example.
- The shortage of health workers is a particular concern in Zambia. The number of doctors, nurses, and midwives per thousand population is only 0.98 while the World Health Organization (WHO) recommends a minimum of 4.45. Therefore, an efficient and informed use of available human resources is key.
- Based on the the integrated dataset, the researcher finds a large imbalance in population access to health workers across primary care facilities in Zambia, with many imbalances even occurring among different facilities in the same district.This raises concerns regarding both equity and efficiency in the provision of health services and calls for further investigation.
- Other applications of the database could potentially include informing the development of new facilities, increasing services to existing facilities, monitoring spatial disease patterns, and coordinating health initiatives. Input from local health experts is essential to support the development of such applications.

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Overview

There is an overall lack of health resources in Zambia and shortage of health workers, which is a particular concern amongst policymakers and researchers. The number of doctors, nurses, and midwives per thousand population is only 0.98[1] while the WHO recommends a minimum of 4.45. Given the shortage of health resources, an efficient and informed use of available resources is key. The Zambian Ministry of Health (MoH) and its partners collect a wide variety of data on health services that could support resource allocation decisions. However, in general this information is recorded in separate, unlinked datasets that can only be used in isolation from each other. This brief illustrates how the integration of administrative datasets into a single health database can support efficient resource allocation. The spatial distribution of health workers is examined as a concrete example.

Integrating administrative databases

The following administrative datasets were used to create the comprehensive health database[2]:

- EQUIP Census: In 2017, EQUIP Zambia conducted a census of all health facilities in the country. This census provides the most complete listing of health facilities in Zambia and includes information on facility locations, catchment populations, and a range of indicators on facility infrastructure and equipment.
- Human Resource Information System (HRIS): The MoH's HRIS provides information on staffing across all government health facilities by position. Data used in this brief is from January 2018.
- MoH Census: The MoH has periodically conducted censuses of facilities in Zambia, with the most recent available census conducted in 2012-2013. This dataset includes information on facility infrastructure, outreach areas, and a breakdown of services offered at each facility.
- Health Management and Information System (HMIS): The MoH's HMIS provides key information on service delivery and patient outcomes by facility. It is maintained by the MoH Monitoring & Evaluation Unit (MoH M&E) and updated monthly.

Because there were no common identifiers across data sets, they were merged by facility name. As the below table on match rates across data sets indicates, coverage of facilities varies across data sets. This is due to differences in target groups (e.g., some data sets are restricted to public facilities) and varying levels of completeness. Moreover, data quality issues, such as different spellings of the names of identical facilities, complicate the combination of the distinct data sets.

1. Source: Global Health Workforce Statistics database (2016).
2. These datasets represent the most current relevant datasets at the time the project began. Analytical examples from this brief are based on the EQUIP Census and HRIS. The accompanying report "The Spatial Distribution of Health Services in Zambia: Integrating Administrative Databases to Improve Resource Allocation in the Zambian Health Sector" additionally contains analysis incorporating data elements from the MoH Census and HMIS.

Reference dataset	Merged dataset: EQUIP Census	MoH Census	HRIS[3]	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[3]	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%)

The spatial distribution of health workers

"... when ranking the population by the relative staffing level of the catchment area they live in, the bottom 10% of the population live in facility catchment areas with more than 8,133 people per medical staff while this number is 850 for the top 10%."

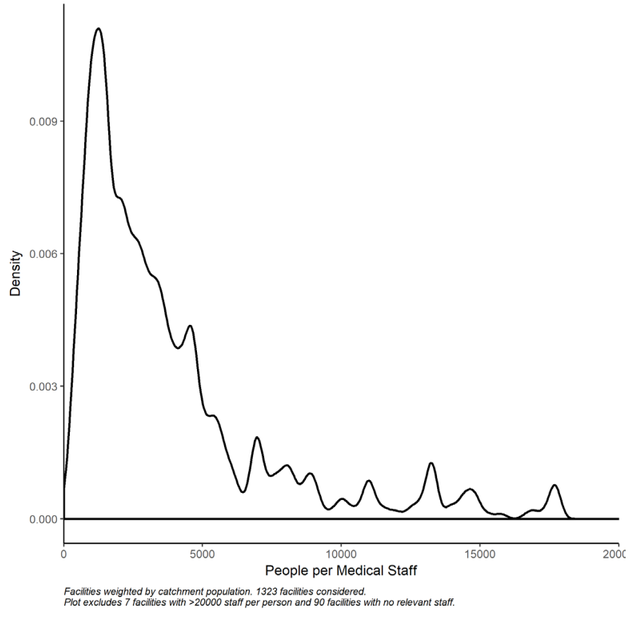
The analysis of primary care facility staffing levels relative to catchment population is one of the key uses of the database, this is illustrated in Figure 1[4]. As the figure shows, there is a lot of variation in relative staffing. On average, there are 3,695 people per medical staff. However, when ranking the population by the relative staffing level of the catchment area they live in, the bottom 10% of the population live in facility catchment areas with more than 8,133 people per medical staff while this number is 850 for the top 10%.

This is further illustrated by Figure 2, which maps the relative supply of health workers across facilities in Zambia. The map shows catchment areas of facilities with low relative staffing levels in shades of red and those with high relative staffing levels in shades of green. Catchment areas for facilities with missing data are in grey[5]. Lack and excess of staff are derived as follows. First, the staffing benchmark is computed by finding the number of staff each facility would have if staff were re-allocated so that relative staffing levels were equalised across facilities. Second, the difference between actual staffing and the benchmark is used to determine lack and excess[6]. As the map shows, there are large differences in staffing

3. Excludes administrative offices and staff with a missing facility name (approximately 10% of the dataset)
4. The figure includes only primary care facilities (health posts and health centres). Population data comes from catchment area headcounts reported in the EQUIP Census. Medical staff is defined as nurses, midwives, clinical officers, environmental and community health workers, pharmaceutical staff, and doctors, though results are similar with different staffing definitions. Facilities are weighted by their catchment population.
5. 928 facilities are missing data. 280 facilities are missing staff data because they could not be matched to HRIS. 655 facilities did not provide EQUIP with counts of their catchment population (EQUIP did not collect this information in parts of Central and Copperbelt Provinces), and some facilities fall into both categories.
6. Note that this is only one of many potential definitions of lack/excess of staff. Alternative definitions could easily be implemented instead.

levels even within the same district. Indeed, the variation in relative staffing levels is much greater within than across districts[7].

Figure 1: Distribution of population per medical staff across health facilities in Zambia

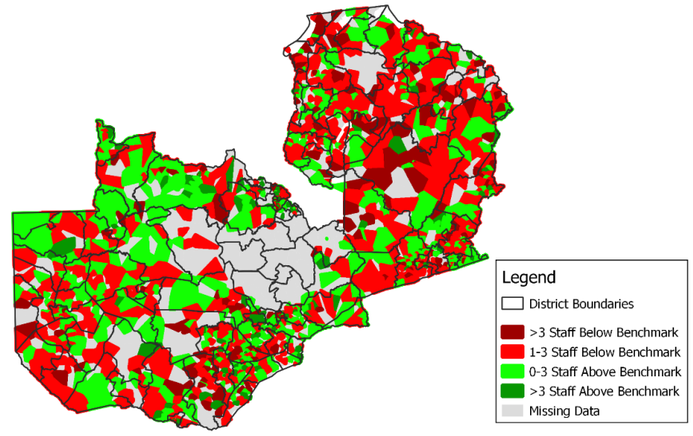


Facilities weighted by catchment population. 1323 facilities considered.
Plot excludes 7 facilities with >20000 staff per person and 90 facilities with no relevant staff.

These findings raise concerns regarding both equity in access to health services and efficiency in the provision of health services. Should medical staff be re-allocated across facilities to reach a more equitable distribution? Would such a re-allocation improve aggregate health outcomes? Why are some facilities understaffed while others are relatively well staffed? While these questions and other related ones remain unanswered here, it is hoped that the above analysis can provide a starting point for addressing these issues.

7. A decomposition of the variance in people per medical staff shows that the within-district variation (how different the relative staffing levels of facilities in the same district are from each other) is 4,595 while cross-district variation (how different the average relative staffing levels of each district are from each other) is 2,046.

Figure 2: Map of health facility catchment areas with high (green) and low (red) staffing levels relative to catchment population



Extensions and other uses of an integrated health data system

A comprehensive database can also be used in a variety of other applications. Other key extensions include but are not limited to:

- **Location choice for the construction of new health facilities:** analysis based on the comprehensive database provide information about the spatial distribution of access to and utilisation of existing facilities and thus help identify areas of under-provision. The accompanying report illustrates this through an analysis of the access to laboratories.
- **Monitoring spatial disease patterns and coordinating countermeasures:** the database allows for monthly monitoring of the occurrences of specific diseases across space. Disease patterns can then be related to observable facility and population characteristics and such linkages may provide guidance for countermeasures.
- **Supply management:** the database could help coordinate supply of facilities with medical equipment if relevant information such as health facility and storage center inventories were added to the system.

It could also be beneficial to incorporate datasets external to MoH into the database. The accompanying report illustrates how adding publicly available high-resolution population and travel time data can enhance the database's utility[8].

8. The considered datasets are WorldPop, produced by the University of Southampton, for population data (see http://www.worldpop.org.uk/ for details) and a tool from Oxford University's Malaria Access Project for travel time (see https://map.ox.ac.uk/research-project/accessibility_to_cities/ for details).

Policy recommendations

To establish and maintain an integrated health database, and to fully develop its applications will require significant input from MoH and other local health experts, but the benefits seem large. The following recommendations can be offered towards setting up an integrated database:

- **Introduction of common facility identifiers across administrative datasets:** While some datasets include a unique facility identifier that is internally meaningful, these identifiers do not relate to identifiers in other datasets. Developing a single identifier for every facility and applying it to all administrative datasets would allow for quick and error-free merges across datasets, and the ready extension of the database when new data is collected.
- **Completion of datasets:** Some facilities are missing from various datasets, even after accounting for their differences in target coverage. If key variables were collected for all facilities, a comprehensive analysis across the universe of facilities could be conducted.
- **Central collection of catchment area boundaries and population counts:** As noted, the EQUIP Census collected data on headcounts of facility catchment population. However, many facilities did not provide headcount data. Moreover, it is unclear which areas a facility is responsible for and thus, which areas its headcounts cover. Mapping the areas that facilities are responsible for and collecting headcounts from those areas at a central level would allow for improved resource allocation and planning.

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