

The strengths and limitations of using hospital records to assess environmental health in Karonga, Malawi

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ABSTRACT This paper explains the methods that were used to study environmental health problems in Karonga, a rapidly growing secondary centre in Malawi. The study used existing information from hospital records and consulted local health officials and academics on how best to use it. The aim was to position the hospital as a disease surveillance site by using its records to generate disaggregated health data at the intra-urban scale. This paper identifies the strengths and limitations of using hospital data to inform joint urban planning and public health interventions. It also provides a summary of the key findings, including a discussion of the implications for enhancing urban health intelligence and urban policy formulation in Malawi and other rapidly urbanizing countries. This paper is intended to show researchers how existing information in low-resource settings can be used to generate needed health data for urban populations, with a particular interest in secondary centres.

KEYWORDS disaggregated data / hospital records / Karonga / Malawi / public health / secondary centres / sub-Saharan Africa / urban health / urban planning

I. INTRODUCTION

This paper reports on the strengths and limitations of using existing information from hospital records to study environmental health problems in Karonga, a rapidly growing secondary centre in Malawi. The paper responds to the widespread recognition of the need to better understand the relationship between the urban physical environment and health inequities in rapidly urbanizing countries.⁽¹⁾ This need for understanding is especially acute in secondary centres, where a large and typically growing share of the world's future urban growth is expected to occur, but where few demographic and health data are available.⁽²⁾ The paper is also based on the recognition that research should guide urban planners and policymakers toward the development of healthy living environments, especially for the urban poor and other vulnerable groups.⁽³⁾ According to Stephens et al.,⁽⁴⁾ this can occur in a number of ways:

- Filling gaps in knowledge about inequalities in environmental resources and health impacts between groups
- Contributing to understandings of the impacts of urban environmental conditions on health
- Developing replicable methods for identifying priorities on the basis of urban health needs
- Producing generalizable information on prevailing environmental health conditions in urban areas

Building on Stephens et al.⁽⁵⁾ and others,⁽⁶⁾ this paper is intended to show researchers how existing information in low-resource settings can be used to generate disaggregated demographic and health data at the intra-urban scale, with specific reference to hospital records. The aim is to encourage methodologies that contribute to an evidence base for urban planning and public health in Malawi and other rapidly urbanizing countries. As a basis for this discussion, Section II examines the need for actionable data to guide joint urban planning and public health interventions at the municipal scale (i.e. at the scale of the city) and intra-urban scale (i.e. at the sub-city scale). Section III reviews existing sources of information that can be used to generate these data using Malawi and Karonga Town as examples. Section IV explains how the methodology was developed to analyse hospital records, while Section V provides a summary of the key findings. The final section concludes by discussing the implications for future practice and research in Karonga Town and beyond.

II. THE NEED FOR ACTIONABLE DATA

Interest in health as an international policy issue was first evident in the 1970s, after the former colonies gained independence and began receiving international aid. At the time, very few population and health data were available at the intra-urban scale beyond that collected by several studies showing high infant and child mortality rates in informal settlements.⁽⁷⁾ Interest in urban health grew in the 1980s following the publication of a widely cited book, *In the Shadow of the City*,⁽⁸⁾ which questioned the prevailing focus of international policy on rural health by emphasizing two emerging trends. The first was the rapid urbanization of low- and middle-income countries, and the second was the growth of informal settlements with very poor housing and living conditions and the health burdens that resulted.⁽⁹⁾ These trends motivated the World Health Organization (WHO) to launch the Healthy Cities Movement in the late 1980s so as to better understand the relationship between the urban environment and health, and to revitalize the role of local governments in urban health promotion.⁽¹⁰⁾

Evidence of the relationship between urban living conditions and inequities expanded in the 1990s and into the 2000s following the release of several other landmark books and reports⁽¹¹⁾ and special issues in this journal⁽¹²⁾ and others.⁽¹³⁾ Among the most groundbreaking studies was one published by the African Population and Health Research Center (APHRC) in 2002 based on data from the Nairobi Urban Health and Demographic Surveillance System (NUHDSS).⁽¹⁴⁾ The study uncovered marked differentials in under-five mortality rates between residents of Nairobi's "slums" and the urban population as a whole, providing new evidence of an "urban health penalty" borne by the urban poor. This growing body of evidence has continued to reveal urban differentials in mortality rates and the prevalence of life-threatening diseases (such as malaria, diarrhoea, malnutrition and respiratory infections) based on socioeconomic status.⁽¹⁵⁾ Given this evidence, it is now widely recognized that the health of the urban poor can be just as bad as, if not worse than, that of the rural poor.⁽¹⁶⁾

Yet a review of the literature indicates the continued lack of demographic and health data disaggregated for urban centres (by city size and location), for people (by age, gender, income and other socioeconomic characteristics) and for small area units (by wards, neighbourhoods, blocks and streets), especially in sub-Saharan Africa.⁽¹⁷⁾ Most health data are aggregated to provide averages for urban populations, obscuring ingrained urban health inequities.⁽¹⁸⁾ Consequently, little is known about the most common causes of disease, death and disability, and even less about the most affected groups, at the municipal and intra-urban scales.

A growing number of scholars⁽¹⁹⁾ emphasize the lack of basic health data in sub-Saharan African urban centres. They call for enhanced urban health intelligence and disease surveillance given the rapid growth of the urban population and the large and complex burden of disease borne by the urban poor. A strand of this scholarship emphasizes the prevalence of health inequities linked to deficiencies in the urban physical environment, notably poor-quality housing, congestion and overcrowding, and inadequate infrastructure and service provision (of, for instance, water and sanitation, drainage and sewerage, solid waste management, and electricity).⁽²⁰⁾ It is argued that urban planning has a key role to play in addressing health inequities given its impacts on the quality and form of the urban physical environment. According to Smit et al.,⁽²¹⁾ urban planning can contribute to public health objectives by enabling the following:

- Access to adequate housing and basic services
- Access to other benefits of urban life (e.g. livelihood opportunities and public facilities, including schools, hospitals and clinics)
- A healthy natural environment (e.g. promoting ecosystem services and protecting ecologically sensitive areas from development)
- A safe living environment (i.e. with low risk of injuries and few negative impacts on mental health)
- A resilient living environment that is better able to cope, resist and recover from the impacts of environmental hazards, such as floods, storms and heat stress
- Food security and nutrition

- Physical activity, including active modes of public transport (e.g. walking and cycling)

For these functions to be fulfilled, local governments and planning authorities require essential data on the intra-urban distribution of environmental health problems and their determinants so as to identify the most affected populations, prioritize investments (particularly in basic services), and guide local interventions.

III. EXISTING DATA IN LOW-RESOURCE SETTINGS

Most of what is known about the intra-urban distribution of environmental health and environmental health determinants in sub-Saharan Africa comes from case studies of informal settlements.⁽²²⁾ Few studies have generated primary data for entire cities due to the prohibitive costs. As an alternative, some studies have drawn on existing information to generate disaggregated demographic and health data at the intra-urban scale.⁽²³⁾

A recent study by Satterthwaite et al.⁽²⁴⁾ provided a detailed review of available data in sub-Saharan African urban centres and of recent studies that have generated needed data using innovative methodologies, including the methodology used by this study to analyse hospital records, as elaborated in the following section. Building on Satterthwaite et al., this section provides a review of routinely collected data generated both inside and outside health information systems, with specific reference to Malawi and Karonga Town. The intention is to show the breadth of secondary sources available in low-resource settings and to highlight their strengths and limitations for guiding local urban/public health interventions in this context.

a. Health information systems

As the basis for public health decision-making, country-level health information systems collect a range of data from different sectors and agencies at the individual, health-facility and population scales.⁽²⁵⁾ Key information sources include many of those discussed below, notably the census, population-based surveys, vital registration systems, and disease surveillance sites.⁽²⁶⁾ At the country level, ministries of health capture data recorded in public health facilities (including hospitals and clinics) on health status (including diseases, births and deaths, and maternal, child and reproductive health), service provision (including the type of services used) and health system resources. These data form the foundation of what are commonly referred to as health management information systems specifically designed to guide planning, management and decision-making in the public health system.⁽²⁷⁾ A key strength of facility-based data is their ability to inform public health surveillance so as to define problems and provide a timely basis for targeted responses, especially during disease epidemics.⁽²⁸⁾

However, health management information systems in sub-Saharan Africa are weak and fragmented and so do not, in general, provide consistent, complete, accurate or reliable data.⁽²⁹⁾ A large portion of the data required by the health system is collected outside it. In Malawi, the health management information system was introduced in 1999 to address the need for a comprehensive approach to provide health information at the community, health facility, district and national levels.⁽³⁰⁾ However, a recent assessment of Malawi's health management information system found that *"the country's health sector still lacks accurate, reliable, complete, consistent and timely health data to inform effective planning and resource management"*.⁽³¹⁾

b. Censuses

A 2006 study by Onsembe and Ntozi⁽³²⁾ found that 36 out of 51 countries in Africa participated in national censuses in 2000 and that of the 15 countries that did not, two-thirds were engaged in conflict and so were unable to implement the census.⁽³³⁾ Despite their uneven coverage, censuses provide the most abundant basic data on population characteristics, including indicators relevant to many social and environmental determinants of health, ranging from socioeconomic status (for instance, age, sex, income), to access to basic services (for instance, water and sanitation, electricity, education), quality of housing (for instance, building materials), and employment.⁽³⁴⁾ Because this information is

collected for all individuals in a population, census data have strong statistical power and policy relevance at the municipal and intra-urban scales.

However, censuses in sub-Saharan Africa, as in most regions, are conducted on a 10-year basis and so do not provide up-to-date information.⁽³⁵⁾ This poses particular problems in urbanizing countries where the size of the urban population is rapidly growing and its composition is in constant flux.⁽³⁶⁾ In addition, some censuses are not processed to provide data at the municipal or intra-urban scale, particularly when the data are aggregated for districts or are not geocoded. Consequently, local governments may find it difficult to access census data in a form useful for local planning.⁽³⁷⁾ Censuses may also underrepresent the urban population if they exclude informal settlements from enumeration⁽³⁸⁾ or if they use unrealistic definitional criteria (such as high population thresholds) that underrepresent the smallest centres.⁽³⁹⁾ In Malawi, the accuracy of current urbanization estimates is questionable given the lack of clear and consistent criteria used by the National Statistical Office (NSO) to define settlements as “urban”.⁽⁴⁰⁾

c. The Demographic and Health Survey (DHS)

The DHS is the primary source of information on population health in most low- and middle-income countries. The DHS is a nationally representative household survey designed to collect demographic and health information on, for instance, maternal and child health, reproductive health, nutrition, child survival and mortality, fertility, immunization, household characteristics, and environmental conditions (including access to basic services). A key strength of the DHS is its use of a multi-stage sample that selects households from geographic units in the form of districts (urban and rural). The sample enables analyses of individual, household and population-level indicators on the distribution of health problems and health determinants. The recent addition of Global Positioning System (GPS) data enables population health to be spatially analysed at lower levels of aggregation.

However, the DHS still does not provide sufficient spatial information to identify urban settlements by size, “*making the city-size dimension of health surprisingly difficult to document*” according to Montgomery.⁽⁴¹⁾ Despite the addition of geocoded data, geographic offsets of four kilometres for households in rural areas and two kilometres for households in urban areas are used to protect the confidentiality of respondents. Offsets can occur in any random angle between 0 and 360 degrees, although the new location of each offset household must fall within its original boundary at the district level. However, it is unclear whether this also applies to municipalities containing urban centres. Consequently, urban households could be offset into outlying rural areas, while rural households could be offset into urban areas. In Karonga Town, for example, Survey Cluster 571, sampled by the 2010 Malawi DHS, could have been initially located in the town before being offset outside of the administrative boundary (Map 1). This uncertainty increases the likelihood of misclassification errors when attempting to disaggregate survey clusters for individual urban centres.

[INSERT MAP 1]

d. Vital registration systems

These systems serve as the primary source of information on live births and deaths worldwide and provide reliable cause-specific mortality data based on medically certified records. However, the vast majority of sub-Saharan African countries have incomplete registration of live births and deaths and incorrect reporting of age and cause of death.⁽⁴²⁾ In Malawi, the vital registration system is based on vital events that occur in public health facilities and so does not capture all relevant events, including deaths occurring under the care of traditional attendants, which are either reported only to traditional leaders or not reported at all.⁽⁴³⁾

Without cause-specific mortality data, many analyses of urban health have been largely presumptive in terms of linking mortality to particular causes. While there is strong evidence attributing a large share of death in “slums” to environmental health risks,⁽⁴⁴⁾ as discussed above, causal links are too often drawn without accurate or reliable data.

e. Urban Health and Demographic Surveillance Systems (UHDSS)

Where vital registration systems and facility-based data are lacking, UHDSS can provide alternative information on causes of death by age and sex through the use of verbal autopsy methods.⁽⁴⁵⁾ A key strength of UHDSS is its ability to generate longitudinal data that can be analysed to monitor and compare differentials in child and adult mortality at the intra-urban and municipal scales and at higher levels of aggregation. These data can reveal changes in the demographic, spatial and temporal distribution of urban health inequities and their determinants, and provide a strong evidence base for urban/public health interventions locally.⁽⁴⁶⁾

The UHDSS in Nairobi was established in 2002 as the first of its kind in sub-Saharan Africa and has provided some of the most detailed data on urban mortality differentials to date,⁽⁴⁷⁾ as discussed above. Disease surveillance sites appear to be expanding in number and coverage. For instance, 37 disease surveillance sites are operational within the regional research network called INDEPTH Network,⁽⁴⁸⁾ including a number of sites (including Nairobi) based in urban areas; however, it is uncertain whether these sites are urban-specific. Rural surveillance sites have also been documented, including one in Chilumba, a port village in the Northern Region of Malawi.⁽⁴⁹⁾ The site has provided detailed longitudinal data on patterns and risk factors for deaths using verbal autopsy.⁽⁵⁰⁾ However, a key limitation of this method is its inability to retroactively identify all causes of deaths reliably due to inherent uncertainties.⁽⁵¹⁾

f. Community-driven enumerations and mapping

Many low-income communities in sub-Saharan African urban centres are not enumerated by official surveys (including censuses and the DHS), either because of their informal or “illegal” status or because local governments lack the capacity to enumerate and map all settlements in their jurisdiction.⁽⁵²⁾ Consequently, basic data on socioeconomic and environmental conditions in informal settlements are widely lacking. Communities affiliated with SDI (previously Slum/Shack Dwellers International) have taken action by enumerating and mapping all households in their neighbourhoods, as documented in Kisumu, a secondary city in Kenya.⁽⁵³⁾ A key strength of community enumerations and maps is that they provide detailed local data on population size and composition, neighbourhood and plot boundaries, and existing infrastructure and services. Many surveys have standardized questions for self-reported health problems, as observed in Sierra Leone and Kenya.⁽⁵⁴⁾ The information from enumerations and maps enables communities to develop detailed settlement profiles, which also serve as a basis to negotiate for formal recognition, secure land tenure, and access to basic services from local authorities.⁽⁵⁵⁾ However, community information may have little influence over local authorities if they are unable or unwilling to take action. Often, the generation of settlement profiles is the first step in a longer process of partnership building with the local state.⁽⁵⁶⁾

g. Community-level surveys

Community health workers (CHWs) can provide a critical link between communities and the formal health system, particularly in peripheral areas. In Malawi, CHWs are called health surveillance assistants (HSAs) and are responsible for delivering a range of primary health care services, including conducting community outreach, carrying out household assessments, performing disease surveillance (including epidemics), monitoring water quality, providing immunizations, facilitating the formation of village health committees (VHCs), recording health data, and disseminating information about water, sanitation and hygiene (WASH) and maternal and perinatal health. Given their role in community-level data collection, HSAs play a key role in supporting the decentralization of Malawi’s health management information system.

In Karonga District, HSAs are employed by the Karonga District Hospital under the Ministry of Health and are assigned to individual villages. Their activities are aimed primarily at preventing disease among high-risk groups, including infants, children, mothers, and people living with HIV/AIDS.⁽⁵⁷⁾ Seven HSAs were followed using participant observation in Karonga Town in order to understand the different types of data they collect and use to guide their work. Some HSAs conduct routine household surveys on access to WASH facilities. For instance, the survey pictured in Photo 1 was designed by an HSA who planned to administer it to all households in the village in order to

provide a complete picture of the WASH situation. But because HSAs use surveys primarily for their own work, the data are seldom made more widely available and may not be known to researchers.

[INSERT PHOTO 1]

h. Newspaper records

Newspapers capture a variety of everyday hazards (such as road traffic accidents and violent crime) and disaster events (such as floods, storms and disease outbreaks) and their effects (such as the number of people killed or displaced, or the number of homes damaged or destroyed).⁽⁵⁸⁾ Since these events are continuously reported, newspaper records can facilitate longitudinal analysis of trends over time. However, newspapers do not capture everyday hazards deemed too small to be newsworthy, including diseases (such as diarrhoea, respiratory infections and injuries) affecting individuals. Newspaper records also tend to be incomplete in terms of age, sex and location, precluding detailed sociospatial analysis. Consequently, newspaper records are not representative of everyday health problems at the individual level.⁽⁵⁹⁾

IV. BACKGROUND AND METHODS

a. Study context

The study draws on the case of Karonga, an emerging secondary centre in the Northern Region of Malawi. Malawi is a small landlocked country in East Africa. As of 2018 (the last census year), Malawi's population was 17.5 million, with 16 per cent living in urban areas,⁽⁶⁰⁾ making it one of the least urbanized countries in sub-Saharan Africa. Malawi is also one of the most rapidly urbanizing countries in the region, with an annual urbanization rate of around 4 per cent.⁽⁶¹⁾ At this rate, 30 per cent of Malawi's population is expected to live in urban areas by 2050.⁽⁶²⁾

While Karonga Town is small by international standards, with a population of 41,074 in 2008,⁽⁶³⁾ it is the seventh largest urban centre in the country. The town is nevertheless considerably smaller than the three largest cities (Lilongwe, Blantyre and Mzuzu), which together with Zomba accounted for most of Malawi's urban population in 2008⁽⁶⁴⁾ (Figure 1). Despite its relatively small size, Karonga Town's population is rapidly growing at an annual rate of around 4.3 per cent, and is projected to reach around 58,000 by 2018.⁽⁶⁵⁾ To capture the town's growth, the administrative boundary, which originally included 46 villages,⁽⁶⁶⁾ was recently expanded to include an additional 13 villages in the town's rapidly expanding periphery.

Karonga Town⁽⁶⁷⁾ is reported to suffer from a range of problems similar to those in other secondary centres in the region.⁽⁶⁸⁾ These problems include a lack of capacity to plan and manage urban growth; provide basic infrastructure and services (notably water, sanitation and electricity); and reduce environmental hazards, ranging from poor water and sanitation, to seasonal floods, road traffic accidents, and large-scale disasters, including earthquakes, floods and drought. Table 1 demonstrates the range of events that impact morbidity, mortality and asset loss in Karonga Town, based on a town-wide questionnaire survey.⁽⁶⁹⁾ It is widely suspected that living in secondary centres with problems similar to those in Karonga Town may be especially hazardous to health. Until now, however, most scholarly and practical attention to urban environmental health has been paid to the largest cities.

[INSERT TABLE 1]

b. Aims

Against this backdrop, the main aim of the study was to use existing information collected from hospital records to generate disaggregated data on environmental health problems in Karonga Town. While hospital records have traditionally been used for clinical purposes, they are increasingly used in epidemiological research to assess trends and patterns in morbidity and mortality across a number of domains, including demographics (age, sex, residential address), vital signs (blood pressure, height, weight, pulse), laboratory data (blood tests), and problem lists (diagnoses).⁽⁷⁰⁾ For instance,

researchers have used hospital records to analyse disease aetiology, assemble groups of patients with specific diseases, and monitor disease (surveillance).⁽⁷¹⁾ However, the use of hospital records in epidemiological research has been largely confined to Europe and the United States, where urban/public health issues are arguably less severe than in sub-Saharan Africa and other developing regions.⁽⁷²⁾ The specific aims of the study were to assess:

- The prevalence of diseases with known environmental causes or contributions (environmental health problems)
- The extent to which environmental health problems change seasonally or following hazard events, including disasters and disease epidemics
- The demographic distribution of environmental health problems by age and sex
- The spatial distribution of environmental health problems between villages

The study represents a form of “descriptive epidemiology”, where the population group is the unit of analysis (i.e. describing health problems in different groups within a particular place).⁽⁷³⁾ The two health problems analysed were morbidity and mortality. The study was designed in partnership with the Karonga District Health Management Team (DHMT⁽⁷⁴⁾) and local academics from Mzuzu University based on their interest in monitoring health status at the urban scale, particularly given the recurrence of cholera outbreaks in the town. The study was granted ethics approval by the National Committee on Science and Technology (NCST) in April 2017 after gaining permission from the Karonga DHMT under the Ministry of Health.

c. Sampling

Hospital records are a form of archival data. Records for inpatients who live in Karonga Town (urban inpatients) were purposively sampled from the admission and discharge registers of the paediatric, female and male wards for a 12-month period between 1 August 2016 and 31 July 2017. Additional data on patients admitted for cholera during an outbreak between January and July 2016 were collected. The inpatient population was used as the sample because it is likely to be representative of more severe manifestations of diseases and injuries (including epidemics, such as cholera) requiring hospitalization. However, the inpatient population may not be entirely representative since it may exclude people who did not seek medical care when sick or injured. These groups may include people with low incomes who cannot afford sick days or people with mobility issues, as discussed below. To increase sample representativeness as much as possible, every single urban inpatient with valid records was included.

The sampling procedure had three stages. First, because Karonga District Hospital serves as a referral facility for the entire district, which includes a vast rural territory, it does not disaggregate records for smaller area units, including urban centres. A list of all 59 villages located in Karonga Town’s administrative boundary was therefore created by consulting local chiefs. The list was used to purposively sample urban inpatients based on the “address” field in the primary registers. Second, because data collection began in April 2017 after ethics approval was granted, as discussed above, the records from 1 August 2016 onward were collected retroactively. Records for the remaining months were collected at the beginning of each successive month (e.g. the records for July 2017 were collected at the beginning of August 2017). Last, the following information was recorded from the admission registers: age and sex, reason for admission (ailment), date of admission (month and year), and name of home village (address). The same information was collected from the discharge registers to determine the number and causes of deaths. No identifying information was collected.

d. Coding

A coding system was developed to identify and classify diseases with known environmental causes or contributions (environmental health problems), developed from a comprehensive report by the WHO⁽⁷⁵⁾ and consultations with the Karonga DHMT. Two criteria from the WHO report were used: health conditions must have known environmental causes or contributions, and they must be related to

environmental factors that can be reasonably modified through physical interventions. Communicable diseases (notably infectious and parasitic diseases), non-communicable diseases (notably cardiovascular and lung diseases and malnutrition) and accidental injuries (notably road traffic injuries) were included. The coding system was continuously refined based on expert medical opinion as new health problems appeared. The coding system was used to create the simplified environmental health matrix presented in Table 2. A more sophisticated matrix was used during the sampling process.

[INSERT TABLE 2]

V. FINDINGS

a. Numbers and causes of admissions

Of all 10,100 inpatients admitted to Karonga District Hospital during the study period (August 2016 to July 2017), 4,489 were from villages in Karonga Town, accounting for 44 per cent of all inpatients. However, 1,494 urban inpatients were excluded for having invalid records, including those that were illegible, contained obvious errors or uncertain information (particularly with regard to clinical diagnoses), decreasing the sample to 2,995 (Table 3).

[INSERT TABLE 3]

Because the urban inpatient population is likely to be representative of more severe manifestations of environment-related diseases and injuries requiring hospitalization, as discussed above, it is possible to draw some tentative inferences about the prevalence and distribution of environmental health problems in Karonga Town's population during the study period. The findings reveal unexpectedly strong links between the environment and health.

First, the relative size of the urban inpatient population is significant not only in terms of patient caseload, but also in terms of population health. Assuming that Karonga Town had an estimated population of around 57,000 in 2017,⁽⁷⁶⁾ the 4,489 urban inpatients admitted to the hospital during the study period accounted for approximately 8 per cent of Karonga Town's entire population in that year. More specifically, of the 2,995 urban inpatients with valid records, 63 per cent were admitted for environment-related diseases or injuries, accounting for 3 per cent of the town's population at the time. This figure would have been higher if urban inpatients with invalid records were included in the sample.

Second, 64 per cent of all environmental health problems were attributed to infectious or parasitic diseases, suggesting the existence of biological pathogens (such as bacteria, viruses, worms, protozoa, fungi) and vectors (such as mosquitoes) in the town's environment.

Third, 93 per cent of all environmental health problems were attributed to five main causes: malaria at 30 per cent, acute respiratory infections (namely pneumonia and tuberculosis) at 22 per cent, malnutrition at 19 per cent, accidental injuries at 13 per cent, and diarrhoea at 8 per cent. This observation points to the prevalence of environmentally related health problems that are largely preventable through physical improvements.⁽⁷⁷⁾

Fourth, 41 per cent of all environmental health problems were experienced by infants and children 5 years and under, although no clear difference between the sexes was observed. This observation reflects the heightened susceptibility of younger age groups to opportunistic infections and accidental injuries linked to local environmental health risks.⁽⁷⁸⁾

Fifth, the rainy season (November–April) accounted for the largest share of environmental health problems, particularly diarrhoea and malaria, indicating a connection between flooding and water- and sanitation-related diseases.

Sixth, 57 per cent of all cholera cases recorded during an outbreak between January and July 2016 were concentrated in villages (notably Mwanjabala) along the lakeshore area (Table 4), where provision of water and sanitation is known to be poorest.⁽⁷⁹⁾

Last, 38 per cent of all deaths were attributable to environmental causes, of which 28 per cent were from pneumonia (Figure 2). Overall, the findings support the hypothesis that Karonga Town is a hazardous place to live.

[INSERT TABLE 4]

[INSERT FIGURE 2]

b. Strengths and limitations

The analysis of hospital records generated disaggregated data on environmental health problems for Karonga Town's inpatient population over a 12-month period, revealing trends and patterns in morbidity and mortality between groups (age and sex) and villages during different seasons. Used as a proxy for the town's population, the urban inpatient records revealed that environmental health risks are the major factors in the prevalence of more severe health problems. This is a key strength of inpatient records: they are likely to be more representative than outpatient records since people with more severe ailments are more likely to seek care. The common argument that hospital data may underrepresent lower-income groups who cannot afford to miss work days may apply less in the case of life-threatening ailments for this reason. Indeed, people suffering from debilitating ailments (such as cerebral malaria) are unlikely to be able to work. The availability of affordable transport (namely bicycle taxis) combined with the town's small size may also mean that lower-income groups may be able to reach the hospital without incurring much cost. However, those who are particularly unwell may require motorized transport, which may be too costly to hire if the hospital's sole ambulance is unavailable.

A key limitation of using hospital records to enhance urban health intelligence is the lack of data on the underlying causes of disease in peoples' living environments. While inpatient records can yield insight into the prevalence and distribution of health problems with known environmental causes or contributions, they do not provide information on environmental or social factors (e.g. the gender division of labour) that render some groups (e.g. women and children) more at risk than others. This point is important because it reaffirms the need for multi-level approaches to understand the determinants of health in urban environments,⁽⁸⁰⁾ as discussed in the concluding section.

The more specific strengths and limitations of using inpatient records to enhance urban health intelligence are as follows:

STRENGTHS

Cost and convenience – Because data collection is funded by the health system, research costs associated with primary methods are avoided. In addition, because data are stored in the hospital, they are centrally accessible. Primary registers in hardcopy format can be removed from the inpatient wards with minimal disruption, which can be further minimized by collecting the registers on a rotating basis between wards.

Data disaggregation – The “home village” field in the registers enables data to be disaggregated for smaller area units. Therefore, where hospitals are located in urban areas, they can provide information on population health problems at the municipal and intra-urban scales. If data are sufficiently representative, as with more life-threatening ailments, hospitals can serve as urban surveillance sites and inform local public health interventions. Surveillance systems are likely to be most useful for monitoring disease outbreaks (such as cholera) and informing interventions targeting local environmental risk factors (such as poor WASH).

Outcome determination – Clinical diagnosis increases the validity of cause-specific morbidity and mortality data. These data can be used to document patterns and trends in disease frequency and disease causation. Coding systems can provide a basis to classify disease groups and sub-groups based on medically certified records. The results can be used to generate hypotheses about the determinants of health problems linked to social and environmental factors.

Conditions captured – Data for inpatients capture more severe manifestations of conditions requiring hospitalization, including those resulting in death. In smaller centres with one main public health facility, it is likely that people with a serious condition will seek treatment there. For this reason, inpatient records are likely more representative than outpatient records, since people with mild conditions may not seek care at the hospital.

Timeframe – Retrospective data, collected across the domains of demographics (age and sex), geographic location (home village) and time (day, month, year), allow trends and patterns in the prevalence and distribution of ailments to be monitored demographically, spatially and temporally. These data can provide a basis to report and monitor changes in population health status, including emerging health problems (such as epidemics), using descriptive epidemiology.

LIMITATIONS

Time and effort – Where primary registers are not digitized and remain in hardcopy format, data collection can be extremely slow and tedious. For this study, it took myself and another researcher working full-time over three months to collect all the data. While one researcher combed through the registers, the other carefully recorded the information. High temperatures made this task especially taxing. However, if the primary registers were digitized, data collection would be much easier and more time efficient.

Additional information – Disaggregating inpatient records by Karonga Town's population required all villages in the town to be first identified and mapped, which had not been done before. The lack of consensus between chiefs regarding the number and boundaries of villages increased the time required for this task. The boundaries of individual villages/neighbourhoods are more likely to be known and mapped in larger urban centres with more established planning and cadastral systems, except where informal settlements are excluded from official maps, as discussed in Section III.

Data recording and storage – Because the primary registers were not digitized, they were replete with missing information and errors stemming from faulty and inconsistent recordkeeping practices. The sample size was significantly reduced as a result (Table 3). This limitation can be partially overcome by consulting clinicians who maintain the registers, but only if they have sufficient time, which they seldom have.

Sample representativeness – Inpatient records will overrepresent more serious conditions requiring hospitalization and underrepresent less serious conditions. They will also underrepresent people who do not seek care when sick or injured (participation bias). For instance, poor people may not seek care if they cannot afford the costs of transportation or because they cannot afford to miss work days. Disabled people may also not seek care if their mobility is impaired or they cannot find people to assist them.

External variables – The demographic domain was limited to age and sex, precluding other social identities (ethnicity/race, religion, class) and more sophisticated intersectional analysis. Behavioural and environmental fields were also excluded. However, the data can inform hypotheses about the social and environmental determinants of health problems, as noted above.

Reliability – In addition to obvious recordkeeping errors, less obvious errors (e.g. incorrectly recording the age or sex of the patient) may reduce the reliability of the data. There may also be uncertainty in the information recorded. For instance, while diagnoses are made by doctors, multiple ailments were listed in instances where the reason for admission could not be definitively determined upon admission. Where the underlying condition was determined later on, the registers appear not to have been updated. A benchmark for determining data reliability includes the absence of both obvious and less obvious errors stemming from faulty and inconsistent recordkeeping as well as clinical uncertainty. If the data prove unreliable, using hospital records for research and practical purposes is

unlikely to be worthwhile, especially given the amount of time required for data collection where the registers are in hardcopy format. Data reliability issues motivated the decision in this study to sample every single urban inpatient with valid records (i.e. records free of errors and evident uncertainty). But in other cases, enhancing sample representativeness may be insufficient to compensate for these issues.

VI. CONCLUSIONS

From the discussion above, several key implications for future practice and research arise. While the focus is on Karonga Town, the insights are anticipated to be relevant to other towns and cities with limited health data and similar demographic, environmental and institutional challenges.

a. Implications for practice

Hospitals can serve as urban surveillance sites – That urban inpatients accounted for 44 per cent of Karonga District Hospital’s entire inpatient caseload and 8 per cent of Karonga Town’s population during the study period makes a case for generating health data at the urban scale so as to better understand the causes and patterns of life-threatening disease in the population. This understanding is especially required given the seasonal occurrence of cholera outbreaks, which tend to disproportionately affect villages in the lakeshore area. The routine data collected by the hospital can be used as a basis for urban health surveillance, particularly for more severe manifestations of diseases (including epidemics) requiring hospitalization, but only where the data meet the benchmarks for representativeness and reliability.

However, while Karonga District Hospital is located in the town, its catchment area encompasses the entirety of Karonga District, so the data are not collected with urban health in mind. To serve as an urban surveillance site, the hospital would need to disaggregate the field in the registers for “home village” into “urban” and “rural” categories based on the sample framework developed for this study. This would require a simple change to the clinical coding system. Ideally, the registers would also be digitized to improve the reliability of the data by reducing recordkeeping errors, but this would require resources the health system currently lacks.

Urban planning has a key role to play in public health – The prevalence of environment-related diseases and injuries requiring hospitalization in Karonga Town reaffirms the critical role that urban planning needs to play in disease prevention and health promotion. In particular, data on cholera cases clearly indicate villages (such as Mwanjabala) where outbreaks tend to concentrate during the rainy season (Table 4). These data are important not only for contagion control (e.g. the delivery of safe WASH messages and the distribution of oral rehydration salts and chlorine tablets), but also for the delivery of basic health-promoting services (notably water and sanitation) in the most affected and ill-served villages. Making these data available in a format that can be used to guide local urban/public health interventions would mark an important step toward reducing the burden of preventable disease and related costs on the health system. Without explicit attention to the environmental determinants of health, policymakers risk failing to address the underlying causes of urban health disparities.

Data gaps form one part of a larger urban governance challenge – Even if better health data were available, it would not necessarily translate into more effective urban policy. In Malawi and other sub-Saharan African countries, local governments generally do not play a strong role in urban planning and development due to their limited capacities and the unwillingness of national authorities to implement decentralization and support urban development.⁽⁸¹⁾ This is especially true in Karonga Town, which lacks a functional town council that should be responsible for urban planning, including basic service provision.⁽⁸²⁾ In addition, the departments and ministries responsible for urban planning and public health generally operate in silos and so do not share data or support joint approaches. Data gaps therefore need to be seen as part of a larger urban governance challenge that will require different forms of support (academic, technical, financial and political) at multiple levels (local, national and international) to fully address.

b. Implications for research

Gather data on environmental health determinants – While inpatient records provide information on residential location (home village) and health problems, they do not provide information on the determinants of health (i.e. the causes of ill health). This includes not only environmental risk factors (including, for instance, airborne particulates, disease vectors and occupational hazards), but also social risk factors. For instance, the gendered division of labour means that women often suffer disproportionately from acute respiratory illnesses linked to the use of dirty cooking fuels, particularly in poor-quality housing lacking adequate ventilation.⁽⁸³⁾ Additional data (quantitative and qualitative) are therefore required to better understand the determinants of environmental health at the individual, household and community scales, necessitating a multi-level approach to urban health research.⁽⁸⁴⁾

Develop a joint database for urban planning and public health – Using Karonga District Hospital as an urban surveillance site would mark a step toward the development of a joint database for urban planning and public health in Karonga Town. Other secondary data relevant to environmental health determinants could be integrated into the database, including data on access to water and sanitation collected by the Northern Region Water Board (NRWB) and access to electricity collected by the Electricity Supply Commission of Malawi (ESCOM), household surveys on access to WASH collected by HSAs, and census data on local socioeconomic and environmental conditions collected by the NSO. However, without a town council, it is unclear who would have the capacity to develop and maintain such a database or how it would be operationalized to guide urban policymaking.

Understand how governance influences knowledge translation in urban policy – While planning has traditionally been seen as a technocratic exercise, it is increasingly viewed as form of governance embedded in power relations among multiple stakeholders (public and private, governmental and non-governmental, formal and informal).⁽⁸⁵⁾ The stakeholders that generate and use information to influence urban planning are not inherently neutral.⁽⁸⁶⁾ In Karonga, for instance, officials could foreseeably use data on cholera outbreaks triggered by flood events to justify the relocation of villages deemed too hazardous for habitation, whereas community leaders (chiefs) could use the same data to advocate for the provision of water and sanitation in the most ill-served villages. In such cases, access to information can play a powerful role in stakeholders' struggle over the framing of urban policy problems. Research is therefore required on the links between not only health and the environment, but also between knowledge and practice. Investigating these links requires a shift away from a narrow focus on "gap-filling" toward a more political understanding of urban health research.⁽⁸⁷⁾ Key questions arising from Karonga Town include how knowledge translation in urban health policy is influenced by the power relations between communities and officials and by the institutional boundaries, as well as possible interfaces, between urban planning and public health.

BIOGRAPHY

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- ⁶⁵ NSO (2008).
- ⁶⁶ In larger and more established Malawian urban centres, community units are typically referred to as “neighbourhoods”. But in Karonga Town, they are referred to as “villages”, which reflects the town’s history as a rural settlement and the continuation of traditional norms.
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