

# Revealing and Responding to Multiple Health Risks in Informal Settlements in Sub-Saharan African Cities

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**Abstract** This paper underscores the need for detailed data on health and disaster risks for sub-Saharan African cities, particularly for their informal settlements. Systems that should contribute to the information base on health and health risks in each locality are rarely functional. In most cities, there is a lack of data on health risks, health outcomes, and health determinants; where data are available, they are usually too aggregated to be useful to urban governments. Such data shortfalls likely hide the scale of premature death, serious illness, and injury in informal settlements; limited data can also curtail the identification of particularly vulnerable urban residents. After outlining data shortfalls, this paper considers two sources of data that can help fill data gaps on health and health determinants. The first is from city case studies undertaken within a research programme called Urban Africa: Risk Knowledge (Urban-ARK). Urban-ARK’s findings reveal the large spectrum of health risks in informal settlements, ranging from ‘everyday’ risks (e.g. infectious and parasitic diseases) to small- and larger-scale disasters. The second is from data collected by slum/shack dweller federations, which offer qualitative and quantitative findings on health, disasters, and other health determinants in informal settlements. Our conclusion reflects upon the need for additional

data on multiple risks to advance urban health and well-being and support the 2030 Agenda for Sustainable Development. It also highlights the need to strengthen accountable urban governance in sub-Saharan Africa.

**Keywords** Risk · Health · Health Determinants · Data · Sub-Saharan Africa

## Introduction: Multiple Health Risks, Inadequate Urban Governance, and Data Shortfalls

Urban governments are usually responsible for providing essential infrastructure (such as piped water, sanitation/drainage, paved roads, and electricity) and services like healthcare and refuse collection. The Intergovernmental Panel on Climate Change (IPCC) noted how provision for such infrastructure and services can significantly reduce health risks and build resilience to climate change [51].

Urban governments are also responsible for land-use management within their jurisdictions to prevent settlements developing in areas at high risk of disaster and to develop disaster-preparedness strategies, appropriate building codes, and other initiatives that reduce risks [60, 66]. Furthermore, urban governments must plan for the risks that climate change is bringing or will bring, especially in sub-Saharan Africa where climate change is likely to exacerbate urban health inequality and other disparities [8, 15, 48]. Few city governments in sub-Saharan Africa meet their responsibilities for what the IPCC terms “risk-reducing infrastructure and services”—

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such as regular, safe, accessible piped water supplies and functioning storm and surface water drainage [51].

Shortfalls in the infrastructure and services that are essential for health are particularly notable in informal settlements (see for instance [5, 6, 26, 56]). But there are no reliable statistics on the proportion of the urban population living in informal settlements in sub-Saharan Africa. Governments do not report on this, although there are case studies of cities that document how 30–70% of their populations residing in such settlements (see [35, 38, 57]). UN-Habitat produces regional and global estimates of the proportion of urban dwellers that live in ‘slums’—and sub-Saharan Africa had 56% of its urban population in ‘slums’ in 2014, the highest proportion among the world’s regions [57]. ‘Slums’ are not synonymous with informal settlements. The UN defines and measures ‘slum populations’ based on indicators of housing conditions and provision for water and sanitation whereas ‘informal settlements’ are areas outside of official land registration, building codes, and/or planning legislation. From city case studies, we know that most of the population classified by UN Habitat as ‘slum dwellers’ live in informal settlements.

It is in informal settlements where data gaps are most acute [23, 34, 39]. The limited data available on health in informal settlements suggest that their populations face elevated levels of communicable and non-communicable illnesses as well as heightened risks stemming from climate change [17, 26, 56]. Sub-Saharan Africa is also the region with the highest proportion of urban households lacking water piped to premises and toilets connected to sewers. In 2015, less than half of the region’s urban population had good-quality water provision that was accessible on premises, available at least 12 h a day, and free from contamination [65]. In this same year, just 11% of Africa’s urban population had toilets with sewer connections (ibid.). Data on provision for water and sanitation are only available for each nation’s urban population, not for city, district or informal settlements ([45], also below).

This paper highlights the lack of detailed data on health and disaster risks in cities, particularly for informal settlements where interventions are most needed (“[The Data Needed to Support Interventions to Reduce Health Risks in Urban Areas](#)” and “[Limited Data on the Full Spectrum of Risk and Vulnerabilities in Informal Settlements](#)” sections). It then describes how a comparative research programme called Urban Africa: Risk Knowledge (Urban-ARK) has helped to fill some of these data gaps that can motivate future strategies to reduce risks. After summarising Urban-ARK’s key findings on health and disaster risks (the

“[Urban-ARK Findings: Revealing the Full Spectrum of Risks in Informal Settlements](#)” section), the paper discusses the contributions of community-led data collection in African informal settlements (the “[A Community-Driven Approach to Generating Data on Health Risks and Outcomes](#)” section). We emphasize the need for an integrated analysis of ‘everyday’ risks and risks from small- and large-scale disasters in informal settlements (see Box 1 for definitions). In our conclusion, we identify remaining gaps and sketch a research agenda to help improve data on health risks and support resilience to multiple risks in informal settlements.

**Box 1** The full spectrum of risk: ‘everyday’ risks, small- and large-scale disasters in urban areas

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Residents of informal settlements face a wide array of risks to their health, their livelihoods and incomes, and their homes or other assets. According to past disaster-risk reduction studies, the impacts of disasters is under-counted because so many events that could be considered as disasters are not classified as such and are not incorporated into disaster databases [14, 58]. The United Nations Office for Disaster Risk Reduction (UNISDR) distinguishes between ‘intensive’ and ‘extensive’ disasters [58]. Intensive disasters include events where at least 30 persons are killed and/or at least 600 houses are destroyed, while extensive disasters are those with impacts below these two thresholds. Global analyze show the importance of extensive disaster risk, both in terms of impacts (e.g. mortality, injuries, damage or destruction of homes, economic losses) and in terms of what drives it [16]. Widening assessments of disaster risk to include extensive risk greatly increases the range of risks and the scale of their impacts. These change even more if attention is given to what can be termed ‘everyday risks’ that are distinct from the above risks because they pose a constant threat to residents in their homes, neighbourhoods, and the wider city [3]. In sum, the full spectrum of risk in urban areas must encompass the risks of the largest disasters to small disaster risks (that are not usually considered as disasters) and everyday risks [54]. However, the boundary separating extensive disasters and everyday risks can be fuzzy: a flood killing one person may be included as an extensive disaster (if it is recorded) but the infection that kills a 3-year-old child is not. Extensive disasters usually arise from physical hazards, but while endemic infectious and parasitic diseases are considered everyday risks, epidemics are usually classified as disasters (see also [55]).

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### **The Data Needed to Support Interventions to Reduce Health Risks in Urban Areas**

Governments are responsible for developing accurate, detailed information systems on health risks and health

outcomes that provide data for each locality and identify who is most at risk or affected [45]. This information base should encompass the full spectrum of health risks in urban areas, including diseases, pollutants, and physical hazards in informal settlements ([29]; also Box 1). Data are also needed to reveal the impacts of social, economic, and political determinants of urban health, including *global* determinants (e.g. international support for health interventions) and *national* determinants, such as national policies relevant to urban health [36, 61].

In sub-Saharan African cities, available data on many health determinants are aggregated for national, urban, and rural populations so these do not provide data needed to inform municipal health interventions [45]. Governments are expected to maintain detailed records of population health, including census data and vital registration systems recording all deaths and causes, patients' ages, and residences [27].

Censuses and household surveys are the most common sources of data about key health determinants. Like vital registration systems, a census can generate data for each locality (e.g. [33]). Although censuses can provide ward- or street-level data, findings are rarely available to city governments at this level of disaggregation. Vlahov et al. [62] notes how census data are not usually processed to provide data at municipal or intra-urban levels. They also note how censuses may not be geocoded—and often leave out key health risks. In addition, censuses are usually conducted every 10 years or still more infrequently in some nations [59]. Furthermore, most censuses do not identify informal settlements, and findings may obscure the particular health risks or the serious service and infrastructure deficits in informal settlements [37].

Patient records from hospitals or clinics can provide a valuable source of health data, but this data is often not available. Some residents (especially low-income households) may not utilize such facilities. Patients' records may also be incomplete, contain errors (especially if registers are not digitized), or aggregated to catchment areas beyond the city scale [12]. In another key source of relevant health data, Demographic and Health Surveys (DHS) regularly gather detailed data on health determinants and some on health outcomes.<sup>1</sup> Where they are undertaken regularly—for instance every 3 years—these also help to reveal trends in health outcomes and infrastructure networks [10, 31]. But the DHS are national sample surveys with sample sizes that

are too small to provide data for individual urban centres, let alone data disaggregated to each ward or district in cities [42, 50]. Similar challenges affect the UN's data on water and sanitation: findings are not available for individual cities or urban sub-districts [65] but it is at these levels that data on water and sanitation is urgently needed to guide action [52]. The paucity of data on health outcomes and health determinants has likely hidden a large health burden (often preventable), as well as constraining the effectiveness of responses in cities.

### Limited Data on the Full Spectrum of Risk and Vulnerabilities in Informal Settlements

The previous section noted how our knowledge of urban health and health determinants in informal settlements in sub-Saharan Africa does not come from conventional data sources such as vital registration systems, censuses and hospital/health care records. But these have the potential to provide data relevant to health for informal settlements, even if they do not include questions on some key health hazards [62]. Much of our knowledge for health in informal settlements comes from case studies in particular informal settlements so they do not provide needed data for all informal settlements. But these do document the range of risks or the scale of particular risks. For instance, there are no data on the impacts of accidental fires for urban areas in the region (or for the region's informal settlements) but there are particular studies of this for particular cities (for Cape Town, see [49]). There are records of road traffic mortality for cities, but usually these are aggregate figures and not available by city or by informal settlement (for an exception, see [69]). There are many case studies of flooding in urban areas in sub-Saharan Africa (see for instance [1, 25]) but most of these floods do not get recorded on national or international disaster databases [59]. The difficulties here are that detailed case studies do not provide the aggregated data needed to inform city and national policy—while much relevant data are too aggregated to inform local action.

The deficiencies in basic data about health outcomes and health determinants also mean that it is difficult to get data for groups that are vulnerable to each risk and the nature of their vulnerability (i.e. greater susceptibility/more impacted, lack of coping capacity, lack of adaptive capacity). The lack of data on causes of death and of illness or injury make it difficult to assess the scale and nature of many vulnerabilities—for

<sup>1</sup> See <http://dhsprogram.com/data/>

instance groups within the population who have high mortality rates (for instance infants, children, and mothers) or larger disease burdens (for instance from malaria or respiratory infections) or injuries from domestic violence. If no data are available on traffic accidents and who was killed or injured by each accident, then there is no evidence of who is most impacted; one of the few studies done on this was the study of road traffic accidents in Kisii and Kisumu, and it was pedestrians, cyclists, and informal public transit-riders who faced higher risks of injury or death [67].

### Urban-ARK Findings: Revealing the Full Spectrum of Risks in Informal Settlements

Rapid urbanisation, climate change, and inadequate local government responses are generating complex risk profiles in cities, but the implications for health in informal settlements are only poorly understood. Residents of informal settlements are at risk from a range of ‘everyday’ hazards as well as small and large disasters and risks linked to climate change (Box 1, also [48]). This section considers what can be learnt about health from city case studies that were undertaken within Urban Africa: Risk Knowledge (Urban-ARK). This is a 3-year research programme seeking to identify the range of risks in sub-Saharan African cities and to develop appropriate responses. We draw on Urban-ARK’s case studies in Ibadan (Nigeria), Karonga (Malawi), Nairobi and Mombasa (Kenya), Niamey (Niger), and Freetown (Sierra Leone). Although Urban-ARK’s case study cities vary widely in size and local hazards, all are experiencing rapid population growth with municipal governments lacking the resources or capacities to meet their responsibilities for infrastructure, service provision, and land-use management [3, 40, 53].

Each Urban-ARK case study aimed to identify the spectrum of contemporary risks, who is most at risk, and the integrated strategies needed to address them. Taken together, the case studies underscore the prevalence of everyday risks and small disasters, as well as their erosive impacts upon household well-being [2, 11]. But the concatenation of risks in informal settlements can, we suggest, create opportunities to achieve multiple benefits for health and to foster more equitable urban development [13]. With additional data on health risks and health outcomes in each locality, health officials and city planners can work with residents to create multi-sectoral interventions that may

achieve co-benefits for well-being, disaster-risk reduction, and resilience to climate change ([8], also the “Conclusions and Research Agenda” section). Such interventions can reduce risks while bolstering social inclusion and enhancing local governance [40, 43].

Research in Ibadan (Nigeria) explored the city’s multiple risks by drawing on 15 years of newspaper reports, as well as hospital records and official data on road accidents and emergency management. In 2006, Ibadan had 1.34 m residents (2.55 m in the metropolitan area), but its projected population will exceed 5 m by 2025 ([2], p. 2). Much of Ibadan’s growth has occurred in peri-urban areas, where provision for services and infrastructure are often highly inadequate [2]. Based upon newspaper reports of ‘small disasters’ in Ibadan from 2000 to 2015, the leading causes of mortality were vehicle accidents (34%), crime (22%), violence (13%), fire (12%), and flood (8%). Major floods were followed by cholera outbreaks, including in 2011 and 2012; flooding in 2011 led to the deaths of over 100 people alongside economic losses of \$40 m (ibid., drawing on World Bank research). Newspaper reports in Ibadan also distinguished between the causes of housing destruction that was attributable to rainstorms (72%), violence (23%), and fires (5%). Such official and published sources still omit most everyday risks; they may also under-report on ‘small’ disasters. Nevertheless, this study reveals the large impacts from a range of risks in Ibadan and the inter-linkages between different risks, such as flooding, inadequate or poorly maintained infrastructure, settlement in areas at high risk of flooding, and inadequate emergency responses.

Findings from Karonga (Malawi) also identified a large spectrum of risks and highlighted the health burdens linked to everyday risks, while also underscoring the critical shortfalls in local governance. Located near Lake Malawi, Karonga is a rapidly expanding town that is projected to reach a population of 63,000 by 2018 [40]. Key risks include earthquakes, floods as well as droughts, and communicable diseases like malaria, acute respiratory infections, and tuberculosis (TB). While much of the attention given to risk focuses on disaster risk, “everyday risks may be causing more premature deaths than disasters,” with Karonga’s hospital data indicating 67 TB-related deaths and 32 respiratory disease-related deaths in 2014 ([40], p. 22). Many informal settlements are situated in a floodplain that brings greater exposure to floods, and these flood risks are compounded by poor drainage and drainage

management (e.g. stopping encroachments into drains and cleaning drains) as well as very inadequate basic services (ibid., p. 29). An underlying driver of risk is a local government incapable of meeting most of its responsibilities. After Malawi's failed devolution policies and the abolition of Karonga's local council in 2009, risk-reduction strategies and urban planning more generally have been halted [34, 39].

A study in Niamey (the capital of Niger and with around 1 million inhabitants) highlighted the erosive impacts of floods on housing and health outcomes in informal settlements, as well as analysing key coping strategies [11]. The study interviewed 300 household heads whose homes were flooded in 2015, focusing upon their food, shelter, economic assets, and social support before and after the flood. Based on this multidimensional analysis, each household's resilience was assessed. Although all respondents experienced 6–8 days of household flooding, no relocation was reported in the most-resilient group, while the very low and low resilience households averaged 15 and 19 days in another lodging, respectively (ibid.). For 28% of the very low resilience households with mud-walled homes, all four boundary walls had collapsed (i.e., walls surrounding a family compound). By contrast, no walls collapsed in high or moderate resilience households; high resilience households were better-able to cope with floods by taking on debt and expending savings. Yet these strategies can have erosive impacts because assets may be unavailable for the next shock, underscoring the long-term consequences of disasters even for better-off households [11]. Respondents were also asked about malaria, injuries, and diarrhoeal diseases (often exacerbated by floods), in hopes of comparing outcomes before and after the 2015 flood. But the participants (mostly male household heads) could rarely recall their household members' health outcomes, let alone judge if the floods increased these burdens. However, the least-resilient households consistently reported higher health burdens, especially linked to malaria (ibid.).

A case study in Nairobi assessed how three upgrading initiatives influenced social capital, conflict/insecurity, and flooding risks [43]. Nairobi is Kenya's capital and had 3.2 million inhabitants in 2009 [30]. The authors analysed multiple risks when comparing the top-down Kenya Slum Upgrading Programme<sup>2</sup> with a

community-led Relocation Action Plan (RAP) and upgrading by Kenya's National Youth Service (NYS). The RAP sought to rehouse households living too close to Nairobi's railway line; railway reserve land in Kibera (and elsewhere) had been encroached by residences, shops, and schools, with the track also serving as a pedestrian path. After a 2010 enumeration spearheaded by Kenya's Slum-Dweller Federation (in Kiswahili, *Muungano wa Wanavijiji*), a core team was established with representatives from all affected settlements and the RAP was developed for an area near the original site.<sup>3</sup> To support well-being and reduce risks in informal settlements, Mitra et al. [43] noted the importance for the RAP providing meaningful grassroots participation and community-led enumerations. The lack of these in KENSUP was among the reasons for its lack of success.

Multi-sectoral upgrading initiatives can offer several valuable co-benefits by reducing disasters and everyday risks, in addition to improving health outcomes [18, 21]. For instance, the National Youth Service improved sanitation, roads, drainage, and rubbish collection in Nairobi's informal settlements (reducing everyday risks and promoting disaster resilience) while simultaneously creating jobs for youths [43].

Despite Kenya's extensive legislation and policies on solid waste management, refuse collection coverage has deteriorated markedly. In the mid-1970s, over 90% of Nairobi's wastes were collected. Currently, around half of the waste in Nairobi is not collected [30]. Inadequate solid waste management has generated many risks, especially for residents lacking regular collection or living near open dumps. Workers whose livelihoods are based on resource recovery and recycling also face significant occupational health risks (ibid., [20]). Furthermore, weak enforcement of solid waste management regulations and state incapacity have created a vacuum that has enabled private cartels to flourish, particularly in Nairobi's informal settlements [30]. Cartels seek to control Nairobi's dumpsites, but rarely offer adequate refuse collection to residents. Such unexpected knock-on impacts of minimal service delivery highlight the need to assess underlying causes of risk—including poor governance—and to develop strategies tackling multiple risks.

<sup>2</sup> For more on UN-Habitat and the Kenyan Government's Kenya Slum Upgrading Programme (KENSUP), see <https://unhabitat.org/books/un-habitat-and-kenya-slum-upgrading-programme-kensup/>

<sup>3</sup> See Lines and Macau [38] and Karanja [32] for analysis of exchanges to Mumbai (where another community-led relocation set a key precedent) and for discussion of the role of Muungano's technical support organisations such as Akiba Mashinani Trust (AMT).



In Freetown (Sierra Leone's capital with around 1 million inhabitants), alongside major floods and the 2014 Ebola epidemic, residents of informal settlements face everyday risks (e.g. from inadequate water and sanitation) and small disaster risks including accidental fires, landslides, and flash floods. As the Urban-ARK study noted, data are rarely available on Freetown's 'everyday' risks from infectious and parasitic diseases or malnutrition [4]. Much as in Karonga, Freetown is facing rapid population growth with little government capacity to manage urban expansion (*ibid.*). Informal settlements in Freetown are often located on lands at risk from flooding, rock falls, building collapse and landslides (*ibid.*). Freetown's large disasters have received media coverage, including the devastating mudslide in August 2017,<sup>4</sup> and this event underscores the interrelated risks linked to intense rainfall, land degradation, and urbanisation in hilly areas. Informal settlements in Freetown (and other African cities) often experience elevated threats of eviction that may undermine households' investments or community collective action, increasing risks still further [47]. Freetown epitomizes the need for simultaneously addressing everyday risks, small- and large-scale disasters, and climate change in a context of rapid urbanisation,<sup>5</sup> with parallels to other African cities facing interrelated, compounding disaster risks [19].

Urban-ARK's findings also highlighted the lack of systems to record each city's premature deaths, serious illnesses, and injuries or the systems' currently incomplete coverage. Collecting and making available this 'routine' data on health events is a key underpinning of effective public health policy but such systems rarely function well (or at all) in much of Africa [12, 45]. Furthermore, there are major challenges in recording *invisible* urban risks: floods are much more visible and readily documented than (for instance) health burdens from malaria or diarrhoeal diseases. This is especially so if no data are available on health burdens from vital registration systems or hospital records. Interviewees can more easily recall flood events and their impacts than details of their households' health problems (see [11]). By contrast, residents may not readily identify infectious and parasitic diseases when asked about the greatest risks they face [40].

<sup>4</sup> See [www.theguardian.com/world/2017/aug/14/deaths-sierra-leone-mudslide-regent](http://www.theguardian.com/world/2017/aug/14/deaths-sierra-leone-mudslide-regent)

<sup>5</sup> See [www.theguardian.com/world/2017/sep/02/flood-waters-rising-urban-development-climate-change](http://www.theguardian.com/world/2017/sep/02/flood-waters-rising-urban-development-climate-change)

## A Community-Driven Approach to Generating Data on Health Risks and Outcomes

A detailed new source of information on risks and health determinants in informal settlements comes from the profiles, maps, and enumerations undertaken by settlement residents, supported by slum/shack dweller federations. Slum/shack dweller federations that are affiliates of Slum/Shack-Dwellers International (SDI) are currently active in over 30 nations throughout Africa and Asia,<sup>6</sup> where they have created profiles of over 7000 informal settlements and maps of informal settlements in over 500 cities [9].<sup>7</sup> We discuss how findings from these 'citizen scientists,' can be utilized to improve health, support accountable governance, and address multiple urban risks (see also [28, 46]). With a finer-grained documentation of risks and their spatial distribution, municipal policymakers and health officials can create appropriate responses while working closely with residents and their community organisations.

The informal settlement profiles undertaken in the city of Kisumu (Kenya) illustrate their depth and detail. In Kisumu, the Slum Dwellers Federation of Kenya—Muungano wa Wanavijiji—supported residents of informal settlements to prepare profiles of the city's 28 informal settlements. These assessed the quality and extent of infrastructure and services as well as identifying residents' priorities for future interventions (Box 2). Three quarters of residents lived on dangerous sites, including flood-prone areas or near garbage dumps [44]. Most residents were tenants and 83% lived in temporary structures; the settlements' minimal services, major infrastructure deficits, and poor access to health facilities only compounded the risks facing residents. Two thirds of residents lacked regular water supplies; in 20 settlements, there were over 100 residents per working toilet, leading to elevated risks of diarrhoea and other waterborne illnesses. Regular garbage collection was almost non-existent, and only 4 of the 28 settlements had access to fire stations. Since just 11 settlements had a health clinic, many residents were forced to walk long distances to clinics (posing particular challenges for pregnant women). Regarding future interventions, residents consistently prioritized improving water, drainage, and sanitation, with a few areas prioritising improved electricity and land tenure.

<sup>6</sup> See <http://knowyourcity.info/>

<sup>7</sup> See <http://knowyourcity.info/>

## Box 2 Key questions from SDI's informal settlement profiles in Kisumu, Kenya

Below is a summary of the issues addressed in community-led profiles of 28 informal settlements in Kisumu, which *Muungano wa Wanavijiji* conducted in 2014 [38]. Profiling, enumeration, and mapping initiatives by SDI affiliates in other cities have covered similar topics.

### *Land ownership and history for each informal settlement:*

Settlement name (community and municipality); year established; brief history. Ownership of land where settlement is located (e.g. central government entities, municipality, private owner, customary land).

*Demographic and structure details:* Number of residential, residential-business and business structures; population of settlement (households); proportion of tenants.

*Location:* Is location considered dangerous (if so, why); any natural disasters experienced in last year; main concerns related to location.

*Evictions:* Past or current eviction threats.

*Water:* Main water sources (nine possibilities); number of individual, community and shared taps.

Individual water taps: Who supplies the water in the taps; how many taps; how many working; how good a quality? Other sources e.g. boreholes/wells, springs ....

On average: what do households spend on water per month? How long does it take a household to collect water; how many hours per day is water available?

Is your settlement connected to mains water? General comments about water.

*Sanitation:* Sewer line passing through or near the settlement? Settlement connected to sewer?

Do people pay to use the toilets? How much do you pay for use of the toilet on average per month.

Mix of toilet types (lots of detail). Public toilets and management of public toilet.

On average, how long does a person have to wait to use the toilet?

*Garbage collection:* Where is garbage usually deposited? How many garbage collection points in settlement and who collects it? Is collection paid for? (If so, how much per month?)

*Health care:* Do residents have access to a health clinic? (If so, inside the settlement? How many minutes' walk?) An AIDS clinic? A hospital? Do residents pay for health care?

*Health:* Top 4 most common diseases in this settlement.

Ambulance availability and access. Can fire engines enter the settlement?

*Electricity:* Electricity provision at household level (cost, reliability, etc.) and street lights.

*Livelihoods:* Common jobs for men, women, and (if relevant) children.

*Transport:* Main modes of transport (for each mode, indicate cost/day/one way); time to walk to railway and bus. How do people in the settlement access their homes?

*Education:* Detailed questions on pre-school facilities, primary and secondary schools.

*Commercial establishments, other services and establishments* such as playgrounds, banks, informal markets, fire and police stations, mosques, temples, churches.

*Organisations:* Community leaders and their roles; how often respondents go to community meetings; provision for conflict resolution; role of local politicians and civil servants. What kind of relationship do you have with the city/council/local authority? Detailed questions about savings groups; youth clubs, religious groups, CBOs/NGOs, political party offices.

*Community priorities:* In relation to settlement upgrading, what are the most important problems you wish to solve as a community.

The value of informal settlement profiles for highlighting multiple risks and limited access to emergency services can also be seen in profiles of informal settlements in urban areas in Sierra Leone, Tanzania, and Kenya.<sup>8</sup> These profiles contain standardized questions on health, disasters, service provision and other health determinants. When asked about their top diseases, residents in Sierra Leone's settlements reported malaria, typhoid, and diarrhoea, with a few areas also reporting respiratory infections and cholera. For informal settlements in Kenya, inhabitants typically reported malaria, typhoid, and HIV as their top illnesses, with lower rates of diarrhoea, pneumonia, and TB. Meanwhile, Tanzanian residents listed malaria, urinary tract infections, typhoid, and TB as their top illnesses, alongside lower rates of diarrhoea and pneumonia. Regarding disasters experienced over the year preceding the survey, the most common were floods, fires and strong winds. The discussions with households and communities about the most serious diseases or physical hazards they face should be seen as the means for opening discussions with local governments and service providers and encouraging more detailed data collection.

Settlement profiles illuminate the overlapping risks in informal settlements and offer qualitative findings on deficiencies in infrastructure, including associated health and gendered burdens. According to the settlement profiles in Sierra Leone and Kenya, over two thirds of settlements with dangerous locations have faced eviction threats; by contrast, just 26% of Tanzanian settlements with dangerous locations have faced eviction threats. A shared concern is informal settlements' poor access to emergency services. Most settlements were either inaccessible to ambulances or had waits of more than an hour. These settlement profiles

<sup>8</sup> Sierra Leone's slum-dweller federation profiled 32 settlements in Freetown, 1 in Makeni, and 1 in Waterloo; the Tanzanian profile includes 218 Dar es Salaam settlements, 38 from Morogoro, 29 from Mwanza, and 12 from Dodoma; and the Kenyan profile including 144 settlements in Nairobi, 37 in Kisumu, 30 Makueni, 28 Nakuru, and 18 in Naivasha.

also reveal the low-quality infrastructure provision, with negative impacts on health and gender equity. In Dar es Salaam, prohibitively expensive electricity connection costs lead households to use oil lamps and candles for lighting increasing fire risks. Kisumu residents explained how inadequate water and sanitation promote disease outbreaks (particularly after floods), impose gender-inequitable time burdens, and create opportunities for over-charging by informal water providers.<sup>9</sup> Gender burdens linked to inadequate water were also highlighted in Freetown, where girls may stay out late at night to find water, leading to school absence or even teen pregnancy. These economic, gender-inequitable, and health consequences of inadequate infrastructure highlight the need for detailed data on multiple risks in informal settlements, which can inform more inclusive and appropriate interventions (as discussed below).

## Conclusions and Research Agenda

The ‘full spectrum’ of risk in any urban centre encompasses risks in residences, local environments, workplaces, and the wider city, including all risks with relevance for health. Understanding this spectrum can inform disease or injury prevention measures, with broader potential to foster health equity and social justice [68]. The centrality of health is only increased if health is recognized as not just the absence of disease or infirmity, but as “a state of complete physical, mental and social well-being” [63].

Detailed data on disease and injury burdens and health determinants can be utilized in risk assessments and reveal the multiple links between everyday, disaster, and climate change risks [14, 47]. Each of these is concerned with local risk, but they bring different lenses and can create contrasting entry-points into risk-reduction interventions for cities. Findings from the Urban-ARK programme, synthesized above, offer a much-needed recognition of the ‘wide spectrum’ of risks in sub-Saharan African cities, encompassing road traffic injuries, inadequate refuse collection, communicable illnesses, and recurrent flooding that can erode households’ coping capacities (e.g., [2, 11]).

<sup>9</sup> Latrines in Kisumu are “usually flooded during floods, leading to spillage of faeces all over thus risking diseases like cholera...Water pipes [can] burst near sewerage. Women take a lot of time to fetch water. Water managers hike the price whenever they feel like it” (quoted in Kisumu profile).

There is a widely recognized need for indicators to monitor the Sustainable Development Goals (SDGs) and their many health-related targets [24]. But little data are available on health risks or health outcomes in informal settlements. The SDGs may emphasize the need for disaggregated data (see [64]) but they say little about how to get it disaggregated to where it is useable to and useful to local governments and informal settlement residents. What changes to existing systems or new systems are needed to achieve this? As discussed above, there are major limitations in censuses and national sample surveys [62]. In addition, vital registration databases and monitoring systems drawing upon patient records are rarely functional [45].

Conventional social science research methods like household surveys, selected informant interviews and spatial analyze can help address the lack of data on health risks by documenting key health determinants and the full spectrum of risks [23]. But as noted above in Niamey [11], residents’ recall of health risks or health outcomes may not yield reliable or detailed results. Additionally, the ranking of risks is strongly influenced by local understandings of what constitutes ‘risk,’—for instance whether or not it includes infectious or parasitic diseases [40]. Due to data gaps on causes of death, illness, or injury in cities, it is difficult to assess the scale and nature of many vulnerabilities, such as groups with high mortality rates (e.g. infants, children and mothers) or larger disease burdens (e.g. from malaria or respiratory infections). In addition, detailed case studies do not provide the aggregated data needed to inform city and national policy—just as much relevant data (from censuses that do not provide disaggregated data and national household surveys) are too aggregated to inform each urban government.

The informal settlement profiles described above can be compared to DHS in the scale and scope of their questions— but unlike these national sample surveys, they provide in-depth data for each informal settlement. The slum/shack dweller federations also undertake enumerations that resemble censuses (with data collected from all households in informal settlements) and these are particularly valuable for supporting the transfer of tenure to the occupants and informing upgrading initiatives.

These slum/shack dweller federations both create and own their findings; communities then utilize the data to identify local priorities for action. The data from settlement profiles, enumerations, and maps are regularly



shared with local officials and often provide the foundation for strengthening local governments' engagement with low-income urban citizens [7, 46]. The data from these are not intended as 'research on health', nor can they serve as substitutes for vital registration systems or other official data. But these grassroots-led informal settlement profiles, enumerations and maps provide a wealth of detail on health-related issues in settlements for which there is little or no official data. Urban-ARK focused on risk not only because of its importance for understanding health outcomes and determinants but also because it can enhance governance and support a more positive engagement between residents of informal settlements and local officials and politicians.

Given the close interplay between most 'everyday' risks with risks from large- and small-scale disasters in informal settlements, multi-pronged responses are needed. Multi-sectoral upgrading can improve access to infrastructure, shelter, and services (promoting health and progress on other SDGs) while also bolstering climate resilience, reducing disaster risks, and enhancing local governments' accountability in informal settlements [18, 21]. If equipped with detailed data on the full spectrum of risks, health practitioners and local authorities can craft more appropriate and effective strategies, working closely with residents and their organisations (ibid., [45]). Where there are pre-existing community governance structures, there are far greater possibilities of joint initiatives with local governments and other public agencies [4, 38].

Both the Urban-ARK case studies and the informal settlement profiles highlight the very large influence of urban governments in what is done or not done on (everyday, disaster, and climate change) risk reduction. Whether due to limited resources, lack of political will, or capacity constraints, failures in local governance seem to be the most influential determinants of ill-health and premature death for the inhabitants of informal settlements through all the deficits in the infrastructure and services that are among their responsibilities.

Urban policymakers need to engage with both the proximate and the ultimate drivers of risk [22]. But Urban-ARK studies consistently highlight the failings of local governments to do so [2, 40]. This failure is also underpinned by national governments not supporting local governments to meet their responsibilities and failing to maintain adequate health information systems [45]. In a further underlying cause, most development

assistance agencies have shown very little interest in supporting urban governments and slum/shack dweller federations to provide needed infrastructure or services.

Moving forward, urban health officials and researchers can work closely with residents, local governments, and disaster response officials to address the interrelated, overlapping risks in informal settlements. Multi-pronged strategies can potentially generate co-benefits for health, disaster-risk reduction, and climate resilience in informal settlements, while also fostering key social determinants of health such as responsive governance and social inclusion (cf. [41]).

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