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**DETERMINANTS, PATHWAYS
AND HEALTH OUTCOMES IN
INFORMAL SETTLEMENTS:
TOWARDS AN INTEGRATED
FRAMEWORK**

EDMUNDO WERNA



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EDMUNDO WERNA

ABSTRACT

Informal settlements constitute one of the most significant spatial expressions of contemporary urban inequality and are home to more than one billion people globally. Health conditions within these settlements are shaped by complex interactions among environmental exposures, inadequate housing, infrastructural deficits, socioeconomic precarity, governance failures and unequal access to healthcare. While the literature on urban health has increasingly recognized the importance of different types of determinants, research on informal settlements often remains fragmented across disciplines, sectors and specific disease categories.

This Research Note presents a systematized global review of the determinants and health outcomes associated with informal settlements, synthesizing evidence across four interconnected dimensions: environmental, economic, social and governance-related. The Note examines how these determinants interact to shape different types of disease. It also highlights the persistence of a double burden of (infectious and non-communicable) diseases and, increasingly, a multiple burden of diseases, including mental health and injuries.

The main argument of the Research Note is that health inequalities in informal settlements are not simply the consequence of individual determinants such as poverty, poor housing or inadequate sanitation. Rather, they are continuously produced and reproduced through interactions among processes operating across multiple scales. Understanding these interactions - not merely identifying additional determinants - is a main challenge for both research and policy. At the same time, although informal settlements experience profound structural disadvantages, they should not be viewed exclusively through a deficit-oriented lens. They are also spaces of agency, adaptation, social organization and resilience, where communities actively respond to and, in some cases, mitigate structural constraints. Improving health in informal settlements requires integrated approaches that address structural drivers while simultaneously recognising and building upon local capacities and community action.

Rather than presenting systemic transformation and localized interventions as opposing approaches, the Research Note argues for multi-scalar strategies linking structural reform with realistic and context-sensitive action.

Keywords: *informal settlements; favelas; slums; urban health; determinants of health; environmental health; urban inequality; climate change; resilience; governance; systems approaches.*

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1. INTRODUCTION

This introductory section establishes the conceptual and analytical foundations for the Research Note. It begins by examining the broader context of rapid urbanization and the expansion of informal settlements, highlighting their significance as a defining feature of contemporary urban development and as an important setting for understanding urban health. Following, it discusses the evolution of thinking on urban health inequalities, because of its significance for informal settlements. Building on this discussion, the section then presents the conceptual framework adopted throughout the Research Note, explaining how determinants, pathways, interactions and feedback mechanisms provide an integrated basis for understanding health in contexts of urban informality. Subsequently the section defines the research question, objectives, principal argument and the contributions of the Note. It concludes by outlining its overall structure.

1.1. URBANIZATION AND INFORMAL SETTLEMENTS

While the broad contours of rapid urbanization and the expansion of informal settlements are well established, their implications for health remain unevenly conceptualized. In addition, the literature contains abundant evidence on individual determinants of health in informal settlements, but these findings have rarely been brought together into a single analytical framework that synthesizes evidence across different regions, disciplines and health outcomes.

According to recent United Nations estimates, approximately 57% of the world's population currently resides in urban areas, a figure projected to rise to nearly 70% by 2050, with the vast majority of this growth concentrated in the Global South. A defining feature of this expansion is the continuing growth of informal settlements, which are home to an estimated 1.1 billion people worldwide. In several regions, between 30% and 60% of urban residents live in informal settlements, although precise estimates vary according to definitions and data availability. (Friesen et al., 2019, 2020; UN-DESA, 2024; UN-Habitat, 2024). Despite some variations across countries, these settlements are typically characterized by insecure land tenure, inadequate housing, limited access to water and sanitation and insufficient infrastructure and services. The scale of informality has remained persistent over time, indicating that it is not merely a transitional phase of development but a structural component of contemporary urbanization processes (Corburn and Sverdlik, 2019; Grant et al. 2025; Kjellstrom et al., 2008).

The expansion of informal settlements is closely linked to broader structural drivers, including rapid population growth, rural-urban migration and the limited capacity of formal housing markets to meet demand. As cities grow, formal systems often fail to provide affordable and adequate housing at the necessary scale, leading to the proliferation of informal solutions. These dynamics are compounded by socioeconomic inequalities, labour market informality as well as governance constraints, which together shape patterns of urban expansion and spatial exclusion.

Informal settlements are frequently located in environmentally vulnerable or marginalized areas, such as flood-prone zones, steep slopes or peri-urban fringes, where land is more accessible but risks are higher. These spatial patterns are reinforced by institutional factors, including exclusion from formal planning processes and limited public investment in infrastructure and services. As a result, residents of informal settlements often experience compounded disadvantages, including poor living conditions, limited access to healthcare and education, and reduced economic opportunities (Amoako & Inkoom, 2018; Porto et al., 2014; Twum & Abubakari, 2019). Furthermore, the lack of granular intra-urban data has historically obscured these inequalities, hindering effective policy responses and masking significant variations within cities (Snyder et al., 2014).

Recent global shocks have further highlighted the structural nature of informal urbanization. The COVID-19 pandemic, for example, exposed the challenges of implementing public health measures such as

physical distancing and hygiene practices in densely populated settlements with limited infrastructure. Studies have shown that overcrowding, reliance on informal livelihoods and inadequate service provision significantly constrained the ability of residents to mitigate risks, thereby exacerbating existing health vulnerabilities (Corburn et al., 2020; Kimani-Murage et al. 2022).

At the same time, informal settlements are not homogeneous spaces of deprivation but complex and dynamic socio-spatial systems. They are characterized by diverse forms of organization, social networks, and adaptive strategies that enable residents to cope with structural constraints. A growing body of literature emphasizes the importance of adopting relational and systems-based perspectives to understand how health and well-being in these contexts are shaped by interactions between environmental, economic, social and governance factors (ARISE Consortium, 2024; Corburn and Karanja, 2016).

Overall, the scale and persistence of informal settlements reflect fundamental features of urbanization (especially in low- and middle-income countries) rather than temporary or residual phenomena. These settlements are deeply embedded within broader urban systems and are shaped by structural inequalities. Understanding these dynamics is essential for analyzing health in informal settlements, as the conditions associated with inequalities influence both exposure to risks and the capacity to respond to them.

1.2. HEALTH INEQUALITIES: URBAN 'ADVANTAGE' AND INTRA-URBAN DISPARITIES

Urbanization has historically been associated with an allegedly urban advantage, including in health, whereby urban populations, on average, experience better outcomes than their rural counterparts due to improved access to healthcare, infrastructure, education and economic opportunities.

Early development thinking was strongly influenced by a longstanding intellectual tradition that idealized rural life while portraying cities as socially and morally problematic. Although this perspective can be traced to much earlier philosophical traditions, including interpretations of Rousseau's (1755) notion of the *noble savage*, it became particularly influential within post-war development theory through the concept of *urban bias*, most prominently articulated by Lipton (1977). This author argued that governments in many low- and middle-income countries systematically privileged urban populations through disproportionate investments in infrastructure, public services, education and political representation, thereby neglecting rural poverty.

By the late twentieth century, however, scholars increasingly questioned whether this rural–urban dichotomy adequately reflected contemporary patterns of deprivation. Authors such as Hapham et al. (1988) and Werna (2000) argued that the assumption of urban advantage obscured rapidly growing inequalities within cities, particularly the expansion of informal settlements characterized by insecure housing, inadequate infrastructure, environmental hazards and limited access to basic services. More recent scholarship has reinforced this critique, demonstrating that aggregate urban indicators frequently conceal profound intra-urban disparities and that informal settlements remain systematically underserved despite continuing urban growth (Akwara et al., 2023; Friel et al., 2011a; Kjellstrom et al., 2008; UN-Habitat, 2024). Rather than viewing rural and urban poverty as competing priorities, contemporary urban health research increasingly emphasizes that poverty is spatially heterogeneous and that effective policy must address inequalities both between and within urban areas. But despite such solid argument and evidence, the rural bias still permeates at least partially across development thinking and practice, with strong supporters such as the ILO (International Labour Office), which has adopted rural development as one of its priorities, delegating urban livelihoods to a lower position.

Therefore, it is important to keep advocating against the heralded existence of an urban bias. Rather than homogeneous spaces of improved well-being, cities (especially in low - and middle - income countries) are increasingly characterized by pronounced spatial and social inequalities, with health outcomes varying significantly across neighborhoods and population groups. Informal settlements, in particular, concentrate multiple forms of disadvantage, including inadequate livelihoods and housing, limited access to services and

exposure to environmental hazards. These overlapping vulnerabilities contribute to disproportionately poor health outcomes among their residents, effectively challenging the notion of a universal urban advantage.

Empirical studies highlight the extent of these intra-urban inequalities. For example, comparative analyses of formal and informal settlements demonstrate significant differences in exposure to health risks and access to protective resources, even within the same metropolitan areas (Alpaugh et al., 2024; Snyder et al., 2014). Such findings underscore that urban averages obscure critical disparities, and that health risks are unevenly distributed within cities along socioeconomic and spatial lines.

A key challenge in understanding urban health inequalities is the persistent scarcity of disaggregated intra-urban data capable of capturing the heterogeneity of living conditions within cities. Although this limitation has long been recognized (e.g. Akerman, 1996; ARISE Consortium, 2024; Werna, 2000), it remains an obstacle to evidence-based policymaking in many places. Conventional data sources, including national censuses, demographic and health surveys, and global health estimates, typically report outcomes at city or national levels, thereby masking substantial inequalities within urban areas, particularly those affecting residents of informal settlements (Akwara et al., 2023; UN-Habitat, 2024).

Health inequalities are not solely the result of individual or household characteristics but are deeply rooted in structural and systemic factors. These include patterns of urban governance, exclusion from formal planning processes, and unequal distribution of resources and services. Addressing health inequities in urban settings requires an understanding of the broader social and environmental determinants that shape living conditions and opportunities (Barten, 2011; Corburn & Sverdlik, 2017; Corburn et al., 2020; Ezech et al., 2017; Grant et al., 2025; Porto et al., 2014; Sverdlik, 2011). Informal settlements can thus be conceptualized as spaces of *concentrated disadvantage*, where multiple risk factors converge and interact. This clustering of risks contributes to the persistence of poor health outcomes and reinforces cycles of inequality over time (Zerbo et al., 2020).

Recent global events, including the COVID-19 pandemic, have further exposed and intensified these inequalities. Evidence indicates that informal settlements faced disproportionate challenges in benefiting from public health measures due to overcrowding, inadequate infrastructure and reliance on informal livelihoods, thereby exacerbating existing vulnerabilities (Chigbu and Onyebueke, 2021; Nix et al. 2020). These dynamics illustrate how shocks interact with underlying structural conditions to widen health disparities within cities.

At the same time, the literature also points to the importance of social networks and community-based mechanisms in mediating health risks and supporting resilience in informal settlements (ARISE Consortium, 2024; Grant et al., 2025; WHO, 2024). While these factors can mitigate some adverse outcomes, they do not offset the broader structural inequalities that shape health in these contexts.

In summary, while cities may offer overall health advantages, these benefits are unevenly distributed. Informal settlements experience systematically worse health outcomes than other urban areas. Recognizing and addressing intra-urban inequalities is therefore essential for understanding health in informal settlements and for developing effective interventions. These patterns of intra-urban inequality and concentrated disadvantage point to the need for a more systematic understanding of how health risks are produced in informal settlements. Rather than viewing determinants in isolation, there is a need for an integrative perspective. The following subsection outlines the conceptual framework adopted to analyze these relationships.

1.3. CONCEPTUAL FRAMING: DETERMINANTS, PATHWAYS AND INTERACTIONS

Traditional approaches to health in low-income urban settings have often focused on specific exposures, such as inadequate sanitation, poor housing or infectious disease transmission, examined in relative isolation. While such approaches have generated valuable insights, they tend to overlook the ways in which these factors interact and reinforce one another within the lived realities of informal settlements. Understanding health in informal settlements requires an analytical framework that moves beyond isolated risk factors to consider the complex

and interconnected processes through which health outcomes are produced. Health is shaped by a wide range of determinants, which operate at multiple levels (Friel et al., 2011a; Grant et al., 2025; Kjellstrom et al., 2008; Salgado et al., 2020; Seraphim et al., 2025). More recent work calls for integrative and systems-oriented perspectives that capture the dynamic relationships between determinants and their cumulative effects on health (Corburn and Karanja, 2016; Grant et al., 2025).

A determinants-based framework provides a useful starting point for organizing this complexity. In this perspective, health outcomes are understood as the result of interacting layers of influence, ranging from structural conditions, such as poverty, governance and urban planning, to more immediate or proximal factors, including environmental exposures, behaviors and access to services. Informal settlements are characterized by the convergence of multiple adverse determinants across these domains, which together shape patterns of risk and vulnerability (Ikiriko et al. 2022; Sverdlik, 2011; Werna et al. 2022).

However, the concept of determinants alone is insufficient to fully capture the dynamics at play. It is also necessary to examine the *pathways* through which determinants influence health outcomes. These pathways may be direct, such as the impact of contaminated water on diarrheal disease, or indirect, mediated through factors such as nutrition, stress or access to healthcare. For example, socioeconomic deprivation may influence health both through material conditions (e.g., inadequate housing) and through psychosocial mechanisms (e.g., chronic stress), illustrating the multiplicity of causal routes (Friel et al., 2011a).

Importantly, these pathways are not linear but are often characterized by *feedback loops* and interactions between determinants. One example of a feedback loop is that poor health can exacerbate socioeconomic vulnerability, further increasing exposure to risk. Environmental conditions may shape economic opportunities, which in turn influence the quality of housing and other buildings and access to services, thereby affecting health outcomes. Similarly, governance arrangements influence the distribution of infrastructure and services, which mediate exposure to environmental risks. Systems-oriented approaches emphasize that these interactions can amplify or mitigate health risks, producing outcomes that cannot be explained by single factors alone (Grant et al. 2025; Newell & Siri, 2016; Salgado et al. 2020; Seraphim et al. 2025; WHO, 2025).

Within this framework, informal settlements can be conceptualized as complex socioeconomic-spatial systems (Diez Roux & Stankov, 2021; Grant et al. 2025). This perspective highlights the importance of examining not only individual determinants but also their combined effects and the structures that sustain them. It also underscores the role of context, as the relative importance of different determinants and pathways may vary across settings.

The framework adopted in this Research Note integrates three complementary dimensions: (i) the identification of the major determinants of health in informal settlements; (ii) the pathways through which these determinants influence health outcomes; and (iii) the interactions across scales, from households and communities to broader urban and institutional contexts.

Adopting this perspective allows the Note to move beyond descriptive accounts of specific health problems towards a more integrated understanding of the processes that shape health in informal settlements. At the same time, it provides a basis for critically assessing the current state of knowledge by revealing where evidence remains fragmented, where key relationships are poorly understood, and where populational groups, contexts, or mechanisms continue to be overlooked.

1.4. RESEARCH QUESTION, OBJECTIVES AND MAIN ARGUMENT

Existing evidence about health in informal settlements remains uneven in scope and analytical depth (Acosta-España et al. 2024; Amegah & Agyei-Mensah, 2017; Amoako & Inkoom, 2018; Demeterova, 2026; Pereira et al. 2024; Romanello et al. 2025). Many studies and reviews are bounded by specific geographic contexts or thematic domains (Núñez Collado & Wang, 2020; Slovic et al. 2024). While determinants of health are well documented, they are frequently treated as discrete or parallel factors. Comparatively less attention has been paid to how multiple determinants interact, how these interactions vary across contexts and populations, and

how they translate into health outcomes through specific pathways (Kihato & Landau, 2021; Jungari et al. 2022; McNab et al. 2022 Watkins et al. 2025). At the same time, the field has evolved in recent years, with increasing attention to climate change, non-communicable diseases, mental health and the complex interplay between environmental exposures and social vulnerability. These developments reinforce the need for an updated and integrated synthesis.

This Research Note is guided by the following question:

What are the key determinants of health in informal settlements globally according to the literature, how are they associated with health outcomes, and through what pathways do these relationships operate?

To address this question, the study pursues three interrelated objectives:

- *To systematically identify and synthesize the principal determinants of health* reported in the literature on informal settlements, across environmental, economic, social and governance domains;
- *To examine the range of health outcomes associated with these contexts*, including communicable and non-communicable diseases, maternal and child health, mental health, and injuries;
- *To analyze the pathways linking determinants to health outcomes*, with particular attention to:
 - interactions between structural and proximal factors (i.e., those operating at broader systemic levels and those exerting more direct and immediate influence at the individual or household level),
 - relationships across different scales (household, neighborhood and wider urban systems), and
 - the mediating role of formal and informal health systems, where relevant.

The main argument of the Note is: *health inequalities in informal settlements are not simply the consequence of individual determinants such as poverty, poor housing or inadequate sanitation. Rather, they are continuously produced and reproduced through interactions among processes operating across multiple scales. Understanding these interactions – not merely identifying additional determinants – is a main challenge for both research and policy. At the same time, although informal settlements experience profound structural disadvantages, they should not be viewed exclusively through a deficit-oriented lens. They are also spaces of agency, adaptation, social organization and resilience, where communities actively respond to and, in some cases, mitigate structural constraints. Consequently, improving health in informal settlements requires integrated approaches that address structural drivers while simultaneously recognising and building upon local capacities and community action.*

In doing so, the Research Note advances current scholarship on health in informal settlements by providing an integrated synthesis of evidence across environmental, socioeconomic, governance and health-system dimensions. It adopts a relational perspective that emphasizes how determinants interact across scales to produce health risks and vulnerabilities, while also recognizing the role of community adaptation and resilience alongside structural inequalities. Finally, by identifying both recurring patterns and persistent evidence gaps, the Note provides a basis for informing future research and more integrated policy responses.

The remainder of this Note is structured as follows. Section 2 presents the methodology adopted. Section 3 synthesizes the principal determinants of health in informal settlements across environmental, economic, social and governance domains. It also examines the pathways linking these determinants to health outcomes. Section 4 analyses the interactions among determinants and pathways (also including feedback mechanisms) and the major types of disease. Section 5 sets up future directions for research. Section 6 concludes by reflecting on the implications of the findings for urban health research and practice.

2. METHODS

2.1. STUDY DESIGN

This study employed a **systematized literature review** to synthesize global evidence on the determinants of health, associated pathways, feedback loops and outcomes in informal settlements. The approach combined elements of systematic and narrative reviews, including a structured search strategy, predefined inclusion and exclusion criteria, and transparent screening procedures, while allowing for analytical flexibility in the thematic synthesis of findings.

2.2. SEARCH STRATEGY

A comprehensive literature search was conducted across three major electronic databases: PubMed/MEDLINE, Scopus and Web of Science. These databases were selected because of their broad coverage of public health, urban studies, environmental health, social sciences and interdisciplinary research relevant to health in informal settlements.

To enhance the comprehensiveness of the Research Note, database searches were supplemented by additional search actions conducted in parallel. First, Google Scholar was used to identify potentially relevant publications that may not have been indexed in the primary databases, as well as recently published material and reports from interdisciplinary fields. Second, citation tracking (snowballing) was employed, whereby the reference lists of key publications were examined to identify additional relevant studies (backward citation tracking), while influential papers citing those studies were also explored where appropriate (forward citation tracking). This iterative process frequently led to the identification of further relevant literature and helped ensure that significant contributions were not overlooked. Third, the Note also built upon the author's prior knowledge of the field and ongoing engagement with academic and professional networks on urban health, informal settlements, planning and development. This facilitated the identification of seminal publications and emerging debates that might not have been captured through database searches alone.

The combination of these complementary actions contributed to a broad coverage of the literature. Many influential publications were identified through multiple search routes, reinforcing confidence in their relevance and significance. At the same time, some studies emerged through only one of the search approaches, illustrating the value of combining database searches, citation tracking, and expert knowledge to maximize coverage and reduce the risk of omission.

The search aimed to identify mainly peer-reviewed articles yet also included selected books and book chapters which obtained relevance in the literature. It was supplemented with a selected number of grey literature publications, with special attention to documents of UN agencies.

Search terms were developed iteratively and combined using Boolean operators. Keywords included terms related to informal settlements (e.g., "slum*", "informal settlement*", "favela*", "squatter settlement*", "shantytown*"), health outcomes (e.g., "health*", "disease*", "mortality*", "morbidity*"), and urban context (e.g., "urban*", "city*", "cities*", "town*", "human settlement*"). An example of a search string, *inter alia*, was structured as follows:

("slum*" OR "informal settlement*" OR "favela*" OR "squatter settlement*" OR "shantytown*")
AND ("health" OR "health outcome*" OR "disease" OR "mortality" OR "morbidity")
AND ("urban" OR "city").

2.3. ELIGIBILITY CRITERIA

Studies were included if they:

1. Focused on populations residing in informal settlements or comparable urban contexts;
2. Examined health outcomes, determinants of health, pathways and/or feedback loops;
3. Were based on empirical research (quantitative, qualitative or mixed methods) or were review articles with clear methodological approaches;
4. Were published in peer-reviewed journals. Significant books and book chapters were also included, as well as key documents from the grey literature (explained in subsection 2.2.);
5. Published in English (the issue of language is explained in subsection 2.7.);
6. Were published during the last 10 years (with some exceptions, noted in subsection 2.7.).

Studies were excluded if they:

1. Focused exclusively on rural populations;
2. Lacked a clear connection to health outcomes, determinants, pathways and/or feedback loops;
3. Were editorials, commentaries or opinion pieces without empirical grounding.

2.4. STUDY SELECTION

All identified records were imported into a reference management system and duplicates were removed. The selection process was conducted in four stages: (1) title screening, (2) keywords screening, (3) abstract screening and (4) full-text review. At each stage, studies were assessed against the predefined eligibility criteria.

The study selection process followed the general principles of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework (Page et al., 2021). PRISMA was used to ensure transparency in the identification, screening, eligibility assessment and inclusion of studies, as well as in documenting the search strategy and study selection process. With the caveat that, unlike a full systematic review, this study did not aim to identify every possible eligible publication or undertake formal risk-of-bias assessment. Instead, it combined systematic and transparent search and selection procedures with the flexibility appropriate for an interdisciplinary narrative synthesis (Grant & Booth, 2009).

2.5. DATA EXTRACTION

Data were extracted using a structured template developed for this Research Note. Extracted information included bibliographic details (author, year, country), study characteristics (design, population), type of settlement and key findings.

In addition, studies were coded according to:

- Categories of health determinants;
- Types of health outcomes (communicable diseases, non-communicable diseases, maternal and child health, mental health and injuries);
- Reported or inferred pathways linking determinants to health outcomes; and/or
- Feedback loops.

2.6. DATA SYNTHESIS AND ANALYSIS

A thematic synthesis approach was used to analyze the extracted data. Studies were grouped according to determinant categories, pathways and health outcomes. Coding and thematic classification were undertaken manually using structured data extraction tables rather than dedicated qualitative analysis software. Given the scope and objectives of this systematized review, manual coding provided sufficient transparency and consistency for the synthesis of the evidence.

Particular attention was given to identifying pathways linking determinants to health outcomes, including direct, indirect and interacting mechanisms. Feedback loops were also analysed. These relationships were used to develop an integrative conceptual framework capturing the multi-dimensional nature of health in informal settlements.

2.7. LIMITATIONS OF THE APPROACH

The review was based on English-language literature. This reflects both practical constraints and the dominant role of English as the principal language of international scientific communication. Most leading journals in public health, urban studies, environmental sciences and related fields publish in English. This limitation should therefore be acknowledged, while recognizing that the search strategy was designed to capture the majority of internationally visible and frequently cited scholarship on health in informal settlements.

The reliance on peer-reviewed literature may underrepresent grey literature (e.g. policy reports) as well as books and book chapters. The rationale was that peer-review is an important filter regarding the quality of a paper. Academic books (including book chapters) many times do not go through a peer-review process - although there are also many cases in which publishers do request technical opinions on a book and its chapters. Grey literature, by definition, does not go through an academic filter, as the publications do not necessarily have a scientific objective, but aim to pass a given political position or/and to give prominence to and raise awareness about a given issue. As noted in subsection 2.2., the Research Note also included selected books and book chapters which obtained relevance in the literature, and was supplemented with a selected number of grey literature publications. Yet only a limited number of such publications was included.

The Research Note gave priority to what has been published during the last 10 years. This reflects a practical constraint, given the size of the literature. At the same time, in the main fields covered by the Note, a more recent publication builds upon previous ones and so on. The recent literature on urban health - and specifically in informal settlements - brings on board what has been produced in the last decades of the 20th. century and in the previous decades of the 21st. century. At the same time, the Research Note also encompasses selected publications from previous decades.

Variations in definitions of informal settlements across studies may affect comparability. Finally, the predominance of cross-sectional studies in the literature limits the ability to infer causal relationships. Despite these limitations, the structured and transparent approach adopted in this Note enhances the reproducibility of the findings.

3. DETERMINANTS OF HEALTH AND PATHWAYS

A determinant is a condition, characteristic or contextual factor that influences the probability of health outcomes by shaping individuals' or populations' exposure to risks, access to health-promoting resources and capacity to respond to adverse conditions (e.g. water, sanitation and hygiene (WASH), housing, income, governance, climate). Those determinants influence health through pathways (e.g., overcrowding, poor ventilation, contaminated water, psychosocial stress, food insecurity, barriers to care). At the same time, health systems constitute mediating mechanisms which intervene along those pathways. They do not constitute another determinant of health in the same sense as housing or poverty. Rather, they modify the effects of the pathways by preventing, detecting, treating, mitigating - or not - health outcomes.

The Research Note argues that the determinants and pathways of health in informal settlements should not be understood as independent categories but as interconnected components of broader urban systems that collectively shape health outcomes. The section includes environmental, economic, social and governance determinants and pathways (subsections 4.1. to 4.4.). Although they are presented separately for analytical clarity, they are closely interconnected and collectively influence patterns of health and disease. Health systems are presented in subsection 4.5. as mediating mechanisms.

3.1. ENVIRONMENTAL DETERMINANTS AND PATHWAYS

Environmental determinants operate through multiple and often interconnected pathways. Rather than acting independently, these pathways frequently reinforce one another, generating cumulative health risks that affect different types of diseases (Ezeh et al., 2017; Lilford et al., 2017; Grant et al., 2025).

3.1.1. Water, Sanitation and Waste Management

Access to safe water, adequate sanitation, drainage systems and effective waste management represents one of the most important environmental determinants of health in informal settlements. Deficiencies in these services influence health through multiple pathways, including contamination of drinking water, inadequate disposal of human waste, environmental pollution and proliferation of disease vectors, thereby increasing the transmission of diarrhoeal diseases, cholera, typhoid fever, intestinal parasites and other infectious diseases (Abdulahadi et al., 2024; Corburn & Karanja, 2016; Lilford et al., 2017). Beyond infectious diseases, inadequate WASH (water, sanitation and hygiene) services also affect dignity, personal safety, educational participation, mental well-being and gender equity, particularly among women and girls who frequently assume responsibility for water collection and household sanitation (Akwara et al., 2023; Corburn & Karanja, 2016).

3.1.2. Housing Conditions and Indoor Environments

Overcrowding, poor ventilation, inadequate lighting, substandard construction materials and insufficient protection from climatic conditions create pathways that increase exposure to respiratory infections, indoor air pollution, heat stress and injuries (Sverdlik, 2011; WHO, 2022). These conditions contribute not only to infectious and chronic diseases but also to anxiety, chronic stress and reduced well-being, particularly among women, children and older adults (Grant et al., 2025; Weimann & Oni, 2019).

3.1.3. Settlement Morphology, Accessibility and Environmental Hazards

High residential densities, irregular street layouts, limited open space, poor accessibility and location in environmentally hazardous areas influence exposure to communicable diseases, environmental pollution, flooding, heat stress, injuries and barriers to emergency response and healthcare access (Acosta-España et al., 2024; Amoako & Inkoom, 2018; UN-Habitat, 2024). While high density may facilitate disease transmission and environmental exposure under conditions of inadequate infrastructure, it may also strengthen social interaction, mutual support, and access to economic opportunities, illustrating that its health implications depend on broader contextual conditions.

Climate change further amplifies many of these pathways. Rising temperatures, more frequent flooding and extreme weather events interact with existing deficits in housing, infrastructure and service provision, intensifying health risks among already vulnerable populations (Pereira et al., 2024; Romanello et al., 2021; Slovic et al., 2024).

In sum, although the aforementioned environmental determinants have been presented separately, they rarely operate in isolation. Poor drainage may contribute to flooding, which damages housing, contaminates water supplies, disrupts livelihoods, increases vector breeding and generates psychosocial stress. Likewise, poor housing quality may simultaneously increase indoor pollution, heat exposure, respiratory disease and mental health burdens. Environmental determinants therefore interact through multiple pathways that reinforce one another, underscoring the importance of integrated approaches to improving health in informal settlements.

3.2. ECONOMIC DETERMINANTS AND PATHWAYS

These determinants refer to the elements shaping individuals' and households' capacity to achieve health and well-being in informal settlements. They include income, employment, livelihoods, education, food security and material deprivation. Together, they influence health through multiple pathways, such as lack of financial means to access basic services and healthcare, nutritional status, inadequate schooling. Throughout this Research Note, economic determinants are distinguished from social determinants, which primarily concern social relationships, cohesion and collective processes. When the term *socioeconomic* is used, it refers to the interaction between these economic and social dimensions.

Poverty and material deprivation remain among the most pervasive determinants of health in informal settlements. Low and unstable incomes, limited assets and constrained access to adequate employment reduce households' capacity to secure decent housing, nutritious food, clean energy, healthcare and other resources essential for maintaining health (Alpaugh et al., 2024; Ezech et al., 2017; Sverdlik, 2011). Occupational exposures contribute directly to injuries and illness, while irregular earnings often undermine access to preventive healthcare and continuity of treatment for chronic conditions (Borg et al., 2021b; Comaru & Werna, 2013; Mercy Corps, 2021).

Food insecurity contributes to undernutrition, micronutrient deficiencies and adverse maternal and child health outcomes. In parallel, the growing availability of inexpensive ultra-processed foods has increased the prevalence of obesity, diabetes, hypertension and other non-communicable diseases, resulting in a double burden of malnutrition within many informal settlements (Crush & Caesar, 2014).

Limited educational opportunities reduce health literacy, constrain employment prospects and reinforce intergenerational cycles of poverty and poor health. These challenges may be exacerbated when children and adolescents enter the labour market prematurely, compromising both educational attainment and long-term health (Ezech et al., 2017; ILO, n.d.).

Beyond material deprivation, economic insecurity generates chronic psychosocial stress. Persistent uncertainty regarding employment, income, debt, housing, and daily survival can adversely affect mental health and increase the risk of cardiovascular disease, hypertension and other chronic conditions (Corburn & Riley, 2016). These economic pathways frequently interact with environmental hazards, social exclusion and barriers to healthcare, amplifying cumulative vulnerability.

Overall, economic determinants and their pathways shape health not only by influencing the distribution of material resources but also by conditioning households' capacity to anticipate, cope with, and recover from health risks. Their close interaction with other pathways further highlights the need for integrated policies that address the structural causes of urban health inequalities rather than their consequences alone.

3.3. SOCIAL DETERMINANTS AND PATHWAYS

Specially in contexts where formal institutions and public services are often weak or inaccessible, residents frequently rely on informal networks for childcare, financial assistance, information sharing, emotional support, and access to healthcare (Corburn & Karanja, 2016; Harpham, 2009; Heller, 2013; Sverdlik, 2011). These networks can strengthen resilience by helping households cope with environmental, economic, and health-related shocks.

Increasingly, the literature presents a more nuanced understanding of informal settlements, emphasizing not only vulnerability but also the importance of social capital, mutual aid, and community organization in supporting health and well-being (Chumo et al., 2023; Romanello et al., 2021). Community-based organizations, savings groups, women's associations and local advocacy initiatives have contributed to improvements in sanitation, housing, healthcare access and disaster preparedness in many settings (Corburn & Sverdlik, 2017). Although these forms of collective action cannot substitute for adequate public investment, they may partially compensate for institutional deficits and strengthen local adaptive capacity.

At the same time, overcrowding, insecurity and resource scarcity can intensify social tensions and exclusion, while gender inequalities continue to shape exposure to health risks and access to support. Women and girls frequently bear disproportionate responsibilities for caregiving, water collection, and household sanitation, while also facing elevated risks of gender-based violence, particularly where sanitation facilities are inadequate or unsafe (Corburn & Sverdlik, 2017; Winter et al., 2019). Violence, crime and insecurity contribute directly to injuries and mortality while generating chronic stress and anxiety (Torres Parra et al., 2024). Social stigma directed towards residents of informal settlements may further restrict access to employment, education, healthcare and political participation.

Migration status and social marginalization represent additional pathways through which social determinants influence health. Informal settlements frequently accommodate recent migrants, displaced populations, refugees and other socially marginalized groups who may lack secure legal status, stable social support networks or access to formal assistance (McMichael, 2023; Werna et al. 2024). These conditions may increase vulnerability while limiting access to healthcare and other essential services.

Overall, social determinants shape health through both vulnerability and resilience. They influence how individuals and communities experience, negotiate and respond to environmental, economic and political challenges, while also demonstrating that informal settlements should be understood not only as spaces of deprivation but also as socially dynamic environments characterized by collective agency and adaptive capacity. At the same time, these social processes remain embedded within broader institutional and governance structures. Community resilience often emerges in response to inadequate public services, insecure tenure and uneven state presence, highlighting the importance of examining governance as a further determinant of health.

3.4. GOVERNANCE DETERMINANTS AND PATHWAYS

These determinants comprise the institutional, legal, regulatory and political arrangements that shape living conditions, access to services, rights and opportunities in informal settlements. Despite growing recognition of their importance, the broader political economy of informality - including land markets, urban development regimes, power relations and cross-scale governance interactions - remains comparatively underexplored.

3.4.1. Institutional Exclusion and Unequal Service Provision

This pathway operates through the unequal provision of basic infrastructure and public services. Longstanding institutional exclusion often leaves informal settlements outside formal planning systems and public investment programmes, resulting in inadequate water supply, sanitation, drainage, waste management, transport, education and healthcare. These governance failures increase exposure to environmental hazards

while simultaneously limiting access to health-promoting resources (Corburn & Sverdlik, 2017; Ikiriko et al., 2022; Lilford et al., 2017; Snyder et al., 2014).

3.4.2. Land Tenure, Housing Policy and Legal Recognition

Insecure tenure and the absence of legal recognition discourage household investment in housing improvements, limit access to formal infrastructure and services, and expose residents to eviction and displacement. These conditions generate both material vulnerability and chronic psychosocial stress. Conversely, tenure regularization and inclusive upgrading programmes can improve housing quality, infrastructure provision and perceived security, producing important health benefits (Dachaga & de Vries, 2021; Subbaraman et al. 2012; UN-Habitat, 2024).

3.4.3. Urban Planning, Regulation and Institutional Capacity

Urban planning systems strongly influence health by determining where and how infrastructure is developed. In many cities, planning regulations fail to accommodate low-income urbanization, while fragmented or overlapping institutional responsibilities hinder effective service delivery. Governance failures therefore arise not only from institutional absence but also from regulatory complexity and weak coordination, particularly in rapidly growing informal settlements (Chigbu & Onyebueke, 2021; Ikiriko et al., 2022; Syal, 2025; Werna, 2000).

3.4.4. Participation and Accountability for Health Systems

Governance also affects health through the organization and accessibility of healthcare systems and through opportunities for community participation. Administrative barriers, discrimination, cost, limited service capacity and poor coordination may constrain access to prevention, diagnosis and treatment, particularly among marginalized populations. At the same time, participatory planning and community engagement can improve the responsiveness and legitimacy of health and upgrading interventions, although participation often remains uneven across different social groups (Corburn & Sverdlik, 2017; WHO, 2022).

3.4.5. Governance under Crisis Conditions

Recent research has highlighted how governance arrangements shape responses to health emergencies and climate-related hazards. During the COVID-19 pandemic, many informal settlement residents experienced uneven enforcement of public health measures, limited social protection and difficulties complying with containment measures because of overcrowding and inadequate services. Similarly, climate adaptation is frequently constrained by fragmented institutions, insufficient financing and weak intersectoral coordination, limiting the capacity of cities to reduce growing environmental health risks (Carmin et al., 2013; Laue et al., 2022; Matamanda et al., 2022; Werna et al. 2022).

3.5. HEALTH SYSTEMS AS MEDIATING MECHANISMS

Unlike the factors discussed in the preceding subsections, health systems are not treated here as primary determinants. Rather, they function as mediating mechanisms that can interrupt, mitigate, amplify or reproduce the pathways through which these determinants influence health outcomes. Access to appropriate healthcare can substantially reduce the health consequences of adverse living conditions. Lack of access may reinforce existing vulnerabilities. Health systems therefore occupy a distinctive position within the analytical framework of this report, serving as a critical interface between the broader determinants and the outcomes experienced by residents of informal settlements (WHO, 2022, 2023; Grant et al., 2025).

For example, inadequate housing, overcrowding and poor sanitation increase exposure to infectious diseases. Yet, accessible primary healthcare, vaccination programmes, disease surveillance and effective treatment can substantially reduce the resulting morbidity and mortality. Likewise, environmental hazards such as flooding, heatwaves and pollution generate health risks whose impacts depend partly on the capacity of health services to respond through prevention, emergency preparedness, continuity of care and rehabilitation.

Health systems should be understood as integral components of broader urban systems. Their effectiveness depends not only on healthcare infrastructure itself but also on transport, governance, financing, urban planning, community participation, and the broader social and environmental conditions within which services operate.

3.5.1. Access to healthcare

Despite considerable variation across countries, residents frequently experience multiple and overlapping barriers to healthcare, including financial constraints, geographic distance, inadequate transport, administrative requirements, limited service availability, discrimination and poor quality of care (Fotso et al., 2009; McNab et al., 2022; WHO, 2022). These barriers often delay healthcare seeking, interrupt treatment, reduce prevention and contribute to avoidable morbidity and mortality. Continuity of care frequently remains difficult because of unstable livelihoods, population mobility, fragmented referral systems and out-of-pocket costs associated with consultations, medicines and diagnostic services (WHO, 2023).

Healthcare accessibility extends beyond physical availability. Even where facilities are geographically accessible, residents may avoid formal healthcare because of previous experiences of discrimination, long waiting times, language barriers, opportunity costs associated with lost income, or lack of confidence in service quality (McNab et al., 2022; WHO, 2023). These findings highlight that health systems mediate not only clinical outcomes but also broader patterns of inequality by determining who can benefit from available services and under what conditions.

3.5.2. Pluralistic provision

Provision in informal settlements rarely depends on a single institutional provider. Instead, residents commonly navigate pluralistic healthcare systems composed of public facilities, private providers, pharmacies, non-governmental organisations, faith-based organisations, traditional healers, informal practitioners and community-based initiatives (Corburn et al., 2020; Weimann & Oni, 2019).

Public provision remains central to achieving equitable health outcomes because they generally provide the broadest population coverage and preventive services. However, shortages of personnel, medicines, equipment and financing often limit their effectiveness in informal settlements (WHO, 2023). Private providers frequently improve geographical accessibility and reduce waiting times but may remain financially inaccessible. Pharmacies and informal providers often constitute the first point of contact because they offer flexible access and immediate treatment, although concerns regarding diagnostic accuracy, inappropriate prescribing and continuity of care have been widely documented (McNab et al. 2022; Grant et al. 2025).

Rather than isolated sectors, they are interacting components of complex urban health systems. Residents frequently move between providers depending on illness severity, financial resources, perceived quality, accessibility and previous experiences.

3.5.3. Community-based healthcare and local capacity

Community-based healthcare performs a different function. Community organizations are also social institutions that mobilize trust, participation, local knowledge and collective action. They mediate health not only through service delivery but also through social organization and community agency. Particularly where formal health systems remain overstretched or inaccessible, these actors frequently facilitate health promotion, disease prevention, health education, referral, surveillance and continuity of care (Perry et al., 2014; Chumo et al., 2023).

The COVID-19 pandemic further highlighted the importance of community engagement in supporting public health responses within informal settlements (Corburn et al., 2020; Wilkinson, 2020). These experiences reinforce broader evidence discussed earlier in this report regarding the importance of community agency and social capital. Nevertheless, community initiatives cannot substitute for adequately funded public health systems or compensate indefinitely for structural deficiencies in infrastructure, governance and service provision.

4. INTERACTIONS AND HEALTH OUTCOMES

The previous section identified the principal determinants of health in informal settlements, their pathways and the mediation of healthcare provision. The present section identifies the interactions that occur between different determinants, the feedback mechanisms that may reproduce vulnerability, the major patterns of disease identified in the literature and the broader implications of these relationships for understanding health in contexts of urban informality.

4.1. INTERACTIONS, FEEDBACK LOOPS AND THE REPRODUCTION OF VULNERABILITY

While pathways help explain how determinants influence health outcomes, these processes are deeply interconnected. Health outcomes in informal settlements rarely result from single exposures or isolated determinants. Urban health is a complex adaptive system in which interacting determinants generate cumulative effects, reinforcing processes, and feedback loops that shape inequalities over time (Danielli et al., 2023; Diez Roux & Stankov, 2021; Mesa-Vieira et al., 2023). Building on these perspectives, the present Research Note synthesizes evidence that is often examined in isolation.

Poverty provides a clear example of interactions. Limited income may restrict access to adequate housing, nutritious food, healthcare, education, and basic services. Poor housing conditions may increase exposure to environmental hazards and infectious diseases, while inadequate healthcare access may exacerbate the consequences of illness. Similar interactions have been documented between environmental degradation, inadequate infrastructure, social exclusion, and recurrent disease burdens, illustrating how multiple disadvantages often accumulate within the same households and communities.

Interactions also occur across spatial and institutional scales. Household-level vulnerabilities are shaped by neighborhood conditions, while neighborhoods reflect broader patterns of urban planning, infrastructure provision, governance, and political economy. Flooding risks, for example, may depend simultaneously on local drainage conditions, settlement location, watershed management and regional climatic trends. Understanding these relationships therefore requires moving beyond linear models of causation toward more integrated perspectives on urban health.

A dimension increasingly emphasized in the literature is that the relationship between health and urban informality is not unidirectional. Poor living conditions contribute to adverse health outcomes, but poor health may also reinforce and reproduce the very conditions that generate vulnerability in the first place. These feedback loops help explain why health inequalities often persist over time and across generations, even where incremental improvements are introduced (Corburn & Riley, 2016).

Illness may reduce household income through lost employment opportunities, reduced productivity, increased caregiving burdens, and direct healthcare expenditures. In contexts characterized by precarious livelihoods and limited social protection, even temporary illness may generate significant economic disruption. Households may be forced to reduce food consumption, postpone healthcare seeking, withdraw children from school, or deplete productive assets (Brown et al. 2025; WHO, 2023).

Similar feedback processes operate across generations. Childhood malnutrition, recurrent infections and inadequate access to healthcare may impair physical and cognitive development, reduce educational attainment, and limit future employment opportunities. These effects may subsequently influence income, housing quality, healthcare access, and health outcomes in adulthood, contributing to the intergenerational reproduction of health inequalities (Huicho et al. 2020; McNab et al. 2022).

Feedback loops may also operate through environmental and infrastructural conditions. Recurrent flooding, inadequate drainage, poor sanitation and insecure housing can generate repeated cycles of disease, asset loss, environmental degradation, and reduced capacity for preventive investment. Climate-related hazards

may further intensify these processes by undermining livelihoods, damaging infrastructure, and increasing exposure to future risks (Borg et al. 2021a; Slovic et al. 2024).

There are also increasing accounts of feedback mechanisms involving mental health and social vulnerability. Chronic stress, insecurity, violence, uncertainty and repeated exposure to environmental hazards may contribute to anxiety, depression, and psychosocial distress. These conditions can affect educational performance, employment stability, social participation and healthcare utilization, thereby reinforcing broader forms of social and economic exclusion. (Abdi et al. 2021; Brearley et al., 2021).

Governance-related feedback constitutes another important mechanism. In many cities, informal settlements remain excluded from formal planning systems, infrastructure investment and public service provision because of insecure tenure, political marginalization or lack of official recognition. Limited investment contributes to poor living conditions and adverse health outcomes, which may in turn reinforce stigmatization and institutional neglect. Such processes help explain the persistence of spatial and social inequalities within urban areas (ARISE Consortium, 2024; Grant et al. 2025).

Interactions among determinants generate not only cumulative vulnerabilities but also adaptive responses, collective action, and localized forms of resilience. Community-based sanitation initiatives, informal drainage improvements, neighborhood organizations and mutual-aid networks illustrate how residents frequently mitigate risks despite limited formal support. Although these initiatives cannot substitute for public investment or structural reforms, they demonstrate that informal settlements are dynamic social systems rather than passive spaces of vulnerability. This perspective also reinforces the value of systems-oriented approaches, which seek to identify strategic interventions capable of generating positive effects across interconnected determinants and pathways.

4.2. HEALTH OUTCOMES

The pathways discussed before contribute to a broad range of health outcomes across informal settlements. While these outcomes are presented separately below, they frequently overlap and share common underlying determinants. The categories adopted here are intended primarily as an analytical device rather than as discrete or independent domains of health.

4.2.1. Communicable Diseases

Communicable diseases remain among the most extensively documented health outcomes associated with informal settlements. Numerous studies report elevated burdens of diarrheal diseases, acute respiratory infections, tuberculosis, vector-borne diseases and other infectious conditions (Ezeh et al., 2017; Lilford et al., 2017).

These outcomes are closely linked to the environmental pathways discussed previously, particularly inadequate water supply, poor sanitation, ineffective drainage, overcrowding and substandard housing conditions. High population densities may facilitate disease transmission, while deficiencies in healthcare access can delay diagnosis and treatment (Corburn et al., 2020). Although infectious diseases remain a major concern, important variations exist across regions, reflecting differences in epidemiological profiles, environmental conditions, infrastructure provision and healthcare systems.

4.2.2. Non-Communicable Diseases

Informal settlements face a growing burden of non-communicable diseases, including cardiovascular diseases, hypertension, diabetes, chronic respiratory conditions and certain cancers (WHO, 2022). These outcomes emerge through multiple pathways. Environmental exposures such as air pollution and heat stress contribute directly to disease risks, while poverty, food insecurity and limited access to healthy diets influence disease prevention and management. Rapid urbanization has also been associated with changes in dietary patterns and physical activity, contributing to the rising prevalence of obesity and metabolic disorders.

4.2.3. Maternal and Child Health

There are elevated risks of maternal mortality, infant mortality, childhood morbidity, undernutrition, stunting and developmental challenges in informal settlements compared with other urban populations (Danaei, 2016; Ezech et al., 2017; Heller, 2013; Huicho et al., 2020).

These outcomes reflect the combined influence of environmental exposures, nutritional conditions, healthcare access, economic constraints, gender inequalities and broader governance factors. Early-life exposures may generate long-term consequences extending into adulthood, reinforcing intergenerational cycles of disadvantage and ill-health.

4.2.4. Mental Health

Residents of informal settlements are disproportionately exposed to mental health stressors associated with poverty, insecurity, violence, discrimination, environmental hazards and uncertainty regarding housing and livelihoods (Weimann & Oni, 2019; Abdi et al., 2021).

Mental health outcomes include depression, anxiety, psychological distress, substance abuse and trauma-related conditions. They frequently interact with physical health conditions, creating complex patterns of vulnerability.

At the same time, studies increasingly highlight the importance of social networks, collective action, cultural practices and community support systems as sources of resilience that may help mitigate adverse mental health outcomes. Such findings challenge purely deficit-based interpretations of informal settlements and point to the importance of understanding both vulnerabilities and adaptive capacities.

4.2.5. Injuries

Injuries constitute a significant but often underappreciated component of the disease burden in informal settlements. Risks arise from unsafe housing, inadequate infrastructure, traffic hazards, occupational exposures, flooding, fires, landslides, other environment-related hazards as well as from violence. Climate-related events may further increase injury risks through extreme weather. Residents may experience a range of less frequently studied outcomes, including disabilities, chronic pain, sleep disorders, and other conditions linked to cumulative exposures (WHO, 2022).

4.3. MULTIPLE BURDENS OF DISEASE

The evidence analysed throughout Section 4 demonstrates that health outcomes in informal settlements are not produced through isolated determinants, singular pathways or independent categories of disease. Rather, they emerge through the interaction of multiple determinants operating simultaneously across different scales and through mechanisms that frequently reinforce one another.

A central theme in the literature is the persistence of a *double burden of disease*, whereby infectious diseases coexist with non-communicable diseases. This has been identified in the 1980s (e.g. Hapham et al. 1988) and from there on has continuously been highlighted. Recurrent infections, malnutrition, and environmental exposures may contribute to long-term physiological vulnerability, while chronic illnesses can increase susceptibility to infectious diseases and worsen health outcomes (Corburn et al., 2020).

The literature also increasingly highlights what could be termed a *multiple burden of disease*, in which infectious diseases and non-communicable diseases - the double burden - are compounded by other factors, such as violence-related, climate-related and environmental stressors (Borg et al., 2021a).

Recent scholarship emphasizes the importance of *cumulative vulnerability*. Health risks are often produced through the convergence of multiple disadvantages operating simultaneously. For example, households experiencing insecure tenure and precarious livelihoods may also face overcrowded housing, inadequate sanitation, flooding risk, food insecurity and barriers to healthcare access. These overlapping exposures magnify health impacts beyond the effects of any single determinant alone (Seraphim et al. 2025; Slovic et al. 2024).

Recognizing complexity does not imply that meaningful improvements depend only on simultaneous transformation of entire urban systems. While health outcomes are influenced by processes operating from household to global scales, there are numerous leverage points capable of generating substantial benefits, including investments in water and sanitation, housing improvements, flood mitigation, primary healthcare and social protection (Catanneo et al., 2009). Understanding interactions and feedback can therefore help identify strategic interventions capable of producing positive effects across multiple determinants simultaneously.

Taken together, the evidence reviewed in Section 4 suggests that health outcomes in informal settlements emerge through complex interactions. In parallel, there are important forms of resilience and adaptation that may partially mitigate adverse conditions (ARISE Consortium, 2024; Borg et al., 2021a; Chumo et al., 2023).

While the previous and current sections reveal a significant progress in understanding the determinants, pathways, interconnections, feedback loops and outcomes associated with health in informal settlements, there are ways to further expand such knowledge, as analysed in the next section.

5. FUTURE RESEARCH

Six interrelated priorities emerge from the analysis: (i) strengthening integrated and systems-oriented analyses; (ii) improving understanding of pathways, causal mechanisms, and feedback loops; (iii) expanding longitudinal and comparative research designs; (iv) addressing geographic and population-related blind spots; (v) strengthening research on climate change and governance; and (vi) promoting interdisciplinary, participatory, and policy-oriented approaches capable of informing action.

5.1. INTEGRATED APPROACHES AND SYSTEMS THINKING

Despite growing recognition that health outcomes in informal settlements are shaped by interacting determinants, many studies continue to examine specific determinants or health outcomes in relative isolation, limiting understanding of how vulnerabilities accumulate and interact across scales and over time (Corburn & Riley, 2016). Future research would benefit from more integrated approaches capable of examining interactions among determinants, pathways, and health outcomes within broader urban systems.

At the same time, an important conceptual challenge concerns the increasing emphasis on systemic approaches within urban health research. Contemporary frameworks increasingly highlight the influence of interconnected processes operating across local, urban, national and global scales. While such perspectives provide valuable insights into complexity and interdependence, they may also become difficult to operationalize if presented as the sole pathway for action. Future research would therefore benefit from exploring how systems thinking can be combined with the identification of strategic intervention points capable of generating meaningful health improvements within existing institutional, financial, and political constraints.

5.2. PATHWAYS, CAUSAL MECHANISMS AND FEEDBACK LOOPS

While associations between adverse living conditions and poor health are widely documented, comparatively fewer studies examine how environmental, economic, social, and governance-related factors operate through mediating processes such as food insecurity, psychosocial stress, mobility constraints, social exclusion, environmental exposures, or differential access to healthcare. Similarly, empirical research explicitly examining cumulative vulnerabilities, temporal dynamics and feedback loops remains relatively limited. Strengthening understanding of these processes would contribute to a more comprehensive explanation of how urban inequalities become biologically and socially embodied.

5.3. METHODOLOGICAL CHALLENGES

Methodological limitations remain equally important. Much of the evidence base continues to rely on cross-sectional study designs, which are valuable for identifying associations but provide limited insight into how vulnerabilities evolve over time, how households adapt to changing conditions, or how interventions influence long-term health trajectories (Lilford et al., 2017). Longitudinal, cohort-based and mixed-methods research remains comparatively scarce, particularly in low-income urban contexts. Greater investment in such approaches could improve understanding of cumulative exposure, intergenerational vulnerability, migration dynamics, and long-term environmental and climate-related health impacts.

5.4. GEOGRAPHIC AND POPULATION-RELATED FRONTIERS

There exist significant geographic imbalances. Research remains concentrated in selected countries and major metropolitan areas, while many rapidly urbanizing regions, secondary cities, intermediary urban centres, fragile states and conflict-affected contexts remain comparatively understudied. Comparative cross-city and cross-regional analyses are likewise relatively limited, constraining understanding of how different governance systems, urban policies, environmental conditions and health systems shape outcomes across diverse settings.

Important forms of social differentiation within informal settlements also remain insufficiently explored. Although women and children are relatively well represented in the literature, significant gaps persist regarding older adults, persons with disabilities, migrants, refugees, adolescents and gender-diverse populations (WHO, 2022). Future research should pay greater attention to how health risks, coping strategies, and access to resources vary among different groups within informal settlements.

5.5. CLIMATE CHANGE AND GOVERNANCE

The Research Note further highlights the growing importance of climate change and environmental instability as topics requiring sustained attention (Borg et al., 2021a; Demeterova, 2026; Twum & Abubakari, 2019). While deficiencies in infrastructure and service provision are widely documented, fewer studies explicitly examine how planning systems, land markets, zoning regulations, tenure insecurity, political exclusion and institutional fragmentation shape health outcomes. Important questions remain regarding adaptation strategies, displacement, infrastructure resilience and the cumulative health impacts of climate change in rapidly urbanizing environments. More integrated research linking climate science, urban planning, environmental governance and public health is therefore needed. Stronger engagement with urban political economy, planning scholarship and governance research could substantially deepen understanding of the structural production of health inequalities.

5.6. INTERDISCIPLINARY AND POLICY-ORIENTED RESEARCH

Finally, the Note argues about the importance of interdisciplinary and participatory approaches. Quantitative epidemiological studies remain essential, but they may not fully capture the lived experiences, coping strategies, perceptions and everyday negotiations through which residents manage health risks. Further participatory research, ethnographic approaches, spatial analysis and mixed-methods designs can therefore provide important complementary insights into the social production of health vulnerability.

There is also a need to strengthen connections between research, policy and practice. Despite growing evidence regarding health inequities in informal settlements, translation into integrated urban policy remains uneven. Future work should therefore place greater emphasis on actionable knowledge capable of informing urban planning, housing policy, climate adaptation, infrastructure investment, social protection and inclusive healthcare systems.

6. CONCLUSION & POLICY RECOMMENDATIONS

This Research Note set out to address the following research question: *What are the key determinants of health in informal settlements globally, how are they associated with health outcomes, and through what pathways do these relationships operate?*² To answer this question, the Note pursued three objectives: (i) to identify and synthesize the principal determinants of health in informal settlements; (ii) to examine the major health outcomes associated with these determinants; and (iii) to analyse the pathways linking determinants and outcomes, including interactions scales and the mediating role of health systems. A conclusion is that health outcomes in informal settlements cannot be adequately explained through isolated determinants or sector-specific perspectives alone. Instead, they are produced through interconnected pathways in which environmental exposures, economic insecurity, social inequalities, governance failures and healthcare access reinforce one another across time and scale. Understanding health in informal settlements consequently requires attention not only to individual risk factors but also to the broader systems through which vulnerability is generated, distributed and reproduced.

The Note highlighted the cumulative and interconnected nature of the process and demonstrated the value of examining it within a broader perspective. By identifying important conceptual, methodological, geographic and policy-related opportunities for research, the Note proposed an agenda intended to support more integrated scholarship as well as to inform future urban health policy and practice.

Particular importance should be attributed to the interactions, cumulative vulnerabilities and feedback loops. Poor health may simultaneously be a consequence and a driver of poverty, social exclusion, educational disadvantage, environmental degradation and reduced opportunities for social mobility. Such dynamics help explain the persistence of health inequalities across households, communities and generations. The Note also highlights the persistence of a double and increasingly multiple burden of disease, in which infectious diseases coexist with non-communicable diseases, mental health challenges and injuries. These overlapping burdens often interact and reinforce one another, generating complex patterns of vulnerability that are unevenly distributed.

The Research Note also presents important priorities for future research. Advancing knowledge on health in informal settlements will require more integrated and systems-oriented approaches. Stronger longitudinal and comparative research designs, greater attention to underrepresented populations and contexts, and deeper investigation of climate change and governance are all needed to strengthen the evidence base. Equally important is the development of interdisciplinary, participatory and policy-oriented research that generates actionable knowledge.

At the same time, the Note highlighted the importance of moving beyond exclusively deficit-oriented approaches to informal settlements. While the literature clearly documents severe inequalities and adverse health conditions, informal settlements are also sites of adaptation, innovation, social organization and resilience. While the present Note was not designed to systematically assess good practices or successful interventions, the evidence suggests that meaningful improvements are possible even under conditions of severe structural constraint. Future research would benefit from examining these experiences more systematically.

An additional contribution of this Note lies in its engagement with contemporary debates on systems approaches. The literature increasingly recognizes that health outcomes are influenced by processes operating from household to global scales. While such perspectives offer important insights into complexity and interdependence, they may become difficult to operationalize if interpreted as requiring the simultaneous transformation of all interacting systems before meaningful progress can occur. The findings suggest a more balanced position. Structural transformation remains essential for addressing the root causes of health inequities, yet substantial health gains may also be achieved through targeted and incremental interventions. Systems thinking and practical action should therefore be viewed as complementary rather than competing approaches.

6.1. POLICIES

The policy recommendations are organized according to main findings of the Research Note, related to: (i) how determinants interact (intersectoral action), (ii) climate as an emerging amplifier (climate-health integration); (iii) the importance of governance (institutional inclusion and urban citizenship); (iv) health systems as mediators of outcomes (coordination among providers) and (v) the agency of residents (participation and co-production).

First, policies confined to a single sector are unlikely to produce substantial or sustained improvements. More effective responses require greater coordination among the different topics including, *inter alia*, urban planning, housing, infrastructure provision, environmental management, social policy and health services.

Second, the evidence reviewed indicates that climate change is increasingly amplifying existing vulnerabilities. Policies aimed at improving health conditions in informal settlements should therefore incorporate climate resilience measures, while climate adaptation strategies should explicitly consider health outcomes and equity.

Third, many of the health vulnerabilities observed in informal settlements are linked not only to material deprivation but also to insecure tenure, exclusion from formal planning processes, unequal access to services, weak political representation and fragmented institutional responsibilities. Addressing health inequalities therefore requires policies which strengthen the governance arrangements through which infrastructure, services, rights and opportunities are distributed within cities.

Fourth, improving health outcomes depends not only on expanding services but also on policies which strengthen coordination among the different types of healthcare providers.

Finally, while recognizing the existence of publications on informal residents' agency, the Research Note highlighted that the literature privileged problems and challenges faced by informal settlements rather than their dynamism. Therefore, policies should recognize residents of informal settlements not merely as beneficiaries of interventions but as active participants in the production of healthier urban environments. Participatory and co-produced approaches are therefore likely to be more effective, equitable and context-sensitive than interventions designed without meaningful community involvement.

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