

ORIGINAL RESEARCH

“The system brought beauty to our community”: Evaluating the impact of a physical address system in Mathare informal settlement, Nairobi, through ripple effect mapping

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ABSTRACT

Introduction: Rapid urbanisation in Nairobi has led to the growth of informal settlements, characterised by overcrowding, poor infrastructure, and limited access to basic services. Often invisible in formal systems, these areas face weak accountability and restricted service access, worsening health and wellbeing. This paper evaluates the impact of a community-led Physical Address System (PAS) in improving visibility, access, and support for residents in the settlement of Kiamutisya in Mathare, Nairobi.

Methods: Drawing on community-led data collection, the PAS introduced a unique address for each physical structure in Kiamutisya to support service delivery and emergency response, addressing the invisibility that residents face. We held three Ripple Effect Mapping (REM) workshops with community leaders, community health promoters and Accountability and Responsiveness in Informal Settlements for Equity (ARISE) Hub co-researchers. REM is a participatory evaluation method that captures the impacts of an intervention, both intended and unintended, from the perspective of the community. Data was coded using NVivo 12 and analysed thematically.

Results: The PAS evaluation found direct impacts like better service delivery by community health promoters, and indirect benefits including stronger community identity, improved safety, and government engagement. It also noted ethical risks like data misuse and resident stigmatization. Key recommendations for policymakers and planners include using physical addresses to enhance service delivery and emergency response, formally integrating addresses into planning systems, and fostering community participation to improve equity in challenging urban environments.

Conclusions: This study underscores the potential of community health systems to address structural vulnerabilities and build resilience in informal settlements. The PAS demonstrates the value of participatory approaches in creating sustainable, scalable models for urban health, reinforcing the critical role of communities as active agents in advancing health and well-being.

Keywords: Urbanization, informal, settlement, address, community-led, participatory planning, equity, Kenya.

Abstract in Español at the end of the article

INTRODUCTION

Nairobi is one of the world's fastest-growing cities, with over 60% of the total population living in informal settlements [1, 2]. Informal settlement residents contribute significantly to Nairobi's economy and provide essential services to the city, such as, for example, construction workers, domestic workers or street vendors [3]. Informal settlements are marked by high population density and a severe lack of essential services, shaping their residents' vulnerability to poor health and well-being [4,5]. This vulnerability is amplified by other shocks and stressors. For example, the curfews imposed during the COVID-19 pandemic significantly reduced the income opportunities of informal settlement residents who often rely on low daily wage jobs in the informal sector [3,6,7].

Despite a significant portion of Nairobi's population living in informal settlements and providing important services to the city, they are not accounted for in official records and do not have a physical address. This renders informal settlements' residents invisible in formal government systems that regulate urban development and service delivery and limit their place-based claims to basic services, healthcare, land tenure and employment. This reflects broader urban power dynamics where informality is both a product and a perpetrator of inequity, often obscuring duty-bearers' obligations [1, 8, 9] and in contrast to Kenya's commitment to achieving universal health coverage, including equitable access to health services for all citizens [10].

Slum Dwellers International (SDI) is a global grassroots movement of urban informal settlement dwellers. In Kenya, SDI's efforts are channelled through Muungano wa Wanavijiji (henceforth Muungano), the national federation of slum dwellers, with professional and technical assistance from the non-governmental organisations Shack Dwellers International-Kenya (henceforth SDI-K) [11]. Together, they are a key partner in the Accountability and Responsiveness in Informal Settlements for Equity (ARISE) Hub, which adopted Community-Based Participatory Research (CBPR) to enhance accountability and improve the health and well-being of marginalised populations living in informal urban settlements [2, 12, 13]. In Nairobi, flexible funding available through ARISE was used to develop and implement a physical address system (PAS - see box 1) in Kiamutisya, a 'village' within the Mathare informal settlement, in response to identified community priorities. The objective of the PAS was to identify and recognise all households within Kiamutisya. Improving the visibility of households is a critical step to support service delivery and social protection [14]. The COVID-19 pandemic served as a catalyst for designing the PAS as difficulties in identifying vulnerable households led to inequitable aid distribution. This challenge prompted community leaders and stakeholders to develop and implement a PAS model that can easily identify vulnerable households, given that the local administration (chief, deputy

county commissioner) did not have the information to enable them to do so.

We sought to evaluate both the intended and unintended impacts of the PAS to provide recommendations for policymakers, urban planners, and community organisations working to improve equitable service provision in contexts facing similar challenges. We also aimed to assess the effectiveness of the PAS in enhancing access to essential services and to inform lessons for scaling up a community-led system for health.



Figure 1. Photo of the Kiamutisya physical address (Credit: SDI-K, 2021).

METHODS

Study site

Mathare informal settlement (Figure 2) is one of the largest informal settlements in Nairobi. Mathare Valley lies approximately six kilometres northeast of Nairobi's central business district. Mathare comprises 13 villages, including Kiamutisya, which this paper focuses on. According to Muungano's settlement profiling exercise [16], Mathare Valley has a population of approximately 210,000 people in which the Mathare River passes through the settlement and covers about 249.87 acres of land.

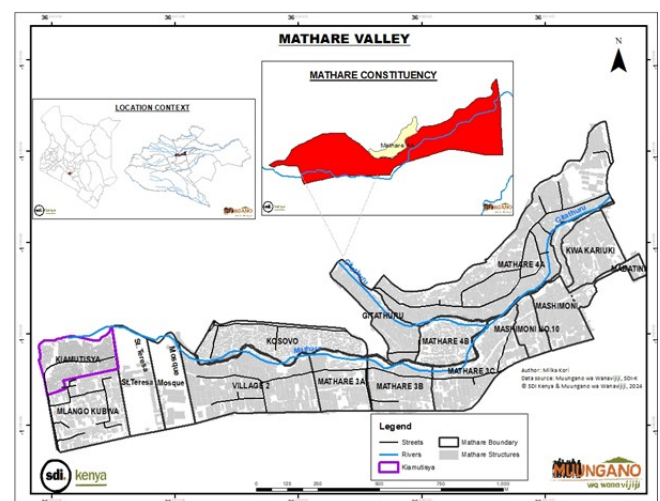


Figure 2. Map of Mathare (Kiamutisya in purple) (Credit: SDI-K, 2024).

Kiamutisya has a population of approximately 5,535 residents (according to data from SDI-K collected in

2021) [17] with an almost equal distribution of sex (2,792 female and 2,738 male residents). It has a young population with just over half (52.5%) of the population aged between 19-35 years. An estimated 7.1% of Kiamutisya's

residents are aged between 36-40 years; 4% are aged between 41-45 years; 2.5% are aged between 46-50 years and 1.6% are above 60 years [17].

Box 1. The Physical Address System (PAS).

The PAS provides accurate household-level data for a specific point in time and is rooted in data collected through a community-led mapping and enumeration process, an approach commonly used by SDI-affiliated federations. The enumeration incorporates the collection of data and information from every household in an area, rather than using a sample to establish baseline information about a given area. Enumeration complements community-led settlement profiling, which focuses on settlement history, land, services as well as details of households including income, size as well as sex and age composition. It also complements a participatory mapping process, which entails the development of detailed maps and spatial databases that represent the settlement's layout, including roads, buildings and infrastructure. These linked processes allow informal settlement residents to collect and use their data, building collective identity and skills to develop a collective understanding of their needs and represent these effectively when engaging, for example, government actors [14, 15]. Comprehensive mapping and enumeration are repeated every five years and are designed to be responsive to change and enabling the communities to update the PAS as their settlement changes. Community members living in Kiamutisya, including community leaders, ARISE co-researchers and Community Health Promoters (CHPs), were involved in the profiling, mapping and enumeration of the settlement and were trained by SDI-K to identify households, record household details and map physical structures using analogue and digitised maps. All structures were digitised using open-source materials such as Google Earth.

ARISE co-researchers and the SDI-K research team developed a unique coding system for physical addresses. Buildings were given a designation and addresses on coloured plates (Figure 1) were installed on each structure, with different colours being used for each structure aligning to the local planning guidelines. The plates were produced by Buildher, a social enterprise providing low-income women with construction training and job opportunities.

The PAS work was supported by a community engagement process through a tool dubbed Tujane Tujengane Mtaani (translated to 'let us know and build each other, in our settlement'). The tool brings individuals together through engaging clusters (i.e. approximately 100 households) in meetings where people get to know each other and discuss their needs and prioritise and address them using community-led data collection [14,15]. Comprehensive mapping and enumeration are repeated every five years in response, allowing for continuous adjustments that reflect new structures, relocations or other changes in the settlement. This process also allows for the PAS to be periodically updated as required.

Study design

We evaluated the PAS intervention using Ripple Effect Mapping (REM), a participatory method that brings stakeholders together in a facilitated session to identify and reflect on the 'ripple effects' that is, both the direct as well as the wider and indirect impacts of the PAS [18]. REM is a low-cost and community-led approach that, critically, highlights the impacts Kiamutisya residents consider important and centres their voices in defining what constitutes meaningful change [19].

The study team leading this evaluation comprised Muungano federation leaders, co-researchers, SDI-K staff and researchers as well as Liverpool School of Tropical Medicine (henceforth LSTM) researchers. The term 'co-researchers' in this context refers to individuals living and working in Kiamutisya and who were actively involved in the research process, including design, data collection, validation, analysis and dissemination. The REM workshops were guided by questions co-developed by SDI-K professionals, LSTM researchers and Muungano federation leaders (JO, EW, JW, MK, RS, NWG) (Appendix 1).

Recruitment, data collection and analysis

SDI-K professional (MK) and Muungano federation leaders (JO, EW) conducted three REM workshops (n=5-

7 per session), lasting 90 minutes each over two days in February 2024. Each of the three workshops engaged a distinct participant group: community leaders (including village elders), CHPs and ARISE co-researchers. This approach enabled data triangulation and allowed differing perspectives and experiences to emerge. All participants were identified through Muungano representatives and at the time of the REM exercise were living in Kiamutisya.

MK and JO recorded and transcribed verbatim each session and translated from Swahili into English. Translations were checked for quality by the SDI-K team. During the workshops the impacts of the PAS were drawn on paper with the participants narrating the impacts. Photos of the maps were then digitised by the SDI-K team. MK, NWG, RS, JW read the transcripts to develop a coding framework to categorise and organise the data into themes and observe recurring patterns. MK and NWG coded the data using NVivo 12 and collectively identified key themes from the data aligned with the thematic analysis. MK, JO, EW co-validated themes with co-researchers and checked the authors' interpretations against other discussions. This validation included an ARISE synthesis workshop, which took place in Nairobi in November 2023, where ARISE researchers, community researchers and key governance

actors came together to discuss and agree on ARISE key activities, highlights and messages [12].

Ethical considerations

The study obtained ethical approval from the LSTM Research Ethics Committee (21-074) and the AMREF Health Africa Ethics and Scientific Review Committee (P747-2019).

All participants provided informed consent. As a community-based organisation, Muungano is embedded within the community, fostering deep connections that aid in collecting and verifying information. To protect participants' privacy and confidentiality, all data was anonymised and securely stored on password-protected computers. Each participant was assigned a pseudonym, which is used throughout this paper. We also adopt Muungano's age classification, referring to participants aged 18–35 as 'younger' and those over 35 as 'older'.

As part of the wider ARISE Hub work, the research team received comprehensive training on safeguarding. The safeguarding training included how to identify potential safeguarding risks in the community, like disclosing information about the undocumented residents or instances of exploitation. The training also covered how to handle risks as well as how to ensure confidentiality in data collection. ARISE has extensively contributed to the development of institutional safeguarding guidelines and practices, which were adopted during the REM exercise [20–22].

This analysis is anchored in the perspective of professionals and researchers from SDI-K and LSTM, as well as Muungano federation leaders. We, the authors, recognise the influence of our distinct backgrounds and privileges as federation leaders, academic researchers and community development professionals on the study's design, data interpretation and conclusions. To acknowledge and mitigate potential impacts on the findings and ensure the integrity of the study, we involved community members in the study design, analysis and validation guided by CBPR principles.

RESULTS

The co-analysis identified three key themes the PAS in Kiamutisya contributed to: service delivery, safety and security as well as community relationships and agency.

Service delivery

CHPs provide critical basic health services in informal settlements including health education, training on disease prevention and treatment as well as offering specialised health service referrals. Due to a range of factors, including a transient population, evictions and incremental structural changes it often remains difficult for the CHPs to keep an accurate record of households. A critical outcome of the PAS was its ability to support efficient healthcare and emergency service delivery in Kiamutisya. CHPs reported that they were now able

to link their patient reports to household addresses, enabling better patient tracking, follow up and referrals as highlighted by two CHPs:

"The mapping helped me identify all my households because we have 100 houses each, at times you do not remember the number of some households but because of [the PAS], you will find 37B here then you know 37C is nearer instead of going round without finding it" (Naliaka, younger female CHP)

"The addresses are helping a lot as a CHP in my referral reports or if there is a person who has an emergency it will help know where they are." (Nafula, younger female CHP)

Moreover, the permanency of the address plates is helpful to their work as CHPs previously used chalk to mark-up houses to support linking to records, but this would be rubbed off. For example, one CHP stated,

"... these addresses cannot be destroyed unless there is fire" (Nekesa, younger female CHP)

The system also facilitated targeted health interventions, such as immunisation drives, by identifying clusters needing services. This ensured equitable distribution of care, particularly to vulnerable populations.

"When we are doing immunisations, we go in clusters where we find it easy to identify the clusters given and the ones that have not, which makes it easier to know where to start because the vaccinator does not know the area." (Nekesa, younger female CHP)

Several community leaders and CHPs emphasised the pivotal role of the PAS in emergency responses, especially in coordinating transport and services. By enabling CHPs to report exact geographical locations and the number of families affected, the local administration and aid organisations such as the Red Cross were able to streamline assistance and targeted emergency response, increasing the overall effectiveness of intervention efforts for vulnerable populations.

"We are mostly affected by fire in our area so we can easily identify the number of houses affected instead of guessing" (Odhis, older male community leader)

The ability to understand the spatial layout of Kiamutisya and give directions was helpful in terms of service delivery and simultaneously allowed residents to pay directly for services:

"Nowadays we call the gas suppliers to deliver them to our houses. We just pay using MPESA (a mobile payment system) and then direct them using the cluster number." (Kimani, older male community leader)

In addition to improving service delivery, community leaders reported that the PAS has helped them and CHPs to identify and locate the specific location of vulnerable people (such as people living with disabilities, older people, reformed youths and orphans) to enrol in the government cash transfer programmes or other social protection programmes. For example, if CHPs or residents identify children who are not enrolled in school, they can use the PAS to collaborate with social workers or local organisations, such as Missions of Hope, to prioritise access to education for children living in Kiamutisya.

"This [PAS] helped because we knew the number of children (within the village) that had done their primary exams in these clusters." (Odhis, older male community leader)

While the data collected as part of the PAS has already enhanced some delivery it has also been crucial for wider advocacy purposes by the resident and Muungano and may have future indirect impacts on service delivery in Mathare. This was described by a community leader as follows:

"The data is very important... we [are] required to have it in advocating for services... having the information about the number of people that live here makes work easier." (Musili, older male community leader)

Safety and security

Several community leaders felt that the PAS has the potential to help curb safety and security issues in Kiamutisya. For example, the system allows Kiamutisya residents to anonymously report suspicious and potentially criminal activity within the area using the house numbers. This generally was felt to increase safety and security by enabling Kiamutisya residents to report criminal activity without fear of reprisals.

"It helps in times when we have a criminal in the community, and we want to expose them without being identified." (Mwenda, male community leader in her 30s)

Another community leader highlighted that the PAS assists in identifying the locations of criminal incidents as well as perpetrators and victims.

"About the safety issue, we had a case last year in December where a young man took a girl and hid her, the parents looked all over for her and even posted on social media platforms, but people saw her and the people around used the number plates to give them out because the houses had them and she was found there." (Kimani, older male community leader)

One CHP further highlighted the potential of the system to support victims of crime if appropriately linked with the police. The example also highlights the need to ensure that the addresses are periodically updated, as structures are often subject to change due to fires and other disasters.

"There was a woman who gave birth in the house and the child was stolen, she reported it to the area chief ... I wanted to know which area that was so that we could track the baby... We tried to understand where the house was. If the physical address were there, we would have asked her to go back and identify the numbers there..." (Nafula, younger female CHP)

In contrast, co-researchers and community leaders reflected on the potential negative consequences of the PAS. They highlighted that those actively involved in designing and implementing the PAS might be blamed if criminal activities were identified, potentially putting co-researchers at risk of retaliation from criminals.

"For instance, if a criminal was being searched, they would claim we were giving them out to the police by giving the house number." (Halima, a younger female co-researcher)

This is linked to an initial hesitation by some residents to implement the PAS due to their concerns that it would enable others to report illicit activities. These concerns were reduced through dialogue between residents and community leaders.

"There were especially those that sell alcohol, they thought the police would be coming easily for them. Most of them developed a fear. They said it was easy to direct police officers to their households by giving out their household numbers." (Odhis, older male community leader)

Relationships, agency and social cohesion

Initial hesitations and concerns about dividing the community were mitigated through the involvement of Nyumba Kumi ('ten households') leaders who are part of the recommended government public participation structure. This structure aims to devolve community engagement through a basic unit of ten households led by village elders. ARISE co-researchers and community leaders facilitated dialogue through this structure during the PAS, strengthening relationships between Kiamutisya residents.

"During the number plate installation, some were refused and we would call the nyumba kumi, or one of us would try and convince them." (Njoroge, younger male co-researcher)

Residents also developed a sense of agency and unity through engagement with community leaders, joint problem-solving and a collective commitment to the PAS's success. The PAS process enhanced community cohesion and pride in their area and residents felt that it demonstrates their capabilities.

"We embraced the process because the system brought beauty to our community because such things were only happening in estates and not in slums, it was also a way to show the world that we are capable of doing it." (Awiti, older female community leader)

Community leaders also highlighted how the PAS allowed them to implement community-led accountability structures in relation to resource distribution. Previously, people would claim they were from the settlement to benefit from disaster relief and other support. The PAS provided a reliable way to confirm addresses and verify which households can access support.

"That is where we say they help a lot because before one would claim they lived there but now we use the numbers and one cannot forget they stay there... People used to fake living in that area so that they could benefit during disasters." (Awiti, older female community leader)

The ongoing precarious relationship between the community and government stakeholders was also highlighted. One co-researcher illustrated this by reporting that the PAS process, particularly the data collection to develop the system, uncovered and addressed relevant community issues, contrasting with government-led data collection processes.

"The difference with the government census is that they asked questions that did not make sense - they would ask how many chickens one had - but Muungano asked issues relating to the community (during the enumeration process). Muungano data identifies real issues like the need for water and toilets in these areas and one can advocate for the services from the government with such issues, this data can be used to bring changes in our community." (Esther, younger female co-researcher)

The importance of community-led work and support from organisations such as SDI-K in absence of external accountability structures to address local needs was highlighted by participants:

"The government does not support us fully because at times they do not come through for us, are the only ones who can hold our hands or help us get support from other organisations. We love [Muungano's] good work." (Wanjiku, older female CHP)

DISCUSSION

Summary of findings

While this PAS intervention was small in scale, our findings indicate that implementing a PAS may directly support community systems for health and social welfare in informal settlements. Among the benefits, it enhanced targeted healthcare delivery by enabling CHPs to reach residents more efficiently, improved the identification of vulnerable households for social protection services and supported emergency response efforts. Although some residents initially expressed hesitancy, the system fostered a sense of community pride and cohesion, with many respondents viewing it as a step toward improved 'beauty', safety and security. Overall, the PAS shows promise as a core element in building a wider functional community health system. However, ongoing attention to data protection to safeguard residents and avoid relationship breakdowns is required. The following discussion situates the findings of our study within the broader literature and examines their implications for improving health, wellbeing and accountability (Figure 3).

Support to the role of community health promoters

Many informal settlement residents face significant barriers to accessing primary care, especially when reliant on public facilities and paying out-of-pocket for healthcare [8]. These obstacles lead to adoption of coping strategies including reducing food intake or seeking care from unregulated private providers, which poses significant risks to their health and wellbeing [23]. For example, the Mathare profiling report by SDI-K [16] found that about 40 of 51 surveyed facilities within the settlement are privately run, with several of them run by informal providers which provide cheap and quick access to healthcare yet do often not meet the standard expected from health care providers. Primary healthcare delivery in informal settlements heavily relies on CHPs who serve as an essential link between communities and the local health system [24-26]. Their essential role was highlighted during the COVID-19 pandemic where they played a key role in supporting infection prevention control, contact tracing and home-based care [27]. CHPs are the primary source for disseminating public health initiatives and programs critical to advancing Universal Health Coverage [28]. CHPs now receive a small stipend (approximately KSH 2,500) but recent evidence suggests that CHPs remain heavily burdened with roles and responsibilities and are often women working at the lower end of the health system hierarchy [29].

Our results indicate that alongside other supportive interventions such as remuneration, training and supportive supervision, the PAS could support CHPs in their roles and enhance the ability of CHPs to plan and effectively deliver public community health programmes. CHPs were able to accurately locate households, streamlining their ability to deliver services by conducting follow-ups and identifying vulnerable popu-

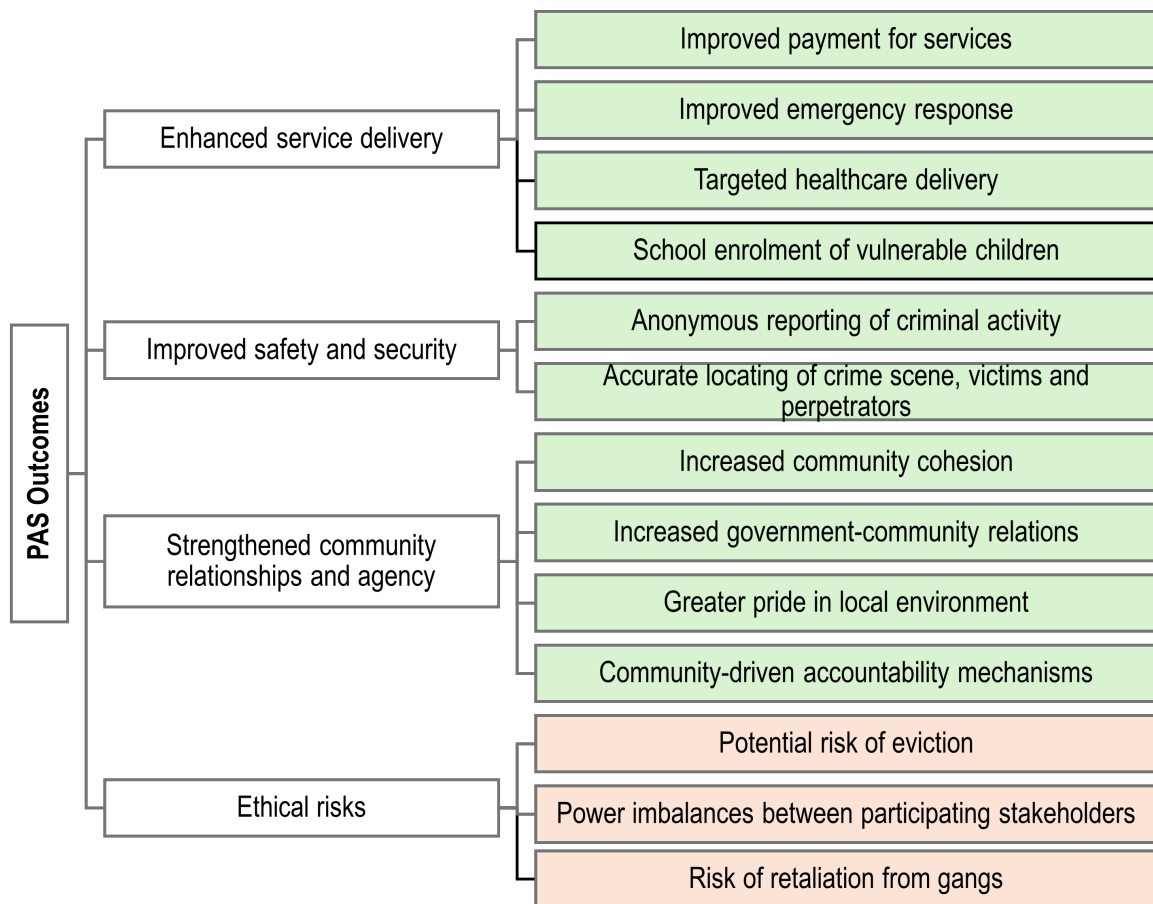


Figure 3. Summary of findings.

lations in need of care. Adequate linkages to affordable, quality healthcare beyond CHP level is also critical to support accountability for residents.

Supporting service delivery and enhancing visibility of vulnerable residents

The absence of formal addresses contributes towards the invisibility of informal settlement residents, minimising their claims to basic service provision. Many informal settlements lack coherent emergency planning [30, 31], which has wide-reaching impacts on their health and wellbeing [9]. Aid organisations and government agencies often struggle to identify and locate vulnerable households in such situations, leading to inefficiencies, inequitable assistance distribution and marginalisation of informal settlements [5]. In emergencies, including fires or floods, responders have used PAS to pinpoint affected areas, ensuring efficient resource allocation and reducing disaster impacts on vulnerable populations. For example, during the 2024 flooding in Mathare, the PAS proved critical in coordinating an effective response. CHPs were able to use the household addresses gathered through the PAS to give out the information to households and support SDI-K and other organisations' efforts in distributing food and essential items to those affected. Increased visibility, however, does not automatically ensure that resources and services are targeted to

vulnerable people, additional advocacy efforts and institutional linkages are required to promote sustainable provision of services and entitlements as highlighted in other ARISE work, including photovoice with child-headed households and CHPs [2, 12, 13].

Safety and security

As elaborated in the wider literature, many people living in informal settlements, particularly women, have experienced crime, which is often raised as a key concern [32-34]. This includes the many women who work as CHPs and who are at risk of sexual and gender-based violence while working in Nairobi's informal settlements [24]. With the communities having better understanding of the spatial layout of the settlement and visibility of households there is the potential for improved safety and security through improved policing services. Responding to criminality, including the tracking of perpetrators and victims, was reported by participants. Whether this may lead to improved safety depends on complex issues, including relationships with the police and the capacity of the police and legal system to deal with offenders effectively [35].

As reported in our results and the wider literature, it can be challenging to ensure transparent and accountable policing in the context of corruption and socio-economic dynamics that impact policing in informal set-

tlements [36]. Kiamutisya has a high number of youths who are often left out in community development initiatives and are highly profiled and targeted and profiled as criminals, making it hard to build trust between communities and law enforcement. By engaging the youths in community-led initiatives, there is a potential to improve community relationships and enhance trust, an important component of crime reduction as evidenced by wider SDI-K youth engagement activities [37].

Community systems for accountability

The PAS constitutes one of the multiple building blocks needed to integrate informal settlements within the wider socio-economic urban fabric. Having no address is not only about loss of access to services but also about identity, citizenship and dignity, as well as aspirations and a sense of belonging [38]. Physical addresses signify visibility and legitimacy, not only for individuals but for the whole settlement. The Universal Postal Union argues an address constitutes a basic human right [39]. The results show the PAS was perceived as bringing beauty to the settlement, demonstrating community visibility and, as such, proving a valuable asset in the transformation of place identity [40].

Many urban planning approaches are grounded in normative colonial-era theories and practices that fail to reflect the realities of rapidly growing and transforming cities, such as Nairobi, today [41]. In contrast, the PAS recognises and incorporates contextually grounded knowledge to inform local action which can contribute to efforts that address health equity [42] while providing evidence for dialogue and local interventions. By integrating the community-generated data, the PAS ensures that interventions are responsive to the needs of the informal settlement, making it more effective in addressing health disparities. The use of community-generated data enhances the credibility of the PAS allowing it to be recognised as a tool for community development by governance stakeholders [43]. It also responds to the transiency in informal settlements, as Kiamutisya residents can generate data periodically to keep the PAS updated.

Leveraging the PAS, including detailed cartographic information, is invaluable for practitioners and policy-makers in enabling evidence-based decision-making and strategy development. Many county government departments have been involved and consulted in the PAS such as the Department of Health within the Nairobi County government and the local administration (chief, deputy county commissioner). Despite ongoing deliberations, Mathare has not yet been formally designated as a Special Planning Area by the government, a status that would permit the suspension or modification of standard planning regulations to facilitate a more contextually appropriate planning approach. The evidence generated by the PAS has the potential to contribute to these efforts as evidenced by the case of Mukuru, another informal settlement in Nairobi where data col-

lected by SDI-K and Muungano supported dialogues with the government, NGOs and academics to identify priorities for in-situ upgrading [15, 44]. In Mathare, the PAS represents an upscaling of enumeration methodologies, refining and formalising them to enhance their impact on urban upgrading efforts. Further, the PAS has contributed to advocacy and dialogue with government stakeholders toward providing informal settlement dwellers with dignified and quality services. Knowledge exchanges between Muungano and other informal settlements in the SDI global network allow communities with similar challenges to learn and be able to adapt solutions to their local context [45].

Ethical risks

There are also ethical considerations related to minimising individual and collective risks for informal settlement residents related to access and use of data within communities that are active in the PAS. It is important to acknowledge the relative power of different interest holders and how this may shape risks to informal settlement residents. For example, household data could be used against people to evict them rather than providing the necessary services [46]. Additionally, stigma attached to the location may also impact residents in different ways, including their ability to access employment outside of their locality, perpetuating socio-economic marginalisation [47]. As such, it is essential to follow safeguarding principles in participatory research and development ensuring that these improvements are sustainable and do not reinforce marginalisation beyond the project line. The ARISE Hub developed a safeguarding policy and identified safeguarding leads, including one for SDI-K, who met quarterly to deliberate on emerging concerns and agree on addressing the safeguarding dilemmas [20-22] including how data is being shared and who holds that and ensuring that data access and use follow the set guidelines to protect the privacy and security of individuals.

Strengths and limitations

A key strength of our approach is the participatory evaluation, centring community voices. The method prioritises the impacts valued by the residents of Kiamutisya rather than those predetermined by external researchers. This approach aligns with CBPR principles that emphasise equitable partnerships that build on community strengths and resources for sustained action [48]. Further research at later time points may be required to demonstrate the full range of changes over time and the sustainability of the PAS. The study is focused on a single site, which limits the generalisability of findings to other informal settlements with different socio-economic, cultural, or environmental contexts. However, we provide a rich exploration of the PAS within a unique context in Nairobi.

Conclusion

The PAS, as a community-led information system, has the potential to increase the visibility and agency of communities, improve service delivery including health-care, increase safety and security and support community cohesion. The PAS, together with other community-generated data such as CHP-held patient records, has facilitated more inclusive responses to urban challenges in Nairobi. This underscores the importance of integrating informal settlements into urban planning frameworks. As cities like Nairobi continue to grow, developing inclusive strategies that address the needs of all residents, particularly those in informal settlements, becomes increasingly essential. The PAS represents a promising intervention that requires further implementation and evaluation at scale.

DECLARATIONS

Publication consent

Not applicable.

Competing interests

The authors report no conflicts of interest.

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Authors' contributions

RT, KJ, RS, JW, KJ acquired the funding for and supervised the ARISE project. MK, JK, JO, EW, JW conceptualised and implemented the PAS system. MK, NW, RS, JO, JW conceptualised the evaluation process and this paper. MK, JO, EW collected the data. MK, NWG and RS were responsible for data coding and analysis. MK, JO and EW validated the data. MK and NWG developed the first draft and all subsequent versions. All authors contributed to reviewing various drafts and approved the final manuscript. *The last two authors (RS, JW) contributed equally.*

Data availability

Not applicable.

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“El sistema aportó belleza a nuestra comunidad”: Evaluación del impacto de un sistema de direcciones físicas en el asentamiento informal de Mathare, Nairobi, mediante la cartografía del efecto dominó

RESUMEN

Introducción: La rápida urbanización en Nairobi ha impulsado el crecimiento de asentamientos informales, caracterizados por el hacinamiento, la infraestructura deficiente y el acceso limitado a servicios básicos. A menudo invisibles para los sistemas formales, estas zonas enfrentan una débil rendición de cuentas y restricciones en el acceso a servicios, lo que agrava los problemas de salud y bienestar. Este estudio evalúa el impacto de un Sistema de Direccionamiento Físico (PAS, por sus siglas en inglés) liderado por la comunidad para mejorar la visibilidad, el acceso y el apoyo a los residentes del asentamiento de Kiamutisya en Mathare, Nairobi.

Métodos: Basado en la recopilación de datos dirigida por la comunidad, el PAS asignó una dirección única a cada estructura física en Kiamutisya para facilitar la prestación de servicios y la respuesta ante emergencias, abordando así la invisibilidad que enfrentan los residentes. Se llevaron a cabo tres talleres de mapeo de efectos en cascada (REM, por sus siglas en inglés) con líderes comunitarios, promotores de salud comunitarios y co-investigadores del consorcio ARISE (Accountability and Responsiveness in Informal Settlements for Equity). REM es un método participativo de evaluación que capta los impactos de una intervención, tanto previstos como imprevistos, desde la perspectiva de la comunidad. Los datos fueron codificados con NVivo 12 y analizados temáticamente.

Resultados: La evaluación del PAS identificó impactos directos como la mejora en la prestación de servicios por parte de los promotores de salud comunitarios, así como beneficios indirectos que incluyen una identidad comunitaria más sólida, mayor seguridad y una interacción más activa con actores gubernamentales. También señaló riesgos éticos como el uso indebido de datos y la estigmatización de los residentes. Las recomendaciones clave para responsables de políticas y planificadores incluyen el uso de direcciones físicas para mejorar la prestación de servicios y la respuesta a emergencias, la integración formal de estas direcciones en los sistemas de planificación, y el fomento de la participación comunitaria para mejorar la equidad en entornos urbanos complejos.

Conclusiones: Este estudio destaca el potencial de los sistemas comunitarios de salud para abordar vulnerabilidades estructurales y fortalecer la resiliencia en asentamientos informales. El PAS demuestra el valor de los enfoques participativos en la creación de modelos sostenibles y escalables para la salud urbana, reforzando el papel fundamental de las comunidades como agentes activos en la promoción de la salud y el bienestar.

Palabras clave: Urbanización, informales, asentamientos, dirección, dirigido por la comunidad, planificación participativa, equidad, Kenia.

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