Real-Time Crowdsourcing of Health Data in a Low-Income Country: A Case Study of Human Data Supply on Malaria First-Line Treatment Policy Tracking in Nigeria

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Abstract

Malaria is one of the leading causes of high morbidity and mortality in Nigeria despite various policy interventions to frontally address the menace. While a national malaria policy agenda exists on the use of Artemisinin-based antimalarial as the first-line drug of choice for the treatment, there have been challenges in the implementation monitoring across various drug distribution layers, particularly the informal channels that dominate over eighty percent of the antimalarial drug distribution value chain. The lack of sustained policy monitoring through a structured and systematic surveillance system can encourage irrational drug usage, trigger antimalarial drug resistance, and worsen the disease burden in an economy where over ninety percent of the population live below the poverty line. We explored the use of real-time data collection through ordinary local residents, who leverages low-cost smartphones with an on-device app to run quick mystery shopping at drug outlets to check recommended malaria treatment drugs in four (4) states across the country. The instant survey data is collected via guided mystery shopping, which requires the volunteer participants to answer three basic questions after a 5 - 10 minutes in-store observation. Each submission is verified with the drug store picture and auto-generated location co-ordinates. The antimalarial policy compliance level is immediately determined and can be anonymously aggregated into a national map for onward sharing with pharmaceutical trade groups, government agencies and non-profits for immediate intervention via requisite stakeholder education. This crowd-sourcing effort provides an affordable option that can be scaled up to support healthcare surveillance and effective policy compliance tracking in developing nations, where there is a paucity of data as a result of high illiteracy and infrastructural inadequacy.

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1 Background

Malaria is responsible for three out of every five outpatient visits in Nigeria [1]. An average Nigerian adult experiences at least one episode yearly, while an average under-five year-old child records up to $3 - 5$ incidences annually [2]. On a broader measure, malaria infection represents 30% of hospitalisation cases in Nigeria as at 2016 while also constituting major cause of unintended pregnancy loss and maternal deaths annually. A recent government statistics indicate that malaria is responsible for as much as 11% of the total maternal mortality cases in the country [3,4]. This places Nigeria as one of countries with most worrisome burdens of malaria in the world, with as much as 97% of Nigeria's population being at the risk of malaria.

Nigeria updated its national first-line malaria treatment policy in 2005, which advocated for full the use of Artemisinin based Combination Therapies (ACTs) because of the widespread resistance to chloroquine. Two years after the policy kick-off, the nation's drug regulatory body stopped the registration of Artemisinin mono-therapies to safeguard the efficacy of ACTs. This has also been complemented with large-scale national awareness campaign and multi-sectoral stakeholder engagement under a holistic "Roll Back Malaria" program. The intervention is in alignment with the global initiative by the World Health Organization (WHO), which recommends the use of Artemisinin Combination Therapy (ACT), for uncomplicated malaria confirmed with either microscopy or rapid diagnostic test (RDT).

However, while there are evidence of significant funding by the Federal Government of Nigeria on mass education aimed to drive the policy message to the prescribers as well as the suppliers, the reality on ground indicates poor compliance.Independent researchers confirmed a significantly lower-than-average level of adherence to the national antimalarial drug policy, especially in the rural and semi-urban areas, where more than seventy percentage of the population lived [3].

The most evident explanation for this is the absence of a robust, inclusive and transparent surveillance system to monitor the implementation of the policy. This is further heightened by the lack of structures for drug distribution, regulation and control, especially in the informal sector where most drugs are sold in the country. The nature of access to centres for the treatment for malaria is another nightmare. The healthcare delivery channels are a diverse range of outlets, dominated by unregistered service channels like private hospitals, pharmacies, patent medicine dealers and roadside drug hawkers. These unregistered and informal channels represent as much as eighty percent in most states of the country [6].

Available studies suggest that fifteen years after the introduction of ACT policy as first line treatment, inappropriate prescription of antimalarial drugs persist, at both public and private health facilities across the country [6]. A study by [7] indicates that low compliance among local drug vendors in a Northern State (Jigawa) in respect of stocking and selling of first-line antimalarial. The research also indicates that more than 80% of the outlets visited were ignorant of and lacked training about new treatment guidelines. In the same vein, [8] revealed that out of a total of 110 informal drug retail shops engaged in an interview, as much as 43.1% were unaware of the government policy on malaria recommended first-line treatment.[9] indicated as much as 88% of non-compliance rate in recommended antimalarial sold through private drug stores, with further insights on how huge variation in pricing makes the cheaper brands of non-ACT the preferred option by the customers who self-medicate. The current situation portends a huge risk if not curtailed. This presents a huge national emergency, hence our proposal to explore easy, fast and affordable means for real-time surveillance to assess the levels of policy compliance across the country in order to drive for accountable and targeted policy enforcement.

2 Method

Crowdsourcing in healthcare delivery has been identified as an effective way for real-time insight gathering [10]. Its ability to offer complementary insights for public policy making for government and institutions have also been noted [11]. Varied use cases have been explored in advanced economies[12,14], with examples as simple as its use for price transparency tracking [13].

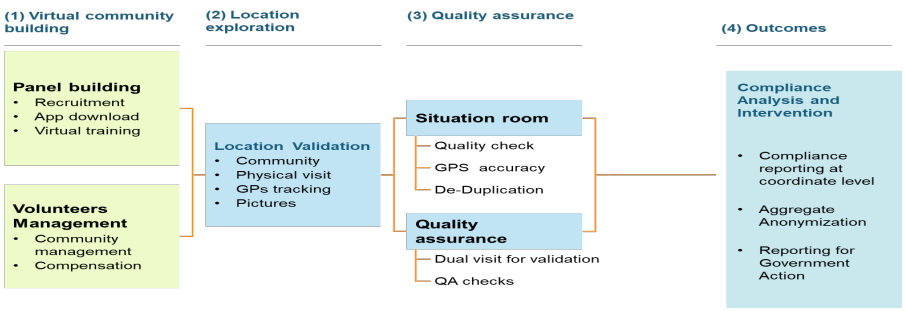

Figure 1: Crowdsourcing Delivery Methodology using DataCrowd App

2.1 Data Collection App

The proprietary data collection application,DataCrowd,is a simple Android-based survey tool designed to facilitate real-time data collection in the form of text, picture, video and sound. It has capacity for offline data capture and geo-fenced data collection capture that validates the physical presence of the volunteer data collector at the specified drug sales outlet.The volunteer data collectors belongs to a curated data collector community managed by the organization the authors work with.

2.2 Sampling

In Nigeria, informal drug sales outlets are part of a major pipeline where the populace seek health services. Both formal and informal drug sales outlets in four (4) states were used for the study based on the availability and nearness of volunteer data collectors. The approach was a basic convenient sampling, informed by the exploratory or pilot nature of the study to validate the appropriateness of the use of ordinary citizen in data collection on antimalarial drug policy tracking based on the on-the-spot antimalarial drug recommendation to an average walk-in customer. While we recognise the limitation of this sampling methodology and obvious lack of representation of population, it serves out intent to confirm the feasibility of the use of ordinary local residents as affordable data collectors.

2.3 Survey Instrument Design on Crowdsourcing App

Basic questionnaire that asks questions about the antimalarial drugs recommended in a mystery shopping exercise were filled into the app. The questions asked are Name of Premise, Type of drug sales outlets(Pharmacy or Patent and Medicine Vendor),Address of Premise,Name and picture of antimalarial drug recommended More than 93% of the survey responses were instantly received at the back-end tracking server within the 10 minutes of submission, accompanied with the coordinate's data of the location and the outlet pictures.

2.4 Quality Assurance

112 data collectors collected data from 217 retail outlets.All the the volunteer data collectors were trained via easy-to-comprehend, step-by-step, how-to-do-it videos[1] were exchanged via Telegram platform. These were followed with proofs of comprehension.The community of data collector consists of a mix of citizens, the criteria for selection is based on proficiency in use of mobile devices and ability to follow instruction. The participants in this survey were paid an equivalent of 1 dollar each for data subscription. A project situation room was created to track the quality of data submitted based on geo-tagged location coordinates and outlet picture matching using Google map extrapolation.

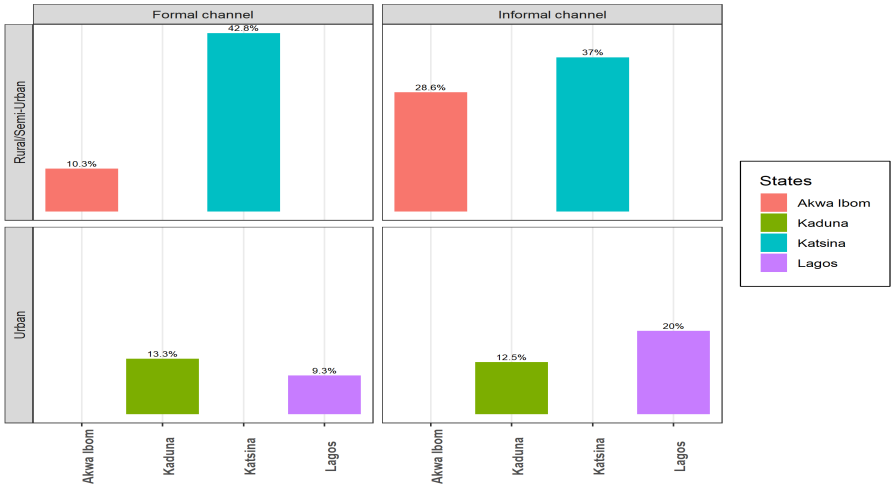

Figure 2: Percentage of Non Artemisinin(Non-ACT) Based Antimalarial Drug Recommendation by State

3 Result/Conclusion

Policy non-compliance level is defined by the proportion of respondents whose prescription patterns do not conform to the appropriate antimalarial drugs stipulated in the national antimalarial treatment guidelines with respect to the first drug of choice for complicated and uncomplicated malaria treatment.

In determining this percentage value, we have calculated the ratio of the sum of all the non-ACT recommendations made at the visited outlets measured against all the first-line anti-malaria recommendations made (ACT, non-ACT, other drugs like antibiotics recommended for malaria treatment) made by the prescribers during the period of study in percentage terms. The observed pattern of non-compliance ratio showed significant geographical peculiarities and channel variance (rural vs urban, formal vs informal).The purpose of split along geographical peculiarities is because there are more informal drug outlets serving the health needs of people in states with predominantly rural areas.The percentage compliance with the antimalarial first-line policy was significantly lower in informal outlets in rural states.

Our research, conducted within a 24-hour timeline in 217 retail outlets across 4 states in Nigeria confirm the feasibility and viability of crowdsourcing for instant, on-the-spot health policy implementation using ordinary residents with basic app-based solution.

This affordable approach can be scaled up with appropriate governance and stakeholder management framework to support health policy surveillance in developing country; as its simplicity and ease of deployment leapfrog existing infrastructural challenges and skill gap.

Broader Impact

This works presents a fast, cheap and alternative method to track implementation of health policies especially in low resource health systems where the budgetary allocation may not make room for such checks.One of the advantage of adopting this method of policy implementation tracking is that better and faster decisions about this type of data can be made without assumptions policy failure when it is simply a non implementation issue.

This project leveraged community relationships to access data from drug sales outlets. Drug sales outlets is only a subset of a larger healthcare ecosystem where policies are being implemented

[1]Link to sample virtual training content for crowdsourcing community `https://www.youtube.com/playlist?list=PL0mGkrTWmp4s1hs5mHpDUfz8y55UFCzSt`

References

[1] Ladi-Akinyemi, T. W., Amoran, O. E., Ogunyemi, A. O., Kanma-Okafor, O. J.,& Onajole, A. T.(2018). Knowledge and implementation of the National Malaria Control Programme among health-care workers in primary health-care centers in Ogun State, Nigeria. Journal of Clinical Sciences, 15(1), 48.

[2] Scott, N., Hussain, S. A., Martin-Hughes, R., Fowkes, F. J., Kerr, C. C., Pearson, R., ...& Wilson, D. P. (2017). Maximizing the impact of malaria funding through allocative efficiency: using the right interventions in the right locations. Malaria journal, 16(1), 1-14.

[3] Obiebi, I. P. (2019). Adherence to antimalarial drug policy among doctors in Delta State, Nigeria: implications for malaria control. Ghana Medical Journal, 53(2), 109-116.

[4] Etuk, E. U., Egua, M. A., & Muhammad, A. A. (2008). Prescription pattern of antimalarial drugs in children below 5 years in a tertiary health institution in Nigeria. Annals of African Medicine, 7(1), 24.

[5] Mangham-Jefferies, L., Hanson, K., Mbacham, W., Onwujekwe, O., & Wiseman, V. (2015). Mind the gap: knowledge and practice of providers treating uncomplicated malaria at public and mission health facilities, pharmacies and drug stores in Cameroon and Nigeria. Health Policy and Planning, 30(9), 1129-1141.

[6] Uzochukwu, B. S. C., Ossai, E. N., Okeke, C. C., Ndu, A. C., & Onwujekwe, O. E. (2018). Malaria knowledge and treatment practices in Enugu state, Nigeria: A qualitative study. International Journal of Health Policy and Management, 7(9), 859.

[7] Berendes, S., Adeyemi, O., Oladele, E. A., Oresanya, O. B., Okoh, F., & Valadez, J. J. (2012). Are patent medicine vendors effective agents in malaria control? Using lot quality assurance sampling to assess quality of practice in Jigawa, Nigeria. PLoS One, 7(9), e44775.

[8] Oladepo, O., Brieger, W., Adeoye, B., Lawal, B., & Peters, D. H. (2011). Awareness of anti-malarial policy and malaria treatment practices of patent medicine vendors in three Nigerian states. African journal of medicine and medical sciences, 40(4), 345-352.

[9] Oladepo, O., Brieger, W., Adeoye, B., Lawal, B., & Peters, D. H. (2011). Awareness of anti-malarial policy and malaria treatment practices of patent medicine vendors in three Nigerian states. African journal of medicine and medical sciences, 40(4), 345-352.

[10] Créquit, P., Mansouri, G., Benchoufi, M., Vivot, A., & Ravaud, P. (2018). Mapping of crowdsourcing in health: systematic review. Journal of medical Internet research, 20(5), e187.

[11] Meisel, Z. F., VonHoltz, L. A. H., & Merchant, R. M. (2016, March). Crowdsourcing healthcare costs: Opportunities and challenges for patient centered price transparency. In Healthcare (Vol. 4, No. 1, pp. 3-5). Elsevier.

[12] Brabham, D. C., Ribisl, K. M., Kirchner, T. R., & Bernhardt, J. M. (2014). Crowdsourcing applications for public health. American journal of preventive medicine, 46(2), 179-187.

[13] Meisel, Z. F., VonHoltz, L. A. H., & Merchant, R. M. (2016, March). Crowdsourcing healthcare costs: Opportunities and challenges for patient centered price transparency. In Healthcare (Vol. 4, No. 1, pp. 3-5). Elsevier.

[14] Wazny, K. (2018). Applications of crowdsourcing in health: an overview. Journal of global health, 8(1).