UON SORT IT- March 2024 Supplement
ROLE OF DATA QUALITY AND HEALTH WORKER CAPACITY IN AN ARTEFACTUAL INCREASE IN MALARIA INCIDENCE: AN INVESTIGATION OF CASES IN KWALE COUNTY, KENYA, 2021

Fredrick Ouma Odhiambo, Ministry of Health, Kenya, Clara Andala, Ministry of Health, Kenya, Paul Murima, Ministry of Health, Kenya, Geoffrey Githinji, Ministry of Health, Kenya, Elizabeth Chomba, Kwale County Department of Health Services, Kwale, Kenya, Fredrick Oluoch, Kisumu County Department of Health, Kisumu, Kenya, Tabitha Waweru, Ministry of Health, Kenya, Maurice Owiny, Ministry of Health, Kenya, Elvis Oyugi, Ministry of Health, Kenya, Regina Kandie, Ministry of Health, Kenya, Ahmeddin Omar, Ministry of Health, Kenya, Erolls Cheruiyot Sigei, Kenya Medical Training College (KMTC), Nairobi, Edward Mberu Kamau, Special Programme for Research and Training in Tropical Diseases (TDR), World Health Organization, Geneva, Switzerland, Rose Jepchumba Kosgei, University of Nairobi Department of Obstetrics and Gynaecology, Kenya, Anne-Beatrice Kihara, University of Nairobi Department of Obstetrics and Gynaecology, Kenya, International Federation of Gynecology and Obstetrics (FIGO), David Gathara, KEMRI Wellcome Research Programme, Nairobi, Kenya.

Corresponding author: Fredrick Ouma Odhiambo, Ministry of Health, Nairobi, Kenya. Email: fredouma12@gmail.com

ROLE OF DATA QUALITY AND HEALTH WORKER CAPACITY IN AN ARTEFACTUAL INCREASE IN MALARIA INCIDENCE: AN INVESTIGATION OF CASES IN KWALE COUNTY, KENYA, 2021

F. O. Odhiambo, C. Andala, P. Murima, G. Githinji, E. Chomba, F. Oluoch, T. Waweru, M. Owiny, E. Oyugi, R. Kandie, A. Omar, E. C. Sigei, E. M. Kamau, R. J. Kosgei, A. B. Kihara, and D. Gathara

ABSTRACT

***Objective*: To investigate the reported increase in malaria incidence in Kwale County, Kenya, in 2021.**
***Design*: Retrospective review of health facility records and key informant interviews.**
***Setting*: County and sub-county hospitals in Kwale County, Kenya.**
***Subjects*: Hospital records of suspected malaria cases managed in hospitals and healthcare workers in public hospitals in Kwale County.**
***Interventions*: Implementation of the test-and-treat guidelines for malaria.**
***Main outcome measures*: Data quality (timeliness, completeness, data accuracy, and overall system assessment).**
***Results*: Of the 17,607 suspected malaria cases identified in the study, 40.1% were children under five years, and 59.1% were females. Msambweni and Kinango hospitals used microscopy, while Kwale and Lunga Lunga hospitals also used rapid diagnostic tests (mRDTs) for diagnosis. Confirmed malaria cases were 1,633, peaking in February. The overall test positivity rate (TPR) was 9.3% (microscopy 9.2%, mRDT 19.5%). Kwale Hospital had the highest TPR (17.3%). The source documents completion rate was 42%, while monthly report timeliness was 58%. There was inadequate sensitization on revised surveillance**

tools, no written reporting guidelines, nor established malaria control targets in the study hospitals.
***Conclusion*: The apparent increase in incidence was due to poor data quality. The Ministry of Health should strengthen the dissemination of malaria policies and cascade capacity building on malaria surveillance and data management to all healthcare workers.**
Keywords: Kenya, Kwale, malaria incidence, data accuracy, Health worker capacity building.

BACKGROUND

Globally, over 229 million people were infected with malaria, and about 409,000 died in 2019 (1). With 67% of malaria fatalities globally in 2019, children under five are the most vulnerable to the disease (2). Malaria cases vary widely in terms of area of occurrence and time, which is contributed to by differences in *Plasmodium* species, among other factors (3). Kenya is a high-burden country with a malaria prevalence of 5.6% in 2020, 18% of outpatient consultations, and 20% of hospital admissions(4–6). *Plasmodium falciparum* accounts for 92% of all cases and results in the severest form of the disease (7). Kwale County is on the Kenyan Coast, which is classified as a malaria endemic zone where higher populations are at risk of malaria infection (7), with a prevalence of 4.5% in 2020 (5). Critical malaria control interventions used in the county include vector control (using long-lasting insecticidal nets), intermittent preventive therapy in pregnancy, diagnosis, and treatment, and social behavior change communication (7).

Malaria is among the leading causes of illness and death in Kwale County (8). Kwale County contributed one of the highest malaria positivity rates in the coast region, accounting for an average of 40% (9). The annual malaria incidence in the coast region increased from 86.3 per population in 2019 to 137.6 per 1000 population in 2020, equivalent to a 22.9% increase (10). The county reported a rise in confirmed malaria cases per 1000 population per year for 2020 at 256 from 161.6 for 2019 (9,11). According to the District Health Information System (DHIS2) data, there were 3.4 confirmed cases per 1000 in January 2021, followed by 18.9 per 1000 population in February 2021 (9). Routine surveillance data from health facilities indicated increased malaria incidence in February (9). A literature review of available data revealed scanty information on recent malaria surveillance in the county. The increased incidence and test positivity rate could have been an actual increase or artefactual. A true increase in incidence, if not contained, would lead to increased morbidity and mortality (12), with subsequent health system strain and socioeconomic consequences such as loss of school and work hours, reduced productivity, catastrophic use of personal and public resources (13), and wastage of the already scarce public resources (14).

The overall goal for the Division of National Malaria Program is to reduce malaria incidence and deaths by at least 75% of the 2016 levels by 2023 (7). The Kenya Malaria Strategy (2019 – 2023) seeks to improve malaria surveillance and the use of data for evidence-based decision-making (7). Successful control and reduction of malaria incidence and deaths depend on reliable surveillance, monitoring, and evaluation of systems put in place to generate high-quality data that can be relied upon. This would ultimately provide vital information that could be used to guide the development and implementation of various malaria control and prevention interventions. Therefore, we

sought to investigate the reported increase in malaria incidence in Kwale County.

METHODS

Study design and setting

The investigation was conducted in all four sub-counties in Kwale County, located on Kenya's southern coast (Figure 1). The county had a population of 866,820, with 441681 females and 425121 males as of 2019 (15). The county is classified in the coastal malaria-endemic region, which has a malaria prevalence of 4.5%. It has four sub-counties: Matuga, Msambweni, Lunga Lunga, and Kinango (16). The county has a tropical climate. Rainfall is bimodal, with short rains experienced from October to December, while long rains are experienced from March/April to July (8). The incidence of malaria increases during the long rainy seasons. The County has four government hospitals, eight health centers, and sixty-four dispensaries. The most common conditions recorded in the county's health facilities are malaria, diarrheal, flu, and respiratory diseases (8). Challenges in health services in the county are mainly attributed to inadequate human resources for health, high disease incidences of preventable diseases like malaria, and drugs and substance abuse (16).

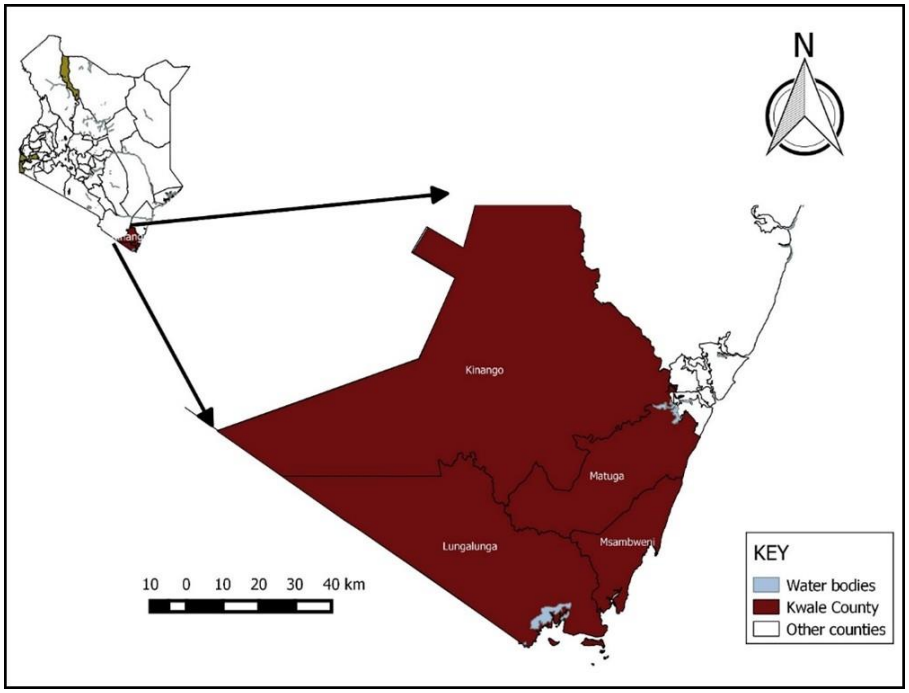

Figure 1: Map of Kenya showing Kwale County, 2021

Study population and sampling techniques

The investigation involved reviewing the laboratory registers of Kwale County's four public hospitals (Msambweni County Referral Hospital, Kwale Sub-County Hospital, Lunga Lunga Sub-County Hospital, and Kinango Sub-County Hospital). The study population consisted of health workers, public health officers, health facility in-charges, health records and information officers, laboratory officers, nursing officers, pharmacy staff, and clinicians who were interviewed to obtain data on capacity building, availability of relevant malaria policy documents, and perceptions on other aspects of malaria control interventions. The interviews were conducted using a structured questionnaire.

Data quality assessment (DQA) was also performed using an electronic tool for malaria data. Hospital records were reviewed, and data was abstracted from the laboratory register from the four public hospitals (Msambweni County Referral Hospital, Kwale Sub-County Hospital, Lunga Lunga Sub-County Hospital, and Kinango Sub-County Hospital) using the MS Excel spreadsheet abstraction tool. Different variables, including patients' demographic information (age and sex), clinical findings (date of hospital visit and type of diagnostic test used), and laboratory results were collected. We also compared the number of confirmed cases with the data from the previous five years on the District Health Information System (DHIS2) in full to check trends in malaria incidence.

Case definitions: A suspected malaria case was defined as any entry in the health facility records with fever and at least one of the following symptoms: headache, backache, chills, sweat, myalgia, nausea, and vomiting without laboratory confirmation. A confirmed malaria case was defined as any entry in the health facility records of fever and any of the following symptoms: headache, backache, chills, sweat, myalgia, nausea, and vomiting and had been confirmed by detection of malaria parasites in a blood smear through microscopy or detection of malaria parasite antigens through a rapid diagnostic test (mRDT).

Data collection methods and data quality control

Using a digital tool, the DQA was conducted in three level-4 hospitals (Kwale, Lunga Lunga, and Kinango Hospitals) and the one level-5 hospital (Msambweni County Referral Hospital). The data sources included the outpatient, laboratory, and pharmacy registers, monthly summary tools, and the DHIS2 Aggregate platform. The DQA tool consisted of standardized checklists that assessed malaria and program data in the following five different ways:

Evaluation of timeliness and completeness: The completeness of data elements and their data sources were assessed and quantified. Completeness of the monthly outpatient summary report sent by the health facility to the next level of reporting (sub-county was calculated by first determining the number of cells expected to be complete and the number completed (that is, filled in). Timeliness of submission of the monthly laboratory report was assessed by reviewing the previous three months (January to March 2021) reports to check if the reports were submitted by the deadline for reporting (5th day of the succeeding month). Data element completeness was also assessed; for each data element in the list, we reviewed the source document (laboratory register) for January to March 2021 and counted the number of entries for which the data element was missing (incomplete).

Reporting accuracy: A validated value for the number of confirmed cases in March 2021 in the laboratory register was compared with the value reported by the site for the same reporting period. The validated value of the indicator was determined by recounting the indicator using the laboratory register and the laboratory monthly summary.

Cross-checks: Data sources were compared to determine the consistency and reliability between data sources with the same or similar information to ensure that the data are accurately transcribed from the primary source document to the secondary source. This involved a comparison of data elements between a client service delivery register (outpatient register) and a register for service delivery support unit (laboratory register and malaria commodity daily activity register). A small sample of records (10 entries) was selected randomly to conduct the cross-check. After sampling the records, the two data sources were compared to check if the patients listed in the primary source document were also recorded in the secondary source document.

Consistency of reported data over time: Data from the laboratory monthly summary were compared for month-to-month consistency for January, February, and March 2021. To evaluate annual consistency and the plausibility of current results compared with historical precedents, data for March 2021 was compared with data for March 2020.

Data management and reporting system assessment: A checklist of best practices for producing good quality data was used to assess the availability of personnel to compile and verify reports, availability of guidelines, registers, and reporting forms, data storage, and displaying of relevant data. The investigators checked "yes" if the practice was evident or "no" if the specific practice was not evident at the facility. The responses were recorded and archived for comparison over time.

Variables of the study

The current study's independent variables were classified into characteristics of malaria cases and attributes of health workers. Characteristics of malaria cases included the age, sex, hospital where treatment was sought, the timeframe (month), and the type of malaria test done. Health worker attributes were cadre, years of experience managing malaria cases, challenges encountered, and knowledge of the 2015 Kenya Malaria Indicator Survey report, the national malaria treatment guidelines, and the Kenya Malaria Strategy (2019-2023). The dependent variables included data quality attributes, specifically completeness, timeliness, accuracy, consistency, and system attributes.

Data processing and analysis

Quantitative data from the abstracted records and key informant interviews: Frequencies and proportions were calculated for categorical variables. Measures of central tendency and measures of dispersion were calculated for continuous variables. Test positivity rates were calculated by dividing the number of confirmed cases by the number of suspected cases.

Qualitative data from the key informant interviews: These were analyzed by classifying them into themes and sub-themes. Responses were compared to establish similarities and differences.

Data Completeness and Timeliness: To evaluate the reporting completeness, the expected cells were calculated by counting the number of cells in the monthly outpatient summary report and subtracting those that the health facilities are generally not bound to fill. For source document (laboratory register) data element completeness, the number of entries with incomplete information (for the priority fields) was calculated by counting all entries in the source document with at least one field missing data and dividing by the total number of entries to get the proportion. For timeliness, the percentage of reports submitted by the deadline was calculated.

Assessment of reporting accuracy: The recounted (validated) value was divided by the reported value (from the monthly report) to derive the verification factor (VF). If there were discrepancies between the validated and the reported values, we determined the cause and recorded the appropriate code on the tool. The recounted value was also compared with the value for the period in the malaria report. A VF value of less than 0.9 (90%) or greater than 1.1 (110%) indicated data quality problems and were investigated.

Cross-checks: If there were discrepancies between the validated and the reported values, we determined the cause and recorded the appropriate code on the tool. The recounted value was also compared with the value for the period in the malaria report. A VF value of less than 0.9 (90%) or greater than 1.1 (110%) indicated data quality problems. They were investigated by comparing the figures and enquiring from the responsible health worker about the main reasons for the discrepancy.

Assessment of the consistency of reported data over time: The numerator was the number of cases in the period under review, and the

denominator was the number of cases in the comparison period (either the previous months or a similar period in the last year). A difference of greater than 20 percent (a consistency ratio of greater than 1.2 or less than 0.8) indicated a potential data quality problem. It was investigated by comparing the figures and enquiring about the main reasons for the discrepancy from the responsible health worker.

Data management and reporting system assessment: The proportions for the various responses were calculated and presented in a graph. The binary yes/no answers were for questions on the availability of dedicated staff who prepare reports, dedicated staff who verify reports before submission to the sub-county level, availability of written guidelines for reporting, availability of reserve stock of blank registers and reporting tools, access to patient's treatment history, availability of demographic data for catchment area and the facility, among other parameters for preparation for proper data management and reporting.

RESULTS

Sociodemographic characteristics

A total of 17,607 records of suspected cases were entered in the data abstraction tool from four hospitals, with 98.1% (17,266) being tested by microscopy. Of those tested by microscopy, 1633 tested positive for malaria, thus an overall test positivity rate (TPR) of 9.3%. The median age for the confirmed cases was ten years (interquartile range 3.0 to 21.5 years). Children under 5 contributed 38.1% (622) of the confirmed malaria cases, while individuals aged 60 or older contributed 4.0% (65). Females contributed 54.6% (892) cases (Table 1).

Table 1

Characteristics of confirmed malaria cases in public hospitals in Kwale County, January to April 2021

Characteristic	FREQUENCY **(N=1633)**	PERCENT %
Age Group		
< 5	622	38.1
5-14	360	22.0
15-24	313	19.2
25-34	135	8.3
35-59	129	7.9
≥60	65	4.0
(Not filled)	9	0.5
Sex		
Female	892	54.6
Male	741	45.4
Type of laboratory test done		
Microscopy	1567	96.0
Rapid diagnostic test	66	4.0

February had 5839 (39.6%) suspected cases, while January had 244 (1.7%). In February, 618 patients were confirmed positive (TPR 10.6%), while in January, confirmed TPR cases were 57 (23.36%). The epidemic curve for confirmed cases peaked around the week of 22nd February 2021 (Fig 1).

From January 2020 to April 2020, about 22722 suspected cases were tested for malaria in Kinango, Lunga Lunga, and Kwale Sub-County Hospitals, of whom 21.5% (4892)

were confirmed positive. In a similar period in 2021, 13,628 suspected cases were tested in the three hospitals, of which 9.0% (1,233) were confirmed positive. The confirmed cases in February were 985 in 2018, 696 in 2020, and 618 in 2021 (Fig 2).

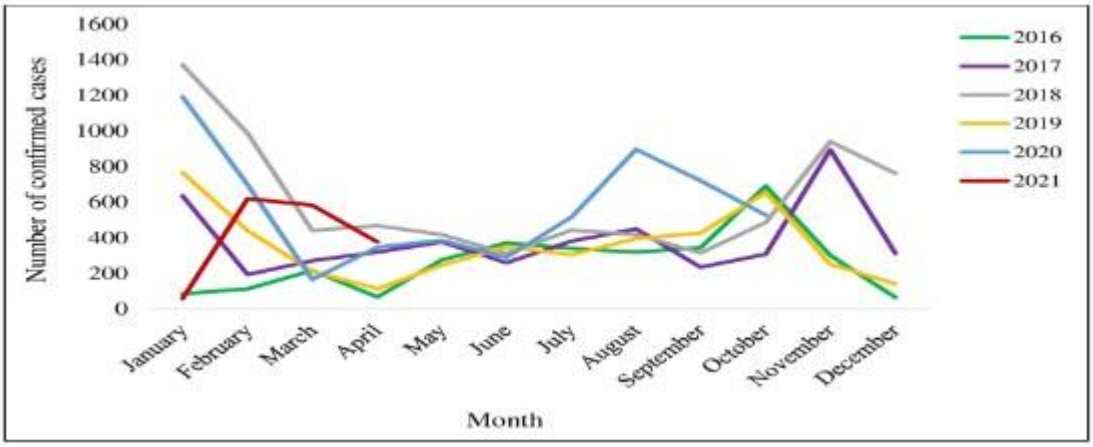

Figure 2: Trend of confirmed malaria cases in Kwale County, Kenya, 2016-2021

Microscopy was used to diagnose 98.1% of the cases. Kwale Sub-county Hospital contributed the highest number of confirmed cases (Table 2).

Table 2

Malaria diagnosis in public hospitals in Kwale County, Kenya, January-April 2021

HOSPITAL	SUSPECTED CASES (PERCENTAGE)	MICROSCOPY TESTS (PERCENTAGE)	RAPID TESTS (PERCENTAGE)	CONFIRMED CASES (PERCENTAGE)	TEST POSITIVITY RATE (%)
MSAMBWENI	3,979 (22.6)	3,979 (100.0)	0	400 (24.5)	10.1
KINANGO	5,290 (30.0)	5,290 (100.0)	0	329 (20.1)	7.1
KWALE	4,278 (24.3)	4,084 (95.5)	194 (4.5)	738 (45.2)	17.3
LUNGA LUNGA	4,060 (23.1)	3,913 (96.4)	147 (3.6)	166 (10.2)	4.3
TOTAL	17607	17,266 (98.1)	341 (1.9)	1633	9.3

Key informant interviews

We interviewed 44 healthcare workers in the relevant areas, with the clinical officers contributing 25% (11) of those interviewed (Table 3). All the key informants were aware of the registers used to capture malaria, and all the registers were available at the facilities, except for the revised weekly epidemic reporting tool. Health workers with over five years of experience in malaria service delivery accounted for 68.2% (30) of the interviewees. Approximately half of the respondents had not read the 5th edition of the national malaria treatment guidelines, while 70.5% (31) had yet to read the Kenya Malaria Strategy (2019-2023) document (Table 3).

One of the main challenges cited in the data capture in the registers was a lack of sensitization on the use of the revised tools since the tools had not been disseminated to the lower-level facilities at the sub-county, thus affecting the data captured. The other challenge was that the antenatal clinic and mother and child health clinic registers did not capture sufficient malaria data at these

service points. Due to a lack of sensitization regarding the use of revised tools, some segments of the registers were not easily understood, leading to less or missed data capture.

Table 3

Characteristics of the Kwale County healthcare workers interviewed, May 2021

Characteristics	Frequency (n=44)	Proportion %
Years of experience		
>5	30	68.2
3-5	12	27.2
1-3	1	2.3
<1	1	2.3
Had read the 2015 Kenya Malaria Indicator Survey		
No	31	70.5
Yes	13	29.5
Had read the 5th Edition Kenya Malaria Treatment Guidelines		
Yes	23	52.3
No	21	47.7
Had read the Kenya Malaria Strategy 2019-2023		
No	31	70.5
Yes	13	29.5
Cadre		
Clinical Officers	11	25.0
Nurses	9	20.5
Public Health Officers	6	13.6
HRIO*	6	13.6
Laboratory Officers	5	11.4
Data Clerk	4	9.1
Medical Doctors	1	2.3
Administrative Officer	1	2.3
Pharmaceutical Technologist	1	2.3

** HRIO = Health Records and Information Officers*

Data quality assessment

The monthly report completion rate was 99%, with 58% timeliness. Complete data was available in 58% of the sources (Fig 3). Outpatient registers were incompletely filled out, hindering the proper identification of suspected malaria cases in all the hospitals. Source documents were available and up to date in all facilities. However, only 81% of these were standard forms.

The verification factor was lower for DHIS2 data in two indicators – the number tested (0.34) and the number of confirmed malaria cases (0.25), indicating under-reporting of the indicator in DHIS2. This was higher for reports in the DHIS2 data for the number of patients receiving Artemether-Lumefantrine (AL, the first-line treatment for uncomplicated malaria) by weight band (1.33). Discrepancies in data captured in the registers and the reported summaries were identified in all the health facilities. Three (75%) facilities scored 61–70% in cross-checking laboratory registers and antimalarial medicines daily activity registers. Arithmetic errors and failure to

upload data on DHIS2 accounted for most discrepancies. The month-to-month consistency ratio was 1.51, while the annual consistency ratio was 0.66.

All the health facilities (100%) had dedicated health records, information officers, data clerks who compiled reports, and staff who reviewed monthly reports. They also had blank registers, reporting tools, accurate demographics, and adequately maintained archives. Three (75%) of the facilities had standard registers. Two (50%) of the facilities had experienced stock-outs of reporting forms in the previous three months. Patient history could only be traced in 2 (50%) facilities. There were no written reporting guidelines, established malaria control targets, or up-to-date disease incidence display in any health facility.

DISCUSSION

This study aimed to investigate the reported increase in malaria cases in Kwale County by assessing the quality of reported data and health worker capacities. An analysis of the health facility data revealed that children under five and women were the most affected by malaria, and most cases were diagnosed using microscopy. Furthermore, the reported increase in incidence was of a smaller magnitude compared to previous years and was, in actual sense, an artifact caused by poor data quality. A possible contributor to the poor data quality was gaps in health workers' capacity to manage suspected malaria cases and manage data.

Children aged under five years were the most affected by malaria in the county. The median age for the confirmed cases was similar to that observed in a similar investigation in Nigeria (17). Females were more affected than males, just as was seen from findings from malaria outbreak investigations in Ethiopia (18), Nigeria (17), and Zimbabwe (19). This could be because Kenya has slightly more females than males (15) or other factors such as individual behavior or social factors. An investigation in an endemic area in Senegal showed that prolonged exposure to the vector during routine activities that made individuals go to bed late was associated with an increased risk of infection (20). This implies a need to develop additional specific strategies for preventing malaria in children and women. Future studies should assess the feasibility of interventions such as intermittent preventive therapy in children and vector control methods such as indoor residual spraying that could reduce exposure to malaria parasites.

Despite a sharp rise in the number of reported cases in February 2021, there was no cause for alarm since the increased gradient resulted from the hospitals not being operational in January 2021, and the number of cases was lower than for a corresponding period in 2020. Microscopy was the diagnostic method of choice in the four hospitals. This could be because the four facilities are level 4 and 5 hospitals with medical laboratory technologists, microscopes, and a relatively reliable power source. Such health facilities were expected to use microscopy as the gold standard for malaria diagnosis. This appears to differ from the findings from a recent ecological analysis of data in high-volume facilities in endemic areas of Uganda, which found that a large majority of cases were diagnosed by mRDT (21). Whether by microscopy or mRDT, the diagnosis should be accurate to improve data quality and usefulness. A study in western Kenya concluded that health facility data on malaria was inaccurate due to misdiagnosis (22). This implies a need to cascade internal and external quality assurance of malaria diagnostics to all health facilities to improve the quality of results, hence improving malaria case management according to the national treatment guidelines.

Poor data quality noted in the facility was consistent with the findings from another study in a malaria-endemic area (23).

Incomplete filling of health facility registers and monthly summary reports can be attributed to the difficulty in filling the tools due to a lack of capacity building, as found in an ethnographic study in two malaria-endemic sub-counties in Kenya (24). This is also consistent with the findings of a survey of the micro-practices and processes that shape routine data quality (25). However, our findings differ from those of the study that blamed the data discrepancies on gaps in the definition of malaria indicators and the development of tools at the national level (25) and one that found that commodity stock-outs and staffing shortages were responsible for poor data quality (26). We noted that in our study area, internal factors such as late submission of monthly reports and arithmetic errors during the compilation of monthly reports were the most typical sources of discrepancies. This could be attributed to our study sites being relatively well-staffed hospitals. The National Malaria Control Program had just rolled out revised tools that captured data better than previous versions. Similarly, another study in the endemic areas in Kenya found that facilities in the coastal region did not submit reports consistently (27). The methods we employed entailed combining both quantitative and qualitative methodologies to assess data quality and considered data from different sources and usage levels as recommended by a review of DQA methods for public health information systems (28). This implies that there is a need for the county Department of Health Services to implement routine malaria data quality assessment and regular data review meetings. This will enhance proper data capture and ultimately improve the utility of data in decision-making.

Not all confirmed malaria cases found in the laboratory register were recorded in the outpatient register. A similar observation was made in a study on health facility-based surveillance using routine malaria data (25). The same study also found, as in our research, that more cases received treatment for uncomplicated malaria than the total number of confirmed cases. A study in Ethiopia concluded that, among other factors, proper monitoring and evaluation are essential for malaria control (18). This implies the need for capacity building in malaria surveillance to ensure the generation of reliable data for decision-making.

There was poor knowledge of malaria treatment and prevention objectives and strategies, and the indicators were poorly tracked in the health facilities. A study in Uganda showed similar results as far as the capacity building of health personnel in the management of malaria is concerned (29). Massive training of health personnel is critical for reducing malaria incidence (30). A quasi-experimental study in Kenya demonstrated the crucial role of capacity building in improving disease surveillance (31). Other studies emphasized the need for additional training in pursuit of malaria elimination (30,32) and to combine capacity building on managing infectious diseases and supportive supervision (24). This implies the need to disseminate various Ministry of Health policy documents widely. The national treatment guidelines and the Kenya Malaria Strategy (2019–2023) are policy documents that facility staff who offer malaria treatment and prevention services should be familiar with, and relevant indicators should be monitored at the health facility level. Health authorities should maintain a database for training and dissemination meetings to ensure all health personnel are capacity-built on the relevant malaria policies. Implementation of effective mentorship programs could also enhance information and skill-sharing among healthcare workers.

This study was not without limitations. Firstly, we did not collect data from lower-level facilities (health centers and dispensaries) and private health facilities. However, routine data obtained from the

Kenya Health Information System indicates that the hospitals from which data was abstracted account for most of the cases in the county. Secondly, the data obtained may not represent the county-wide malaria incidence in January when public health facilities were essentially not operational throughout the period under review. Nevertheless, the data analyzed gives a good summary of the business-as-usual scenario in the health facilities and hence can be used to identify systemic gaps in malaria case management and data management.

CONCLUSION

The weekly surveillance data for malaria in Kwale County depicted an unusual increase in cases. Still, upon investigation, the increase was found artefactual due to poor data quality. Many healthcare workers need an understanding of the critical malaria policy documents and need more capacity for malaria control and prevention interventions. Several data quality issues – including missing data in source documents, late submission of monthly reports, and variations in the reported number of confirmed malaria cases in the monthly summary compared to the source document – were noted in all four public hospitals in the county. All these could have led to a false increase in malaria incidence.

RECOMMENDATIONS

We recommend that the National Malaria Control Program works closely with the Kwale County Department of Health Services to develop the capacity of healthcare workers to conduct proper malaria surveillance and manage malaria cases according to the national guidelines. Further studies covering a representative sample of health facilities are needed to assess factors associated with poor malaria data quality.

REFERENCES

1. World Health Organization. World Malaria Report 2019 [Internet]. 2019. Available from: https://www.who.int/malaria/publications/world-malaria-report-2019/en/
2. World Health Organization. World Malaria Report 2020: 20 years of global progress and challenges [Internet]. Vol. WHO/HTM/GM, World Health. 2020. Available from: https://www.who.int/malaria/publications/world-malaria-report-2020/en/
3. Ogola EO, Odero JO, Mwangangi JM, Masiga DK, Tchouassi DP. Population genetics of Anopheles funestus, the African malaria vector, Kenya 06 Biological Sciences 0604 Genetics. Parasit Vectors. 2019;12(1):1–9.
4. Ministry of Health. National Malaria Control Program Website. 2019 [cited 2023 Mar 1]. p. 1 Kenya Malaria Fact Sheet. Available from: https://www.nmcp.or.ke/index.php/kenya-malaria-fact-sheet
5. Ministry of Health. Kenya Malaria Indicator Survey 2020: Key Indicator Report. Nairobi; 2020.
6. Ministry of Health. Kenya Malaria Strategy 2019-2023 [Internet]. Nairobi; 2019 [cited 2023 Mar 1]. Available from: http://www.nmcp.or.ke
7. Ministry of Health. Kenya Malaria Strategy 2019-2023 [Internet]. 2019 [cited 2023 Mar 1]. Available from: http://www.nmcp.or.ke
8. County Government of Kwale. Kwale County integrated development plan (2018 - 2022). 2018.
9. Ministry of Health. DHIS2. 2021 [cited 2021 May 12]. DHIS 2 Pivot Tables. Available from: https://hiskenya.org/dhis-web-pivot/
10. DHIS 2 Pivot Tables [Internet]. [cited 2021 Aug 12]. Available from: https://hiskenya.org/dhis-web-pivot/
11. Nyamu GW, Kihara JH, Oyugi EO, Omballa V, El-Busaidy H, Jeza VT. Prevalence and risk factors associated with asymptomatic Plasmodium falciparum infection and anemia among pregnant women at the first antenatal care visit: A hospital based cross-sectional study in Kwale County, Kenya. PLoS One [Internet]. 2020;15(10 October):1–14. Available from: http://dx.doi.org/10.1371/journal.pone.0239578

12. Chauhan I, Yasir M, Kumari M, Verma M. The Pursuit of Rational Drug Use: Understanding Factors and Interventions. Pharmaspire [Internet]. 2018;10(2):48–54. Available from: www.isfcppharmaspire.com
13. Barasa EW, Maina T, Ravishankar N. Assessing the impoverishing effects, and factors associated with the incidence of catastrophic health care payments in Kenya. Int J Equity Health. 2017;16(1):1–14.
14. O'Meara WP, Menya D, Laktabai J, Platt A, Saran I, Maffioli E, et al. Improving rational use of ACTs through diagnosis-dependent subsidies : Evidence from a cluster-randomized controlled trial in western Kenya. PLoS Med. 2018;15(7):1–24.
15. Kenya National Bureau of Statistics. 2019 Kenya Population and Housing Census Volume 1: Population by County and Sub-County [Internet]. Vol. I. 2019. Available from: https://www.knbs.or.ke/?wpdmpro=2019-kenya-population-and-housing-census-volume-i-population-by-county-and-sub-county
16. County Government of Kwale. Official Website of Kwale County Government [Internet]. 2021 [cited 2021 Apr 29]. Available from: https://kwalecountygov.com/kwale/#
17. Saleh JEA, Wondimagegnehu A, Mpazanje R, Ozor L, Abdullahi S. Investigation of a Suspected Malaria Outbreak in Sokoto State, Nigeria, 2016. OAlib. 2017;04(12):1–8.
18. Mitiku BD, Alemayehu BK, Taklu MM. Malaria outbreak and contracting factors in Afar Region, Ethiopia, 2016. J Public Health Epidemiol. 2018;10(7):233–40.
19. Kureya T, Ndaimani A, Mhlanga M. Malaria outbreak investigation in Chipinge, Zimbabwe: A case-control study. Iran J Parasitol. 2017;12(3):423–32.
20. Wotodjo AN, Diagne N, Gaudart J, Richard V, Raoult D, Sokhna C. Malaria risk factors in Dielmo, a Senegalese malaria-endemic village, between October and November of 2013: A case-control study. American Journal of Tropical Medicine and Hygiene. 2015;92(3):565–8.
21. Okiring J, Epstein A, Namuganga JF, Kamya V, Sserwanga A, Kapisi J, et al. Relationships between test positivity rate, total laboratory confirmed cases of malaria, and malaria incidence in high burden settings of Uganda: an ecological analysis. Malar J. 2021;20(1):1–11.
22. Afrane YA, Zhou G, Githeko AK, Yan G. Utility of Health Facility-based Malaria Data for Malaria Surveillance. PLoS One. 2013;8(2).
23. Manya A, Nielsen P. Reporting Practices and Data Quality in Health Information Systems in Developing Countries : An Exploratory Case Study in Kenya. J Health Inform Dev Ctries. 2016;10(1):114–26.
24. Mbonye MK, Burnett SM, Burua A, Colebunders R, Crozier I, Kinoti SN, et al. Effect of Integrated Capacity-Building Interventions on Malaria Case Management by Health Professionals in Uganda : A Mixed Design Study with Pre / Post and Cluster Randomized Trial Components. PLoS One. 2014;9(1).
25. Okello G, Molyneux S, Zakayo S, Gerrets R, Jones C. Producing routine malaria data : an exploration of the micro - practices and processes shaping routine malaria data quality in frontline health facilities in Kenya. Malar J [Internet]. 2019;1–13. Available from: https://doi.org/10.1186/s12936-019-3061-y
26. Okello G, Gerrets R, Zakayo S, Molyneux S, Jones C. " Every day they keep adding new tools but they don ' t take any away " : Producing indicators for intermittent preventive treatment for malaria in pregnancy (IPTp) from routine data in. PLoS One. 2018;1–14.
27. Maina JK, Macharia PM, Ouma PO, Snow RW, Okiro EA. Coverage of routine reporting on malaria parasitological testing in Kenya, 2015-2016. Glob Health Action. 2017;10(1):1413266.
28. Chen H, Hailey D, Wang N, Yu P. A Review of Data Quality Assessment Methods for Public Health Information Systems. Int J Environ Res Public Health. 2014;5170–207.
29. Kyabayinze DJ, Achan J, Nakanjako D, Mpeka B, Mawejje H, Mugizi R, et al. Parasite-based malaria diagnosis : Are Health Systems in Uganda equipped enough to implement the policy ? BMC Public Health. 2012;12(1):1.
30. Woyessa A, Hadis M, Kebede A. Human Resource Capacity to Effectively Implement Malaria Elimination: A Policy Brief for Ethiopia. Int J Technol Assess Health Care [Internet]. 2013 Apr [cited 2021 Aug 18];29(2):212–7. Available from: https://www.cambridge.org/core/journals/international-journal-of-technology-assessment-in-

health-care/article/abs/human-resource-capacity-to-effectively-implement-malaria-elimination-a-policy-brief-for-ethiopia/129E8684D045749DA8264134BDD6E5A6

31. Njeru I, Kareko D, Kisangau N, Langat D, Liku N, Owiso G, et al. Use of technology for public health surveillance reporting: Opportunities, challenges and lessons learnt from Kenya. BMC Public Health. 2020;20(1):1–11.

32. Boncy PJ, Adrien P, Lemoine JF, Existe A, Henry PJ, Raccurt C, et al. Malaria elimination in Haiti by the year 2020: an achievable goal? Malar J [Internet]. 2020;(2015):1–11. Available from: http://dx.doi.org/10.1186/s12936-015-0753-9