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Quality of Malaria Case Management and Reporting at Public Health Facilities in Six Health Districts in Guinea, 2018

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Abstract. Data on fever and malaria cases reported by health facilities are used for tracking incidence and quantification of malaria commodity needs in Guinea. Periodic assessments of the quality of malaria case management and routine data are a critical activity for the malaria program. In May–June 2018, survey teams visited 126 health facilities in six health districts purposefully selected to represent a spectrum (Stratum 1—high, Stratum 2—intermediate, and Stratum 3—low) of perceived quality of case management and reporting, as assessed from an a priori analysis of routine data. Surveyors performed exit interviews with 939 outpatients and compared results with registry data for interviewed patients. Availability of rapid diagnostic tests (RDTs) and artemisinin-based combination therapies (ACTs) was 100% in Strata 1 and 2, compared with 82% (95% CI: 63–92%) for RDTs and 86% (68–95%) for any formulation of ACT in Stratum 3. Correct case management for suspect malaria cases was 85% in both Stratum 1 (95% CI: 78–90%) and Stratum 2 (79–89%), but only 52% (37–67%) in Stratum 3. Concordance between exit interviews and registry entries for key malaria indicators was significantly higher in Strata 1 and 2 than in Stratum 3. Both adherence to national guidelines for testing and treatment and data quality were high in Strata 1 and 2, but substandard in Stratum 3. The survey results reflected the trends seen in the routine data, suggesting that analysis of routine data can identify areas requiring more attention to improve malaria case management and reporting.

INTRODUCTION

Malaria is a significant public health problem in Guinea and is the most common cause of hospitalization and death in the country.[1] It is endemic throughout the nation, varying from marked seasonal transmission in the central highlands to year-round, hyperendemic transmission in the forested southeast. In 2016, the national prevalence of malaria infection in children aged less than 5 years was measured by microscopy to be 14%,[2] down from 44% in 2012.[3] There were 992,146 incident cases of malaria registered in 2016, accounting for 31% of all health facility consultations.[4]

A key tenet of malaria control in Guinea is appropriate case management at health facilities.[5] National guidelines recommend malaria testing for all patients with fever or history of fever and treating only confirmed cases with antimalarials. Malaria rapid diagnostic tests (RDTs) are the most common diagnostic tool and are used at all levels of the public health sector, including by community health-care workers. Microscopy is restricted by national policy to hospitals and certain larger health centers. The Guinea National Malaria Control Program (NMCP) recommends oral artemether–lumefantrine (AL), a type of artemisinin-based combination therapy (ACT), for uncomplicated malaria. Artemether–lumefantrine dosing is weight based, and the drug is available in four formulations of increasing strength. For severe malaria, intravenous artesunate, intramuscular artemether, or intravenous quinine is recommended.[6]

Although care for febrile illness in children is not sought in most cases in Guinea, government-run facilities are the single largest source of care sought for febrile illness in children, measured at 26% in 2016.[2] Public health facilities are organized into three tiers: district- and national-level hospitals, located in large urban areas and offering specialist care; health centers, medium-sized facilities operating in towns; and health posts, small facilities with very basic care serving the hardest-to-reach communities. All public health facilities should be supplied with malaria RDTs and antimalarial medications to facilitate rapid diagnosis and treatment wherever patients present. Guinea operates a *pull* supply chain system, in which health facilities request commodities from regional depots, which are supplied in turn out of the central medical stores.[4]

Facilities maintain paper registers with information on malaria cases they have diagnosed and treated.[4] Outpatient registers do not include a separate column for fever, but do contain fields in which health-care workers (HCWs) record reported symptoms, diagnoses, and test results. At the end of the month, health facilities fill out monthly malaria reports, which involves tallying several key indicators, including the number of suspect malaria cases (defined as any patient with fever as a symptom), tested malaria cases, confirmed malaria cases, and treated malaria cases.

To monitor malaria case management throughout the country, the NMCP requires that health facilities submit these monthly reports to the NMCP via the district health offices. This data collection has occurred electronically via the routine malaria information system (RMIS) since 2013, and closer monitoring and monthly analysis of key indicators have allowed the NMCP to make significant strides in reducing malaria burden.[4,5] However, reports routinely indicate testing and treatment rates of 100% across the country, reflecting a common tautology where the number of suspect cases is de facto tallied as the number of tested cases and the number of treated cases is de facto tallied as the number of confirmed cases.[7] To evaluate the true quality of malaria case management,

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one option for the malaria program is for teams to visit health facilities and compare registry and patient data.

Health facility surveys are a routine means of evaluating adherence to clinical guidelines in many countries, particularly for malaria.[8–11] In Guinea, the most recent malaria-related health facility surveys occurred in 2014 and 2015. In 2014, the evaluation focused on changes in malaria case management in light of the concurrent Ebola virus epidemic. Substantial disruptions in malaria care delivery were identified, including reduced health-care seeking and reductions in the numbers of patients treated with antimalarials,[12] although these have since rebounded. The survey also identified low uptake of temporary Ebola-specific malaria case management guidelines.[13]

In addition, a Service Availability and Readiness Assessment (SARA) was performed in Guinea in 2015. Service Availability and Readiness Assessment is a tool designed to evaluate the readiness of the health sector to manage a host of diseases, including malaria.[14] Guinea's 2015 SARA identified strengths and gaps in malaria case management. For example, 85% of facilities had personnel trained in malaria case management, but only 43% had national malaria case management guidelines available to reference. Whereas 79% of health facilities visited had the capacity to perform malaria RDTs or microscopy, only 67% had ACTs available on the day of the survey. Overall, 46% of suspect malaria cases were assessed and treated in accordance with national malaria case management guidelines. These results suggest a continued need to monitor the provision of malaria services and reporting practices in Guinea.[5]

Building on these past studies, the Guinea NMCP and its partners undertook a cross-sectional survey of case management and data documentation practices in health facilities in May and June 2018. The purpose of this evaluation was to assess the quality of malaria case management in diverse facilities and to determine if reported RMIS data accurately reflect case management practices. Pinpointing the constraints across the malaria case management spectrum will allow resources to be targeted most closely to areas of need.

METHODS

Study design. After an initial assessment of data and case management quality based on the review of routine indicators, a cross-sectional survey of health facilities was performed in six purposely chosen health districts in Guinea. At each health facility, surveyors performed exit interviews with patients, interviewed HCWs, assessed stocks, and abstracted data from registers.

Site selection. Six of Guinea's 38 health districts were purposefully selected by NMCP staff to encompass a range of malaria burden, geography, and perceived a priori quality of malaria case management and RMIS reporting. We used the corrected fever testing proportion[7] as a proxy measure to assess the quality of malaria case management. This measure is used to estimate how many febrile patients are tested for malaria by looking at the rate of malaria testing among all persons presenting to a health facility who do not have documented malaria. The ratio of RDTs reported consumed to the number of suspect malaria cases was chosen as a proxy for perceived data recording. Both indicators were calculated for each health district, averaging for the entire period of 2017, the year preceding the survey. Health districts were grouped into three strata based on the perceived quality of case management and recording: high quality (Stratum 1), intermediate quality (Stratum 2), and low quality (Stratum 3). Two health districts were purposely chosen from each stratum: Dabola and Forécariah (both high transmission) in Stratum 1; Gaoual and Mali (both low transmission) in Stratum 2; and Guéckédou and Siguiri (both high transmission) in Stratum 3 (Figure 1). The corrected testing proportion was 39–53% in the health districts chosen in Stratum 1, 31–39% in Stratum 2, and 18–19% in Stratum 3. The ratio of RDTs reported to be used to tested malaria cases was 1.18–1.20 in Stratum 1, 1.27–1.54 in Stratum 2, and 1.50–1.81 in Stratum 3.

There were a total of 441 health facilities in the six districts, of which 126 were chosen for inclusion in the study. Within each stratum, 42 health facilities were randomly selected from a list of all facilities in both health districts. The selection was stratified so that two hospitals, 20 health centers, and 20 health posts were included. A total of 42 health facilities were required to detect a 20% difference in all-patient–level RMIS data quality indicators between strata with 80% power, assuming 30% performance in the lowest performing level, assuming 15 patients interviewed per health facility, and adding a 5% allowance for potentially closed facilities.

Data collection. Five survey questionnaires were designed to assess different components of malaria case management and reporting: health facility managers, HCWs, patients, registers, and commodity supplies. One health facility manager and up to five HCWs working in each selected health facility were invited to participate in the survey, chosen by simple random sampling if additional personnel were present. A maximum of 15 patients per facility presenting for unscheduled care were invited to participate, regardless of their age or chief complaint. Patients were selected throughout the day according to a sampling frame based on the number of patients who had visited the health facility the previous day.

Survey questions evaluated managers' and HCWs' training and experience, roles and responsibilities, knowledge of malaria case management guidelines, recent supervisory visits, and attitudes toward patients and case management practices.

Adult patients and adults accompanying pediatric patients were interviewed after completing their health facility visits. Patient surveys assessed their symptoms, questions the provider asked or did not ask, diagnostic testing and treatments provided, and final diagnosis. If patients had fever but were not diagnosed or treated during the health facility visit, they were offered an RDT and, as appropriate, AL treatment by survey staff. Any patients with severe malaria who were not appropriately diagnosed or treated during their visits were transported by survey staff to the nearest facility with injectable antimalarial treatments. Information from individual patient surveys was cross-referenced with information from their register entries to assess reporting quality.

Finally, stocks of malaria commodities were assessed via examination of each health facility's stockroom. The type, amount, and expiration dates of commodities were recorded. Stock cards were examined to determine the number and duration of malaria commodity stockouts (i.e., no stock available).

Data analysis. Survey data were collected electronically on tablets, using the SurveyCTO application (Dobility, Inc., Cambridge, MA). Data were analyzed using R statistical

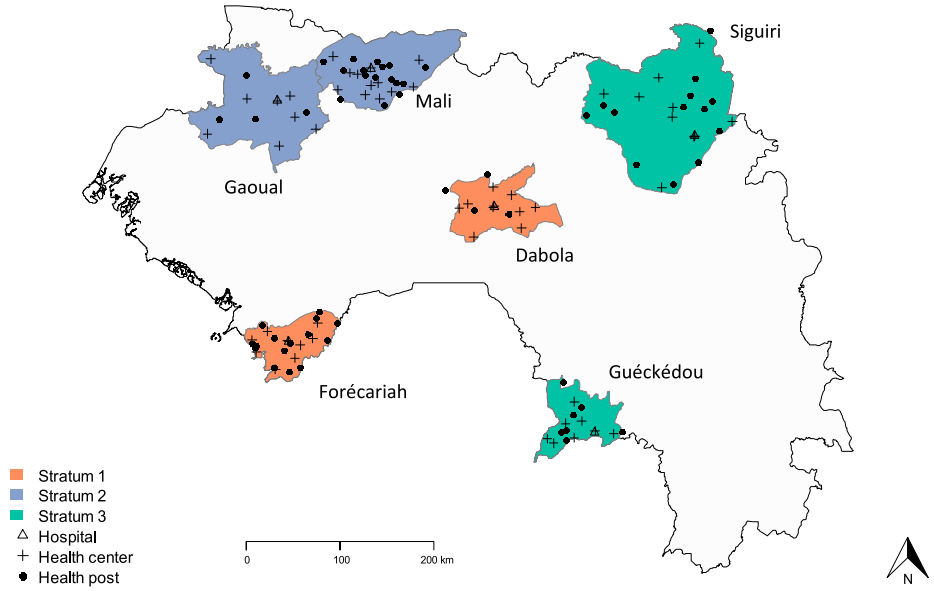

FIGURE 1. Health districts and health facilities selected for malaria health facility survey, Guinea, 2018. Two health facilities had missing geographical coordinate data. This figure appears in color at www.ajtmh.org.

software version 3.3.2 (R Foundation for Statistical Computing, Vienna, Austria). Standard indicators on health facility readiness and quality of malaria case management were calculated, as previously described.[9] In brief, a suspect malaria case was defined as a patient reporting fever as a symptom of their present illness during the exit interview or with an axillary temperature ≥ 37.5°C measured during the reexamination. Suspect malaria cases were considered to be correctly managed if they were tested by RDT or microscopy and treated in accordance with the test result.

For the subset of patients considered to be true symptomatic malaria cases (defined as reporting febrile illness and testing positive during the health facility visit or during reexamination), components of the full malaria case management pathway were evaluated separately: identification of fever, testing, and correct treatment.

Principal component analysis (PCA) was used to calculate knowledge, efficacy, attitude, and norms indices from dichotomized responses[15] from HCWs to a 10-question knowledge quiz, and a self-assessment on HCW efficacy (10 questions), attitude (14 questions), and norms (five questions) (Supplemental Table 1). For each of the four indices, a separate PCA was run, and the first eigenvector was used to convert the dichotomized responses to the questions to a single value, which was then normalized to range from 0 (low) to 1 (high). The proportion of the variance explained by the first eigenvector ranged from 8% (knowledge index) to 20% (attitude index).

The cluster sampling design was accounted for by adjusting health facility– and patient-level indicators using the survey R package.[16] Health facility–level indicators were weighted by the inverse of the probability of selection of each health facility, and patient-level indicators were weighted by the inverse of the product of the health facility probability of selection and the patient probability of selection.

For each stratum, a multivariate logistic model was fit to identify factors associated with correct management of suspect malaria cases. A generalized linear model with a logit link function was fit using the glm R function. All possible covariates of interest and potential confounders were included in the final model. Patient-level variables included age and gender. Health facility–level variables included health facility type, availability of RDTs and ACTs, HCW supervision and training rates, and the average knowledge, efficacy, attitude, and norms indices for HCWs in each health facility. District was included as a fixed effect.

Data for interviewed patients were compared with data abstracted from the registries. Considering the interview data as the gold standard, sensitivity and specificity of the registry in capturing fever, whether or not an RDT or microscopy had been performed, and the result of the test were calculated. Separately, the proportion of surveyed outpatients with fever, the proportion of surveyed febrile patients reporting having been tested by the HCW, and the proportion of febrile outpatients testing positive during the consult or the reexamination were compared with the corresponding data submitted by the provinces through the RMIS. Data for May and June 2018, the months of the survey, were averaged, and the reported proportion of suspect cases among all-cause patient consults, the proportion of confirmed cases among all-cause patient consults, and the test positivity rate were calculated. Survey- and RMIS-derived indicators for these months were compared using the χ^2 test.

Ethical review. No personally identifying information was recorded in the database. Health-care workers and health facility managers provided oral consent to participate in the survey, whereas patients provided written informed consent. Guardians provided written permission for pediatric patients. The survey was reviewed and approved as nonresearch by the Office of the Associate Director for Science in the Center for Global Health at the Centers for Disease Control and Prevention (protocol number CGH2018-120) and the Guinea Ministry of Health.

RESULTS

Overall, 126 facilities were evaluated in six health districts. A total of 126 health facility managers, 381 health-care

HCWs, and 939 patients were interviewed, and 126 inventories were examined (Table 1). The patient age distribution and percentage presenting with fever were grossly similar across all three strata. The percentage of true malaria cases among participants varied according to health districts' malaria burden, ranging from 4% in Stratum 2 to 36% in Stratum 3.

Malaria case management readiness. All health facilities reported the ability to diagnose and treat malaria cases (Table 2). All but one reported regular availability of RDTs, although less than half of hospitals and health centers had microscopy resources available on the day of visit. Across strata, 85–95% of facilities had at least one staff member trained in RDT performance, but fewer than 5% had anyone trained in malaria microscopy. All facilities in Strata 1 and 2 had RDTs and ACTs available during the survey visit, although only 82% (95% CI: 63–92%) and 86% (68–95%) of facilities in Stratum 3 had any malaria diagnostic modality or ACT available, respectively. All health facilities used and documented the use of RDTs more frequently than microscopy.

In all strata, 85% or more of health facility managers reported having at least one staff member trained on malaria treatment or RDT use, and training in malaria case management was reported by 58–75% of HCWs. More than 80% of facilities in Strata 1 and 2 had received malaria case management supervisory visits in the past 6 months, but this was true for only 58% (95% CI: 45–70%) of facilities in Stratum 3, a statistically significant difference.

Health facility stocks. More than 95% of all health facilities in all zones reported regularly managing RDTs (i.e., expecting to stock and use them) (Supplemental Table 2). No facilities in Stratum 1 or 2 experienced RDT stockouts on the day of the survey, but this occurred in 20% of facilities in Stratum 3. More than 89% of facilities stocked each of the four AL formulations, but facilities experienced stockouts of each formulation at rates ranging from 4% to 37% across all strata. In general, higher rates of AL stockouts were observed in Stratum 3 than in Stratum 1 or 2.

A substantial proportion of health facilities across all three strata (34–51%) reported not regularly managing quinine tablets. Furthermore, high rates of stockouts of quinine tablets were observed in all three strata among health facilities reporting managing quinine tablets, with stockout rates ranging from 53% to 100%.

Most health facilities in all strata reported that they did not stock each of the injectable antimalarials. Injectable artesunate (40 mg/2 mL) was the most commonly stocked drug, but even then, it was only managed by 43% of facilities in Stratum 3. Among facilities that stocked injectable antimalarials, the frequency of stockouts ranged from 0% to 79% on the day of the survey.

Quality of case management. Overall correct case management for suspect malaria cases, including performing diagnostic testing on those with fever, treating confirmed cases appropriately, and withholding antimalarial treatment from those who did not test positive, was achieved for 85% of patients with febrile illness both in Stratum 1 (95% CI: 78–90%) and Stratum 2 (95% CI: 79–89%), but was significantly lower (52% [37–67%]) in Stratum 3 (Table 3). Of true malaria cases, 91% (79–97%) were managed appropriately in Stratum 1, 67% in Stratum 2 (20–94%), and 77% (62–88%) in Stratum 3. Of note, only 11 cases of malaria were detected among all patients in Stratum 2, resulting in imprecise estimates for this indicator.

More than 75% of all fever cases in each zone were tested for malaria, overwhelmingly via RDTs as opposed to microscopy (Table 3). This proportion of fever cases tested was higher in children aged less than 5 years, ranging from 87% to 93% across strata, than in older age groups.

Among confirmed malaria cases, patients were treated according to NMCP guidelines 91% (95% CI: 73–97%) of the time in Stratum 1, 67% in Stratum 2 (20–94%), and 81% (65–91%) in Stratum 3. Among patients with fever who tested negative for malaria, fewer than 5% were given an antimalarial in Strata 1 and 2, but 44% were so treated in Stratum 3. No patient in Stratum 1 or 2 received antimalarial treatment without a malaria test, but this did occur for 21% of patients with fever in Stratum 3.

Analysis of the case management pathway of true malaria cases revealed that the rates of fever identification and testing were high in all three strata (95–100%) (Figure 2). The step least likely to be performed correctly was treatment with an appropriate antimalarial. This step accounted for the largest contribution to incorrect case management, with 89% of

TABLE 1
Numbers and characteristics of health facilities, HCWs, and patients surveyed in Guinea, 2018

	n (%)			
	Stratum 1 (Forécariah/Dabola)	Stratum 2 (Gaoual/Mali)	Stratum 3 (Guéckédou/Siguiri)	Total
Health facility	42	42	42	126
Hospital	2 (5)	2 (5)	2 (5)	6 (5)
Health center	20 (48)	20 (48)	20 (48)	60 (48)
Health post	20 (48)	20 (48)	20 (48)	60 (48)
HCWs interviewed	130	108	143	381
Patients interviewed	319	314	306	939
< 5 years	121 (38)	101 (32)	113 (37)	335 (36)
5–15 years	52 (16)	32 (10)	39 (13)	123 (13)
> 15 years	146 (46)	181 (58)	154 (50)	481 (51)
Female	176 (55)	178 (57)	189 (62)	543 (58)
Pregnant women	42 (13)	36 (11)	45 (15)	123 (13)
Suspect malaria cases*	257 (81)	235 (75)	235 (77)	727 (77)
True malaria cases†	96 (30)	11 (4)	109 (36)	216 (23)

HCWs = health-care workers.
* Fever/history of fever.
† Fever/history of fever and rapid diagnostic test or microscopy positive either during consult or survey reexamination.

TABLE 2
Standard key indicators on health facility readiness for malaria care delivery, as assessed in the health facility survey in Guinea, 2018

	Stratum 1 (Forécariah/ Dabola)		Stratum 2 (Gaoual/Mali)		Stratum 3 (Guéckédou/ Siguiri)	
	%	95% CI	%	95% CI	%	95% CI
Health facilities						
Offering any malaria diagnostic services	100	*	100	*	100	*
RDT	100	*	100	*	99	96–100
Malaria microscopy†	32	17–52	18	7–39	46	27–67
Offering any malaria treatment	100	*	100	*	100	*
With RDT or malaria microscopy available on the day of visit	100	*	100	*	82	63–92
With any formulation of ACT available on the day of visit	100	*	100	*	86	68–95
With at least one HCW trained on RDT use	85	73–93	95	81–99	89	73–96
With at least one HCW trained on malaria microscopy	5.4	3–11	3.1	1–7	4.8	2–10
With at least one HCW trained on malaria treatment	89	78–95	87	71–95	86	68–95
With guidelines for diagnosis and treatment of malaria	84	70–92	91	76–97	65	46–80
HCWs trained in malaria case management	60	53–67	75	65–83	58	47–68
HCWs supervised in last 6 months	82	74–88	92	83–97	58	45–70

ACT = artemisinin-based combination therapy; HCW = health-care worker; RDT = rapid diagnostic test.
* CIs undefined.
† Excluding health posts.

incorrectly managed patients failing at this step. Notably, 13 (46%) of the 28 incorrectly treated true malaria cases were pregnant women.

All true malaria cases in each stratum were assessed for fever. In Strata 1 and 2, patients were incorrectly managed only at the treatment stage, where some true malaria cases were not given appropriate antimalarials. However, only five of 107 patients were inappropriately treated across both of these strata. In Stratum 3, 5% of true malaria cases did not undergo malaria testing and 18% of malaria patients were mismanaged at the treatment stage. Furthermore, for a small number of patients in each stratum, testing information was not documented.

Factors associated with correct case management. The most strongly and consistently predictive factor for proper malaria case management was the HCW norms index, which measured the perceived adherence to malaria case management guidelines among the HCWs' colleagues (Table 4). The adjusted odds ratio (OR) for this association was 23 (95% CI: 1.4–400) in Stratum 1 and 109 (3.1–5,212) in Stratum 2, but did not reach statistical significance in Stratum 3. Male gender in patients was statistically significantly associated with worse management in Stratum 2 (OR: 0.29; 95% CI: 0.11–0.71). Availability of testing was associated with better case management in Stratum 3 (OR: 13; 95% CI: 1.6–196). There was no statistically significant association between HCW training or supervision and correct case management in any of the strata.

Assessment of data quality and completeness. Generally, the sensitivity of the register in reflecting key indicators, using the exit interview data as the gold standard, was higher in Stratum 1 and Stratum 2 than in Stratum 3 (Table 5). The sensitivity of the register in documenting the presence of fever was more than 80% in Strata 1 and 2, compared with 66% in Stratum 3. Documentation of RDT performance occurred at least 20% points less frequently in Stratum 3 than in Stratum 1 or 2. Specificity of documentation of the presence of fever in the register was lower than its sensitivity, with 66–75% of

TABLE 3
Standard key indicators on health-care worker performance in malaria case management, as assessed in health facility surveys in Guinea, 2018

	Stratum 1 (Forécariah/Dabola)		Stratum 2 (Gaoual/Mali)		Stratum 3 (Guéckédou/ Siguiri)	
	%	95% CI	%	95% CI	%	95% CI
Suspect malaria cases receiving malaria test	90	85–94	87	82–92	78	64–87
< 5 years	93	84–97	90	80–95	87	78–93
RDT	93	84–97	87	77–93	86	77–92
Microscopy	8	4–18	3	0.8–10.0	5	2–12
≥ 5 years	88	80–93	86	78–91	71	50–85
RDT	87	78–92	85	77–90	69	49–84
Microscopy	2	1–5	1	0.3–3.7	5	2–14
Confirmed malaria cases treated with appropriate antimalarials	91	73–97	67	20–94	81	65–91
Suspect malaria cases negative for malaria* but treated with antimalarials	3	1–9	0	2e-10–3e-10	44	21–69
Suspect malaria cases not tested and treated with appropriate antimalarials	0	4e-10–1e-09	0	4e-10–1e-09	21	10–39
Suspect malaria cases managed correctly†	85	78–90	85	79–89	52	37–67
True malaria cases appropriately treated‡	91	73–97	67	20–94	77	62–88

RDT = rapid diagnostic test.
* During reexamination.
† Tested and treated with antimalarials only if positive.
‡ Treated with first-line antimalarials.

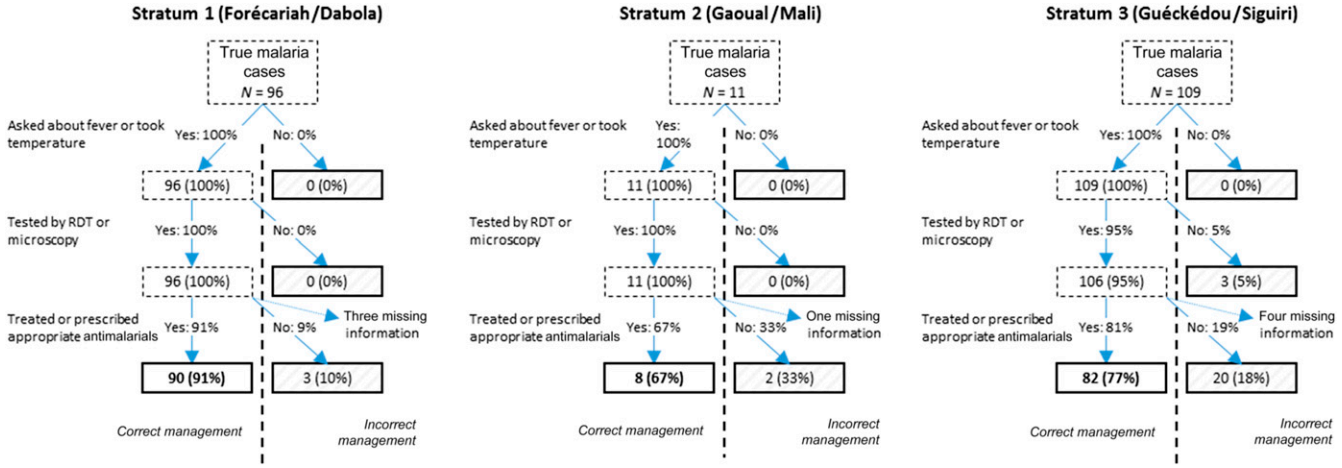

FIGURE 2. Case management pathway and errors for true malaria cases seen at health facilities in Guinea, 2018. Percentages in boxes are adjusted for sampling weights.

patients not reporting fever also not having fever documented in the register. Specificity for the RDT performance and result was greater than 85% in all three strata. Documentation of the microscopy performance in the register was much less sensitive than the RDT performance or fever presence (albeit with very wide CIs reflecting low numbers) but had greater than 95% specificity in all strata.

When comparing indicators calculated from RMIS data from May and June 2018 to the exit interview data, there was evidence of substantial (> 20% points) underreporting of the proportion of patients with fever in the RMIS in Strata 2 and 3 (Table 6). Conversely, there seemed to be overreporting of the proportion of patients with malaria in Strata 1 and 2. As a consequence, the overall test positivity rate in suspect malaria cases reported through the RMIS was substantially higher than that observed during the exit interviews in all three zones.

DISCUSSION

Overall, suspect malaria cases were generally well managed throughout the facilities assessed, particularly in Strata 1 and 2. Health facilities almost always had RDTs and AL in stock, as well as staff trained on malaria diagnosis and treatment. Moreover, most information was documented appropriately in the registers. Finally, the quality of case management and data quality as assessed during the evaluation in the three zones largely matched the a priori classification of the zones based on routine data to categorize the

TABLE 4
Factors associated with correct management of suspect malaria cases attending health facilities in Guinea, 2018

	Stratum 1 (Forécariah/Dabola)		Stratum 2 (Gaoual/Mali)		Stratum 3 (Guéckédou/Siguiri)	
Variable	Adjusted OR	95% CI	Adjusted OR	95% CI	Adjusted OR	95% CI
Patient age (years)						
< 5	Ref.	–	Ref.	–	Ref.	–
5–15	0.87	0.22–4.4	1.1	0.17–22	0.47	0.13–1.7
> 15	0.55	0.19–1.5	0.42	0.15–1.1	0.63	0.29–1.4
Patient gender						
Female	Ref.	–	Ref.	–	Ref.	–
Male	1.1	0.46–2.8	**0.29**	**0.11–0.71**	1.9	0.9–4.2
Health facility type						
Hospital	Ref.	–	Ref.	–	Ref.	–
Health center	3	0.13–29	0.77	0.047–7.3	1.1	0.29–4.2
Health post	1.6	0.06–19	0.55	0.025–7.6	0.37	0.081–1.6
RDT or microscopy available on the day of visit	NA	NA	NA	NA	**13**	**1.6–196**
ACT available on the day of visit	NA	NA	NA	NA	0.2	0.024–1.2
Proportion of interviewed HCWs supervised in last 6 months	1.8	0.23–15	0.71	0.038–6.3	0.38	0.064–2.1
Proportion of interviewed HCWs trained in malaria case management	0.75	0.13–4	1.5	0.16–11	3.3	0.69–17
HCW knowledge index*	0.35	0.016–8.8	0.11	0.0011–7.1	**0.27**	**0.0052–13**
HCW efficacy index*	4.4	8.9e-05–107,108	0.0031	3.1e-07–2.8	9.2	0.32–295
HCW attitude index*	0.11	0.0059–1.5	0.11	0.00042–7.2	3	0.43–23
HCW norms index*	**23**	**1.4–400**	**109**	**3.1–5,212**	0.44	0.0049–33

ACT = artemisinin-based combination therapy; HCW = health-care worker; OR = odds ratio; RDT = rapid diagnostic test; NA = not applicable. Statistically significant associations in bold.
* Normalized on a 0 (low) to 1 (high) scale.

TABLE 5
Sensitivity, specificity, and Cohen's kappa of registry data as compared to gold standard interviews with patients, Guinea, 2018

	Stratum 1 (Forécariah/Dabola)			Stratum 2 (Gaoual/Mali)			Stratum 3 (Guéckédou/Siguiri)		
Indicator	Sensitivity	Specificity	Cohen's kappa	Sensitivity	Specificity	Cohen's kappa	Sensitivity	Specificity	Cohen's kappa
Presence of fever	83 (78–87)	66 (53–77)	0.43	87 (82–91)	75 (63–84)	0.59	66 (59–72)	70 (58–80)	0.28
RDT performed	89 (84–93)	86 (75–93)	0.69	96 (93–98)	100 (95–100)	0.94	65 (58–72)	87 (77–93)	0.43
RDT performed and positive	87 (79–93)	96 (92–98)	0.84	60 (27–86)	100 (98–100)	0.74	68 (58–77)	97 (94–99)	0.70
RDT performed and negative	84 (76–89)	93 (88–96)	0.78	95 (90–98)	97 (91–99)	0.92	56 (46–66)	93 (88–96)	0.52
Microscopy performed	13 (2–42)	99 (97–100)	0.18	100 (66–100)	100 (98–100)	0.95	53 (35–70)	97 (94–98)	0.54
Microscopy performed and positive	12 (0.7–53)	100 (98–100)	0.19	75 (22–99)	100 (98–100)	0.86	25 (10–49)	98 (96–99)	0.30
Microscopy performed and negative	14 (0.8–58)	99 (97–100)	0.19	100 (40–100)	100 (98–100)	0.89	22 (4–60)	100 (98–100)	0.32

RDT = rapid diagnostic test.

areas, particularly between the well-performing and poor-performing zones.

Previous studies have demonstrated that failure to identify and test suspect malaria cases is usually the limiting factor in appropriate malaria case management,[9,11,17–19] but in Guinea, provision of treatment seems to be the main constraint,[7,20] which was confirmed by this survey. Although performance at facilities in Stratum 2 was high throughout the assessment, only 67% of true malaria cases were appropriately managed in this stratum. However, with a sample size of only 11 cases of the 314 patients interviewed, it is impossible to draw definitive conclusions. Further study is needed to determine if any true difficulties exist with malaria case management in Gaoual and Mali, and also to examine potential barriers to providing the correct treatment in all health districts.

Because nearly half of all errors in management of true malaria cases occurred in pregnant women, more focus on training in case management of pregnant women should be considered. In addition, improving the availability of oral quinine, the preferred oral treatment in pregnant women in the first trimester, which was scarcely available across all strata, might increase the rate of correct case management of malaria in pregnant women. Gaps in malaria case management in pregnant women have been observed in other countries in sub-Saharan Africa,[21] and this might be an area that would improve with targeted intervention from the malaria control community in Guinea.

Most health facilities reported having at least one staff member trained in malaria diagnosis and treatment. However, among HCWs, approximately 30% reported no malaria case management training. Even those who have received malaria case management training could likely benefit from an occasional refresher course, and improving the understanding of proper malaria case management could lead to improvements in many of this survey's indicators. However, an assessment of the quality of existing training and its effect on workforce behavior change is also important; a meta-analysis of evaluations of HIV, tuberculosis, and malaria training programs revealed that such programs are rarely robustly evaluated.[22] A systematic review recently highlighted the effectiveness of combining HCW training and supervision for improving HCW performance, although the effect size was still moderate.[23]

One notable finding of this survey was how strongly linked correct malaria case management was to perceived HCW norms around case management. Health facilities in which behavior such as universal testing and treatment according to the test result had ostensibly been "normalized" had substantially better case management than health facilities where HCWs felt that best practices were not routinely followed. Interventions based on instilling and strengthening norms around proper case management practices in HCWs through social and behavioral change communication[24] could be quite impactful.

This assessment revealed stark differences between the quality of malaria case management in Strata 1 and 2 (the high and intermediate performers, respectively) as opposed to Stratum 3 (poor performer). Facilities in Stratum 3 had more frequent stockouts of RDTs and AL, fewer supervisory visits, less compliance with case management guidelines, and more incomplete register documentation. All of these factors likely contribute to the reduced RMIS data quality observed in Stratum 3. Furthermore, geography may play a part in the case management difficulties observed in Stratum 3. Both health districts chosen from Stratum 3—Siguiri and Guéckédou—are located in remote corners of Guinea, 2 days' drive from the coastal capital. Because of this distance, providers there may not benefit from the same level of attention as those in health districts closer to the capital. Guéckédou and Siguiri also have some of the highest malaria rates in Guinea[4]; with such a large number of malaria patients presenting to health facilities, it may be difficult to give each one proper care and documentation.

TABLE 6
Comparison of key indicators between exit interview data and RMIS data, in May–June 2018 in selected health facilities in Guinea

	Stratum 1 (Forécariah/Dabola)			Stratum 2 (Gaoual/Mali)			Stratum 3 (Guéckédou/Siguiri)		
Indicator	Exit interviews (%)	RMIS* (%)	*P*-value	Exit interviews (%)	RMIS* (%)	*P*-value	Exit interviews (%)	RMIS* (%)	*P*-value
Proportion of patients with fever	78	73	0.06	73	49	0.00	78	54	0.00
Proportion of patients with malaria	27	42	0.00	3	9	0.00	32	36	0.40
Test positivity in suspect malaria cases	35	58	0.00	4	18	0.00	41	67	0.00

RMIS = routine malaria information system.
* Average of May and June data.

Improving case management and data quality among low-performing health districts, such as those in Stratum 3, should include strengthening the supply chain system in these areas to prevent RDT and ACT stockouts. Mobile phone–based inventory monitoring could also be used to reduce RDT and ACT stockouts of key commodities.[25,26] The lower rates of supervision in these zones can be addressed by increasing the rates of national-, regional-, and district-level supervision in these harder-to-reach areas.

Comparison of exit interview data and registry data revealed largely complete and reliable documentation of patient fever, malaria testing, and malaria test result in the registers. Notably, however, the quality of registry data was poor in Stratum 3, the area chosen a priori as an area with evident gaps in data quality. The registry is the vital link between patient encounters and data that are reported through monthly reports in the RMIS. If key data are incorrectly recorded in the register, then these inaccuracies will propagate through the system, even with perfect tallying and completion of the monthly reports. Indeed, comparison of RMIS data from the districts included in the survey with the exit interview data suggested substantial underreporting of fever rates, resulting in consequent overreporting of the test positivity rate. As in other countries, Guinea relies on routine data to estimate fever and malaria cases seen at health facilities and, thus, to inform quantifications of RDT and ACT needs. Procurement decisions should factor in the potential biases in the reported data observed and documented in this survey. One potential solution is to triangulate these data with consumption and stock data reported through the RMIS.[27]

Revision of registers to include a fever variable/column might be considered. Another consideration would be to base malaria key indicator analysis on portions of register data that are most likely to be accurate. For example, whereas the presence of fever or number of health-care visits for fever are often improperly recorded in the absence of a separate fever variable/column, the numbers of all-cause outpatient acute care consultations, patients tested for malaria, and patients who test positive are all more reliably tabulated. A recent study of data from Guinea and Senegal describes how to use these indicators to calculate a robust malaria testing proportion.[7]

This survey was performed during Ramadan, which is associated with a large reduction in health-care seeking across Guinea. Therefore, only 52% of the target sample size in terms of number of patients was achieved. In addition, only 11 cases of malaria were identified among all patients in Stratum 2, reducing the precision of the survey results for many of this stratum's case management indicators. Moreover, the limited geographic scope and cross-sectional nature of the survey impede extrapolation of the results to other areas and time periods. The definition of strata in this study, in particular pooling of geographically distant health districts, complicates the ability of the NMCP to remediate identified problems. Purposeful selection of districts within each stratum also hinders generalizability. The months of the study represent the end of the dry season in Guinea, and malaria case management practices could potentially be different during the higher transmission rainy season. Recall bias could have been introduced by patients misremembering details about their consults during the exit interview.[28] The presence of study teams at the health facilities could have influenced HCW practices, biasing the results toward better malaria case management. Finally, comparison of exit interview data and RMIS data required comparison of a point estimate with an average of RMIS data across two calendar months, impeding its generalizability. Nevertheless, despite the range of possible limitations, the survey reveals strong evidence that surveillance data can be used to identify areas requiring targeted interventions to improve case management and reporting.

CONCLUSION

Most cases of malaria were appropriately diagnosed, treated, and documented. The quality of malaria case management and data quality reflected patterns previously detected through the RMIS, suggesting that reviews of routinely collected data can be used to identify priority areas for continued improvement of malaria case management in Guinea.

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