RESEARCH ARTICLE

Malaria management in children with fever in rural Sierra Leone. Has anything changed after the Ebola outbreak?

[version 1; peer review: 1 approved, 1 approved with reservations]

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Abstract

Background: Sierra Leone is one of the highest malaria burden countries in the world and was severely affected by the 2014-15 Ebola outbreak. As fever is a common symptom of both malaria and Ebola, it might have affected the management of fever in children. Among under-fives in Koinadugu district, Sierra Leone, we determined fever cases that had malaria diagnostic testing and treated with Artemisinin-based Combination Therapy (ACT) during pre-Ebola, intra-Ebola and post-Ebola periods.

Methods: The study population included all children under five with fever who presented to 68 primary healthcare facilities in Koinadugu district. Malaria management was in line with national guidelines. All individuals presenting with fever should be subjected to a malaria diagnostic test, which may involve a Rapid Diagnostic Test (RDT) or microscopy. Only confirmed malaria cases should receive ACTs. The study spanned pre-Ebola (June 1, 2013 – April 30, 2014), intra-Ebola (June 1, 2014 – April 30, 2015) and post-Ebola (June 1, 2016 – April 30, 2017) periods. Data were sourced directly from routine morbidity registers available at each health facility.

Results: In the 68 health facilities, fever cases increased from 43,245 pre-Ebola to 74,367 post-Ebola (1.7-fold increase). Diagnosed malaria ranged between 66% and 75%. Only 47% of malaria cases were treated during Ebola. ACT use was 95% pre-Ebola, 99% intra-Ebola and dropped to 71% post-Ebola. Post-Ebola, an average of 40 (59%) facilities had monthly stock-outs of ACT (range 28-45).

Open Peer Review

Approval Status ? ✓

	1	2
version 1 23 Oct 2019	? view	✓ view

1. **Khin Thet Wai**, Ministry of Health and Sports, Yangon, Myanmar
2. **Martina Oneko**, Kenya Medical Research Institute, Kisumu, Kenya

Any reports and responses or comments on the article can be found at the end of the article.

Conclusion: What has changed since the Ebola outbreak is the increased utilisation of services for malaria. However, ACT stockouts are of concern, and this requires attention in order to ensure compliance with national malaria treatment guidelines.

Keywords

Health Systems Strengthening, SORT IT, Sustainable Development Goals, Artemisinin Combination Therapy

This article is included in the **TDR** gateway.

This article is included in the **Emerging Diseases and Outbreaks** gateway.

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Introduction

A cross-sectional study conducted in 2017¹ involving 68 primary health facilities in Koinadugu district of rural Sierra Leone compared the management of children with fever for malaria for a period before, during and after the Ebola outbreak. There were two key findings. First, less than half of all confirmed malaria cases were treated for malaria during the Ebola outbreak. As fever is a common symptom of both malaria and Ebola, health workers may have “played safe” by simply referring such children to Ebola management sites². Second, monthly utilization of malaria diagnostics closely matched the number of reported fever cases, implying that fever cases were being routinely subjected to malaria testing³.

Although the post-Ebola period was included in this evaluation, it was for a relatively short period (six months) which was probably too soon to gauge health system recovery. At the primary healthcare level in the same district and among children under five, we thus performed a new analysis with a longer post-Ebola period and compared these data for similar periods before and during the Ebola outbreak. Our specific objectives were to determine: a) numbers of reported fever cases and malaria tests done, and b) numbers treated for malaria with artemisinin combination treatment (ACT) and within 24 hours of fever onset

Methods

This was a cross-sectional study using routine program data. The setting has been previously described¹. The study population included all children under five with fever who presented to 68 primary healthcare units. Malaria management was in line with national guidelines and has been described previously⁴. In brief, all individuals presenting with fever to any given health facility were subjected to a malaria diagnostic test, which may involve a Rapid Diagnostic Test (RDT) or microscopy. Only confirmed malaria cases should receive ACT.

The study spanned a pre-Ebola (June 1 2013 – April 30 2014), intra-Ebola (June 1 2014 – April 30 2015) and post Ebola (June 1 2016 – April 30 2017) periods.

Data were sourced directly from routine morbidity registers available at each health facility. A data manager was responsible for data quality, and a dedicated data entry clerk performed data entry. We used EpiData software for data entry and analysis (version 4.1 for entry and version 2.2.2.182 for analysis; EpiData Association, Odense, Denmark).

Ethics approval was obtained from the Sierra Leone Ethics and Scientific Review Committee (dated 18 December 2018) and the Union Ethics Advisory Group (International Union against Tuberculosis and Lung Disease, Paris, France; EAG number 70/18). As we used aggregated data, the need for informed consent was waived by the ethics committees.

Results

Numbers of reported fever cases and malaria tests done

Table 1 shows the numbers of fever cases reported and malaria tests done during the pre-, intra- and post-Ebola periods (see underlying data⁵). Fever cases increased from 43,245 pre-Ebola to 74,367 post-Ebola (1.7-fold increase). Diagnosed malaria among fever cases ranged between 66% and 75%. During Ebola, all diagnosed malaria cases had malaria tests, while in the pre- and post-Ebola periods, 99% received testing and 1% was diagnosed on clinical grounds.

Numbers treated for malaria in relation to ACT and fever onsets

Table 2 shows numbers treated for malaria in relation to ACT and timing of fever onset. While all diagnosed malaria cases received treatment in the pre- and post-Ebola periods, only 47% were treated during Ebola. ACT use was 95% pre-Ebola, 99% intra-Ebola and dropped to 71% post-Ebola. In the

Table 1. Fever cases reported (suspected malaria) and malaria tests done during the pre-, intra- and post-Ebola outbreak periods at the primary healthcare level in Koinadugu District, Sierra Leone¹.

	Pre-Ebola		Intra-Ebola		Post-Ebola		Total	
	n	(%)	n	(%)	n	(%)	n	(%)
Reported fever cases (suspected malaria)	43,245		50,453		74,367		168,065	
Diagnosed with malaria								
Total	32,505		36,804		49,186		118,495	
Confirmed malaria ²	32,219	(99)	36,804	(100)	49,128	(99)	118,151	(99)
Clinically diagnosed ³	286	(1)	0	(0)	58	(<1)	344	(<1)

¹ Pre-Ebola (1st June, 2013 to 30th April, 2014); Intra-Ebola (1st June, 2014 to 30th April, 2015); Post-Ebola (1st June 2016 to 30th April, 2017)

² Using Rapid Diagnostic Test or Laboratory-based Microscopy

³ Without Rapid Diagnostic Test or Laboratory-based Microscopy

Table 2. Number of patients treated for malaria stratified by type of medication and timing (within 24 hours of fever onset) during the pre-, intra- and post-Ebola outbreak periods¹ at the primary healthcare level in Koinadugu District, Sierra Leone.

	Pre-Ebola		Intra-Ebola		Post-Ebola		Total
	n	(%)	n	(%)	n	(%)	n
Total diagnosed with malaria	32,505		36,804		49,186		118,495
Treated for malaria	32,505	(100)	17,438	(47)	49,186	(100)	99,129
Treatment type							
with ACT ²	30,922	(95)	17,417	(99)	34,894	(71)	83,233
with other antimalarials ³	1,583	(5)	21	(1)	14,292	(29)	15,896
Treatment timing							
within 24 hours of fever onset ⁴	21,817	(67)	12,682	(73)	34,894	(71)	69,393

¹ACT: Artemisinin-based Combination Therapy. Percentage of all treated with ACT is calculated out of total positive Malaria cases

²Injectable artesunate, rectal artesunate, quinine tablets, injectable quinine. Percentage treated with other antimalarials is calculated out of total treated for malaria

³Percentage treated within 24 hours of fever onset is calculated out of total treated for malaria

post-Ebola period, out of 68 health facilities, an average of 7.5 facilities per month had 7 days stockouts of ACT.

Discussion

This study shows that despite the Ebola outbreak, the number of reported fever cases progressively increased and was 1.7 times higher post-Ebola compared to the pre-Ebola period.

Reassuringly, while less than half of malaria cases received treatment with ACT drugs during Ebola, in the post-Ebola period, all cases received treatment (which included ACT and other anti-malarial drugs). ACT use declined from 99% during Ebola to 71% post-Ebola, and this was accompanied with ACT stock-outs. This could be explained by the increase in numbers needed to be treated for malaria in the post-Ebola period (2.8-times that during Ebola), which might have caused pressure on available ACT stocks and supply chains.

As part of Sierra Leone's post-Ebola health recovery strategy⁶, more health personnel were trained in surveillance and reporting, incentives were introduced, and community involvement was promoted. Operationally, this seems to have increased health service utilisation for malaria, but the health system seemed unable to cope with the increased ACT demand. This needs to be addressed in order to ensure compliance with malaria treatment guidelines and the rational use of antimalarial drugs.

The main study strength is that we used data from all health facilities in the district and compared similar periods of time before, during and after the Ebola outbreak. A study limitation was the lack of data on complicated and uncomplicated malaria cases. Availability of such information would help to justify (or not) the use of other antimalarial drugs apart from ACT

which was seen in the post-Ebola period. A short-coming in the district health information system (DHIS2) is that it does not capture severity of malaria (complicated and uncomplicated malaria). Adding this variable would improve monitoring of rational use of antimalarials.

In conclusion, what has changed since the Ebola outbreak is the increased utilisation of services for malaria. However, ACT stockouts are of concern, and this requires attention in order to ensure compliance with national malaria treatment guidelines.

Data availability

Source data

Original, hard-copy data is accessible through consultation with the Ministry of Health and Sanitation's District Health Management Team, Kabala, Koinadugu, Sierra Leone, led by Dr Kwame O'Neill, District Medical Officer (shakoneill@yahoo.com).

Underlying data

Open Science Framework: Dataset 1. Sesay_JosephB_SORTIT2_malaria_data 2019. <https://doi.org/10.17605/OSF.IO/GS2CP>⁵

This project contains the following underlying data:

- Sesay_F_malaria_data.csv (CSV file contain Koinadugu district child malaria data)
- Sesay_F_malaria_datadictionary.csv (Data dictionary for Sesay_F_malaria_data.csv)

Data are available under the terms of the [Creative Commons Zero "No rights reserved" data waiver](#) (CC0 1.0 Public domain dedication).

Acknowledgements

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(The Union) and Médecins sans Frontières (MSF). The specific SORT IT programme which resulted in this publication was jointly developed and implemented by: WHO/TDR, the Sierra Leone Ministry of Health and Sanitation, WHO Sierra Leone and the Centre for Operational Research, The Union, Paris, France; Alliance for Public Health, Ukraine; Institute of Tropical Medicine, Antwerp, Belgium; and Sustainable Health Systems, Freetown, Sierra Leone.

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Reviewer Report 03 July 2020

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Martina Oneko

Centre for Global Health Research, Kenya Medical Research Institute, Kisumu, Kenya

The manuscript expands on previously published data regarding the management of malaria before, during, and after the Ebola outbreak in Sierra Leone.

While the conclusions seem more sound than in the first article published by the same group, this manuscript cannot be interpreted without the first article and is, therefore, more of an addendum than an original article. This should be made clearer in the introduction, including a more elaborate description of why this additional analysis was necessary. While the first article describes a deterioration of malaria reporting in the post-Ebola period, this new analysis claims a higher utilization of health services for malaria is responsible for the higher number of fever cases. However, they could have mentioned some details about the 'other' fever cases, which were higher in the post-Ebola period.

Overall the article is a useful addition to the previous article and in combination, the two articles give valuable advice for improvement of the management of febrile illness in under-fives in this area of Sierra Leone. Whether they are generalizable to a wider region is not known to me.

Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

I cannot comment. A qualified statistician is required.

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Pediatrician with experience in neuropsychiatrics and clinical trials, especially malaria vaccines

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 20 November 2019

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Khin Thet Wai

Department of Medical Research, Ministry of Health and Sports, Yangon, Myanmar

1. The authors used recent references to synthesize the research gap and the generation of new knowledge. However, scientifically strong justification is essential to clarify why the existing records needed a comparative analysis (pre, intra and post Ebola periods). Please include why this research is necessary.
2. The study design used is appropriate in addressing the research question.
3. Sufficient details of the methods used were noted except the list of variables used for analyses. The authors can improve the methods section by adding the type of variables extracted from the morbidity register so as to allow replication by others.
4. For the analysis, in Table 1, the percentages of total cases diagnosed as malaria either by RDT or microscopy out of all fever cases are to be included and interpreted carefully. "Diagnosed malaria among fever cases ranged between 66% and 75%" is not enough. In fact, in post Ebola period, diagnosed malaria among fever cases was lower than pre and intra Ebola outbreak period (66%). This indicates less need for diagnostics despite increased utilization of health services for children with fever.
5. In Table 2, during Ebola period, cases treated for malaria dropped to 47% which should be included in the discussion part.
6. Conclusion part is weak and needs to rewrite and add what needs to be done further.

Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

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