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Original Article

Laboratory-confirmed malaria in Southern Libya 2024: A Surveillance-Based Descriptive Cases in a Malaria-Free Setting

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Abstract

Background: Indigenous malaria transmission in Libya was interrupted in 1973, and Libya was subsequently included by WHO among countries recognized as malaria-free in 2012. Nevertheless, malaria cases continue to be reported, particularly in association with population movement and travel to endemic areas. **Methods:** We conducted a retrospective, surveillance-based descriptive case series of laboratory-confirmed malaria reported in southern Libya in 2024. Surveillance records were reviewed for demographic, occupational, travel, parasitological, clinical, treatment, hospitalization, outcome, and environmental characteristics. **Results:** 11 patients accounted for 12 laboratory confirmed malaria episodes. All were male, with a mean age of 32.5 ± 9.9 years. Six (54.5%) were truck drivers and five (45.5%) were traders. Five patients (45.5%) had documented travel to malaria-endemic countries, whereas six (54.5%) had no documented international travel history. *Plasmodium falciparum* was recorded in all patients, including one mixed *P. falciparum/P. vivax* infection. Two patients (18.2%) developed cerebral malaria and died. Treatment completion was documented for five patients (45.5%). One patient had a second confirmed episode approximately two months later; its mechanism could not be determined. **Conclusion:** Continued malaria detection in southern Libya highlights the need for complete case-based surveillance. Cases without documented travel remained of undetermined origin. These findings do not establish local malaria transmission.

Keywords: Malaria; malaria surveillance; imported malaria; malaria-free setting; Libya.

INTRODUCTION

Malaria remains an important infectious disease globally, particularly in countries where transmission persists and where population movement facilitates the spread of malaria parasites across geographical boundaries. In countries that have interrupted indigenous malaria transmission, however, the epidemiological context is different. Although local transmission has been eliminated, infections may continue to be detected through the introduction of parasites by infected travelers or other mobile populations. Consequently, maintaining effective case-based surveillance remains essential for the early detection, investigation, and management of malaria cases and for preventing the re-establishment of local transmission [1].

Libya provides an important example of this post-elimination surveillance context. The last documented local malaria case in Libya was reported in 1973, and Libya was subsequently included among the countries recognized by WHO as malaria-free in 2012 [2]. Nevertheless, malaria cases have continued to be detected in Libya. In recent years, reported cases have included patients with documented travel to malaria-endemic coun tries as well as a smaller number of patients for whom a travel history was not documented. WHO reports have highlighted the difficulty of determining the origin of some infections when epidemiological information, particularly travel history, is incomplete [3]. These circumstances underscore the continuing importance of surveillance even after interruption of indigenous transmission.

The classification of malaria cases according to their likely origin is particularly relevant in malaria-free settings. Imported malaria generally refers to an infection acquired outside the area in which it is diagnosed, but establishing importation requires adequate spatial and temporal information, including travel history and, where possible, the timing of travel, return, symptom onset, and diagnosis [4, 5].

Southern Libya is of particular epidemiological interest because malaria cases have been reported in this region in recent years. Previous surveillance and WHO reports have documented malaria cases in southern Libyan locations, including Sebha and Murzuq, and have emphasized the predominance of cases considered imported while also identifying patients without a documented travel history [3, 6, 7].

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In addition, the movement of people between Libya and malaria-endemic countries in the Sahel and neighboring regions provides an epidemiological context in which imported infections may occur. Population mobility is recognized as an important challenge for malaria surveillance and elimination because infected individuals may move between areas with different levels of malaria transmission, making the geographical origin of an infection difficult to establish without sufficiently detailed case-based information [4].

Despite the continuing detection of malaria cases in Libya, detailed descriptions of laboratory-confirmed cases reported in southern Libya during 2024 remain limited. In particular, there is a need to characterize the demographic and occupational profile of affected patients, documented travel histories, Plasmodium species, clinical manifestations, treatment documentation, outcomes, and selected environmental characteristics. Such information can help describe the epidemiological profile of detected cases while also identifying limitations in routine surveillance data that may affect the assessment of the possible origin of infection [7]. Importantly, descriptive surveillance data alone cannot establish local transmission in the absence of epidemiological and entomological evidence demonstrating transmission within the area.

Therefore, this study aimed to describe the epidemiological and clinical characteristics of laboratory-confirmed malaria cases reported in southern Libya during 2024, with particular emphasis on demographic and occupational characteristics, residence, travel history, Plasmodium species, clinical presentation, treatment documentation, hospitalization, outcomes, and selected environmental factors. The study also aimed to characterize the available surveillance information relevant to the possible origin of infection and to identify gaps in case-based surveillance that may limit the assessment of malaria importation and the prevention of re-establishment of local transmission.

Materials and Methods

Study design and setting: A retrospective, surveillance-based descriptive case series was conducted using malaria surveillance records from southern Libya for the period January to December 2024. The identified patients resided in Sebha and Murzuq.

Study population and units of analysis: The study population comprised patients with laboratory-confirmed malaria recorded in the available surveillance records during 2024. Eleven unique patients were identified. These patients accounted for twelve laboratory-confirmed malaria episodes because one patient experienced two confirmed episodes during the study period.

Laboratory diagnosis and parasite identification: Only laboratory confirmed malaria infections recorded in the surveillance system were included. According to the available records, diagnosis and parasite identification were based on rapid diagnostic testing and microscopy. Recorded Plasmodium species were categorized according to the documented laboratory results as P. falciparum only or mixed P. falciparum/P. vivax infection.

Clinical, treatment, and outcome variables: Clinical manifestations were extracted from the available surveillance and clinical records. Documented manifestations included fever, cerebral malaria, vomiting, anemia, and generalized weakness. Severe disease and death were recorded when explicitly documented.

Hospitalization was analyzed at the patient level: One 45-year-old patient was hospitalized on 12 September 2024 for two days after laboratory confirmation and was discharged before completing treatment. The same patient had a second laboratory-confirmed malaria episode on 12 November 2024. The second episode in the same patient was treated as a separate laboratory-confirmed episode but not as a second patient. The available information was insufficient to determine whether it represented recrudescence after incomplete treatment or a new infection.

Epidemiological classification: Patients with documented travel to malaria endemic countries were considered epidemiologically compatible with possible importation when the available information supported that interpretation. Patients without documented international travel were classified as having an undetermined origin rather than as locally acquired cases. This conservative classification follows the principle that absence of a documented travel history is not sufficient to establish local acquisition [1].

Data analysis: The analysis was descriptive. Categorical variables were summarized using frequencies and percentages. Continuous variables were summarized using the mean, standard deviation, median, interquartile range, and range where appropriate.

Results

Eleven unique patients were identified. All were male (11/11, 100%). Age ranged from 13 to 45 years, with a mean age of 32.5 ± 9.9 years and a median of 32 years (IQR: 28–40). Six patients (54.5%) were truck drivers and five (45.5%) were traders. Eight patients (72.7%) resided in Sebha and three (27.3%) in Murzuq. International travel to malaria endemic countries was documented for five patients (45.5%). Two had travelled to Niger, two to Chad, and one to Sudan. Travel dates ranged from April to September 2024, whereas laboratory confirmed diagnoses occurred between May and November 2024. Dates of return to Libya and symptom onset dates were not consistently available; therefore, the temporal relationship between travel and diagnosis could not be established reliably for all patients (Table 1).

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Table (1): Demographic and epidemiological characteristics of laboratory-confirmed malaria patients in southern Libya, 2024 (N=11).

Characteristic	n	%
Age, years: mean ± SD	32.5 ± 9.9	—
Age, years: median (IQR)	32 (28–40)	—
Age range	13–45	—
Male	11	100.0
Female	0	0.0
Truck driver	6	54.5
Trader	5	45.5
Sebha	8	72.7
Murzuq	3	27.3
Documented international travel: Yes	5	45.5
Documented international travel: No	6	54.5
Travel destination: Niger	2	18.2
Travel destination: Chad	2	18.2
Travel destination: Sudan	1	9.1

Malaria diagnosis and parasite identification were based on rapid diagnostic testing and microscopy according to the available surveillance records. *P. falciparum* was recorded in all eleven patients (100%). Ten patients (90.9%) had *P. falciparum* infection only, while one (9.1%) had mixed *P. falciparum/P. vivax* infection.

Fever was the most frequently documented clinical manifestation and was recorded in six patients (54.5%). Two patients (18.2%) had documented cerebral malaria and died. Two additional patients (18.2%) had fever and vomiting, while one patient (9.1%) had fever, vomiting, anemia, and generalized weakness. One patient (9.1%) had a documented history of blood transfusion. Previous malaria/infection was recorded for two patients (18.2%), and another disease was recorded for one patient (9.1%); the available records did not provide sufficient detail to further characterize these variables (Table 2).

Table (2): Clinical characteristics and outcomes of laboratory confirmed malaria cases (N=11).

Clinical characteristic	n	%
P. falciparum only	10	90.9
P. falciparum + *P. vivax*	1	9.1
Fever	6	54.5
Cerebral malaria	2	18.2
Fever + vomiting	2	18.2
Fever + vomiting + anemia + generalized weakness	1	9.1
Previous malaria/infection	2	18.2
Blood transfusion	1	9.1
Other disease	1	9.1
Death	2	18.2

One patient (9.1%) was a 45-year-old man with documented travel to Sudan. He was hospitalized on 12 September 2024, the date of the first laboratory confirmation, remained hospitalized for two days, and was discharged before completing treatment. A second laboratory-confirmed *P. falciparum* episode was documented on twelve November 2024. This was counted as a second episode in the same patient rather than as a second patient.

Treatment was documented as “Quinin 600” for all 11 patients. Five patients (45.5%) had documented treatment completion, four (36.4%) were recorded as not completing treatment, and two (18.2%) had an unknown completion status. Hospital admission, discharge, and length-of-stay data were not sufficiently complete for quantitative analysis beyond the specifically documented hospitalization.

Mosquitoes were reported around the homes of all 11 patients (100%). Open water tanks were reported by 10 patients (90.9%), and ponds by one patient (9.1%). Only one patient (9.1%) reported using insect barriers (Table 3).

Table (3): Treatment completion and environmental indicators among laboratory confirmed malaria patients (N=11)

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Libyan Journal of Medical Research

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Treatment/environmental indicator	n	%
Treatment completed	5	45.5
Treatment not completed	4	36.4
Treatment completion unknown	2	18.2
Mosquitoes reported around residence	11	100.0
Open water tanks	10	90.9
Ponds	1	9.1
Insect barriers used	1	9.1
No insect barriers	10	90.9

Discussion

This study describes eleven individual Libyan patients accounting for twelve laboratory-confirmed malaria episodes recorded in southern Libya during 2024. The findings should be interpreted within the context of Libya's malaria-free status and the continued need to prevent the reestablishment of indigenous transmission. The detection of laboratory-confirmed malaria cases, in itself, does not demonstrate renewed local or endemic transmission. In malaria-free settings, confirmed cases should instead prompt epidemiological investigation to determine the most likely origin of infection and to identify potential gaps in surveillance and case management. The World Health Organization considers malaria surveillance a core intervention in settings where transmission has been interrupted and where vulnerability to re-establishment remains [7]. The current WHO surveillance framework specifically emphasizes case-based investigation, data quality, and the use of surveillance information to support the prevention of re-establishment of malaria transmission. Five patients had documented travel to Niger, Chad, or Sudan, providing epidemiological information compatible with possible importation. However, six patients had no documented international travel history. These cases should not be classified as locally acquired solely because travel was not documented. Reliable classification of imported malaria requires adequate spatial and temporal information, including the most likely location of infection, countries and areas visited, travel and return dates, and the timing of symptom onset **[4].** In the present study, incomplete travel information limited the ability to determine the most likely origin of infection for these six patients.

The findings are consistent with the broader malaria surveillance context in Libya. Libya has maintained malaria-free status following the interruption of indigenous transmission, while malaria cases continue to be detected through surveillance. WHO reports have documented confirmed malaria cases in central and southern Libya in recent years, with most cases considered imported but with some patients lacking documented travel histories. These observations illustrate the importance of complete travel and epidemiological information when assessing the origin of malaria infections in a malaria-free setting. More recent national surveillance has continued to identify malaria cases in Libya, reinforcing the need for sustained case-based surveillance and timely epidemiological investigation [3].

The occupational profile of the cases is also noteworthy. All eleven patients were either truck drivers or traders, occupations that may involve substantial population mobility and travel through areas where malaria transmission occurs. Previous research has described malaria among long-distance truck drivers and other mobile populations in malaria-endemic settings, highlighting population mobility as an important consideration for malaria surveillance and control [6, 8, 9]. However, because the study did not include a comparison group or population denominator, these occupational findings should be interpreted as a descriptive surveillance signal rather than evidence of an occupational association with malaria infection.

The predominance of *Plasmodium falciparum* in the present series is clinically relevant because falciparum malaria can progress rapidly to severe disease and death if diagnosis and effective treatment are delayed. Two patients in the present series were documented as having cerebral malaria and died. WHO guidance emphasizes prompt parasitological diagnosis and timely, effective treatment, with clinical management determined by parasite species, disease severity, and the clinical circumstances of the patient [10].

The treatment data illustrate an important limitation of routinely collected surveillance information. All patients were recorded as receiving "Quinin 600"; however, the available dataset did not consistently specify the formulation, route of administration, dosing frequency, treatment duration, treatment initiation date, or subsequent changes in treatment. Therefore, the clinical appropriateness or effectiveness of the recorded regimen cannot be assessed from the surveillance data alone. Current WHO malaria guidance is periodically updated, and treatment decisions depend on parasite species, disease severity, patient characteristics, and clinical circumstances [10]. The absence of these treatment details represents an

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important data-quality gap that should be addressed in future malaria surveillance records.

The repeated laboratory confirmed episode in one patient is particularly relevant to surveillance practice. The patient had a laboratory-confirmed malaria episode on 12 September 2024, was hospitalized for two days, was discharged before completing treatment, and subsequently had another confirmed *P. falciparum* episode on 12 November 2024. The available data do not establish whether the second episode represented recrudescence, reinfection, or another mechanism. It is therefore more appropriate to describe it as a second laboratory-confirmed malaria episode in the same individual. Linking patient identifiers with episode-level records is important for distinguishing recurrent episodes from newly identified patients and for supporting appropriate clinical and epidemiological follow-up. This distinction is particularly important in surveillance systems because counting episodes without linking them to individual patients may overestimate the number of affected persons.

Mosquitoes were reported around the homes of all patients, while open water tanks were reported for most patients. These observations indicate environmental conditions that may be relevant to malaria surveillance but do not demonstrate local malaria transmission. Establishing local transmission requires additional epidemiological and entomological evidence, including investigation of competent mosquito vectors, potential breeding sites, parasite circulation, and the spatial and temporal relationship between human cases and vector populations [1]. The WHO surveillance framework includes entomological and case-investigation information among the components that can support assessment of transmission and surveillance-system performance. Therefore, the environmental observations in the present study should be regarded as descriptive findings rather than evidence of locally acquired malaria.

The findings also highlight opportunities to strengthen malaria surveillance in southern Libya. Routine case records should include countries and specific locations visited, departure and return dates, duration of travel, date of symptom onset, diagnostic method, parasite species, treatment regimen and route of administration, treatment initiation and completion dates, hospitalization, clinical outcome, and unique identifiers that allow patient-level records to be linked across individual infection episodes. These elements would improve the classification of potentially imported infections, facilitate investigation of recurrent episodes, and strengthen the capacity of the surveillance system to identify evidence suggestive of local transmission [1, 4]. WHO's current surveillance framework emphasizes standardized case-based information, data quality, case investigation, and the integration of epidemiological, laboratory, clinical, and entomological information across different malaria transmission settings.

Overall, the present findings demonstrate the value of detailed case-based surveillance for interpreting malaria detections in southern Libya. The identification of eleven Libyan patients and twelve laboratory confirmed episodes provides evidence of continued malaria detection in the study area, but the available data are insufficient to establish re-established local transmission. The combination of incomplete travel histories, substantial occupational mobility, limited treatment information, and the absence of entomological or molecular investigation underscores the need for more complete and standardized surveillance data. Strengthening these elements would improve the ability of the malaria surveillance system to distinguish imported infections from cases of undetermined origin and to identify any future evidence of local transmission in a timely manner.

Conclusion

Laboratory-confirmed malaria continues to be detected among patients in southern Libya despite Libya's malaria-free status. In this 2024 surveillance series, documented travel to Niger, Chad, and Sudan was present in five of 11 patients, whereas six had no documented international travel history and therefore remained of undetermined origin. The predominance of P. falciparum and the occurrence of fatal cerebral malaria underscore the clinical importance of maintaining diagnostic and treatment capacity.

The study does not demonstrate re-established local transmission. Instead, it identifies important surveillance and data-quality gaps that limit epidemiological classification and follow-up. Strengthening case-based surveillance through complete documentation of travel and mobility, symptom onset, treatment, treatment completion, hospitalization, outcomes, and patient–episode linkage would improve the interpretation of malaria detections and support prevention of re-establishment in Libya.

Ethical considerations: Ethical approval was the relevant institutional review board (Approval Number: LY NS473221). No biomedical experimentation was involved.

Duality of interest: The authors declare that they have no duality of interest associated with this manuscript.

Author contributions:

Fadwa Mahanay: Conceptualization and study design; data collection; contribution of data and analytical tools; data analysis and interpretation; drafting and revision of the manuscript; and approval of the final version of the manuscript.

Libyan Journal of Medical Research

www.lmjr.ly/ E.ISSN: 2413-6096

Eman Elgusbi: Critical revision of the manuscript for important intellectual content and approval of the final version of the manuscript.
Walid Daw: Contribution to the conception and design of the study; data collection; and approval of the final version of the manuscript.

All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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