

Epidemiological Characterization of Chikungunya Outbreak in Lahj Governorate, Southern Yemen

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Abstract

Background and Objective: An outbreak of Chikungunya fever was poorly documented in the twenty three countries of the Eastern Mediterranean Region of the World Health Organization. The first case of Chikungunya fever was reported in Northern Yemen in the beginning of January 2011. This paper documents the first outbreak of Chikungunya fever in Southern Yemen and highlights the activities and findings of the epidemiology and laboratory team investigation during the outbreak.

Methods: This was a case-series investigation in which the response teams conducted epidemiological and laboratory investigations on suspect cases. The cases identified were line-listed and a data analysis was undertaken regularly to guide the outbreak response.

Results: Overall, 234 cases meeting the Chikungunya fever suspected case definition, were reported between 21st March and 8th May, 2012, from 19 areas in Al-Hawtah district, Lahj Governorate, Southern Yemen. Only 30 (12.8%) of the suspected Chikungunya cases underwent laboratory testing and only 13(43.33%) of them were laboratory confirmed as Chikungunya. Suspected Chikungunya cases had fever (100%) and arthralgia and joint swelling were reported in 95% and 64% of the cases, respectively. The overall attack rate was 7.52 cases/1000 populations. All age group and gender were affected.

Conclusion: This is the first isolation of Chikungunya virus in Al-Hawtah district of Lahj governorate, Southern Yemen. The risk of expansion of Chikungunya fever to other governorates in Yemen and also to neighboring countries remains considerably high, as many of these governorates and countries are dengue prone, host large number of travelers from abroad and competent vectors for indigenous transmission of both dengue and Chikungunya exist in these countries. The location of this outbreak, in a coastal area of the country, makes the spread of the disease a further possibility.

Keywords: Chikungunya; Outbreak; Yemen

Introduction

Chikungunya virus (CHIKV) is an acute viral infection transmitted to humans through the bite of an infected adult female *Aedes* mosquito. The CHIKV belongs to the genus *Alphavirus*, in the family *Togaviridae*. It was first reported in humans in 1952-1953 in Tanzania [1,2]. It is one of the epidemic vector-borne diseases which has recently re-emerged, mainly in Asian and African continents and has led to a significant global public health problem in these countries [3,4]. *Aedes aegypti* and *Aedes albopictus* are the two *Aedes* species commonly responsible for transmission [3,5,6]. Chikungunya is characterized mainly by fever and arthralgia with additional symptoms which include nausea, vomiting, chills, headaches and rashes. It is rarely a life threatening infection and treatment is mainly symptomatic. Clinical manifestations of CHIKV fever show some overlap with, and must be distinguished from dengue fever, as well as juvenile rheumatoid arthritis, rubella, and several other diseases [7].

An outbreak of CHIKV fever was poorly documented in the twenty three countries of the Eastern Mediterranean Region of the World Health Organization (EMRO/WHO). The evidence for the presence of CHIKV from the region came only fortuitously from serological survey done in 1983 in Pakistan [8] and in 2005 from Sudan [9].

In Yemen, the CHIKV was first confirmed in Al-Hodeida governorate in early 2011 with approximately 15, 000 cases including 104 deaths [10]. The CHIKV has been suspected to be the cause of similar

manifestations in other governorates in Yemen including Shabwah, Taiz and Hajjah; however, these infections had not been confirmed to be CHIKV by the time this investigation took place. Dengue fever, which has a clinical manifestation similar to that of CHIKV, is also present in Yemen, in which Lahj governorate experienced a major dengue fever outbreak, notably in Al-Hawtah and Tuban districts, between March and May 2010, affecting more than 1,000 persons. The trend of the disease in Yemen occurs in the period between October-April every year. Extensive health education of households by school students played a key role in encouraging families to eliminate the breeding sites of the vector, thereby, containing the 2010 dengue outbreak in a short time and at low cost. This paper documents the first outbreak of CHIKV fever in Southern Yemen and highlights the

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activities and findings of the epidemiology and laboratory team during the outbreak

Objectives of the outbreak investigation

- i. Describe the outbreak, identify the at-risk population and monitor the trend of the outbreak;
- ii. Confirm the etiology of the outbreak;
- iii. Initiate control interventions and monitor their impact.

Methods

Epidemic site

Lahj governorate is the fifth largest governorate in the Republic of Yemen, covering a total area of 13,046 km². It is located 320 km southwest of the Capital City of Sana'a and 30 km to the east of the coastal City of Aden. Al-Hawtah is the capital city of Lahj and is considered a crossing point to and from many governorates. Al-Hawtah is also a favorite stopover for tourists, because of the presence of vital facilities, administrative centers and markets. Lahj governorate borders Abyan governorate in the East, Taiz governorate to the Southeast, Al-Bayda governorate to the Northwest and Aden governorate to the South (Figure 1). The governorate is subdivided into 15 districts with an estimated total population of 869,253 with a sex distribution of 50% (435,028) females and 50% (434,225) males, and 793,964 (91%) of the total population living in the rural areas (health office of Lahj Governorate). The topography of Lahj varies from high mountains reaching 2500 meters above sea level as part of As-Sarat mountainous range, to fertile Wadis (valleys), such as Wadi Tuban less than 600 meters, which is one of the most fertile Wadis in Yemen. The climate varies according to the topography with temperatures in the coastal plains increasing to 32°C in the summer and decreasing to 20°C in the winter. Rainfalls occur during the winter and autumn in the coastal plains and in spring and summer in the mountainous areas.

Investigation team

The epidemiology and laboratory team was one of the subcommittees of the national task force established to respond to the outbreak. The experts on the team included medical epidemiologists, physicians, laboratory experts, and social workers drawn from the Ministry of Health & Population and World Health Organization (WHO) office in Yemen.

Epidemiology and laboratory activities

Epidemiology: This was a case-series investigation in which the field teams conducted detailed clinical descriptions of all suspected cases. A working case definition was developed initially for unknown disease, followed by the identification of Chikungunya using the WHO standard case definition for Chikungunya, as followings:

- i. Clinical criteria: Acute onset of fever (>38.5°C) and severe/incapacitating arthralgia not explained by other medical conditions
- ii. Epidemiological criteria: Residing in or having visited epidemic areas, having reported transmission lasted for 15 days prior to the onset of symptoms.
- iii. Laboratory criteria: At least one of the following tests in the acute phase:
 - Virus isolation
 - Presence of viral RNA by RT-PCR
 - Presence of virus specific IgM/IgG antibodies in single serum sample collected during acute or convalescent stage.

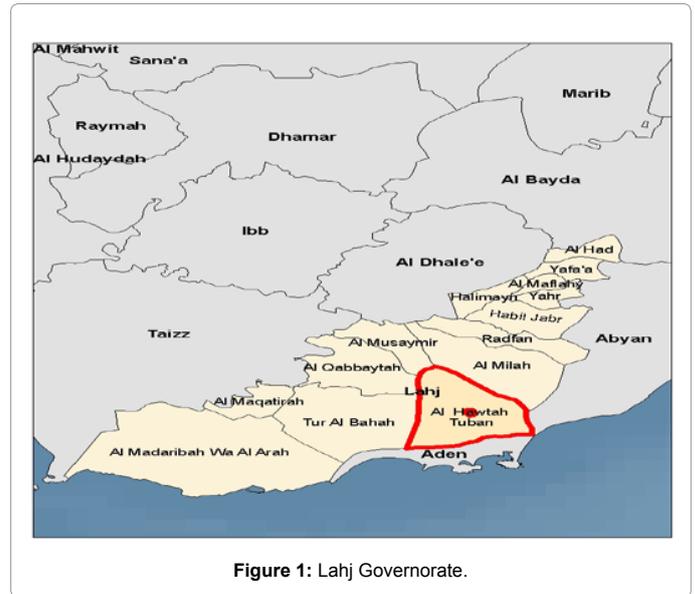


Figure 1: Lahj Governorate.

- Four- fold increase in IgG values in samples collected at least three weeks part
- iv. Case classification:
 - Suspected case: a patient meeting clinical criteria using the WHO standard case definition for Chikungunya as mentioned above.
 - Probable case: a patient meeting both the clinical and epidemiological criteria
 - Confirmed case: a patient meeting the laboratory criteria, irrespective of the clinical presentation

All new suspected Chikungunya cases were given supportive treatment at designated treatment centers that maintained case line-lists with key variables including: identifiers, age, sex, residence, date of onset of illness, clinical signs and symptoms, date of specimen collection, laboratory results, case classification, and case outcome.

Laboratory: Prior to the confirmation of Chikungunya, blood specimens were collected from each case “under investigation” and sent to either of the two reference laboratories: Public Health Laboratory Center in Aden and National Public Health Laboratory Center in Sana'a for quality control. The diagnosis was confirmed by real-time reverse transcription-PCR (Real Star[®] Chikungunya RT-PCR-Altoona Diagnostics GmbH-Mörkenstraße 12; D-22767 Hamburg. Sensitivity and specificity was 100%).

Data analysis

A Microsoft Excel data-entry screen incorporating all the variables on the Chikungunya line-list was developed and used to capture all the information on the cases reported during the outbreak. The population projections for the affected district were obtained and used to compute disease attack rates by age groups. Epidemic curves were drawn using the dates of onset to determine outbreak trends.

Ethical consideration

All epidemiological and laboratory data were collected as part of the routine outbreak investigation by national multi-sector teams, hence ethical clearance approval from the Academic Research Committee of the Faculty of Medicine of the University of Thamar, Ministry of Public Health and Population in Sana'a and verbal consent from all patients included in this study was obtained prior to data collection

Results

Outbreak investigation and response

Following prolonged outbreak investigations that lasted for 15 days, laboratory confirmation of Chikungunya was made on April 27, 2012 by the National Public Health Laboratory Center in Sana'a using a real-time reverse transcription-PCR. A national response plan prioritizing surveillance and laboratory confirmation, case management, social mobilization and health education was developed to control the outbreak in coordination with WHO office in Yemen.

Index case investigations

In Al-Hawtah district, the index case was a child of 14 year of age. His illness, which started on 21st March 2012, was characterized by fever, headache, arthralgia and joint swelling. He received supportive treatment from the health center in Al-Hawtah district. He had not travelled out of his home village or stayed with any sick persons prior to the onset of illness; hence the origin of this outbreak most probably remains unknown although purely circumstantial evidence suggests an introduction of virus from outside. Lahj governorate, an important seaport in Yemen, probably provided an optimal opportunity for such introduction through any viraemic patient amongst the non-resident workers who usually return to the country using this port during the holiday season. The timing of the return of these workers coincided with the beginning of the outbreak. It is plausible that that once the virus was introduced, transmission was sustained due to a susceptible host and the presence of high vector densities of *Ae. Aegypti* which probably peaked following a record rainfall in the area. The governorate is well known for its dengue endemicity already had efficient vectors-*Ae. aegypti* populations. While these vector pockets maintained transmission, continuous population movement between the port city, an important place for local economic activities, and other districts helped spread the disease.

Epidemiological and clinical description of cases

A total of 234 cases meeting the case definition of the suspected Chikungunya were reported during the period between 21st March to 8th May, 2012, from the 19 areas (sub-districts) of Al-Hawtah district of Lahj Governorate in Southern Yemen. The sub-districts included Fish market, Alhawtah, Edu.street, Alhdad, Aldoba, Alnkhraa, Alshakh Saeed, Masawe, Alrubat, Allebi, Abas, Alsseah, Hamahem, Aladani, Alseahh, Almahlah, Obar Laslom, Alseyah and other areas in the same district. The majority of suspected cases (46%) were from the fish market area of Al-Hawtah district (Table 1).

Fever and headache were present in all cases (100%). Arthralgia and joint swelling were reported in 95% and 64% of the cases, respectively. Nausea or vomiting was present in 85% of the cases, with most of the cases having nausea rather than vomiting. Half of the cases exhibited rash. One case exhibited bleeding manifestations (hematemesis) (Figure 2).

Among the 234 cases that met the case definition for suspected Chikungunya, 30 (12.8%) underwent laboratory testing for Chikungunya and only 13 (43.33%) were laboratory confirmed as Chikungunya. The age of Chikungunya suspected cases varied from 4 to 45 years, with a mean of age grouped 25.4 years (range from 4-45years) and standard deviation 14.9. The age among patients was almost normally distributed, with a slight skewing towards the older age groups.

On 18th April, 2012, a physician working in a private clinic in Al-

Hawtah, reported to the Lahj governorate surveillance coordinator that he had seen three patients complaining of fever, headache and severe joint pain not explained by the common infectious diseases existent in that area. Another report was received on the 21st of April that about 20 persons from Al-Hawtah, and from the same extended family, were complaining of fever with severe joint pain and the inability to walk. The surveillance department responded immediately to investigate these cases and search for other similar cases in the surrounding areas. In the subsequent days there was a gradual increase in cases reported from the affected areas, reaching a plateau on 20th April, 2012; the number of reported cases declined from 21st April to 2nd May 2012 and again increased gradually from 3rd May reaching a plateau on 6th May, and declined on 8th May 2012 (Figure 3).

The overall attack rate (cases per 1000 population) for Chikungunya in the 19 areas (sub-districts), where an outbreak was confirmed was 7.52; this varied from 5.3 among age group 0-4 to 12.2 among ≥ 45 age group (Table 2).

The risk of Chikungunya transmission was highest among patients on the age group 25-29 years. Of the total 234 cases recorded, 122 were males (52%) and 112 were females (48%), Male to female Ratio was 1.09:1 (Table 3).

Laboratory findings

Out of 30 specimens tested, only 13 were confirmed positive for Chikungunya: four cases by PCR, nine cases by IgM positive. One sample from a suspected case had a positive IgM serological test for dengue fever and malaria was confirmed in 2 cases.

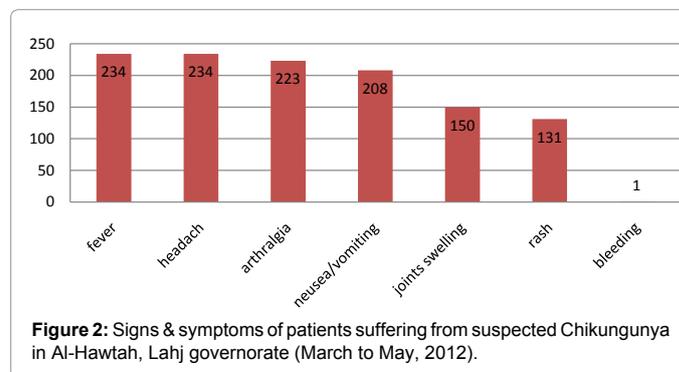


Figure 2: Signs & symptoms of patients suffering from suspected Chikungunya in Al-Hawtah, Lahj governorate (March to May, 2012).

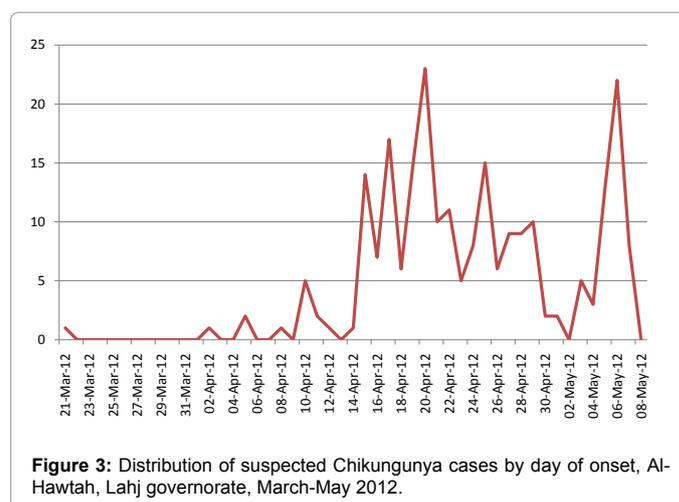


Figure 3: Distribution of suspected Chikungunya cases by day of onset, Al-Hawtah, Lahj governorate, March-May 2012.

Area(sub-district)	Frequency (%)	Area(sub-district)	Frequency (%)	Area(sub-district)	Frequency (%)
Fish market	108(46%)	Alshakh Saeed	6 (3%)	Hamahem	3 (1%)
Alhawtah	24 (10%)	Masawe	5 (2%)	Aladani	3 (1%)
Edu. Street	11(5%)	Alrubat	4 (2%)	Alseahh	2 (1%)
Alhdad	9 (4%)	Allebi	4 (2%)	Almahlan	2 (1%)
Aldoba	8 (3%)	Abas	4 (2%)	Obar Laslom	2 (1%)
Alnkhraa	7 (3%)	Alsseah	4 (2%)	Alseyah	2 (1%)
				Other areas in the same district	25 (11%)

Table 1: Distribution of suspected Chikungunya cases by place in Al-Hawtah district, Lahj governorate, during the period between 21st March to 8th May, 2012.

Age group	Population	No. Cases	Attack rate/1000 population
0-4	4108	22	5.3
5-9	3549	23	6.5
10-14	3549	25	7
15-19	3398	19	5.6
20-24	3396	23	6.7
25-29	3366	34	10.1
30-34	2119	18	8.5
35-39	2116	14	6.6
40-44	2085	14	6.7
≥ 45	3443	42	12.2
Overall attack rate	31129	234	7.52

Table 2: Attack rate of suspected Chikungunya cases, by age group, Al-Hawtah-Lahj, March- May 2012.

Age group	Female	Male	Total
0-4	10	12	22
5-9	11	12	23
10-14	11	14	25
15-19	12	7	19
20-24	6	17	23
25-29	14	20	34
30-34	9	9	18
35-39	7	7	14
40-44	10	4	14
≥45	22	20	42
Total	112	122	234

Table 3: Distribution of the Chikungunya suspected cases by the age and gender, Lahj, March-May 2012.

Discussion and Conclusion

An outbreak of Chikungunya fever was poorly documented in the twenty three countries of the Eastern Mediterranean Region of WHO. The evidence for the presence of CHIKV from the region came only fortuitously from serological survey done in 1983 in Pakistan [8] and in 2005 from Sudan [9]. The first case of Chikungunya fever was reported in Northern Yemen in the beginning of January 2011 [10]. This paper documents the first outbreak of CHIKV in Southern Yemen and highlights the activities and findings of the epidemiology and laboratory team during the outbreak.

During the period between March to May 2012, Yemen experienced an outbreak of Chikungunya in Al-Hawtah district of Lahj Governorate, southern Yemen, which is the fifth largest governorate in the Republic of Yemen, covering a total of 13046 km². The overall attack rate in the 19 areas (sub-district), where the outbreak was confirmed, was 7.52 cases per 1000 population. Prior to the outbreak in northern Yemen in 2011, the attack rate was 6.25 cases per 1000 population. However, this was the first time in which a Chikungunya outbreak has been confirmed in southern Yemen.

In terms of outbreak severity, the case fatality rate (CFR%) was zero (234 reported cases with no deaths) comparing with previous outbreak in the north of Yemen CFR was 0.70 % .The CFR measures the quality

of care, which is premised on a timely and definitive diagnosis and also represents the killing power of the diseases. Our findings suggest that Chikungunya is almost self-limiting and rarely fatal, a consistent finding with other studies [7,11].

In the present study in Al-Hawtah district of Lahj Governorate, fever, arthralgia, headache, itch/rash, and nausea were found in majority of the patients. This study showed that age seemed to play a significant role in the manifestation of symptoms with infants experiencing an abrupt onset of fever followed by flushing of the skin and a generalized maculo-papular rash and older children experiencing an acute fever, headache, and arthralgia involving various joints, which is similar to results found in other studies [7,12-14].

In India, during 2006 CHIKV epidemic more cases were reported in the adult age groups even though all age groups were affected [15,16]. In Reunion, women (68%) were reported to be more affected than men, with more adults being affected than children (74% of victims were over 30 yrs of age) [17]. In Andhra Pradesh of India, Chikungunya fever affected all the age groups and both gender [7]. Similar features were also observed in this study, with all age groups and gender affected.

Hemorrhagic manifestations including, bleeding, petechiae and/ or skin rashes were generally uncommon in the Chikungunya cases

during earlier outbreak episodes worldwide [8]. In our study we have just reported one case with hemorrhagic manifestations.

The surveillance department response did not occur until 29 days after the outbreak was initiated and hence there was a delay in initiating the recommended supportive treatment and reactive control measures. The delay in obtaining early response during this outbreak could be attributable to several factors; the atypical presentation of cases was one of the reasons for the delayed confirmation, together with the observation by the physicians of those patients that improved on antibiotics and supportive treatment. The patients identified during the Chikungunya outbreak in northern Yemen presented with a febrile illness that was characterized by fever (100%), headache (100%) and arthralgia (95%); bleeding manifestations was rare and only reported in 0.4% of the suspected Chikungunya cases. Given the country's recent experience with flavivirus (Dengue fever outbreak) and malaria, which were the top diseases on the list of differential diagnoses, resulting in these two diseases being prioritized for clinicians and laboratory testing? Due to the weak, case based, surveillance for CHIKV in the country with no capacity for CHIKV testing in Lahj Governorate when the outbreak started, hence the need to refer specimens to the Central laboratory in Sana'a City, the Capital of Yemen and consequently the delay diagnosis of the disease.

The epidemic curve for the CHIKV outbreak in northern Yemen showed a gradual rise in cases before reaching a plateau that lasted for nearly 4 weeks, indicating a continuous common-source epidemic, a pattern that is seen in vector-borne disease outbreaks like CHIKV due to delayed initiation of reactive control measures.

Conclusion

This is the first time that Chikungunya virus has been isolated in Al-Hawtah district of Lahj governorate, Southern Yemen. The risk of expansion of Chikungunya fever to other governorates in Yemen and also to the neighboring countries of Yemen remains considerably high as many of these governorates and countries are dengue prone, host large number of travelers from abroad and competent vectors for indigenous transmission of both DENV (Dengue virus) and CHIKV exist in these governorates or countries. The location of this outbreak in a coastal area of the country makes the spread of the disease a further possibility.

Study limitations

A limitation of this study arises from the fact that not all suspected CHIKV cases underwent laboratory investigation. The few suspected cases of CHIKV that were not tested could easily have had any other diseases particularly DENV infection, which has been endemic in Yemen since 2004. Many cases of febrile illness with any signs of bleeding were reported as suspected hemorrhagic fever cases. Most of these were not confirmed as CHIKV or dengue fever virus cases and were not investigated further.

Recommendations

Following the re-emergence of CHIKV in Yemen, we recommend that case-based surveillance for CHIKV is strengthened. CHIKV should be considered as a differential in all cases presenting with a febrile hemorrhagic illness. In addition, the in-country capacity for CHIKV testing should be established. A nationwide risk assessment should be undertaken to inform the national CHIKV control strategy. Given that Chikungunya fever mosquitoes are peri-domestic and have breeding sites close to human dwellings, often in backyards, the reduction of

mosquito breeding sites is crucial to interrupt the transmission of virus circulation.

Authors' Contributions

All authors attest to having contributed substantially to conception and design and acquisition of data and drafting the article and revising it critically for important intellectual content. All authors give approval of the final version to be published.

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