

SHORT REPORT

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Investigation of a typhoid fever epidemic in Moyale Sub-County, Kenya, 2014–2015

Dahabo Adi Galgallo^{1,2*}, Zeinab Gura Roka², Waqo G. Boru², Khalumi Abill¹ and James Ransom^{2,3}

Abstract

Aim: Typhoid fever is a vaccine-preventable bacterial disease that causes significant morbidity and mortality throughout Africa. This paper describes an upsurge of typhoid fever cases in Moyale Sub-County (MSC), Kenya, 2014–2015.

Methods: We conducted active hospital and health facility surveillance and laboratory and antimicrobial sensitivity testing for all patients presenting with headache, fever, stomach pains, diarrhea, or constipation at five MSC health facilities between December 2014 and January 2015. We also conducted direct observation of the residential areas of the suspected cases to assess potential environmental exposures and transmission mechanisms. Demographic, clinical, and laboratory data were entered into, and descriptive statistics were calculated with, MS Excel.

Results: A total of 317 patients were included in the study, with mean age 24 ± 8.1 years, and 51% female. Of the 317 suspect cases, 155 (49%) were positive by Widal antigen reaction test. A total of 188 (59%) specimens were subjected to culture and sensitivity testing, with 71 (38%) culture positive and 54 (76%), 43 (60%), and 33 (46%) sensitive to ceftriaxone, cefuroxime, and ciprofloxacin, respectively. Environmental assessments through direct observations showed that commercial and residential areas had limited (1) clean water sources, (2) latrines, and (3) hygiene stations for street food hawkers and their customers.

Conclusions: Typhoid fever is endemic in MSC and causes significant disease across age and sex groups. The local health department should develop policies to (1) assure community access to potable water and hygiene stations and (2) vaccinate specific occupations, such as food and drink handlers, against typhoid.

Keywords: Typhoid epidemic, Kenya, Sanitation, Laboratory

Introduction

Typhoid fever, caused by the bacterium *Salmonella typhi* (*S. typhi*), sickens millions of people each year and remains a significant public health problem in low-income countries [1]. Annual incidence in Africa ranges from 13 to 845 cases per 100,000 population, but its epidemiology in Kenya is poorly characterized [2]. In 2014, Moyale Sub-County (MSC), the northernmost point of Marsabit County, reported 3498 cases of typhoid—an annual incidence three times higher than the highest estimates in African countries [1]. MSC (population 130,000) shares a border with Ethiopia and is served by 90 health facilities comprised of 4 hospitals,

17 health centers, 54 dispensaries, 13 private health facilities (nursing homes), and 2 functional clinical laboratories (Fig. 1). This report describes a hospital- and health facility-based epidemiological investigation of suspected typhoid cases at five health facilities in MSC, from December 2014 to January 2015.

Methods

Descriptive epidemiology

We conducted active hospital and facility surveillance for clinically diagnosed cases of typhoid fever by reviewing records from five health facilities in MSC of patients admitted between December 5, 2014, and January 5, 2015. Our case definition was any patient presenting with clinical signs and symptoms consistent with typhoid fever, including headache, fever, stomach pains, diarrhea, or chronic constipation. Laboratory procedures included rapid

* Correspondence: adi.dahabo@yahoo.com

¹Moyale Sub-County Hospital, Moyale, Marsabit County, Kenya

²Field Epidemiology and Laboratory Training Program, Ministry of Health, Nairobi, Kenya

Full list of author information is available at the end of the article





Fig. 1 Map of MSC

diagnostic tests (Widal), confirmatory culture from stool specimens, and antimicrobial sensitivity testing. Sociodemographic, clinical, and laboratory data were entered into, and descriptive statistics were calculated with, MS Excel.

Environmental survey

We conducted direct environmental observation and site visits to the most affected areas (based on

reported residence of suspect cases) over a consecutive 3-day period. Each day was a 12-h continuous session in areas home to most cases to examine access to hygiene stations (toilets, water) and frequency of handwashing by food and drink vendors and their customers. Documentation included detailed observation notes and photographic evidence of the environment.

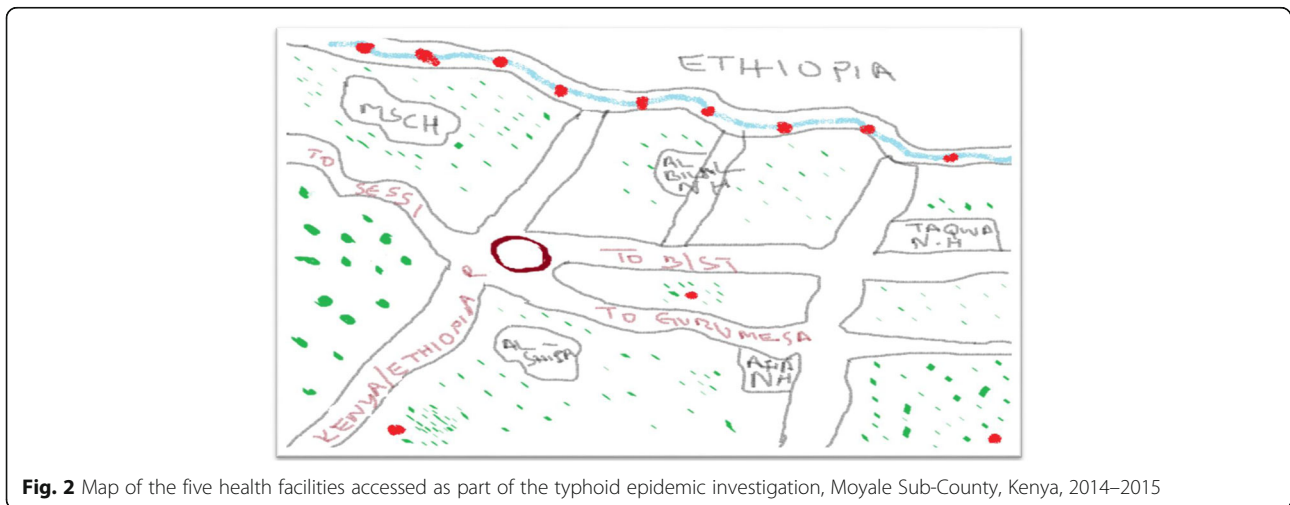


Fig. 2 Map of the five health facilities accessed as part of the typhoid epidemic investigation, Moyale Sub-County, Kenya, 2014–2015

Results

Descriptive epidemiology

A total of 317 patients were identified between December 5, 2014, and January 5, 2015, with mean age of 24 ± 8.1 years. Most [95 (30%)] cases were from Taqwa Nursing Home. MSC Hospital and Al Shifa Clinic had 82 (26%) and 73 (23%) cases, respectively (Fig. 2).

Laboratory

Of the 317 patients, 155 (49%) were positive via the Widal rapid diagnostic test, with 87 (56%) < 18 years old. Of the 317 patients, 188 (59%) submitted a stool specimen suitable for culture, of which 71 (38%) showed growth. Antimicrobial testing on culture-positive samples showed sensitivity to ceftriaxone [54 (76%)], ciprofloxacin [33 (46%)], and cefuroxime [43 (60%)], which is the drug of choice for treatment of typhoid in MSC (Table 1).

Environmental assessment

We observed multiple open-air food and drink markets in many of the areas where the cases reside (Fig. 3a, b). Within the city, there is a no-man's land between the Kenya and Ethiopia sides of MSC where animal and human waste are deposited very near a water source (Fig. 3c). Villages such as Manyatta and Butiye, which reported the fewest number of positive cases, depend on water from the main water supply or sometimes from harvested rain water. Analysis of the direct observation notes also showed that people in areas that reported most of the positive cases depend on water from shallow wells, which are likely contaminated with human waste (Fig. 3d).

During the 96 h of observation, 55% (65/119) of vendors' and 69% (37/54) of customers' fecal-hand contamination events were not followed within 15 min by handwashing. Potential transmission of fecal material to food, drink, or mouth occurred in 64% of cases within 1 h of hand contamination. When we measured the amount of water used at these sites, the mean water usage (6.5 l) was low compared to international disaster relief standards [3].

Discussion

A typhoid epidemic was detected in MSC due to an increase in the numbers of Widal tests performed at the MSC Hospital laboratory in 2014. This epidemic, which may be part of an overall increase in prolonged, severe, and widespread typhoid outbreaks in both rural and urban populations in Africa, seemed to be predicated on limited access to and use of safe water and sanitation [4]. One possible explanation for the low use of water and poor hand hygiene practices, especially in areas with many commercial food and drink vendors, is the lack of

Table 1 Patient demographic characteristics and positive typhoid laboratory results, Moyale Sub-County, Kenya, 2014–2015

Variable	N (%)
Sex (n = 157)	
Male	77 (49)
Female	80 (51)
Age group (years) (n = 155)	
< 18	87 (56)
> 18	68 (44)
Facility (n = 157)	
Taqwa Nursing Home	47 (30)
Moyale Sub-County Hospital	40 (26)
Al Shifa Clinic	36 (23)
Afya Nursing Home	17 (11)
Al Bilal Nursing Home	16 (10)
Residence (n = 155)	
Township	37 (24)
Biashara Street	37 (24)
Sessi	37 (24)
Butiye	22 (14)
Manyatta	17 (11)
Gurumesa	5 (3)
Laboratory	
Widal (n = 317)	155 (49)
Culture (n = 188)	71 (38)
Antimicrobial sensitivity testing (n = 71)	
Ceftriaxone	54 (76)
Cefuroxime	43 (60)
Ciprofloxacin	33 (46)
Ofloxacin	27 (38)
Nitrofurantoin	25 (35)
Chlorophenicol	23 (32)
Gentamicin	19 (26)
Amoxicillin	11 (15)

Any record that did not contain the specific part of the case's sociodemographic information was excluded from the analysis; therefore, denominators differ from one variable to the next

regular access to chlorination products [5]. In low-income countries like Kenya, typhoid infection is usually acquired by consumption of food or water contaminated with human excreta that contains *S. typhi* [1].

Our results via direct observation of the cases' environments highlight the need for more effective interventions to improve knowledge of typhoid fever transmission and prevention and increase uptake of preventive behaviors such as handwashing [6, 7]. Areas experiencing inaccessibility to clean and safe water like Sessi, Township, and Biashara Street had

a Open-air food market**b** Open-air milk and drink market**c** Neutral zone, Kenya-Ethiopia border**d** Accessing water at shallow well

Fig. 3 a-d Potential sources of spread documented during direct observation/environmental assessments, typhoid epidemic investigation, Moyale Sub-County, Kenya, 2014–2015

the most cases (111 [71%]), whereas areas with access to clean water like Butiye, Manyatta, and Gurumesa had the fewest cases (44 [28%]). Areas where food hawking was rampant, such as in Township and Biashara Street, had more cases of people who were < 18 years of age, possibly due to more frequent visits to the food and drink vendors.

In our study, the antimicrobial sensitivity results and the overall culture results are suspect because of rampant self-medication with antibiotics that can be purchased at pharmacies throughout MSC. It is probable, from the histories provided by the patients, that they had antibiotic treatment prior to coming to hospital, hence complicating our ability to interpret culture results [8].

Despite better surveillance and understanding of the epidemiology of typhoid fever, public health seems to be losing the battle against typhoid fever in most African countries [9]. Traditional “hygiene” recommendations did not prevent this epidemic, as there was no mechanism for the communities to remediate the water that was available to them nor to install proper latrines near their homes or near the market areas. Because necessary improvements to water and sanitation are likely to take decades to achieve, we think that targeted and appropriate vaccination campaigns or availability of typhoid vaccines at health

facilities could potentially reduce morbidity and mortality [10]. Recommendations should also focus on targeting water treatment packs to the areas that have the bulk of cases, which would reduce risk of specific practices rather than discuss elimination, which is not practical in most affected areas.

Abbreviations

MSC: Moyale Sub-County; *S. typhi*: *Salmonella typhi*

Acknowledgements

We thank the clinical and laboratory staff at the five health facilities in Moyale Sub-County and the faculty and staff at the Kenya Field Epidemiology and Laboratory Training Program in Nairobi.

Authors' contributions

DAG, ZGR, KA, and WGB designed the study. KA and DAG conducted all laboratory procedures. JR and DAG organized and analyzed all data. DAG and KA conducted the environmental assessment observations and created the community map. JR conducted the final data analysis and checks. All authors read and approved the final manuscript.

Ethics approval and consent to participate

Ethical approval was granted by the head of Moyale Sub-County Hospital and Department of Public Health, Moyale Sub-County, Kenya.

Consent for publication

All authors consent to the publication of this manuscript.

Competing interests

The authors declare that they have no competing interests.

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Author details

¹Moyale Sub-County Hospital, Moyale, Marsabit County, Kenya. ²Field Epidemiology and Laboratory Training Program, Ministry of Health, Nairobi, Kenya. ³Piret Partners Consulting, Washington DC, USA.

Received: 17 March 2017 Accepted: 30 April 2018

Published online: 15 May 2018

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