

*Research Article*

## **Measles disease outbreak and genotype identification in Libya, 2018**

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### **Abstract**

**Background:** There is no data published related to measles outbreaks in Libya. The study aims to report a descriptive analysis of measles outbreaks that occurred in 2018.

**Methods:** Retrospective data of measles outbreaks in 2018 were analysed to describe the characteristics of the outbreaks and their incidence in Libya. Data aggregations of seven outbreaks were extracted during the period January to December 2018 from the National Measles Surveillance Programme which is the official institute responsible for measles surveillance in the country. Data were categorised as confirmed measles cases, district distribution, deaths, age distribution, sex ratio, monthly trends, and measles vaccination status in the outbreaks. Also, the measles virus genotype was identified and compared with the reference strain.

**Results:** A total of 934 confirmed measles cases were detected in seven outbreaks in different locations of the country in 2018. The biggest outbreak was found in Zliten (449 measles cases, 48.0%) followed by Benghazi (374 measles cases, 40.0%). The majority were below 15 years (811 measles cases, 87.0%). The incidence rate of cases was 223/million population. The peak of occurrence began in June 2018 and continued to December. Children with measles who had completed two doses of vaccines were 18.0%, whilst 62.0% were unvaccinated. The genotype sequence was identified in three outbreaks being B3.

**Conclusion:** A significant measles incidence was detected in many outbreaks mainly in the age group below 15 years. The immunity building programme must be evaluated to address the weakness of routine immunisation.

*Keywords: Measles, Outbreak, Vaccine, Age groups, Libya*

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## Introduction

Measles is a contagious infectious disease, with significant mortality in children with malnutrition and low immunity, although all age groups are vulnerable, especially if unvaccinated. It could cause lifelong complications such as blindness. In spite of the availability of a cost effective vaccine, WHO reports that in 2018, there were more than 140,000 deaths due to measles globally, mostly among children under five years.<sup>1,2</sup> Measles is six times more infectious than influenza, and complications may occur in 20% of cases.<sup>3</sup> The measles vaccine (MCV) is effective, safe, and relatively inexpensive. Measles can be prevented by giving the vaccine to children between 9 months and 15 years. The coverage rate of the measles vaccine is substantially increased through routine childhood vaccination and mass vaccination campaigns globally.<sup>1</sup> The effectiveness of MCV may reach 97% of children if two doses are given but does not exceed 93% if only one dose is given.<sup>4,5</sup> In Libya, two doses of MCV are given to children through routine childhood vaccination at the ages of 12 and 18 months.<sup>6</sup> Measles outbreaks can occur when there are enough susceptible individuals for effective transmission. These outbreaks can occur every two to three years with low vaccine coverage and may occur with lengthened inter-epidemic periods when there is high vaccination coverage.<sup>7</sup>

According to surveillance standard operating procedures for communicable disease surveillance and response (SOPs) in Libya, an outbreak is proven when there are at least 3 confirmed cases which are epidemiologically or virologically-linked.<sup>8</sup> The genetic characterisation of the measles virus in Libya was B3 since 2005. The country planned to take action for an elimination stage goal in 2005, starting with a national measles and rubella (MR) campaign. The number of cases dropped from 2771 in 2004 to 292 in 2005. However, the number of cases steadily increased thereafter to reach 1852 in 2018. Measles outbreaks have not been reported in the last five years<sup>8,9,10,11</sup>

This study aims to introduce a descriptive analysis of the measles burden including the genotype in Libya in 2018.

## Methods

The study provides a descriptive analysis of the measles outbreak and an estimated incidence of measles cases during the outbreaks in 2018, and a comparison with the measles outbreaks between 2013 and 2017. Data for the period January to December 2018 was extracted from the National Measles Surveillance Programme (NMSP). NMSP is an official laboratory affiliated to the National Centre for Disease Control (NCDC) and is responsible for the collection of data on measles. The data used in the study were confirmed measles cases, distribution in districts, deaths, age distribution, sex ratio, monthly trends, and vaccination status of each case.

To confirm a measles case, NMSP receives the notification of suspected measles from a surveillance officer at a health facility based on a case definition which is “a case with skin rash and fever at any age”<sup>8,11,12,13</sup>. The case officer then completes an application form and collects a blood sample from the suspected case. The form and sample are sent to the National Measles Laboratory (NML) where testing is done using the SERION ELISA, Measles Viruses IgM from

INSTITUT VIRION/SERION GMBH industry approved and supplied by the WHO. The NML is a part of the NCDC, approved by the World Health Organisation (WHO) which supplies kits and materials, and trains laboratory staff. Results are interpreted by the national measles focal point who is responsible for implementing the measles programme, issuing weekly reports and identifying outbreaks.

In addition, the study will present the distribution of measles cases on a spot map. The NMSP determined the outbreaks according to the measles outbreak definition which is “three or more laboratory-confirmed cases epidemiologically linked”<sup>8,13</sup>.

Measles genotype was identified at the regional reference laboratory in Tunis. The genotype detected was compared with previous measles genotypes (the reference strain) to determine whether it is identical or imported.<sup>14,15</sup> The SOPs (as defined in the introduction) are used to identify any outbreak of infectious diseases in Libya.

Excel software was used to analyse the data. SPSS software was used to compare measles cases according to age and gender using T-Test, with significance at p-values <0.05. . The incidence of cases in the outbreak were calculated based on estimates of population census in 2018.<sup>16</sup>

The management of NMSP gave permission for the measles outbreak data for 2018 to be analysed and published.

## **Results**

### **Number of cases, districts, and genotype**

There were seven outbreaks that occurred in different districts of the country. The total number of confirmed measles cases in the 7 outbreaks was 934 of which 214 were NML confirmed, while 720 were epidemiologically linked to positive measles cases confirmed by NML.

Two measles death were confirmed as epidemiologically-linked in Algatroun and Zliten with no complications registered. Measles virus genotype was determined in the three outbreaks to be B3.

Table 1 shows the number of cases in each outbreak. Figure 1 shows the distribution of the outbreaks within the country and the density of cases within each city. All the outbreaks were related to each other as shown in Figure 2.

### **Spot map of measles cases**

Most measles cases were detected in Zliten (n=449; 48%) which was the largest outbreak in 2018 followed by Benghazi (n=374; 40%). The number of cases elsewhere varied from 5 (0.5%) in Obari to 70 (7%) in the capital, Tripoli (Figure 1)

### **Monthly trends**

The cases significantly increased to a peak in July (n=183) and steadily decreased until September; and then continued at a similar level up to the end of the year (Fig 3).

### Age distribution, sex ratio, and case fatality rate

Children less than one year made up 38% of all patients with measles in 2018 with 33% between 1-5 years and 18% between 5-15 years. Children <15 years therefore contributed to 87% of measles cases during the 2018 outbreaks (Table 2). There was no gender difference as shown in Table 2. Deaths occurred in 2 measles cases with a case fatality rate of 0.2%. No complications were registered in the patients' files

Two-thirds of measles cases (575, 62%) were unvaccinated children, whilst 49 children were vaccinated with one dose (5%) and 155 (18%) had received two doses (Figure 4).

**Table 1. Libyan outbreaks, 2018**  
Location of outbreaks, case characterization, deaths, genotype and incidence

District	Started (Month)	Lab measles confirmation	Epi-Linked	Deaths	Total	%	Genotype	Total population*	Incidence per/million
Algatroun	Apr	7	2	1	9	0.9%	-	14,310	629
Zliten	May	89	360	1	449	48.0%	B3	250,420	1793
Obari	May	5	0	0	5	0.5%	-	33,146	151
Alabiar	July	14	3	0	17	2.0%	-	31,720	536
Morzoq	July	10	0	0	10	1.0%	-	25,895	386
Tripoli	Aug	61	9	0	70	7.4%	B3	2,647,301	26
Benghazi	Sept	28	346	0	374	40.0%	B3	1,193,670	313
<b>Total</b>		<b>214</b>	<b>720</b>	<b>2</b>	<b>934</b>			<b>4,196,462</b>	<b>223</b>

\* Measles incidence was calculated using a formula ( Total number of measles cases / population X one million)

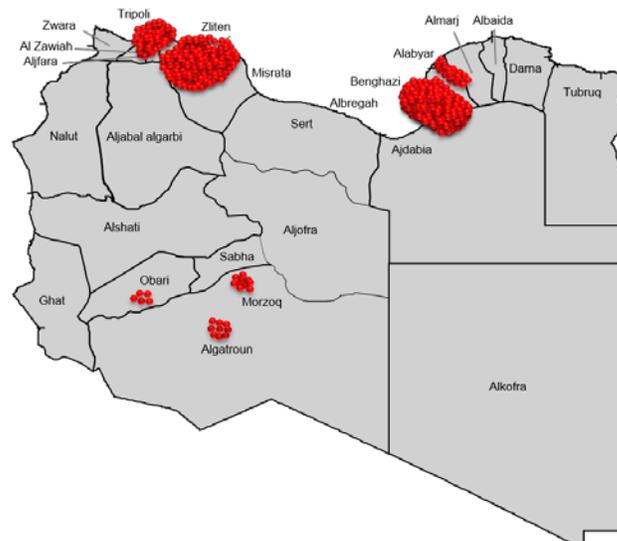


Figure 1. Spot map with distribution of measles cases in Libya, 2018

The movement of measles from time of entry to Libya in April 2018 is shown in Figure 2.

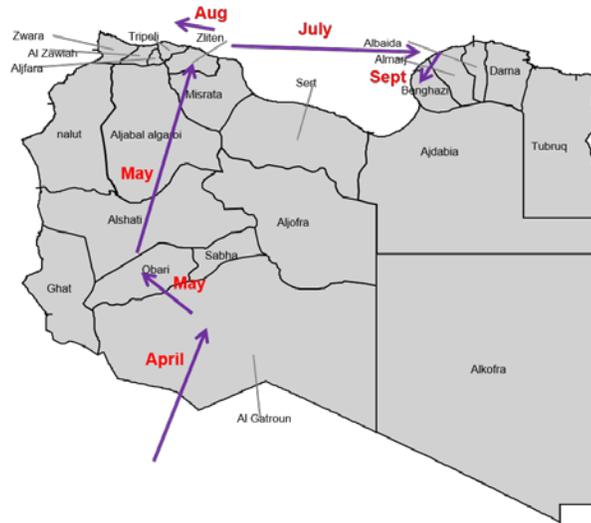


Figure 2. Spot map with measles outbreak movement in Libya, 2018

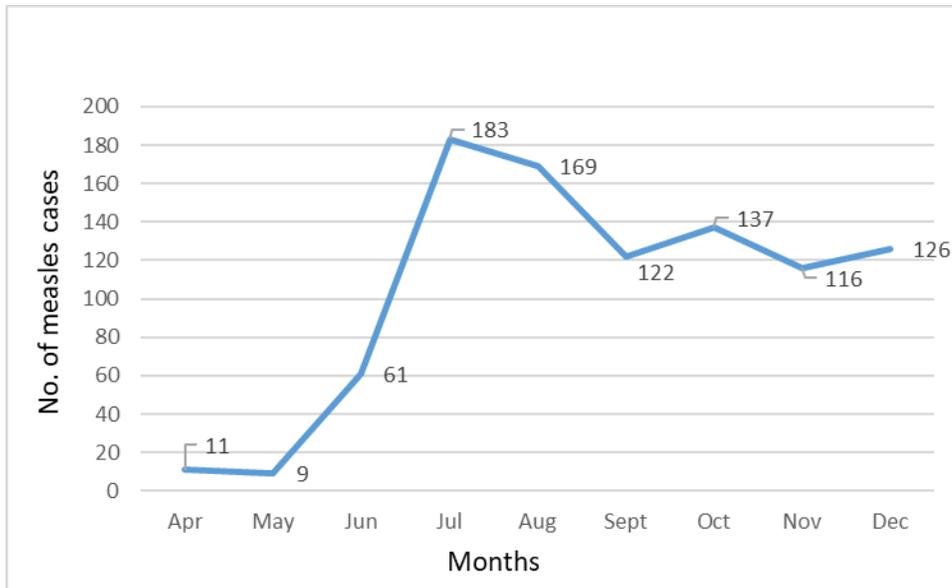


Figure 3. Monthly trends of measles cases through the outbreaks in 2018

**Table 2. Age distribution, sex ratio, and case fatality rate in Libya outbreaks, 2018**

Characteristics	Confirmed Measles Cases	%	Death	Case Fatality Rate	T-Test p-value
<b>Age Distribution</b>					< 0.05
0 - < 1	351	38.0%	0	0	
1 - < 5	312	33.0%	1	0.3%	
5 - < 10	64	7.0%	0	0	
10 - < 15	84	9.0%	0	0	
15 - < 20	16	2.0%	0	0	
20 - < 25	21	2.0%	0	0	
25 - < 30	4	0.4 %	0	0	
30 - < 35	25	3.0%	0	0	
35 - < 40	23	2.0%	0	0	
40 - < 45	28	3.0%	1	3.6%	
45 - < 50	5	0.5%	0	0	
> 50	1	0.1%	0	0	
<b>Sex Ratio</b>					> 0.05
Male	406	43.0%	1		
Female	528	57.0%	1		
<b>Total</b>	<b>934</b>		<b>2</b>	<b>0.2%</b>	

### Vaccination status

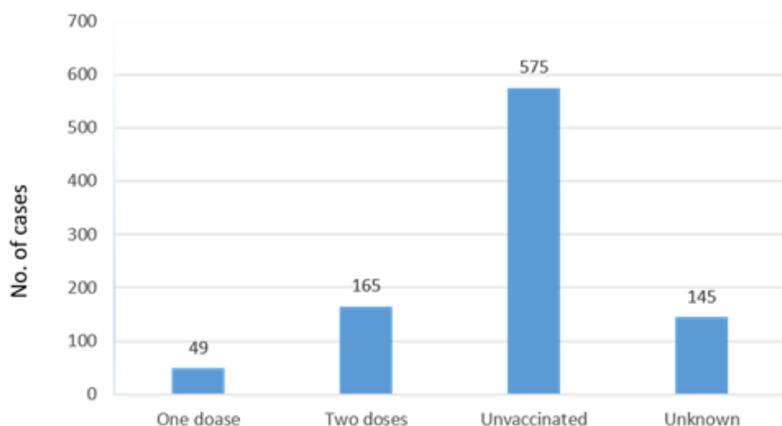


Figure 4. Vaccination status of measles cases in Libya outbreaks, 2018

### Discussion

This study shows the burden of measles outbreaks in 2018 in Libya. The source of the outbreak data was obtained from the NMSP. According to SOPs, measles cases are classified as an outbreak if there are three or more lab-confirmed measles cases or epidemiologically-linked cases.<sup>8</sup> The study aimed to provide a descriptive analysis of measles outbreak data.

The incidence in previous years was 1.4/million in 2017, 3.2/million in 2016, 9/million in 2015, 57/million in 2014, and 29/million in 2013.<sup>17</sup> In 2018, there were seven outbreaks with 934 confirmed measles cases detected in different areas in the country. The first outbreak erupted in the south, Algatroun, in April, then moved to the north causing hundreds of cases (Fig 3). The largest outbreaks were in Zliten, located in the north-west region, that infected 449 people and a second major outbreak in Benghazi, located in the north-east of the region, with 374 measles cases. The measles genotype sequence identified was B3 which was similar to the reference strain in the country.<sup>11,18</sup>

Measles has spread rapidly during the last few years, and the risk of the disease continues to increase for millions of people globally. The US reported its highest number of measles cases in the last 25 years.<sup>19</sup> The WHO European region reported approximately 90,000 measles cases in the first six months of 2019, which exceeds the total number of cases in 2018 (84 thousand) and is the highest in this decade. In 2017, WHO estimated 6.7 million measles cases and 110,000 measles-related deaths globally.<sup>19</sup> The global cases are most likely to be higher as only 55% countries report measles cases. WHO is conducting a programme towards measles elimination that started in 2000, and decreased measles incidence by 66%, from 145 to 49 cases per million population during 2000-2018. However, the number of global measles cases increased by 167% compared with 2016, the highest measles burden since 2011.<sup>20</sup>

The increase of incidence of measles in Libya is almost comparable with the global spread of the disease. The outbreaks began in April (spring) and peaked in June (summer) and remained high until the end of the year. This trend is unlike the seasonality of measles which is in late winter and early spring. The mortality rate in the outbreak was very low (2 deaths, 0.2%) which is less than the estimated mortality rate (142,300 deaths, 1.5%) worldwide.<sup>20,21</sup> Most cases (38%) were found in the age group below one year, and 33% were between 1 to 5 years. The majority of measles cases (71%) were found in children aged < 5 years, and 87% were < 15 years. Measles had a low impact (13%) in those >15 years old which could be due to the national immunisation campaign conducted in 2005.<sup>22</sup>

The study showed that only 165 (18%) measles cases received two vaccination doses, and 49 (5%) received one dose, while 575 (62%) were unvaccinated. Many studies and measles elimination field guides clearly state that unvaccinated children are more vulnerable to be infected as shown with the current results.<sup>14, 23-25</sup>

Measles in children <one year occurs because the first dose of measles vaccine through the national vaccination programme is given at 12 months.<sup>26</sup> However, the official estimate of coverage for the first dose (97%) and second dose (96%)<sup>27</sup> needs to be reviewed since only 18% of the cases were fully vaccinated. Official coverage rates are based on monthly reports of vaccinated children and population estimates. The study found that only 18% of cases were fully vaccinated which could be attributed to the effectiveness of the vaccine. Thus, an independent survey for coverage of rate estimates, and of vaccine management assessment is crucial for identifying and strengthening the weak points of the immunisation programme.

The results of the study will be useful to implement supplementary immunisation activities for age groups with the highest infection rates. There is no doubt that the ongoing evaluation of

surveillance and vaccination programmes are playing a crucial role in eliminating measles and achieve milestones towards the future eradication of measles.<sup>28</sup>

## Conclusion

Measles is a vaccine-preventable disease. The occurrence of seven measles outbreaks in one year could be attributed to a gap in the immunity building system. One-third of measles cases were below one year of age who are not targeted to be vaccinated since the vaccine is administered to children aged 12 and 18 months. This situation requires discussion to find a solution to strengthening immunity, whether by expanding routine vaccination to children less than one year or implementing supplementary immunisation activities. The independent calculation of measles vaccine coverage rate and assessment vaccine management is crucial to improving immunity building. The measles surveillance programme should be strengthened for early detection and initiation of preventive strategies to reduce transmission and achieve measles elimination.

## Declarations

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Conflict of Interest: There is no conflict of interest

Ethics statement: Consent for publication has been obtained and granted from Faculty of Health Science, Al Asmarya Islamic University

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