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A Retrospective Investigation of a Measles Outbreak in a District in North-western Nigeria

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Abstract: The prevalence of measles has been drastically reduced by well over 70% globally, through vaccination with a proven and potent vaccine. Despite these efforts, children under 5 years of age in many developing countries remain plagued by it's scourge in recurrent waves of epidemics. This study retrospectively investigated an outbreak of measles by reviewing surveillance, epidemiologic and laboratory records, including Integrated Disease Surveillance & Response (IDSR) forms, measles line lists, routine immunization reports, vaccine ledgers etc. A total of 422 cases were reported, 96% of whom were children under 5 years. Estimated mortalities were 20 (representing a case fatality rate of 4.7%). Vaccination among cases was very low as most of the children (99%) had never received any measles vaccine. Intensified efforts, in order to increase herd immunity among birth cohorts through routine immunization and innovative methods of positively influencing resistant sub-groups within the population towards embracing vaccination are non-negotiable in attaining higher immunization coverages.

Keywords: Vaccines, Outbreak, Immunization, Measles, CFR

1. Introduction

Measles is a viral, vaccine-preventable, childhood communicable disease. Highly contagious in nature, it is often characterized by high morbidity and mortality rates globally, particularly in African and other developing countries [1]. Mortality as a result of measles infection is often secondary to severe complications of both short and long term import. These complications range from severe diarrhoea and related dehydration, to kerato-conjunctivitis leading to blindness as well as ear infections sometimes resulting in permanent deafness. Others include affectation of the central nervous system manifesting as encephalitis and severe respiratory infections such as pneumonia [2]. Severe measles disease and it's complications are particularly typical among malnourished children (particularly with regards to hypo-vitaminosis A), unimmunized children, children with immunosuppressive diseases such as HIV/AIDS, children under the age of five (5) years etc. However, recovery from measles infection often confers natural, life-long immunity to it's survivors.

Although endemic in Nigeria, epidemics of the disease, which are typically seasonal in occurrence, are not uncommon; particularly in northern Nigeria [3, 4]. Outbreaks or epidemics of the disease sometimes lasting up to 6 months or more [5] tend to occur with a cyclical pattern [6] of about 1-3 years interval among children under the age of five years, particularly after the age of nine months when the level of maternal antibodies in circulation (acquired trans-placentally) begin to wane [7].

The last decade (from the year 2006 to date) has witnessed a number of such recurrent outbreaks in northern Nigeria [8]. Some of these outbreaks were recorded or witnessed in the (years) 2007-2008, 2011-2012, 2013-2014 seasons etc. This study examined the first of these outbreaks which occurred over a period of seventeen weeks in Zaria Local Government Area (LGA), a district of Kaduna State, north-western Nigeria. Initially characterized by reports of increase in the

number of suspected cases of measles, this eventually culminated in increasing number of cases, complications and death tolls, escalating above and beyond those of the weeks preceding, during similar periods in previous years, and consistent with measles outbreak definition in the guidelines of the Federal Ministry of Health/World Health Organisation. [9]. Details of this outbreak were reviewed in the light of and in comparison to findings of previous other studies conducted in similar settings or environments, with a view to highlighting areas where reinforced efforts could contribute to forestalling further occurrences.

2. Materials and Methods

2.1. Study Location

Zaria LGA is located in the northern part of Kaduna State with an estimated total population (as at the period of the outbreak) of 434,740 and under-five population of 86,948. It shares boundaries to the north with Sabon Gari LGA, to the east with Soba LGA, to the west with Giwa LGA and to the south with Igabi LGA. The LGA is predominantly urban. The major occupations of the people are trading and farming. It is made up of 13 political wards namely Unguwan Juma, Unguwan Fatika, Kwarbai A and Kwarbai B, Dambo, Wuciciri, Dutsen-Abba, Kaura, Gyallesu, Tudun Wada, Tukur-Tukur, Kufena and Limanci-Kona.

Health care delivery in the LGA is provided by both primary and secondary health facilities. There are about 26 Primary Health Care (PHC) facilities of different categories and 3 secondary health facilities (one public and two of religious ownership). There are also 16 registered private health facilities. Numerous traditional practitioners also provide non-orthodox services, with high patronage by the population.

2.2. Study Methods

A retrospective investigation of the outbreak was conducted. Investigation activities were examined for a period extending from the recognition of the index patient until the last reported case.

A review of all surveillance, epidemiologic and laboratory records was carried out at the state level and in Zaria LGA. Records reviewed include Integrated Disease Surveillance and Response (IDSR) 002 and (IDSR) 003 forms, active surveillance and medical records, measles line lists and laboratory results. The LGA routine immunization reports, vaccines supply and distribution records (vaccine ledgers) were also reviewed.

Information on the demographic characteristics of the patients and their family members, morbidity and the setting of transmission was obtained from interviews with health workers and residents of the communities as well as from medical records and the measles line lists.

The vaccination status of all patients was checked by reviewing their vaccination records on line lists and health facility vaccination registers. The LGA's and health facility immunization registers were examined to determine measles vaccination coverage.

2.3. Operational Definitions

The period of the outbreak was defined as extending from one incubation period (14days) before the onset of rash in the index patient until two incubation periods after the onset of rash in the last patient.

Suspected cases were defined as those who had fever, rashes and any of the following- conjunctivitis, coryza and cough or anyone suspected by a clinician as having measles; while confirmed cases were those who either had laboratory-confirmed acute measles infection or were epidemiologically-linked to a patient with laboratory-confirmed measles infection [5].

2.4. Data Analysis

Data collected was analyzed using the EPI-INFO software version 3.3.2.

2.5. Ethical Considerations

The permission/consent of the relevant state and LGA authorities was sought, for the use of data for this purpose. Assurance was given to handle all information provided in strict confidence.

3. Results

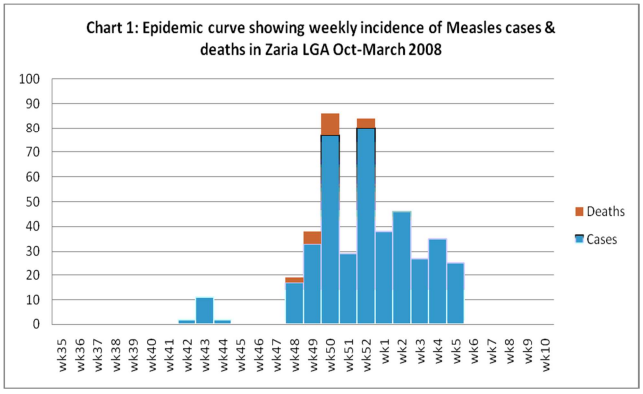

Figure 1. *Epidemic curve of weekly incidence of measles cases and deaths in Zaria LGA.*

The date of onset of the index case was in week 42 of the first year (2007). Number of cases peaked between weeks 50 and 52 of the same year and reached zero in week 6 of the succeeding year (2008).

Table 1. *Age/sex distribution of measles cases in Zaria LGA.*

Age	Cases		Deaths		Total		Case Fatality Rate (%)
	Males	Females	Males	Females	Cases	Deaths	
< 1year	24	24	2	0	48	2	4.2
1-4 years	188	170	5	13	358	18	5.0
5-14 years	6	10	0	0	16	0	0
≥ 15years	0	0	0	0	0	0	0
Total	218	204	7	13	422	20	4.7

About 84.8% of the cases were between the ages of 1-4 years, with a case fatality rate of 5% for this age group (reflecting the period following the decline of maternally-acquired antibodies, in utero); while 18 (90%) out of the 20 deaths were also from this age group.

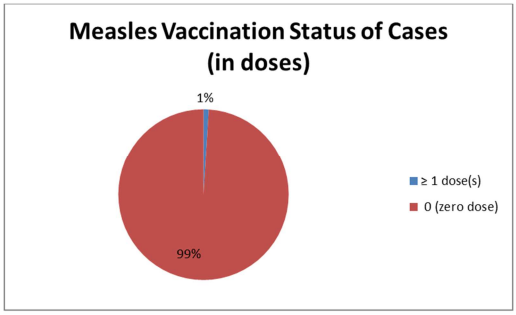

Figure 2. *Distribution of cases by their measles vaccination status.*

Ninety-nine percent (99%) of the reported measles cases never received a single dose of measles vaccine, while only 1% received at least one dose of the vaccine.

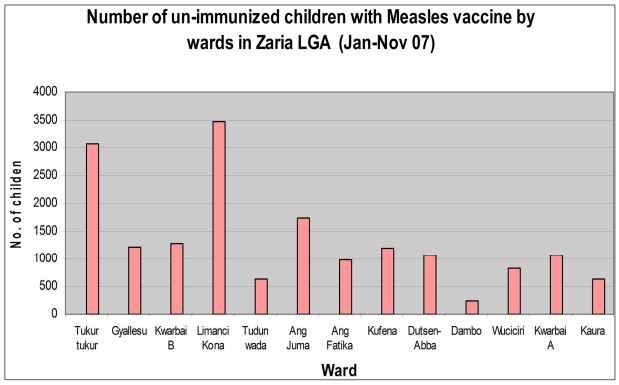

Figure 3. *Number of unimmunized children with measles vaccine by wards (districts) in Zaria LGA.*

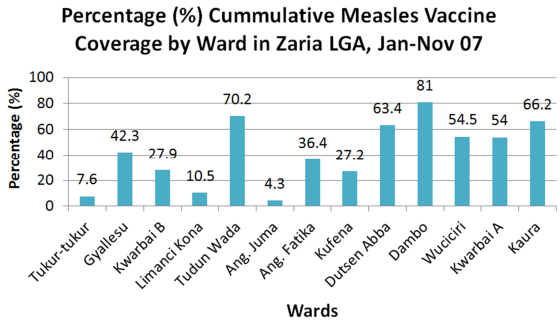

Figure 4. *Percentage cumulative measles vaccination coverage by wards (districts) in Zaria LGA.*

The cumulative number of un-immunized children was very high; with 9 out of the 13 wards (69%) recording at least 1,000 un-immunized children. Limanci Kona and Tukur-Tukur Wards had over 3,000 children un-immunized.

The cumulative measles vaccine coverage was less than 80% in 12 out of the 13 wards in Zaria LGA. Only one ward-Dambo Ward achieved measles vaccination coverage of at least 80%.

4. Discussion

Measles is erroneously considered among some to be a 'normal' childhood experience (or disease) in many communities in northern Nigeria, particularly in rural areas. Furthermore, it is also perceived by certain individuals that the outcome of the disease still remains the same whether a child is immunized or not [10, 11]. And in the event of the occurrence of the disease, many caregivers do not seek orthodox treatment unless and until complications arise [12] and the chances of salvaging the situation, arising largely by the setting in of complications, by medical intervention becomes very slim. Also, the experience of many community health workers (such as monitors and house-to house vaccination teams) during Immunization-Plus Days (IPDs) shows that there is gross under-reporting of measles cases [13]. This is because majority of the cases are treated at home [5]; thus many cases of the diseases never show up in health facilities and are not captured by statistics. This scenario coupled with low coverages of routine vaccination, creates situations where large clusters and cohorts of children with low herd immunity provide a suitable potential for the recurrent outbreaks of measles typical in urban slums and rural parts of the country [14]. These eventually translate into the high morbidity and mortality figures associated with measles in this part of the world [1].

In this study, ninety-nine (99%) of the suspected cases of measles reported to the state level by Zaria LGA had never received a single dose of measles vaccine. This compares with findings by Adeoye *et al* who reported 96.5% non-immunisation among measles cases in an outbreak in Owode LGA of Ogun State, south-western Nigeria [14] as well as those by Grais *et al* in Adamawa State, north-eastern Nigeria [5]. The study by Grais *et al* reports that "only 1.0% of patients had documented (evidence of) measles vaccination" in Dong District of Adamawa State, as compared with the relatively higher vaccination coverages of 37.3% and 70% in Boukoki and Moursal areas of neighbouring Niger and Chad Republics, respectively. In a retrospective study of similar nature, Coronado *et al* obtained an average immunisation

coverage of 48.6% in two states of northern Sudan [15].

Furthermore, it was also observed from the documents reviewed in this study that the cumulative number of un-immunized children in the LGA was very high. Nine (9) out of the thirteen (13) wards of the LGA recorded over 1,000 un-immunized children per ward (Limanci Kona Ward in particular, had about 3,500 children un-immunized). With an estimated under-five population of 86,948 in the LGA (district) at the time of this outbreak, it implies that there would have been (approximately) an average of 6,688 children under the age of 5 years per ward. A cohort of between 1,000 to 3,500 un-immunised children represents about 15% to 52% of the under-five population. The interpretation of these figures would imply a low herd immunity in these communities. The projections reflected by these figures obviously, do not send positive nor encouraging signals to the public health sector. Likewise, the LGA's immunization coverage records reveal extremely low immunisation coverages of less than 80% (ranging from as low as 4.3% to 70.2%) in twelve (12) out of the thirteen (13) wards in Zaria LGA. However, it is projected that it will take coverages of about 95% among children up to 15 years of age to prevent the occurrence of such large outbreaks [16].

Juxtaposing the foregoing findings with the fact that about 96% of the cases under review in this study were children under the age of five (5) years and in view of the guidelines by the Federal Ministry of Health/World Health Organization [9, 17] for determining the likely cause(s) of measles outbreaks, low immunization coverage may be alluded to partly as contributing to the occurrence of this outbreak.

Furthermore, the heavy burden of morbidity and complications are not the only features of measles as a disease. High death tolls are also typical of measles, particularly when it occurs in epidemic proportions; making measles mortalities of public health concern. A universally acceptable index of measuring the mortality potency or potential of a disease (that is, it's capability or probability of causing death in the event of it's occurrence) is the case fatality rate (CFR); conventionally expressed in percentage (%). In this outbreak, the case fatality rate was 4.7%; falling within the range of the World Health Organization's estimates of 4%-6% case-fatality rate for measles in West Africa [18]. However, in other studies within the sub-region such as that already cited (by Grais *et al*), covering Chad, Niger and Nigeria, a slightly wider range of 2.8%–7.0% was obtained [6]. Such varying degrees of mortalities may be due to diverse factors peculiar to the particular areas under study; and may require further research, which obviously extend beyond the scope of this study. The aforementioned figures from the West African sub-region clearly outweigh that of Coronado *et al*, who found an unusually lower CFR of 0.9% in northern Sudan [15]. Of the two states studied by Coronado *et al*, Khartoum State, which is the more urban state, had a much lower CFR of 0.4%. This was attributed to several factors such as higher vaccination coverage in the areas investigated, access to health-care facilities, better case management (particularly with regards to the administration of vitamin A) etc. This finding was interpreted within the context of Khartoum being a capital city and thus, enjoys the privileges characteristic of an urban status within the settings of a developing nation or economy. Such indices are not of negligible significance in developing countries; as Byass, Adedeji, Mongdem, Zwandor *et al* give credence to this factor in a study assessing the control of measles in urban Nigeria [19].

Indeed, studies from developing countries with lower outcomes in terms of CFRs often reflect some level or degree of urbanisation in the area under study. For instance, data analysed in a study by Sudfeld and Halsey [20] suggested "higher CFRs in rural areas compared to urban communities". This was also reflected in the findings of the WHO case fatality review of 2009 [17]. Many areas in Zaria LGA (being understudied here) are predominantly urban or semi-urban [21], as opposed to being out rightly rural. This may explain why the CFR in this study falls within the lower half of the expected range of estimates (4%-6%) for the West African sub-region.

Another observation worthy of note in this study, is that of the total number of deaths (20) recorded, thirteen (13) were female and seven (7) were male. This reflects observations made by previous studies of measles mortality in West Africa, which show significantly higher case-fatality rates (CFR) among girls as compared with boys [22, 23]. Indeed, Wolfson *et al* report of studies in Bangladesh, India and Nigeria, which found excess measles mortality among females [17]. Among these studies include one by Bhuiya, Wojtyniak *et al*, which observed that "girls had 2.73 times higher risk of death than boys" [24] with regards to measles infection. The previously cited study by Byass *et al* [19] also reports an elevated adjusted odds ratio for the female sex compared with males, as a risk factor for measles mortality in urban Nigeria. Additionally, Vaisberg, Alvarez *et al* in a study on measles antibody titres among infants in Peru noted that "boys showed higher antibody titers than girls at all ages" (that is within the time span of their study, which is the first 10 months of life) [7]. However, a notable limitation of that study was a rather small sample size of 34 children. So far however, sex has not been clearly identified as a major or significant determining risk factor for mortality in measles infection.

Finally, it is of significant note that previous outbreaks of measles in Nigeria have clearly occurred seasonally, in cyclical patterns of two to four years. This knowledge can be exploited and harnessed advantageously in the efforts currently employed in controlling measles, towards the possibility of a future elimination (and even eradication) of the disease. For instance, the index case in the epidemic under review was reported in week 42 of the epidemiological year, coinciding with the onset of the dry season (following the rains), about the latter half of October. The outbreak lasted up till the 5^{th} to 6^{th} weeks of the succeeding year, in early February. This period is typically characteristic of both the infection and it's epidemics, as corroborated by findings in study by Adu, Ikusika and Omotade [25] in Ibadan, south-

western Nigeria, stating that "In Nigeria, measles outbreaks peak between the months of October and March, a hot dry season when the average ambient temperature ranges between 45°C and 58°C." A similar seasonal variation has also been observed and reported in the neighbouring Niger Republic, north of Nigeria by Ferrari, Djibo *et al* [26].

Given that in many instances health systems and structures in developing countries are often caught off guard or unprepared for the rather overwhelming magnitude of cases and complications that arise from such outbreaks, this documented predictability of measles epidemics ought to position our health sector better (in terms of emergency preparedness and response) to combat and contain them. Thus, drastically and significantly reducing and minimizing the associated complications and currently high mortality rates arising from measles outbreaks. Needless to say that this in no way compares with the "gold standard" of attaining and maintaining higher and better immunization coverages, with higher herd immunity amongst children under the age of five years.

5. Conclusion

In conclusion, despite the significant decline in the number of cases of measles recorded globally following the discovery and administration of a single dose of a safe vaccine, recurrent outbreaks still plague many developing countries. Nigeria still remains a focus of attention; and northern Nigeria of particular concern (not only for measles, but for a number of other vaccine-preventable diseases as well). Be it as it may, a two-pronged approach of primary prevention by way of widespread routine immunization with sustained high coverages; as well as secondary preventive measures, namely early detection/reporting of cases (backed up by prompt and appropriate case management) remains the mainstay in the journey forward towards the conquest of measles in Nigeria and the developing world.

5.1. Limitations

1) Under-reporting of cases may affect the absolute number of cases reported in this review.
2) The reported vaccination status of the cases may not be verifiable and in many cases may not be provided by way of evident documentation such as immunization cards.
3) The outcome of illness of all cases may not be known especially with regards to cases treated as out-patients.

5.2. Statement of Conflicting Interests

The authors declare no (known) conflict of interest in this study.

5.3. Acknowledgement

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References

[1] Nandy R, Handzel T, Zaneidou M, Biey J, Coddy RZ, Perry R, *et al*. Case-fatality rate during a measles outbreak in eastern Niger in 2003. *Clin Infect Dis* 2006; 42:322-8.

[2] World Health Organization (WHO): Measles- Fact sheet. Accessed on the 21st of August, 2016. Available at: http://www.who.int/mediacentre/factsheets/fs286/en/

[3] Ekpemauzor CN. Current Measles Status and Plans for Measles Control in 2015-16 in Nigeria. Presentation at the 13th Annual Meeting of the Measles Rubella Initiative, 9th-10th Sept. 2014 at the American Red Cross National Hqs, Washington DC, U.S.A.

[4] Sawa BA and Buhari B. Temperature Variability and Outbreak of Meningitis and Measles in Zaria, Northern Nigeria. *Research J of Applied Sci, Eng and Tech* 2011; 3(5): 399-402, ISSN: 2040-7467.

[5] Grais RF, Dubray C, Gerstl S, Guthmann JP, Djibo A, Nargaye KD, Coker J, Alberti KP, Cochet A, Ihekweazu C, Nathan N, Payne L, Porten K, Sauvageot D, Schimmer B, Fermon F, Burny ME, Hersh BS, Guerin PJ. Unacceptably high mortality related to measles epidemics in Niger, Nigeria, and Chad. *PLoS Med* 2007; 4(1):e16.

[6] The Johns Hopkins University and Moss W. Measles: 2007; pg. 32-6.

[7] Vaisberg A, Alvarez J0, Hernandez H, Guillen D, Chu P and Colarossi A. Loss of Maternally-Acquired Measles Antibodies in Well-Nourished Infants and Response to Measles Vaccination, Peru. *Am J of Pub Health* 1990; 80(6):736-38.

[8] Kassem TG, Ndam JN. A stochastic modeling of recurrent measles epidemics. *Sci World J*. 2008; 3(4):29-32.

[9] Federal Ministry of Health/ World Health Organization. Guidelines for measles surveillance and outbreak investigation in Nigeria. Abuja, Nigeria. 2006; 5-40.

[10] Cockcroft A, Usman MU, Nyamucherera OF, Emori H, Duke B, Umar NA and Andersson N. Why children are not vaccinated against measles: a cross-sectional study in two Nigerian States. *Archives of Pub Health* 2014; 72:48, DOI: 10.1186/2049-3258-72-48.

[11] Ambe JP, Omotara BA and Mandu-Baba M. Perceptions, beliefs and practices of mothers in sub-urban and rural areas towards measles and measles vaccination in Northern Nigeria. *Trop Doct* 2001 Apr; 31(2):89-90.

[12] World Health Organization (WHO): Immunization, Vaccines and Biologicals. Immunization Highlights: 2010- Reaching more people with existing vaccines. Accessed on the 10th of August, 2016. Available at: http://www.who.int/immunization/newsroom/highlights/2012/en/index3.html

[13] Odegaa CC, Fatireguna AA and Osagbemi GK. Completeness of suspected measles reporting in a southern district of Nigeria. *Pub Health* 2010; 124(1): 24–27.

[14] Adeoye IA, Dairo MD, Adekunle LV, Adedokun HO and Makanjuola J. Investigation of a measles outbreak in a rural Nigerian community – The Aladura experience. *Afr J of Microbiol Research* 2010; 4(5):360-366.

[15] Coronado F, Musad N, El Tayeb El SA, Haithamie S, Dabbaghf A, Mahoneyg F, Nandy R and Cairns L. Retrospective Measles Outbreak Investigation: Sudan, 2004. *J of Trop Paed* 2006; 52 (5): i doi:10.1093/tropej/fml048

[16] Salako AA and Sholeye OO. Control of Measles in Nigeria: A Critical Review of the Literature. *Brit J of Med & Med Research* 2015; 5(2): 160-168; Article no. BJMMR.2015.017

[17] Wolfson LJ, Grais RF, Luquero FJ, Birmingham ME and Strebel PM. Estimates of measles case fatality ratios: a comprehensive review of community-based studies. Int. J. Epidemiol 2009; 38 (1): 192-205. doi: 10.1093/ije/dyn224

[18] Nandy R, Handzel T, Zaneidou M, Biey J, Coddy RZ, Perry R, Strebel P and Cairns L. Case-fatality rate during a measles outbreak in eastern Niger in 2003. *Clin Infect Dis* 2006; 42:322-8.

[19] Byass P, Adedeji MD, Mongdem JG, Zwandor AC and Brew-Graves SH. Assessment and Possible control of endemic measles in urban Nigeria. *J Pub Health Med* 1995; 17: 140–145.

[20] Sudfeld CR and Halsey NA. Measles Case Fatality Ratio in India: A Review of Community Based Studies. *Indian Paediatr* 2009; 46:983-89.

[21] Levy JK, Curtis S, Zimmer C and Speizer IS. Assessing Gaps and Poverty-Related Inequalities in the Public and Private Sector Family Planning Supply Environment of Urban Nigeria. *J Urban Health* 2014; 91(1): 186–210.

[22] Aaby P and Lamb WH. The role of sex in the transmission of measles in a Gambian village. *J of Infec* 1991; 22(3):287-92. doi: 10.1016/S0163-4453(05)80014-3

[23] Aaby P. Influence of cross-sex transmission on measles mortality in rural Senegal. *The Lancet* 1992; 340(8816):388-91 doi: 10.1016/0140-6736(92)91470-S

[24] Bhuiya A, Wojtyniak B, D'Souza S, Nahar L, Shaikh K. Measles case fatality among the under-fives: a multi-variate analysis of risk factors in a rural area of Bangladesh. *Soc Sci Med* 1987; 24: 439–43.

[25] Adu FD, Ikusika A and Omotade O. Measles Outbreak in Ibadan: Clinical Serological and Virological Identification of Affected Children in Selected Hospitals. *J of Infec* 1997; 35:241-245.

[26] Ferrari MJ, Djibo A, Grais RF, Bharti N, Grenfell BT and Bjornstad ON. Rural-urban gradient in seasonal forcing of measles transmission in Niger. *Proc. R. Soc. B* 2010; 277:2775–2782. doi:10.1098/rspb.2010.0536.