Review Article

Epidemiological Pattern of Rubella in Africa: A Review of Selected Sub-Saharan African Countries

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Abstract

Rubella, (German measles) is vaccine-preventable and a viral disease of public health importance. It presents with mild febrile rash illness, attendant congenital sequel and foetal death. This paper seeks to do a review of the epidemiology of rubella in selected sub-Saharan African countries. This is a review of literatures involving data triangulation of rubella surveillance data. World Health Organization (WHO)rubella surveillance data (2015-2018) available online was used to present the seasonal/time-variation. Data was extracted from the site into Microsoft Excel over three months period (October-December, 2018). Univariate data analysis was done using SPSS-23 and data were presented with appropriate tables and charts to show the trend.

Epidemiologic findings showed that periodicity of rubella varies across countries in Africa with seasonal variation across the four sub-regions. In the West Africa sub-region, sharp increases occurred in reported cases in January with peaks in March-April. In Nigeria, a West African country, available data showed that seasonal peak occurs in the first four months (Jan-April) of the year with most of the burden among those below fifteen years of age, affects both sexes and incidence cuts across both rural and urban areas. However, in the Central sub-region, spikes generally occur between February and March with troughs in September to November. In the East sub-region, dual peaks occur in March-April and in September-October; in the South sub-region, unique annual seasonality with few cases reported in January-June each year. The peak incidence of rubella has been observed to be a function of the seasonal peaks/variation in Africa. Therefore, the knowledge of this seasonal variation can be leveraged upon by Governments to control the disease through scaling up of awareness creation and surveillance during the identified peaks and beyond.

Keywords: Rubella; Epidemiology; Sub-Saharan Africa.

Introduction

Rubella, (German measles) is caused by the Rubella virus (RV) and it is a mild febrile rash illness in children and adults. These two symptoms of fever and maculopapular rash are common presentation of the disease.[1] Rubella infection occurring in the first thirteen weeks of pregnancy can severely affect the foetus leading to miscarriage, foetal death, or a baby born having Congenital Rubella Syndrome (CRS).[2-4] The major public health concern posed by rubella is its teratogenicity; and this devastating teratogenic effect makes it a disease of public health importance in pregnancy.[5,6]

In Africa, rubella sero-prevalence ranges from 71-

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91% and this age group-dependent; from 84% to 94% among women of childbearing age.[3] In another study in Hossawa, Southern Ethiopia, the sero-prevalence of rubella IgM and IgG antibodies was 2.1% and 86.3%, respectively.[7] In Algeria, out of the 834 women of reproductive age tested, the seroprevalence of rubella IgG antibodies was 68.6% with no statistical differences in women with positive rubella specific IgG antibody levels by age.[8]Rubella is equally endemic in Nigeria. In Ilorin, Nigeria, Agbede *et al*[9] obtained a seroprevalence of 16.3% among 92 pregnant women; and 87% (IgG seropositivity) and 1.5% (IgM seropositivity) among women in the childbearing age.[10] In another study[11] in Ilorin, Nigeria,only 23 (8.1%) were Rubella IgM antibody seropositive. Also, in the Ilorin study, all (100%) participants with rubella-specific IgM sero-positivity also had rubella-specific IgG antibodies. In Osogbo, Southwest Nigeria, 175 (87.5%) were positive and more than
three quarters, 85%, had a positive result among those 30-34 years ($P = 0.716$).[12]

With the increase in burden of rubella and the non-incorporation of RCV into the National Immunization Schedule in most African countries, there is likelihood of a rise in the burden of congenital rubella syndrome. Seasonal variations or trend of rubella across multiple African countries has not been well elucidated and this is important so as to understand the seasonal variations in spread and burden in order to inform action on control activities. Therefore, the need to understand the epidemiological variation across African countries so as to channel efforts towards introduction of rubella vaccination policy in concerned countries and controlling the disease cannot be overemphasized. This review, therefore, seeks to examine the epidemiology of rubella across six selected sub-Saharan African (Central African Republic, Rwanda, Ethiopia, Ghana, South Africa and Nigeria) countries with a view to highlighting the seasonal variations and trends.

Methodology

This is a review of epidemiology of rubella which also involved the use of WHO rubella surveillance data from selected African countries. Internet search and retrieval of literatures was achieved using Google search. Data bases accessed were Pubmed, Hinari and African Journals Online (AJOL) using keywords, Boolean logic and field searching as search techniques. Relevant articles between the year 2000 and 2018 were considered, retrieved and skimmed for their appropriateness. A total of 30 original articles (OA), 1 review article (RA) and 4internet articles (IA) were initially retrieved, reviewed and findings triangulated. However, of the materials, 27 OA, 1 RA and 2 IA were used to achieve the final write up. Five papers were excluded because they were old articles and outside the scope of this review. (Figure 1).

Rubella surveillance data from the available World Health Organization (WHO) measles and rubella data (2015-2018) was used to present the seasonal/time-variation. From the online source, data were extracted manually for each country and for the years under consideration into Microsoft Excel. The data were extracted and collated over three months period (October-December, 2018). Univariate data analysis was done using SPSS version-23 and data were presented with appropriate tables and charts to show the seasonal trend for the selected countries.

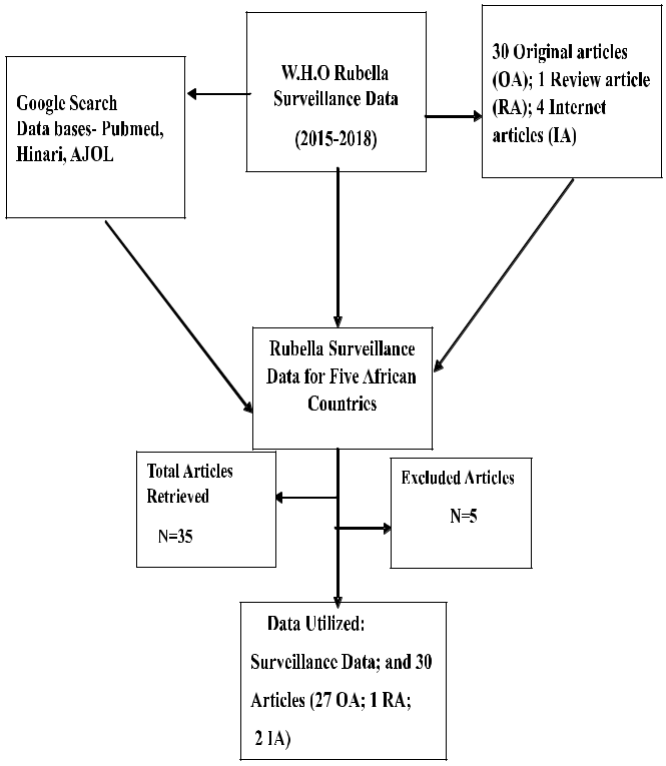
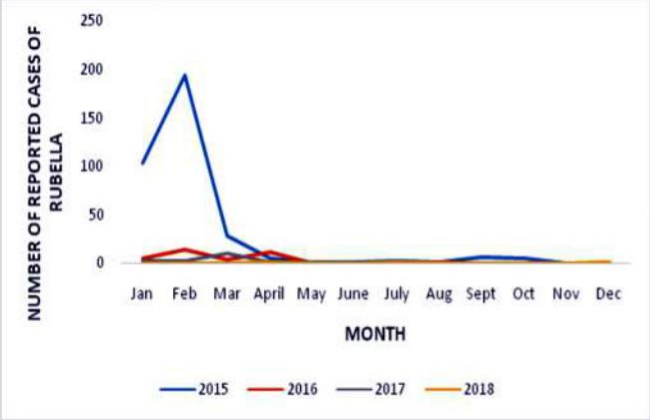
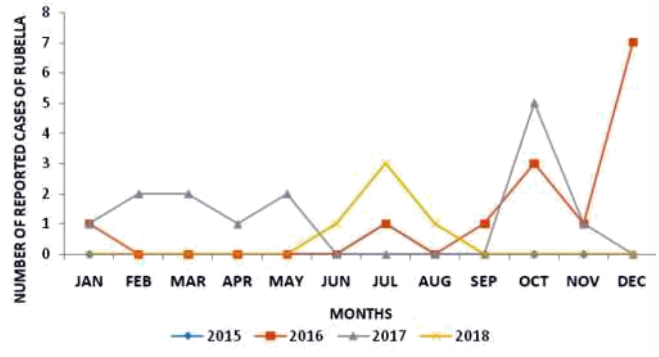


Figure 1: Framework for Literature Search for the Study



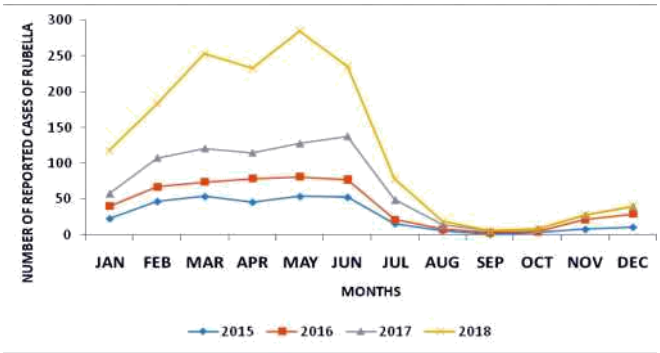
Data: WHO Measles and Rubella Surveillance Data (secondary)[30]

Figure 2: Monthly reported cases of rubella (2015-2018) in C.A.R



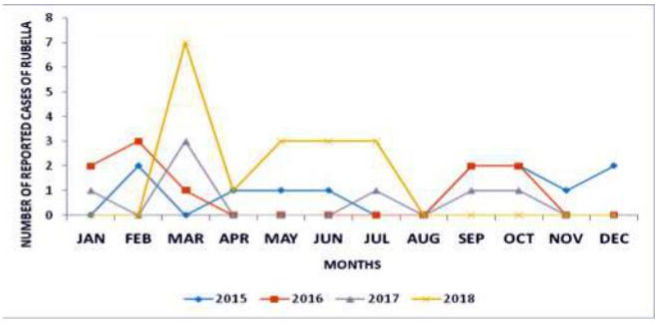
Data: WHO Measles and Rubella Surveillance Data (secondary)[30]

Figure 3: Monthly reported cases of rubella (2015-2018) in Rwanda



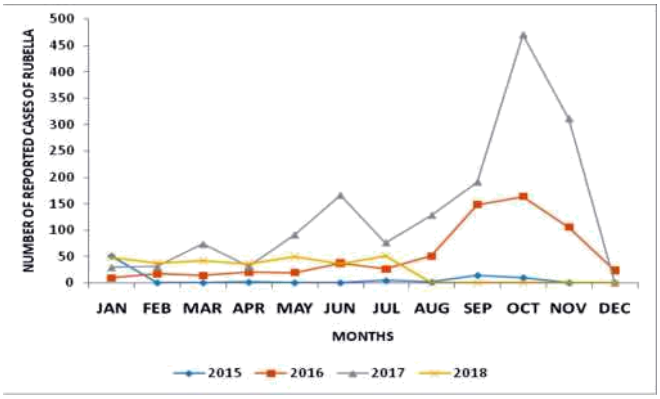
Data: WHO Measles and Rubella Surveillance Data [30]

Figure 4: Monthly reported cases of rubella (2015-2018) in Ethiopia



Data: WHO Measles and Rubella Surveillance Data (secondary)[30]

Figure 5: Monthly reported cases of rubella (2015-2018) in Ghana

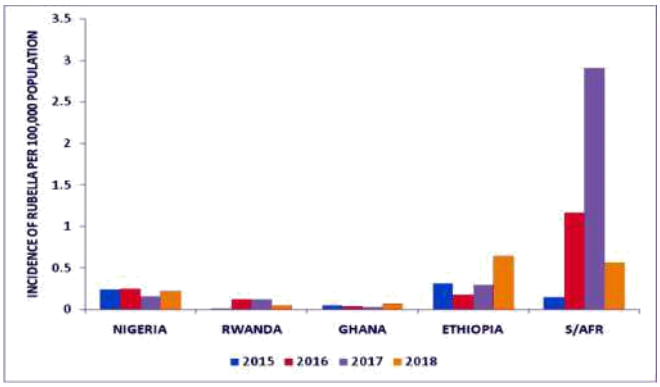


Data: WHO Measles and Rubella Surveillance Data (secondary)[30]

Figure 6: Monthly reported cases of rubella (2015-2018) in South Africa

Table 1: Climatic conditions and Seasons in selected sub-Saharan African countries

Country	Climate	Weather/Seasons
Central African Republic	Tropical	**Two seasons:** Rainy season (May-Oct); peak rain- August; July-Sept (wettest); Dry (Dec-April)
Ethiopia	Generally Tropical; 3 different climatic zones according to elevation: Tropical, Subtropical & Cool zone	**Three seasons:** Short rainy/*Belg* (Feb-May); Long rainy/*Kiremt* (Jun-mid Sept); Dry season/*Baga* (Oct-Jan) with dry weather and secondary peak in rainfall
Ghana	Tropical	**Two seasons:** Wet and Dry North Ghana- rainy season (April to mid-October); South Ghana rainy season (March to mid Nov)Dry season (Dec-March)
Rwanda	Tropical highland	**Four seasons:** Long rainy (March-May); Long dry (June-Mid Sept); Shorter rainy (Oct-Nov) and Short dry (Dec-Feb)
South Africa	Three climatic zones: Mediterrancan (Southwestern), Temperate (interior plateau); and Desert (Northwest)	**Four seasons:** Autumn/Fall (Mar-May); Winter (Jun-Aug); Spring(Sept-Nov); Summer (Dec-Feb)
Nigeria	Tropical	**Two seasons** Wet (April-Oct); Dry (Nov-Mar)



Data: WHO Measles and Rubella Surveillance Data (secondary)[30]

Figure 7: Four-year incidence of rubella in five sub-Saharan countries per 100, 000 populations

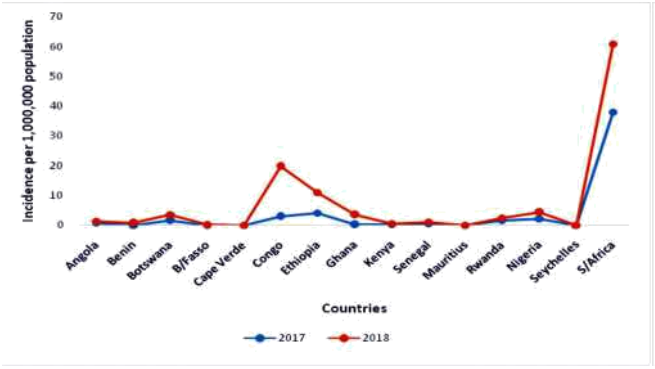
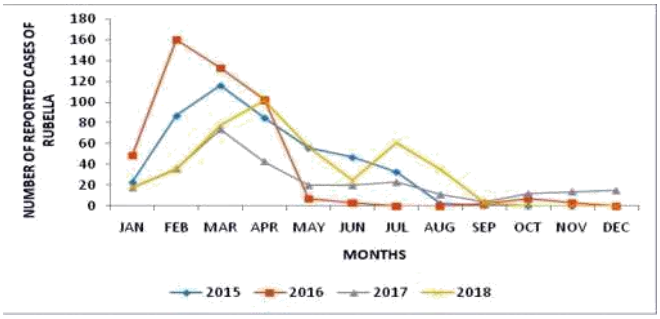


Figure 8: Incidence of rubella in fifteen African countries in 2017-2018 (per 1,000,000)[30]



Data: WHO Measles and Rubella Surveillance Data (secondary)[30]

Figure 9: Number of monthly reported of cases of rubella (2015-2018) in Nigeria

Discussion

Epidemiology of Rubella in selected sub-Saharan African countries

In Africa, rubella virus is in circulation and children are the primary targets. Analysis of surveillance data showed that by fifteen years of age, a number of children have acquired immunity due to natural infection. Out of the cases of rubella reported in Africa, 5% occur among the women in the childbearing age group in a study conducted in the pre-vaccination era.[13]Quite, a number of studies[14-17]in Africa focusing on rubella transmission among women in the child-bearing age, reported wide circulation of rubella virus which presents a huge public health burden. Examining surveillance data for measles in Africa (between 2002 and 2009) with rubella testing on measles IgM negative specimens, showed that 95% of rubella IgM positive cases are found in children fifteen years of age and below which is an indication of burden and transmission within that age group.[18] Therefore, occurrence of approximately 5% of cases in those above fifteen years of age points to a heightened risk of CRS among women of child bearing age.[18]However, despite the fear of risk of CRS, sentinel CRS surveillance is operationalized only in six countries in Africa; and CRS cases have been documented. The distribution of cases of rubella, as seen in Africa, showed rubella as primarily a disease occurring mostly among the 5-9year olds.[13] In some African countries, the proportion of cases has been found to be highest among the <5year olds which is a pointer to the likelihood of infection at a younger age group.[13]Occurrence of rubella-specific IgM antibodies, reported by the World Health Organization (WHO) for the Africa region between 2002 and 2009, ranged from 13 to 38 %.[19] Evaluations of the rubella surveillance data, as reported by Mitiku *et al*[20] in Ethiopia and Junaid *et al*[21] in Nigeria, between 2004 and 2009; and in 2011, reported a prevalence of 12.1% and 45.2 % respectively.

Epidemiology of Rubella in Central African Republic (C.A.R)

Asero-prevalence survey of natural measles and rubella antibodies in children below 15 years, based on the detection of IgG in Bangui, reported in 2008, a prevalence of 55.4 % for rubella.[19]. Although, cases are notified all the year round, most occur in the first three months, with a peak in January and February from the trend chart. However, in the year 2014, the notification rate also remained high throughout the year, but with a second spike between July and August.[19]However, as shown in Figure 2, the review showed that the year 2015

recorded a peak incidence of rubella in Jan-March with a second subtle peak in August-September. C.A.R has a tropical climate with two seasons (dry (Dec-Apr); and rainy (May-Oct) with the wettest months being in July-Sept. Rubella cases occur majorly during the dry season in the country. The second peak of rubella, shown for 2015, coincides with the peak of the rainy season in the country.

Epidemiology of Rubella in Rwanda

Rwanda is a tropical highland with four seasons which are the long rainy (March-May), long dry (June-mid Sept), shorter rainy (Oct-Nov) and short dry (Dec-Feb) as shown in Table 1.In the graphical trend of the review, the pattern seen in Rwanda showed multiple/polymodal seasonal peaks across the different years under review. In 2017, a bi-modal peak was seen in April-June and September-November. However, the year 2018 recorded the highest number of cases in the month of July which is in the long dry season. Of the four years under review, highest number of cases was seen in December, 2016 (Figure 3).

Epidemiology of Rubella in Ethiopia

Ethiopia generally has a tropical climate with three climatic zones based on elevation and these are the tropical, sub-tropical and cool zones as presented in Table 1. It has three seasons- short rainy (Feb-May), long rainy (Jun-Mid Sept) and dry season (Oct-Jan) In Ethiopia (Figure 4), another East African country like Rwanda, most of the cases reported in all the four years clustered around the first seven months of the years. There seems to be a trough between August and October follow by a slight rise from November to December. Though, there is variation of seasonal peaks from year to year, but worthy of note is the peak incidence seen in March in years 2017 and 2018. Therefore, the incidence of rubella in Ethiopia cuts across both dry and rainy seasons. This year to year variation in seasonal peaks of Rubella seen in the chat was also buttressed by a study conducted in Ethiopia by Getahun *et al*[22]. The descriptive analysis of rubella cases showed that rubella is endemic in Ethiopia with a predilection for children below 10 years being the most affected; and with a year to year seasonal variation in burden, but a seasonal peak in March.

Epidemiology of Rubella in Ghana

Ghana is a West African country with tropical climate and two major seasons which are dry season (Dec-Mar) and rainy season which is between April-Mid Oct. in North Ghana; and March-Mid Nov in South Ghana as shown in Table 1. Therefore, in Ghana, of the four years under review, 2018 recorded highest number of rubella cases in March. There are multiple plateaus noticed between the months of April-July and August-October in the years, 2015, 2016 and 2018 (Figure 5). Most cases of rubella tends to occur in the rainy season in the country.

Epidemiology of Rubella in South Africa

As shown in Table 1, South Africa has three climatic zones which cuts across the nine provinces of the country. These climatic zones are Mediterranean (southwestern axis), Temperate (interior plateau) and Desert (north-east). The seasons in the country are Autumn/fall (March-May), winter (Jun-Aug), spring (Sept-Nov); and summer (Dec-Feb) when rainfall generally occurs. In Figure 6, South Africa recorded three peaks in the reported cases of rubella in the year 2017. These peaks were found in March, June and October which falls in autumn, winter and spring. The least number of cases was recorded in the year 2015. Indeed, aside the year 2017, in all the other periods under consideration, there were low reported cases in the first six or seven months. By modelling data collected from nationwide serological studies, 654 cases of CRS were predicted and Free state (one of the nine provinces with temperate climate and summer rains and chilly winter) had the highest predicted burden of rubella and CRS followed by Mpumalanga and Eastern cape with Mediterranean climatic conditions.[23] In overall, a pre-vaccination era (2002-2009) study showed that yearly seasonal variation of confirmed rubella cases by month of rash onset varied across the four sub-regions.[13] In the West, between 2003 and 2009,yearly seasonal variation of rubella occurred with spike in reported cases in January and peaks in March–April followed by waning in May, leading to yearly troughs during October–December.[13]However, for Central sub-region, sparse data notwithstanding, rubella cases do spike during February–March with troughs in September–November. In the East sub-region, reported cases vary yearly; biphasic reporting generally observed with peaks in March–April and

in September–October and annual declines in December–January and May–June. In South sub-region, unique annual seasonal variation with consistently few cases do occur January–June each year and followed by gradual increases in June–July and spikes in September–October.[13]

Incidence of Rubella Disease in selected Sub-Saharan African countries

Available secondary data, as reported by the World Health Organization, showed that South Africa has the highest incidence in the years 2016 and 2017 as shown in Figures 7 and 8. Ghana has the lowest incidence of rubella among the five countries in the four years under review; and this is closely followed by Rwanda.

Epidemiology of Rubella in Nigeria

While no national data on the prevalence or incidence of rubella exist in Nigeria, studies have shown that the prevalence of rubella varies across the different geo-political zones in Nigeria and with seasonal peak. However, according to some studies[24,25], point prevalence estimates from serological surveys of rubella susceptibility among children suggested that, by age fifteen years, most children have developed immunity against natural infection. Regardless of the immunity, recurrent exposure to already infected people increases the sero-positivity of the children most especially in crowded environments like schools, playgrounds and during convergence for social function.[25] As shown in Figure 9, available data showed that the seasonal peak of rubella in Nigeria is seen in the first four (January-April) months of the year. Therefore, the peak incidence occur during the dry season in Nigeria. In the four years depicted in the graph, the highest number of reported cases in Nigeria was recorded in February, 2016. While the peak is seen in the first four months of the year, there is a plateau in reported cases from Sept-Oct. In between these two periods, the pattern of the aggregate reported cases assume a waxing and waning pattern with peaks and troughs. A number of studies have also been in Nigeria on the epidemiology of rubella in Nigeria.

A retrospective study conducted in Kebbi State, North-west Nigeria, showed that rubella infection was found to be common among the under 5 children with a peak incidence during the hot season (February-April).[26] In Southwest Nigeria, Fatiregun *et al*[27]analyzed the measles-cased surveillance for the period 2007-2012 and established that rubella infections occurred widely in the geopolitical zone and affect young children majorly. During the period under consideration, cases of rubella were reported from all six states of the Southwest region. The bulk of the cases were individuals aged less than 15 years (range 3months-56 years; median of 4 years) and 40.9% were females. The tri-annual peak, Q1 (Jan-April) was also demonstrated in Southwest Nigeria.[27] In terms of geographical distribution, Yahaya *et al*[28] also showed, in another review of the prevalence of rubella between 1977 and 2015, that the distribution of rubella infection (IgM and IgG) in Nigeria based on age groups, gender and location did not show consistent trend of infection amongst rural and urban settings. However, like other studies, females were more affected than the males.[27]

Rubella Seasonal Variations and the Policy gap in Control Measures in Africa

The observed seasonal variations showed the burden of the disease as it also demonstrates that transmission varies across the different countries and at different times of the year. Epidemiological exploration of this period prevalence to understand the factors responsible for such and the needed measures to take to halt transmission is key. Such peak periods serves as thresholds and a warning sign to activate the public health emergency response. [29] In addition, the periods with such highest peaks is a potential impetus for the disease to flare up in epidemics as not all African countries have a policy on rubella vaccination.[29] This is a policy gap in the efforts towards rubella control in Africa.

Conclusion

Rubella occurs in Africa with a seasonal variation. It is an epidemic-prone disease that is endemic in most parts of Africa with a demonstrable time variation in incidence. The seasonal/time variation differs across the different sub regions in Africa with a predilection for both sexes, adults and children, but particularly commoner among those ≤15 years and cuts across both rural and urban areas. In Nigeria, just like the other African countries presented, the peak incidence of rubella has been observed to be a

function of the seasonal peaks/variation.

The observed seasonal variation as presented, can be leveraged upon and serve as window for appropriate preparedness and adequate response to prevent escalation of cases especially when most African countries do not have rubella vaccination policy. Governments in the selected African countries, and indeed in all parts of Africa, can use this seasonality to adequately respond through interventions (increase awareness creation and health education on preventive measures); and enhance surveillance geared towards controlling escalation of rubella cases at those peak periods, thereby preventing full blown epidemics to which rubella is prone.

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