Factors contributing to increased Neonatal Mortality in Grand Kru County, Liberia, January 2017-December 2021

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ABSTRACT

Introduction: The average global neonatal mortality rate is 17 deaths per 1,000 live births, while in Liberia, the neonatal mortality rate is 30.6 deaths per 1,000 live births as of 2020. Liberia is among the countries in the world with the highest neonatal mortality rate. In 2016, the former president of Liberia declared neonatal mortality as a public health emergency due to the high neonatal mortality rate which was recorded as 42 deaths per 1,000 live births. Grand Kru County is one of the counties in Liberia where neonatal death is reported nearly every month. The aim of this study is to describe the burden of neonatal death in Grand Kru from 2017-2021 and identify direct causes and contributory factors. **Methods:** A cross-sectional study was conducted at 24 health facilities in Grand Kru We reviewed neonatal death investigation forms, health management information system (HMIS) monthly reports, weekly surveillance reporting ledgers and the county's integrated disease surveillance and response (IDSR) line list to obtain the total neonatal deaths, its causes, and contributory factors. We determined the number of live births by reviewing the labour and delivery ledgers from January 2017 to December 2021. Data was cleaned and analyzed in Excel, we calculated the proportion for each socio-demographic variable, direct causes of death and contributory factors. **Results:** There were 126 neonatal deaths and 3,714 live births reported from 2017-2021. Sixty-seven (53.2%) of the neonatal deaths were females, 82.5% (104/126) occurred in the health facilities, the median age was 2 days (interquartile range [IQR]: 1 - 4) days. Barclayville district accounted for 49.2% (62/126), followed by Jroah district 30.1% (38/126). The main direct causes of neonatal death were birth asphyxia 39.6% (50/126) and neonatal sepsis 25.3% (32/126), while contributing factors include: late community referral 58.7% (74/126), lack of functional incubators 28.6% (36/126) and delayed ambulance services for patient referral 16.7% (21/126). The average neonatal death rate in Grand Kru from 2017-2021 was 33.9 deaths per 1,000 live births. **Conclusion:** Neonatal rate in Grand Kru was high. Birth asphyxia and neonatal sepsis were the leading causes of neonatal deaths, while late community referral, lack of functional incubators and delayed ambulance services for patients' referral were leading factors contributing to neonatal mortality in Grand Kru County.

Introduction

Neonatal mortality (NM) is a death of a newborn at birth or within 28 days of life. This period is the most vulnerable time for a child´s survival [1]. The first 28 days of life remain the most critical period for a neonate to survive during childhood [2]. The average global neonatal mortality rate is 17 deaths per 1,000 live births as of 2020. Annually an estimated 2.4 million newborns die within the first 28 days of life, which is approximately 6,700 newborn deaths occurring per day. This has accounted for more than 40% of deaths in children under five [3]. The major causes of neonatal mortality are preterm birth complications, intrapartum-related events, and infections [4]. Most of these deaths are preventable with timely health interventions. In the Sustainable Development Goals (SDGs), the global community has committed to reducing neonatal mortality and stillbirths to 10 deaths per 1,000 live births by 2035 [5]. Despite a declining neonatal mortality rate globally, disparities in neonatal mortality still exist across regions and countries [6]. Regionally, neonatal mortality is high in sub-Saharan Africa and South Asia [7]. The chance of survival from birth varies widely depending on where a child is born. Sub-Saharan Africa had the highest neonatal mortality rate in 2020 at 27 (25-32) deaths per 1,000 live births, followed by central and southern Asia with 23 (21-25) deaths per 1000 live births. A child born in sub-Saharan Africa is 10 times more likely to die in the first month than a child born in a high-income country[1].

Africa has the highest risk of death in the first month of life and is among the regions showing the least progress [8]. However, Sub-Saharan Africa has seen a faster decline in its under-five mortality rate, with the annual rate of reduction doubling between 1990-2000 and 2000-2011, 177 deaths per 1,000 live births to 90 deaths per 1,000 live births [9]. Sub-Saharan Africa, which accounts for 38 percent of global neonatal deaths, has the highest newborn death rate of 34 deaths per 1,000 live births [10]. As a result of the devastating effects of childhood mortality especially in low and middle-income countries (LMICs), 189 United Nations member states unanimously agreed to adopt the reduction of under-five mortality by two-thirds between 1990 and 2015 [11]. Studies have also indicated that, the total neonatal mortality rate (NMR) greatly varied between developed and developing countries [12-13].

Liberia is among countries in the world with the highest NMR [14]. In 2016, the former president of Liberia declared neonatal mortality as a public health emergency, coupled with free healthcare services [15] and crafting of maternal and neonatal death review policies due to the high NMR which was recorded as 42 deaths per 1,000 live births [16]. These actions contributed to the significant decrease of newborn deaths from 42 deaths per 1,000 live births from 2011 - 2016 to 30.6 deaths per 1,000 live births in 2020 [17]. Despite the reduction, neonatal mortality is still a major challenge in Liberia especially in rural counties [18]. Grand Kru County is one of the counties in Liberia where neonatal death is reported nearly every month. The aim of this study is to describe the burden of neonatal death in Grand Kru from 2017-2021 and identify direct causes and contributory factors.

Methods

Study setting This study was conducted in Grand Kru County, one of the 15 counties of Liberia, located in the southeast with an estimated population of 77,468 inhabitants [19]. About 17,818 of the population constitute women of child bearing age and the yearly expected delivery is approximately 3,486 [20]. The county is divided into 5 health districts and twenty-four (24) health facilities (1 hospital, 4 health centers and 19 clinics). The county has 22 public facilities and 2 private facilities [20]. Each district has a referral facility but is not fully capacitated to manage maternal and newborn emergencies. In addition, about 20% of the health facilities are located across rivers and inaccessible by road, especially during the rainy season. More than 50% of the county´s population does not have access to health facilities [21]. Notwithstanding, basic healthcare services including maternal and child health are offered at all health facilities in the county. The major occupations of residents are mainly subsistence farming, fishing and petty trading, while an estimated 80% of the county´s population live in extreme poverty [22].

Study design and sampling technique

A cross-sectional study was conducted at the 24 health facilities in Grand Kru County. All 24 health facilities were selected for the survey. We purposefully selected 5 district surveillance officers (DSOs) who reside in the various health districts to

collect data. In each health district, we generated a list of all health facilities and collected data for total deaths, causes, contributing factors and live births.

Study population and exclusion criteria

The target population for the study were neonates aged 0 to 28 days who died at a health facility or in the community and women who gave birth at any of the twenty-four health facilities in Grand Kru County from January 2017 to December 2021. Neonatal deaths and live births with missing variables such as age, sex, causes of death, place of death, date and year of death were excluded from the study.

Outcome variable

Neonatal mortality was defined during data collection as the probability of dying within the first 28 days of life [23]. Sex, age, causes of death including birth asphyxia, neonatal sepsis, prematurity, neonatal tetanus, aspiration pneumonia and contributing factors were determined during the data collection process. We classified the place of death as community or health facility deaths and determined the time of neonatal death as early neonatal period (0 to 7 days) or late neonatal period (8 to 28 days) [24].

Data source and analysis

To determine the total neonatal deaths, and assess the causes and contributing factors, we extracted and reviewed data from neonatal death investigation forms, health management information system (HMIS) monthly reports, and weekly surveillance reporting ledgers. To determine the number of live births, we extracted data from the labour and delivery ledgers. The data on the cause of death and the contributory factors was captured on the neonatal death investigation form completed by the team in each hospital where the neonatal death occurred. Data was cleaned and analyzed in Microsoft Excel and summarized by person place and time. We calculated frequency and proportion for variables such as age, sex, time of death, district of deaths, causes of death and contributing factors. To determine the neonatal ratio per district and year, we calculated the neonatal mortality rates by dividing the total deaths by live births and multiplied by the constant (1,000). We displayed results by using tables and graphs.

Availability of data and material

The data upon which this write-up is based, belong to the Grand Kru County Health Team, Ministry of Health Liberia and are not publicly available. However, the data could be availed from the corresponding author with reasonable request and with permission from the Grand Kru County Health Team, Ministry of Health Liberia.

Ethical considerations

We obtained written permission to use the data from Grand Kru County Health Team (GKCHT) and permission from officers-in-charge (OICs) at the various health facilities where data was collected. The personal identifying information were removed from the dataset and confidentiality of the patients were maintained throughout the study.

Results

A comprehensive record review conducted in Grand Kru County from January 2017 to December 2021 revealed a total of 126 recorded neonatal deaths and 3,714 live births. Sixty-seven (53.2%) of the neonatal deaths were females, 82.5% (104/126) occurred in the health facilities while 17.5% (22/126) occurred in the community. The median age of the neonates was 2 days (Interquartile range (IQR): 1-4) days. One hundred and two (81.0%) of the deaths occurred during the early neonatal period (0 - 6 days of life), while 19.0% (24/126) occurred during the late neonatal period. Barclayville district accounted for 49.2% (62/126) of the total deaths, followed by Jroah district 30.2% (38/126), Trehn district 9.5% (12/126), Buah district 8.0% (10/126) and Dorbor district 3.1% (4/126) **Table 1**

During the period under review, birth asphyxia accounted for 39.6% (50/126), followed by neonatal sepsis 25.3% (32/126), prematurity 24.6% (31/126), aspiration pneumonia 4.0% (5/126), low birth weight and neonatal tetanus 3.1% (4/126) each **Figure 1**. The neonatal death rate was 55.5 per 1,000 live births for Jroah health district in 2017, 62.9 per 1000 live birth in 2018; 76.1 deaths per 1000 livebirths in 2019, 41.0 per 1000 livebirths and 94.8 deaths per 1000 livebirths in 2020 and 2021 respectively. While in Barclayville health district the neonatal death rate was 37.9 per 1000 livebirths in 2017, and 66.9 per 1000 livebirths in 2021.

Of the total deaths, the proportion that occurred at health facility level were 58.8% (10/17) in 2017, 92.3% (24/26) in 2018, 84.4% (27/32) in 2019, 91.7% (11/12) in 2020 and 82% (32/39) in 2021. While at the community level, 41.2% (7/17) of the deaths occurred in 2017, 7.7% (2/26) in 2018, 15.6% (5/32) in 2019, 8.3% (1/12) in 2020 and 18% (7/39) in 2021 Figure 2. While the neonatal death rate in Grand Kru County were 25.2 deaths/1000 live births in 2017, 34.9 deaths/1000 live births in 2018, 40 deaths/1000 live births in 2019, 20.5 deaths/1000 live birth in 2020 and 42.7 deaths/1000 live birth in 2021, while the average neonatal death rate from 2017 to 2021 was 33.9 deaths per 1000 live births Figure 3.

Among the factors that contributed to neonatal mortality in Grand Kru County, late community referral accounted for 58.7% (74/126), followed by the lack of functional incubators for newborn emergencies 28.6% (36/126), delayed ambulance services for patient referral 16.7% (21/126), lack of oxygen concentrators 15.1% (19/126) and poor clinical and biochemical monitoring 1.3% Table 2.

Discussion

The highest burden of neonatal mortality was observed in Jroah and Barclayville health districts. The high burden in these health districts could probably be because of the presence of the county´s referral hospital and the maternity hospital in the two districts. These hospitals are more likely to receive high-risk cases with a higher likelihood of mortality compared to the other health centres and clinics. These deaths that occurred in hospitals, health centers and clinics are more likely to be reported. It is likely, that a number of deaths that occurred in the community were not reported to the surveillance system for fear of community action due to the existing community policy that has some punitive measures against community delivery of babies leading to underreporting of community deaths.

Birth asphyxia, neonatal sepsis and prematurity were the major causes of neonatal deaths. These are generally related to the care of the baby at the perinatal period. There is a significant proportion of births which are unattended by skilled health attendants and are also not reported as such because of fear of punishment. These could have led to increased cases of poorly managed birth asphyxia, sepsis, and premature babies. There were also reported cases of lack of essential resuscitative equipment in the hospitals, sometimes when these equipment are available they are not functional due to lack of supporting facilities such as oxygen and electricity to operate them. Studies in Ghana, Ethiopia and Zambia reported similar findings that birth asphyxia, sepsis and prematurity were the leading causes of neonatal death [25, 26, 27].

Most of the deaths occurred in the health facilities, during the early neonatal period and females accounted for the highest proportion of neonatal death recorded for the period under review. The high proportion of the deaths reported in the hospitals could be relative to the possible underreporting in the community. It could also be related to the fact that the more severe cases are more likely to present to the hospitals for intervention. The higher number of deaths reported at the referral hospitals in the districts has been observed earlier. The high proportion of the neonatal deaths observed in our study could probably be related to the nature of the cause of the neonatal deaths observed which were mainly complications surrounding events around the perinatal period such as prematurity, asphyxia, and neonatal sepsis. These require early and prompt intervention which when lacking could lead to high mortality. The reason for the high proportion of neonatal deaths occurring among female newborns is not immediately apparent. Our finding however was found to be contrary to the findings reported in Tanzania and Cameroon in which the majority of the neonatal deaths were mostly males occurring in the late neonatal period [28-29].

We identified late community referral, lack of functional incubators and delayed ambulance services for patients as the leading contributing factors. These factors are critical to the control of neonatal deaths in the study population. Delays in the decision to refer a case to the next level of care have been identified as a contributory factor to the mortalities. These delays could be due to the inability of the health workers at the lower level to identify danger signs or due to the delay in the caregiver to accept the decision to transfer to the higher level of care or delays in getting transportation or other services that are crucial in moving the patients to the next level of care to receive the services deserved.

There is therefore need for the government to invest more not only in the health system but also in other sectors like the road network and transport systems which ensure that the health system is more efficient.

Despite the declaration of maternal and neonatal mortality as a public health emergency, the introduction of free healthcare services across the fifteen (15) subdivisions of Liberia and the crafting of maternal and newborn death review policies by the Government of Liberia, neonatal mortality remained a serious challenge in Grand Kru County where pregnant women walked more than 20km crossing rivers in search of healthcare services.

Our study was limited to data on the neonatal deaths reported in the community and health facilities. Due to the community policy punishing people who do not deliver in a health facility, there could be some unreported deaths for fear of punishment. Despite this limitation, we believe the available data was sufficient to provide guidance to further reduce the burden of neonatal deaths in the county.

Conclusion

Neonatal death is still a major public health problem in Grand Kru County needing some urgent interventions.

We recommended that the Ministry of Health (MoH) and National Public Health Institute of Liberia (NPHIL) provide functional incubators, oxygen concentrators for hospitals and health centers, and that the Grand Kru County Health Team provide a timely ambulance services for patient referral and at the community level. We recommended to the health facilities to ensure proper sterilization of delivery set, improved infection prevention and control during at delivery, and at the community level, community health volunteers (CHVs) should refer all pregnant women and mothers of newborn babies to the health facility to seek care especially during maternal and neonatal emergencies. The communities are encouraged to ensure that each delivery is attended to by a skilled health worker.

What is known about this topic

- Neonatal mortality is a public health emergency in Liberia
- Liberia is among the countries in the world with a high burden of neonatal mortality
- The sustainable development goal targets the reduction of neonatal mortality rate to less than 12 deaths per 1,000 live births in all countries by 2030

What this study adds

The neonatal mortality rate has remained high in Grand Kru County during the period under review

- Birth asphyxia, neonatal sepsis and prematurity were the main causes of neonatal death in Grand Kru County
- Late community referral, lack of functional incubators and delayed ambulance services for patients' referral were the major contributing factors to neonatal mortality in Grand Kru County

Competing interests

The authors declare no competing interests.

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Authors´ contributions

JL took lead in the study and manuscript writing. MAA, CDU, HWS, OJB, LS, FTW and LM provided technical guidance during the survey and development of the initial draft of the manuscript while FB and BN participated in the data collection process and in manuscript writing. All authors reviewed and approved the final version of the manuscript.

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Tables and figures

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Figure 2: Proportion of neonatal deaths reported by health facilities and communities in Grand Kru County, January 2017 to December 2021

Figure 3: Distribution of neonatal deaths rate per 1,000 live births reported in Grand Kru County, January 2017 to December 2021

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Table 1: Social-demographic characteristics and causes of neonatal deaths reported by health facilities in Grand Kru County, January 2017 to December 2021		
Characteristics	**Frequency (n=126)**	**Percent (%)**
Sex		
Female	67	53.2
Male	59	46.8
Place of death		
Health Facility	104	82.5
Community	22	17.5
Age (days)		
0 - 6	102	81.0
7 - 27	24	19.0
Median age (IQR)	2 (1 – 4)	
Health districts		
Barclayville	62	49.2
Buah	38	30.2
Dorbor	12	9.5
Jroah	10	8.0
Trehn	4	3.1
IQR= Interquartile range		

Table 2: Factors contributing to neonatal mortality in Grand Kru County, Liberia, January 2017 to December 2021.

Contributing factors*	**Frequency (n=126)**	**Percent (%)**
Late community referral	74	58.7
Lack of functional incubators for newborn emergencies	36	28.6
Delayed ambulance services for patient referral	21	16.7
Lack of oxygen concentrators	19	15.1
Poor monitoring of patients	2	1.6
*Multiple response allowed		

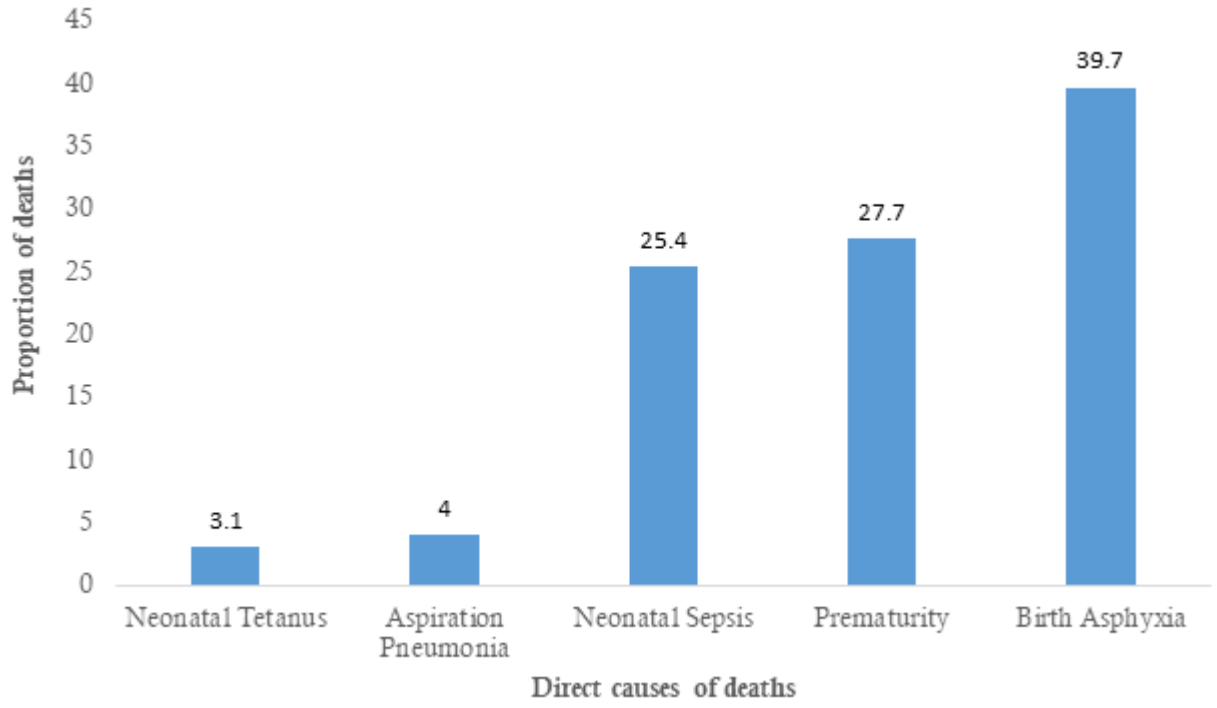

Figure 1: Direct Causes of neonatal deaths reported by health facilities in Grand Kru County, January 2017 to December 2021

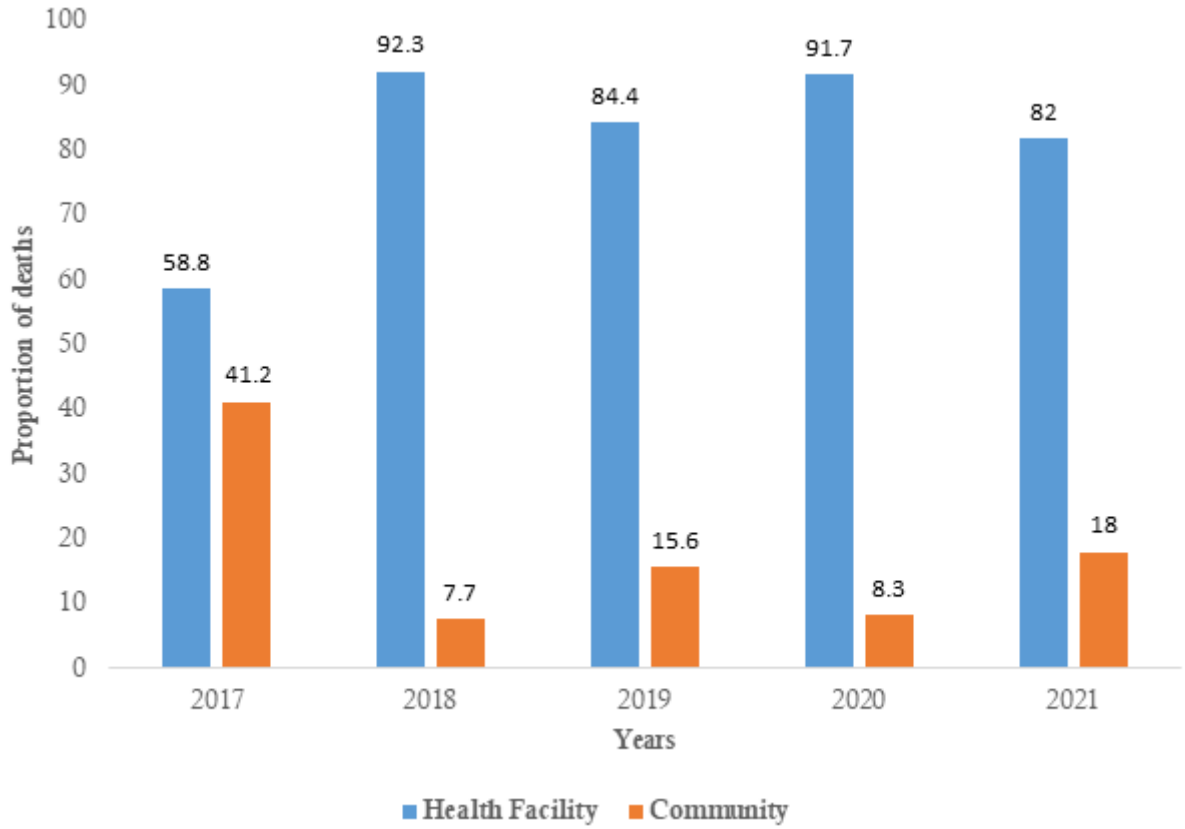

Figure 2: Proportion of neonatal deaths reported by health facilities and communities in Grand Kru County, January 2017 to December 2021

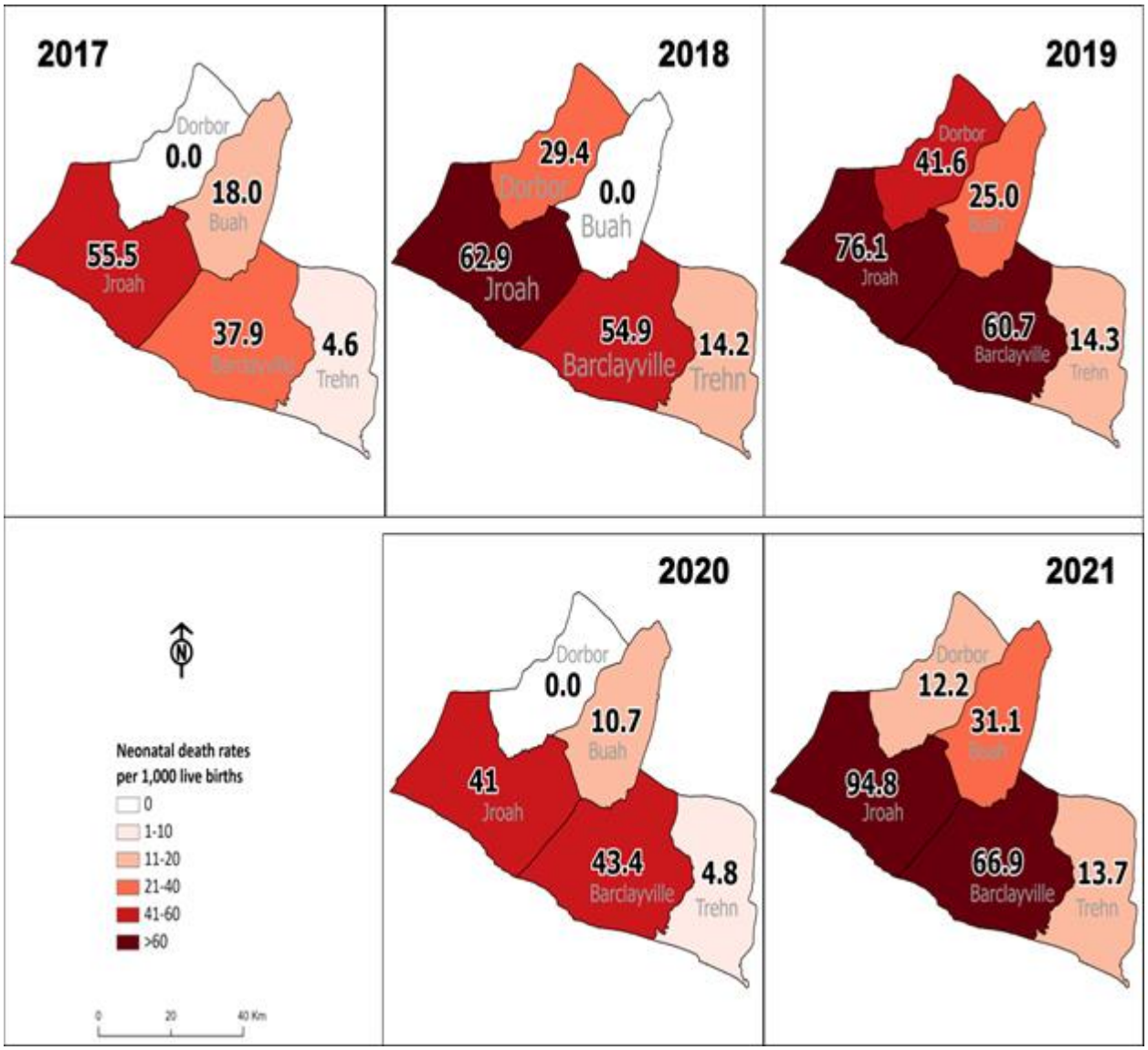

Figure 3: Distribution of neonatal deaths rate per 1,000 live births reported in Grand Kru County, January 2017 to December 2021