Verification of Neonatal Tetanus Surveillance Systems in Katsina State, Nigeria

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and Monoj Sharma[1]

Abstract

Background: The incidence and mortality rates of neonatal tetanus (NNT) remain underreported in Nigeria. The goal of the study was to compare the NNT prevalence and the mortality rates from the existing surveillance system and active surveillance of health facility records in 7 selected health facilities from 2010 to 2014 in Katsina State, Nigeria.

Methods: The study is a retrospective record review using extracted data from NNT records and analyzed using descriptive statistics.

Results: The prevalence of NNT and mortality rate were 336 cases and 3.4 deaths per 100 000 population, respectively, whereas the prevalence of NNT and mortality rate reported through the Integrated Disease Surveillance and Response (IDSR) system were 111 cases and 1.0 death per 100 000 population, respectively.

Conclusion: The study shows underreporting of NNT in the existing IDSR system.

Implications: Active surveillance is a good strategy for verifying underreporting of NNT in the surveillance system. The IDSR system should be strengthened with the capacity to detect events associated with a disease toward global elimination.

Introduction

Globally, the prevalence/incidence rates of neonatal tetanus (NNT) are grossly underreported in existing disease surveillance systems.[1] Therefore, the actual incidence of the disease may continue to remain unclear if this situation is not addressed adequately. Furthermore, recent studies indicate the need to incorporate the capacity to detect events associated with a disease in such surveillance systems.[2] The Institute of Medicine has recommended new methods of disease surveillance systems to strengthen the existing ones.[3] Disease surveillance involves systematic collection and analysis of data obtained from several sources. The data are interpreted to determine the extent of the disease and risk of transmission for evidence-based decision-making. The NNT surveillance system in Nigeria was not well established until 1998 when the federal government introduced a national disease surveillance system termed the Disease Surveillance and Notification System (DSN).[4] The DSN was formed in response to a yellow fever outbreak, which was largely attributed to a nonfunctional disease surveillance system in the country.[5] The surveillance of NNT in the DSN was based on the identification of NNT cases collected at the health facility level and then reported to the Federal Ministry of Health for analysis.[5] However, despite this new approach, underreporting of NNT cases persisted in the surveillance system because there were no local, state, and national bodies that could regulate the collation, harmonization, and coordination of surveillance data from the different levels of the health facilities.[6]

Neonatal tetanus under the DSN still remained largely underreported even after the 1989 World Health Assembly resolution to eliminate the disease by the year 2015.[7] Detection and reporting of NNT in the early 1990s was challenging because most NNT cases occurred in regions that were underserved and difficult to reach.[8] In essence, neither incidences nor

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mortality rates attributable to NNT were reported from these "silent areas." Consequently, NNT was termed as a "silent killer" because many newborns died of the disease that were not identified and reported by the disease surveillance system.[9] This resulted in a relatively high NNT mortality rate of 20.6 deaths per 1000 live births in Nigeria.[10] The World Health Organization (WHO) African Regional Office introduced the Integrated Disease Surveillance and Response (IDSR) in September 1998, due to prolonged inconsistencies in the generation of surveillance data for action by its surveillance systems as well as competing vertical disease surveillance systems that focused primarily on a single specific disease or health events. The IDSR system was established with the following objectives: (1) integrated implementation of surveillance activities promotions regarding effective use of resources, (2) use of several organization's processes and personnel for surveillance activities, and (3) strengthening disease surveillance and response systems at community, health facility, state, and national levels.[4] The IDSR system differs from the DSN system because the IDSR system utilizes the same human and material resources for the surveillance of all priority diseases, while separate human personnel and tools were used for the surveillance of each priority disease in the DSN system. Additionally, the IDSR system promotes community participation for the identification and response to disease outbreaks, while only surveillance officers and health personnel are required in the DSN system.[11] The main initiative toward global elimination of NNT is the United Nations Children's Fund (UNICEF), United Nations Population Fund, WHO, Maternal and Neonatal Tetanus Elimination initiative strategy, which put forth the goal of reducing NNT cases to <1 case per 1000 live births by the year 2015.[12] This strategy conforms to the realization of the United Nations Millennium Development Goals and the WHO/UNICEF Global Immunization Vision and Strategy.[8]

Strengthening NNT surveillance is a major component for achieving the goal of elimination; however, despite the introduction of IDSR to strengthen the surveillance system, NNT still remains underreported in many states in Nigeria.[13] The WHO[14] reported that Nigeria and other African countries including Guinea Bissau, Mali, Mauritania, Chad, Cameroon, Senegal, Niger, Ethiopia, Angola, Burkina Faso, Liberia, and Ghana still report less than 5% of the actual NNT cases. Failure of the IDSR system to promptly report NNT cases for response was probably accountable for the high NNT mortality rate reported from surveys conducted in some health facilities in Nigeria.[14] Although NNT is a notifiable disease in Nigeria, it is still acknowledged that the timeliness, completeness, and quality of notification remain major challenges of the IDSR.[15] Nigeria alone was responsible for over 40% of a global NNT mortality rate from 1998 to 1999, which should be viewed in consideration of the gross underreporting,[16] which is the second highest in the world after India.[17] The level of underreporting and inadequate data of the incidence and mortality rate of NNT specifically in Northern Nigeria both remain serious obstacles to the elimination of the disease in Nigeria. Evidence from contemporary literature indicates that evaluations of NNT

surveillance systems in Nigeria were mostly conducted in the Southern region.[18] An active surveillance approach was used in this study to determine the actual prevalence, mortality rate, and level of underreporting of NNT cases in the existing surveillance system.

Research Questions and Hypotheses

Research question of the study was: Is there any difference in the prevalence of NNT and the NNT mortality rate as reported in the IDSR system and the prevalence of NNT and the NNT mortality rate as identified through active surveillance of the health facility records in Katsina State? The null and alternate hypotheses of the research question were:

H_0: There is no difference in the prevalence of NNT and the NNT mortality rate as reported in the IDSR system and the prevalence of NNT and the NNT mortality rate as identified through active surveillance of the health facility records in Katsina State.

H_a: There is a difference in the prevalence of NNT and the NNT mortality rate as reported in the IDSR system and the prevalence of NNT and the NNT mortality rate as identified through active surveillance of the health facility records in Katsina State.

The NNT survey form was used to answer the research question.

Methods

Study Design

This study is a cross-sectional survey of surveillance data from 2010 to 2014 obtained from 2 independent sources: primary sources extracted from passive surveillance and secondary sources extracted from active surveillance approach.

Study Population

The study population consisted of patients with NNT admitted from January 01, 2010, to December 31, 2014, from 7 health facilities in the 3 geopolitical zones in Katsina State, Nigeria

Sample Size Determination

The sample size population was determined by the prevalence of NNT cases admitted in each health facility from January 01, 2010, to December 31, 2014.

Inclusion/Exclusion Criteria

The inclusion criteria were (1) only infants born within the neonatal period, that is, first 28 days of life, (2) all cases that had met the WHO case definition of NNT, (3) all NNT cases treated in health facilities, and, (4) all NNT cases treated from January 01, 2010, to December 31, 2014. While the exclusion

criteria were: (1) all infants born outside the neonatal period, that is, above 28 days old, (2) all cases that have not met the WHO criteria for NNT, (3) all NNT cases treated at home, and (4) all NNT cases treated prior to January 01, 2010, or after December 31, 2014.

Sampling and Sampling Procedure

The sample size for this study was realized through multistaged sampling technique that included random sampling to select 3 local government areas and 7 health facilities. Then the study population was selected through proportional probability sampling technique due to the variations in the amount of patients with NNT admitted in the health centers.

Procedures for Data Collection

The process involved 3 key participants: (1) the primary investigator, (2) the data abstractors, and (3) the medical reviewers who were clinicians. The nurses (data abstractors) extracted information on NNT prevalence and mortality rates from 1489 health facility records of 7 health facilities. They also screened for double reporting of NNT cases in both IDSR and health facility records. However, the clinicians (medical reviewers) screened for NNT cases based on the WHO case definition of NNT as any newborn who could suckle normally in the first 2 days of life but was unable to suckle between the 3rd and 28th days and has muscles spams or becomes stiff during the period of illness.[14] Any record that did not meet the WHO NNT case definition was termed as a "negatively screened record," while records that have met the WHO NNT case definition were "positively screened records." The negatively screened records were returned back to the health facility records department, whereas all positive screened records were forwarded to the medical reviewers for further evaluation. The medical reviewers reduced the risk of screening errors associated with undetermined variables in individual records and ensured quality, complete, and accurate review of data. Data were extracted using a modified version of the WHO tool used for the survey of assessing NNT incidence and mortality in the community.[19] Access to both NNT IDSR data and health facility records was gained with the permission obtained from Katsina State Ministry of Health.

Data Analysis

Descriptive analysis expressed as percentages, rates, and frequency distributions was used to estimate NNT prevalence rates, NNT mortality rate, and any differences in the prevalence of NNT reported in primary sources and cases identified from secondary sources. The prevalence rate of NNT was assessed as the total number of NNT cases divided by the total number of live births from January 1, 2010, to December 31, 2014, while the NNT mortality rate was assessed as the proportion of NNT cases who died of the disease. The estimated NNT mortality
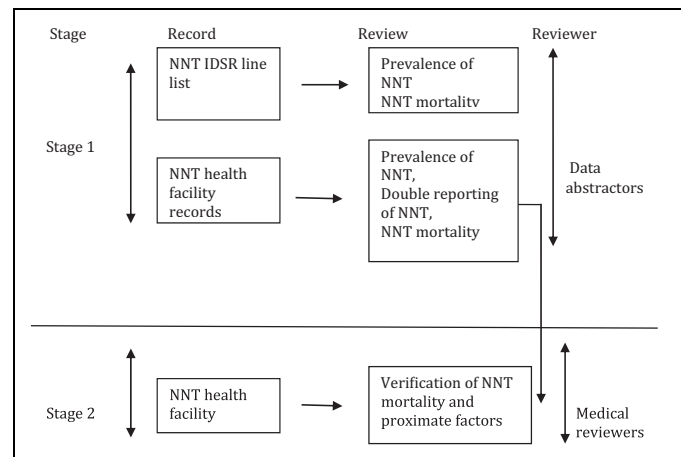

Figure 1. Active surveillance retrospective record review process used in the study. Active surveillance and retrospective record review process used in the study. At the first stage of the review process, data abstractors extract information on the prevalence of neonatal tetanus (NNT) and NNT mortality from the Integrated Disease Surveillance and Response (IDSR) database of each health facility. Secondly, the data extractors will also screen for information on the prevalence of NNT, NNT mortality, and double reporting of NNT from health facility records and IDSR line list. The second stage of the review process is the verification of positively screened data by medical reviewers. The medical reviewers will verify information on neonatal tetanus mortality and proximate factors. Adapted from Zegers et al.[22] Reproduced with permission.

rate in Katsina State was calculated using the formula: NNT mortality rate equals NNT mortalities identified through active surveillance (2010-2014) divided by total population and multiplied by 100 000. The total population of Katsina State according to 2006 census was 5 801 584,[20] and the average population growth in Nigeria between the 2006 census and 2014 is 2.7.[21] Thus, the projected 2014 population of Katsina State was 7 179 763. The data abstractors and medical reviewers reviewed an estimated 30 to 40 medical records per day. Data were analyzed by the primary researcher using SPSS version 23. Figure 1 depicts the retrospective review process in the study and Figure 2 depicts the summary of the participant flowchart for the study.

Ethical Considerations

The participants for this study were sampled from the IDSR database and hospital records. Prior to data collection, approval to gain access to hospital records and IDSR database was obtained from Katsina State Ministry of Health. Information from IDSR and health facility records was used strictly for the purpose of this study and be kept confidential in computer database protected by a password. All questionnaires used by data abstractors and medical reviewer are properly archived to ensure that the privacy of participants is protected. And similarly, the names of data abstractors and medical reviewers are coded to ensure anonymity of information.
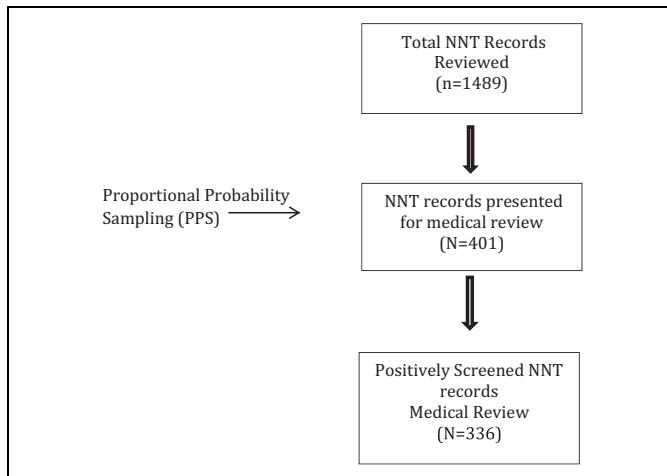
Figure 2. Participant flowchart. The neonatal tetanus (NNT) records reviewed for the study were selected from the positively screened records using proportional probability sampling.

Table 1. Prevalence of NNT Cases in the Selected Health Facilities (2010-2014).

Health Facility	Year					
	2010	2011	2012	2013	2014	Total (%)
General Hospital Katsina	22	17	15	11	9	74 (22.0)
Federal Medical Centre Katsina	11	12	7	6	3	39 (11.4)
MCHC Kofar Guga	7	4	4	5	2	22 (6.6)
General Hospital Malumfashi	14	11	12	7	8	52 (15.4)
MCHC Malumfashi	23	19	12	16	11	81 (24.1)
General Hospital Daura	12	15	11	10	5	53 (16.0)
PHC Dannakola	5	3	2	2	3	15 (4.5)
Total	94	81	63	57	41	336 (100)

Abbreviations: MCHC, Maternal and Child Health Center; NNT, neonatal tetanus; PHC, primary health center.

Results

A total of 336 NNT cases were identified in the 7 health facilities sampled in the study area. The demographic factors for the study included gender, year of admission, and sources of information used for the review. Table 1 shows the prevalence of NNT cases from 2010 to 2014 identified through active surveillance in the 7 selected health facilities. Maternal and Child Health Center (MCHC) Malumfashi had the highest prevalence of NNT cases (24.1%) followed by General Hospital Katsina (22.2%), General Hospital Daura (16.0%), General Hospital Malumfashi (15.4%), Federal Medical Center Katsina (11.4%), MCHC Kofar Guga (6.6%), and primary health center (PHC) Dannakola (4.5%), respectively. Table 2 shows comparison between the prevalence of NNT and NNT mortalities reported in the IDSR system and the prevalence of NNT and NNT mortality rate identified through active surveillance of the

Table 2. Five-Year Assessment (2010-2014) of NNT Surveillance in the Selected Health Facilities.

Health Facility	Prevalence		Reported		Underreported (%)	
	NNT	Mortality	NNT	Mortality	NNT	Mortality
General Hospital Katsina	74	53	23	17	51 (69)	36 (68)
Federal Medical Centre Katsina	39	27	21	12	18 (46)	15 (56)
MCHC Kofar Guga	22	17	8	5	5 (23)	12 (71)
General Hospital Malumfashi	52	28	12	9	40 (77)	19 (68)
MCHC Malumfashi	81	64	27	13	54 (67)	51 (80)
General Hospital Daura	53	45	18	14	35 (67)	31 (69)
PHC Dannakola	15	13	2	2	13 (87)	11 (85)
Total	336	247	111	72	225 (68)	175 (71)

Abbreviations: MCHC, Maternal and Child Health Center; NNT, neonatal tetanus; PHC, primary health center.
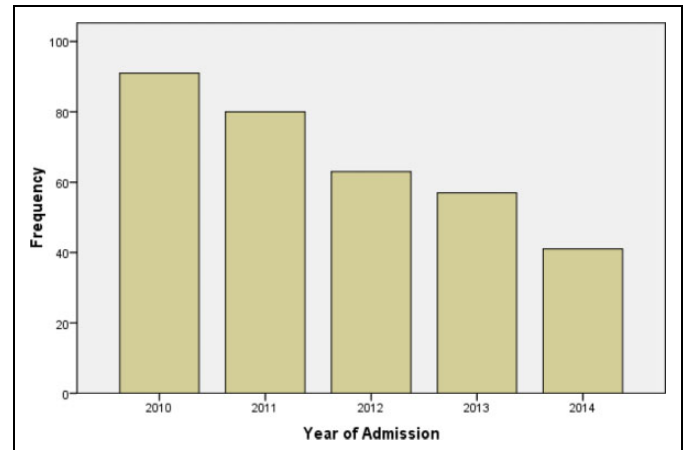

Figure 3. Frequency of neonatal tetanus (NNT) cases by year of admission 2010 to 2014.

health facility records from 2010 to 2014. The results indicate the 336 NNT cases were identified through active surveillance, while only 111 NNT cases were reported through the IDSR system. These discrepancies indicate underreporting of the prevalence of NNT and NNT mortality rates reported through the IDSR system in Katsina State. Thus, the alternate hypothesis is accepted. Figure 3 shows the frequency of NNT cases admitted from 2010 to 2014. Most of the NNT cases (27.4%) were admitted in 2010, followed by 2011 (24.1%), 2012 (19.0%), 2013 (17.2%), and 2014 (12.3%). In terms of distribution by
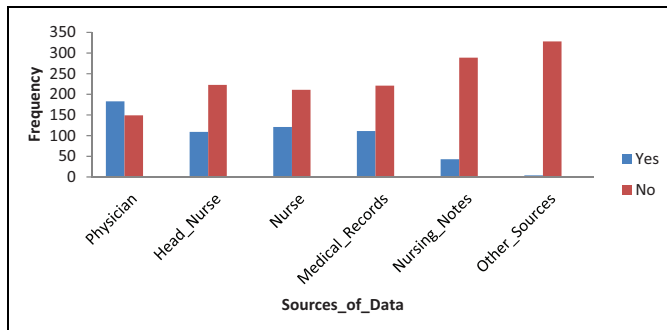
Figure 4. Frequency of sources of information for the retrospective record review.

health facility, MCHC Malumfashi had the highest number of NNT cases, 80 (24.1%), followed by General Hospital Katsina, 73 (22.0%), General Hospital Daura, 53 (16.0%), General Hospital Malumfashi, 51 (15.4%), Federal Medical Center Katsina, 38 (11.4%), MCHC Kofar Guga, 22 (6.6%), and PHC Dannakola, 15 (4.5%). Concerning gender, specifically, 55.4% (184) were males and 44.6% (148) were females. Figure 4 depicts the frequency of sources of information for the retrospective record review. Information from 55% (183) of NNT case files was extracted from physicians records, 32.8% (100) from head nurses records, 36.4% 121 from nurses records, 33.4% (111) from medical records department, 13% (43) from nursing notes recorded in patient registers, and 0.9% (3) from other sources like prescription notes.

The estimated NNT mortality rate in Katsina State from January 1, 2010, to December 31, 2014, was 3.4 deaths per 100 000 population, while the NNT mortality rate reported in the IDSR system within the same period was 1.0 death per 100 000 population.

Discussions

Main Findings

Neonatal tetanus remains a preventable global public health concern, and evidence is weak regarding the global effort toward eliminating the disease due to underreporting of NNT mortality in surveillance systems, especially in developing countries.[23] This quantitative, cross-sectional study was undertaken with the objective of comparing the prevalence and mortality rates of NNT reporting between the IDSR system and active surveillance of health facility records. Findings from the study indicate a far lower NNT mortality rate than that of 3.1 per 1000 live births that was obtained by Lawoyin and colleagues, who conducted a 5-year (1993-1998) community-based autopsy to assess the risk factors associated with neonatal mortality in a rural setting in Southwestern Nigeria.[24] The reduction in NNT mortality can be attributed to improved tetanus toxoid immunization coverage in developing countries including Nigeria,[23] which consequently increased the level of immunity against NNT (protected at birth) among neonates to up to 60%.[21]

The results confirm differences in the prevalence of NNT and the NNT mortality rate as reported in the IDSR system and the prevalence of NNT and the NNT mortality rate as identified through active surveillance. The results also confirm underreporting of NNT and NNT mortality in the surveillance system in Katsina State. These findings correspond with the outcome of an NNT survey by Peterside et al,[25] in which the researchers found that only 5% of NNT cases were actually reported to health facilities. This is a vital outcome because it confirms references in contemporary literature that claim a low NNT detection rate found in the surveillance systems of developing countries.[12,26]

Secondary Outcomes

Demographic features of the study population indicate that more males (55.4%) were admitted with NNT than females (44.6%). This finding is in contrast with findings by Babatunde et al,[27] who observed that of those admitted with NNT, 83.3% were females and 16.7% were males. Additionally, the results showed a steady decline in the frequency of NNT cases from 2010 to 2014, with most of the NNT cases (27.4%) admitted in 2010, followed by 2011 (24.1%), 2012 (19.0%), 2013 (17.2%), and 2014 (12.3%). This is similar to the findings observed in Northeast Nigeria by Jalal-Eddeen,[28] who obtained 26% NNT cases recorded in 2010 and only 9% NNT cases recorded in 2013. The frequency of NNT cases is inversely proportional to increasing years, which is likely attributable to increased awareness of tetanus toxoid immunization during antenatal care among women of child-bearing age in Nigeria, especially in urban settings.[29] Data on frequency of sources of information showed that 55% (183) of NNT case files were extracted from physicians records, 32.8% (100) from head nurses records, 36.4% (121) from nurses records, 33.4% (111) from medical records department, 13% (43) from nursing notes recorded in patient registers, and 0.9% (3) from other sources such as prescription notes. More NNT records were extracted from physicians' records than other sources of information because most of the diagnoses of NNT were made by physicians, probably due to better knowledge of clinical presentations of the disease.

Study Strength

Retrospective record review of health facilities was considered as the appropriate approach for this study because it could determine the prevalence and risk factors for health events.[30] Several studies have been conducted using retrospective record reviews because it can be replicated and used to review wide coverage of medical records.[31] Ibrahim et al[32] conducted a 7-year record review of NNT cases in a tertiary hospital in Jos, North Central, Nigeria. Other similar examples include studies by Oyedeji et al[16] and Emodi et al[33] in southwest and southeast Nigeria, respectively. Retrospective record reviews are generally easier to extract than other forms of prospective study designs because they are a more efficient approach of

collecting and analyzing medical data after exposure to the causative agent.[34] Thus, a retrospective record review was appropriate for this study because it was used for active surveillance of NNT cases in health facilities and identification of information on the risk factors for NNT in the study area. Additionally, the approach was used to review a wide coverage of NNT cases in the study area, which increased the validity and reliability of the study.

Limitations of the Study

The study failed to examine the relationships between sociodemographic variables and NNT due to missing data. This is attributed to poor record keeping observed among health personnel in PHCs in the rural communities during data collection.

Recommendations

The outcome of this study is recommended for DSN officers and directors of epidemiology to strengthen the surveillance of NNT through active surveillance. Active surveillance of NNT is a good strategy for verifying the efficacy of NNT surveillance system and should be enhanced to strengthen the existing IDSR system. Underreporting of NNT through the existing surveillance system may possibly create inaccurate estimates of the prevalence, incidence, and mortality rates of the disease, which eventually makes it challenging for policy makers and stakeholders to decide on the appropriate interventions and resources allocated to eliminate the disease. Future research should explore the possible reasons for underreporting of NNT in the existing NNT surveillance system.

Conclusion

Neonatal tetanus is said to be eliminated when the prevalence rate in a country is less than 1 case per 1000 live births. Although a total of 38 countries reached this milestone between 2008 and June 2015,[9] the disease is still endemic and was accountable for the high neonatal mortality rate in some surveys conducted in Nigeria.[14] Evidence from this study suggests that NNT reporting is ineffective in the existing IDSR system, which is vital gap toward the elimination of the disease in Nigeria. Thus, it is imperative to strengthen the existing NNT surveillance system through regular active surveillance in order to reduce the burden of the disease and attain elimination goals.

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Hadi Danawi trained in Public Health with a Ph.D. in Epidemiology from the University of Texas at Houston and a master degree in Environmental Health from the American University of Beirut, Dr. Danawi has an international exposure to various Public Health issues in the U.S. Middle East and Africa. Dr. Danawi is passionate about creating positive social change and truly believes his research interests should be multidisciplinary as is Public Health. Dr. Danawi currently serves as a full time faculty at Walden University, College of Health Sciences teaching and mentoring doctoral dissertations.

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