

1 **TETANUS IN SCHOOL AGE CHILDREN SEEN AT THE UNIVERSITY OF PORT**  
2 **HARCOURT TEACHING HOSPITAL: A NEED FOR BOOSTER DOSES OF TETANUS**  
3 **TOXOID VACCINE IN NIGERIA.**

4 **ABSTRACT**

5 **Background:** Tetanus still causes significant morbidity and mortality amongst children in  
6 Nigeria despite decades of immunisation with tetanus vaccine.

7 **Objectives:** To determine the prevalence, case fatality rate and predictors of fatality amongst  
8 school age children treated for tetanus at the University of Port Harcourt Teaching Hospital.

9 **Materials and Methods:** This was a retrospective study of all children aged 4 to 17 years  
10 treated for tetanus at the University of Port Harcourt Teaching Hospital between January 1, 2009  
11 and December 31, 2019. Data was obtained from the case notes and ward registers. Socio-  
12 demographic characteristics, presenting complaints, incubation period, onset interval, number of  
13 Diphtheria, Pertussis and Tetanus (DPT) vaccine received at infancy, treatment outcome,  
14 duration and cost of hospital stay were obtained, entered into a spread sheet and analysed with  
15 SPSS version 20. Results are presented in tables and percentages. The level of significance was  
16 set at P value <0.05.

17 **Results:** During the period under review, there were 53 children aged 4 to 17 years treated for  
18 tetanus, accounting for 0.3% of the total admission. The mean age was  $10.79 \pm 3.35$  years. There  
19 were 33 (62.26%) males and 20 (37.74%) females. Majority 26 (49.06%) of the children were of  
20 low socioeconomic class. The commonest 28(52.8%) route of infection was broomstick injury.  
21 Majority 32(60.3%) of the children were not immunised in infancy. The mean incubation period  
22 was  $7.34 \pm 4.21$  days and the mean onset interval was  $8.87 \pm 10.44$  hours. The two most common  
23 symptoms were generalized spasms 49 (21.03%) and trismus 47 (20.17%). Short incubation  
24 period ( $\leq 4$  days) and short onset interval ( $\leq 4$  hours) were significantly associated with higher  
25 death rates ( $p=0.0002; p=0.012$ ). Patients with short incubation period of  $\leq 4$  days and short onset  
26 interval of  $\leq 4$  hours are more likely to die ( $p=0.0002; p=0.012$ ).

27 **Conclusion:** There was a high tetanus case fatality rate amongst school age children at  
28 University of Port Harcourt. Short incubation period and onset interval were associated with

29 higher mortality. Booster doses of TT containing vaccines should be administered to primary and  
30 secondary school children in Port Harcourt to curb the menace.

31 **Keywords:** Tetanus, School age, Children, Tetanus toxoid, Vaccine

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## 34 1. INTRODUCTION

35 Despite being vaccine preventable, tetanus continues to cause significant morbidity and  
36 mortality among children in Nigeria as well as in many developing countries, where  
37 immunization rates are still low.<sup>1</sup> The disease is contracted through exposure to the spores of the  
38 bacterium *Clostridium tetani*, a gram positive organism which only survives in anaerobic  
39 environments.<sup>1</sup> Tetanus spores are commonly found in the environment, especially in soil, dust  
40 and animal faeces and easily contaminate wounds. The very potent neurotoxin produced by the  
41 spores in contaminated wounds is responsible for the signs and symptoms of the disease.<sup>1</sup> Whilst  
42 post neonatal tetanus may follow deep puncture wounds, crush wounds, otitis media, dental  
43 infection,<sup>2</sup> maternal and neonatal tetanus follow abortions, unclean deliveries and unhygienic  
44 umbilical cord care practices.<sup>1</sup>

45 Tetanus is characterized by a sudden onset of painful contractions of the muscles of the face,  
46 jaw, neck and back, hypertonia and generalized muscle spasms.<sup>3</sup> The case fatality rate for  
47 tetanus varies from 10% to 70% globally and 27.4% to 51.0% at the University of Port Harcourt  
48 Teaching Hospital, depending on the age of the patient; with most of the deaths occurring during  
49 the neonatal period.<sup>4,5,6,7,8</sup>

50 Tetanus is easily preventable through immunization with tetanus toxoid containing vaccines.<sup>9</sup>  
51 The World Health Organization (WHO) recommended 3 primary and 3 booster doses of such  
52 vaccines for complete protection for life.<sup>9</sup> The primary doses are to be given at 6, 10 and 14  
53 weeks of age with a minimum interval of 4 weeks in between doses.<sup>9</sup> The 3 booster doses are  
54 preferable to be given during the second year of life (12-23 months), 4 -7 years and 9-15 years of  
55 age, with at least 4 years interval between the booster doses.<sup>9</sup>

56 The three primary doses of tetanus toxoid containing vaccines only protect during the first three  
57 to four years of life, while the three booster doses provide long term immunity.<sup>4</sup> The recipients  
58 antitoxin levels are expected to rise considerably greater than the protective level of 0.1IU/ml  
59 after the first 4 doses of TT.<sup>2</sup> In countries where these recommendations have been followed  
60 judiciously and where immunisation coverage rates have been consistently high, tetanus  
61 incidence have remained low.<sup>1</sup>

62 Nigeria adopted the WHO's immunisation guideline<sup>9</sup> but only included the 3 primary doses of  
63 TT in her immunization schedule and since 1979 children have been receiving the 3 doses of the  
64 Tetanus Toxoid vaccines as DPT1,2 and 3 in infancy,<sup>10</sup> without the benefits of the booster doses.  
65 Furthermore, Nigeria's immunisation coverage rate has remained consistently low despite  
66 several decades of immunisation practice .<sup>11</sup> The recent demographic and health survey revealed  
67 that only 31% of Nigeria's infants are fully vaccinated according to the National Programme on  
68 Immunisation (NPI) schedule and the coverage rate for DPT 3 was only 50%.<sup>11</sup> Though this  
69 represents a slight improvement from the 2013 DPT 3 coverage rate of 38%,<sup>12</sup> it is still not  
70 acceptable that 50% of Nigeria's children are not protected against tetanus. Even among those  
71 who received the three primary doses of TT in infancy, the antitoxin levels have been known to  
72 fall below the minimal protective level during the school age period,<sup>2,5,13,14</sup> predisposing school  
73 age children to developing post neonatal tetanus, thus necessitating the recommendation for the  
74 administration of pre-school entry and in-school booster doses of TT to school age children.<sup>9</sup>  
75 Consequently, despite more than 3 decades of immunisation, school age children in Nigeria still  
76 continue to suffer from tetanus, including those ones that received the three doses of tetanus  
77 toxoid in infancy.<sup>14</sup>

78  
79 Reports from several studies in Nigeria showed that school age children accounted for 87% to  
80 95.5% of the cases of post neonatal tetanus cases seen in the health facilities across Nigeria .<sup>8,15,16</sup>  
81 Despite knowing this, no research on post neonatal tetanus have targeted school age children to  
82 evaluate the impact of the disease on this particular age group. This study therefore aimed to  
83 evaluate the prevalence, case fatality rate and predictors of fatality among school age children 4-  
84 17 years treated for tetanus at the University of Port Harcourt Teaching Hospital.

## 85 **2. MATERIALS and METHODS**

86           **2.1: Study Site:**

87           University of Port Harcourt Teaching Hospital is a tertiary hospital situated in Port Harcourt the  
88 capital of Rivers State in Southern Nigeria. The hospital is a referral centre for most life  
89 threatening diseases like tetanus. Department of Paediatrics is one of the major clinical  
90 departments in the hospital. The department runs general outpatient and specialist clinics every  
91 working day, from where patients are admitted into the children's emergency room and the  
92 children's medical wards. All children diagnosed with tetanus are admitted directly into the  
93 Tetanus Room within the children's medical ward.

94           **2.2.Methods**

95           This was a descriptive, retrospective cross-sectional study carried out at the Department of  
96 Paediatrics of the University of Port Harcourt Teaching Hospital. The ward registers and case  
97 notes of all children aged 4 years to 17 years admitted with the clinical diagnosis of tetanus into  
98 the tetanus room from January 1, 2009 to December 31, 2019 were retrieved. Information  
99 obtained included socio-demographics; presenting complaints; portal of entry; incubation period;  
100 onset interval; doses of DPT received during infancy; treatment received; treatment outcome;  
101 duration and cost of hospital stay. The social class of the patients was calculated using the  
102 educational qualification and occupation of their parents (Oyedeki classification).<sup>17</sup>

103           **2.3.Statistical Analysis**

104           The data obtained was entered into a spreadsheet, coded and analysed with SPSS version 20.  
105 Categorical data were presented in the form of frequencies and percentages and summary  
106 statistics in means and standard deviations with results presented in tables. Chi-square test was  
107 performed to test for association between two or more categorical variables and to determine the  
108 level of statistical significance between variables. Bivariate analysis was used (with a two-by-  
109 two contingency table) to determine the risk association (using odds ratio, ORs). All ORs were  
110 reported with their 95% confidence interval (CI) and corresponding p-values. An observation  
111 was said to be statistically significant if the p-value was  $\leq$  to 0.05 at a 95% CI.

112           **3. RESULTS**

113 During the period under review, there were 16,980 admissions of which 53 were cases of tetanus  
114 amongst children aged 4 to 17 years, accounting for 0.3% of admissions. The mean age was  
115  $10.79 \pm 3.35$  years. About half 28 (52.83%) of them were in the 10 to 15 years age group. Thirty  
116 three (62.26%) were males and 20 (37.74%) were females with male to female ratio of 1.7:1.  
117 Majority 29(54.72%) were in primary school. Most of the children 26 (49.06%) were of low  
118 socioeconomic class (Table 1). Majority of the fathers 32(60.38%) and mothers 25 (47.17%)  
119 had secondary education. The most common occupation amongst the fathers 12 (22.64%) and  
120 mothers 19 (35.85%) was trading.

121 Figure 1 showed the trend in tetanus prevalence, with the highest prevalence in 2017 and 2018.

122 Table 2 showed that the commonest route of the infection was broomstick injury 28 (52.8%),  
123 followed by injuries from other penetrating objects 11(20.8%) and road traffic accidents 11  
124 (20.8%). Majority 32 (60.3%) of the children were not immunised in infancy. **Table 3 showed**  
125 **that 62.5% and 50.0% of patients admitted in 2018 and 2019 respectively were not immunised**  
126 **with TT in infancy**

127 The mean incubation period was  $7.34 \pm 4.21$  days and the mean onset interval was  $8.87 \pm 10.44$   
128 hours. The most common complaint at presentation were: Spasms (21.03%); inability to open  
129 mouth (20.17%) and neck stiffness (16.31%).

130 Thirty six (67.92%) children recovered and were discharged home; 13 (24.53%) died; 1 (1.89%)  
131 developed deep bed sores and was referred to the Burns and Plastics Unit of the hospital; 1  
132 (1.89%) absconded with the parents, and the parents of 2 (3.77%) children signed against  
133 medical advice. The mean duration of hospital stay was  $22.94 \pm 13.53$  days and the average cost  
134 of hospital stay and treatment was 142, 571.69 $\pm$ 70,784 naira (593 USD).

135 Figure 2 showed that the death rate from tetanus dropped from 30.8% in 2010 to 7.7% from 2016  
136 to 2019.

137 **Table 4** showed that gender ( $p=0.654$ ) and socioeconomic status ( $p=0.937$ ) were not significantly  
138 associated with death. Patients who had incubation periods of 4 days and below ( $\leq 4$  days) had a  
139 significantly higher fatality rate compared to those with incubation periods of 5 days and above  
140 ( $\geq 5$  days) (76.92 vs. 23.08;  $p=0.0002$ ). Patients who had incubation period of 4 days and below

141 were 15.71 times more likely to die compared to those with incubation periods of 5 days and  
142 above (OR=15.71; p=0.0002; 95CI: 3.41-72.31). Patients who had onset interval of 4 hours and  
143 below (1-4 hrs) had a significantly higher fatality rate compared to those with onset interval of 5  
144 hours and above ( $\geq 5$  hrs) (43.48% vs. 23.08%; p=0.012). Patients who had onset interval of 4  
145 hours and below were 6.92 times more likely to die compared to those with onset interval of 5  
146 hours and above (OR=6.92; p=0.012; 95%CI: 1.62-29.51) (Table 4).

147 Patients with duration of hospital stay of 10 days and below ( $\leq 10$  days) had a significantly  
148 higher case fatality rates, compared to those with duration of hospital stay of 11 days and above  
149 ( $\geq 11$  days) (76.92% vs. 23.08%; p=0.001). Patients with duration of hospital stay of 10 days  
150 and below were 28.33 times more likely to die compared to those with duration of hospital stay  
151 of 11 days and above ( $\geq 11$  days) (OR=28.33; p=0.001; 95%CI: 5.42-148.23) (Table 4).

#### 152 4. DISCUSSION

153 Despite decades of immunisation, tetanus is still prevalent in Nigeria with a significantly high  
154 morbidity and mortality among children.<sup>8,15,16, 18</sup> This study revealed a prevalence of 0.3%,  
155 which is similar to reports from various studies in Nigeria.<sup>14,18,19,20,21,22,23</sup>

156 There was a male preponderance which is in accordance with the findings of previous studies in  
157 Nigeria and India.<sup>8,15,18,19,24</sup> Perhaps the fact that males are more adventurous and so are more  
158 likely to sustain injuries on their lower limbs may explain the male preponderance observed.  
159 Most of the children belong to families in the lower socioeconomic class, which is in complete  
160 agreement with the report of a previous study in Nigeria<sup>15</sup> and which lends credence to the  
161 likelihood that they may have engaged in risky habits like walking and playing barefooted as is  
162 common among children from lowly backgrounds.

163 Findings from this study and other studies in Nigeria showed that broomstick injuries are the  
164 commonest route of infection with *Clostridium tetanus* in older children.<sup>8,14,15</sup> This is probably  
165 because broomsticks are commonly used to sweep floors in Nigeria and so are commonly found  
166 in homes and schools. These brooms get easily contaminated with the spores of *Clostridium*  
167 tetanus when used to sweep floors. Flogging children with brooms, as is commonly done in  
168 homes and schools in Nigeria<sup>25</sup> constitutes a significant risk factor for tetanus infection as the  
169 strands easily penetrate the skin, introducing the tetanus spores into the broken skin. However, a

170 study done in India reported chronic suppurative otitis media as the most common portal of entry  
171 of tetanus,<sup>19</sup> indicating differences in cultural practices between India and Nigeria.

172 Lack of immunisation with primary and booster doses of TT or incomplete immunisation have  
173 been identified as major risk factors for the persistence of post neonatal tetanus in Nigeria.<sup>5,15,</sup>  
174 <sup>26,27,28</sup> In this study, as much as 79.2% of the children were either not immunised or were  
175 incompletely immunised with TT containing vaccines in infancy, which is consistent with the  
176 reports from other studies in Nigeria.<sup>8,14,15</sup> **Even among those admitted in the recent past (2018**  
177 **and 2019) the immunisation coverage rate was still poor.** Also consistent with the report of  
178 previous studies in Nigeria<sup>12,13,15</sup> is our observation that no child received the booster doses of  
179 TT recommended by WHO.<sup>9</sup> The fact that a few children received the three primary doses of TT  
180 containing vaccines in infancy and still came down with tetanus is a serious indicator of the  
181 inadequacy of the primary doses of TT in protecting school age children against tetanus and  
182 supports the clamoring for the inclusion of booster doses of TT containing vaccines in Nigeria's  
183 NPI schedule.

184 The mean incubation period of  $7.34 \pm 4.21$  days and mean onset interval of  $8.87 \pm 10.44$  hours are  
185 within the range of what have been reported in other studies.<sup>14,27</sup> Generalised spasms, inability to  
186 open the mouth (trismus) and neck stiffness were the common symptoms amongst the patients,  
187 which is similar to previous reports.<sup>21,27</sup>

188 Ill health is one of the very common reasons for absenteeism in Primary schools in Nigeria<sup>29</sup> and  
189 our findings corroborated this statement. The average duration of hospital stay was  $22.94 \pm 13.56$   
190 days, which is 22 days spent away from school. If regular school attendance is a pre-requisite for  
191 acquiring skills and knowledge for good academic success,<sup>29</sup> it then follows that this long  
192 duration of hospital stay will impact negatively on the academic achievements of these children.  
193 Other studies in Nigeria showed similar duration of hospital stay.<sup>8,14,16</sup>

194 The average cost of hospital stay among the patients in this study is  $142,571.69 \pm 70,784$  naira, an  
195 equivalent of 593 dollars. This is quite a lot of money in a country where half (90 million) of the  
196 population live in extreme poverty, earning less than 1.90 United States dollars per day.<sup>30</sup> With  
197 less than 5% of the population of Nigeria registered with the National Health Insurance Scheme  
198 (NHIS),<sup>31</sup> most families in Nigeria pay their medical bills out of their pockets, further  
199 impoverishing them.<sup>32</sup> This situation is even worse for families in the low socioeconomic class,

200 like majority of the families in this study who may not have been  
201 able to foot their medical bills without assistance.

202 Tetanus death rate is said to be high in countries like Nigeria with very poor immunisation  
203 coverage rates.<sup>4,5,6</sup> The high case fatality rate (24.53%) is within the range of 4.1%-50%  
204 reported in other studies in Nigeria and India<sup>15,16,19,24, 32</sup> This may be related to the fact that  
205 majority of the study sites are tertiary health facilities where critically ill patients requiring  
206 intensive care are referred. Our result further showed a consistent reduction in the tetanus case  
207 fatality rates from 30.8% in 2010 to 7.7% in 2019, indicating a much improved tetanus case  
208 management.

209 Short incubation periods and onset intervals are associated with higher fatality rates in this study,  
210 which is consistent with what is generally known about tetanus and also with what has been  
211 reported in other studies.<sup>18,33,34</sup> Patients with short incubation periods of  $\leq 4$  days and short onset  
212 intervals of  $\leq 4$  hours were 15.71 and 6.92 times more likely to die from the disease respectively.  
213 Contrary to our observation, Ajite et al found no positive correlation between incubation period  
214 and onset interval with the clinical outcome and opined that both factors may not be useful tools  
215 to determine prognosis in post neonatal tetanus.<sup>12</sup>

216 The study further revealed a higher mortality rate among patients with short duration of hospital  
217 stay ( $\leq 10$  days). This observation may be related to the natural history of the disease in which  
218 symptoms are severe in the first and second week of the onset of the disease, coinciding with the  
219 half-life of the circulating toxins.<sup>14,34</sup> It therefore follows that majority of the deaths are likely to  
220 occur within the first and second week of the onset of the disease.

## 221 CONCLUSION

222 Tetanus still causes high morbidity and mortality among school age children in Port Harcourt,  
223 even among those who received the three primary doses of TT during infancy. There is need to  
224 strengthen the routine immunisation programme in Port Harcourt to ensure that every child  
225 receives the three primary doses of TT in infancy. Booster doses of TT should be administered to  
226 primary and secondary school children to prevent the disease. Extensive campaign against  
227 flogging children with broomstick should be conducted in Port Harcourt to prevent tetanus.

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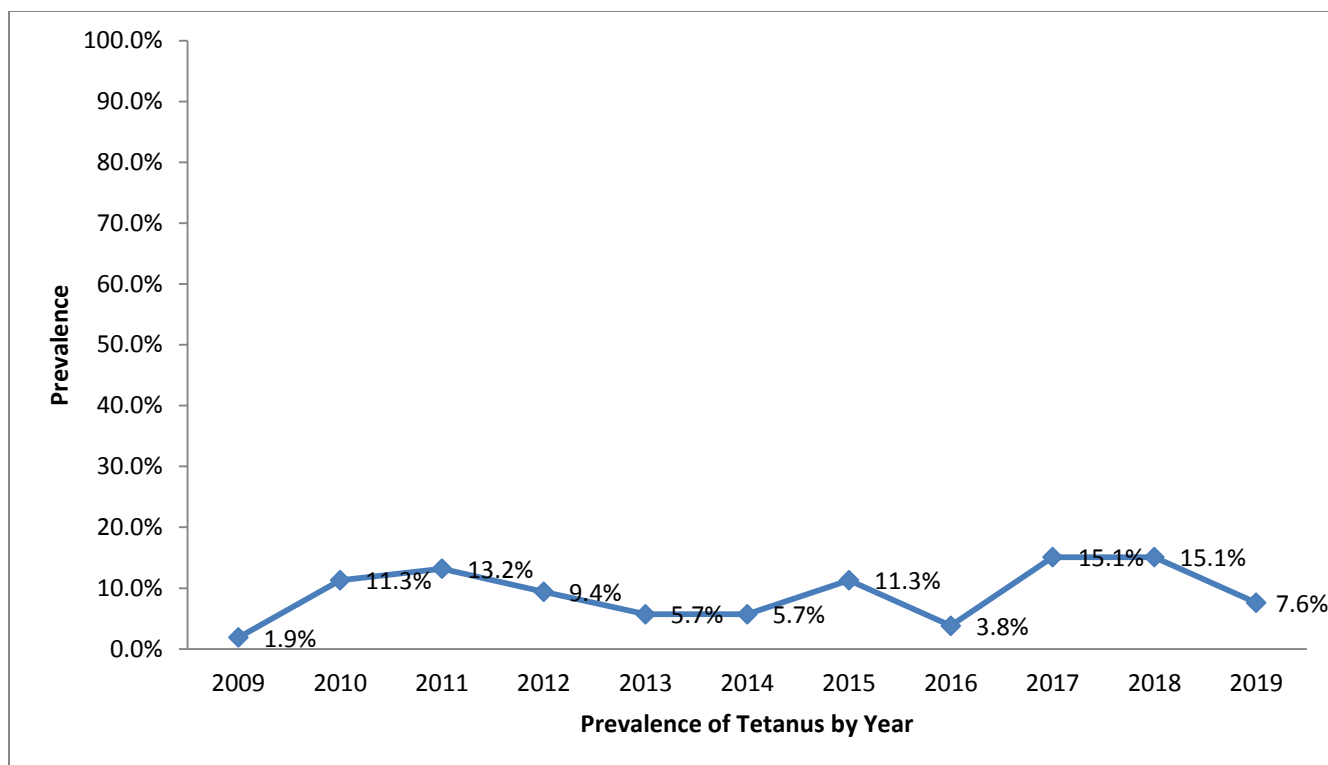
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354 **Table 1: Sociodemographic characteristics of the patients.**

<b>CHARACTERISTICS</b>	<b>FREQUENCY (53)</b>	<b>PERCENTAGE (%)</b>
<b>Age (Years)</b>		
4-9	20	37.74
10-15	28	52.83
≥16	5	9.43
<b>Sex</b>		
Male	33	62.26
Female	20	37.74
<b>Educational Level</b>		
Secondary	22	41.51
Primary	29	54.71
Nursery	1	1.89
None	1	1.89
<b>Family Socioeconomic Class</b>		
High social class	3	5.66
Middle social class	24	45.28
Low social class	26	49.06

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358 **Figure 1: Trend in Tetanus prevalence from 2009 to 2019.**

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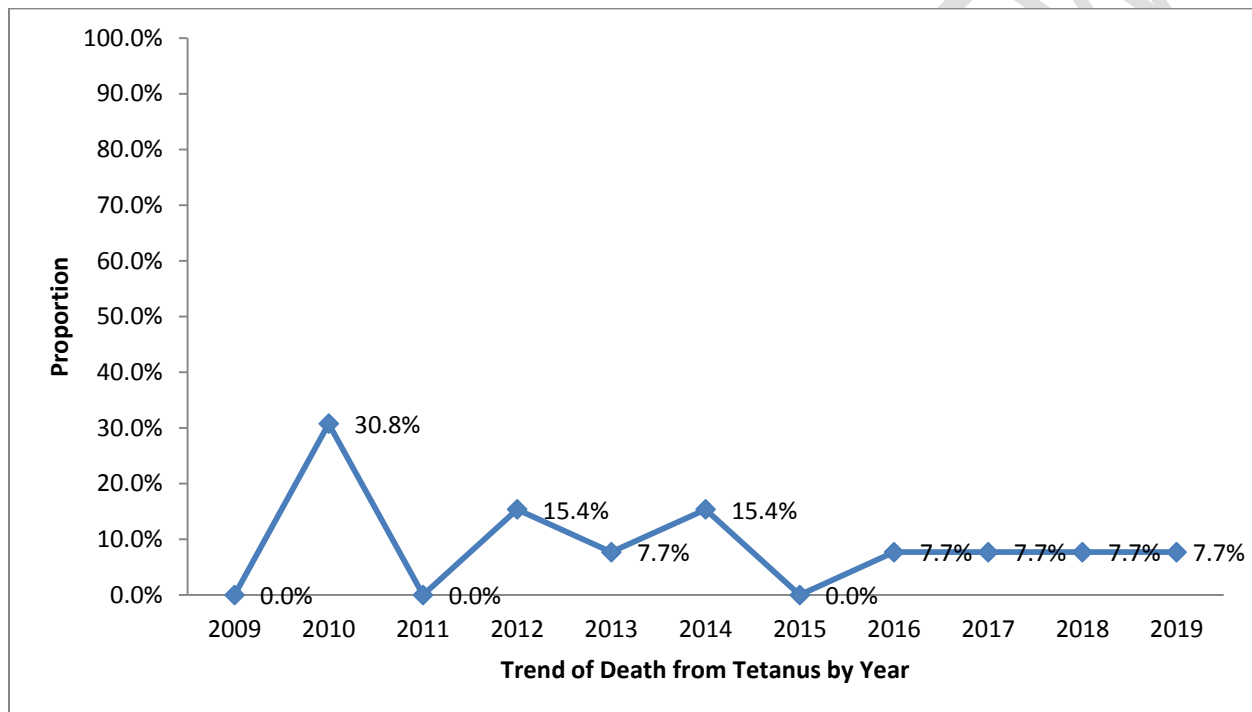
364 **Table 2: Route of infection and Immunisation status of the patients**

<b>ROUTE</b>	<b>FREQUENCY (53)</b>	<b>PERCENTAGE</b>
Broomstick injury	28	52.8
Injuries from road traffic accidents	11	20.8
Other deep penetrating injury on the lower limbs	11	20.8
Chronic ear infection	2	3.8
Tooth extraction	1	1.8
<b>TT Immunisation status of the children</b>		
Completed immunization in infancy	11	20.8
Incomplete immunization in infancy	10	18.9
Not immunised	32	60.3
Received booster doses of TT	0	0.0

365 **Table 3: Immunization Status of Patients Admitted in 2018 & 2019**

<b>Immunization Status</b>	<b>2018 (n=8)</b>	<b>2019 (n=4)</b>
<b>Completed</b>	<b>2 (25.0)</b>	<b>2 (50.0)</b>
<b>Incomplete</b>	<b>1 (12.5)</b>	<b>0 (0.0)</b>
<b>Not Immunized</b>	<b>5 (62.5)</b>	<b>2 (50.0)</b>
<b>Received booster doses of TT</b>	<b>0 (0.0)</b>	<b>0 (0.0)</b>

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368 **Figure 2: Trend of Death from Tetanus by Year**

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**Table 4: Association of Gender, Socioeconomic status, Onset interval, Incubation period and TT immunisation status of the patients with Number of Deaths**

CHARACTERISTICS	DEATH (%)		TOTAL	$\chi^2$ ( <i>p</i> -value)	OR (95% CI)
	YES	NO			
<b>Sex</b>				0.15 (0.654)	0.63 (0.18-2.24)
Male	7 (53.85)	26 (65.00)	33 (62.26)		
Female	6 (46.15)	14 (35.00)	20 (37.74)		
<b>Socioeconomic class</b>				0.006 (0.937)	1.29 (0.37-4.52)
Low Class	7 (53.85)	19 (47.50)	26 (49.06)		
Middle/High class	6 (46.2)	21 (52.50)	27 (50.94)		
<b>Incubation period</b>				13.29 (0.0002)	15.71 (3.41-72.31)
≤4 days	10 (76.92)	7 (17.50)	17 (32.08)		
≥	3 (23.08)	33 (82.50)	36 (67.92)		
<b>Onset interval</b>				6.18 (0.012)*	6.92 (1.62-29.51)
1-4 hours	10 (43.48)	13 (56.52)	23 (43.40)		
≥5 hours	3 (23.08)	27 (67.50)	30 (56.60)		
<b>Duration of hospital stay</b>				18.24 (0.001)*	28.33 (5.42-148.23)
≤10 days	10 (76.92)	6 (15.00)	16 (30.19)		
≥11 days	3 (23.08)	34 (85.00)	37 (69.81)		
<b>TT immunisation status in infancy</b>				0.405 (0.817) review	
Completed	2 (15.38)	9 (22.50)	11 (20.75)		
Incomplete	3 (23.08)	7 (17.50)	10 (18.87)		
Not immunised	8 (61.54)	24 (60.0)	32 (60.38)		

\*=statistically significant.