

# Risk factors for neonatal tetanus in KwaZulu-Natal

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**Objective.** To study cases of neonatal tetanus (NNT) in an intensive care unit (ICU) to support formulation of appropriate intervention strategies.

**Site.** Paediatric ICU, King Edward VIII Hospital, Durban.

**Method.** (i) Trend in number of admissions with NNT between 1983 and 1993; (ii) prospective study of NNT cases admitted during 1993.

**Results.** The mean annual admission rate decreased from 41 cases before 1985 to 24 cases between 1985 and 1988 and 18 cases between 1989 and 1992. There were 27 cases in 1993. Most patients in 1993 were from informal settlements, squatter camps and rural areas (44%, 22% and 22% respectively). All 27 patients were delivered at home. Fourteen mothers (52%) had attended an antenatal clinic; 12 of them had attended at least twice. Fifteen mothers had used a clean sterile instrument to cut the cord. Only 1 mother had used cow dung to staunch blood flow from the severed cord. Ninety-three per cent of cases were severe; the overall mortality rate was 22%. The mean duration of ventilation was 23 days (range 17 - 60 days) and of ICU stay 35 days (range 13 - 87 days).

**Conclusions.** These results suggest that the promotion of the maternal immunisation campaign is perhaps the most important factor for the elimination of NNT. Measures should be taken to ensure universal coverage with tetanus toxoid of all pregnant women, and coverage of all women of reproductive age in underserved areas.

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The World Health Organisation had set 1995 as a target date for the elimination of neonatal tetanus (NNT).<sup>1</sup> Worldwide there are half a million NNT deaths annually;<sup>2</sup> in Africa alone there are between 150 000 and 210 000.<sup>3,4</sup> In South Africa there is gross under-reporting, as indicated by figures from the recent South African Paediatric Association Congress workshop held at the Karos Lodge, Eastern Transvaal, in August 1994. Two independent studies, one from MEDUNSA and the other from Natal, each reported cases that exceeded the national total.

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Success rates have varied since the introduction of the Expanded Programme on Immunisation (EPI) for NNT by the WHO.<sup>4,5</sup> In KwaZulu-Natal, the immunisation programme for maternal tetanus toxoid was implemented in 1987; the predicted coverage is between 23% and 72% with a vaccine efficacy of 87%.<sup>6</sup> It is recognised that vaccination alone cannot eliminate this disease. The WHO therefore also advocates clean delivery practices through the provision of neonatal and delivery kits to mothers, and education of birth attendants.<sup>7</sup>

The objective was to study cases of NNT in an intensive care unit (ICU) in order to support formulation of appropriate intervention strategies.

## Method

This included collection of retrospective and prospective data on patients with NNT admitted to the ICU at King Edward VIII Hospital, Durban. The retrospective study reviewed the prevalence of NNT at the ICU prior to and after the implementation in 1987 of the maternal tetanus toxoid immunisation programme.

During 1993, all patients with NNT admitted to the paediatric ICU at King Edward VIII Hospital were prospectively studied in terms of patient characteristics, history, clinical features, investigations and outcome. Outcome measures used were infectious complications, duration of intermittent positive-pressure ventilation, ICU stay and mortality.

## Results

### Retrospective study

The number of cases fell substantially after the immunisation campaign (Table I). The mortality rate remains variable and is intermittently high. The Mann-Whitney U-test showed a significant difference in number of cases before and after the immunisation campaign ( $P = 0.14$ ).

Table I. Admissions and mortality, paediatric ICU, King Edward VIII Hospital, Durban, before and after the maternal tetanus toxoid immunisation programme (1987)

Year	No. of cases	No. of deaths	Mortality rate (%)
1983	42	23	55
1984	39	13	33
1985	28	5	18
1986	29	8	27
1987	28	11	39
1988	29	16	55
1989	19	2	11
1990	17	10	59
1991	19	2	11
1992	17	7	41
1993	27	6	22

### Prospective study

The number of NNT cases increased from 17 in 1992 to 27 in 1993 and the mortality rate decreased from 41% in 1992 to 22% in 1993. The drop in the mortality rate was not statistically significant (chi-square test). There were approximately equal numbers who presented early and late and the male/female ratio was 1:0.8. In 1993 all 27 infants had been delivered at home by untrained birth attendants. Many of the patients came from the informal settlements and squatter areas around Durban (Table II) where there is a paucity of health care facilities.

**Table II. Residential sites of babies with NNT admitted to the paediatric ICU, King Edward VIII Hospital, Durban**

Informal settlements	12
Formal settlements	6
Squatter areas	6
Other	3
Total	27

Fourteen mothers (52%) had attended antenatal care, 12 (86%) of whom had been at least twice. Three mothers had received intramuscular injections in the gluteal region; none was certain of the substance injected. Razor blades were the commonest instruments used to cut the cord, and in the majority of cases ( $N = 15$ ) a clean new blade had been used. Cotton or string had been used in all cases to ligate the umbilical cord. Of the 13 (48%) mothers who applied material to staunch blood flow from the severed cord, only 1 (4%) used cow dung; others applied gentian violet (37%) or expressed breast-milk (8%). There was no seasonal variation in prevalence; patients were admitted throughout the year.

Twenty-five infants had severe disease (tetanus score  $> 3$ )<sup>8</sup> while 2 had mild disease. The mean duration of ICU stay was 35 days (range 13 - 87 days) while the mean duration of ventilation was 23 days (range 17 - 60 days). Nosocomial bacterial and viral infections were the commonest complicating factors (Table III). There were 3 early deaths and 3 late deaths; the overall mortality rate was 22%. All early deaths were due to sympathetic overactivity ( $N = 3$ ) while late deaths were due to nosocomial infection.

**Table III. Pathogens isolated from babies admitted with NNT to the paediatric ICU, King Edward VIII Hospital**

Diagnostic method	Organism	Number
Culture, ETT*	Viruses	
	Adenovirus	4
	Enterovirus	1
Antibody response†	Respiratory syncytial virus	1
	Influenza	1
	Bacteria	
Culture ETT*	<i>Staphylococcus aureus</i>	6
	<i>Pseudomonas aeruginosa</i>	6
	Blood	
	<i>Klebsiella pneumoniae</i>	3
	<i>Escherichia coli</i>	1
	<i>Acinetobacter</i>	1
	<i>Enterococcus cloacae</i>	1

\* Endotracheal tube.

† Complement fixation tests greater than 4-fold rise in titre.

### Discussion

There has been a reduction in numbers of cases of NNT admitted to the paediatric ICU at King Edward VIII Hospital between 1985 and 1992. This is probably related to impact of the maternal tetanus immunisation campaign. In 1993 there was an increase in the number of cases admitted. This may be related to the failure to vaccinate, as 14 infants had developed NNT despite their mothers' attending an antenatal clinic, while only 3 had received intramuscular injection. Although these 3 mothers could have been vaccinated with tetanus toxoid and their problems related to vaccine failure, it is more than likely that they received some other drug, given that the incorrect vaccination site was used.

In this study all patients with NNT admitted had been delivered at home by untrained personnel, and most came from informal settlements and squatter areas. We assume that these risk factors may be important for acquisition of the disease. As South Africa undergoes rapid urbanisation there is likely to be a dramatic increase in these settlements. Many of these areas have inadequate health care facilities, while in others that are situated closer to urban health centers, there is an underutilisation of services. This may be due to lack of readily available transport facilities or to the higher incidence of violence reported in these areas.

Unsterile instrumentation to sever the cord and contaminated applications to the cord appear to be less important, and reflect a possible change in cultural practices. Because the pathogen, *Clostridium tetanii*, is usually found in soil, it is likely that the infection occurs during delivery when the baby is maximally exposed to environmental hazards. This needs further evaluation.

The outcome of failed prevention is serious. A mortality rate of 22% was recorded in this cohort. This figure has remained unchanged over the last decade, suggesting a plateau in curative management success, given currently available resources.<sup>9,10</sup> As previously noted, nosocomial infections and autonomic instability accounted for the majority of deaths.<sup>11,12</sup>

The prolonged duration of ventilation and intensive care reflect the morbidity caused by the disease. This also has financial implications as the cost of treating these children can be predicted to exceed the cost of intensified immunisation and educational campaigns.

Other countries within Africa have identified similar problems with regard to the NNT campaign.<sup>4,5</sup> The WHO has recognised the limitations of its elimination campaign, and has suggested complementary strategies. To optimise delivery practices in high-risk areas, cost-effective, re-usable delivery and neonatal kits have been recommended. These consist of a plastic sheet, cord tie, clean razor, blanket and two cotton wool swabs. Clean water is also essential. There is an increased emphasis on providing adequately trained birth attendants. Regular quality check of vaccine potency and handling are advised to guard against vaccine failure.

This study, based on admissions to a paediatric ICU, identifies some important risk factors for acquiring NNT. Although the target of elimination of NNT by 1995 has not been reached, the WHO through all its allies continues to pursue this goal. Significant progress has been made and the number of cases is falling, but elimination has not as yet been achieved.

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