Process of neonatal tetanus elimination in Nepal

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ABSTRACT

Background In late 2005, Nepal demonstrated through surveys that it had reached the World Health Organization criterion for having eliminated neonatal tetanus (NT), i.e. NT cases occurred at a rate of less than 1 per 1000 live births in every district. This paper summarizes how a combination of strategies contributed to this success.

Methods For each of the 4 strategies (clean delivery, routine immunization, supplemental immunization campaigns, and surveillance) activities before and after 2000 are described and achievements are summarized using published and unpublished data.

Results Through routine immunization of pregnant women with tetanus toxoid (TT), NT cases had decreased substantially by 1999, but the final push was provided through the national TT supplemental immunization activities in 2000–2004, which raised the proportion of children protected at birth against tetanus to above 80%. Fewer than 20% of deliveries take place with trained assistance. Although NT surveillance has improved since the extensive Acute Flaccid Paralysis/Polio surveillance infrastructure in Nepal was made available for the NT elimination initiative, it is likely that a number of cases still occur without being reported, particularly in rural areas.

Conclusions NT elimination was achieved in 2005 in Nepal, but activities must continue and be strengthened to ensure that NT incidence will not increase in the future. The introduction and further expansion of school-based immunization will, in combination with diphtheria-tetanus-pertussis vaccine given in infancy, reduce the need for future cohorts of childbearing age women to be immunized at every pregnancy. However, booster doses will still need to be given in early adulthood to ensure ongoing protection.

Keywords health services, immunization, neonatal tetanus, Nepal, public health

Introduction

Tetanus in the first 28 days of life, known as neonatal tetanus (NT), develops when Clostridium tetani spores, omnipresent in nature, are introduced via the umbilical cord during an unhygienic delivery or after delivery through improper umbilical stump care.¹

Hygienic delivery and cord care practices can easily prevent NT, as can immunization. After the mother has been immunized, maternal antibodies will, through transplacental transfer, protect the newborn for the first 2 months of life. For women who never received tetanus toxoid (TT) vaccine, two TT doses given at least one month apart can prevent neonatal and maternal tetanus for a few years. To maintain protection, additional booster doses are required.² In developing countries, these doses are often given during pregnancy at antenatal care contacts.

Since nearly 800 000 NT deaths occurred annually worldwide in the 1980s despite the availability of prevention strategies, the World Health Assembly in 1989 called for global elimination of NT by 1995. NT elimination at country level is defined as having less than 1 case of NT per 1000 live births in every district. By 1995, 63 countries had not yet eliminated the disease,³ including Nepal. In 2000, Nepal developed a strategy to eliminate maternal and neonatal tetanus (MNT) by 2005. World Health Organization (WHO) considers maternal tetanus as eliminated when NT elimination is validated. This report summarizes the activities undertaken in Nepal to achieve NT elimination and the challenges in maintaining it.

Background

Nepal, a landlocked country in South Asia, consists of 75 districts in five regions distributed across the three ecological
zones: the Himalayan mountains region in the north, the hill region in the center and the Terai plains in the south. Nepal has a population of 27 million people and approximately 780,000 births annually. With a gross domestic product per capita in 2005 of US $272, it is one of the poorest countries in Asia and heavily dependent on external aid. Poor infrastructure, difficult terrain and civil strife make delivery of public health services difficult in many parts of the country, resulting in large discrepancies in levels of coverage of health interventions across different areas.

The extent of NT as a public health problem in Nepal is documented. Community-based surveys in the 1980s and early 1990s found that NT mortality rates ranged from 4 to 24 per 1000 live births in selected rural areas, representing up to an estimated 55% of all neonatal deaths (Table 1).

### Table 1 Summary of results of surveys assessing neonatal tetanus burden in Nepal, 1980–1991

<table>
<thead>
<tr>
<th>Area</th>
<th>Year</th>
<th>Number of live births samples</th>
<th>Neonatal mortality rate (per 1000 live births)</th>
<th>Neonatal tetanus mortality rate (per 1000 live births)</th>
<th>% Neonatal deaths due to tetanus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morang</td>
<td>1980</td>
<td>3346</td>
<td>37</td>
<td>15</td>
<td>39</td>
</tr>
<tr>
<td>Dhanusha</td>
<td>1983</td>
<td>1078</td>
<td>35</td>
<td>19</td>
<td>53</td>
</tr>
<tr>
<td>Kathmandu Valley</td>
<td>1983</td>
<td>1007</td>
<td>14</td>
<td>7</td>
<td>50</td>
</tr>
<tr>
<td>Dang, Kapilvastu, Panchtar, Sindhuli</td>
<td>1983</td>
<td>—</td>
<td>—</td>
<td>22</td>
<td>—</td>
</tr>
<tr>
<td>Rural Nepal</td>
<td>1983</td>
<td>1997</td>
<td>44</td>
<td>24</td>
<td>55</td>
</tr>
<tr>
<td>Morang</td>
<td>1987b</td>
<td>728</td>
<td>19</td>
<td>4</td>
<td>23</td>
</tr>
<tr>
<td>Dhanusha</td>
<td>1990b</td>
<td>451</td>
<td>33</td>
<td>10</td>
<td>27</td>
</tr>
<tr>
<td>Dang</td>
<td>1991b</td>
<td>1419</td>
<td>22</td>
<td>9</td>
<td>39</td>
</tr>
</tbody>
</table>

*aSurveys were conducted in rural areas with the exception of Kathmandu Valley, which included both urban and rural areas.

bPost-TT vaccine introduction.

### NT surveillance

Nepal started reporting NT cases in 1981 (Fig. 1); however, the systematic collection of data with an established case definition did not start until 1994. Since 1994, NT has been reported as part of government’s Health Management Information System (HMIS), which covers all government health facilities in Nepal. In the past, surveys indicated that the number of reported cases vastly underestimated the true burden, and that was certainly the case in the 1980s and early 1990s.

Overall, there was a downward trend in reported NT cases since 1995. No data were officially reported for 1999. The increase in 2001 is partially due to 204 NT cases being reported.
by one district (Sarlahi). It has not been established whether these cases were all genuine NT cases. In addition, throughout the country, attention for NT increased in 2001 because of intensive training and micro-planning activities ahead of the scheduled TT supplemental immunization activities (SIAs).

As NT data collected through HMIS did not provide detailed information, such as geographic distribution or maternal immunization status, and reports are often incomplete and not timely, NT surveillance was integrated into the acute flaccid paralysis (AFP) surveillance system in 2003. The AFP surveillance system was set up in 1998 to monitor polio eradication and utilizes a network of Surveillance Medical Officers. Through the AFP surveillance system, AFP, measles, rubella, Japanese encephalitis and NT data are collected weekly from 413 sentinel surveillance sites throughout the country, which represents about 10% of all government health facilities. Although only major health centers and hospitals are included in this system, the data collected are more timely and detailed, and identified NT cases are investigated using a standard case-investigation form. Nevertheless, it can be assumed that a number of NT cases occur (and die) at home, without ever seeking medical assistance or being reported, as NT is typically a disease occurring in underserved areas. Officially reported NT cases are those reported through the HMIS system, which includes some of the cases reported and investigated through the AFP surveillance system.

Clean delivery practices
In the 1990s, approximately 10% of deliveries in Nepal took place with the help of trained health workers. According to Demographic Health Surveys, 9% of all deliveries took place with the help of a trained assistant in the 3 years prior to 1996, with only a marginal improvement to 11% in the following 5 years.9,10

Clean delivery figures for Nepal remain low after 2000. The Demographic Health Survey in 2006 showed that in the 5 years prior to 2006 19% of deliveries took place with the help of trained health workers, only a slight increase from previous years.11

Routine immunization and protection at birth
In Nepal, immunization was initiated in 1979 with the establishment of the Expanded Program on Immunization. Initially implemented in only three districts, the program was gradually expanded and included all 75 districts by 1989.12 Diphtheria–tetanus pertussis (DTP) and TT vaccines were included in the schedule from 1981. Reported TT2+ coverage, i.e. the proportion of pregnant women who received their second or subsequent TT dose, appeared to remain low until 1997, partly due to a flaw in the reporting system in which non-pregnant women were also included in the denominator. After correcting this anomaly in 1998 and with further improvements in program performance, the reported TT2+ coverage reached 65% by 1999 (Fig. 2). Surveys found that TT2+ coverage was 33% in the period 1993–19959 and 45% in the period 1996–2000.10

The reported TT2+ coverage after 1999 shows a drop to below 40% as a result of the TT SIAs (see below), i.e. after receiving a TT dose in the SIAs, pregnant women do not need a dose that same year in the routine program and doses administered in the TT SIAs are reported separately from doses administered through the routine system. Coverage increased back to 72% by 2006.13 As TT2+ does not capture the women who are protected after having

![Fig. 2. Reported DTP3 and TT2+ coverage and proportion of children protected at birth, Nepal, 1980–2007.](https://academic.oup.com/jpubhealth/article-abstract/31/4/561/1493294/563)
previously received five doses, women who received one dose without documentation of previous doses and women who received DTP in their childhood and thus require fewer TT booster doses, interpretation of reported TT2+ coverage with regard to protection against tetanus can be difficult. In order to more accurately estimate the proportion of births in a given year that can be considered as having been protected against tetanus (protection at birth or PAB), WHO and UNICEF developed a mathematical model that takes the above scenarios into account. When modeling PAB in Nepal, an increase in protection levels after 2000 is apparent, mainly due to the impact of the TT SIAs. The 2006 Demographic and Health Survey estimated TT2+ in the 5 preceding years at 62% and the PAB at 78%.

**TT SIAs**

With only 45% of pregnant women receiving a protective dose of tetanus immunization in the late 1990s, only about 10% of deliveries taking place with a trained assistant, and the assumption that the number of NT cases was above the elimination threshold, the government decided to conduct TT SIAs. The SIAs, supported by UNICEF, were aimed at increasing protection levels and at achieving NT elimination. SIAs typically target all women of childbearing age in high-risk areas with three properly spaced doses of TT or tetanus–diphtheria vaccine. Starting in 2000, Nepal’s SIAs targeted all women of childbearing age in all 75 districts, irrespective of previous immunization status. A total of 5.3 million women were targeted over a period of 5 years (2000–2004). Overall, more than 80% of the women targeted received at least two doses of TT and over 75% of women received three doses (Table 2). In total, around 13.6 million doses of TT were distributed through the TT SIAs. Coverage was relatively equally distributed among districts, with only two districts reporting coverage with two doses of TT below 70%.

**Confirmation of NT elimination**

Although the number of reported NT cases steadily decreased after 2001 despite improving surveillance, the number of cases that occurred without being reported was unknown; therefore, an assessment was required to confirm that NT elimination had been achieved. In December 2005, a community-based lot quality assessment cluster survey was implemented in three districts purposely selected for poor performance based on a review of a series of district-level indicators. This survey determined that the NT rate was below the NT elimination threshold of 1 case per 1000 live births. Assuming that better-performing districts would have NT rates that would likely be even lower, it was concluded that Nepal had by the end of 2005 met the WHO criterion of NT elimination. The 2006 Nepal Demographic and Health Survey reported that neonatal deaths observed to be due to NT were fewer than 1 per 1000 live births, which was consistent with the findings of the 2005 survey.

**Maintaining NT elimination**

Despite the remarkable achievement of NT elimination in Nepal, the number of NT cases may gradually increase again, as protection obtained through TT SIAs wanes and as new birth cohorts enter childbearing age. Maintaining NT elimination will require ongoing implementation of immunization and clean delivery practices.

Nepal is targeting that by 2015 at least 60% of all deliveries will take place with assistance from a skilled birth attendant. Strategies to achieve this goal include upgrading health facilities to include birth centers, additional training for health workers in hygienic delivery practices, implementation of a no-fee maternity service in public health facilities (‘Aama Suraksha kaaryakram’ or “save mothers program”), distribution of a Birth Preparedness Package and strengthening of health education for mothers.

WHO recommends that after three primary doses of DTP in infancy, TT booster doses should be given at 4–7 and 12–15 years of age, as well as 1 dose in adulthood. Using a school-based immunization approach, Nepal has piloted TT immunization at entry to primary school in 12 districts with plans to expand nationwide. Each year, health workers visit

<table>
<thead>
<tr>
<th>Fiscal year</th>
<th>Number of districts targeted</th>
<th>Age group targeted (years)</th>
<th>Number of women targeted</th>
<th>Women who received TT1 (%)</th>
<th>TT2 (%)</th>
<th>TT3 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000–2001</td>
<td>8</td>
<td>15–44</td>
<td>849,426</td>
<td>83</td>
<td>87</td>
<td>78</td>
</tr>
<tr>
<td>2001–2002</td>
<td>17</td>
<td>15–44</td>
<td>1,804,561</td>
<td>98</td>
<td>88</td>
<td>81</td>
</tr>
<tr>
<td>2002–2003</td>
<td>27</td>
<td>10–39</td>
<td>1,687,651</td>
<td>92</td>
<td>84</td>
<td>76</td>
</tr>
</tbody>
</table>

*The fiscal year in Nepal runs from July to July.*
primary schools and immunize children in their first year of school with a single dose of TT. Since net primary school attendance in Nepal is 82% for girls (2000–2006),\(^{20}\) school-based immunization is a suitable delivery strategy for targeting young children. However, due to high dropout rates (only 38% of girls attend secondary school), the same approach would be less appropriate for delivering a booster to adolescents.

Booster doses at earlier ages, such as during school attendance, will likely not be sufficient to ensure life-long immunity and protection of future neonates. To sustain NT elimination it is necessary that women continue to receive booster doses during pregnancy, i.e. during antenatal care contact, as foreseen in the routine immunization program, although fewer boosters will be required in the future. In areas where routine administration of (booster) doses to pregnant women is not feasible with existing services, Nepal may have to consider conducting small repeated follow-up SIAs to ensure ongoing high levels of protection and maintenance of NT elimination.

Inclusion of serology in future community-based surveys may help to monitor overall protection levels against tetanus in the population.

**Conclusion**

Elimination of MNT in Nepal is an example of how various strategies can interact to achieve a common goal. With fewer than 20% of deliveries taking place with trained assistance and slow improvements over time, immunization was the strategy chosen to quickly reduce the burden of NT in Nepal. Immunization of pregnant women does result in an impact on disease burden, but could not achieve levels that were sufficient to achieve NT elimination. The use of SIAs, targeting all childbearing age women, managed to immunize over 80% of women against tetanus, resulting in NT elimination.

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**References**