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The Role of Vaccination Programs in Reducing Infant Mortality: A Review

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ABSTRACT

Background: Recently, Pakistan has had high neonatal and child mortality rates, a problem for many developing nations. We found many causes of these rates in our narrative assessment of comprehensive evidence. These include preterm births, birth deformities, poor immunization, hazardous deliveries, inadequate breastfeeding, delivery complications, SIDS, low socioeconomic conditions, and a failing healthcare system.

Objective: We aimed to generate practical suggestions for lowering the newborn tetanus incidence in Pakistan by reviewing measures that have significantly reduced the infant death rate in LMICs caused by neonatal tetanus.

Methods: In order to find effective therapies for lowering infant mortality due to tetanus, we searched the published literature in the Pubmed and Pubget databases. After deleting redundant material, ten out of twenty studies were selected for preliminary screening.

Results: The following interventions were found to be effective in reducing neonatal mortality in low- and middle-income countries: a) vaccinating all pregnant women (married or not) against tetanus toxoid; b) community-based interventions, such as vaccinating all mothers; providing clean and skilled care during delivery; resuscitating newborns; promoting exclusive breastfeeding; cleaning and disinfecting the umbilical cord; and managing infections in newborns. c) Additional vaccinations (on top of the standard EPI program) d) safer methods of administration.

Conclusion: Vaccinating pregnant moms is the most effective method for reducing the fatality rate from newborn tetanus. Along with the "high-risk" strategy, clean deliveries, frequent effective prenatal visits, and this one step, resource-poor nations like Pakistan can minimize neonatal tetanus.

Keywords: Vaccination, LMIC's, Neonatal tetanus

1. INTRODUCTION

Pakistan is one of only two nations where the transmission of wild poliovirus is still possible [1]. Coverage of fully vaccinated youngsters is much lower than the national norm in some areas. The percentage is 37.6% in Balochistan and 42.8% in Southern Khyber Pakhtunkhwa (KP), for instance. According to the Expanded Program on Immunization (EPI) schedule, a fully vaccinated kid is one who has finished all recommended vaccines up to the first dose of measles, with the exception of the rotavirus vaccine, and is between the ages of twelve and twenty-three months [2]. Pakistan ranks first globally for infant mortality at 39 per 1000 live births and among the top countries for under-five mortality at 63 per 1000 live births [3]. Plus, there has been some little improvement in nutrition and MNCH indices, which measure the health of mothers, newborns, and children. More than a third of children under the age of five have stunted development, which is a deeply troubling number [4]. New obstacles arose in 2020 and 2022 as a result of COVID-19 and related mitigating efforts, which continue to have an influence on the health of populations and healthcare systems [5]. Providing high-quality healthcare services

should be a top priority, but it is far more difficult to guarantee fair access for all populations, especially those affected by violence and those who are already marginalized. Lack of healthcare professionals and deliberate attacks on healthcare workers, especially those who provide polio vaccines, have hampered the delivery of MNCH services. The rising tide of violence and fears for one's safety has had a profound impact on how people in the community seek medical attention, especially in the provinces of KP and Balochistan. [6]. Natural disasters and food insecurity exacerbate the problem.

Immunization ranks high among the most budget-friendly public health programs. For every $1 spent on childhood vaccination, there is a sixteen dollar return on investment (ROI) in terms of health care costs, lost wages, and productivity due to sickness and death. When the whole cost of people living longer and healthier lives is taken into account, the ROI improves to $44. According to Ozawa et al. (2016), vaccination is projected to bring around $586 billion in benefits to the world economy from 2011 to 2020.[7]. Compared to the expenses of treating diseases that may otherwise spread, the implementation costs of vaccination programs are often significantly cheaper (WB 2010). Vaccination against diseases is becoming more and more supported as the best and most cost-effective way for public health officials to reduce the illness load. Despite the health benefits of vaccines, vaccine-preventable diseases (VPDs) continue to be an expensive burden on Pakistani society and individuals. Reason being, public vaccination programs are frequently ill-managed and underfunded. This category includes costs associated with doctor's visits, early deaths, and hospitalizations. Following the smallpox eradication campaign's success, the World Health Organization (WHO) started the expanded effort on Immunization (EPI) in 1974 with the aim of expanding children's immunization internationally in accordance with global norms and regular vaccination schedules. Ensuring that all children, in all nations, could access the life-saving immunizations was the primary purpose of founding the EPI. In 1978, Pakistan implemented the EPI.A great number of factors influence the IMR of any given country. For example, between 1990 and 2006, the rate of premature births in the US increased by about 20%. Problems throughout the first year of life increase the risk of mortality for premature newborns.[9] Unfortunately, this still doesn't explain why the US IMR hasn't changed much since 2000.[10]

According to Pakistani data, the under-five mortality rate decreased from 117 to 94 per 1000 live births between 1991 and 2007. With a rate of 56–54 per 1000 live births, the infant mortality rate has remained relatively unchanged [11]. Pakistan had a far lower fall in neonatal tetanus cases compared to the rest of the globe, with a mere 50% drop from 1988 to 2010 [12]. Tetanus is known as a "silent killer" in LICs because many cases of neonatal mortality in remote and difficult-to-reach areas do not get reported. Although verbal autopsy is the only method for assessing tetanus burden in LMIC, traditional sources of data on the descriptive epidemiology of diseases, injuries, and risk factors are frequently incomplete, fragmented, and whose comparability and reliability are in dispute.

Consequently, this study aims to provide realistic strategies to lessen the neonatal tetanus-related NMR in Pakistani contexts by analyzing therapies that have substantially lowered newborn mortality rates in low- and middle-income countries (LMICs).

2. MATERIALS AND METHODS

We sought out research on therapies aimed at lowering infant death rates by searching the available literature. A thorough search was carried out utilizing particular critical phrases. "Pub get" and "Pub med" served as databases for the resources. Newborn tetanus, newborn mortality, and tetanus toxoid women were the search phrases used. Both search engines used these phrases at the same time. In order to decrease newborn tetanus mortality, we included all English-language publications with an abstract that detailed treatments. Any publications published between June 2012 and June 2023 were considered for this assessment.

The 'Pub get' search yielded 8 articles, whereas the 'Pub med' search yielded 12 articles. Ten articles made up the final search after sifting through all the articles and removing those that were common to both databases. Two studies were omitted from the list of ten because (i) they did not provide any methods or treatments to lower neonatal mortality. (ii) two studies lacked an abstract or author; (iii) one study couldn't be found online; (iv) one research was based in a developed country; and (v) one study had nothing to do with newborn tetanus mortality or tetanus toxoid vaccination. At last, the data extraction form was filled out with four research that were eligible.

Two of the publications were reviews, one was a cross-sectional research, and the other was a systematic review.

3. RESULTS

This section summarizes, from a review of these four research, the most important approaches for lowering the newborn tetanus fatality rate. Furthermore, the evidence-based feasibility of each intervention for Pakistan has been thoroughly examined. Three out of four studies have emphasized immunization of pregnant women with tetanus toxoid as the most effective intervention.

Table-1: Articles pertaining to strategies for decreasing the number of infant deaths caused by neonatal tetanus

Author	Study Design	Key findings
Khan et al [13]	Systematic review	An estimated 94% decrease in newborn tetanus mortality might be achieved by immunizing pregnant women or women of reproductive age with a minimum of two doses of tetanus toxoid.
Afshan K et al [14]	Cross sectional survey	Increases in mother age, longer intervals between births, better delivery procedures, postnatal care, tetanus toxoid vaccine rates, and birth spacing were all associated with lower rates of infant death.
Tharwani ZH et al [15]	Review paper	Improving prenatal care, vaccinating women against tetanus toxoid, and encouraging clean deliveries and postpartum cord care are all components of the intervention packages that aim to reduce the incidence of tetanus in both mothers and infants.
Nayir T [16]	Review paper	The deployment of community-based care packages led to a significant decrease in maternal morbidity, newborn mortality, stillbirths, and perinatal death.

4. DISCUSSION

The first paper to be included was a systematic review that sought to evaluate the impact of the tetanus toxoid vaccination on the mortality rate of infants infected with tetanus [13]. Women who were pregnant or of childbearing age were the focus of the review. According to this research, two studies matched the criteria for meta-analysis: one from India and one from Columbia. Both studies were cohort studies. The meta-analysis in this research found that vaccinating pregnant women or women of childbearing age with a tetanus toxoid dosage or two can reduce newborn tetanus mortality by 94% (CI 80-98%). A large impact size and trustworthy mortality statistics led to this evaluation's conclusion that the evidence was of moderate quality. There are certain limitations to this assessment and its effect estimate because there aren't enough high-quality research. One high-quality research plus two primary studies with methodological limitations but consistent findings is a moderate-quality review, according to our criteria, whereas two high-quality primary studies that consistently find the same results constitute a high-quality review. Two trials in a peri-urban area of India confirmed that tetanus toxoid immunization protected infants against death. According to this research, pregnant women who had never had a baby die were more likely to be ready to take tetanus toxoid (53% vs. 29%, $p < 0.001$; reference 14). Thirdly, tetanus toxoid vaccines and iron and folic acid supplements for mothers shielded their infants from harm. Researchers used multivariate Cox proportional hazards models to identify the factors linked to infant death at a young age. The hazard ratio was used as the association measure in the research. Researchers found that mothers who received prenatal care, iron and folic acid supplements, or two or more tetanus toxoid injections significantly reduced the risk of early neonatal death in their infants. The study included 40,576 newborns [14]. The third study was a narrative review that highlighted the positive impact of tetanus toxoid vaccination on lowering newborn mortality rates in low- and middle-income countries [15].

Among the publications we included was one that discussed community-based interventions to enhance neonatal outcomes, reduce maternal and infant mortality, and make a difference [16]. Eleven studies including 136,425 infants in low- and middle-income countries (LMICs) demonstrated that community-based interventions including tetanus toxoid immunisation for mothers, clean and skilled delivery care, newborn resuscitation, exclusive breastfeeding, umbilical cord care, and management of infections in newborns reduced neonatal mortality by 24% (average RR 0.76; 95% CI 0.68 to 0.84). Using subgroup analysis, the same study found that four studies in Bangladesh, Pakistan, and India assessed the effectiveness of advocacy and support group building packages, including community mobilization and house visits. There was a 21% reduction in average newborn death (RR 0.79; 95% CI 0.68 to 0.92) in these trials. Treatments such as sepsis management and home-based newborn care considerably reduced infant mortality (average RR 0.43; 95% CI 0.27 to 0.69; sample size 2089) in India, according to another research. [17].

Vaccination programs that include tetanus toxoid have reduced the number of cases and fatalities caused by tetanus on a countrywide level. Even though only 10% of babies in Nepal are attended by skilled personnel, the country has managed to eradicate infant tetanus through supplemental immunization action (SIA) supported by UNICEF. A total of three doses of tetanus toxoid were administered to the women who were specifically targeted, with 80% of those women receiving a

minimum of two doses. This endeavor helped bring about the aim of tetanus eradication in Nepal within six years [18]. Women with no neonatal deaths had a substantially lower number of inexperienced birth assistants (62.1%) compared to those with neonatal deaths (71%; $p < 0.001$). Furthermore, the research found that the instrument used to snip the umbilical chord was more often sterile (85%) when the last living baby was born than when the babies who did not make it (75%), and this disparity was statistically significant ($p < 0.001$). [19]. Receiving prenatal care during a woman's pregnancy is also crucial in reducing the infant mortality rate. The percentage of prenatal checkups was lower among pregnant women in the peri-urban context of India who had a previous child death during birth (12%) compared to those who had a previous live child delivery (41%; $p < 0.001$) [19].

The approach significantly reduced the risk of a missed opportunity for vaccination (MOV) [20] in situations when a vaccine-eligible child was aware of the health system but did not get the vaccine, for reasons such as practitioners failing to screen them, insufficient vaccine supply, or parental resistance. According to the comprehensive vaccination coverage survey [21], almost all SHRUCs in Pakistan assessed missed opportunities for simultaneous vaccinations (MOSVs) for IPV1, with a rate of over 40%. In Balochistan, the proportion was much higher. The Naunehal team improved accessibility and immunization rates by giving residents advance notice of when the mobile health service will be arriving and by returning to the same spot to provide booster shots at regular intervals. In unstable and rural communities, offering immunization services through outreach initiatives can become quite costly, despite their typically cost-effective nature [22]. Naunehal was put into action using a highly economical method. Vaccines, healthcare services, and nutritional advice were to be delivered by key staff members in an optimal number of targeted visits at ideal times according to this strategy. There was less needless expenditure on the outreach effort since community mobilization provided an additional safeguard that the community was informed and open.

The study's strength is that it assesses the integrated strategy in a real-world, conflict-affected setting utilizing a low-cost model. Evaluation of health care and vaccination delivery in conflict-affected regions is the focus of the present study, which addresses a gap in the literature. There is a dearth of research in the fields of zero-dose children and polio eradication, which are the subjects of this study [23]. The study's strengths, which included local community engagement and government collaboration on vaccine distribution, staff training, and facility modifications, helped make the concept cost-effective and viable in the long run.

It is possible to extend the study's findings to the Pakistani setting as well. Pakistan has a number of vertical programs that aim to improve women's health, and the most recent one is Emergency Obstetric Care (EmOC), which aims to assure safe childbirth. It is critical to teach healthcare professionals to maintain clean, sanitary delivery procedures and to take actions to boost people's confidence in the quality of accessible services in order to accomplish the worldwide aim of tetanus eradication.

5. CONCLUSION

Vaccinating pregnant moms is the most effective method for reducing the fatality rate from newborn tetanus. Along with the "high-risk" strategy, clean deliveries, frequent effective prenatal visits, and this one step, resource-poor nations like Pakistan can minimize neonatal tetanus.

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