ORIGINAL ARTICLE

EFFECTIVENESS OF SURVEILLANCE OF DIPHTHERIA AND PERTUSSIS IN TAMIL NADU: A SECONDARY DATA ANALYSIS FOR JANUARY − DECEMBER, 2023.

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ABSTRACT

INTRODUCTION: Surveillance of vaccine-preventable diseases (VPDs) such as diphtheria and pertussis are vital for monitoring immunization program effectiveness. This study evaluates the performance of Tamil Nadu's surveillance system using data from the Vaccine Preventable Diseases Surveillance Information Management System (VSIMS) for 2023.
METHODS : A cross-sectional analysis of suspected diphtheria (n=101) and pertussis (n=57) cases reported in Tamil Nadu during January-December 2023 was conducted. Indicators assessed included timely notification, investigation, sample collection, active case search (ACS), and follow-up. Performance was benchmarked against targets in the Diphtheria, Pertussis, and Neonatal Tetanus Surveillance Field Guide.
RESULTS : Timely notification exceeded the 80% target for both diseases, with 89.1% for diphtheria and 89.5% for pertussis cases. Timely investigations were conducted in 93.1% and 91.2% of diphtheria and pertussis cases, respectively. Adequate sample collection surpassed targets but was predominantly limited to single specimens. However, ACS performance was suboptimal, with only 33.7% for diphtheria and 17.5% for pertussis cases. Follow-up documentation was notably poor (27.7% for diphtheria, 8.8% for pertussis).
CONCLUSION : While the performance of the Diphtheria and Pertussis surveillance system in Tamil Nadu aligns with national targets for notification and investigation, ACS and follow-up documentation require significant improvement. Strengthening these areas is essential for identifying clustering, ensuring timely public health responses, and achieving Immunization Agenda 2030 goals.

KEYWORDS : Surveillance, Vaccine Preventable Diseases, Effectiveness, Diphtheria, Pertussis, Indicators, Evaluation

INTRODUCTION

Immunization is the foundation of the primary health care system and an indisputable human right. Vaccination against childhood communicable diseases has contributed significantly in achieving Sustainable Development Goals (SDGs) by reducing mortality and morbidity among children.[1] Under the Universal Immunization Programme (UIP), Govt of Tamil Nadu provides 11 Vaccines to children and pregnant mothers against the 12 Vaccine Preventable Diseases, namely, Poliomyelitis, Diphtheria, Pertussis, Tetanus, Measles, Rubella, Tuberculosis, Hepatitis B, Hemophilus Influenza type B (Hib), Rotavirus, Pneumococcal and Japanese Encephalitis, the latter being given in 14 selected endemic districts.[2] In children <1 year old, Diphtheria, Pertussis, Tetanus, Hepatitis B, Hib are provided as pentavalent vaccine. Children in the age group of 1-7 years receive diphtheria, pertussis and tetanus in the form of DPT. In addition, for adolescents and pregnant women, tetatus and diphtheria (Td) vaccine is given as a standalone vaccine.[3] The progress and impact of vaccination programmes can be effectively assessed by surveillance for Vaccine Preventable Diseases (VPDs).[1]

Immunization Agenda 2030 envisions a world where everyone, everywhere, at every age, fully benefits from vaccines to improve health and well-being. Surveillance for VPDs forms part of wider infectious and non-infectious public health surveillance and is one of the strategic priorities for achieving Immunisation agenda 2030.[4] VPDs under surveillance in India are Polio, Measles, Rubella, Diphtheria, Pertussis, Neonatal tetanus, Tuberculosis, Bacterial Meningitis, Acute Hepatitis B, Japanese Encephalitis and Typhoid. Currently, surveillance of six VPDs namely, Polio, Measles, Rubella, Diphtheria, Pertussis, and Neonatal tetanus are focussed in India, supported by WHO.[5]

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VPD surveillance system in India has been established with technical, operational and monitoring support from WHO-NPSN and encompasses more than 51,000 Reporting Sites (RS). The RS network includes Reporting Units (RU) and Informer Units (IU). All RUs are required to report suspected VPD cases or death due to VPDs immediately. In addition, all RUs are required to send weekly reports including nil reports with details of cases reported in the past one week to the District Health Officer, who also functions as District Immunization Officer. Informer Units (IU) such as hospitals and clinics with single practitioners, facilities with traditional healers or faith healers that are likely to encounter suspected VPD cases should also report cases to the DIO/SMO, but are not mandated to send weekly reports. Currently, there are approximately 1,308 RUs functional in Tamil Nadu. All the VPD cases are updated in Vaccine Preventable Diseases Surveillance Information Management System (VSIMS).

Diphtheria and Pertussis are life-threatening VPDs. Their incidence has gradually declined globally due to effective immunization programs.[6,7] However, diphtheria continues to be a public health problem in India, with 10 Indian states accounting for most of the reported cases since 2000 largely attributed to low vaccination coverage and waning vaccine immunity in adults.[8,9] Diphtheria, an acute infectious disease of the respiratory tract caused by toxigenic strains of Corynebacterium diphtheriae, spreads from person to person through respiratory droplets or direct contact with respiratory secretions. Complications of Diphtheria include myocarditis, neuritis, Pneumonia, respiratory insufficiency, and death. Most cases of diphtheria develop in non-immunized individuals. The attack rate, severity of disease and risk of complications are much lower in immunized patients.[1]

Pertussis, also known as whooping cough, is a highly contagious disease caused by the bacterium Bordetella pertussis. It is clinically characterized by intense cough paroxysms lasting for weeks, often accompanied by inspiratory whooping and post-tussive emesis. The most common complication is secondary bacterial pneumonia, which causes pertussis-related deaths. Neurological complications such as seizures and encephalopathy also occur as a result of hypoxia from coughing or possibly from toxins. Infants are at the highest risk for developing pertussis-related complications.[1]

A case definition has been established by a set of criteria to report suspected cases of that disease for public health surveillance. It enables consistent reporting of cases by the reporting network and improves specificity of reported cases. A suspected case of diphtheria is defined as an illness of the upper respiratory tract characterized by the following: laryngitis or nasopharyngitis or pharyngitis or tonsillitis and adherent membranes of tonsils, pharynx, larynx and/or nose.[1] A suspected case of pertussis is defined as a person of any age with a cough lasting ≥2 weeks, or of any duration in an infant or any person in an outbreak setting without a more likely diagnosis and with at least one of the following symptoms on observation or parental report: paroxysms (i.e. fits) of coughing inspiratory whooping, post-tussive vomiting, or vomiting without other apparent cause, apnoea in infants (< 1 year of age) or clinician suspicion of pertussis.[1]

As part of VPD Surveillance, Monitoring, and supervision are important tools for establishing and maintaining efficient surveillance and response systems. Monitoring and review of key performance indicators are essential to assess the quality of the surveillance system against set norms and standards. Implementation of a surveillance system without a periodic review of the performance indicators will result in no improvements in the system, thus leading to an increased risk of failure. Hence, this study attempted to assess the performance of the Diphtheria and Pertussis Surveillance system in Tamil Nadu using the Vaccine Preventable Diseases Surveillance Information Management System (VSIMS) data for January - December 2023.

METHODS

A cross-sectional study was conducted using secondary data on Diphtheria and Pertussis Surveillance. All the suspected Diphtheria and Pertussis cases reported in the Vaccine Preventable Diseases Surveillance Information Management System (VSIMS) portal during the period January - December 2023 have been included for analysis. The data containing details on the date of onset of symptoms, notification, investigation, date and number of samples collected, Active Case Search (ACS), and follow-up was extracted in Excel format from the VSIMS portal.

Qualitative variables are expressed as proportions. All the key performance indicators were compared with the Diphtheria, Pertussis, and Neonatal Tetanus Surveillance Field Guide 2020 released by the Ministry of Health and Family Welfare (MoHFW), Government of India, supported by WHO.[1] Monitoring indicators recommended in the Surveillance Field Guide are i) Proportion of suspect cases with timely notification ii) Proportion of suspected cases with timely investigation iii) Proportion of cases with adequate sample collection iv) Proportion of rejected cases v)

Proportion of timely ACS in the community vi) Timeliness of weekly reporting and vii) Completeness of weekly reporting presented in Table 1.

Table 1: Timelines of activities to be conducted for suspect

	% of Timely notification	% of Timely investigation	% of Suspect cases with adequate sample	% of Timely active case search (ACS)
Diphtheria	within 7 days of onset of first symptom	within 48 Hrs of case notification	within 4 weeks of onset of first symptom	within 7 days of investigation
Pertussis	within 4 weeks of onset of first symptom			

RESULTS

This study analysed 101 reported suspect Diphtheria cases and 57 suspect Pertussis cases, reported in Tamil Nadu through the VSIMS portal during January – December 2023. The key monitoring indicators compared in this study are i) Proportion of suspect cases with timely notification ii) Proportion of suspected cases with timely investigation iii) Proportion of cases with adequate sample collection iv) Proportion of timely ACS in the community. Other components of Surveillance like final classification of cases, follow up and outcome updation in portal were also analyzed.

i. Timely notification: Among the 101 suspected Diphtheria cases, 90 (89.1%) cases were notified within 7 days of onset of sore throat. Out of the 57 suspected Pertussis cases, 51 (89.47%) cases were notified within 4 weeks of onset of cough. Target set for timeliness for notification of Diphtheria and Pertussis is >80% (Fig 1).

ii. Timely investigation: Out of 101 Diphtheria suspect cases, 94 (93.06%) cases were investigated within 48 hours of notification, and of the 57 suspected Pertussis cases, timely investigation done in 52 (91.23%) cases. Target for timely investigation is >80% (Fig 2).
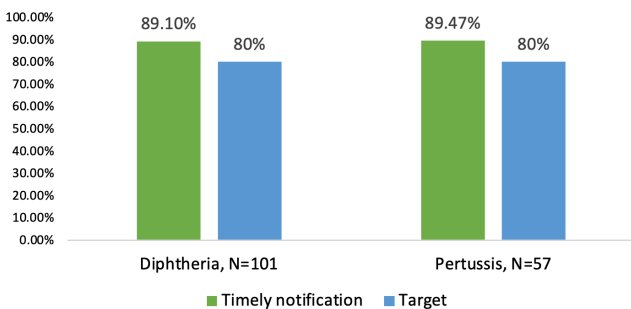

Figure 1: Timeliness of Notification of suspected Diphtheria & Pertussis cases, Jan-Dec 2023, Tamil Nadu
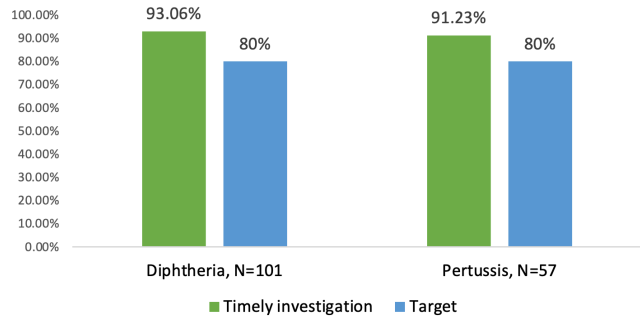

Figure 2: Timeliness in investigation of suspected Diphtheria & Pertussis cases, Jan-Dec 2023, Tamil Nadu

iii) Proportion of cases with adequate Sample collection:

For Diphtheria, 2 samples of Throat Swab or pieces of membrane within 4 weeks of onset of sore throat. For Pertussis, 2 samples of nasopharyngeal swabs within 4 weeks of the onset of Cough and 1 serum sample within 12 weeks of the onset of Cough. Among the 101 Diphtheria cases, 1 sample has been collected for 97 (96.04%) cases and 2 samples have been collected for 1 (0.99%) of suspected Diphtheria cases. Among the 57 Suspected Pertussis cases, 1 sample has been collected for 51 (89.47%) suspected cases and 2 samples have been collected for 1 (1.75%) of suspected Pertussis cases (Fig 3). The adequacy of sample collection is determined by the timeliness of sample collection. Among 97 (96.04%) of Diphtheria cases and 49 (85.96%) of Pertussis cases, adequate sample collection was taken. The target for adequate sample collection is >80% (Fig 4).
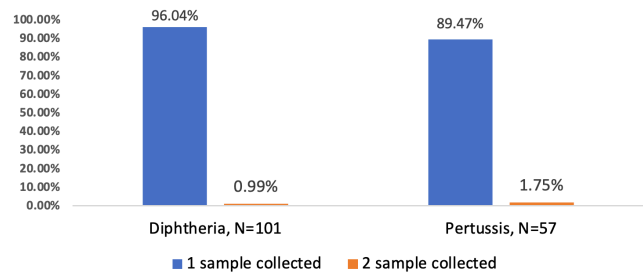

Figure 3: No. of samples collected among suspected Diphtheria & Pertussis cases, Jan-Dec 2023, Tamil Nadu
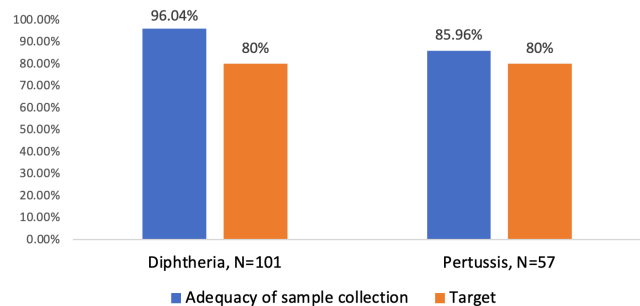

Figure 4: Timeliness of sample collection among suspected Diphtheria and Pertussis cases Jan-Dec 2023, Tamil Nadu

i)Proportion of Timely Active Case Search (ACS) in the community: ACS should be conducted soon after identification of suspected cases, preferably within 7 days of investigation. Among the 101 suspected Diphtheria cases, ACS has been conducted for 34 (33.66%) cases, and among the 57 Pertussis cases, ACS was conducted for 10 (17.54%) cases (Fig 5). Timely ACS has been conducted for 28 (27.72%) suspected Diphtheria cases and 5 (8.77%) suspected Pertussis cases. Target for timeliness in ACS is >80% (Fig 6)
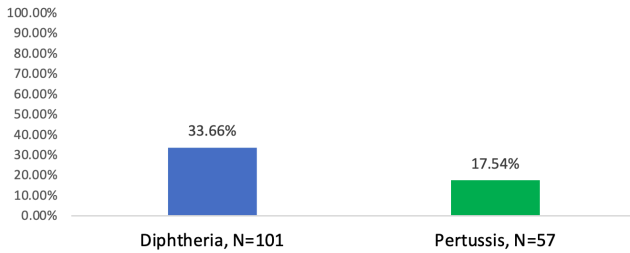

Figure 5: Active Case Search (ACS) Conducted for suspected Diphtheria & Pertussis cases, Jan-Dec 2023, Tamil Nadu
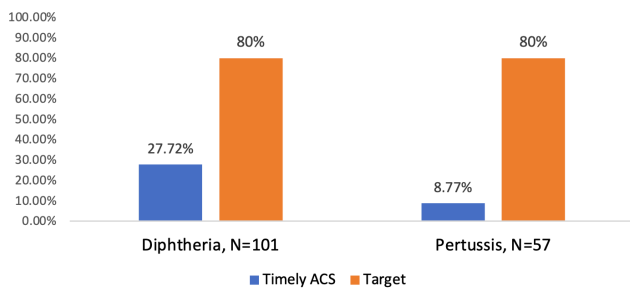

Figure 6: Timeliness in conducting Active Case Search (ACS) conducted for suspected Diphtheria & Pertussis cases, Jan-Dec 2023, Tamil Nadu

ii) Follow up of cases: Telephonic follow-up of suspect cases after 60 days from the date of onset of symptoms needs to be done and outcomes to be updated. Follow-up has been updated for 28 (27.72%) suspect Diphtheria cases and 5 (8.77%) Pertussis cases (Fig 7).
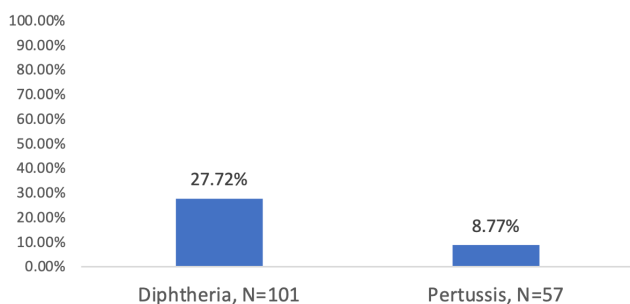

Figure 6: Timeliness in conducting Active Case Search (ACS) conducted for suspected Diphtheria & Pertussis cases, Jan-Dec 2023, Tamil Nadu

iii) Final Classification & outcome of cases: Of the 101 reported suspect Diphtheria cases, one case is positive for Diphtheria following laboratory testing and the outcome status is alive. The remaining 100 cases are clinically compatible cases, of these cases, the outcome has been updated for only 48 (48%) cases and as alive. All the suspected Pertussis cases are clinically compatible cases and no lab-confirmed cases. The outcome has been updated as alive for only 15 (26.32%) cases.

DISCUSSION

101 suspected Diphtheria and 57 suspected Pertussis cases were analyzed for performance against the monitoring indicators as per the Surveillance guidelines.[1] The key performance indicators are timely notification, investigation, timely sample collection, conducting ACS and follow-up.

All suspected cases of Diphtheria and Pertussis cases having a date of onset within the past 3 months should be notified. However, the ideal time for notification is within 7 days of onset of sore throat for Diphtheria and 4 weeks of the onset of cough for Pertussis. This indicator is most crucial in determining the speed and quality of a surveillance system and offers many advantages, a) Sample collection during the early phase of disease increases the probability of laboratory confirmation, early detection of impending outbreaks and case management and b) Timely public health interventions can reduce the morbidity and mortality rates. Timelines in the notification of suspected Diphtheria and Pertussis cases exceed the target of >80%.

Timeliness in investigation determines the alertness of the surveillance system to respond to notified cases. All notified cases should be investigated within 48 hours of notification. Timelines in the investigation of notified suspect Diphtheria and Pertussis cases exceed the target of >80%. Appropriate laboratory testing should be done in all suspect cases to confirm or rule out the suspicion. If no testing is done, it means that monitoring is inadequate or ineffective. Hence, a target of collecting samples in ≥80% of suspected cases of diphtheria and pertussis was set in the guideline. Even though two samples are recommended for both diseases, less than 2% of suspect cases had 2 samples collected. However, one sample has been collected on time, and this exceeds the set target (>80%).

The occurrence of a diphtheria case in the community indicates gaps in Routine Immunization (RI) coverage and the build-up of a susceptible cohort. Due to the high attack rate of these diseases, there is a very high probability of finding additional cases among contacts of

diphtheria and pertussis cases. Hence, ACS in response to the identification of diphtheria and pertussis cases in the community is very important. A thorough ACS in the community will identify any clustering of cases and timely interventions have the potential to curtail the outbreaks and reduce case morbidity and mortality. Mortality to diphtheria increases with the severity of local disease, the extent of pseudo-membrane, and the delay between onset of local disease and administration of antitoxin. However, ACS was conducted in 33.66% of Diphtheria suspect cases and 17.54% of pertussis suspect cases. This needs to be focused, on to achieve the target (>80%) set by MoHFW.

Telephonic follow-up of suspect cases after 60 days from the date of onset of symptoms need to be done and outcomes to be updated. However, the outcome status was updated in 48.51% and 26.32% of suspect Diphtheria & Pertussis cases respectively. This need to be updated in the portal for all cases. Only one suspected case of Diphtheria and nil suspected case of Pertussis are positive following laboratory testing. The remaining cases are clinically compatible cases. The outcome status in follow-up has been updated, however, this need to be updated for all the cases. As the suspect definition for Public Health Surveillance includes clinician suspicion of Diphtheria and Pertussis, a greater number of finally classified clinically compatible cases reflects an effective surveillance system that ensures potential cases are identified and managed promptly.

Overall, the surveillance of Diphtheria and Pertussis in the State aligns fairly well with timely notification, timely investigation, and final classification of cases. However thorough ACS which helps in identifying the clustering of cases demands attention. Even though the outcome was updated in positive Diphtheria cases, updating needs to be improved for clinically compatible cases also. As this study analyzed the data available in the VSIMS portal, whether shortfalls in indicators are actual shortfalls at the field level or insufficient documentation in the portal needs to be ascertained.

CONCLUSION

The proportion of suspected Diphtheria & Pertussis cases notified and investigated within the timeline exceeds the target set by MoHFW. Timely sample collection exceeds the target; however, this was with a single specimen. The occurrence of Diphtheria cases in a community indicates gap in RI coverage and the build-up of suspected cohorts, due to the high attack rate of these diseases. Hence ACS has to be updated for all the suspect cases to reduce morbidity. Follow up after 60 days from the onset of symptoms and outcome status need to be updated, which was less. Thus, Tamil Nadu is performing aligned with the surveillance guidelines by MoHFW, thus paving way for achieving the strategic priority of Immunization agenda 2030. Nevertheless, the gaps identified in sample collection, ACS, and follow up need to be improved.

CONFLICT OF INTEREST

None

REFERENCES

1. Surveillance for Diphtheria, Pertussis and Neonatal Tetanus - Field Guide 2020. Ministry of Health and Family Welfare, Government of India.

2. Health and Family Welfare Department. Policy Note 2024-2025. Demand No. 19. Ministry of Health and Family Welfare, Government of Tamil Nadu. [Internet]. 2024. Available from: https://cms.tn.gov.in/sites/default/files/documents/hfw_e_pn_2024_25.pdf

3. National Health Mission [Internet]. 2024 [cited 2024 Oct 12]. Immunization: National Health Mission, Ministry of Health and Family Welfare, Government of India. Available from: https://nhm.gov.in/index1.php?lang=1&level=2&sublinkid=824&lid=220

4. Global strategy for comprehensive Vaccine-Preventable Disease (VPD) surveillance [Internet]. [cited 2024 Dec 31]. Available from: https://www.who.int/publications/m/item/global-strategy-for-comprehensive-vaccine-preventable-disease-(vpd)-surveillance

5. Routine Immunization. Manual for Medical Officers. Ministry of Health and Family Welfare, Government of India, 2024. [Internet]. [cited 2024 Dec 31]. Available from: https://mohfw.gov.in/?q=Organisation/Departments-of-Health-and-Family-Welfare/immunization

6. Truelove SA, Keegan LT, Moss WJ, Chaisson LH, Macher E, Azman AS, et al. Clinical and Epidemiological Aspects of Diphtheria: A Systematic Review and Pooled Analysis. Clin Infect Dis. 2020 Jun 24;71(1):89–97.

7. Carrasquilla G, Porras A, Martinez S, DeAntonio R, Devadiga R, Caceres DC, et al. Incidence and mortality of

pertussis disease in infants <12 months of age following introduction of pertussis maternal universal mass vaccination in Bogotá, Colombia. Vaccine. 2020 Oct;38(46):7384–92.

8. Murhekar M. Epidemiology of Diphtheria in India, 1996–2016: Implications for Prevention and Control. Am Soc Trop Med Hyg. 2017 Aug 2;97(2):313–8.

9. Phalkey RK, Shukla S, Shardul S, Ashtekar N, Valsa S, Awate P, et al. Assessment of the core and support functions of the Integrated Disease Surveillance system in Maharashtra, India. BMC Public Health. 2013 Dec;13(1):575.