

Diphtheria in India: Trends, Antitoxin Availability, and Challenges in Early Diagnosis

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Abstract

Review Article

Diphtheria is an acute, toxin-mediated, potentially fatal infectious disease caused by *Corynebacterium diphtheriae*. Despite the availability of an effective vaccine for over seven decades, diphtheria continues to pose a significant public health challenge in India. The persistence of the disease reflects gaps in immunization coverage, waning immunity among adolescents and adults, delayed diagnosis, and limited access to diphtheria antitoxin (DAT). Periodic outbreaks reported from several Indian states underscore systemic weaknesses in surveillance, laboratory confirmation, and early clinical recognition. This review examines the epidemiology of diphtheria in India, historical and current trends, transmission dynamics, clinical manifestations, diagnostic challenges, antitoxin availability, government strategies, and recommended preventive and therapeutic measures. The article also highlights complications, public health implications, and future directions for diphtheria control and elimination in India.

Keywords: Diphtheria, India, *Corynebacterium diphtheriae*, Diphtheria Antitoxin (DAT), Universal Immunization Programme (UIP), Diphtheria Toxin.

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INTRODUCTION

Diphtheria is a communicable bacterial disease primarily affecting the upper respiratory tract and, less commonly, the skin. The disease is caused by toxigenic strains of *Corynebacterium diphtheriae*, *C. ulcerans*, or *C. pseudotuberculosis*, which produce a potent exotoxin responsible for systemic complications. Historically, diphtheria was a leading cause of childhood mortality worldwide before the introduction of diphtheria toxoid vaccination.

India introduced diphtheria vaccination under the Expanded Programme on Immunization (EPI) in 1978, later integrated into the Universal Immunization Programme (UIP). Although vaccination substantially reduced disease incidence, diphtheria has not been eliminated. India continues to report one of the highest global burdens of diphtheria, contributing a significant proportion of cases reported to the World Health Organization (WHO).

The resurgence and persistence of diphtheria in India raise important concerns regarding immunization gaps, inequities in healthcare access, diagnostic delays, and inadequate antitoxin availability. These issues

necessitate renewed attention from clinicians, public health authorities, and policymakers.

Microbiology and Pathogenesis

Corynebacterium diphtheriae is a Gram-positive, non-motile, non-spore-forming bacillus characterized by a club-shaped appearance and metachromatic granules. Only toxigenic strains cause classical diphtheria, and toxin production depends on lysogenization by a β -phage carrying the *tox* gene.

Mechanism of Toxin Action

The diphtheria toxin inhibits protein synthesis by inactivating elongation factor-2 (EF-2), leading to cell death. The toxin has both local and systemic effects:

- **Local effects:** Necrosis and inflammation at the site of infection, resulting in the formation of a characteristic grayish-white pseudomembrane.
- **Systemic effects:** Myocarditis, neuritis, renal failure, and thrombocytopenia.

The severity of disease depends on the bacterial load, toxin production, host immunity, and timing of antitoxin administration.

Epidemiology of Diphtheria in India

Historical Perspective

Before widespread immunization, diphtheria was endemic in India, with high morbidity and mortality among children. Following the introduction of vaccination, incidence declined sharply. However, unlike many high-income countries, India did not achieve elimination.

Current Epidemiological Trends

India consistently reports a high number of diphtheria cases annually. Surveillance data from the Integrated Disease Surveillance Programme (IDSP) and WHO indicate:

- Persistent transmission in several states
- Periodic outbreaks, particularly in underserved populations
- Increasing proportion of cases among older children, adolescents, and adults

Geographical Distribution

States frequently reporting cases include:

1. Uttar Pradesh
2. Bihar
3. Rajasthan
4. Madhya Pradesh
5. Jharkhand
6. West Bengal
7. Assam
8. Telangana
9. Kerala

Urban slums, rural areas with poor healthcare access, and migrant populations are disproportionately affected.

Age and Gender Distribution

Earlier, diphtheria predominantly affected children under five years of age. Recent data show a shift toward:

- School-aged children
- Adolescents
- Young adults

This shift reflects waning immunity due to missed booster doses.

Transmission and spread in India

Diphtheria spreads primarily through:

- Respiratory droplets
- Direct contact with infected individuals
- Contact with contaminated fomites
- Skin-to-skin contact in cutaneous diphtheria

Factors facilitating transmission in India include:

- Overcrowding
- Poor ventilation
- Low immunization coverage
- Inadequate booster vaccination
- Malnutrition
- Delayed healthcare-seeking behavior

Seasonal clustering, particularly during cooler months, has been observed in several regions.

Clinical Manifestations

Respiratory Diphtheria

The most common and severe form, presenting with:

- Sore throat
- Fever (usually low-grade)
- Cervical lymphadenopathy ("bull neck")
- Formation of an adherent pseudomembrane over tonsils and pharynx

Cutaneous Diphtheria

Characterized by:

- Chronic non-healing ulcers
- Gray membrane over skin lesions
- Often seen in tropical and resource-limited settings

Other Forms

- Nasal diphtheria
- Laryngeal diphtheria
- Conjunctival diphtheria

Challenges in Early Diagnosis

Early diagnosis is critical, yet remains a major challenge in India due to:

1. **Clinical Misdiagnosis**
 - Confusion with streptococcal pharyngitis
 - Mislabeling as viral sore throat or tonsillitis
2. **Low Clinical Suspicion**
 - Declining familiarity among younger clinicians
 - Reduced exposure due to vaccination-era rarity
3. **Laboratory Limitations**
 - Limited access to culture and toxin testing
 - Delayed confirmation from reference laboratories
4. **Delayed Presentation**
 - Patients often present late due to socioeconomic barriers

Delayed diagnosis leads to increased mortality, as antitoxin is ineffective against toxin already bound to tissues.

Diphtheria Antitoxin (DAT): Availability and Challenges

Role of Antitoxin

Diphtheria antitoxin neutralizes circulating toxin and is the cornerstone of treatment. It must be administered immediately on clinical suspicion, without waiting for laboratory confirmation.

Availability in India

India faces chronic shortages of DAT due to:

- Limited domestic production
- Dependence on equine-derived antitoxin
- Low commercial demand
- Logistical and cold-chain challenges

The Government of India has designated select centers and state medical stores for DAT distribution, but access remains uneven.

Policy Challenges

- Delayed procurement
- Inadequate stockpiling
- Lack of awareness regarding emergency use protocols

Government Measures and Public Health Response

Universal Immunization Programme (UIP)

Under UIP, the following vaccines are provided:

- Pentavalent vaccine (DPT-HepB-Hib)
- DPT boosters
- Td (Tetanus-diphtheria) for adolescents and pregnant women

Surveillance and Outbreak Response

- Integrated Disease Surveillance Programme (IDSP)
- Rapid response teams
- Case-based surveillance during outbreaks
- Contact tracing and chemoprophylaxis

Guidelines Issued by Government of India

The Ministry of Health and Family Welfare (MoHFW) has issued:

- Case definitions
- Treatment protocols
- Immunization catch-up strategies
- DAT administration guidelines

Treatment Protocols (As per Government Guidelines)

Immediate Management

1. Diphtheria Antitoxin

- Administer immediately based on clinical severity
- Dosage depends on disease duration and extent

2. Antibiotic Therapy

- Erythromycin or penicillin for 14 days
- Alternatives: azithromycin or clarithromycin

3. Supportive Care

- Airway management
- Cardiac monitoring
- Intensive care for severe cases

Isolation and Infection Control

- Droplet precautions
- Isolation until two consecutive negative cultures

Complications

Major complications include:

- Myocarditis (most common cause of death)
- Cardiac arrhythmias

- Peripheral neuropathy
- Cranial nerve palsies
- Acute renal failure
- Secondary infections

Complications may occur weeks after initial infection, even with treatment.

Preventive Measures

Immunization

- Primary series and boosters are the most effective preventive strategy
- Emphasis on adolescent and adult boosters

Public Awareness

1. Education on early symptoms
2. Importance of vaccination

Healthcare System Strengthening

- Ensuring DAT availability
- Training healthcare workers
- Strengthening laboratory capacity

Guidelines for Citizens

The Government of India advises citizens to:

1. Ensure complete immunization
2. Seek medical care for sore throat with fever
3. Avoid contact with suspected cases
4. Follow isolation advice
5. Complete prescribed antibiotic courses

CONCLUSION

Diphtheria remains a significant yet preventable public health problem in India. Persistent transmission reflects systemic gaps in immunization coverage, surveillance, early diagnosis, and antitoxin availability. Strengthening routine immunization, ensuring timely booster doses, improving clinician awareness, and guaranteeing equitable access to diphtheria antitoxin are essential steps toward reducing morbidity and mortality. With sustained political commitment, robust public health infrastructure, and community participation, India can move closer to the elimination of diphtheria as a public health threat.

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