www.ijarp.com ISSN 2456-9992 Page: 01-12

International Journal Advanced Research Publications

Review Article

Volume: 02
Issue: 04

# STRATEGIES FOR LEPROSY CONTROL: A COMPREHENSIVE APPROACH TOWARDS ELIMINATION

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**Article Received: 27 February 2026, Article Revised: 17 March 2026, Published on: 07 April 2026**

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DOI: https://doi-doi.org/101555/ijarp.1673

## 1. ABSTRACT

Leprosy (Hansen's disease) remains a significant public health challenge in developing countries, particularly in South Asia, affecting marginalized populations and causing permanent disabilities if left untreated. This comprehensive review examines the multifaceted strategies essential for leprosy control and elimination, with emphasis on early case detection, multidrug therapy (MDT), contact tracing, disability prevention, and stigma reduction. The World Health Organization's Global Leprosy Strategy 2021–2030 envisions zero leprosy through integrated, country-owned roadmaps and scaled-up prevention initiatives. Current evidence demonstrates that a combination of rapid case identification, complete treatment compliance, household contact screening with post-exposure prophylaxis, systematic disability management, and community-based rehabilitation can significantly reduce transmission and prevent disease-related deformities. Furthermore, addressing stigma through information, education, and communication (IEC) programs and integrating leprosy services within general healthcare systems enhances service accessibility and patient acceptability. This article synthesizes evidence on evidence-based control strategies, programmatic

approaches, emerging technologies, and policy interventions necessary to achieve leprosy elimination in endemic countries while respecting the rights and dignity of affected persons.

**2. KEYWORDS:** Leprosy control, Hansen's disease, multidrug therapy, case detection, contact screening, disability prevention, stigma reduction, post-exposure prophylaxis, health system integration, rehabilitation, Mycobacterium leprae, public health strategy.

## 3. INTRODUCTION

Leprosy, caused by the bacterium *Mycobacterium leprae*, is a chronic infectious disease that predominantly affects the skin and peripheral nerves, leading to progressive and permanent disabilities when left untreated. Despite being curable with multidrug therapy for over four decades, leprosy continues to affect more than 120 countries worldwide, with approximately 200,000 new cases reported annually. The disease is particularly prevalent in South-East Asia, where India, Brazil, and Indonesia account for more than 70% of global cases. Beyond its medical implications, leprosy carries profound psychosocial consequences, as affected individuals face severe stigmatization and discrimination that often preclude early consultation and treatment-seeking behavior, thereby perpetuating disease transmission and disability development.[8][9][10][11][12][7]

The control of leprosy demands a comprehensive, multistrategy approach that extends beyond pharmacological treatment to encompass early detection mechanisms, contact management, disability prevention, rehabilitation services, and community engagement. The transmission of *Mycobacterium leprae* occurs through respiratory droplets during prolonged close contact with untreated cases, making community-level interventions crucial for interrupting disease transmission. Early diagnosis and prompt multidrug therapy can prevent disability development and arrest transmission, yet diagnostic delays remain endemic in resource-limited settings where specialized expertise has been integrated into general health services. Additionally, psychological and social barriers—including fear, shame, and misconceptions about disease transmissibility—hinder early presentation and treatment adherence among vulnerable populations.[5][6][9][10][12][1][7][8]

The World Health Organization's Global Leprosy Strategy 2021–2030 represents a paradigm shift toward elimination, emphasizing integration of services, scaled-up prevention, disability management, and stigma reduction as interconnected pillars. This strategy recognizes that control of leprosy extends beyond the clinical domain into community mobilization, policy advocacy, and addressing underlying social determinants such as poverty, marginalization,

and limited healthcare access. This review synthesizes evidence on evidence-based control strategies and programmatic approaches essential for achieving leprosy elimination in endemic countries.[2][6][1][5]

## 4. Epidemiology and Disease Burden

Leprosy prevalence and burden vary significantly across endemic regions, with South-East Asia bearing the greatest disease burden. India alone reports over 50% of global leprosy cases, followed by Brazil and Indonesia. In 2024, approximately 200,000 new cases were reported worldwide, though this represents a gradual decline from peak incidence levels. However, this decline masks persistent challenges in certain high-endemic districts and among marginalized populations, particularly tribal communities and economically disadvantaged groups.[6][11][13][14][7]

Within India, the National Leprosy Eradication Programme (NLEP) has achieved significant progress, reducing the national prevalence rate from 57.2 per 10,000 population in the pre-MDT era to less than 1 per 10,000, meeting the elimination threshold. However, spatial heterogeneity persists, with states like Chhattisgarh, Maharashtra, Madhya Pradesh, and Odisha maintaining higher disease burden. Notably, the scheduled tribe population, comprising only 8.6% of India's population, accounts for 18.5% of newly detected leprosy cases, reflecting disproportionate disease burden linked to marginalization, poor healthcare access, and socioeconomic vulnerability.[4][13][14][15]

Risk factors for leprosy development include genetic predisposition, nutritional deficiencies, immunosuppression, close household contact with untreated cases, and socioeconomic disadvantage. Men are twice as likely as women to develop leprosy, though women often experience more severe social consequences. Globally, approximately 2–3 million individuals live with leprosy-related disabilities, underscoring the urgent need for prevention-focused strategies.[10][11][12][4][7]

## 5. Strategic Interventions for Early Case Detection

Early case detection represents the cornerstone of leprosy control, as identification before visible disability development prevents permanent nerve damage, arrests transmission, and reduces stigma-related complications. The WHO Global Leprosy Strategy emphasizes systematic case detection through multiple approaches: active surveillance in endemic areas, passive case-finding through strengthened health systems, and targeted campaigns in high-risk populations.[1][4][5]

**Integrated active case detection** involves periodic surveys in endemic districts to identify undiagnosed cases, particularly among marginalized and difficult-to-reach populations. These campaigns employ trained multipurpose workers who conduct community health assessments, identify suspected cases through cardinal sign detection (hypopigmented skin lesions with loss of sensation or thickened peripheral nerves), and refer for confirmatory diagnosis. Evidence demonstrates that active case detection increases case identification compared to passive case-finding alone, with a substantial proportion of cases detected through community outreach.[16][14][15][6][10]

**Strengthening passive case detection** requires capacity building of general health workers—ASHA (Accredited Social Health Activists), ANM (Auxiliary Nurse Midwife), and primary health center staff—to recognize leprosy cardinal signs and refer suspected cases promptly. Integration of leprosy services into general health facilities enhances accessibility and reduces stigma associated with standalone leprosy centers, thereby improving population reach and acceptability.[15][5][16][1]

**School-based screening programs** target children as a priority population, as early detection in pediatric cases prevents childhood disability and reduces transmission within families and schools. Mobile clinics and outreach camps in remote and tribal areas address geographic barriers to healthcare access.[14][4][16]

## 6. Multidrug Therapy and Treatment Optimization

Multidrug therapy, consisting of rifampicin, dapsone, and clofazimine, represents the definitive treatment for leprosy. The WHO-standardized regimens achieve very high cure rates: six months for paucibacillary (PB) cases (1–5 skin lesions, smear-negative) and 12 months for multibacillary (MB) cases (≥6 skin lesions, or smear-positive, or nerve involvement). MDT eradicates bacterial load, cures the patient, and renders treated individuals non-infectious within a short period after therapy initiation.[16][7][10]

Optimization of MDT delivery demands ensuring drug availability, affordability, and accessibility. WHO provides MDT free of cost through a long-standing donation program, significantly reducing financial barriers. However, supply chain management, storage capacity, and distribution logistics require strengthening in resource-limited settings. Shorter regimens and simplified dosing schedules improve adherence, particularly in decentralized service delivery models.[4][6][7][10][15][1][16]

**Monitoring treatment compliance** is critical for cure and preventing relapse. Community health workers conduct directly observed therapy (DOT), home visits for defaulter retrieval,

and adherence counseling. Adverse effect monitoring, including managing dapsone hypersensitivity reactions and clofazimine hyperpigmentation, requires health worker training and patient education to prevent treatment discontinuation.[10][15][4][16]

**7. Contact Screening and Post-Exposure Prophylaxis**

Contact screening represents a paradigm shift from reactive to proactive leprosy control. Household and social contacts of newly detected cases are at 8–10 fold increased risk of developing leprosy compared to the general population. Systematic contact screening with administration of single-dose rifampicin (SDR-PEP) as post-exposure prophylaxis has emerged as a highly effective prevention strategy, reducing leprosy risk by around 50–60% among contacts.[3][17][18][19][1][10]

The contact management protocol involves:

- Identification of household, neighborhood, and social contacts based on intensity and duration of exposure.[18][16]
- Clinical examination of contacts for cardinal signs.[19][16]
- Administration of SDR-PEP to eligible asymptomatic contacts according to national guidelines.[17][3]
- Health education on early symptom recognition and healthcare-seeking behavior.[9][8]
- Scheduled follow-up for several years to detect early signs of disease.[18][19]

Evidence from pilot projects demonstrates that integrating contact-based prevention into routine leprosy programs is feasible and cost-effective. BCG vaccination of household contacts, particularly children, provides additional protection through immunoprophylaxis. This shift toward contact-focused prevention acknowledges that case detection and MDT alone have proven insufficient to interrupt transmission, necessitating complementary preventive strategies.[6][19][1][18][10]

**8. Disability Prevention and Medical Rehabilitation**

Leprosy-related disabilities constitute a leading cause of permanent physical impairment among infectious diseases globally. Two major mechanisms generate disability: primary impairment resulting from nerve damage at disease onset, and secondary impairment developing from complications and inadequate self-care. Prevention of disabilities requires three integrated components: early case detection and adequate treatment, proactive

identification and management of complications, and rehabilitation of existing disabilities.[20][7][4][10]

**Prevention of primary disabilities** relies on early diagnosis before irreversible nerve damage occurs. MDT eliminates infection and halts disease progression, with efficacy increasing when initiated within the first years of symptom onset. Education of patients and families on self-care practices—including daily skin inspection, regular washing, moisturizing, and protection of anesthetic limbs from trauma and thermal injury—prevents secondary complications.[20][4][6][10]

**Lepra reactions** (Type 1 and Type 2) represent potentially disabling complications requiring urgent intervention. Type 1 reactions involve cell-mediated immune responses in existing lesions that can cause nerve function impairment, while Type 2 reactions (erythema nodosum leprosum) cause systemic inflammation and painful nodules. Early recognition and treatment with immunosuppressive therapy, particularly corticosteroids and in some settings thalidomide, prevents permanent nerve damage. Health workers require training in identifying reaction signs and timely referral for specialist management.[4][20][6][16][10]

**Neuritis management** involves anti-inflammatory therapy, physiotherapy, and in severe cases, surgical decompression of compressed nerves to prevent muscle paralysis and sensory loss. Regular assessment of muscle strength and sensation enables early detection of nerve damage progression.[20][4]

**Rehabilitation of established disabilities** employs multidisciplinary approaches including physiotherapy to maintain muscle function, protective footwear to prevent ulcers in anesthetic feet, hand splints to prevent contractures, reconstructive surgery to correct deformities and restore function, and vocational training to enable economic independence. Comprehensive rehabilitation addresses physical impairments alongside psychosocial and socioeconomic needs, incorporating livelihood generation, inclusive education, and microfinance schemes.[21][22][4][20]

**Leprosy Disability Management Strategy**

| Phase | Focus Area | Key Actions |
|---|---|---|
| **Level 1: Primary Prevention** | **Early Detection** | Early diagnosis, MDT (Multi-Drug Therapy) to halt progression. |
| **Level 2: Secondary Prevention** | **Complication Mgmt** | Immunosuppressive therapy for Reactions (Type 1 & 2), Neuritis management. |
| **Level 3: Tertiary Prevention** | **Self-Care** | Daily skin inspection, moisturizing, protecting anesthetic limbs. |

| Phase | Focus Area | Key Actions |
|---|---|---|
| **Level 4: Rehabilitation** | **Restoration** | Reconstructive surgery, physiotherapy, vocational training. |

### 9. Stigma Reduction and Community Engagement

Stigma represents a profound barrier to leprosy control, as deeply ingrained cultural beliefs, misconceptions about disease transmissibility, and historical associations with deformity and exclusion perpetuate discrimination. Stigma delays treatment-seeking by several years on average, contributing to diagnostic delays, transmission, and disability development. Effective stigma reduction requires multi-level interventions targeting individual, community, and institutional levels.[12][23][8][9]

**Information, Education, and Communication (IEC) programs** disseminate accurate knowledge about leprosy's curability, non-transmissibility after treatment initiation, and preventability of disabilities through early detection. Community awareness campaigns emphasizing messages such as "leprosy is curable" increase case detection rates and healthcare-seeking behavior. IEC programs target vulnerable populations—women, tribal communities, and persons with disabilities—addressing gender-specific stigma and social vulnerabilities.[23][24][5][8][9][14]

**Integration of leprosy services into general health systems** normalizes leprosy as a treatable communicable disease rather than a unique, stigmatized condition. Decentralization of diagnosis and treatment to primary health centers and peripheral clinics reduces perceptions of difference and facilitates community acceptance of leprosy services alongside other health programs.[5][15][1][16]

**Community participation and empowerment** of affected persons and recovered patients in program planning and service delivery builds social acceptability. Self-help groups of leprosy-affected individuals provide peer support, reduce perceived stigma, and advocate for inclusive community participation. Involving community leaders, schoolteachers, and local organizations in stigma reduction initiatives enhances behavioral change and social mobilization.[22][24][9]

**Legal and human rights frameworks** establishing protection against employment discrimination, ensuring educational access, and safeguarding inheritance and marriage rights constitute structural approaches to stigma reduction. Advocacy for legislative reforms addressing stigmatizing language and discriminatory practices complements behavioral interventions.[24][9][6]

## 10. Health System Integration and Program Management

Integration of leprosy control into general health systems represents a defining feature of contemporary leprosy programs, particularly following India's transition from vertical to integrated services in 2003. Integration improves program sustainability, enhances service accessibility, and normalizes leprosy within broader health frameworks.[15][1][5][4]

**Decentralization of services** to primary health centers and outpatient departments enables community-proximate diagnosis and treatment, reducing geographic barriers and treatment-seeking delays. General health workers require training in leprosy diagnosis, treatment protocols, adverse effect monitoring, and disability management through competency-based modules and periodic refresher training.[16][15][4]

**Surveillance and monitoring systems** track program performance through standardized indicators: new case detection rate, treatment completion rate, disability prevention indicators, and contacts receiving prophylaxis. The digital platform NIKUSTH in India enables real-time surveillance, data quality assurance, and performance monitoring at district and state levels, supporting evidence-based decision-making.[13][15][4]

**Coordination among stakeholders**—ministries of health, nongovernmental organizations, academic institutions, and affected person networks—ensures comprehensive, coherent implementation. Regular review meetings, capacity building workshops, and operational research inform program refinement and scale-up of effective strategies.[1][5][6]

**Resource allocation and financing** for leprosy programs require sustained political commitment and budgetary allocation. Cost-effective decentralized service models, community-based rehabilitation programs, and leveraging digital technologies optimize resource utilization while maintaining quality.[21][22][6][1]

## 11. Emerging Strategies and Future Directions

Contemporary leprosy control increasingly incorporates emerging evidence, innovative technologies, and refined strategic approaches to accelerate progress toward elimination.

**Targeted prevention strategies** focus on high-risk populations—tribal communities, persons with disabilities, and economically disadvantaged groups—through location-specific campaigns and tailored health education. Genomic studies identifying genetic susceptibility markers may enable future targeted interventions.[13][14][6][10][1]

**Diagnostic innovations** including rapid molecular assays, enhanced slit-skin smear microscopy, and biomarkers for disease activity and treatment response aim to improve diagnostic accuracy and early detection, particularly in challenging cases. Electronic health

records and point-of-care diagnostics facilitate decentralized diagnosis in resource-limited settings.[6][10][13][15]

**Drug-resistant leprosy surveillance** through sentinel surveillance networks monitors MDT resistance trends, enabling early detection and management of resistant cases through modified regimens. Moxifloxacin-based alternative regimens provide backup for cases with rifampicin resistance.[10][6]

**Research priorities** identified in the WHO Global Leprosy Strategy include development of improved vaccines offering enhanced protection, host factor studies elucidating genetic determinants of susceptibility, and implementation research optimizing delivery of existing interventions within diverse health systems and cultural contexts.[25][1][6]

| Strategy Pillar | Key Innovations & Future Directions |
|---|---|
| **Precision Prevention** | Targeting **tribal and high-risk populations**; using **genomic studies** to identify genetic susceptibility markers for future tailored interventions. |
| **Advanced Diagnostics** | Transitioning to **rapid molecular assays**, AI-enhanced microscopy, and **Point-of-Care (POC)** diagnostics for decentralized, resource-limited settings. |
| **Drug-Resistance (AMR)** | Establishing **sentinel surveillance networks** for early detection of MDT resistance; utilizing **Moxifloxacin-based** alternative regimens for rifampicin-resistant cases. |
| **Digital Integration** | Scaling up **Electronic Health Records (EHR)** and platforms like NIKUSTH 2.0 to facilitate real-time performance monitoring and data-driven decisions. |
| **WHO Research Priorities** | Development of **enhanced vaccines**, host-factor studies on susceptibility, and **implementation research** to optimize how care is delivered across cultural contexts. |

## 12. CONCLUSION

Leprosy control requires comprehensive, integrated strategies extending beyond individual treatment to encompass community-level interventions addressing transmission, disability, and stigma. The WHO Global Leprosy Strategy 2021–2030 provides a unifying framework

emphasizing four pillars: integrated country-owned roadmaps, scaled-up prevention with active case detection, disability management, and stigma reduction. Evidence from national programs, particularly India's NLEP experience, demonstrates that combining early case detection, complete MDT treatment, systematic contact screening with prophylaxis, and disability prevention achieves substantial reductions in disease incidence and prevalence.[2][19][15][1][4][6]

Success in leprosy control rests on sustained political commitment, adequate resource allocation, continuous health worker training, and community engagement. Integration of leprosy services into general health systems enhances accessibility while normalizing the disease within broader health frameworks. Digital surveillance platforms enable real-time monitoring and data-driven program management.[5][13][15][1]

Addressing persistent challenges requires targeted interventions for marginalized populations experiencing disproportionate disease burden due to geographic remoteness, socioeconomic disadvantage, and limited healthcare access. Community mobilization through affected person networks, empowerment of recovered patients, and involvement of community leaders facilitate social change and stigma reduction essential for sustained program effectiveness.[9][14][22][13]

The pathway to leprosy elimination is achievable through unwavering commitment to comprehensive control strategies, evidence-based programming, and inclusive approaches respecting the rights and dignity of affected persons. Continued investment in research, particularly regarding vaccines and host immunogenetics, promises future breakthroughs. As global attention to neglected tropical diseases strengthens and endemic countries align their roadmaps with WHO strategies, leprosy elimination—the vision of zero infection, disease, disability, and stigma—approaches from aspiration toward reality.[25][1][6]

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