

## Impact of Migration on Epidemiology and Control of Leprosy

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Received : 18.09.2018

Accepted : 15.03.2019

Migration has been a major influencing factor facilitating movement of disease between endemic and non-endemic areas. Both internal migration and global immigration contributes to spread to disease to non-endemic areas. This review discusses the findings of studies carried out all over the world regarding the role of migration in leprosy. It focuses on factors contributing to migration within the country, effect of migration on leprosy control programme, migration related factors adding to stigma and leading to administrative problems in leprosy control programmes. Migration of leprosy patients affects the opportunities to seek timely treatment at other places due lack of leprosy treatment facilities or awareness among the users. This review analyses the published studies available in PubMed and news articles related to migration in Leprosy. Out of total 2506 search results, only 18 were found to be relevant. In these studies migration has been identified as one of the important obstacles in achieving elimination of leprosy as the affected individuals may continue to spread the disease and themselves may suffer from disabilities with social consequences. The review also finds paucity of scientific studies carried out to study the role of migration in leprosy at present. There is clear need to focus on in depth studies on this aspect in the contemporary scenario for achieving the goal of world without leprosy.

**Keywords :** Migration, Leprosy Control, Eradication, Stigma

### Introduction

Leprosy still remains a neglected tropical disease with its major burden concentrated in India, Indonesia and Brazil. Government of India has been working in this direction since many years and had launched the National Leprosy Control Programme for the same in 1955. This program was re-designed as the National Leprosy Eradication Program (NLEP) in 1983 with the introduction of multidrug therapy (MDT). It has

achieved major success in reducing the overall prevalence of the disease to below 1/10,000 in 2005 (Dhillon 2007, Jacobs & Faranco-Parades 2008). After that, the situation has been static with very little change in prevalence as well as annual new case detection rate (ANCDR) 2006 onwards. Because of this stagnation, there is a need for analysis of all the possible factors that influence the prevalence and epidemiology of this disease including migration.

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That brings us to the next question of 'who exactly is a migrant'. Is migrant a person coming from another place and staying in the place of registration/ detection for less than 15 years. What exactly is migration/ immigration/ emigration ?

- o Migration could be within one's state/ region, within country or inter-country.
- o Immigration is when people come into a region other than ones native land.
- o Emigration is when they migrate away from their native land to settle in another.

Not only for leprosy, but migration has been a major influencing factor for many of the tropical diseases that have not received enough attention over the years. As obvious as it might seem, migrants coming from endemic to non-endemic areas, bring new diseases in the pool. (Ramos et al 2016) Although it might be challenging to reach the WHO standards, as health care individuals, it becomes our solemn responsibility to understand many factors associated with migration, including many local factors, internal migration being one of the common and important factors. Movement of affected people across national and international borders continues to add new perspectives and angles to the complete picture of leprosy, baffling healthcare professionals worldwide (Singh et al 2019). Although it is a known fact that the incidence of leprosy is decreasing, with the advent of globalization, the world is becoming a connected place hence increasing the movement of individuals throughout the globe (Aagard-Hansen et al 2010). According to United Nations estimates, there were approximately 214 million international migrants (those living in a country different from that in which they were born) in 2009. This number is "greater than at any time in history" (Ki-Moon 2009).

In India, a relative paucity of trained dermatologists in rural as well as remote areas leads to rushing of leprosy-affected patients to metropolitan cities for treatment. However, the poor socioeconomic status, and limited job opportunities along with the difficulty to sustain a living over the prolonged course of treatment forces many of these patients to return back to their native places with incomplete treatment. This leads to high defaulter rates and possibility of drug resistance (Singal & Sonthalia 2013). In addition, the open borders between countries like Nepal and India allow free migration of people across borders including leprosy-affected people. This impedes early case detection and treatment of leprosy patients. (Singh et al 2019). Over 45.58 crore Indians were found to be "migrants" for various reasons during the enumeration exercises of Census 2011. The previous Census (2001) had recorded the number of migrants at 31.45 crore - more than 30% lower than the 2011 figure. (Govt of India, Census of India 2011) This increase in migrant population is primarily from Bihar, Odisha, Uttar Pradesh, Chattisgarh, which are highly endemic states for leprosy to Maharashtra, Gujarat & New Delhi contributing to complex scenario of Urban Leprosy. Because of this analyses of effects of migration on health care delivery and its implication in health program becomes even more important.

### **Materials and Methods**

Considering the primary objective of this review was to examine impact of migration on various aspects of leprosy (Leprosy spread, management and control), search strategy of online search was made using MESH terms, "leprosy" [MeSH Terms] OR "leprosy" [All Fields] AND "migration" [All Fields] in the PubMed Central (PMC). Of the

Table 1 : Important findings from studies on impact of migration on leprosy

Study title	Type of study	Remarks : Impact of migration
Patterns of Migration and Risks Associated with Leprosy among Migrants in Maranhão, Brazil. (Murto et al 2013)	This case control study compared individuals newly diagnosed with leprosy in 2009-2010 (n=340) and a clinically unapparent control group in same time period (n=340) without any clinical signs of leprosy and were matched for age, sex and location in the four endemic municipalities in the state of Maranhão, north-eastern Brazil.	Migration is thought to be one of the factors associated with continued leprosy transmission, as seen with other Neglected Tropical Diseases (NTDs). Past five-year migration was significantly associated with leprosy, and remained significant after controlling for household and familial contact as potential confounders. Factors found to be associated with leprosy among past 5-year migrants included alcohol consumption, poverty, and household, family and other leprosy contact. Key patterns of movement emerged from the study that may aid future regional leprosy control efforts.
Imported Infectious Diseases in Mobile Populations, Spain (Monge-Maillo et al 2009)	This retrospective, Cohort study was carried out at The Tropical Medicine Unit (TMU) which is a referral center at the Infectious Diseases Department of the Ramón y Cajal Hospital in Madrid, Spain. In parallel with clinical work, data was collected regarding the Latin American and sub-Saharan African immigrants seeking health care at TMU from April 1989 through June 2008 for this epidemiologic and clinical study.	Of total 2,198 immigrants referred to the Tropical Medicine Unit of Ramón y Cajal Hospital over a 20-year period, 8 (0.4) had Leprosy. Increased population mobility has led to the disappearance of existing barriers for the spread of certain diseases.
Travel and migration associated infectious diseases morbidity in Europe, 2008 (Field et al 2008)	Analysis of diagnoses of 6957 ill returned travelers presenting with a presumed travel associated disease in 2008 to EuroTravNet centres was done to investigate the morbidity of travel associated infectious diseases in European travelers. Only one case of leprosy was seen.	Intense international travel within and outside Europe, along with significant intra-European migration, results in greater vulnerability to the transmission of old, new and re-emerging infectious diseases, with travelers as a key element in disease dissemination.

<p>WHO Multidrug Therapy for Leprosy: Epidemiology of Default in Treatment in Agra District, Uttar Pradesh, India (Kumar et al 2015)</p>	<p>Analysis of the data collected in active surveys in Agra was done. Patients were given treatment after medical confirmation and were followed up. The treatment default and other clinical outcomes were recorded. Of the total 94 defaulters, 13 were, 9 with MB leprosy and 4 with PB leprosy.</p>	<p>Migration was the most common cause of defaulting treatment in both MB and PB leprosy cases (9.6% and 15.5% respectively) The group of 'lost to treatment' was due to either migration to the other areas or job related non availability.</p>
<p>Neglected Tropical Diseases outside the Tropics (Norman et al 2010)</p>	<p>There were 6168 patients (2634 immigrants, 3277 travelers and 257 visiting friends and relatives (VFR travelers) in this cohort study conducted in Spain. Neglected tropical diseases (NTD) occurred more frequently in immigrants, followed by VFR travelers and then by other travelers (p,0.001 for trend).</p>	<p>Out of the total 10 cases of leprosy detected, 9 are immigrants and 1 was traveler. Immigrants are potential source of disease in non-endemic region for leprosy.</p>
<p>Evaluation of the economic burden of leprosy among migrant and resident patients in Guangdong Province, China (Xiong et al 2017)</p>	<p>These authors conducted a population-based cross-sectional survey from February to July, 2016 based on a self-designed Questionnaire to evaluate the economic burden of leprosy on patients. A total of 254 participants completed the questionnaires (168 males and 86 females). Migrants and residents accounted for 33.9% and 66.1% of patients, respectively. Among migrant patients, the median cost before diagnosis was \$131.6 (39.2-450.9), the median yearly cost of leprosy treatment after diagnosis was \$300.6 (158.4-868.5), and the median yearly cost of leprosy complications was \$69.5 (11-178.4). In comparison, among residents the median yearly costs were \$152.4 (30.7-770.9) pre-diagnosis, \$309.7 (103.2-1016.7) after diagnosis, and \$91.9 (32.6-303.1) for leprosy complications. Based on this, the authors determined that the median yearly total expense after diagnosis comprised a larger share in annual income of residents (38%) as compared to the migrants (15%).</p>	<p>Leprosy places a heavy economic burden on both migrant and resident leprosy patients and governmental policies. Programs could substantially alleviate this burden. The needs of migrant and resident leprosy patients may vary and hence require different approaches. The majority of migrant patients have long working long hours in unprotected environments which may accelerate the progression of disease in terms of new lesions, peripheral nerve damage as well as disabilities adding to their economic burden.</p>

Human migration, railways and the geographic distribution of leprosy in Rio Grande do Norte State - Brazil (Nobre et al 2015)	A review based on analysis of a database of registered leprosy cases in Rio Grande do Norte state, which compared leprosy's geographic distribution among municipalities with local socio-economic and public health indicators and with historical documents about human migration in this Brazilian region.	Living and work conditions for migrants to the North region in Brazil were very difficult forcing many of them to return to their states of origin, even many years after relocation. These bidirectional migratory movements should be considered as a factor in the introduction and dissemination of leprosy in the Northeast region of Brazil.
Epidemiology of Leprosy in Spain: The Role of the International Migration (Ramos et al 2016)	Observational, retrospective study on incident leprosy cases reported through the National System of Compulsory Disease Notification, or SCDN (in Spanish, the Sistema de Enfermedades de Declaración Obligatoria) from 2003 to 2013. Of the 168 leprosy cases registered during the study period, 40 (24.6%) were in Spanish patients, while 128 (76.2%) were detected in legally resident immigrants.	The increased migration of people from leprosy endemic areas into Europe, Northern America, Japan and Australia undoubtedly has an impact on the incidence of leprosy in these countries where leprosy has been considered to be eradicated or controlled for decades.
Interruption and Defaulting of Multidrug Therapy against Leprosy: Population-Based Study in Brazil's Savannah Region (Heukelbach et al 2011)	This population-based cross section study in 78 municipalities in Tocantins State, central Brazil applied structured questionnaires on leprosy-affected individuals. Of the target population of 1635 individuals from 78 municipalities, 936 (57.2%) from 74 municipalities were included in data analysis. One municipality did not diagnose a single case of leprosy in the study period, while in other three municipalities though there had been few cases of leprosy, no participants were included due to non-consent.	Study shows that defaulting and interruption of MDT against leprosy are associated with some poverty-related variables such as family income, household size, and migration.
Transmission of leprosy in Qiubei county, Yunnan, China: insights from an eight year molecular Epidemiology investigation (Weng et al 2011)	Total case ascertainment in Qiubei County was 189 cases from 2002 to 2010, out of which 164 cases were enrolled in the study. In a few families there was history of recent migration of patients or family members from Guanganan and Luxi counties.	Traditional relocation of women to the spouse's family after marriage may promote the dispersal of <i>M. leprae</i> genotypes because of migration.

<p>Genome-Wide Analysis in Brazilians Reveals Highly Differentiated Native American Genome Regions (Mychaleckyj et al 2017)</p>	<p>Six cohort's studies conducted on DNA samples from populations in North-Eastern Brazil and centered on Fortaleza, Ceara state were reviewed.</p>	<p>On analysis of candidate gene and comparing it with other analyses, genomic differentiation was seen which may arise due to migration from Asia to America.</p>
<p>Factors Associated with Migration in Individuals Affected by Leprosy, Maranhão, Brazil: An Exploratory Cross-Sectional Study (Murto et al 2013)</p>	<p>This Population-based cross-sectional Study included 394 newly diagnosed leprosy cases and 391 individuals from a clinically unapparent population.</p>	<p>Among environmental, socioeconomic, and cultural risks, migration is suggested to be a determinant for NTDs. Migration interacts with these factors when fundamental social inequalities determine the necessity to migrate. This can place migrants at heightened risk for disease while extending disease distribution into new areas.</p>
<p>The burden of Neglected Tropical Diseases in Brazil, 1990-2016: A subnational analysis from the Global Burden of Disease Study 2016 (Martins-Melo et al 2016)</p>	<p>This analytic study is based on secondary databases which are publicly available, without identification of individual data. This included data from GBD 2016 to assess years of life lost (YLLs), years lived with disability (YLDs), and disability-adjusted life-years (DALYs) for NTDs by sex, age group, causes, and Brazilian states, from 1990 to 2016. All NTDs that were a part of the priority list of the World Health Organization (WHO) in 2016 were included.</p>	<p>Internal migration, tourism activities, and poor sanitary conditions still favour the persistence and expansion of disease foci.</p>
<p>Leprosy in Toronto: an analysis of 184 imported cases (Boggild et al 2004).</p>	<p>A review of the clinical records of 184 leprosy patients referred to the Tropical Disease Unit at Toronto General Hospital.</p>	<p>Immigration from endemic areas has resulted in the importation of leprosy into countries.</p>
<p>Unsolved matters in leprosy: a descriptive review and call for further research (Franco-Paredes &amp; Rodriguez - Morales 2016)</p>	<p>A descriptive review was done for better understanding of epidemiology of leprosy, mode and route of transmission, role of various socioeconomic environmental and behavioural factors affecting its transmission and strategies for achieving early diagnosis and preventing disability.</p>	<p>Human migration has been crucial in the global spread of leprosy. It is feasible that shedding of <i>M. leprae</i> from nasal discharges or cutaneous lesions of populations migrating into previously leprosy free biotopes may have caused a spill over of the bacteria into environmental niches with optimal biotic and abiotic factors. This may have subsequently amplified the cycle of transmission of leprosy.</p>

<p>Early Human Migrations (ca. 13,000 Years Ago) or Post-contact Europeans for the Earliest Spread of <i>Mycobacterium leprae</i> and <i>Mycobacterium lepromatosis</i> to the Americas (Mark 2017)</p>	<p>A review article of different historical, paleopathological, representational and molecular studies support the fact that leprosy did not exist in America before the arrival of migrants from Europe and Philippines.</p>	<p>From the Indian Ocean region, humans carried both species of leprosy to the Caribbean Islands and Brazil through Europe and port of Manila. This signifies role of migration in early spread of leprosy.</p>
<p>The Potential Use of Natural and Structural Analogs of Antimicrobial Peptides in the Fight against Neglected Tropical Diseases (Lewies et al 2015)</p>	<p>Review article to evaluate successful treatment of neglected tropical diseases with selected antimicrobial peptides.</p>	<p>Comparative genomic studies have deduced that leprosy spread from Africa to India, Europe and the Americas, through colonisation, migration and slave trade. There are four distinct and regionally specific <i>M. leprae</i> strains found globally. Strain 1 is mainly found in Asia, East Africa and the Pacific; strain 2 is only found in regions of Malawi, Ethiopia, Nepal and New Caledonia; strain 3 in America, Europe and North Africa; and strain 4 is predominant in the Caribbean and West Africa.</p>
<p>Social Research on Neglected Diseases of Poverty: Continuing and Emerging Themes (Manderson et al 2009)</p>	<p>A review based on expert consultation hosted by Special Programme for Research and Training in Tropical Diseases (TDR) at the World Health Organization (WHO) on April 23-24, 2007 for establishing the ongoing and emerging challenges in neglected tropical diseases (NTDs).</p>	<p>Social research has drawn attention to the difficulties in ensuring effective and sustained interventions for NTDs in both urban and rural communities, and in environments that have been disrupted by war, resettlement, and migration.</p>

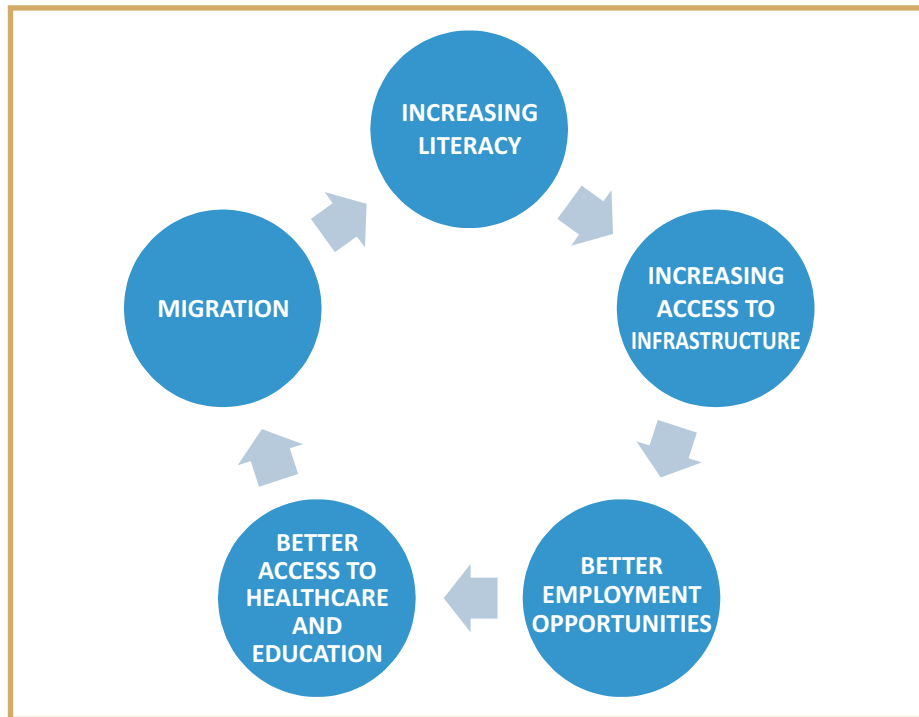


Fig 1 : Factors linked with Migration (Cavalcanti Magalhaes et al 2007)

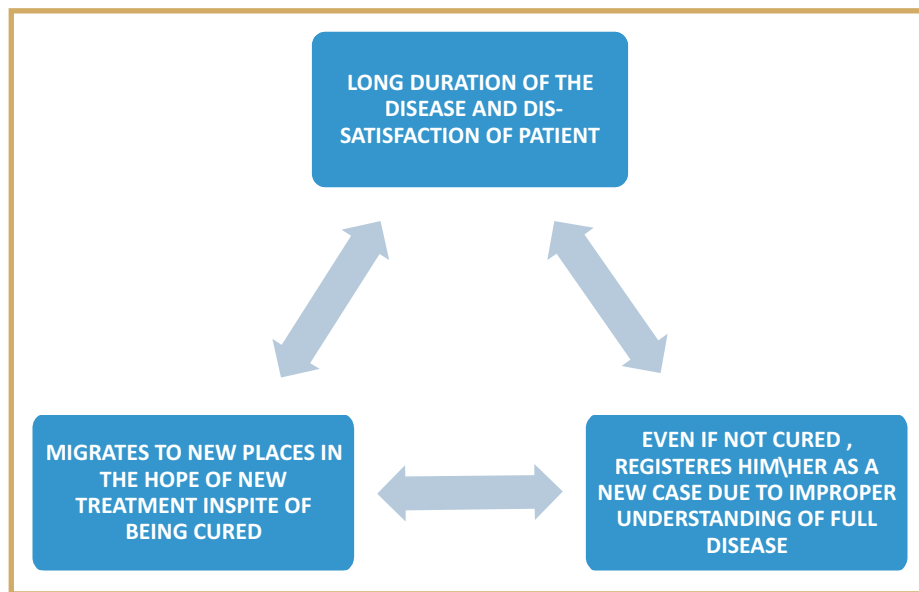


Fig 2 : Chain of Migration due to dissatisfaction of leprosy patients with treatment (Cavalcanti Magalhaes et al 2007)



resultant 2506 studies (from 1970 to 2018), abstracts as well as available full text of the articles were accessed and reviewed for the methodology of the study. Eighteen studies, which had studied or shown the impact of migration, were selected for the review process. These included one Meta-analysis, (Socio-economic risk factors), 9 cohort studies; 1 Case-control study 1 Case series & Case reports & 7 review articles. The remaining 2488 studies were excluded.

Following important studies assessing impact of migration on leprosy were evaluated. Important findings are summarized in Table 1.

### Discussion

The data analysed from these selected studies available in PubMed shows that internal migration is common in many countries across globe. This may influence timely management of cases leading to continued leprosy transmission, thus hampering control efforts. Migration facilitates movement of disease between endemic and non-endemic areas, and has been considered a possible factor in continued leprosy incidence. The movement of people across international borders adds new dimensions to the experience of leprosy, as affected individuals confront different sets of understandings of the disease among healthcare professionals, friends, family, and employers in host and sending countries. Preconceptions of the immigrant 'other' in host countries may be bound up with notions of disease and danger, further complicating the experience of leprosy treatment for immigrants. Even as leprosy incidence worldwide slowly decreases, the movement of people around the globe is accelerating. According to United Nations estimates, there were approximately 214 million international migrants (those living in a country different from that in which they were born) in 2009. This number is "greater than at any time in

history." (Ki-Moon 2009) Migration among persons affected by leprosy was reported as early as 1929 (Bhaskara Rao 1930). Leprosy history around 600 BC indicates that colonialism and the slave trade helped bring the sickness to West Africa and much of the New World. There were 4 different types of strains associated with leprosy. Most central Asian strains were of type 1 variety, whereas type 2 predominated in Ethiopia, type 3 in Europe, North Africa and the Americas and type 4 in West Africa and the Caribbean. The mutation patterns among the strains suggest that leprosy originated in either central Asia or East Africa (Grimm 2005).

Leprosy should not be considered as a problem of developing countries only, but should be considered as a global issue. Migration has been found to be an impediment to both leprosy elimination and control efforts. It can increase the risk of disease transmission and susceptibility, as non-immune migrants move into areas of leprosy endemicity, and infected migrants may return to non-endemic areas through circular migration or permanent movement as depicted in Fig. 1 (Cavalcanti Magalhaes et al 2007). In past, it has also lead to creation of leprosy colonies, particularly in urban areas. The 'push factors' such as stigma; refusal of employment, turning away from the family existed about 50 years ago that necessitated a need for a sanatorium at various places. Endemic areas of the disease continue to persist despite large-scale national efforts to control the disease. A challenge in disease control efforts is compounded as leprosy can be diagnosed many years after infection took place due to the long incubation period, and mild early symptoms of the disease may be overlooked. Migration has been found to be a social determinant of disease, and has been hypothesized as a risk factor in continued leprosy incidence (Penna et al 2009).

**Influencing factors** : Reasons for migration are manifold: employment opportunities and access to better infrastructure, such as healthcare and education, can attract migrants from other areas (Rayp & Ruysen 2010); this is especially reflected in rural to urban population movement. This increase in population leads to congestion and many times these migrants tend to stay in overcrowded slums with poor hygiene, thus providing favourable environment for transmission of leprosy. People who move to new places can either stay there permanently or on temporary basis, thus forming an unstable pool. There can be intra or inter slum migration also, as a result of changing job opportunities on daily basis. Fall in economic growth can further lead to people moving out to newer places and form an important link between primary case and new unexposed individuals. Other factors influencing migration include unforeseen catastrophes like violence, fire, earthquake, floods or any other natural calamity.

**Effects of migration on leprosy control** : As an infectious disease caused by *Mycobacterium leprae*, leprosy primarily considered to affect the skin and peripheral nerves and causing sensory loss. While nasal mucosa is considered the main transmission site, new research indicates that oral presence of *M. leprae* bacilli may be an additional mode of transmission (Martinez et al 2011). The proliferation of leprosy bacteria occurs in low socio economic conditions of poverty like poor sanitation, overcrowded substandard housing and illiteracy. Rapid population growth and uncontrolled urbanization, often as a consequence of migration for employment and differential access to services between rural and urban areas, has facilitated the expansion of the poor social and environmental conditions on the peripheries of cities associated with leprosy infection. Additionally, new road construction

and railways have enabled movement between rural communities and urban areas. Leprosy continues to be an endemic disease in many parts of the world. International migration also poses a problem in leprosy scenario worldwide. The movement of people across international borders adds new dimensions to the experience of leprosy. Although the movement of people affected by leprosy is certainly not a new phenomenon, in analysing and addressing 'leprosy stigma', it is important to be aware that prevailing attitudes about immigrants, differential knowledge about leprosy in host and sending countries, and transnational practices, among many other factors, influence how this stigma manifests. Dis-satisfaction with the response to treatment also becomes a factor responsible for migration of patient to new location. (Fig. 2)

**Factors influencing migration** : Factors thought to be responsible for migration of people are known and depicted in Fig. 1. All these factors combined, lead to an increase in population, congestion, and increasing residency in overcrowded places and slums, hence increasing the predisposition to all diseases including leprosy. Increasing literacy leads to more and more open doors for better opportunity and access to the newer facilities hence increasing the movement of people from the rural to urban areas thus creating increased risk of transmission of the disease (Cavalcanti Magalhaes et al 2007). Besides increasing opportunities and vocational reasons, other factors such as natural calamities like volcanoes, earthquakes also play a role in affecting the migration.

**Effect of migration on leprosy control programme** : Conditions like low socio economic standards, poverty, over crowdedness, illiteracy, all make a conducive environment for the lepra bacilli to proliferate. Easy connectivity to urban

areas, new infrastructure and new roads, facilitate the migration thus making it a facilitatory factor for spread of the disease. Due to long incubation period of leprosy, sometimes the disease may manifest many years after the person has left the endemic area. This increases the infectious pool, leading to longer exposure of susceptible individuals and hence, migration increases the burden on health care system. There is also additional work for the staff for surveillance and delaying elimination of leprosy. Some of the indicators, which are affected due to migration are increased detection, low completion rate leading to high prevalence rate, which affects requirement of multi drug therapy and other logistics under National Leprosy Eradication programme. Other problems put forward by leprosy-afflicted migrants include :

1. Re-registration : It is registration of a case, as new, for the reason who has already been treated elsewhere and declared cured. Patients who have completed their treatment and declared cured in one centre may migrate and get themselves registered again as new case in other area. The reason is patients are not satisfied with the services provided to them and migrate in search of better treatment.
2. Duplication of registration : It means a person is registered at one dispensary and is under treatment; he migrates to another city and gets registered as a new case there also. In spite of relentless efforts by the government, doctors and paramedics, complete elimination remains a dream for all of us. The hurdles can be due to three main reasons :
  1. Problems related to people : flow of population, puts both the migrants, as well as non migrants at risk.
  2. Problems related to the disease : long latency period and few symptoms on presentation which often can lead to misdiagnosis.
  3. Problems in infrastructure : unavailability of proper medication and health care services at site of diagnosis.

#### **Migration, Stigma and human rights in leprosy :**

Migration remains a serious concern for most of the developed nations where people from developing world try to settle legally, illegally, as asylum seekers, with a job or just like as infrastructure, health care delivery and other services are concerned. Many countries have leprosy as a ground for refusal of visas and for inadmissibility of migrants. Countries having such discriminatory rulings include Barbados, Hungary, Iraq, Namibia, the United Arab Emirates, United Kingdom and United States of America. Immigrants because of language, culture, racism or ethnicity are itself not welcome in new areas and if they suffer from leprosy, it is a further cause of stigma and discrimination (Martelli et al 1995).

#### **Anti-immigration sentiment, racism, and ethnocentrism :**

Negative stereotypes that exist in the host society about people of particular nationalities or ethnic identities may negatively influence migrants' experiences with disease treatment in that country. Generalised anti-immigration sentiment during a particular historical era may also influence perceptions of immigrants affected by infectious disease. The circumstances of immigration and the combination of social, cultural, and linguistic barriers between health-care workers and patients can generate increased difficulties in diagnosis and general communication about illness and treatment. International migration creates circumstances so that stigmatizing beliefs about leprosy are compounded by anti-immigrant sentiment, social and cultural differences in the host country and language barrier, which can create difficulties in communication about diagnosis and treatment. Disease presence is used as a tool for racist or xenophobic attitudes. Disease in immigrants is used to bring back memories of policies of isolation. Politically motivated attempts have been frequently made to portray immigrants with leprosy as a threat to

nation's safety. Individuals with leprosy due to social customs and stigma might be separated from family and community and some of them in the past left the community entirely as migrants or otherwise. All these factors and association of leprosy with immigrants is particularly an effective means of generating anti-immigrant sentiment. This is a clear disincentive to patient to disclose or even present with early symptoms. The impact of IEC (information, education and communication) programme in all endemic countries including India is gradually reducing the stigma related to leprosy, so also migration and other related factors including colonization. (White 2011, Sermrittirong & Van 2014)

**Effect of Global Migration :** One of the biggest misconceptions regarding leprosy in today's times is that leprosy is a condition affecting only developing countries. It is, to many people's surprise, very much a global issue. Migration being one of the biggest hurdles for the elimination of leprosy was noted as early as 1929 (Bhaskara Rao 1930). As research has it, there are various strains responsible for the transmission of the disease specifically four different types. Most central Asian strains were of type 1 variety, whereas type 2 predominated in Ethiopia, type 3 in Europe, North Africa and the Americas and type 4 in West Africa and the Caribbean (Kerr-Pontes et al 2004). The mutation patterns among the strains suggest that leprosy originated in either central Asia or East Africa.

### Conclusion

Population movement can put both migrants and non-migrants at risk when diseases move between endemic and non-endemic areas. Latent nature of leprosy and clinically non-symptomatic presentation could facilitate the distribution of disease when no symptoms are present, or when mild symptoms are overlooked. When

these infected migrants reach non-endemic areas where there is less access to treatment, further creates a challenge in case detection and management. Elimination of leprosy thus seems a faraway dream because of the multitude of contributing factors, of which migration forms an important link.

### References

1. Aagaard-Hansen J, Nombela N, Alvar J (2010). Population movement: a key factor in the epidemiology of neglected tropical diseases. *Trop Med Int Health*. **15**: 1281-1288.
2. Bhaskara Rao P (1930). Working of the skin clinics RM Headquarters Hospital, Tanjore, for the year 1929. *Lepr India*. **2**: 76-78.
3. Boggild AK, Correia JD, Keystone JS et al (2004). Leprosy in Toronto: an analysis of 184 imported cases. *CMAJ*. **170**: 55-9.
4. Cavalcanti Magalhaes MC, Santos ES, de Queiroz MDL et al (2007). Spatial differentiation of leprosy in Brazil. *Epidemiol e Serviços de Saúde*. **16**: 75-84.
5. Dhillon GPS (2007). NLEP - Current situation and strategy during the 11th plan period (2007-2012). *J Indian Med Assoc*. **104**: 671-672.
6. Field V, Gautret P, Schlagenhauf P et al (2010). Travel and migration associated infectious diseases morbidity in Europe. *BMC Infect Di*. **10**: 330.
7. Franco-Paredes C, Rodriguez-Morales AJ (2016). Unsolved matters in leprosy: a descriptive review and call for further research. *Ann Clinl Microbiol Antimicrob*. **15**: 33.
8. Govt of India (2011), Census of India 2011.
9. Grimm D (2005). Microbiology, Global spread of leprosy tied to human migration, *Science*. **308** (5724): 936-7.
10. Heukelbach J, Chichava OA, de Oliveira AR et al (2011). Interruption and defaulting of multidrug therapy against leprosy: population-based study in Brazil's Savannah Region. *PLoS Negl Trop Dis*. **5**: e1031.
11. Jacob JT, Franco-Paredes C (2008). Stigmatization of Leprosy in India and Its Impact on Future

- Approaches to Elimination and Control. *PLoS Negl Trop Dis.* **2**: e113.
12. Kerr-Pontes LR, Montenegro AC, Barreto ML et al (2004). Inequality and leprosy in Northeast Brazil: an ecological study. *Internat J Epidemiol.* **33**: 262-9.
  13. Ki-Moon B (2009). Opening address of HE Mr. Ban Ki-Moon, Secretary General of the United Nation sat the third global forum o migration and development. Athens-4 November 2009.
  14. Kumar A, Girdhar A, Chakma JK et al (2015). WHO multidrug therapy for leprosy: epidemiology of default in treatment in Agra district, Uttar Pradesh, India. *BioMed Res Int*: 2015, <http://dx.doi.org/10.1155/2015/705804>.
  15. Lewies A, Wentzel J, Jacobs G et al (2015). The potential use of natural and structural analogues of antimicrobial peptides in the fight against neglected tropical diseases. *Molecules.* **20**: 15392-433.
  16. Manderson L, Aagaard-Hansen J, Allotey P et al (2009). Social research on neglected diseases of poverty: continuing and emerging themes. *PLoS Negl Trop Dis.* **3**: e332.
  17. Mark S (2017). Early Human Migrations (ca. 13,000 Years Ago) or Postcontact Europeans for the Earliest Spread of *Mycobacterium leprae* and *Mycobacterium lepromatosis* to the Americas. *Interdiscipl Perspect Infect Dis.* vol. 2017. <http://doi.org/10.1155/2017/6491606>.
  18. Martelli CM, Neto OM, Andrade AL et al (1995). Spatial patterns of leprosy in an urban area of central Brazil. *Bull World Health Org.* **73**: 315.
  19. Martinez TS, Figueira MM, Costa AV et al (2011). Oral mucosa as a source of *Mycobacterium leprae* infection and transmission, and implications of bacterial DNA detection and the immunological status. *Clin Microbiol Infect. Dis.* **17**: 1653-8.
  20. Martins-Melo FR, Carneiro, M, Ramos Jr, AN et al (2018). The burden of neglected tropical diseases in Brazil, 1990-2016: a subnational analysis from the Global Burden of Disease Study 2016. *PLoS Negl Trop Dis.* **12**: e0006559.
  21. Monge-Maillo B, Jiménez BC, Pérez-Molina JA et al (2009). Imported infectious diseases in mobile populations, Spain. *Emerg Infect Dis.* **15**: 1745-52.
  22. Murto C, Chammartin F, Schwarz K et al (2013). Patterns of Migration and Risks Associated with Leprosy among Migrants in Maranhão, Brazil. *PLoS Negl Trop Dis.* **7**: e2422.
  23. Murto CH, Kaplan CH, Ariza LI et al (2013). Factors associated with migration in individuals affected by leprosy, Maranhão, Brazil: an exploratory cross-sectional study. *J Trop. Med.* Vol 2013, <http://dx.doi.org/10.1144/2013/495076>.
  24. Mychaleckyj JC, Havt A, Nayak U et al (2017). Genome-wide analysis in Brazilians reveals highly differentiated Native American genome regions. *Molr Biol Evol.* **34**: 559-74.
  25. Nobre ML, Dupnik KM, Nobre PJ et al (2015). Human migration, railways and the geographic distribution of leprosy in Rio Grande do Norte State-Brazil. *Lepr Rev.* **86**: 335-44.
  26. Norman FF, Pe´rez de Ayala A, Pe´rez-Molina J-A et al (2010). Neglected Tropical Diseases outside the Tropics. *PLoS Negl Trop Dis.* **4**: e762.
  27. Penna ML, De Oliveira ML, Penna GO (2009). The epidemiological behavior of leprosy in Brazil. *Lepr Rev.* **80**: 332-44.
  28. Ramos JM, Romero D, Belinchon I (2016). Epidemiology of leprosy in Spain: the role of the international migration. *PLoS Neglected Trop Dis.* **10**: e0004321.
  29. Rayp G, Ruysen I (2010). Africa on the move: an extended gravity model of intraregional migration. In : *Migration, a world in motion: a multinational conference on migration and migration policy*. Maastricht: Association for Public Policy Analysis and Management, The Netherlands.
  30. Sermrittirong S, Van W (2014). How to reduce stigma in leprosy - a systematic literature review. *Lepr Rev.* **85**: 149-157.
  31. Singal A, Sonthalia S (2013). Leprosy in post-elimination era in India: Difficult journey ahead. *Indian J Dermatol.* **58**: 443-6.

32. Singh R, Singh B, Mahato S (2019). Community knowledge, attitude, and perceived stigma of leprosy amongst community members living in Dhanusha and Parsa districts of Southern Central Nepal. *PLoS Negl Trop Dis*. **13**: e0007075.
33. United Nations Development Program. Mobility and migration. A guidance note for human development report teams. New York: United Nations Development Program; 2010. [http://hdr.undp.org/sites/default/files/nhdr\\_migration\\_gn.pdf](http://hdr.undp.org/sites/default/files/nhdr_migration_gn.pdf).
34. Weng X, Vander Heiden J, Xing Y et al (2011). Transmission of leprosy in Qiubei County, Yunnan, China: insights from an 8-year molecular epidemiology investigation. *Infect Genet Evol*. **11**: 363-74.
35. White C (2011). Leprosy and stigma in the context of international migration. *Lepr Rev*. **82**: 147-154.
36. Xiong M, Li M, Zheng D et al (2017). Evaluation of the economic burden of leprosy among migrant and resident patients in Guangdong Province, China. *BMC Infect Dis*. **17** (1): 760.

**How to cite this article :** Rathod S, Jagati A and Agarwal P (2019). Impact of Migration on Epidemiology and Control of Leprosy. *Indian J Lepr*. **91**: 139-152.