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OVERVIEW OF LEPROSY, INCLUDING THE DIAGNOSIS AND CURRENT AVAILABLE TREATMENTS

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Abstract

The disease Hansen's is another name for leprosy. It is a communicable disease that can be treated and is still widespread in the majority of the world's nations. Mycobacterium leprae and Mycobacterium lepromatosis are the most common causes of this chronic granulomatous infection, which mostly affects the skin and peripheral nerves. Leprosy has long been known as "the death before death" because of the immense social stigma and rejection that victims have endured from their families, communities, and even medical professionals in addition to the physical effects of the condition. Armauer Hansen, who discovered Mycobacterium leprae, stated that "there is hardly anything on earth, or between it and heaven, that has not been regarded as the cause of leprosy." "And this is but natural since the less one knows, the more actively does his imagination work" MDT has been the main weapon in the fight against leprosy since its inception in 1981, and by 2005, India had a prevalence of less than 1/10000. In India's fight against leprosy, this was a huge victory. Affected individuals numbered 0.69/10000 by the end of 2010. The pathogenesis, aetiology, treatment, diagnosis, and risk factors for leprosy are covered in this review article.

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Introduction

The bacillus Mycobacterium leprae causes leprosy, commonly referred to as Hansen's disease, a persistent infectious condition. Due to M. leprae's preference for a colder temperature of around 37°C, leprosy mostly affects the skin and peripheral nerves [1]. The Greek word "lepros," which means scaly, is where the name "leprosy" originates. In honor of Gerhard Armauer Hansen, who discovered the bacteria Mycobacterium leprae as the cause of leprosy, the illness is known as Hansen's sickness. Despite numerous developments, the management of leprosy is still referred to as "living death" [2]. Leprosy lesions are uncommon in particular immunological zones, such as the scalp, eyelids, axillae, palms and soles, lumbosacral area, midline back, groins, and genitalia [3]. Leprosy has long been characterized as "the death before death" due to the extreme social shame and ostracism that sufferers have experienced in addition to the physical impacts of the illness from their families, communities, and even

medical professionals. "There is hardly anything on earth, or between it and heaven, that has not been regarded as the cause of leprosy," observed Armauer Hansen, who discovered Mycobacterium leprae. "And this is but natural since the less one knows, the more actively does his imagination work" [4]. The acute clinical inflammatory episodes known as leprosy reactions take place over the course of the disease's protracted course. Because they continue to produce morbidity from nerve damage even after treatment is over, they provide a difficult dilemma. Type I [reversal reaction; RR] and type II [erythema nodosum leprosum; ENL] reactions are the two categories under which they fall. In contrast to ENL, which exclusively manifests in BL and LL forms, type I reaction manifests in borderline patients [BT, mid borderline, and BL]. Reactions are seen as a change in the patient's immunologic condition. Predisposing circumstances for reactions have been found as chemotherapy, pregnancy, concomitant infections, and emotional and physical stress [5]. In lepromatous leprosy, nasal mucosal lesions produce between 10,000 and 10,000 000 bacilli. Most lepromatous individuals exhibit leprosy bacilli in their nasal secretions, which are gathered by blowing one's nose. Lepromatous patients' nasal secretions could produce up to 10 million live organisms each day [6]. It was determined that "Leprosy was incurable" at the First International Congress in Berlin in 1897. Leprosy is treatable, nevertheless, thanks to the discovery of M. leprae by Armauer Hansen and

the application of chaulmoogra oil. The entire situation was altered by the 1941 discovery of dapsone and the subsequent 1981 application of multi-drug therapy [MDT]. Despite the fact that there is still much to learn about the pathophysiology and spread of diseases, research into these topics has made significant strides. Leprosy has been nearly eradicated over the past 20 years thanks to the combined efforts of the World Health Organization [WHO], local governments, medical professionals, and non-governmental organizations [NGOs] [7]. As early as 2400 BCE, the disease most likely had its beginnings in Egypt and other Middle Eastern nations. Its global expansion was aided by an apparent lack of understanding about treatment. The first bacterium to be recognized as causing disease in humans was *Mycobacterium leprae*, which was discovered by G. H. Armauer Hansen in Norway in 1873. Leprosy is now less common than it was 20 years ago, with less than one case per 10,000 people in 90% of the endemic countries, thanks to the WHO's deployment of MDT. However, it is still a hazard for public health in nations like Tanzania, Madagascar, Brazil, Congo, Madagascar, and Mozambique[6]. Since its introduction in 1981, MDT has been the primary tool in the fight against leprosy, and by 2005, India had a prevalence of less than 1/10000. This was a significant accomplishment in India's struggle against leprosy. By the end of 2010, 0.69/10000 people were affected [8].



Fig.1: The origins of leprosy.

❖ Leprosy control programs in India

The Government of India established the SET [survey, education, and treatment] strategy-based National Leprosy Control Program [NLCP]. The National Leprosy Eradication Program [NLEP], with an ongoing SET strategy, was created in 1983 as a result of the advent of MDT and replaced the NLCP. On December 31, 2005, the government of India declared leprosy to have completely eradicated [prevalence rate 1/10,000][9,10]. Leprosy prevalence in India was 0.69/10000 as of March 2015. Up till April 2013, 33 states and union territories [UTs] had achieved leprosy eradication. The current goal of the World Health Organization's worldwide strategy for leprosy control is to reduce the number of new cases of grade 2 leprosy per 100,000 people by at least 35% by the end of 2015 [11–13].

Epidemiology

The World Health Organization [WHO] declared leprosy to be entirely eradicated in 2000. Infection elimination was finally determined to be the general decrease in prevalence to less than 1 case per 10,000 individuals. The number of instances

that were registered decreased from 5.4 million to about 219000 between 1985 and 2011. Including Europe, the prevalence rate fell from around 21.1 to 0.37 per 10,000 people by 2011. The prevalence of leprosy varies; however it is typically seen in developing nations. In 2009, over 1600 new cases were reported from about 16 different nations. The majority of cases were found to be in Bangladesh, Brazil, Nigeria, Bangladesh, Indonesia, and Brazil. Not all leprosy cases are reported, according to data. Bangladesh saw a nearly fivefold rise in cases when door-to-door outreach attempts were performed as opposed to using simply self-reported data[14,15]. The earliest indication of a condition resembling leprosy dates back to Egypt circa 1400 BC. Leprosy spread over the world as a result of migration. The existence of leprosy in India from 2000 BC has been established via research and examination of ancient skeletal remains. In India, leprosy is thought to have existed since 2000 BC, according to research and study of old skeletal remains. In Vedic texts, leprosy was referred to as kuth, which is how the illness is still known as in India today[10,16].

Etiology

Mycobacterium leprae complex, which consists of *M. leprae* and *M. lepromatosis*, contains the gram-positive, acid-fast bacilli known as *M. leprae*. The first of these two multiplies more slowly than the later, with a generation time of approximately 12 to 13 days. Less than half of the functional TB genes are present in this obligate intracellular bacterium, which cannot be cultivated on artificial substrates. According to lab testing, *M. leprae* grows best between the temperatures of 27 and 33 C. This supports the original explanation explaining *M. leprae*'s propensity to spread more quickly in cooler areas of the body. This includes upper respiratory tract membranes, skin-surface nerves, and skin-surface nerves. The nine-banded armadillo, which is primarily found in south-central America and naturally has a core temperature of 34 C, also exhibits robust growth of this strain. In addition to armadillos, *M. leprae* has also been found in chimpanzees, mangabey monkeys, and cynomolgus macaques [17–19]. Leprosy's exact cause was unknown for a very long time. The well-known Norwegian leprosy researchers of the 19th century were Dr. Daniel Cornelius Danielssen and Dr. Carl Wilhelm Boeck. They served as the authors and publishers of the widely read book "Om Spedalskhed" [On Leprosy]. Danielssen, who was supported by other medical professionals in his age, had a strong belief in the genetic explanation of leprosy transmission. Due to the disease's extended incubation period, its infectiousness remained a mystery for a long time. In 1868, Danielssen appointed Gerhard Armauer Hansen as an assistant physician. He came to the conclusion that leprosy was an incurable social ill with a clear etiology. He believed that a bacterium was involved in the spread of leprosy, which put him at odds with his boss on the job. Nobody has proven that germs could cause disease in people at the time when the principle of contagious disease transmission was poorly understood. *Mycobacterium leprae*, rod-shaped leprosy nodular formations, were found in 1873. By 1879, via the application of improved staining techniques, it was possible to demonstrate a significant number of these rod-shaped structures that were typically clustered in parallel cells. Believed that the rod-shaped bacillus was the cause of leprosy. Thus, the first

researcher to suggest that germs could be to blame for the origin of human disease [13].

Signs and Symptoms

Leprosy infection symptoms are similar to those that can appear in syphilis, tetanus, and leptospirosis and are mild and slowly manifesting. Leprosy's primary symptoms include numbness, loss of temperature and contact sensations, needles sensation, ache in the joint, weak or absent deep pressure stimuli, nerve damage, ulcers, rashes, lesions on the skin [pigmented areas on the skin that cause the skin to lose its color], loss of eyebrows, disappearance of facial features, etc. Furthermore, it was shown that lepromatous leprosy [MB leprosy] has a poor prognosis and is more contagious than other forms [20–23].



Fig.2: Leprosy warning signs and symptoms.

Risk Factors

Lack of adequate housing, being close to the patient, crowding, eating improperly [malnutrition], being in an immunocompromised state [HIV], and living in a rural area all lower cell-mediated immunity, making these conditions ideal for infection whether by droplets or skin-to-skin contact[6,24]. Close Contact: Compared to the general population, close contact with a leprosy patient significantly raises the risk of contracting the illness. Exposure through armadillos: The nine-banded armadillo is a native host of the *M. leprae* strain in the southern US. Although the exact mechanism by which the germs are transferred from armadillos to humans is unknown, genetic typing techniques have demonstrated the transmission from animal to human. Age: Older people in society are more at risk of contracting leprosy. A bimodal link between age and several studies' findings. 5 to 15 indicated an elevated risk, and 30 and beyond showed a continuing danger [25–27]. Genetic Influences: As was already noted, genetics affects the immune system's reaction. The PARK2/PACRG gene is one genetic component that is responsible for innate immunity. Genetic ties were significant, according to a study involving 21,000 contacts and more than 1000 individuals with recent diagnoses of leprosy. These connections demonstrated that genetics can be a significant risk factor regardless of interaction distance [26,28].

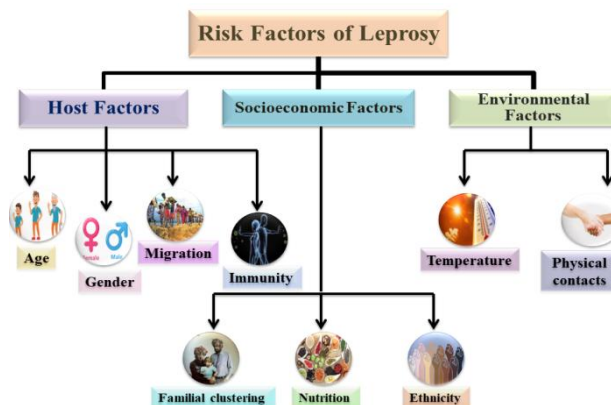


Fig.3: Possible risk factors for leprosy.

Pathogenesis

The pathogen *M. leprae* is an acid-fast, Gram-positive, obligatory intracellular bacillus that prefers cells of the peripheral nervous system, particularly Schwann cells. The susceptible host will typically contract the species through systemic or skin contact [between the exudates of a leprosy patient's skin lesions and another person's abraded skin]. Only a small percentage of infected people experience disease symptoms, which may take anywhere between 6 months and 40 years or longer to manifest. After entering the body, bacteria with low pathogenicity move in the direction of the Schwann cells in the brain tissue. Toll-like receptors [such as -1 and 2], which are located on the surface of Schwann cells, also play a significant role in activating the genes that cause apoptosis and accelerating the start of nerve damage in moderate illness. Bacilli often begin slowly growing [it takes one bacteria 12–14 days to divide into two] within cells, where they eliminate damaged cells and penetrate other healthy cells. Bacilli grow, the body's bacterial burden rises, the immune system detects infection, and lymphocytes and histiocytic [macrophages] invade the diseased tissue while the individual is still devoid of leprosy symptoms. clinical manifestation may show over time as nerve involvement and/or impairment of sensation and/or pain[29]. The severity of the patient's immune response determines how far the disease will advance if it is not identified and treated in its early stages. Protection is provided by specific and efficient cell-mediated immunity [CMI], which also controls the infection inside the body or causes PB type leprosy. If CMI is insufficient, the disease spreads unchecked and results in MB leprosy with multiple system involvement. This might culminate in bloodstream invasion, which would cause foci to form in the liver, spleen, adrenal glands, testicles, bone marrow, and excrete in the milk. Lepromatous leprosy, also known as MB leprosy, has been noted to be more contagious than other forms and to have a bad prognosis in numerous publications [30–35].

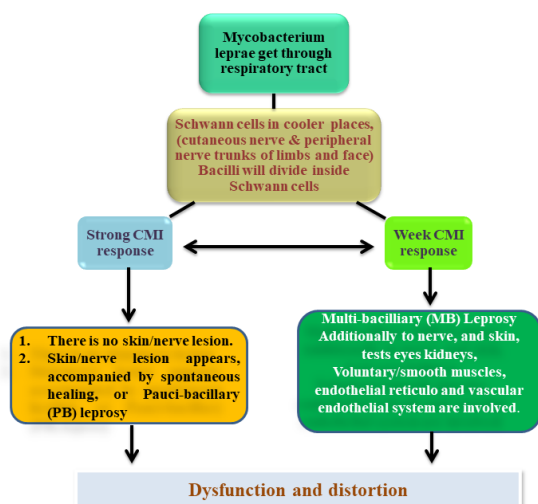


Fig.4: Leprosy's pathogenesis [29].

Evaluation and Diagnosis

❖ Evaluation of leprosy

Histopathological investigation utilizing skin samples and PCR was important to the development of laboratory procedures. Laboratory tests had the following features in common when assessing for leprosy: increased liver function tests, elevated serum, elevated leukocyte, decreased hemoglobin, low hematocrit, and decreased inflammatory cytokines [36].

▪ Polymerase Chain Reaction

laboratory method DNA from *M. leprae* and *M. lepromatosis* can easily be found in tissue by using PCR. When used as a detector rather than an identifier, PCR is more useful. Current research found that biopsy PCRs had a sensitivity of over 90% and a specificity of 100%. Results for instances with tuberculoid illness demonstrated a sensitivity of 34% and a specificity of 80%. Proteins and peptides that were still present in the sample were taken out during the development of skin tests, leaving only *M. leprae*. Another test, referred to as the "lepromin test," employs skin injections of *M. leprae* that have been calibrated and autoclaved, followed by a 3- to 4-week examination. Positive results from this method do indicate exposure to the leprosy in issue, but they also raise the chance that granulomas will develop after exposure to the strain[37–40]. In a region with a high prevalence of leprosy, it was observed that whereas only 15% to 50% of confirmed leprosy patients responded favorably, 70% of controls did [41].

▪ Serologic Test

The *M. leprae*-specific phenolic glycolipid-1 [PGL-1] is mentioned in serology research but is not frequently used in American clinical practice since it is not highly sensitive in the absence of clinical and histological evidence. People who have been diagnosed with lepromatous illness typically exhibit an enhanced polyclonal immune response to the phenolic glycolipid-1 [PGL-1] of *M. leprae* as well as a high number of false-positive tests. Since the tuberculoid disease rarely causes the body to produce antibodies against PGL1, this kind of testing is useless for this particular group of individuals[42–47]. In conclusion, PGL1 has not been shown to be a confirmatory or even marginally predictive marker of infection progression. Serologic research keeps us informed and helps us refine our techniques[48,49].

▪ Skin Biopsy

A thorough biopsy, including subcutaneous tissues, is advised for the lesion's most active and dynamic margin due to the severity of the lesions and the infiltration of the nerves. The substantial variation in the spectrum that was previously noted is demonstrated using hematoxylin and eosin sectioning. Polymorphonuclear leukocytes are typical of type 2 reactions, but fibrin thrombi are clearly seen in lesions known as Lucio's phenomenon. Studies are now being conducted to clarify the histologic requirements for type 1 reactions. Making ensuring that cutaneous diseases like *M. tuberculosis* and non-tuberculin mycobacteria are excluded from interfering with prospective evaluation is crucial when examining the mycobacterial cultures [50].

❖ Diagnosis of leprosy

When the patient is unable to feel any sensory stimuli, including light touch and pin pricks, in the lesion, that could be a confirmatory indicator of leprosy. Skin biopsies are frequently used to establish the diagnosis. These things are considered differential:

▪ Mycosis fungoides

The cutaneous appearance is not consistent and includes patches, tumors, erythroderma, and baldness. A skin biopsy is used for diagnosis confirmation [51,52].

▪ Neurofibromatosis

Café-au-lait macules, axillary freckles, and inguinal freckles are features of the skin. Neurofibromas are also confirmed. Clinical traits are the main criteria used to establish this case [51,52].

▪ Cutaneous leishmaniasis

These types of lesions typically develop on skin that is exposed. Local cases begin as pink papules that evolve into nodules as they progress. The development of ulceration with no pain and localized hardness follows the creation of nodules. The diagnosis of type 1 reactions is typically made only by clinical examination. Standard lab tests are not easily accessible to help with diagnosis. CXCL10 chemokine levels in the serum have been linked to type 1 reactions. CXCL10 shouldn't be regarded as a T1R indication. There is little faith in CXCL10's ability to anticipate outcomes because it is not demonstrated that it is present in significant amounts before the reaction [51,52].

▪ Fungal infection

A scaling, circular, erythematous area with a radial distribution and a clearing marks the beginning of the fungal infection. Raised and erythematous skin also covers the border. Through the preparation of potassium hydroxide, a diagnosis is confirmed[51,52].

▪ Granuloma annulare

The condition shows up as an erythematous, scaleless plaque with marginal papules that is asymptomatic. With a clearing in the middle, the border is typically rope-like. The wrists, hands, feet, and ankles are common locations for manifestation [51,52].

▪ Annular psoriasis

Although it does not happen frequently, psoriasis can cause an annular lesion. The diagnosis of this is also connected to the occurrence of psoriasis symptoms, such as typical plaques and nail disease, more frequently. The only way to be certain is through a biopsy [51,52].

▪ **Systemic lupus erythematosus**

Lupus can present with either localized [butterfly rash] or extensive cutaneous symptoms. After skin is exposed to sunlight outside, further erythematous macular eruption also happens [51,52].

▪ **Keloid**

Dermal lesions with a raised look at the wound site are called keloids. Extension outside the original wound's borders is possible if the primary site progresses to nearby locations [50–52].

Leprosy's Currently Available Treatment Options

The majority of leprosy cases are treated with antibiotics, and the type of the disease determines the best dosage and time to take the medication. To treat leprosy infections, primarily three medications- clofazimine, rifampicin, and dapsone- are typically prescribed. To treat the sickness, doctors normally recommend taking antibiotics for at least 6 to 12 months or longer. The WHO has recently suggested that single-dose therapy with rifampicin, minocycline [Minocin], or ofloxacin [Floxin] for individuals with just one skin lesion is effective. Research on different antibiotics is ongoing [53–62]. In order to reduce pain and acute leprosy inflammation, several medical professionals have tried steroid therapies; nevertheless, clinical trials have not revealed any obvious long-term impact on nerve damage. Surgery plays a part in the treatment of leprosy once the patient has had medicinal therapy [antibiotics] and has negative skin [no visible acid-fast bacilli]. Surgery is usually only necessary in severe instances. In order to prevent the development of antibiotic resistance by bacteria, which could otherwise occur owing to the amount of therapy, disease is treated with a combination of antibiotics, such as utilizing rifampicin dapsone, and clofazimine. The average length of a disease's therapy is one to two years. If the prescribed therapy is followed, it can be reversed. Additionally, there are other herbal treatments accessible, such as neem paste, hydrocotyle asiatica, and frankincense aromatherapy [29].

Leprosy was being treated with chaulmoogra oil and gurjon oil. The use of chaulmoogra oil for the treatment of leprosy dates back to 600 BC in India, according to the Sushruta Samhita. Gurjon oil, a tree extract from the Andaman and Nicobar islands, was first applied topically for the treatment of leprosy in the 1870s by Surgeon Dougall. Both the Chaulmoogra tree [Taraktogenos kurzii] from Northeast India and the Marotti [Hydnocarpus wightiana], a tree native to Kerala, were used to produce the chaulmoogra oil. Sir Leonard Rogers and Ernst Muir delivered chaulmoogra oil orally, subcutaneously, and intravenously as sodium chaulmoograte and sodium hydnocarpate in the early decades of the 20th century. Patients using chaulmoogra oil reported smoother skin and gentler reactions, significantly decreasing the usefulness of gurjon oil. Chaulmoogra oil was the cornerstone of treatment in India up until 1946, when the dapsone period began, despite the lack of evidence supporting its efficacy [63,64].

❖ **Multidrug therapy**

Multidrug therapy [MDT], as advised by a World Health Organization [WHO] Study Group on Chemotherapy of Leprosy for Control Programs, was introduced in 1982 due to the requirement for exceptionally long-term treatment when employing dapsone, as well as the developing issues with dapsone resistance. For lepromatous and borderline [multibacillary] leprosy, MDT was administered as rifampicin, clofazimine, and dapsone for at least two years, and for tuberculoid [paucibacillary] leprosy, rifampicin and dapsone for six months [12]. Multiple changes have been made to MDT since its debut. Initially being provided for 24 months in 1992, MDT was then lowered to 12 months in 1998. Currently, MDT is administered for 6 months for paucibacillary cases and 12 months for multibacillary cases throughout India [63,65,66]. Numerous new medications have demonstrated excellent antileprosy action in both animal research and clinical trials during the past 20 years. Broad spectrum fluoroquinolone moxifloxacin was reported to have greater bactericidal activity than ofloxacin against *M. leprae* in the mouse footpads. The rifamycin compounds rifapentin and rifabutin have also shown to be superior to rifampicin in terms of effectiveness. Minocycline, clarithromycin, brodimoprim, fusidic acid, deoxy fructose, linezolid, and diarylquinolones are some other more recent antileprosy medications [67–69].

Conclusion and Future Direction

Leprosy's aetiology, pathophysiology, epidemiology, risk factors, and treatment choices, including signs and symptoms, are all covered in detail in the beginning section of our review articles. Despite the fact that pharmaceutical medicines have no side effects, natural supplements take longer but yield better outcomes. Additional randomised controlled studies must be carried out to understand more about the ideal method of treating leprosy. We want to keep working on leprosy research. A second study that includes counseling will be conducted in our nation or state with the help of our colleagues in order to evaluate patients' physical and mental health and to present a more thorough understanding of leprosy and its improved treatment.

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Table.1: Current status of clinical trials on Leprosy.

Drug	Mode of administration	Disease	Enrollment	Allocation/Intervention model/Masking	Official Title of the study	Status	Clinical trial	Year
standardised exposure questionnaire	Intervention	Leprosy	368	Case-Control	Epidemiology of Leprosy in French Guiana	NA	NCT05031091	2021
Metformin Placebo	Intervention	Leprosy	166	Randomized/ Parallel Assignment/Quadruple	Efficacy and Tolerability of Adjunct Metformin in Combination With Multidrug Treatment for Multibacillary Leprosy: A Randomized Double-blind, Controlled Proof-of-Concept Phase 2 Trial in Indonesia	Phase-2	NCT05243654	2023
CC-11050	Intervention	Leprosy	50	N/A/ Single Group Assignment/ None [Open Label]	A Single Center, Open Label Pilot Study to Evaluate the Safety and Efficacy of CC-11050 in Nepalese Patients With Erythema Nodosum Leprosum	Phase-2	NCT03807362	2020
Methotrexate/ Placebo/ Prednisolone	Intervention	Leprosy	550	Randomized/ Parallel Assignment/Quadruple	Methotrexate and Prednisolone Study in Erythema Nodosum Leprosum [MaPS in ENL	NA	NCT03775460	2023
Secretome	Intervention	Leprosy	27	N/A/ Single Group Assignment/ None [Open Label]	Effectiveness of Giving Injection of Human Umbilical Cord Secretome in the Case of Trophic Ulcers [Pre-post Intervention]	Phase-1	NCT05777213	2023
exercise and orientation	Intervention	Leprosy	55	Non-Randomized/ Single Group Assignment/ None [Open Label]	Proposal Evaluation and Intervention Through Prevention of Disability in Leprosy Patients	Phase-1	NCT01006759	2009
Dapsone	Intervention	Leprosy	37	N/A/ Single Group Assignment/ None [Open Label]	Population Pharmacokinetic Analysis of Dapsone in Normal, Overweight and Obese Volunteers	Phase-4	NCT01165840	2016
Modified Tarsorrhaphy/ Gold Weight Implant	Intervention	Leprosy	19	Randomized/ Parallel Assignment/Triple [ParticipantCare ProviderInvestigator]	Modified Tarsorrhaphy vs Gold Weight Implant Technique for Paralytic Lagophthalmos Treatment in Leprosy Patients: a Randomized Clinical Trial	NA	NCT04944498	2021
Acetylcholine Iontophoresis/ sodium nitroprusside Iontophoresis	Interventional	Leprosy	20	Non-Randomized/ Parallel Assignment/ None [Open Label]	Observation of Microcirculation Impairment in Patients With Lepromatous Leprosy Using Orthogonal Polarization Spectral [OPS] Imaging and Laser Doppler Iontophoresis	NA	NCT02085317	2014

ClofaziminePlacebo	Interventional	Leprosy	100	Randomized/Parallel Assignment/Quadruple	Effect of Additional Clofazimine on ENL Reactions in Leprosy	Phase-4	NCT01290744	2015
Ciclosporinprednisolone	Interventional	Leprosy	12	Randomized/Parallel Assignment/Double [ParticipantInvestigator]	A Pilot [Double Blind Controlled] Study Randomizing Patients With New Acute ENL to Treatment Either With Ciclosporin or Prednisolone.	Phase-2	NCT00919542	2015
Prednisolone/ciclosporin	Interventional	Leprosy	20	Randomized/Parallel Assignment/Double [ParticipantInvestigator]	A Pilot Double Blind Controlled Study Randomizing Patients Whose ENL is Not Controlled With Standard Prednisolone, and Comparing a Group Treated With Ciclosporin to a Group Treated With Additional Steroid Only.	Phase-2	NCT00919776	2015
The Virtual Human Project	Interventional	Leprosy	94	Randomized/Parallel Assignment/None [Open Label]	Educational Virtual Objects [The Virtual Human Project] Assessment Inserted in Learning Based on Team [Team-based Learning] in Leprosy Education on Undergraduate Medical Setting	NA	NCT02484469	2015
LEP-F1 + GLA-SE	Interventional	Leprosy	24	Non-Randomized/Parallel Assignment/None [Open Label]	A Phase 1, Open Label, Antigen Dose-Escalation Clinical Trial to Evaluate the Safety, Tolerability, and Immunogenicity of LEP-F1 + GLA-SE in Healthy Adult Subjects	Phase-1	NCT03302897	2019
ciclosporin	Interventional	Leprosy	16	N/A/ Single Group Assignment/None [Open Label]	A Pilot Study Assessing the Efficacy and Safety of Ciclosporin as a Second - Line Drug in Patients With Type 1 Reactions Who Have Not Responded to a 12 Week Course of Prednisolone.	Phase-2	NCT00919451	2015
NA	Observational	Leprosy	1554	Cohort	Molecular Epidemiology of Leprosy in Colombia	NA	NCT00138437	2014
MB 12 doses - Rifampicin, Clofazimine and Dapsone	Interventional	Leprosy	859	Randomized/Parallel Assignment/None [Open Label]	Independent Study to Establish the Efficacy of the Six Doses Uniform MDT Regimen [U-MDT] for Leprosy Patients	Phase-4	NCT00669643	2017
Routine treatment/ Low level laser therapy [LLLT]	Interventional	Leprosy	25	Randomized/Parallel Assignment/None [Open Label]	Clinic-Epidemiological Evaluation of Ulcers in Leprosy Patients and the Use of Low Level Laser Therapy: a Randomized Clinical Trial	NA	NCT00860717	2009

CiclosporinPrednisolone	Interventional	Leprosy	73	Randomized/Parallel Assignment/Double [Participant/Investigator]	A Randomised Double Blind Controlled Trial Comparing Ciclosporin and Prednisolone in the Treatment of New Leprosy Type 1 Reactions	Phase-2& 3	NCT00919815	2015
NA	Observational	Leprosy	889	Cohort	Improved Understanding of Ongoing Transmission of Leprosy in the Comoros, a Region Hyperendemic for the Disease.	NA	NCT03526718	2021
NA	Observational	Leprosy	310	Case-Only	Molecular Epidemiology of Leprosy - Philippines	NA	NCT00315809	2011
MLCwA/ MLSA-LAM/ Mock Antigen	Interventional	Leprosy	10	Randomized/Parallel Assignment/None [Open Label]	Phase I Study to Evaluate New Leprosy Skin Test Antigens: MLSA-LAM and MLCwA	Phase-1	NCT01920750	2014

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Conflict of Interest

The authors confirm that they have no known financial or personal conflicts of interest that would affect the research presented in this study.

Informed Consent

Using websites, review articles, and other sources to produce research content.

Ethical Statement

In addition to providing patients with the right medications, an excellent pharmacist offers them Compassion and empathy.

Author Contribution

Fair participation from all authors.

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