

HANSEN'S DISEASE (LEPROSY)

Leprosy : chronic, mildly communicable disease of man which primarily affects the skin, mucous membranes, peripheral nerves, eyes, bones and testes due to *Mycobacterium leprae*, an acid fast bacillus. **Hansen's Disease** is synonymous to leprosy.

Classification of Leprosy

Ridley-Jopling classification -indeterminate (I) , -tuberculoid (TT) , -borderline tuberculoid (BT) , -mid-borderline (BB) , -borderline lepromatous (BL) and -lepromatous (LL)	WHO classification -single lesion paucibacillary (SLPB) -paucibacillary (PB) , i.e., those with 2 - 5 lesions, -multibacillary (MB) with six or more lesions. -Paucibacillary patients = skin smear negative and no evidence of more advanced disease on biopsy. -Multibacillary patients = skin smear positive and/or have a biopsy indicating more advanced disease	Generally PB disease is equivalent to I, TT and BT disease in the Ridley-Jopling classification; MB is equivalent to BB, BL and LL disease.
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Epidemiology & Transmission

Airborne Transmission: more probable route. Nasal washings from untreated lepromatous cases have from 10,000 to 10,000,000 *M.leprae*. A majority of the lepromatous patients have bacilli in their nasal secretions. The primary infection site may be the respiratory tract or the skin. Aerosols with *M.leprae* successful in infecting immunosuppressed mice.

Skin-to-skin: suspected to be route of transmission. Bacilli present in large number in ulcers, not found on the unbroken skin. Few anecdotal cases of skin transmission: inoculations during surgical procedures and tattooing.

Insects suspected but role minor (if any).

NOT very communicable: Only 5-10% of population susceptible to develop disease. U.S. close contact 1:300 ~0.3%. HCW 1:300 same as high risk contacts. Most contact infected at first exam. Rare development of disease later → No need for long term follow up of close contacts.

Lepromatous and borderline cases infectious; indeterminate and tuberculoid non-infectious.

Example 1935: Attack rates per 1000 person-years = 0.83 for no known contacts, 1.60 for contacts of non-L, 6.23 for contacts of L.

Communicability after Tx drops: Patients adequately treated no longer infectious a few weeks or months after treatment started

Asymptomatic carriers?

- 2-8% may have pos PCR in nose; Nose portal of entry of simple filter; Large asymptomatic reservoir may be source of new cases
- Infection with *M.leprae* is far more common than generally accepted. ELISA pos from 5% to 50% of contacts.

Leprosy Epidemics: Nauru, Ponape, Truk, Hawaii, Irian Jaya and Eastern Nigeria. Nauru 1920: 4 cases, by 1925 - 33% of total population (1200) infected. Hawaii 1835 first cases were diagnosed in 1835, by 1865 - 700 cases, by 1915 more than 10,000 cases.

Epidemics characterized by sudden increase in paucibacillary forms and low incidence of multibacillary forms. Cases evenly distributed by age, little clustering. After the peak incidence, rapid decline. Possibly all susceptible individuals infected. During decline: incidence of multibacillary cases increases, shift towards younger age groups and clustering reappears. Epidemics are exceptions.

Declining leprosy: Cases in older age groups; age of onset decreases with successive cohorts; proportion of L cases increase. Patterns started long before chemotherapy. Attack rates of leprosy ↓ within families. Ex. Hawaii, family attack rates from 10%, to < 0.01% but, transmission still taking place (by serology tests) though attack rate approaching 0. It appears that as a result of the economic development there is a decrease in risk of disease due to either environmental (crowding) or host-related (nutrition, immune resistance) factors. These changes occur independently of leprosy control measures; they have been observed in countries with no isolation as well as in countries with strict isolation policy.

Clustering of cases: Not evenly distributed. Major differences between villages, between households. Not clear whether due to genetic, environmental focal differences or secondary to social pressures that segregate and aggregate cases

Limitations in epidemiologic studies: rare disease, long incubation, poor early dx

Genetic susceptibility may be inherited as shown by the aggregation of cases in some families.

Age, Sex: LL sex ratio M:F 2:1, TT M:F 1. In most countries, incidence / prevalence higher in males. Incidence rises in children between 10 and 20. Children said to be more susceptible than adults. In families with an index case of leprosy, the incidence of disease is higher among children than among spouses or older siblings.

Environmental factors: *M.leprae* viable in dried nose secretions for 9 days, in moist soil at room temperature for 46 days.

Crowding, poor sanitation, malnutrition and other environmental conditions favor transmission.

Closer contact → higher risk. Children sharing same mat as parents in Indonesia higher incidence of leprosy that children sleeping on separate mat

Humans only **host** in most countries. In the southern coastal marshland areas of Texas, Louisiana and Mississippi, armadillos naturally infected by *M.leprae*.

Prevalence (antibodies) in armadillos 4 to 30%; ~100,000 infected armadillos

Leprosy introduced in Louisiana around 1850. Armadillo in the U.S. in 1880; in LA in 1926.

Up to 1980s a family disease; in 1990s start to have cases without family contact

Epidemiological indicators used are prevalence and incidence. Measures of **Incidence** particularly useful because they reflect the current risk of transmission. More useful to monitor progress of control programs. Incidence data sensitive to case detection activities. Contact tracing and special surveys likely to increase incidence artificially.

Incubation period: average 2 to 5 years. Difficult to determine precisely because exposure time & degree impossible to determine.

Bacteriology

Cultivation & Animal Models

Not yet been possible to culture the *M.leprae* in vitro.

- The nine banded ARMADILLO only source of large amounts of *M.leprae* for research. Grows to $> 6 \times 10^{12}$; armadillo $> 10^{12}$;
- Inoculation of the normal MOUSE FOOT PAD is the basic tool. Grows to 10^4 in mouse foot pad
- IMMUNODEFICIENT MICE (thymectomized, irradiated, bone marrow reconstituted, nude) or neonatally thymectomized rats
- Grows best at low temperature
- Very long time to divide

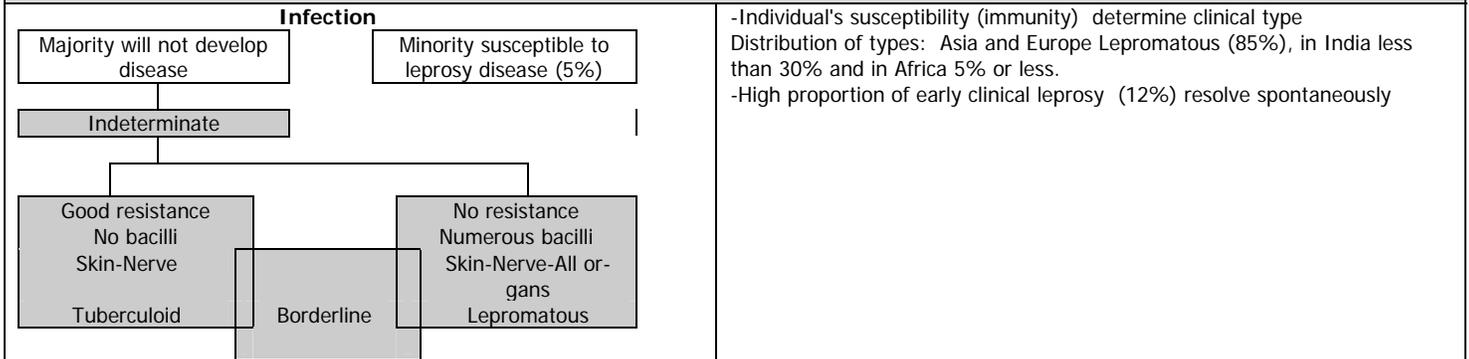
Immunology /Serology

Infection with *M.leprae* detected by

- lymphocyte transformation test, immunogel diffusion,
- radioimmunoassay
- fluorescent antibody absorption test (FLA-ABS)

- ELISA test using a highly specific phenolic glycolipid (PGL) more sensitive but less specific than the FLA-ABS
Positive ELISA is present in 95% of cases 1 or 2 years before clinical signs.

Clinical Presentation



Indeterminate type: earliest state of disease. Single hypopigmented or erythematous skin lesion ±insensitive. Skin smear- negative. The indeterminate type may heal spontaneously, remain indefinitely at this stage or progress into one of the other types. To confirm a diagnosis of I leprosy there must be impairment of sensibility (thermal sensibility gets impaired before tactile sensibility). Biopsies are useful to support the clinical diagnosis.

Tuberculoid type

-Few (1 to 3) skin lesions; large (3 to 30 cm) macules; hypopigmented or erythematous; well defined border, rough and scaly; Periphery raised and erythematous or hyperpigmented; the center flat and hypopigmented.

-Nerve lesions: Anesthesia or hyperesthesia = major characteristic lesions. Sensation of light touch, temperature and pain impaired in that order. Deep sensation intact. Deep tendon reflexes normal. Loss of ability to perspire important sign. Peripheral nerve involvement common. The main nerves involved are the ones in the periphery of the lesions, the ulnar above the elbow, the median at the wrist, the common peroneal at the knee, the posterior tibial at the ankle, the radial at the elbow, the greater auricular in the neck, the sural at the lateral aspect of the ankle, and the superficial branches of the V and VII cranial nerves.

Although tuberculoid Leprosy is a relatively benign disease, severe disabilities may develop.

Lepromatous type:

-Skin lesions very numerous small macules; Copper colored or erythematous; margin vague and they tend to coalesce; symmetrically distributed; not necessarily anesthetic; generalized infiltration of the skin, by palpation rather than by visual inspection.

-Nodules and papules which characteristic. A common site for nodules-earlobes. Loss of eyebrows (starting with lateral brows) and loss of eye lashes (madarosis) are a common late signs. Alopecia of the scalp is rare.

As the disease progresses, most organs may become involved: Nasal congestion, epistaxis, laryngeal inflammation, eye lesions, renal involvement, testicular atrophy and secondary gynecomastia.

Borderline or Dimorphous type: Clinical and histological features of both the lepromatous and tuberculoid types. Majority of leprosy cases are borderline, but for particular purposes, they are often classified as Tuberculoid or Lepromatous (T or L). The word dimorphous is sometimes used instead of borderline.

Skin lesions are a mixture of T or L lesions, with a tendency to be more erythematous. Disease unstable and may progress towards more polar (T or L)

Eye involvement: Hypoesthesia of cornea, paralysis of the eyelid muscle, inflammation of tear duct and lacrosse gland → eye lesions.

Lagophthalmos = incomplete closure of palpebral tissue when lids are shut.

In LL leprosy, beading of corneal nerves early sign. The ciliary body, iris, and cornea are directly involved. As the disease progresses, it will lead to loss of visual acuity, cataract, glaucoma and blindness.

Nose involvement: Rhinitis and nose bleeds common in early LL. Thick, mucous fluid contains large numbers of bacilli and is probably a major source of infection.

Peripheral nerve involvement:

Sensory and motor impairment of the peripheral nerve will lead to the following deformities:

Ulnar nerve	- Clawing of fingers IV and V - Adductor weakness of thumb - Pinch impairment
Median nerve	- Clawing of fingers I and II always associated - Opposition and adduction of (to ulnar) thumb impairment - Abnormal grasp mechanism
Lateral Popliteal	- Loss of dorsiflexion - Loss of eversion
Posterior Tibial	- Clawing of toes

Ulceration: Ulcers ← repeated trauma on skin anesthetic areas.

-Feet injured by poorly fitting shoes. Walking barefooted injure feet and no awareness.

Anesthetic hands exposed to injury as burns while smoking or cooking, use of ill fitted tools. Ulcer secondary infection common.

Bone involvement: Secondary infection → osteomyelitis → bone absorption. Mostly fingers & toes affected; partial or total loss of digits. Direct invasion of bones by *M. leprae* may provoke bone destruction. Nasal bones and hard palate often involved. Concomitant mucous membrane involvement → perforation of the nasal septum.

Disabilities:

-not usually life threatening unless severe complications:

-severe reactions,

-secondary amyloidosis and fulminating LL

-untreated leprosy often causes permanent disabilities.

Grade	Hand	Foot	Eye
1 Mobile	insensitivity Ulcers, injuries	insensitivity Trophic Ulcer	conjunctivitis Lagophthalmos
2 Contracture	Claw Hand Slight absorption Wrist Drop	Clawed Toes Slight absorption Foot Drop	Iritis or keratitis Blurring Severe loss
3 Stiff joint	Severe Absorption	Severe Absorption	Blindness

Inactive Leprosy: means that disease process has been stopped. The purpose of continued treatment is to consolidate this stage and to prevent later relapses. Patient no longer infectious. Criteria:

1. Negative skin smears for one year

2. Absence of clinical activity and/or reactions

3. Negative skin biopsy after one year.

NOTE: Inactivity does NOT mean that all *M. leprae* have been killed in the body. It means that they cannot be found by the usual methods; however, special studies may show the existence of some viable bacilli.

Diagnosis

The key to the diagnosis is a **thorough clinical examination**.

-The total skin area should be examined carefully. Use the brightest available natural light, side lighting may be useful. Examine from close and far distance.

-Light touch can be tested by touching the skin with a wisp of cotton, while the patient's eyes are closed. Some surface areas with thick callous skin are normally less sensitive: elbows, knees, soles, fingers of manual workers. Stroking a hair may cause a sensation. Test tubes with hot and cold water may be used to test temperature perception. A pin is useful to test for pain.

-A detailed examination of the eye is necessary. Check the eyebrows, eyelashes, motricity of the eyelids, the cornea, conjunctiva and iris.

-Inspect the mouth and throat.

- Examine the earlobes.

- Palpate for enlarged nerves especially the areas where a superficial nerve may be involved. Watch for wincing during nerve palpation, indicating pain.

- Examine the extremities for contracture and trophic changes.

- Look for a Motor deficit:

--Facial Nerve - Blink reflex is normally noted when the examiner waves his hand before the eyes.

--Ulnar, Median, and Radial Nerves - The patient is asked to approximate the tip of the thumb to the tip of the straight little finger with the hand outstretched in the pronated position.

--Lateral Popliteal Nerve - Patient is asked to dorsiflex the great toe against resistance.

--Posterior Tibial Nerve- The patient is asked to spread the toes.

Skin Smear

-may demonstrate AFB in skin.

- bacilli quantified with **Bacteriological Index (BI)**. Ranges from 0 to +6 according to the number of bacilli per oil immersion field (OIF) at microscopy

-Rate of clearance under Tx approximately 1 per year.

-Late marker of the antibacterial action of chemotherapy although it is of prime importance in the diagnosis of new cases or relapses.

0	No bacilli	
1+	1 to 10	bacilli per 100 OIF
2+	1 to 10	bacilli per 10 OIF
3+	1 to 10	bacilli per 1 OIF
4+	10 to 100	bacilli per 1 OIF
5+	100 to 1000	bacilli per 1 OIF
6+	Over 1000	bacilli per 1 OIF

Morphological Index (MI) = of solidly stained bacilli of normal size and shape. Solid stain = viable

Technique of the skin smear: A skin smear may be taken on any suspect lesion, or on the earlobe, the elbow or the knee. This procedure is easy and totally harmless. It can easily be done by physicians, nurses and lab technicians.

-Pinch the skin to reduce blood flow.

-Wipe the area with an alcohol sponge.

-Make a small slit with a sterile scalpel blade or razor blade approximately 5mm long and 2mm deep.

-Wipe away any blood which exudes.

-Scrape the edges of the wound with the blade.

-Spread the materials obtained on a microscopic slide. Obtain as little blood as possible.

Paucibacillary cases are the smear negative I and T cases of Madrid classification (I, TT and BT of Ridley Jopling classification) with a BI=0 at all sites.

Multibacillary cases are L and B cases of Madrid classification (LL, BL, BB and BT of Ridley Jopling classification) with a BI>0. In previous definition, paucibacillary had a BI of 0 or 1 but this was reduced in the latest definitions because of the poor results obtained by therapy in the BT group who had BI of 1.

Microbial persistence: Persisters are *M.leprae* who have survived in the organism in spite of bactericidal concentrations of antileprosy drugs. Persisters have been detected in about 10% of all biopsy specimens from L cases. No clear relationships between the presence of persisters and relapses.

Skin Biopsy: Definitive diagnosis and classification of the type of leprosy; edge of skin lesions or the nodules = best sites for obtaining a biopsy.

Punch or surgical incision. deep enough to include subcutaneous fat. Specimens are best preserved in neutral buffered formaldehyde solution (a solution containing phosphate buffer and 10 % of formaldehyde 37-40 %)

Early lesions: Perineural infiltrates + AFB (Fite stain) = Leprosy

Treatment

US NHDP Recommendations				WHO Recommendations	
Tuberculoid (TT & BT) or Paucibacillary, (PB)					
Dapsone	100 mg daily	1-2 mg/kg/day	12 months,	Dapsone 100mg daily (self administered) for 6 months	
Rifampin	600 mg daily	10-20 mg/kg/day	then discontinue	Rifampin 600mg daily once monthly (supervised) for 6 months.	
Lepromatous (LL, BL, BB) Multibacillary, (MB)					
Dapsone	100 mg daily	1-2 mg/kg/day	24 months	Dapsone 100mg daily (self administered)	
Rifampin	600 mg daily	10-20 mg/kg/day	then discontinue	Rifampin 600mg daily once monthly (supervised)	
Clofazimin	50 mg daily			Clofazimine: 300 mg once a month & 50 mg daily Duration= 12 months	
Never use rifampin alone or rifampin+dapsone without a third bactericidal drug to avoid rifampin resistance.					
Examine at least once a year (clinical examination, skin smear) for 5 years.					
Children: PB → Dapsone+Rifampin; MB → Dapsone+Rifampin+Clarithromycin					
Recommended durations of Tx sufficient. Many dead bacilli remain in tissues for years. Prolonged Tx does not hastens elimination of dead organisms.					
Alternative Treatment					
Minocycline	100 mg daily Not for children			-substitute for Dapsone if intolerance -sub for Clofazimine, but anti-inflammatory activity against Type 2 reactions weaker	
Clarithromycin	500 mg daily 7.5 mg/kg/day			-sub for any other drug -sub for clofazimine in children in USA	
Ofloxacin	400 mg daily Not in children			-sub for clofazimine -not in children	
DDS: (4-4 Diamino diphenyl sulfone) or dapsone					
DDS = drug of choice. Synthesized in 1908 but not used until 1938. Bacteriostatic and weakly bactericidal at 100mg. Brand names = DAPSONE, AV-LOSULFON. Half-life in blood = 24 hours. Orally 50 to 100mg/day with meals. Start at full dosage. Precaution: Before tx, screen for G6PD deficiency (Hemolytic anemia). Regular surveillance of CBC and bilirubin. Macrocytic anemia, leukopenia, and granulocytopenia unusual reactions. Dermatitis due to drug sensitization rare but serious. First sign of EXFOLIATIVE DERMATITIS, stop. Cyanosis due to methemoglobinemia, continue except when very severe cyanosis. Gastrointestinal reactions, liver damage, and hematuria unusual. Monitor G6PD, CBC					
Rifampin or rifampicin (in Europe):					
Bactericidal, rapidly effective. Single dose of 1500 mg kills 99% of all bacilli. → MI close to 0 in 2-3 months. Orally 300 to 600 mg daily and taken on an empty stomach for good absorption. With 600 mg daily, infectivity for mouse footpad disappears completely at 7 days. Precaution: In combination with other drug to prevent resistance. Combined with dapsone or clofazimine. Hepatic & hemato abnormalities uncommon. Monitor CBC w platelets, creatinine & BUN, phosphatase, bilirubin, AST & ASP					
Clofazimine:					
-Clofazimine (B663 or Lamprene) is an excellent drug for the treatment of lepromatous leprosy. It is bacteriostatic and antiinflammatory. It is not available commercially in the US. It is given orally at a dose of 100 mg daily. In some cases higher doses, up to 300 mg daily, may be used. The drug is a RED DYE. It gives a reddish brown color to the skin, urine, sweat and sputum. In light-skinned people this may be a major inconvenience. It disappears 6 months after cessation of therapy. Upper gastrointestinal symptoms may occur. The major advantage of this drug is its effectiveness in the treatment of reactions. This action takes place in several days or weeks. -Clofazimine not on open market. Only available as investigational new drug (IND). NHDP holds IND for use in U.S.; Call NHDP at 1-800-642-2477					
Ethionamide and Prothionamide: They are bactericidal but at a slower rate than rifampin. They must be used with care because of the risk of liver damage.					
Thalidomide:					
Thalidomide is used only to treat reaction. It is very effective. It cannot be given to women of child-bearing age.					
Treatment of leprosy during pregnancy and lactation					
MB: Exacerbated during pregnancy, CONTINUE multidrug therapy during pregnancy. WHO Action Program for Elimination of Leprosy stated the standard MDT regimens are considered SAFE, both for mother & child. Small quantity of antileprosy drugs excreted through breast milk but no adverse effects except mild skin discoloration due to clofazimine. PB: Defer until after delivery.					
Managing Reactions					
25% of patients w reactive episodes ("reactions") of varying degrees of severity most during 1 st of Tx Less common in clofazimine tx. Due to destruction of bacilli and immune response to released bacterial antigens. Continued tx in spite of reaction					
Erythema Nodosum Leprosum (ENL or type 2 reactions) almost exclusively in BL & LL Fever and painful erythematous nodules, peripheral neuritis, orchitis, lymphadenitis, iridocyclitis, nephritis, periostitis, arthralgias Mild episodes → no therapy, or symptomatic tx as aspirin Severe episodes → Corticosteroids: effective in all patients, always use for acute neuritis to prevent permanent nerve injury. Dose=40-60 mg prednisone daily (1 mg/kg per day). After reaction controlled for few days, taper down (alternate day, lower dose) over 2-3 weeks For recurrence, increase dose. If chronic, prolonged tx. If prolonged use of corticosteroid, give rifampin 1/ month → Thalidomide: 100 mg x4 times daily, reaction controlled within 48 to 72 hours, taper over 2 weeks to maintenance of 100 mg daily Try to taper or discontinue, but patients may need to continue for months to years. Side effects are few: drowsiness. NOT for fertile females because of TERATOGENICITY, except under strict conditions → Clofazimine: 100 mg x2 to x3 daily, few weeks to few months, depending on its severity. Gastrointestinal symptoms with high doses, reduced to 100 mg daily within 1 year, if possible. Pigmentation quite marked.					
Reversal (type 1 reactions), occurring in BT, B, BL					
Lucio's phenomenon relatively rare. In patients with diffuse LL from Mexico and some. Patients develop multiple ulcers often difficult to heal. Managed with corticosteroids and treatment of the underlying infection					

Treatment of patients with concomitant HIV injection

The management of a leprosy patient infected with HIV is the same as that of any other patient. The information available so far indicates that the response of such a patient to MDT is similar to that of any other leprosy patient and management, including treatment reactions, does not require any modifications.

Patient who cannot take rifampicin

Special treatment regimens are required for individual patients, who cannot take rifampicin because allergy or intercurrent diseases, such as chronic hepatitis, or who have been infected with rifampicin-resistant leprosy.

In 1997, the WHO Expert Committee on Leprosy recommended the following 24-month regimen for adult patients with multibacillary leprosy, who cannot take rifampicin:

Length of Treatment 6 months

- Clofazimine 50mg daily
- Ofloxacin 400mg daily
- Minocycline 100mg daily

Followed by an additional 18 months

- clofazimine 50 mg daily
- + ofloxacin 400 mg daily
- or minocycline 100 mg daily

In 1994, the WHO Study Group on Chemotherapy of Leprosy stated that daily administration of 500 mg of **clarithromycin** can be substituted in the above regimen for either ofloxacin or minocycline during the first six months of treatment of multibacillary patients, who cannot take rifampicin.

Patient who refuses to take clofazimine

Patients with multibacillary leprosy, who refuse to take clofazimine because of skin discoloration, also need a safe and effective alternative treatment. In such patients, clofazimine in the normal 12 month multidrug therapy may be replaced by:

- Ofloxacin, 400 mg daily for 12 months

Or

- Minocycline, 100 mg daily for 12 months

In 1997, the WHO Expert Committee on Leprosy also recommended the following alternative 24-month multidrug therapy regimen (3 drugs) for adult patients with multibacillary leprosy, who refuse to take clofazimine:

Rifampicin, 600 mg once a month for 24 months

Ofloxacin, 400 mg once a month for 24 months

AND minocycline, 100 mg once a month for 24 months

Patients who cannot take dapsone

If dapsone produces severe toxic effects in any leprosy patient, either with paucibacillary or multibacillary leprosy, dapsone must be immediately stopped. No further modification of the regimen is required for patients with multibacillary leprosy. However, clofazimine in the dosage employed in the standard multidrug therapy for multibacillary leprosy should be substituted for dapsone in the regimen for paucibacillary leprosy for a period of 6 months.

Treatment of neuritis

Neuritis may occur during lepra reactions or can occur independently of lepra reactions. Neuritis is an acute inflammation of the nerves with nerve pain, local edema and rapid loss of function. Neuritis may occur before leprosy is diagnosed, during leprosy treatment, or several years after leprosy treatment has been completed. All neuritis of less than 6 months duration should be treated with the standard 12 week regimen of prednisolone. The usual course of oral prednisolone treatment begins with 40-60 mg daily up to a maximum of 1 mg/kg body weight per day and normally controls neuritis within a few days. Most neuritis can be treated successfully under field conditions with the standard 12 week oral prednisolone treatment. If patients with neuritis do not respond to corticosteroid therapy, they should be sent to the specialist centre.

Other special situations

After completing the multidrug therapy regimen for leprosy, patients may have a lepra reaction (Type 1 or Type 2) or may develop neuritis. These patients should be treated with oral prednisolone as if they had developed lepra reactions during MDT. There is a small risk of relapse in these patients since corticosteroids are known to accelerate the multiplication of organisms located in dormant foci and may cause disseminate reactivation. Thus, it is recommended that **clofazimine 50 mg daily, should be given as a prophylactic measure** if the duration of corticosteroid therapy is expected exceed 4 months. Clofazimine should be continued until corticosteroid therapy is stopped.

For MB leprosy treated with dapsone monotherapy, they range from 0.5% to 2.5% person-years, according to the regularity of treatment. The cumulative probability show a sharp increase during the first 5 years to reach a plateau by 10 years, by then 10 to 25% of patients would have relapsed.

For MB leprosy treated with multidrug therapy, 60-70% of patients are negative within 6 months of treatment and 95% by 1 year. Relapse rates are in the order of 1-3% person-years of follow up.

CONTROL

The main objectives of a leprosy control program are:

- 1-To interrupt transmission of the infection, reducing the incidence of the disease so that it no longer constitute a public health problem.
- 2-To find new cases that are symptomatic or before symptoms develop.
- 3-To follow up all known cases, and ascertain that they receive proper medical care and take regular treatment.
- 4-To prevent the development of associated deformities
- 5-To educate the patient, his family, the health professional and the public.

In recent years, leprosy control programs have had to deal with increasing secondary and primary resistance of *M.leprae* to dapsone. The main strategy for control remains early detection of cases and chemotherapy.

SURVEILLANCE

CASE FINDING

Identifying Suspects is the primary goal of case finding. The health practitioner comes in contact with many persons during the workday. They should keep aware of leprosy and always suspect it if working in an endemic area. Suspects should be examined promptly by a person (physician, nurse) experienced in the diagnosis of leprosy.

ALL new cases should be treated, even paucibacillary cases. Although a proportion of these cases can heal without therapy, there is no way to tell which one will heal and which one will get worse.

Following the diagnosis of a new case, it is important to start a **Case Investigation**. The purpose of this investigation is to provide epidemiological information, baseline clinical information on the patient, and contact information for follow up. Collect information on the patient's identity, address, ethnic group, birth, education and employment. The places of residence should be investigated with great care. The information provided is essential to determine where the patient was contaminated, clinical information at the time of diagnosis. It is important to note the clinical type of leprosy since it will determine the length of treatment and the length of follow-up of contacts, names of contacts and possible source of infection. The source of infection is considered as anyone having leprosy that came into contact with the patient. It is impossible to ascertain whether this person was actually the source of infection. The most important contacts are first, the bedroom contacts, then the household contacts, then relatives, friends, co-workers not living in the household, but only if there is frequent contact. Judgment is necessary in determining who should be listed as a contact.

Programs should promote **Self Detection** through health education, as self reported patients generally are better compliers. Where multidrug therapy has been successfully implemented, self reporting has been improved.

Bacteriological Examination is highly relevant to leprosy control programs. The quality of smears and of microscopy is often the weakest link in most leprosy control programs. It is essential to train personnel in proper collection procedures for smears and to organize an efficient system for processing the smears.

CASE NOTIFICATION

New cases must be notified to a central register. The register should include 1-cases of leprosy (patients needing or undergoing treatment), 2- persons under surveillance (those who have completed multidrug therapy and require or are under surveillance) and 3-disability (those with deformities or disabilities resulting from leprosy in the past and needing care). Lack of distinction between these categories is a source of error in computing prevalence and other statistics necessary for leprosy control programs. It is important to adapt a **UNIVERSAL CASE DEFINITION**: a case of leprosy is a person showing signs of leprosy, with or without bacteriological confirmation of the diagnosis requiring treatment. Patients who have completed treatment and are under surveillance, patients who are followed-up for disabilities and patients who are released from all surveillance (released from control) should not be counted as leprosy cases but should kept in separate lists.

CONTAINMENT

ISOLATION

Isolation was used for many centuries as the only way to prevent spread of the disease. It has not proven very efficient. Patients knowing they would be isolated for a long period of time avoided medical care and attempted to hide their disease. Although they were isolated when the diagnosis became obvious, it was usually very late. At that time, most contacts were already contaminated. Infectious cases become noninfectious within a few weeks or months following the initiation of treatment. Isolation of the patient is **NO LONGER NECESSARY**. Common sense and hygienic precautions with regards to an infectious case are sufficient.

HOSPITALIZATION

Following the diagnosis of a new case, hospitalization is not systematically recommended before starting treatment. The major medical indication for hospitalization is in the event of a **REACTION** to drug therapy. Severe reactions may lead to severe disabilities and death. It is to the patient's benefit to be hospitalized when a reaction occurs. Cases that are diagnosed early with minimum signs of leprosy do not need to be hospitalized and may begin treatment as outpatients.

FOLLOW-UP OF KNOWN CASES

One must understand the public's prejudices toward leprosy. Persons with leprosy have been unfairly and irrationally ostracized and sequestered for many years. An understandable and common reaction from patients is to refuse any control from anyone. A great deal of tact is necessary in dealing with these cases.

The health practitioner should record the successive addresses of the case; due to the usual length of treatment and need for follow-up, the patients should be referred when they move out of the jurisdiction, to the appropriate health center serving the patient's new location.

New leprosy cases need to be seen at least every month for the time of drug administration. The purpose of the follow-up visits is:

- 1-to assess the patient's condition and his needs for specialized care
- 2-TO CHECK ON THE REGULARITY OF TREATMENT and for the presence of any signs of reaction
- 3-To administer directly supervised drugs and renew other drugs

COMPLIANCE is a major problem in leprosy control. The old regimen of monotherapy with dapsone was partly unacceptable because of the requirements for extremely long treatment: 3, 5 years or lifetime treatment. With multiple drug therapy, the length of treatment has been considerably shortened but is still very long in comparison with treatment for other diseases: 6 months, 2 years or longer. The magnitude of the non-compliance is seldom assessed. Rates of defaulters vary according to studies and definitions used: around 10% per year, at the end of 5 years of unsupervised monotherapy, it was not unusual to have only 25 to 50% of patients still attending clinics. Mere attendance at the clinic does not mean that the patient faithfully takes his drugs. Urine controls of drug intake showed that 50 to 70% only of patients attending clinics do take their drugs regularly. With multiple drug therapy and monthly supervised drug administration, compliance improved slightly. Patients seem to prefer the new regimen and make an effort to be more regular. Patients can see faster results and are told that they will be released from treatment within a near future, therefore their motivation is higher. Monitoring patient compliance is essential. Attendance at clinic appointments is essential, however it is not sufficient. To monitor the compliance at home, patient interview are inadequate. Even pill counts may overestimate compliance. A urine test is probably the best option for monitoring drug intake.

CONTACT EXAMINATION

The health practitioner should carry out the identification and examination of close contacts. Household contacts are considered to be at highest risk. They are all persons who have lived in a living unit with a patient for at least one month between the onset of symptoms and the time the patient is considered non-contagious. A health practitioner or a nurse trained for this procedure may perform the screening examination and arrange for this patient to be examined by a physician or a more experienced person.

Guideline For Screening Contacts: select a suitable area where the patient will not be embarrassed by onlookers for performing the examination.

1-SKIN EXAMINATION: Begin the examination at the head and proceed down to the extremities.

- Examine the entire skin surface for any lesions (patches, nodules, ulcers...)
- Check for thinning or absence of eyebrows.
- Examine earlobes for nodules and enlargement.

2-NEUROLOGICAL EXAMINATION:

- Examine the skin lesions, the medial parts of the hands and the feet for decreased sensation. Use a wisp of cotton and have the patient point to the area that was touched.
- Check the ulnar groove for enlarged ulnar nerve
- Check the popliteal area for enlarged peroneal nerve
- Check for decreased motor function ability in the hand: ability to oppose thumb to each finger (medial nerve), ability to spread fingers apart and resist any opposition.

If no lesions resembling leprosy are found, consider the patient NON-SUSPECT and advise him on leprosy signs and the necessity for regular follow-up examinations. If any suspect lesion was found:

- Obtain a skin smear or skin scraping on all suspect skin lesions and on both earlobes.
- Arrange for the patient to be seen by a physician or nurse with experience in leprosy.

Frequency Of Contact Examination: The frequency of contact examination is based on the infectiousness of the index case.

- Lepromatous & borderline case: Screen contacts once a year for 10 years after diagnosis of case.
- Tuberculoid & indeterminate case: Screen contacts once a year for 5 years after diagnosis of case.

The following are factors to be taken into consideration:

- 1-Degree of closeness of contact: A close bedroom contact needs to be followed longer than an occasional visitor
- 2-Infectiousness of the case: Contacts of patients with high bacteriological and morphological index need to be followed for a longer time
- 3-Age of contacts: Young children are thought to be more susceptible to leprosy and therefore should be followed for a longer time
- 4-Regularity of treatment of index case: An index case that does not take medication regularly will continuously expose his contacts
- 5-Development of resistance : Contacts of drug resistant cases should be followed for 10 years following the initiation of an effective treatment.

CHEMOPROPHYLAXIS

Dapsone and Acedapsonone were effective in the chemoprophylaxis against leprosy in studies carried out in Micronesia, China and India. Acedapsonone (150-225mg /10weeks) was 55% effective in India, 95% in Micronesia, Dapsone (1-4mg/kg per week) 35-75%. Prophylactic treatment had to be given at least 3 years or until the index case became negative. The maximum benefit was in children exposed to multibacillary cases. The project in Micronesia failed because of inadequate control of lepromatous cases who had relapsed and infected children after the cessation of trial.

VACCINATION

BCG seems to provide some protection against leprosy. The results of 5 controlled trials have given mixed results:

Country	Protection
Uganda	80%
New Guinea, Karimui	50%
Malawi	50%
Burma	25%
India	25%

The observed protective effect was highest against paucibacillary leprosy. Protection against borderline and lepromatous types has been observed in 3 of the 4 trials. The variations in protective effects are not fully understood but resemble the variations observed with BCG protection against tuberculosis.

Other Vaccines are in preparation. They include killed *M.leprae*, mixtures of BCG and killed *M.leprae*, cultivated mycobacteria (ICRC bacillus, Mycobacterium W). These are not yet at the stage of field trial. The main assumption is that induction of a cell mediated immunity (CMI) will protect against *M.leprae* (there are good correlations with CMI and restriction of growth of *M.leprae*). Killed *M.leprae* produces strong delayed type hypersensitivity in mice and guinea pig with limitation of multiplication. A combination of *M.leprae* and BCG was capable of upgrading the immune status of some LL and BL leprosy cases. A double blind trial on the protective effect of killed *M.leprae* +BCG compared with BCG alone is underway in Venezuela, in a high risk contact population of 30,000 contacts (household and non-household). Results in 10 years. A large scale immunoprophylactic trial has been initiated in Malawi in a population of 120,000.

PREVENTION OF DISABILITIES

DEFORMITIES CAN BE PREVENTED and should not be accepted as an inevitable outcome of leprosy. Diagnosis of the disease at an early stage, adequate case management, effective detection of reaction (neuritis above all) are the best strategies to prevent disabilities to develop. In patients who already have sensory losses or other disabilities, further deterioration can be prevented by proper instruction regarding protection of insensitive extremities and protection of the eye.

The leprosy control program should have some very specific objectives regarding disability prevention. Impairment and disability records should be maintained. Education of patients should stress disability prevention.

REHABILITATION of patients with disabilities has two objectives: 1-prevention of further deterioration in the patient's physical, social and economic situation, 2-restoration of the patient's level of economic independence and social status. Priority should be given to those who are likely to be rehabilitated, particularly at the beginning of a program where it is essential to show patients and the community that leprosy cases can be rehabilitated. Rehabilitation can be mediated through the medical care system but also through a community based rehabilitation program.

EDUCATION

The success of an education program depends on the quality of the communication between the practitioner and the patient. The patient population reflects the cultural diversity of the country. Patients and practitioner employ different cognitive systems for understanding sickness resulting from differences in cultural and educational backgrounds.

Practitioners are well aware that leprosy has strong social implications. In western cultures leprosy cases are stigmatized, but this is not the case in all cultures.

It is useful to elicit from patients their explanatory model for the sickness. This would give valuable information about the cultural context of experiencing sickness and shed some light about the potential conflicts between patient and practitioner's perspectives. Areas to be explored are: 1-etiology, 2-time and mode of onset of symptoms, 3-pathophysiology, 4-course of sickness, 5-treatment.

Many patients embrace differing explanatory concepts using biomedical and traditional concepts as well. The germ theory of disease and the natural consequence of killing the organisms as a mean to obtain cure originated in the western culture and is not universally used. It does not provide a satisfactory answer to many questions. Why does this germ affect only some people and not others, 'Why me?' Bad luck, demerit or some circumstantial event are often cited as the cause of disease. A survey on the knowledge about the evolution of the disease done in the U.S. showed that very little factual information was known about leprosy. The popular view is one of a fantasy of extremely severe and debilitating illness. Treatments are often started and discontinued according to the perception of benefits and losses. Patients frequently change practitioners and treatment throughout the course of the illness. Different events may not be seen by the patient as the many possible outcomes of a single disease. Ulcers, macules, loss of sensation, claw hand, shortening of the hands are seen as different sicknesses. Patient education should stress the relationship between symptoms and repeatedly emphasize the need for prolonged therapy. A good knowledge of the local traditional illness beliefs may provide some culturally meaningful explanations that can be used. Modern chemotherapy seldom wins over patients by its own merits.

EDUCATE THE PATIENT: The health practitioner assumes responsibility for the initial counseling and education of the patient and his family. The health practitioner should ascertain the patient's level of knowledge regarding leprosy in addition to thoughts and feelings about having the disease. Misconceptions should be corrected. The anxiety level of the patient may limit the patient's ability to engage in effective teaching during the first interview. The basic facts, however, should be presented. It is recommended that several interviews be conducted in order to repeat and reinforce the teaching. False reassurance contributes to the development of a non-therapeutic relationship and is unfair to the patient. It takes time for a practitioner-patient relationship to develop. Whenever possible, the same nurse should provide care over a period of time. Common to patients with leprosy is the fear that the diagnosis will become known by others. The practitioner must respect this desire for confidentiality.

Points to emphasize to the patients are:

- the necessity for regular treatment and surveillance
- the good prognosis of leprosy treated regularly
- the possibility of reactions, their early signs and the necessity to seek medical care for reactions.
- In the case of existing disabilities, the patient should be taught to cope with them. Special information to cover are: 1-Care of insensitive hands, 2-care of insensitive feet, 3-care of the eyes.

EDUCATE THE FAMILY: The family and close contacts of the case have been exposed to the leprosy bacilli and should be examined regularly for early signs of leprosy. The nurse should:

- emphasize the purpose of these systematic examinations, explain their frequency;
- teach the contacts how to check for early signs of leprosy; change in skin color, change in skin sensitivity, nodules in any part of the body, change in motor function;
- stress the importance of the contact to have any suspect lesions checked by a health person;
- discuss the transmission of Leprosy, the immunity of the majority of people, the incubation and any other relevant epidemiological information;
- answer any questions the contact may have regarding leprosy.
- assist the contact to adjust and accept the need of regular check-ups.

The family plays an important role in the patient's care and progress. They should be taught basic facts in the care and evolution of leprosy.

EDUCATE THE PUBLIC: The public health practitioner has a prime responsibility in public and individual education. It is desirable that the community have a wholesome attitude toward leprosy as a communicable disease. The attitude of the community toward the patient largely determines the ease or

difficulty with which the patient returns to his original environment and job. The goal of the public education should be to remove all erroneous stigma and dishonor from leprosy patients.

EDUCATE YOUR COLLEAGUES: Many health professionals hold similar misconceptions about leprosy. Opportunities should be used to correct these misconceptions and to provide education regarding leprosy.

SOCIAL PROBLEMS OF LEPROSY

The importance of social and cultural factors in leprosy control and the serious implications of these factors on the leprosy patients are now well recognized. The ancient practice of isolation has helped perpetuate the stigma of leprosy in many countries. Since cases are treated at home, it become obvious that customs, culture, social attitudes and restrictive laws of the past have a great impact on leprosy control and on the well-being of patients. Therefore it is important that leprosy workers become involved in the efforts to improve the social and economic conditions of patients through health education and other activities.