M. leprae can be seen lying singly or in clumps in a split skin smear, stained with Ziehl–Nelson method of staining. On treatment with MDT bacilli die but dead bacilli are eliminated slowly and remain in the tissue for long time, even on completion of treatment for 12 months because their elimination from the tissue takes a long time. M. leprae, like other mycobacteria, stains with Carbol Fuchsin and resists decolorization with acid/alcohol, even when dead. A health worker, examining skin smears during treatment, may get the impression that the patient is not improving, despite regular and adequate treatment, unless one can differentiate living from dead bacilli. Familiarization with the appearance or morphology of the bacilli, seen after Ziehl-Nelson’s staining, is important, since living bacilli appear as uniformly stained rods (solid-staining) and dead bacilli appear irregularly stained (fragmented bacilli) or as granules (granular bacilli). Hence, two types of indices are reported.

**Bacterial index**

The density of bacilli in smears is known as the bacterial (bacteriological) index (BI) and includes both living and dead bacilli. It can be recorded in Ridley’s logarithmic scale (below). This is based on the number of bacilli seen in an average High Power microscopic field, using an oil-immersion objective (1/12 in or 2mm).

**Ridley’s Logarithmic Scale for BI**

6+ Many clumps of bacilli in an average field (over 1000)  
5+ 100-1000 bacilli in an average field  
4+ 10-100 bacilli in an average field  
3+ 1-10 bacilli in 10 fields  
2+ 1-10 bacilli in 10 fields  
1+ 1-10 bacilli in 100 fields

When several smears are taken, mean index is calculated. In bacilliferous (MB) patients, on treatment, it may be found that there is no fall (or only a slight fall) in the BI during the first 12 months, because dead and living bacilli are both being counted (both being stained by carbol fuchsin), but after this, a steady fall in density of bacilli takes place over the next 5-10 years. With adequate and effective treatment BI declines by 1 log/year i.e. 1+ per year.

**Morphological index:**

A more sensitive index of bacteriological improvement is required for patients; hence the introduction a system of classifying the bacilli in smears into two groups, solid stained (living), and irregularly-stained (dead). Gerhard Hansen, in 1895, was the first to put forward the view that granular bacilli should be considered dead. The morphological index (MI) is the percentage of solid stained bacilli, calculated after examining 200 red staining elements, lying singly, and this index indicates whether the patient’s leprosy is active, responding to
treatment, and whether the patient has defaulted on treatment or developed bacterial resistance to chemotherapy. An increase in MI therefore indicates a worsening of the patient’s condition, and a decrease indicates improvement. In general, it can be said that the MI of lepromatous patients, commencing treatment, will be somewhere between 25 and 75 (%) and there is a steady fall in MI to zero in 4-6 months of multi-drug therapy.

The BI of a smear reflects the density of bacilli in the skin lesion sampled/tested. Of the two indices, it should be noted that the BI is the most commonly used. The MI calls for consistently high standards of fixation, staining and microscopy which are not usually available outside referral centers, and is thus not routinely advised. Furthermore, it is important to note that the current WHO advice on skin smears in leprosy is that the procedure to the essential minimum (particularly in the field setting), since all skin-piercing methods have the potential risk of transmitting HIV and HBV infection.