

# A Decision Support System Based on Leprosy Scales

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**Abstract**—Leprosy is an infectious disease caused by *Mycobacterium Leprae*, this disease, generally, compromises the neural fibers, leading to the development of disability. Disabilities are changes that limit daily activities or social life of a normal individual. When comes to leprosy, the study of disability considered the functional limitation (physical disabilities), the limitation of activity and social participation, which are measured respectively by the scales: EHF, SALSA and PARTICIPATION SCALE. The objective of this work is to propose an on-line monitoring of leprosy patients, which is based on information scales EHF, SALSA and PARTICIPATION SCALE. It is expected that the proposed system is applied in monitoring the patient during treatment and after healing therapy of the disease. The correlations that the system is between the scales create a variety of information, presented the state of the patient and full of changes or reductions in disability. The system provides reports with information from each of the scales and the relationships that exist between them. This way, health professionals, with access to patient information, can intervene with techniques for the Prevention of Disability. Through the automated scale, the system shows the level of the patient and allows the patient, or the responsible, to take a preventive measure. With an online system, it is possible take the assessments and monitor patients from anywhere.

**Keywords**—Leprosy, Medical Informatics, Decision Support System, Disability.

## I. INTRODUCTION

LEPROSY is an infectious disease caused by *Mycobacterium Leprae*. This factor commits the offense neural fibers, producing a decrease or loss of sensation,

lubrication of skin and muscle strength, leading to the development of physical disabilities [1] [2]. Because the characteristics of leprosy there were different names for those who are affected by it, such as: patients affected by leprosy, leprosy, victims, among others [3]. In this study, the option was, generally, use the term patients.

In the 80s, the World Health Organization (WHO) introduced poliquimiotherapy (PQT), treatment that eliminates all germs, stopping the development of the disease and the chain of transmission, that means, promotes healing therapy of leprosy. With the MDT, patients who receive prompt treatment tend not to develop disability [4]. However, even after healing therapy patients can continue to develop disability because of nerve damage prior to treatment. Brazil currently detects an average of 47,000 new cases each year and about 12,700 (23%), nerve damage and have a disability at diagnosis [2].

As the nerve damage is irreversible, even after treatment the disabilities tend to evolve. The nerves most affected are around the eyes, hands and feet [5]. The elimination of the bacillus, which is considered a therapeutic cure of the disease, not means, necessarily, the end of the development and progression of disability. For there is not such an evolution and development, patients should be monitored continuously as a means of prevention.

Disability, more generally, are changes that limit daily activities or social life of a normal individual, according to age, socioeconomic and education [6]. In leprosy, the study of disability is considered a functional limitation (physical disabilities), the activity limitation and social participation of individuals [7], this limitations are measured, respectively, by the scales: EHF, SALSA and PARTICIPATION SCALE.

Such scales are used to collect information that identify the patient's condition and follow the development of disability [8] [9] [2] [10]. The applications of the scales, during the life of the patient provide evidence that can be used in medicine.

The evidence-based medicine suggests that decisions are taken as obvious facts and findings. This involves finding, understanding and applying the results of studies of specific cases of patients. This process can be facilitated with the support of medical informatics [11].

The objective of this work is to propose an on-line monitoring of leprosy patients based on information scales EHF, SALSA and PARTICIPATION SCALE. It is expected that the proposed system is applied in monitoring the patient during treatment and post-discharge. The correlations that the system is between the scales generates a variety of information, presented the state of the patient and full of

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changes or reductions in disability.

## II. METHODOLOGY

To understand the disability in a better way, there are various scales that identify the status of those affected by leprosy, assisting in monitoring and prevention. Disabilities can be measured based on three elements: a functional limitation, restriction of activities and social participation [10].

The Eyes-Hands-Foot (Eyes-Hands-Feet) (EHF) [2] is a scale measure from the dermatology and neurological exams, used for the diagnosis of functional limitations.

The SALSA scale - Screening of Activity Limitation and Safety Awareness [12] notes the limitation of daily activities and awareness of risk of the individual affected by leprosy [2]. The PARTICIPATION SCALE [2] measures the participation in social life of people affected by stigmatized illnesses [13].

### A. SCALES

#### 1) Functional Limitation – EHF

There is some difficulty to distinguishing functional limitation and disability. Functional limitation refers to the change in the function of a member, besides the purpose and intent of this member. In contrast, disability refers to the effect that the limitation is involving cultural differences and their social representation [7].

Therefore, a functional limitation can be considered a disability, or not, depending on the cultural context that it operates. The EHF is identified as an instrument to measure functional limitation, it does not provide for broader issues such as cultural representation of deformity or disability. To assess the disability is necessary to include the measurement of EHF impressions that the individual has about their difficulties, which can be assessed by other instruments [7].

The dermatology and neurological exams, EHF, is used for to identify the extent of functional limitation. Since 1960, the World Health Organization has been developing a standard for the classification of physical disabilities. In 70 years, was published a tool, which defined a range of 4 degrees of disability and had the intention to create a profile of patients and their disabilities. However, after some studies, in 1988, was published a new tool, with 3 degrees of disability, this new instrument is intended to verify the delay in diagnosis. As lower the grade was find, earlier this diagnosis was made. And as higher the degrees were find, later came the discovery process of the case [5].

To the maximum degree of disability, published in 1988, enter the highest value found in any body segment analyzed (0, 1 or 2) as the degree of disability for a particular person. The EHF score, however, represents an alternative to degrees of disability; it describes the data on disability in more detail. The total EHF score determined the maximum degree for each of the six body sites. Thus, confers degrees from 0 to 2 for each of the places, observing the right and left (right eye, left eye, right hand, left hand, right foot and left foot) and then summing the six scores, obtaining a total value that can vary from 0 to 12 [5].

According to Van Brakel and Brandsma (2003) [5], the peculiarity of the EHF is to present the diagnosis when the patient is being evaluated, their degrees do not have definitive disabilities only, but variable. So, an ulcer, grade 2, depending on the interventions can regress to grade 0, representing no more than a physical disability [10]. This instrument has the function to assist in visualization of the physical condition of the patient from diagnosis to post-discharge. It is a tool that should be applied at various times to review progress or return interventions [4].

#### 2) SALSA – LIMITATION OF ACTIVITY

The SALSA's scale questionnaire was developed by an international group, between 2000 and 2002 and validated in April 2007 as a standardized tool to measure activity limitation and awareness of risk in individuals affected by leprosy, diabetes and other peripheral neuropathies, both in areas where they have developed disabilities as well as in development. It is a tool for rapid implementation, according to the validation: 10 minutes. Its purpose is to diagnose constraints and check the awareness of each interviewee, also has the function to assist the managers of health care in the design of appropriate interventions [13].

The scale provides a total score for limitation of activity and awareness of risk. A low score indicates little difficulty with activities of daily living, while higher scores indicate increasing levels of activity limitation.

The SALSA scale correlates well with the EHF. It appears that when the EHF score is less than 5, the scale of SALSA average is below 30, when the EHF score is greater than or equal to 5, the SALSA scale average is greater than 40. Studies have shown that the SALSA scale tends to increase with age, but no significant difference between men and women [10].

The awareness of risk, in other way, is calculated separately by the number of questions they receive a response with 4 circles. The result is a value between 1 and 11. Higher values indicate a growing awareness of the risks involved in certain activities, but also indicate that there is a limitation of activity due to this fact [5].

#### 3) PARTICIPATION SCALE

The PARTICIPATION SCALE is the result of an international research program dedicated to develop tools for assessment, monitoring and evaluation in rehabilitation [2] [14]. Often, the score of this scale varies more a matter of personal, psychological and emotional, than for reasons of physical health. The comparison between the instruments allows the evaluation of the patient in physical levels and how it is adapting to the physical and psychological restraint and the environment where they live [13].

The PARTICIPATION SCALE is use to identify the restriction on the participation of people affected by leprosy with 15 years of age or older, as defined in the validation of the scale. The scale covers eight of the nine major areas of life, defined in the International Classification of Functioning (ICF) [15]. In a pre-set consists of an interview with 18 items, with scores of each response as indicated in the score board. The total points ranging from 0 to 90 and the average

recommended to be considered normal is 12. People who reach up to 12 points are classified as having no significant impediment to participation and from this value, identifies different degrees of restriction, as noted in table 1 [5] [14].

TABLE I  
GRADES OF PARTICIPATION RESTRICTION

No significant restriction	Mild restriction	Moderate restriction	Severe restriction	Extreme restriction
0 – 12	13 – 22	23 – 32	33 – 52	53 – 90

Source: (PARTICIPATION SCALE - Users manual, 2008. p. 13; BRASIL, 2008. p. 125-126)

Through the application of the scales is acquired information about the patients, but the large amount of data, considering the relations between the scales, complicates the assessment manual. For this reason, it is necessary to use computational methods that assist in monitoring the patients and the analysis of many variables. The information from these tests can subsidize the activities of health professionals, particularly in regard to evidence-based medicine.

The evidence-based medicine suggests that all health professionals, in the care of their patients, make decisions from the bests and most current evidence [16] [11]. This

practice implies, besides the clinical experience and knowledge, in easy to find, understand and apply the results of scientific studies to the specific cases of patients. This requires intelligence and skill. The medical information, by its specific methods, processes information and offers levels of reliability possible results from the correlations among the data, supporting evidence with the medical practices [11]. Based in computer resources, data are processed in different ways and cleared, using complex techniques, which are difficult to be performed in manual mode.

### III. RESULTS

Knowing that the scales in the world are typed manually, we developed a system where that is possible fill the information in a system with automated tests and conducting the User to correct completion.

The Figure I shows the area that the responsible for the patient can view the information in a practical way. This same aspect ratio is used to register information from other scales, the only difference is that there is an entry of data concerning the patient being evaluated. The data entries are relative from EHF scales: Eyes, Hands, Foot and Nose. Each variable received a value to obtain a final score. Zero is part of the scale, the X was used to say that the individual does not have a problem.

The screenshot displays the 'Leprosy System V 1.7 BETA - EHF' application. It features a menu bar (File, Register, View, Help) and four main data entry panels:

- Eye:** A table with columns for Side, Cataract, Not count fingers up to 6m, Lagophthalmos, Trichiasis, Corneal, Ectropion, Corneal anesthesia, and No problem. Data is entered for Left and Right sides.
- Hand:** A table with columns for Side, Mobile Grab, Rigid Grab, Resorption, Cleft, Ulcer, Callosity, Fallen Hand, Dryness, Traumatic Injuries, Anesthesia, and No problem. Data is entered for Left and Right hands.
- Foot:** A table with columns for Side, Mobile Grab, Rigid Grab, Resorption, Cleft, Ulcer, Callosity, Fallen Foot, Dryness, Traumatic Injuries, Anesthesia, Stagnant Articulation, and No Problem. Data is entered for Left and Right feet.
- Nose:** A table with columns for Dryness, Nasal Secretion Increased, Crusts, Bloody discharge, Ulcers, Nasal septum perforation, and No Problem. Data is entered for the patient's nose.

At the bottom, the 'EHF (SCORE) - ABSTRACT' section shows a summary table with columns for Right eye, Left eye, Right hand, Left hand, Right foot, Left foot, Date, and Evaluator. Below this, the 'Total Score' is displayed as 8, with buttons for 'Save', 'Clear Fields', and 'Update'.

Fig. I EHF Scale

To understand how the system monitoring work with leprosy patients, Figure II shows a scheme with all the features. The system allows it to be registered patient's personal data without needing to be assessed by the scales. This permission is important so the patients can be registered in the system through interviews in the home and when you

arrive for an evaluation, first registration is unnecessary, making the consultations focused on ratings.

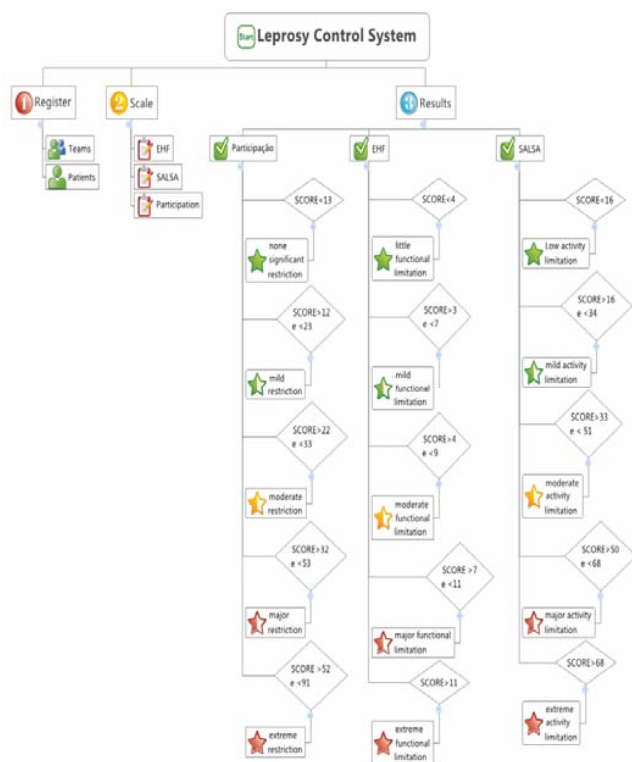


Fig. 2 Leprosy Control System (Functions)

Considering the operation system shown in Figure II, it is important to mention that the Register (1), each User receives permission within the system are divided as follows: only access to register patients or access to register patients and

Right Eye	Left Eye	Right Hand	Left Hand	Right Foot	Left Foot	Total Score	Date	Evaluator
2	2	1	0	2	1	8	12/07/2009	Hugo

Easy	Bit Difficult	Very Hard	Not gonna do it	Physically I c...	I avoid beca...	SALSA SCORE	Awareness Risk	Evaluator
1	6	12	0	28	4	51	4	Claudia

Fig. 3 Compact Report

The report presented in Figure III also allows access to more detailed reports, as well as displays by date query the state of the patient, allowing the physician to take a decision according to each case. These reports are based on the scale

scales. The results (3) are automatically generated by algorithms and is available online for patients to access with login and password and those who have access to the register and scales.

The system integrates the three scales EHF, SALSA and participation, facilitating the visualization of the patient. For all information concerning the physical deformities (EHF), the limitation of activity (SALSA) and social participation, are included in it.

For monitoring the development of disability in the patient, even after cure therapy, the system provides reports with information from each of the scales and the relationships that exist between them. Health professionals, with access to detailed information about patients, they can act with precise techniques for the Prevention of Disability contributes to preventing the development and progression of disability. Figure III shows the reports of a compact form, allowing the doctor a view of the situation of the patient who is waiting for consultation or just to watch the evolving framework.

register with patient score demonstrated in results cases (Figure II).

In this example case represented in Figure III, the patient was considered "none significant restriction" from

participation scale, "little functional limitation" from first EHF scale, "major functional limitation" from second EHF and "major functional limitation" from SALSA.

#### IV. CONCLUSION

A system for decision support that can help in surveillance and monitoring of the development and progression of disability in leprosy patients was presented. The scales: SALSA, EHF and PARTICIPATION SCALE are excellent indicators for monitoring the development and progression of disability in leprosy patients, considering that they provide information on the various aspects of disability. Through the automated calls, the system shows the level of the patient and allows the responsible for this patient to take the best decision as a preventive measure for the development of disability. With an online system, is possible take measurements, monitoring and verifying the evolution of the status of patients, even if they are unable to reach the health units or have they changed address, for this is only necessary that the assessor have a computer with access Internet access and a login that allows such access.

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