Monitoring impairment in leprosy: choosing the appropriate tool

JANNINE EBENSO & BASSEY E. EBENSO
The Leprosy Mission, PMB 179, Minna, Niger State, Nigeria

Accepted for publication 10 July 2007

Summary
Objective To assess to what extent the Maximum WHO Impairment Grade, the EHF Score and Impairment Summary Form (ISF) reflect changes in impairment, both in number(s) and severity.
Design The impairment data at registration and at release from treatment of 444 persons affected by leprosy registered for MDT from 1994–2003 in Federal Capital Territory, Nigeria were analysed using three monitoring tools.
Results Of the 444 patients, 92 people had a change (10 deteriorated, 70 improved while 12 had improvement in some parts of their body and deterioration in other parts) in their impairment between Registration and Release from Treatment. Of the 10 people whose impairment status deteriorated, the WHO Grade missed 7 and the EHF Score missed 4. The ISF missed none. Of the 70 whose impairment status improved, the WHO grade missed 27; the EHF score missed 20 and the ISF missed 9. The WHO Grade had a sensitivity of 50%, the EHF Score 61% and the ISF 90%. Negative predictive values were 88%, 91% and 98% respectively.
Conclusions The Maximum WHO Impairment Grade use should be limited to an indicator of late case detection. The EHF score is better used at programme level than individual patient level. The ISF is a sensitive tool for monitoring impairments at patient level to aid clinical decision making.

Introduction
It is estimated that more than three million people are living with disability from leprosy. Much of this disability can be prevented and the new WHO Global Strategy for reducing the Burden of Leprosy and Sustaining Leprosy Control Activities calls for increased efforts to reduce this ‘burden’ by preventing disability in new cases, by helping to rehabilitate those with disability and by fighting stigma wherever it exists.1

According to the International Classification of Functioning, Disability and Health (ICF) disability is the overall term which includes impairments, activity limitation and participation restriction.2 Impairments are problems in body function or structure such as a significant deviation or loss. Activity Limitations are difficulties an individual may have in executing
activities. Participation Restrictions are problems an individual may experience in involvement in life situations.

One of the objectives of Leprosy Control Programmes (LCP) is to prevent new impairments and to prevent deterioration in existing impairments through a comprehensive prevention of disability (POD) programme which has the following components: early case detection, management of lepra-reaction, eye care, self care, provision of protective footwear and management of ulcers.³

Impairments may be present or absent at the time leprosy is diagnosed.¹ During multi-drug therapy (MDT), new impairments may develop, and existing impairments may become worse, remain the same or improve. These impairments are mainly a result of nerve damage.⁴

There are three commonly used tools for monitoring impairments in leprosy; the Maximum WHO Impairment Grade, the EHF Score and the Impairment Summary Form.

THE MAXIMUM WHO IMPAIRMENT GRADE

In the 1988 WHO system,⁵ impairment is reflected by grades assigned to each eye, hand and foot using a scale of three possible outcomes (0, 1, 2). The maximum of these six grades, the ‘Maximum WHO Impairment Grade’, specifies the patient’s overall score. In 1998 the grades of the eyes were re-defined and the scale updated.⁶

The Maximum WHO Impairment Grade recognises both first onset of impairment and total recovery of existing impairment. It is widely used in Nigeria at present as it is one of the essential indicators needed on the forms to be submitted to the National TB/Leprosy Control Programme and also on the annual ILEP B form.

THE EYE, HAND & FOOT IMPAIRMENT (EHF) SCORE

The EHF Score was first introduced by de Rijk et al. in 1994.⁷ It uses the sum instead of the maximum of the individual grades for eyes, hands and feet. The EHF score is suggested as preferable to the Maximum WHO Impairment grade for evaluation purposes.⁸ It is used routinely in less than 15 projects in Nigeria at present.

THE IMPAIRMENT SUMMARY FORM (ISF)

The ISF was developed by Jean Watson and included in the ILEP Guidelines for Prevention of Disability in Leprosy Control Programmes (1993) as the District Disability Summary Form.⁹ It has been subsequently adapted and renamed the Impairment Summary Form.⁹ It is not routinely used in Nigerian projects to date.

The methods adopted by the Nigerian programme to measure effectiveness of POD activities as set out in the workers’ manual include assessing effectiveness of early case detection and treatment of recent nerve damage and evaluating self-care and footwear programmes using vision, bone loss and wound counts as indicators by comparing impairment recorded for each patient at diagnosis with that recorded at Release From Treatment (RFT).¹⁰

Many researchers have studied the presence of impairments at diagnosis of leprosy, but few have looked at the dynamics of impairment.¹¹ Previous studies have studied the relative sensitivity of the WHO and EHF.¹¹,¹² These studies recommend the EHF sum score above the
Maximum WHO Impairment Grade for evaluation purposes. No studies have looked at the relative sensitivity of the impairment summary form compared to the other two tools. The objective of this study therefore is to assess to what extent the three tools reflect changes in impairment status, both in number(s) and severity.

Materials and Methods

Study Area

The Federal Capital Territory (FCT) is situated in the centre of Nigeria, and consists of a large urban development of more than 3 million people and surrounding semi-urban townships with smaller rural villages.

The Federal Capital Territory TB and Leprosy Control Programme (FCT-TBLCP) is the TB/Leprosy Control programme covering an area of 8,000 km². Managed by the Department of Community Health of the Federal Capital Development Authority (FCDA), the programme covers all six area councils in the FCT. There is a programme manager who is a medical officer and the programme activities are carried out by six TB/Leprosy Supervisors (TBLS). Most of the people affected by leprosy in FCT are urban migrants from the 36 states in Nigeria.

Impairment data is routinely collected by the TBLS at each of the MDT clinics in the FCT. These TBLS are qualified community health extension workers with special training in leprosy at the National TB/Leprosy Training Centre, Zaria.

Study Design

This study is a retrospective, descriptive, cross-sectional study.

Study Population

All people affected by leprosy registered for MDT within the FCT between 1994 and 2003 were included in the study.

Exclusion Criteria

Registered cases with incomplete or absent impairment data at both registration and release from treatment (RFT).

Data Collection

The record cards of all newly registered leprosy patients seen in all six area councils in FCT over the 10 year period from 1994–2003 were collected together and the impairment data at registration and RFT noted.

The impairment data routinely collected by the TBLS and recorded onto the leprosy patient record card were:

- Sensory testing using a ballpoint pen at 10 sites on each palm and each sole
- Voluntary Muscle Testing of the four movements indicated on the patient record card; eye lid closure; 5th finger out; thumb up and foot up
- Visual Acuity using counting fingers at 6 metres or preferably an E chart
- Observation of spontaneous blink
- Wound charting – by drawing the wounds or open cracks on the hand and foot maps where the sensory testing is charted
- Bone loss charting – by marking on the hand and foot maps where the fingers/toes have been amputated or absorbed

From each patient record card, the impairments were extracted onto Impairment Summary Forms and the Maximum WHO Impairment Grade and EHF score at Registration and RFT were recorded. The actual impairment recorded of the eyes, hands and feet on each of the cards was noted by one of the researchers and was used to compare with the impairments reflected by the three tools.

DATA ANALYSIS

The data was analysed using Microsoft Excel. Each tool was compared to the actual impairment recorded on the patient record card to measure sensitivity to change in impairment and each tool was also compared with the other two tools. Data were presented in tables as appropriate.

Using the actual impairments recorded on the cards as standard the sensitivity, specificity and positive and negative predictive values were assessed.

ETHICAL CONSIDERATIONS

Approval to carry out the study was obtained from the Programme Manager and also from The Leprosy Mission International. Confidentiality was ensured by using numbers only on the summary sheets.

DEFINITIONS

The operational definitions used by FCT-TBLC as at the time of the study were:

**WHO Impairment Grade**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
</table>
| Grade 0 | No anaesthesia.  
| | No visible deformity due to leprosy |
| Grade 1 | Anaesthesia present  
| | No visible deformity due to leprosy |
| Grade 2 | Visible impairment  
| | Lagophthalmos, corneal ulcer, iridocyclitis  
| | Visual acuity < 6/60 |

Each eye, hand and foot is assessed and graded separately giving six individual scores.
Maximum WHO Impairment Grade

This is the highest value of the six individual grades (0, 1, or 2)

EHF Sum Score

This is the sum of the six individual grades (range 0–12)

Impairment Summary Form

The Impairment Summary Form has three variables for each eye, five variables for each hand, and four variables for each foot. That gives a total of 24 variables that can be easily and quickly checked for changes. \((3 + 5 + 4) \times 2 = 24\)

Each of the variables can be scored in more detail than in the EHF sum score and Maximum WHO Impairment Grade. The total number of outcomes that can be reflected in the Impairment Summary Form used in FCT-TBLCP is shown in table 1.

Table 1. The number of variables that are reflected in the Impairment Summary Form used in FCT-TBLCP

<table>
<thead>
<tr>
<th>Variables</th>
<th>Outcome</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye</td>
<td>Blink</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Blink</td>
<td>No</td>
</tr>
<tr>
<td>Vision</td>
<td>Normal &gt; 6/18</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Impaired &lt; 6/18</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Blind &lt; 3/60</td>
<td>2</td>
</tr>
<tr>
<td>VMT</td>
<td>Lid gap in millimetres</td>
<td>millimetres</td>
</tr>
<tr>
<td>Hand</td>
<td>5th finger</td>
<td>Strong</td>
</tr>
<tr>
<td></td>
<td>5th finger</td>
<td>Resistance reduced</td>
</tr>
<tr>
<td></td>
<td>5th finger</td>
<td>Movement reduced</td>
</tr>
<tr>
<td></td>
<td>5th finger</td>
<td>Paralysed</td>
</tr>
<tr>
<td>Thumb</td>
<td>Strong</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Resistance reduced</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Movement reduced</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Paralysed</td>
<td>3</td>
</tr>
<tr>
<td>Sensation</td>
<td>Number of points with sensory loss</td>
<td>0–10</td>
</tr>
<tr>
<td>Wound Count</td>
<td>Count number of wounds</td>
<td>Count</td>
</tr>
<tr>
<td>Bone Loss</td>
<td>Count number of sensory testing points lost</td>
<td>0–10</td>
</tr>
<tr>
<td>Foot</td>
<td>Foot up</td>
<td>Strong</td>
</tr>
<tr>
<td></td>
<td>Foot up</td>
<td>Resistance reduced</td>
</tr>
<tr>
<td></td>
<td>Foot up</td>
<td>Movement reduced</td>
</tr>
<tr>
<td></td>
<td>Foot up</td>
<td>Paralysed</td>
</tr>
<tr>
<td>Sensation</td>
<td>Number of points with sensory loss</td>
<td>0–10</td>
</tr>
<tr>
<td>Wound Count</td>
<td>Count number of wounds</td>
<td>Count</td>
</tr>
<tr>
<td>Bone Loss</td>
<td>Count number of sensory testing points lost</td>
<td>0–10</td>
</tr>
</tbody>
</table>
Variables = 5 outcomes each eye = 10 (plus lid gap in millimetres)
Variables = 30 outcomes each hand = 60 (plus wounds)
Variables = 26 outcomes each foot = 52 (plus wounds)
Grand total = 10 + 60 + 52 = 122 outcomes (plus wounds plus lid gap)

Results

Five hundred and forty eight (548) patient record cards were found, out of which 444 (81%) that had impairment data at registration and RFT were included in the study. The remaining 104 cards were excluded from the study.

Table 2 shows there was a gradual annual reduction of new patients registered for MDT in FCT. In 1994 the proportion of cards with complete impairment data was only 65%, more recently, the proportion has been much higher, reaching at least 90% every year since 1998. By 2003 it was 100%.

The actual impairment was assessed by the researchers from the leprosy patient record cards, noting each impairment of the eyes, hands and feet recorded. Of the 444 cases under review 324 (73%) had no impairment at diagnosis, while 400 (90%) had no impairment at RFT. Impairment at registration is more common in MB cases (22%) than PB cases (15%). At RFT, the impairment is more common in PB (10·5%) than MB (7·8%). Most patients (80%) showed no change in impairment between Registration and RFT. (Table 3).

The Impairment Summary Form was able to accurately reflect the 10 people who had an increase in impairment during the treatment period, whereas the WHO Grade and the EHF sum score missed 7 of the 10 and 4 of the 10 respectively. (Table 3)

Neither the WHO Grade nor the EHF score reflected the 12 people who had deterioration in some impairment and improvement in other impairment, as the changes either cancelled each other out or did not change the grade for that body part anyway. (Table 3)

Of the 444 people included in the study, 352 had no change in impairment during MDT. The Maximum WHO Impairment Grade reflected 398 as having no change in impairment. Of these, 46 actually had a change in impairment. (Table 4).

<table>
<thead>
<tr>
<th>YEAR</th>
<th>PB</th>
<th>MB</th>
<th>Total</th>
<th>Cards with impairment data at both registration and RFT</th>
<th>Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>24</td>
<td>114</td>
<td>138</td>
<td>89 (65)</td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>21</td>
<td>62</td>
<td>83</td>
<td>68 (82)</td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>5</td>
<td>53</td>
<td>58</td>
<td>47 (81)</td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>10</td>
<td>59</td>
<td>69</td>
<td>47 (68)</td>
<td></td>
</tr>
<tr>
<td>1998</td>
<td>14</td>
<td>34</td>
<td>48</td>
<td>47 (98)</td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>9</td>
<td>29</td>
<td>38</td>
<td>37 (97)</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>5</td>
<td>34</td>
<td>39</td>
<td>38 (97)</td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>3</td>
<td>26</td>
<td>29</td>
<td>26 (90)</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>6</td>
<td>24</td>
<td>30</td>
<td>29 (97)</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>1</td>
<td>15</td>
<td>16</td>
<td>16 (100)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>98</td>
<td>450</td>
<td>548</td>
<td>444 (81)</td>
<td></td>
</tr>
</tbody>
</table>
The EHF score recorded 388 as having no change in impairment, of these, 36 did have change. The ISF recorded 361 as having no change. Of these, nine actually had a change.

(Table 4)

None of the three tools reflected all the changes in impairments. Using the actual impairments recorded on the cards as standard the sensitivity, specificity and positive and negative predictive values were assessed. The Maximum WHO Impairment Grade was the least sensitive; with a sensitivity of 50% the Maximum WHO Impairment Grade missed half of the patients who had change in impairment. The EHF score was more sensitive, but with a sensitivity of 61% it still missed over a third of patients who had a change in impairment. With a sensitivity of 90%, the impairment summary tool is the most sensitive and missed only 10% of the patients who had change in impairment during MDT. (Table 5)

With a negative predictive value of 0.98, when the ISF reflects no change, there is 2% chance that there really is change in impairment. For the Maximum WHO Impairment Grade

The EHF score recorded 388 as having no change in impairment, of these, 36 did have change. The ISF recorded 361 as having no change. Of these, nine actually had a change. (Table 4)

None of the three tools reflected all the changes in impairments. Using the actual impairments recorded on the cards as standard the sensitivity, specificity and positive and negative predictive values were assessed. The Maximum WHO Impairment Grade was the least sensitive; with a sensitivity of 50% the Maximum WHO Impairment Grade missed half of the patients who had change in impairment. The EHF score was more sensitive, but with a sensitivity of 61% it still missed over a third of patients who had a change in impairment. With a sensitivity of 90%, the impairment summary tool is the most sensitive and missed only 10% of the patients who had change in impairment during MDT. (Table 5)

With a negative predictive value of 0.98, when the ISF reflects no change, there is 2% chance that there really is change in impairment. For the Maximum WHO Impairment Grade

<table>
<thead>
<tr>
<th>Actual Impairment</th>
<th>More impairment</th>
<th>Less impairment</th>
<th>No change</th>
<th>Change (+ and −)*</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHO</td>
<td>10</td>
<td>70</td>
<td>352</td>
<td>12</td>
<td>444</td>
</tr>
<tr>
<td>Maximum WHO Impairment Grade</td>
<td>3</td>
<td>43</td>
<td>398*</td>
<td>0</td>
<td>444</td>
</tr>
<tr>
<td>EHF Score</td>
<td>6</td>
<td>50</td>
<td>388+</td>
<td>0</td>
<td>444</td>
</tr>
<tr>
<td>Impairment Summary Form</td>
<td>10</td>
<td>61</td>
<td>361+</td>
<td>12</td>
<td>444</td>
</tr>
</tbody>
</table>

* Those cards that showed improvement in some impairments and deterioration in other impairments in the same patient were classed as ‘change (+ and −)’.

+ In these cases, the number of people recorded as no change by the summary tool was higher than the number who really had no change.

For all three tools, the most frequently missed impairment data were the records of visual acuity.

Table 3. Comparison of changes in impairment in 444 patients registered for MDT in FCT-TBLCP as reflected by the maximum WHO impairment grade, the EHF Score and the Impairment Summary Form

<table>
<thead>
<tr>
<th>Actual Impairment</th>
<th>Change</th>
<th>No change</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHO</td>
<td>46</td>
<td>0</td>
<td>46</td>
</tr>
<tr>
<td>Change</td>
<td>46</td>
<td>352</td>
<td>398</td>
</tr>
<tr>
<td>No change</td>
<td></td>
<td>352</td>
<td>444</td>
</tr>
<tr>
<td>Total</td>
<td>92</td>
<td>352</td>
<td>444</td>
</tr>
<tr>
<td>EHF</td>
<td>56</td>
<td>0</td>
<td>56</td>
</tr>
<tr>
<td>Change</td>
<td>36</td>
<td>352</td>
<td>388</td>
</tr>
<tr>
<td>No change</td>
<td>92</td>
<td>352</td>
<td>444</td>
</tr>
<tr>
<td>Total</td>
<td>92</td>
<td>352</td>
<td>444</td>
</tr>
<tr>
<td>ISF</td>
<td>83</td>
<td>0</td>
<td>83</td>
</tr>
<tr>
<td>Change</td>
<td>36</td>
<td>352</td>
<td>361</td>
</tr>
<tr>
<td>No change</td>
<td>92</td>
<td>352</td>
<td>444</td>
</tr>
<tr>
<td>Total</td>
<td>92</td>
<td>352</td>
<td>444</td>
</tr>
</tbody>
</table>
and EHF score, the negative predictive values are 0.88 and 0.91 respectively. This results in a 9% and 12% chance that there really is change in impairment when they do not detect any change. (Table 5)

**Discussion**

The Maximum WHO Impairment Grade, EHF Score and Impairment Summary Form (ISF) do not have equal sensitivity or predictive values. In this study, the Maximum WHO Impairment Grade has a sensitivity of 50% and a negative predictive value of 88%. The EHF Score has a sensitivity of 61% and a negative predictive value of 91%. The ISF has a sensitivity of 90% and a negative predictive value of 98%. These findings are similar to those in previous studies by Meima et al.\(^\text{11}\) and van Brakel & Reed.\(^\text{12}\)

The strength of this study is that it is the first to compare the Impairment Summary Form with the Maximum WHO Impairment Grade and EHF Score.

The weaknesses of the study are that it is limited to a small population of only 444 and only looks at the change in impairment within the MDT period. Clients already released from treatment when impairments are expected to be more dynamic were not included. Meima et al.\(^\text{11}\) studied the dynamics of impairment not only during the MDT period but also after RFT. Also, only one person examined each card for the ‘actual impairment’. A more objective analysis may have been gained from an expert panel examining the cards.

The Maximum WHO Impairment Grade is widely used not only in Nigerian projects but in all leprosy control programmes. The six individual grades are routinely collected by health workers managing people affected by leprosy. In most projects it is the only impairment indicator that is used (probably because it is the indicator requested on the annual ILEP B forms). The Maximum WHO Impairment Grade is simple to use, but is not sensitive to change. In this study, only 50% of patients who had a change in impairment were reflected by the WHO grade. Van Brakel & Reed,\(^\text{12}\) Buddingh & Idle\(^\text{13}\) and Meima et al.\(^\text{11}\) have extensively discussed the weaknesses of the Maximum WHO Impairment Grade as a monitoring tool. One criticism of the Maximum WHO Impairment Grade is that it is unable to discriminate between a major change in one component and minor changes in several components. Also, it only recognises the first onset of impairment and the total recovery of an existing impairment.\(^\text{11}\) More subtle changes in impairment are not reflected by the Maximum WHO Impairment Grade. Once grade 2 is reached (e.g. mobile claw), there is no change in the impairment grade even if the visible impairment becomes worse (complete loss of all fingers). In this study, seven out of the 10 patients with increased impairment during MDT

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity %</th>
<th>Specificity %</th>
<th>+ ve Pred. Value %</th>
<th>-ve Pred. Value %</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHO</td>
<td>50 (39, 61)</td>
<td>100 (99, 100)</td>
<td>100 (90, 100)</td>
<td>88 (85, 91)</td>
</tr>
<tr>
<td>EHF</td>
<td>61 (50, 71)</td>
<td>100 (99, 100)</td>
<td>100 (92, 100)</td>
<td>91 (87, 93)</td>
</tr>
<tr>
<td>ISF</td>
<td>90 (82, 95)</td>
<td>100 (99, 100)</td>
<td>100 (94, 100)</td>
<td>98 (95, 99)</td>
</tr>
</tbody>
</table>

95% Confidence Interval in brackets
were missed by WHO grade. These patients therefore missed out on being further examined for signs of lepra-reaction or other complications.

With this low sensitivity to change, we concur with previous studies that the Maximum WHO Impairment Grade be used only to compare the impairment profiles of newly detected cases.\textsuperscript{11}

The EHF score is more sensitive to change in that it allows each of the six parts of the body that are examined to reflect in the impairment grade.\textsuperscript{7} The EHF score is simple, reproducible, and like the WHO Grade, the six grades needed to calculate the score are routinely collected in control programmes.

Papers published recently have used the EHF score as the tool of choice for evaluation purposes, rather than the Maximum WHO Impairment Grade.\textsuperscript{7,8,11,12} The EHF sum score has been suggested as a tool for monitoring the effectiveness of steroid programmes.\textsuperscript{11,12} The EHF score gives an indication of the extent of nerve involvement. A score of 5 or more implies extensive nerve involvement, with at least three nerves affected. The EHF score measures both primary impairments (sensory loss and muscle weakness related to active neuritis) and secondary impairments (wounds, ulcers, tissue loss).

The EHF score is not a perfect impairment indicator as it is a simple sum of the WHO impairment grades of the extremities and eyes. Hence the weaknesses of the WHO grade mentioned above are carried over into the EHF score. Meima \textit{et al.}\textsuperscript{11} state that EHF score change does not necessarily reflect a patient’s impairment dynamics well because improvement in one extremity or eye may coincide with worsening in another. In this study, 12 patients had this change in both directions and were not picked up by the EHF score.

In this study, the EHF failed to recognise deterioration in four out of the 10 patients who developed increased impairment whilst on MDT. These patients may have needed reaction management of other interventions for complications of leprosy. This finding agrees with Broekhuis \textit{et al.}\textsuperscript{8} who have demonstrated that the EHF score is not a suitable device for monitoring individual patient management. It is rather a tool for monitoring at Programme level. The EHF score should be the tool of choice to assess programme effectiveness in impairment prevention.

The Impairment Summary Form is promoted as a tool for monitoring patients in leprosy control programmes as it is more sensitive to change than both the other tools. In this study, we found a sensitivity of 90%. The ISF we used has 24 variables with 122 outcomes that can reflect change in impairment for better or for worse. Each variable is completely independent of the others. The sensitivity of the ISF will be reduced if fewer columns are used.

Apart from in the eye, the ISF can be used not only to monitor secondary impairments (for which it was initially designed), but also can show the development of primary nerve damage. If another column for eyelid strength were added to the ISF that was used in this study, then it would be more useful as a monitoring tool for primary nerve damage.

The recently published ILEP Learning Guide 4, \textit{How to prevent Disability in Leprosy}, recommends the ISF as a suitable tool for monitoring impairment.\textsuperscript{9}

The common weakness of all three tools is that they all depend on the accuracy of the assessor in carrying out and recording the physical examination of the patient. All three tools require the person summarising the impairments for the individual patient to understand the leprosy patient record cards and understand how to transfer data from the record card to the summary form. The degree of skill at this stage is the same whichever summary tool will eventually be used.
As with all summary tools, the fact that one is summarising information may lead to some information being lost in the process. However, the ISF appears to have an advantage in the amount of information that is retained after summary when compared to the Maximum WHO Impairment Grade and the EHF score. The Maximum WHO Impairment Grade and the EHF score both appear to lose information in the summary process, particularly information related to primary impairments.

In this study we looked at change in impairment during MDT. Meima et al.\textsuperscript{11} have shown that there is more dynamicity of impairment after RFT, making the need for a sensitive tool more urgent. On the other hand the retaining of more information is balanced by the greater complexity of the ISF, resulting in more errors when transferring the information from card to form.

The unanswered question is what level of sensitivity do we need in our programmes at national, district, clinic and individual level? Future research could assess the sensitivity, specificity and predictive values of the Impairment Summary Form suggested in ILEP Learning Guide 4, especially in RFT populations.

**Conclusion**

The Maximum WHO Impairment Grade, although widely used has been shown to not be sensitive enough to be an effective tool for monitoring changes in impairment. Its use should be limited to an indicator of late case detection.

There is ample published evidence of the effectiveness of the EHF score as a simple tool to monitor changes in impairment over time. However, with a sensitivity of only 61\%, it is better used at programme level than individual patient level.

With high sensitivity and predictive value, the Impairment Summary Form is a useful tool for monitoring impairments at patient level to aid clinical decision making.

**Acknowledgements**

We are grateful to the staff of FCT-TBLCP for recording of the impairments of the patients which enabled this evaluation to take place. Many thanks also to Dr. Clara Ejembi, Department of Community Health, ABU Teaching Hospital, Zaria who supervised the writing of this paper and assisted with statistical analysis.

**References**