

## Task Force Report on Scales to Assess Dyskinesia in Parkinson's Disease: Critique and Recommendations

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**Abstract:** Drug-induced dyskinesia is a common phenomenon in Parkinson's disease (PD) and is often socially as well as physically disabling for patients. The Movement Disorders Society commissioned a task force to assess available clinical rating scales, critique their clinimetric properties, and make recommendations regarding their clinical utility. A task force composed of six clinical researchers who systematically searched the literature for scales measuring dyskinesia in PD, evaluated the scales' previous use, performance parameters, and quality of validation data (if available). A scale was designated "Recommended" if the scale has been used in clinical studies beyond the group that developed it, has been specifically used in PD reports, and if clinimetric studies have established that it is a valid, reliable, and sensitive. "Suggested" scales met two of the above criteria and those meeting one were "Listed." Based on the systematic review, eight rating scales for dyskinesia that have either been validated or used in PD were identified. These were the Abnormal Involuntary Movement Scale (AIMS), The Unified Parkinson's Disease Rating Scale (UPDRS) part IV,

the Obeso Dyskinesia Rating Scale, the Rush Dyskinesia Rating Scale, the Clinical Dyskinesia Rating Scale (CDRS), the Lang-Fahn Activities of Daily Living Dyskinesia Scale, the Parkinson Disease Dyskinesia Scale (PDYS-26), and the Unified Dyskinesia Rating Scale (UDysRS). Based on this review, at present two of the reviewed dyskinesia scales (AIMS and the Rush Dyskinesia Rating Scale) fulfill criteria for Recommended for use in PD populations, albeit weakly so; all of the remaining met criteria to be Suggested. However, the two most recent scales (PDYS-26 and UDysRS) have excellent clinimetric properties and appear to provide a reliable and valid assessment tool of dyskinesia in PD. If they are used successfully beyond the groups that developed them, both have the potential to be re-ranked as Recommended. As further testing of these scales in PD is warranted, no new scales are needed until the available scales are fully tested clinimetrically. © 2010 Movement Disorder Society

**Key words:** dyskinesia; Parkinson's disease; clinimetrics; rating scales; validity; reliability

Supporting Information may be found in the online version of this article.

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Potential conflict of interest: The development of the UDysRS was supported by grants from the Michael J. Fox Foundation and EMD/Merck KGaA Pharmaceuticals. The Training Program was additionally supported by Santhera Pharmaceuticals. Final production, supplemental filming and editing expertise were provided by i3 Research, Inc. He has also consulted with Solvay Pharmaceuticals on the use of the UDysRS and Juvantia Pharmaceuticals and EMD/Merck KGaA in the development and analysis of data related to dyskinesia treatments.

Received 2 June 2009; Revised 13 January 2010; Accepted 7 February 2010

Published online 22 March 2010 in Wiley InterScience (www.interscience.wiley.com). DOI: 10.1002/mds.23072

Drug-induced dyskinesia is common in Parkinson's disease (PD) and is often associated with social and physical disabilities. Cross-sectional prevalence ranges from 20 to 56%, and established risk factors are onset of PD at young age, long disease duration, and high total dosage of levodopa and other dopaminergic drugs.<sup>1-4</sup> Studies performed in patients chronically receiving levodopa or after acute dopaminergic challenge have suggested that dyskinesia usually appears first on the body part most affected by parkinsonian symptoms.<sup>3</sup> In a minority of patients with asymmetric parkinsonism, dyskinesia can also begin bilaterally or in the cranial region.<sup>4</sup> As PD progresses, dyskinesia inevitably spreads to the other parts of limbs and may involve the trunk and the cranial region. The underlying mechanisms for drug-induced dyskinesia are unclear though several experimental studies indicate the pathogenic importance of pulsatile stimulation of striatal dopaminergic receptors.<sup>1</sup>

Several rating scales have been used in clinical practice since the 1970s for the assessment of dyskinesia in PD. Some were specifically developed for dyskinesia in PD, whereas others were part of global scales that measure motor disability in PD. Some scales were originally developed for use in other syndromes with dyskinesia, but later adapted to score PD dyskinesia.<sup>5</sup> In the last decade, new pharmacological and surgical treatments for advanced PD have been developed and tested.<sup>6</sup> These efforts are limited by the lack of a single, reliable, and widely accepted clinical rating instrument for dyskinesia. In 1998, an international symposium specifically devoted to dyskinesia in PD was held in Toulouse, France, and its summary document emphasized the critical need for a single validated scale for assessing dyskinesia.<sup>7</sup> The development of a good clinical rating instrument has been made difficult by inherent features of dyskinesia such as the extreme variability of involuntary movements in relationship to the point in time of observation and to the activity carried out by the patient during the evaluation; furthermore, the discrimination among the different types of dyskinesia and between drug-induced dyskinesia and parkinsonian tremor may not be easily captured in a standard rating scale.

Because of the impact of dyskinesia on activities of daily living, quality of life, and consequent global disability of patients with advanced PD, the Movement Disorder Society (MDS) organized a systematic review of the clinimetric properties of the scales used to measure dyskinesia in PD. MDS-sponsored reviews of scales for assessing other aspects of PD have already

been published,<sup>8-11</sup> and the methodology of this review is similar.

## MATERIALS AND METHODS

### Administrative Organization and Critique Process

The steering committee of the MDS Task Force on Rating Scales for PD invited the chairman (CC) to form a task force to critique existing dyskinesia rating scales for their use in PD and to place them in a clinical and clinimetric context. This group consisted of MDS members with diverse background and expertise and followed the same working methods as the task forces that critiqued rating scales for anxiety, apathy, depression, and psychosis in PD.<sup>8-11</sup> The task force members selected the scales to be included in the review and identified unresolved issues and limitations of the critiqued scales. The *proforma* previously used to assess the other PD rating scales was adapted for reviewing dyskinesia rating scales. This *proforma* allowed structured assessment of the scales with regard to their descriptive properties, availability, content, use, acceptability, clinimetric properties, and overall impression in patients with and without PD (Supporting Information Material 1). Each scale was reviewed by one task force member. The completed reviews were then assessed by all other members of the task force and modified according to their suggestions. In a final appraisal of a scale, the task force used the terminology developed for the Appendix of Ancillary Scales to complement the MDS-sponsored revision of the Unified Parkinson's Disease Rating Scale (UPDRS) (MDS-UPDRS).<sup>12</sup> This terminology was also used in recent reviews of scales to assess other aspects in PD.<sup>8-11</sup> The final assessment was based on consensus among the task force members and the Steering Committee of the overall Task Force on Rating Scales for PD.

The official definitions for Task Force critiques are as follows: a scale is considered "Recommended" if it has been applied to PD populations, if there are data on its use in studies beyond the group that developed the scale, and if it has been studied clinimetrically and found to be valid, reliable, and sensitive to change (see below). A scale is considered "Suggested" if it has been applied to PD populations, but only one of the other criteria applies. A scale is "Listed" if it meets only one of the three criteria defined for Recommended scales. Because of the paucity of demonstrated treatments for dyskinesia, the

**TABLE 1.** Main characteristics of the scales assessed

Scale	Time to complete (minutes)	Patient historical rating	Clinical examination	Administration burden*
AIMS	15	No	Yes	+
UPDRS	20 <sup>a</sup>	Yes	Yes	+
Obeso (CAPIT)	2	Yes	Yes	+
Rush Dyskinesia Rating Scale	5	No	Yes	+
CDRS	10	No	Yes	+
Lang-Fahn	5	Yes	No	+
PDYS-26	10	Yes	No	+
UDysRS	15	Yes	Yes	+

\*Administration burden was rated as follows: “+”(easy, e.g., summing up of the items), “±” (moderate, e.g., visual analogue scale (VAS) or simple formula), “-” (difficult, e.g., VAS in combination with formula, or complex formula, “?” (no information found on rating method).

<sup>a</sup>Time necessary to complete the all scale. Abbreviations: AIMS, Abnormal Involuntary Movement Scale; UPDRS, Unified Parkinson’s Disease Rating Scale; CDRS, Clinical Dyskinesia Rating Scale; PDYS-26, Parkinson Disease Dyskinesia Scale; UDysRS; Unified Dyskinesia Rating Scale.

clinimetric criterion in this report did not categorically require responsiveness [the ability of the scale to capture changes] to be demonstrated. In the event that a scale fulfilled the requirements of reliability and validity, the criterion was considered to be met, although the absence of responsiveness is noted as a weakness of the given scale.

As an official MDS document, this report was submitted and approved by the Scientific Issues Committee of the MDS before submission to *Movement Disorders*.

**Literature Search Strategy**

All scales designed to assess dyskinesia and either validated or used in studies with patients with PD were included in the review. These scales were identified by a systematic literature search. Medline on PubMed was searched for relevant papers with the terms “Parkinson’s disease,” “parkinsonism” or “Parkinson disease,” and “dyskinesia” or “dyskinesias” published until December 2008. For each scale, a search was conducted for the terms “Parkinson’s disease” (or “parkinsonism” or “Parkinson disease”) and the name of the scale. Additionally published or *in press* peer reviewed papers or abstracts known to the task force members were included in this review.

**Identified Scales and Their Utilization in Clinical Practice and Research**

Eight rating scales for dyskinesia in PD were identified (Table 1). These were the Abnormal Involuntary Movement Scale (AIMS),<sup>13</sup> The UPDRS part IV<sup>14</sup> with its recent revision by the MDS,<sup>12</sup> the Obeso Dyskinesia Rating Scale,<sup>15,16</sup> the Rush Dyskinesia Rating Scale,<sup>17</sup> the Clinical Dyskinesia Rating Scale,<sup>18</sup> the Lang-Fahn Activities of Daily Living

Dyskinesia Scale,<sup>19</sup> the Parkinson Disease Dyskinesia Scale (PDYS-26),<sup>20</sup> and the Unified Dyskinesia Rating Scale (UDysRS).<sup>21</sup> Home diaries for patients’ self-assessment of dyskinesias have been developed,<sup>22</sup> but these rating instruments are primarily focused on motor fluctuations. Given that a critique of scales on motor fluctuations is in development as a separate project within the Task Force mission, motor fluctuation diaries that include dyskinesia were not considered in this report.

**SCALES FOR DYSKINESIA IN PD**

A summary review of each scale is given here. The complete reviews are available online at the journal Web site.

**AIMS: Abnormal Involuntary Movement Scale**

**Description of the Scale**

The AIMS is a clinician-rated instrument to assess the severity of abnormal movements in different parts of the body.<sup>13</sup> The AIMS consists of 10 items organized in a five-point Likert model. Each item is scored on a scale from 0 to 4 (absent, minimal, mild, moderate, severe), with higher scores indicating more severe abnormal movements. Items 1 to 4 rate the presence and severity of the abnormal movements in the face and mouth, items 5 to 6 rate the presence and severity of abnormal movements in the limbs, and item 7 rates the presence and severity of abnormal movements in the trunk. The last three items rate, respectively, the global severity of the abnormal movements, the disability derived from the abnormal movements, and patient’s awareness of the abnormal movement. The maximum score is 40. Two final points refer to dental

hygiene and wearing of dentures. The scale includes specific instructions to standardize the evaluation and requires the examiner to observe the patient sitting quietly at rest and again while carrying out selected motor tasks. The highest severity of the abnormal movements is rated. If movements only occur upon activation procedures such as opening and closing of the mouth, finger tapping, standing, and sitting, but are not seen spontaneously, the severity rating is ranked as one level lower than if the same intensity is seen spontaneously. The scale does not provide word anchors to explain the ratings. The scale was originally developed for rating tardive dyskinesia, but has been used for rating of Huntington's disease-related dyskinesia and PD-related dyskinesia. Modifications that exclude the one-point reduction for movements seen only with activation, and exclude the dental questions have also been used.

### Clinimetric Properties

Clinimetric data for AIMS rely mainly on inter-rater and intrarater coefficient. In patients without PD, the scale showed high inter-rater and test-retest reliability for tardive dyskinesia.<sup>23,24</sup> Others substantial clinimetric data (such as floor and ceiling effect or concurrent validity) are not available. Only the original version of the scale has been assessed, whereas none of the modified versions of the scale has gone through validation procedures. The clinimetric properties of the scale have been only partly tested in PD. In one study, the mean correlation coefficient (*R*) between two raters for total score was 0.81 ( $P < 0.01$ ).<sup>20</sup> Internal consistency, concurrent validity, discrimination validity, and content validity have not been examined in this condition. A partial correlation was found between a modified AIMS version and accelerometric parameters of dyskinesia in PD<sup>25</sup>; however, no firm evidence that AIMS is able to detect change in dyskinesia severity across different stages of PD is available.

### Strengths and Weaknesses

AIMS has been extensively used for many years to assess abnormal involuntary movements in psychiatric patients. The scale is particularly valid to determine an overview of the anatomy of the involuntary movements. The scale also provides a total score for the presence of abnormal movements on the entire body. AIMS is a simple scale sensitive to changes across patients. The administration of the scale is short and repetitive scores can be easily obtained. AIMS has

been used in several studies in patients with PD to assess the benefit of medical and surgical procedures in the treatment of dyskinesia<sup>26,27</sup> and appears appropriate for responsiveness to an intervention.

AIMS does not capture the phenomenology (e.g., chorea vs. dystonia) of the movement that is observed, thus all movements are merged during the rating. Furthermore, as AIMS was originally developed for the rating of tardive dyskinesia, it emphasizes ratings for movements in the facial-oral-lingual areas, and less for movements in the limbs and trunk, that are frequently encountered in PD-related dyskinesia.<sup>7</sup> A number of modifications of the scale have therefore been introduced by different authors for its use in PD. This has raised problems in the overall clinimetric evaluation of the scale and the extent of clinimetric testing is limited. The motor activation procedures do not reflect the activities of daily living and it is difficult to determine the impact of the abnormal movement on the subject's life. This scale also does not give an estimate of the duration of dyskinesia during the day and of their pattern (peak dose or diphasic).

### Final Assessment

AIMS formally fulfils the criteria for Recommended scale (it has been applied to PD populations, there are data on its use beyond the group that developed the scale to rate dyskinesia in patients with PD, and some clinimetric studies have been performed). In designating this rating, however, the Task Force recognizes that clinimetric testing has only been partial and there have been a number of AIMS versions, not all of which have been independently studied, which tempers the designation of Recommended. In addition, the Task Force recognizes that most of the clinimetric data on AIMS comes from other disorders than PD and the overall structure of the scale has been designed to score other types of dyskinesia. Furthermore, although AIMS is also able to measure changes during treatment procedures, it does not allow differentiation between chorea, dystonia, and other forms of dyskinesia. It also does not allow the impact of dyskinesia on quality of life of patients with PD to be measured.

### The Unified Parkinson's Disease Rating Scale (UPDRS-3.0)

#### Description

The UPDRS was developed by incorporating elements from previous PD scales to provide a comprehensive assessment of disability and impairment in this

disease. The development of this scale involved multiple trial versions, and the final published scale is officially known as UPDRS version 3.0.<sup>14</sup> The UPDRS is the most widely used clinical rating scale for PD, in routine clinical practice and clinical trials. This scale seeks to accurately measure the spectrum of PD severity and consists of four subscales: (1) Part I: mental status, behavior, and mood; (2) Part II: activities of daily living, which may be scored in "on" or "off" states; (3) Part III: motor examination (this section produces 27 scores due to assessment of several signs in different parts of the body); and (4) Part IV: complications. Complications should be evaluated in the past week only. Part IV is further divided in three segments: a first segment (1) comprising four items for dyskinesia including off dystonia, a second one (2) comprising four items for fluctuations, and a final one (3) comprising three items for other complications. Part IV (1) assesses historical information on dyskinesia duration (dividing the waking day into four segments, items 32) and an overall assessment of intensity (item 33). Items 34 and 35 look at the amount of painful dyskinesia and at the presence of early morning dystonia, respectively. UPDRS subscales are used at different frequencies, with those most often used being sections II and III.<sup>5</sup> Scoring of items in parts I, II, and III, ranges from 0 to 4 (0, normal; 4, severe), whereas scoring of part IV is irregular (with some items scoring from 0 to 4, and others 0 = no and 1 = yes).

### Clinimetric Properties

Of all available PD rating scales, the UPDRS is the most thoroughly tested instrument from a clinimetric point of view, most of the works dealing with parts II and III of the scale. Very little clinimetric work was performed on the items dealing with dyskinesia. Because of relevant limitations present in this scale,<sup>28</sup> an ad hoc Task Force of the MDS developed a revision of the UPDRS, termed the MDS-UPDRS. Its clinimetric assessment has been recently published in this journal.<sup>12</sup> The MDS-UDPRS Task Force revised and expanded the UPDRS using recommendations from the published critique, maintaining the same structure of four parts of the original UPDRS: in particular, dyskinesia are still scored in section IV, in two items only, 41 and 42. The first item is related to time spent with dyskinesia and is similar to number 32 in old UPDRS, whereas for item 42 (functional impact of dyskinesia) MDS-UPDRS now provides written anchors in contrast to item 33 of the old UPDRS which used only "mild, moderate, severe, and marked" definitions. In the fac-

tor structure analysis, both MDS-UDPRS dyskinesia items are grouped as an independent factor into the Part IV.

### Strengths and Weaknesses

The main strength of the Part IV of the scale is that it can be performed in the office and the time required is very short. The UPDRS as a full scale include good inter-rater and intrarater reliability, but the individual or collective items covering dyskinesia have not been independently studied from a clinimetric perspective. The questions, however, capture symptoms over a period of time through historical questions that are clearly anchored. On the other hand, being based on just a few items, the scale provides a relatively limited or only a general assessment of the functional impact of dyskinesia. The MDS-UPDRS is more clearly written and the dyskinesia items comprise an established factor structure. Other clinimetric assessments have not been conducted on the dyskinesia section.

### Final Assessment

The UPDRS is Suggested as a rating scale for dyskinesia. Two of the three of criteria are met (applied in PD and used by several investigators). Clinimetric studies are insufficient to meet this criterion. Despite the identified weaknesses, the original UPDRS, specifically the items covering the disability due to dyskinesia and the duration of the waking day when dyskinesia is present, has been the primary outcome measure in recent clinical trials for antidyskinetic agents.<sup>26</sup> At the current time, the MDS-UPDRS is also Suggested. It meets two of the three criteria (use in PD and strong clinimetric testing). Because it is new, it has not been used by groups other than the development team. In the future, the designation will likely change to Recommended.

### Obeso Dyskinesia Rating Scale (CAPIT)

#### Description

This scale combines the patient's historical assessments and the examiner's objective rating of dyskinesia. Disability is assessed using two categories of information: severity (0–5) and duration (0–5). These scores are combined to provide a single score based on the mean of the two subscores. The intensity score combines two clinical issues, namely, patient awareness of movements and the actual observed intensity of such movements. The duration score, similar to the UPDRS

part IV query on duration, divides the waking day into four segments.

### **Clinimetric Properties**

After its development, it was later included in the widely used Core Assessment Program for Intracerebral Transplantations (CAPIT) protocol for evaluation of patients undergoing neurosurgical interventions for PD.<sup>15,16</sup> This scale has not been subsequently explored from a clinimetric point of view.

### **Strengths and Weaknesses**

The main strength of the scale is that it very easy to apply, being the arithmetic mean of just two numbers. Instructions to rater are simple but clear, apart from the lack of indications about the time frame of dyskinesia evaluation. This short scale is probably suitable just for dyskinesia screening and prevalence studies and not for treatment trials.

### **Final Assessment**

Obeso Dyskinesia Rating Scale has been applied to PD populations and as a component of the CAPIT protocol has been extensively used in the evaluation of dyskinesia. The scale, however, lacks validation and needs a careful assessment of its clinimetric properties. Therefore, it is designated as Suggested scale.

## **Rush Dyskinesia Rating Scale**

### **Description of the Scale**

The Rush dyskinesia scale<sup>17</sup> contains items similar to the Obeso Dyskinesia Rating Scale.<sup>15,16</sup> The scale assesses the severity of dyskinesia based on interference with three standardized motor tasks. The rater observes the patient walking, drinking from a cup, and putting on and buttoning a coat. The greatest degree to which dyskinesia interferes with function is rated on a 0 to 4 scale that includes descriptors (0, absent; 1, minimal severity, no interference with voluntary motor acts; 2, dyskinesia may impair voluntary movements but patient is normally capable of undertaking most motor acts; 3, intense interference with movement control and daily life activities are greatly limited; 4, violent dyskinesia, incompatible with any normal motor task). In addition, the rater indicates which types of dyskinesia (chorea, dystonia, other) are present and which single type is most disabling.

It has been applied in trials beyond the original authors.<sup>29</sup> In the original version, three activities were

observed and the highest rating of disability from any of the activities was entered as the score. Modifications have included separate scores for the three activities and in the UDysRS (see below) that incorporates the Rush dyskinesia scale, communication has been added as a fourth task.

### **Clinimetric Properties**

A videotape that included segments of 20 patients was rated by 13 physicians and 15 study coordinators.<sup>17</sup> After responses were returned, each rater evaluated a second tape with 70% repeat cases from the first tape and 30% new cases. Combined physician and coordinator ratings exhibited high inter-rater and intrarater reliability for severity of dyskinesia. The scale also has been rated highly for its ease of application, appropriateness of tasks for reflecting disability, and overall utility.

### **Strengths and Weaknesses**

The main strengths of the scale are that it assesses functional disability of dyskinesia and that clinimetric testing revealed relatively high inter-rater and intrarater reliability. The evaluation can be performed in the office and the time required is short.

In terms of weaknesses, assessments are performed at single time points and the evaluation time point may or may not reflect the rest of the day. In addition, the assessment is (usually) performed in the office and the patient may exhibit more or less dyskinesia than he or she normally does at home. The assessment is confined to an observer rating of motor disability during specified tasks and may not capture disability related to other tasks that are important to the patient. Furthermore, there is no consideration made for pain or discomfort that the patient may experience from dyskinesia.

Another shortcoming is that the rater has to consider all types of dyskinesia when assessing interference with function. However, chorea is commonly a peak-dose phenomenon whereas dystonia is often a wearing-off or off phenomenon. It is likely that if a patient has both types of dyskinesia, worsening of the less disabling type of dyskinesia would not be captured when only the most disabling dyskinesia is rated. This may be particularly relevant in that an antidyskinesia medication might improve chorea, but worsen parkinsonism and dystonia. Conversely, an antiparkinsonian medication might improve parkinsonism and dystonia, but worsen chorea.

Although this scale exhibited good inter-rater and intrarater reliability, based on raters viewing the same videotape segments, consistency might be much less during an actual on-site assessment as raters might not evaluate the patient at exactly the same time, patients may feel more or less comfortable in a particular environment, and the objects that are used during the evaluation may differ in their ability to be manipulated. Thus, the actual inter-rater and intrarater reliability is not known. Furthermore, it is noted that the ratings were not compared with other scales nor were they compared with patient's self-ratings. Feedback from the coordinators and physicians seemed to indicate that it may not be easy to identify types of dyskinesia and most disabling dyskinesia.

### Final Assessment

Because the scale has been applied to PD populations, utilized extensively in clinical trials, and has undergone some clinimetric testing, the Rush dyskinesia rating scale meets the criterion for Recommended. It is a scale that assesses only disability and not impairment or patient perceptions, and the clinimetric testing is limited, but within these limitations, it fulfils the Task Force criteria.

## Clinical Dyskinesia Rating Scale (CDRS)

### Description of the Scale

Only one version of this scale was published in English in 1999.<sup>18</sup> The scale is in the public domain and was developed for use in patients with PD. CDRS independently evaluates hyperkinesia and dystonic posture, scored for each body region (face, neck, trunk, right and left upper extremities, right and left lower extremities). Scores range from 0 (none observed) to 4 (extreme), with use of 0.5-scoring intervals permitted for six items. The maximum total score for each subscale (dyskinesia and dystonia) is 28. Ratings are based on patient observation at rest and during activation. Separate ratings exist for different body parts, including lateralization, as well as for dystonia and hyperkinesia; however, no estimate of disability is made. The scale was validated by different health care workers, several of whom lacked experience in formal clinical dyskinesia rating, and none of whom was familiar with the scale. Analysis of these ratings is discussed below. Ratings are based on observations of the patient during activation and at rest. The scale is proposed as a screening tool and to measure severity during acute L-dopa challenge testing, applicable during "on" and "off" conditions. The scale is appropriate for multiple

assessments during a drug cycle. It appears easy to administer while performing standardized PD motor tests and is appropriate for use in the clinical setting or bedside. No instructions on its use are described.

### Clinimetric Properties

Inter-rater reliability in patients with PD was explored for different groups of raters (neurologists, neurosurgeons, and nurses specialized in PD), proving excellent for hyperkinesia ( $W = 0.88$ ) and moderate for dystonia ( $W = 0.44$ ). Overall test-retest reliability was satisfactory (Kendall's tau = 0.74). Dystonia ratings had less concordance (with some Kendall tau coefficients as low as 0.31). It is valid across all disease stages. However, the scale's sensitivity to change (over time or to treatment) has not been demonstrated.

Several scale properties were not evaluated in the original publication or subsequent studies. Content or criterion validity was not evaluated against a gold standard, nor was construct validity compared with that of other scales. No information on its use across different populations or on potential differences between genders was reported, nor was scale utility evaluated in patients with PD suffering from dementia. Its properties in dyskinesia occurring in patients other than those with PD were not evaluated.

### Strengths and Weaknesses

The CDRS shows overall, a high level of reliability both for individual raters, as well as between different raters assessing the same videotaped patient sequences. The CDRS is a useful tool for clinical evaluation of dyskinesia severity in PD. Nonetheless, it provides limited information and relevant clinimetric properties remain unexplored.

### Final Assessment

Based on the data as outlined above, the CDRS meets the following criteria: it has been used in PD and has some clinimetric testing, but it has not been used outside of the developing group. It is therefore classified as Suggested.

## Lang-Fahn Activities of Daily Living Dyskinesia Scale

### Scale Description

The Lang-Fahn Activities of Daily Living Dyskinesia Scale is an attempt to capture disability that is of-

ten not manifested during a routine medical visit. An ordinal scale similar to the UPDRS is the basis for assessing five activities potentially impacted by dyskinesia at their maximum severity over the past few days (handwriting or drawing, cutting food and handling utensils, dressing, hygiene and walking). Therefore, zero is assigned for the absence of dyskinesia during the activity and the ability to perform the activity represents function in the best on state. Four is scored for the inability to perform the task independently and even with assistance, the task is exceedingly difficult or impossible because of the dyskinesia.

The scale is completed by the physician based on historical information provided by the patient. Patients are asked to recall their function over the last few days and respond based on the worst interference by dyskinesia. Further information regarding the dyskinesia pattern such as diphasic, peak dose, or dystonia is not captured by the scale. Like other scales based on patients' declaration, it does not take into account that many patients will defer activities until dyskinesia resolve and, therefore, might state that dyskinesia are not disabling.

### Clinimetric Properties

One study attempted validation of this scale.<sup>19</sup> Based on the clinical trial in which it was piloted, the Lang-Fahn ADL Dyskinesia Scale did not correlate with the modified Goetz Dyskinesia Rating Scale, had moderate correlation with the patient diary completed 1 week prior to the visit, and moderate correlation with the clinic assessment by patient and clinician using a Clinician's Global Impression and the Patient's Global Impression. The scale was used in two other studies but further attempts to validate the scale including test-retest reliability have not occurred. Therefore, some relevant clinimetric properties remain unexplored for this scale.<sup>5</sup>

### Strengths and Weaknesses

The scale is brief to administer and training is not needed for its use. It is constructed on the logical idea to assess five routine activities potentially influenced by dyskinesia. However, the scale is based on retrospective recall of patient over "last few days, the worst interference by dyskinesia," which may be quite vague. Furthermore, no quality of life assessment of the impact of dyskinesia is provided.

### Final Assessment

Despite the weaknesses as outlined above, the Lang-Fahn Activities of Daily Living Scale was applied in

patients with PD and some clinimetric studies have been carried out. However, it has not been used extensively by others outside the Parkinson Study Group. This scale should therefore be classified as Suggested, but weakly so because of the relatively sparse clinimetric data.

### Parkinson Disease Dyskinesia Scale (PDYS-26)

#### Scale Description

The PDYS-26,<sup>20</sup> is a 26-item, patient-based measure "for quantifying the impact of dyskinesia on activities of daily living" in PD. Items include basic, instrumental, and social daily activities. The question for each item is about interference by involuntary movements (when they are at their worst) with those activities. Time frame is "during the past week." There are five response options per item, scored from 0 (Not at all) to 4 (Activity impossible). A total score is calculated through the sum of items' scores (0 to 104).

In the instructions, dyskinesia is equalled to "involuntary movements," but some abnormal movements (tremor, dystonia) are excluded. Therefore, the scale assesses choreic dyskinesia.

### Clinimetric properties

The scale was developed following Item Response Theory (Rasch analysis) principles and methodology. Later, it was validated by means of Rasch analysis, again, and also applying Classical Test Theory methods. There is only one study (the original article<sup>20</sup>) on the psychometric properties of the scale. As per this article, the scale has satisfactory acceptability, with no floor or ceiling effect (although neither standard nor observed values are given) and appropriate distribution of scores. The internal consistency was very high ( $\alpha = 0.97$ ), perhaps related to redundancy, and the item homogeneity coefficient resulted satisfactory (0.59). The test-retest reliability was excellent (for the total score,  $ICC = 0.92$ ). Concerning the convergent construct validity, PDYS-26 showed strong correlation with the UPDRS<sup>14</sup> items 32 to 34 ( $R = 0.56-0.71$ ; for the total of these items,  $R = 0.78$ ). Correlation was moderate/high with items of the Rush Dyskinesia Rating Scale<sup>17</sup> ( $R = 0.36-0.78$ ) and variable with the components of the AIMS<sup>13</sup> ( $R = 0.20-0.84$ ). Factor Analysis identified a single factor, explaining 58% of the variance.

### Strengths and Weaknesses

It is a specific scale for patients with PD with dyskinesia. The clinimetric properties of the scale are satis-



factory by both methodological approaches.<sup>20</sup> Therefore, the scale is considered a consistent, reliable, and valid measure to assess the perceived impact of dyskinesia on ability for daily activities. PDYS-26 is easy to complete and possesses good acceptability. A particular advantage is the short administration time. One disadvantage is the potential redundancy on modalities of activity. There is no information about PDYS-26 responsiveness and minimal clinically important change at the present time.

### Final Assessment

PDYS-26 is Suggested as a measure for assessing the patient's perception of functional impact from dyskinesia in PD. It has been used in PD and is clinimetrically valid and reliable. Sensitivity to change has not been studied. Largely because the scale is new, it has not been used yet beyond the group that developed the scale. Given the scale's recent appearance, and otherwise strong attributes, the designation of Suggested may be changed in the future to Recommended if other researchers adopt the scale for studies.

### The Unified Dyskinesia Rating Scale (UDysRS)

#### Description of the Scale

The Unified Dyskinesia Rating Scale (UDysRS) is a new rating scale developed specifically for the assessment of dyskinesia in PD.<sup>21</sup> The UDysRS contains both self-evaluation questions (by the patient alone or with their caregivers) and items that are assessed directly by the physician to objectively rate the abnormal movements associated with PD. In general, the time frame for rating of dyskinesia refers to the prior week (including the day of which the examination is performed). The UDysRS consists of two primary sections (Historical and Objective); each section is divided in two parts. All parts consist of several items, and each item is scored on a scale from 0 to 4 in a Likert model (0, normal; 4, severe). The total score of the UDysR ranges from 0 to 104. Part I: Historical Disability or patients' perception of On-dyskinesia impact (11 items, maximum score 44); Part II: Historical Disability or patients' perception of Off-dystonia impact (four items, maximum score 16). In both Historical parts, one item (number 1 in Part I and 12 in Part II, respectively) is obtained by the rater assisting the patient/caregiver in giving the answer. Part III: objective impairment with rating of dyskinesia severity, type of movement (dyskinetic or dystonic), anatomical distribution over seven body region; the objective evalua-

tion is based on the observation of patients performing four motor tasks: communication, drinking from a cup, dressing, and ambulation (seven items, maximum score 28); Part IV: disability scale. The rating is based on the activities performed by the patient in part III (four items, maximum score 16). The highest value for each body part is reflective of the impact of dyskinesia on which function is rated. The scale includes specific instructions to standardize the evaluation and a video recording protocol for clarity and consistency.

### Clinimetric Properties

Internal consistency, factor structure, and reproducibility of the scale were determined in 70 patients with PD. Twenty international movement disorder experts participated in the study (for complete methodology see Goetz et al.<sup>21</sup>). Inter-rater and intrarater reliability scores were calculated for all parts and sections of the scale. In summary, the inter-rater reliability for impairment and disability ranged from fair (kappa 0.4 to 0.59) to very good (kappa > 0.8). The inter-rater reliability for the total score was very good (kappa 0.89). Intrarater reliability also ranged from fair (kappa 0.4 to 0.59) to very good (kappa > 0.8) for both impairment and disability. The intrarater reliability for the total score was also very good (kappa 0.90). The UDysRS showed high internal consistency for both the subjective (Cronbach's alpha = 0.92) and objective rating sections (Cronbach's alpha = 0.97).

### Strengths and Weaknesses

The UDysRS represents a comprehensive rating tool that captures patient perceptions, time factor of dyskinesia, anatomical distribution, phenomenology (dystonia vs. other dyskinesia), objective impairment, and severity and disability of dyskinesia and dystonia in PD. The tested clinimetric properties of the scale range are excellent. The objective components of the scale, which could be used for frequent ratings during studies involving treatment, also have very good inter-rater and intrarater reliability. The motor activation procedures reflect the activities of daily living and provide a global score to reflect the impact of the abnormal movement on the subject's life. The scale has not been evaluated for responsiveness testing to an intervention and has not been used by other groups beside the researchers involved in its development. Convergent validity, discrimination validity, and content validity have also not been examined.

TABLE 2. Classification of the scales assessed

Scale	Applied in PD	Applied beyond original authors	Successful clinimetric testing	Qualification
AIMS	X	X	X <sup>a</sup>	Recommended
UPDRS	X	X	0 <sup>b</sup>	Suggested
Obeso (CAPIT)	X	X	0	Suggested
Rush Dyskinesia Rating Scale	X	X	X	Recommended
CDRS	X	0	X	Suggested
Lang-Fahn	X	0	X	Suggested
PDYS-26	X	0	X	Suggested
UDysRS	X	0	X	Suggested

For an explanation of the qualification groups see text.

<sup>a</sup>AIMS has several modified versions and it is not entirely clear whether clinimetric analyses are uniform across all versions.

<sup>b</sup>Clinimetric testing not performed specifically on the part IV. Abbreviations: AIMS, Abnormal Involuntary Movement Scale; UPDRS, Unified Parkinson's Disease Rating Scale; CDRS, Clinical Dyskinesia Rating Scale; PDYS-26, Parkinson Disease Dyskinesia Scale; UDysRS; Unified Dyskinesia Rating Scale.

### Final Assessment

As the newest scale to be developed, the UDysRS fulfils the criteria for Suggested to rate dyskinesia in patients with PD. It has been applied to PD populations and studied clinimetrically as both a consistent and reliable measure. The scale, however, has not been tested to measure its sensitivity to changes, and has not been studied by other groups, independent of the large number of investigators who participated in its development. More wide-spread use of the scale is to be expected and this Suggested status is likely to change to Recommended.

### CONCLUSIONS AND RECOMMENDATIONS

There are several critical issues in developing valid scales to score drug-induced dyskinesia in PD. First, assessment of dyskinesia in PD may be based on objective scoring by the physician or on subjective evaluation (based on patient or caregiver interview) and both the choices have some critical limitations. Objective assessment is limited to a specific point in time when the patient is assessed by the examiner. On the other hand, subjective scoring (based on patient interview) is based on the patient's personal impression and therefore more reflective of the overall dyskinesia burden during the day, but is prone to bias (related to the mood and cognitive status of the patients). In addition, it may be difficult to distinguish dyskinesia from parkinsonian tremor for the inexperienced examiner and this is even more of a challenge for the patients. This error may significantly affect the score and the overall evaluation of the disability related to dyskinesia.

An ideal scale for dyskinesia should capture patient perceptions, time factors of dyskinesia, anatomical distribution, objective impairment, and disability. At pres-

ent, only two of the reviewed dyskinesia scales (AIMS and Rush Dyskinesia Rating Scale) can be recommended for use in PD populations (Table 2). Notwithstanding, in both cases there are specific limitations already mentioned in the description of the scales. A major limitation in the older dyskinesia scales is that despite most of the scales were translated, local versions were rarely validated.<sup>30,31</sup> Currently, in depths programs of translations are on-going for newer scales such as the MDS-UPDRS and the UDysRS. Two scales (PDYS-26 and UDysRS), which have been recently developed and applied to PD populations, both have excellent clinimetric properties and appear to provide a reliable and valid assessment tool of dyskinesia in PD. However, their use has not been explored beyond original authors and consequently in our final assessment they could not be considered more than Suggested at the moment. Their use in future clinical trials will tell us whether they are reliable and easy-to-use rating instruments in routine clinical research. As a matter of fact, the PDYS-26, which is a patient-derived scale generating linear measurements, could well complement dyskinesia measures mainly (even if not exclusively) clinician-based such as the UDysRS. Since further testing of these scales in PD is warranted, no new scales are needed until PDYS-26 and UDysRS are fully tested clinimetrically.

**Acknowledgments:** Dr. Colosimo is the chairperson of the Dyskinesia Scale Assessment Program and Drs. Martínez-Martin, Fabbrini, Hauser, Merello, and Miyasaki are members. Drs. Poewe, Rascol, Sampaio, Stebbins, and Schrag are members of the Parkinson's Disease Rating Scales Task Force Steering Committee, chaired by Dr. Goetz. Critiques of scales are presented in more detail in the Appendix that is part of the Supporting Information Materials on the *Movement Disorders* Journal website.

**Author's Roles:** Carlo Colosimo: Conception, organization, and execution of the research project; writing of the first

draft of the manuscript. Pablo Martínez-Martin: Organization of the research project; review and critique of the manuscript. Giovanni Fabbrini, Robert A. Hauser, Marcelo Merello, and Janis Miyasaki: Execution of the research project. Werner Poewe, Cristina Sampaio, Olivier Rascol, Glenn T. Stebbins, Anette Schrag, and Christopher G. Goetz: Review and critique of the manuscript.

**Financial Disclosure:** Carlo Colosimo: Consultancies and Advisory Board Membership with honoraria: Boehringer Ingelheim; Pharmaceuticals, Ipsen Pharmaceuticals, Novartis Pharmaceuticals, UCB/Schwarz; Royalties: CIC Edizioni Internazionali Publishers; Salary: Sapienza University. Pablo Martínez-Martin: Honoraria (for lectures only): Novartis, Solvay, Newron, Medtronic, Boehringer Ingelheim, UCB, Movement Disorder Society; Grants: Michael J Fox Foundation and Carlos III Institute of Health; Employment: Carlos III Institute of Health only. Giovanni Fabbrini: Consultancies: Boehringer Ingelheim, Glaxo Pharmaceuticals, Ipsen Pharmaceuticals, Novartis Pharmaceuticals; Advisory Boards: Boehringer Ingelheim; Employment: Sapienza University of Rome. Robert A. Hauser: Honoraria from the following pharmaceutical companies for consulting, advisory or speaking services: Allergan Neuroscience, AlphMedica, ApotheCom, Axis Health Care, Bayer-Shering, Boehringer Ingelheim, CNS Schering Plough, Centopharm, Embryon, Eisai, Genzyme, GlaxoSmithKline, Impax, Ipsen Pharmaceuticals (formerly Vernalis), Kyowa Pharmaceutical, Merck, Novartis, Ortho, McNeil, Pfizer, Prestwick, Quintiles, Santhera, Schwarz Pharma; in addition, the University of South Florida receives revenue related to the ON/OFF/troublesome dyskinesia diary. Marcelo Merello: Employment: FLENI. Janis Miyasaki: Consultancies Shering Plough, Merz, Common Drug Review, Ontario Drug Benefits MOHLTC, Biovail; Advisory Boards: Teva; Honoraria Prestwick, Teva; Grants Impax, Solvay, NIH, MJFF, Neurogen; Employment: University of Toronto; Contracts: NIH. Werner Poewe: Consultancy and lecture fees from Teva, Novartis, GSK, Boehringer-Ingelheim, UCB/Schwarz; Pharma, Orion Pharma; Employment: University of Innsbruck; Task Force critique of dyskinesia: 31. Cristina Sampaio: Stock Ownership in medically-related fields; Consultancies/Advisory Boards (In all cases the honoraria due are paid to the department): Lundbeck, Abbott, Bial, Boehringer -LMS Group/Schering-Plough, Solvay; Employment: University of Lisbon. Olivier Rascol: Unrestricted grant for scientific research programs and honorarium for participation into scientific advisory boards from the following pharmaceutical industries: Boehringer-Ingelheim, Eisai, Euthérapie, GSK, Lundbeck, Novartis, Orion, Solvay, Teva; Employment: University of Toulouse. Glenn T. Stebbins: Honoraria: Movement Disorder Society, American Academy of Neurology; Grants: National Institutes of Health, Michael J. Fox Foundation, American Cancer Society; Employment: Rush University Medical Center. Anette Schrag: Advisory Boards: Osmotica Pharmaceutical Corp, Boehringer Ingelheim Pharmaceuticals; Honoraria: Boehringer Ingelheim Pharmaceuticals; Employment: University College London. Christopher G. Goetz: Consulting and Advisory Board Membership with honoraria: Allergan, Biogen, Boehringer-Ingelheim, Ceregene, EMD Pharmaceuticals, Embryon, EMD/Merck KGaA, Impax; Pharmaceuticals, I3 Research, Juvantia Pharmaceuticals, Kiowa Pharmaceuticals, Merck and Co; Neurim Pharmaceuticals, Novartis Pharma-

ceuticals, Osmotica Pharmaceuticals, Ovation; Pharmaceuticals, Oxford Biomedica, Schering-Plough, Solstice Neurosciences, Solvay; Pharmaceuticals, Synergy/Intec, Teva Pharmaceuticals; Grants/Research: Funding from NIH, Michael J. Fox Foundation, Kinetics Foundation, and directs the Rush Parkinson's Disease Research Center that receives support from the Parkinson's Disease Foundation; Honoraria: Movement Disorder Society, Northwestern University, American Academy of Neurology, Robert Wood Johnson Medical School; Royalties: Oxford University Press, Elsevier Publishers; Salary: Rush University Medical Center. Financial disclosure related to research covered in this article: Carlo Colosimo, Pablo Martínez-Martin, Giovanni Fabbrini, Robert A. Hauser, Marcelo Merello, Janis Miyasaki, Werner Poewe, Cristina Sampaio, Olivier Rascol, Glenn T. Stebbins, Anette Schrag: none.

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