Proposed International Clinical Diabetic Retinopathy and Diabetic Macular Edema Disease Severity Scales

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Purpose: To develop consensus regarding clinical disease severity classification systems for diabetic retinopathy and diabetic macular edema that can be used around the world, and to improve communication and coordination of care among physicians who care for patients with diabetes.

Design: Report regarding the development of clinical diabetic retinopathy disease severity scales.

Participants: A group of 31 individuals from 16 countries, representing comprehensive ophthalmology, retina subspecialties, endocrinology, and epidemiology.

Methods: An initial clinical classification system, based on the Early Treatment Diabetic Retinopathy Study and the Wisconsin Epidemiologic Study of Diabetic Retinopathy publications, was circulated to the group in advance of a workshop. Each member reviewed this using e-mail, and a modified Delphi system was used to stratify responses. At a later workshop, separate systems for diabetic retinopathy and macular edema were developed. These were then reevaluated by group members, and the modified Delphi system was again used to measure degrees of agreement.

Main Outcome Measures: Consensus regarding specific classification systems was achieved.

Results: A five-stage disease severity classification for diabetic retinopathy includes three stages of low risk, a fourth stage of severe nonproliferative retinopathy, and a fifth stage of proliferative retinopathy. Diabetic macular edema is classified as apparently present or apparently absent. If training and equipment allow the screener to make a valid decision, macular edema is further categorized as a function of its distance from the central macula.

Conclusions: There seems to be a genuine need for consistent international *clinical* classification systems for diabetic retinopathy and diabetic macular edema that are supported with solid evidence. The proposed clinical classification systems provide a means of appropriately categorizing diabetic retinopathy and macular edema. It is hoped that these systems will be valuable in improving both screening of individuals with diabetes and communication and discussion among individuals caring for these patients. *Ophthalmology 2003;110: 1677–1682 © 2003 by the American Academy of Ophthalmology.*

The number of patients with diabetes is dramatically increasing, and worldwide blindness caused by diabetic retinopathy will become more common unless improvements occur in the care process. Two landmark clinical trials, the Diabetic Retinopathy Study[1] and the Early Treatment Diabetic Retinopathy Study (ETDRS),[2] have demonstrated that effective treatment for diabetic retinopathy could reduce severe vision loss by 90%. These studies have underscored the critical need for periodic eye examinations for all patients with diabetes. Careful follow-up with prompt intervention with laser photocoagulation and vitrectomy when necessary is the most effective method to reduce potential visual disabilities. However, despite the availability of successful treatments, a number of barriers to optimal care remain. These include a variety of financial, sociological, educational, and psychologic barriers to regular ophthalmic examinations.[3] Early detection of significant retinopathy and prompt treatment when necessary remain the fundamental goals in the effort to reduce visual disability in patients with diabetes.

A standard set of definitions that describes the severity of retinopathy and macular edema are critical in clinical decision making and for communication among colleagues and between medical specialties. The ETDRS severity scale was based on the modified Airlie House classification of diabetic retinopathy and was used to grade fundus photographs.[4] It has been widely applied in research settings, publications, and in meetings of retina subspecialty groups, and it has shown satisfactory reproducibility and validity. Although it is recognized as the "gold standard" for grading the severity of diabetic retinopathy in clinical trials, its use in everyday clinical practice has not proven to be easy or practical. The photographic grading system has more levels than might be necessary for clinical care, and the specific definitions of the levels are detailed, require comparison with standard photographs, and are difficult to remember and apply in a clinical setting. Several unpublished contemporary surveys have documented that most physicians managing patients with diabetes do not use the full ETDRS severity scale, because it is too complex for application and communication in the clinical practices of retinal specialists, comprehensive ophthalmologists, endocrinologists, and primary care physicians.

Despite a need for a more practical retinopathy severity scale, to date there is no common practical clinical standard terminology that has been accepted for the worldwide exchange of information and data. For example, the organizers of a recent massive screening campaign for diabetic retinopathy in 15 Latin America and the Caribbean countries had to develop their own simplified classification based on the ETDRS severity scale.[5] Because they used their own unique grading system, their data could not be compared appropriately with findings obtained in other parts of the world or in different ethnic groups.

In several countries, simplified severity scales have been developed in an effort to improve both the screening of patients with diabetes and communication among caregivers. In 1993, a simplified diabetic retinopathy severity scale was developed as part of "The Initiative for the Prevention of Diabetic Eye Disease," sponsored by the German Society of Ophthalmology. Another similar severity scale has been used in Japan since 1983.[6] A third severity scale has been in wide use in Australia since 1997.[7] Despite the development of different severity scales in several countries, there remains a genuine need for a single standardized practical clinical classification system that can be used around the world to facilitate communication across groups of practitioners. The severity of retinopathy might lead to different treatment recommendations in different regions, because practice patterns and health care delivery systems for patients with diabetes mellitus differ around the world. Nevertheless, an optimal clinical classification system should be useful for a broad range of caregivers with varying skills and diagnostic equipment, ranging from retinal specialists with contemporary equipment to trained physician assistants using only direct ophthalmoscopes. In September 2001, the American Academy of Ophthalmology (AAO) launched a consensus development project regarding a new clinical severity scale for diabetic retinopathy. This report is intended to review the deliberations that lead to the establishment of the scale and to present the final document on which consensus was achieved. The development process was sponsored by the AAO, and the AAO Board of Trustees formally approved the final scales in February 2003.

Material and Methods

At the time of the initiation of this project, it was agreed that the clinical disease severity scale should be evidence based, using data from important clinical studies such as the ETDRS and the Wisconsin Epidemiologic Study of Diabetic Retinopathy (WESDR)[8,9] The severity scale was intended to be primarily aimed at comprehensive ophthalmologists and primary care physicians, because these individuals see most patients with diabetes. Retinal specialists were considered to be familiar with the ETDRS classification system and expected to continue using either it or their personal customized modifications. An initial planning meeting was held in conjunction with the Annual Meeting of the AAO in 2001. This initial meeting included representatives from five countries. At this meeting, Ronald Klein, MD, MPH, and Frederick Ferris, MD, presented scientific rationales for developing modified severity scales. Issues were discussed, and the scope and audience for the classification system were identified.

In preparation for a larger consensus development workshop, to be held at the International Congress of Ophthalmology in Sydney in April 2002, 14 additional individuals representing 11 countries were asked to participate (Appendix I). Participation was intended to be by invitation only, but every attempt was made to involve interested parties from different parts of the world. Participants included retina specialists, comprehensive ophthalmologists, endocrinologists, and epidemiologists. Before the meeting, background materials synthesizing the need and purpose of a new severity scale, as well as a proposed initial severity scale, were distributed to participants for the purpose of orientation.

A modified nominal group technique or modified Delphi technique was used to evaluate the level of consensus regarding this initial clinical classification.[10] Participants were asked to describe their views on agreement by means of e-mailed questionnaires. A 9-point rating scale was used, with 1 being strong disagreement and 9 being strong agreement. The results were mathematically aggregated to summarize the group results. To determine agreement and disagreement, a binomial distribution was applied. Depending on the number of participants, agreement is said to exist if more than 80% rate within a 3-point range of 1 to 3, 4 to 6, and 7 to 9. Disagreement is defined when 20% rate in the 7 to 9 range and at least another 20% rate in the 1 to 3 range. Otherwise, agreement is rated as "equivocal" or "partial" (with many participants in the 4–6 range). The initial statistical analysis of a pilot 4-stage rating system revealed that there was relatively strong agreement on the proposed pilot severity scales. Although there were no significant disagreements in the basic scheme proposing classifications for diabetic retinopathy severity and macular edema, the range of responses was tighter for the macular edema classification. Before participants were brought together at the workshop, the group results were returned to each member of the group for comparison with their own individual ratings indicated on the distribution.

The workshop agenda in Sydney was organized to define the need, international scope, and scientific rationale for the proposed classification of the severity of diabetic retinopathy and diabetic macular edema (DME). Time was allotted so that the group could address individual concerns and questions regarding each item. A meeting facilitator structured the interactions by allowing each topic to be discussed. The most important proposed changes in the

Table 1. Results of the Modified Delphi Approach Survey of Global Diabetic Retinopathy Project Participants

Diabetic Retinopathy Disease Severity				Diabetic Macular Edema Disease Severity			
Question	% in Range 7–9*	% in Range 4–6†	% in Range 1–3‡	Question	% in Range 7–9*	% in Range 4–6†	% in Range 1–3‡
Level for no apparent retinopathy	100	0	0	Level for diabetic macular edema absent	94	6	0
Level for both no apparent retinopathy and mild retinopathy	24	16	60	Level for diabetic macular edema present	94	6	0
Level for mild retinopathy alone	94	0	6	Level for mild diabetic macular edema	88	12	0
Level for moderate NPDR	94	6	0	Level for moderate diabetic macular edema	82	18	0
Level for severe NPDR	88	6	6	Level for severe diabetic macular edema	94	6	0
Level for severe NPDR that includes ETDRS Level 47	35	12	53				
Level for PDR	100	0	0				

*Percentage of participants voting 7–9 on a scale of 1–9, with 7 representing agreement and 9 representing strong agreement.
†Percentage of participants voting 4–6 on a scale of 1–9, with 5 representing neutral.
‡Percentage of participants voting 1–3 on a scale of 1–9, with 3 representing disagreement and 1 representing strong disagreement.
ETDRS = Early Treatment of Diabetic Retinopathy Study; NPDR = nonproliferative diabetic retinopathy; PDR = proliferative diabetic retinopathy.

initial classification scheme included those regarding (1) the addition of a level of "no apparent retinopathy," (2) the establishment of the lowest ETDRS level indicating "severe nonproliferative retinopathy," and (3) a modification in the grading of DME, as noted in the following.

The workshop did not include efforts to force consensus or create a final version by the end of the meeting. Rather, a working group developed a revised classification based on the deliberations at the workshop. This revised classification was circulated to all the workshop participants for comments and input before it was finalized. The responses of the workshop attendees to this second round of ratings were then reevaluated in a fashion identical to that described earlier. On the basis of these results, a consensus regarding the final version of this clinical disease severity schema was achieved.

Results

The results of the ratings for each of the stages (and some alternative definitions based on alternative views) after all deliberations are presented in Table 1. Regarding diabetic retinopathy, there was 100% agreement regarding the desirability of a level for "no retinopathy," and there was significant disagreement for including "no apparent retinopathy" and "minimal nonproliferative retinopathy" in a single significant level (Table 1). There was 100% agreement regarding a level for "proliferative diabetic retinopathy (PDR)" that included all eyes with any neovascularization. There was substantial agreement regarding all other levels. However, a decision to include ETDRS level 47 in the "severe nonproliferative retinopathy" level was controversial, and this ETDRS level ultimately was placed as the highest level in the "moderate nonproliferative diabetic retinopathy (NPDR)" group, because there was significant disagreement regarding the placement of this level in the "severe NPDR" group (Table 1). Regarding DME, there was significant agreement at all levels. High agreement was noted for levels of DME categorized as "apparently present" or "apparently absent" and for DME involving the fovea being designated in a separate level (assuming that examiner training and equipment allowed location of edema to be documented). A minor degree of disagreement was noted in two subcategories of "apparently present" DME that did not involve the fovea. This was primarily due to the reality of the difficulties involved in assigning precise levels for stages that were admittedly difficult to specify.

The diabetic retinopathy disease severity levels are listed in Table 2. This consists of five scales with increasing risks of retinopathy. The first level is "no apparent retinopathy," and the second level "mild NPDR" includes ETDRS stage 20 (microaneurysms only). The risk of significant progression over several years is very low in both groups. The third level, "moderate NPDR," includes eyes with ETDRS levels 35 to 47, and the risk of progression increases significantly by level 47. Still, the fourth level, "severe NPDR" (ETDRS stages 53 and higher), carries with it the most ominous prognosis for progression to PDR. The lower threshold for entry into this category was the presence of lesions consistent with the "4:2:1 rule." The fifth level, "PDR" includes all eyes with definite neovascularization. There was no attempt to

Table 2. Diabetic Retinopathy Disease Severity Scale

Proposed Disease Severity Level	Findings Observable on Dilated Ophthalmoscopy
No apparent retinopathy	No abnormalities
Mild nonproliferative diabetic retinopathy	Microaneurysms only
Moderate nonproliferative diabetic retinopathy	More than just microaneurysms but less than severe nonproliferative diabetic retinopathy
Severe nonproliferative diabetic retinopathy	Any of the following: more than 20 intraretinal hemorrhages in each of 4 quadrants; definite venous beading in 2+ quadrants; Prominent intraretinal microvascular abnormalities in 1+ quadrant *And no* signs of proliferative retinopathy
Proliferative diabetic retinopathy	One or more of the following: neovascularization, vitreous/preretinal hemorrhage

Table 3. Diabetic Macular Edema Disease Severity Scale

Proposed Disease Severity Level	Findings Observable on Dilated Ophthalmoscopy
Diabetic macular edema apparently absent	No apparent retinal thickening or hard exudates in posterior pole
Diabetic macular edema apparently present	Some apparent retinal thickening or hard exudates in posterior pole

If diabetic macular edema is present, it can be categorized as follows:	
Proposed Disease Severity Level	**Findings Observable on Dilated Ophthalmoscopy***
Diabetic macular edema present	☐Mild diabetic macular edema: Some retinal thickening or hard exudates in posterior pole but distant from the center of the macula ☐Moderate diabetic macular edema: Retinal thickening or hard exudates approaching the center of the macula but not involving the center ☐Severe diabetic macular edema: Retinal thickening or hard exudates involving the center of the macula

*Hard exudates are a sign of current or previous macular edema. Diabetic macular edema is defined as retinal thickening, and this requires a three-dimensional assessment that is best performed by a dilated examination using slit-lamp biomicroscopy and/or stereo fundus photography.

subdivide this level as a function of ETDRS "high-risk characteristics," because significant rates of progression are expected to occur in all of these cases.

The DME disease severity scale in listed in Table 3. The initial and most important designation is to separate eyes with apparent DME from those with no apparent thickening or lipid in the macula. It was recognized that significant variations in examiner education and available equipment could make this grading relatively difficult, because many examiners would be using direct ophthalmoscopy and therefore would not have the stereopsis necessary for a definitive diagnosis of retinal thickening in many cases. Thus, a two-tiered system was recommended. The initial decision regards the presence or absence of apparent retinal thickening or lipid in the posterior pole. The ability to make the second level decision will depend on the ability of the examiner to document details related to the apparent DME. This might depend on the equipment available to the examiner. These additional levels of DME are based on the distance of retinal thickening and/or lipid from the fovea. Eyes with obvious foveal involvement by edema or lipid are categorized as "severe DME." Eyes with edema and/or lipid relatively distant from the macula are graded as "mild DME." Although the term "moderate DME" was used to identify cases in which retinal thickening and/or lipid are close to (or "threatening") the fovea, the specific distance from the fovea was deliberately not specified.

Discussion

The need to provide a framework for improved communications and transfer of information among the primary care physician, endocrinologist, ophthalmologist, and other eye care providers was a major impetus to develop simplified clinical disease severity scales that could be used internationally. This international clinical classification system is based on an evidence-based approach, particularly the findings of the ETDRS and the WESDR.[2,9] These two studies have provided an understanding of the natural history, risk factors, and effect of treatments for both diabetic retinopathy and DME. The risks of disease progression associated with each of the stages of this simplified classification system can be correlated with ETDRS and WESDR findings. Assessing these risks in various clinical settings can lead to appropriate clinical recommendations for follow-up or treatment.

Most previously proposed severity scales have required the recognition and recording of abnormalities such as the following: microaneurysms, hemorrhages, hard exudates, soft exudates ("cotton-wool patches"), intraretinal microvascular abnormalities (IRMA), venous beading (VB), new vessels <1 disc diameter from the optic nerve, new vessels elsewhere, vitreous hemorrhages, preretinal hemorrhage, and fibrous proliferations. In this proposed new scale, the examiner might evaluate these various lesions, but he or she records only the overall severity level. In addition, the absence of diabetic retinopathy is documented as a distinct first level. This designation of "no apparent retinopathy" is important in the care of patients with diabetes. Patients in particular might feel different if they think that they have no detectable signs of retinopathy than if definite beginning signs are detected. Although an examiner might miss one or two microaneurysms, if a microaneurysm is definitely detected, this indicates that retinopathy has started, and this observation might make a difference to patients and their primary care physicians or endocrinologists.

Perhaps the most important groups in the classification system are those indicating that a patient is at risk for vision loss from diabetic retinopathy. The levels of grading of retinopathy (Table 2) include three with relatively low risk and two with significant risk for visual loss. Eyes with severe NPDR are at high-risk for developing PDR.[11] Continuing evaluations of ETDRS data have shown that a simplified clinical method of defining severe NPDR can be developed by identifying the presence and severity of three retinopathy lesions. These include retinal quadrants containing extensive retinal hemorrhages (approximately 20/quadrant), two quadrants containing definite VB, or any quadrant containing definite IRMA. This simplified method of defining severe NPDR is called the "4:2:1 rule." The workshop panel agreed that the 4:2:1 rule should remain the basis of classifying an eye as having "severe NPDR." On the basis of ETDRS data, 17% of eyes with this severity of retinop-

athy will develop high-risk proliferative disease within 1 year, and this rate increases to 44% within 3 years. The 1-year and 3-year rates for eyes with this severity of retinopathy developing any degree of PDR are 50% and 71%, respectively.

A major problem regarding IRMA and VB is the difficulty in recognizing them. Thus, more easily recognized surrogate markers, such as retinal hemorrhages and/or microaneurysms, have been evaluated in an effort to make recognition of severe NPDR more apparent. In preparation for the development of this classification, Klein reevaluated data from the WESDR for the association of specific lesions with the severity of diabetic retinopathy (unpublished data). The use of retinal hemorrhages/microaneurysms alone to predict the risk of progression to PDR was demonstrated to be inadequate, because there was a lack of concordance of these lesions with the presence of more important IRMA and VB. In addition, the use of hemorrhages alone was not as strongly related to risk of progression to PDR as was either IRMA or VB. For right eyes with IRMA present, 41% of patients with type 1 diabetes and 38% of patients with type 2 diabetes did not have hemorrhages/microaneurysms > standard ETDRS photograph 1 in one or more fields. For right eyes with VB present, 29% of patients with type 1 diabetes and 15% with type 2 diabetes did not have H/MA > ETDRS standard photograph 1 in one or more fields. The sensitivity of using H/MA greater than ETDRS standard photograph 1 in one or more fields for detecting the presence of IRMA or VB is approximately 60% to 64%, and the specificity is approximately 85% to 94%. Similarly, the presence of hard exudates or soft exudates was not predictive of IRMA and/or VB being present. Therefore, it is necessary to identify the specific lesions IRMA and/or VB and not rely on H/MA or exudates alone to differentiate the third grade ("moderate") from the fourth ("severe") NPDR. For this reason, photographs of IRMA and VB are included with a description of this clinical disease severity scheme. Eyes with findings less than the 4:2:1 rule but with more than "microaneurysms only" are classified in a third stage, "moderate NPDR."

The grading of macular edema was recognized as being problematic, because direct ophthalmoscopy is often used to examine the retina. Thus, a two-tiered system was recommended (Table 3). The initial decision involves the recognition of the presence of any retinal thickening in the posterior pole. Because intraretinal lipid deposits ("hard exudates") are usually seen in association with significant macular edema, their presence might aid the relatively inexperienced screener in detecting retinal thickening with a monocular device. If the examiner can examine the retina in stereo, and is capable of further defining retinal thickening in terms of its extent, three grades of edema severity are differentiated. These are related to the distance of the thickening from the center of the retina.

The proposed clinical disease severity scale is intended to be a practical and valid method of grading severity of diabetic retinopathy and DME. It is recognized that examiner skills and equipment will vary widely around the world. Nevertheless, this system should allow observers to recognize and categorize levels of retinopathy and the presence of most DME. The identification of specific severity levels should result in more appropriate and consistent referrals to treatment centers. This system is not intended as a guide for treatment of diabetic retinopathy and DME. Although effective therapy for eyes with designated stages of NPDR, PDR, and DME was demonstrated in the ETDRS and Diabetic Retinopathy Study, the severity of these disorders might lead to somewhat different treatment and follow-up recommendations in different regions of the world, because specific practice patterns and health care delivery systems differ from country to country.

Although this staging system is intended primarily for comprehensive ophthalmologists and others with acquired skills necessary for evaluating the retina, it is hoped that this system will also allow better communication regarding retinopathy severity to all physicians and physician extenders caring for patients with diabetes. This improved communication should lead to more effective and consistent follow-up.

Implementation of this system will rely on its dissemination to ophthalmologists and other eye care providers, and it is also important that endocrinologists, diabetologists, and primary care physicians who care for patients with diabetes become familiar with these scales. Different localities and different structures for care will vary in their approaches to implementation and will use different care providers and care delivery processes in managing patients with diabetes.

Ideally, there will be a process to pilot test this system in a variety of local settings and to reevaluate its feasibility and usefulness in a variety of routine clinical environments around the world. As experience with the system is acquired, the scheme should be reevaluated. The system can be refined to maintain its currency as new developments occur in the management of diabetic retinopathy and diabetic macular edema.

References

1. Diabetic Retinopathy Study Research Group. Photocoagulation treatment of proliferative diabetic retinopathy: the second report of diabetic retinopathy study findings. Ophthalmology 1978;85:82–106.
2. Early Treatment Diabetic Retinopathy Study Research Group. Early photocoagulation for diabetic retinopathy. ETDRS report number 9. Ophthalmology 1991;98:766–85.
3. Klein R. Barriers to prevention of vision loss caused by diabetic retinopathy. Arch Ophthalmol 1997;115:1073–5.
4. Diabetic Retinopathy Study Research Group. A modification of the Airlie House classification of diabetic retinopathy. Report 7. Invest Ophthalmol Vis Sci 1981;21:210–26.
5. Verdaguer TJ. Screening para retinopatia diabetica en Latino America. Resultados. Rev Soc Brasil Retina Vitreo 2001;4:14–5.
6. Fukuda M. Clinical arrangement of classification of diabetic retinopathy. Tohoku J Exp Med 1983;141(Suppl):331–5.
7. National Health and Medical Research Council. Clinical Practice Guidelines: management of diabetic retinopathy. Canberra: NHMRC, 1997.
8. Klein R, Klein BE, Moss SE, et al. The Wisconsin epidemiological study of diabetic retinopathy. IX. Four-year incidence

and progression of diabetic retinopathy when age of diagnosis is less than 30 years. Arch Ophthalmol 1989;107:237–43.

9. Klein R, Klein BE, Moss SE, et al. The Wisconsin epidemiological study of diabetic retinopathy. X. Four-year incidence and progression of diabetic retinopathy when age of diagnosis is 30 years or more. Arch Ophthalmol 1989;107:244–9.

10. Shekelle PG, Kahan JP, Bernstein SJ, et al. The reproducibility of a method to identify the overuse and underuse of medical procedures. N Engl J Med 1998;338:1888–95.

11. Early Treatment Diabetic Retinopathy Study Research Group. Fundus photographic risk factors for progression of diabetic retinopathy. ETDRS report number 12. Ophthalmology 1991; 98(Suppl):823–33.

Appendix I

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