Disability Evaluation – Vision

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This chapter discusses the rationale and background of the *Functional Vision Score* *system implemented in the* *AMA Guides* *5th edition.*

It is similar to Chapter 36 in the 2nd edition (Mosby / AMA, 2003) of "Disability Evaluation" – Demeter, Anderson, editors

INTRODUCTION

Ophthalmology has experiences many firsts. After the invention of the ophthalmoscope in 1851 it became the first organ-based specialty. Disability evaluation received early attention. In the 1890's Magnus, in Germany, developed detailed scales [1]. In 1925, the AMA Committee for the Compensation of Eye Injuries[2] adopted a new set of compensation scales for vision loss that were based on an employability study by Snell [3] and a mathematical formula developed by Snell and Sterling [4]. Through its 4th edition the Vision chapter in the AMA *Guides* [5] has been based on Snell's "Visual Efficiency" scale. From 1925 to 2000, however, insights in disability have changed, while numerous revisions led to internal inconsistencies. The Vision chapter in the 5th edition has undergone radical change. A detailed listing of the steps and procedures is provided in Chapter 12 (the Visual System) of the AMA *Guides* and will not be repeated in this chapter. The purpose of the chapter before you is to explain the underlying philosophy and the consequences of the changes that were made. The discussion will assume that the Vision chapter of the AMA *Guides* is available for reference.

ASPECTS OF VISION LOSS

As has been described in the introductory chapters, ability loss can be approached from various points of view. Just as all aspects of a complex sculpture cannot be captured in a single snapshot, so must the description of vision loss with all its consequences take account of multiple aspects.

The most commonly used set of aspects [6] is the one promoted by the *WHO's International Classification of Impairments, Disabilities and Handicaps (ICIDH-80)* ([7]). This publication, intended as a companion to the *WHO's International Classification of Diseases (ICD-9* [8] *and ICD-9-CM* [9]*),* was prepared in the 70's and published in 1980. Its successor, the *International Classification of Functioning, Disability and Health (ICF)* [10] was published in 2001. It is interesting, however, to note that the terminology of Impairment, Disability and Handicap had already been used in a report on *Rehabilitation Codes* [11] prepared in 1968 for the predecessor of the National Eye Institute. This appears to be another instance in which developments in ophthalmology were ahead of other specialties.

The four most important aspects of vision loss are summarized in Table 1. Although these aspects can be applied to any functional loss, this chapter will mainly discuss their application to vision loss. The first two aspects refer to the organ system. The first aspect is that of anatomical and structural changes (diseases, injuries, anomalies, etc.). The second aspect is that of functional changes at the organ level, such as visual acuity loss and visual field loss. These aspects are the traditional domain of clinical ophthalmology. The third and fourth aspects describe how these changes affect the individual. The third aspect describes the skills and abilities of the individual. This would include such items as reading skills, mobility skills, daily living skills. The last aspect points to the social and economic consequences of a loss of abilities. This might include effects such as the loss of a driver's license, loss of earning capacity, loss of social contacts, etc.

TABLE 1 – Aspects of Vision Loss

	THE ORGAN		**THE PERSON**	
ASPECTS:	Structural change, Anatomical change	Functional change at the Organ level	Skills, Abilities of the individual	Social, Economic Consequences
Negative terms Neutral terms	 Health Condition	Impairment Organ Function	Dis-ability Activities	Handicap Participation
Application to VISION:	Eye diseases, disorders, injuries	**"visual functions"** measured quantitatively	**"functional vision"** described qualitatively	Vision-related Quality of Life
Examples:	*Corneal scar, Cataract, Retinal Degeneration Optic Atrophy*	*Visual Acuity Visual Field Color Vision, Dark Adaptation*	*Reading skills Mobility skills Daily Living skills*	*Social isolation, Job loss, Loss of earnings*

Legend: Vision loss can be approached from different points of view *(see text)*. The different aspects are sometimes described by different names.

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Anatomical and Structural Changes

The first aspect describes the underlying disorders or diseases at the organ level. Describing only the deviations from normal is a negative approach. The term *'Health conditions'* provides a more neutral term, which could include the normal condition. Ophthalmoscopy and slitlamp biomicroscopy have given ophthalmology tools to describe anatomical changes in more detail than is possible for many other organ systems. Yet, these descriptors give us relatively poor cues to the severity of their functional consequences.

This aspect is extensively coded in ICD-9 and ICD-9-CM. Since these are classifications of diseases, normal conditions are referred to an appendix. ICIDH-80 used the term disorders to describe this aspect. ICIDH-2 prefers the term Structural change.

Visual functions

The second aspect describes **functional changes at the organ level**. Visual functions are not limited to visual acuity and visual field, but also include functions such as contrast sensitivity, color vision, dark adaptation, binocularity, etc. The term *'impairment'* is commonly used to describe this aspect; like the term disease or disorder, it describes loss and emphasizes that "the glass is half-empty". The general term *'organ function'* and the vision-specific term *'visual function'* are neutral terms, which can be used to indicate that "the glass is half-full". The distinction between negative and neutral terms has consequences for the use of scales. A scale of organ function (on which a higher value refers to better function) can easily include acuity levels that are better than standard vision (better than 20/20). An impairment scale (on which a higher value refers to lesser function) would require negative numbers to recognize such acuity levels. Here again, ophthalmology has developed unique tools that can measure organ functions, such as visual acuity and visual field, objectively and in great detail.

To describe this aspect, ICIDH-80 used the term Impairment. ICIDH-2 uses the term Functional change as well as the term Impairment. The AMA *Guides* also use the term Impairment.

It is important to recognize that measurements of visual functions can be used for two purposes: to assist in diagnosing the underlying disorder or to estimate the functional consequences *(see Table 2).* This distinction has consequences for the choice of tests used. E.g.: Tests such as ERG and VEP are helpful in diagnosing the underlying condition, but are poor predictors of the functional consequences. Since visual acuity loss can have many different causes, visual acuity testing adds little to the differential diagnosis, but can help in estimating the impact on Activities of Daily Living (ADL). The Ishihara color test is good at diagnosing even minor red-green deficiencies for genetic studies, but overestimates the functional consequences. The D15 color test on the other hand, was designed to be insensitive to minor deficiencies and to detect only those that might have functional consequences. The discussion in this chapter will be oriented towards the functional consequences.

Functional vision

The third aspect reaches beyond the description of organ function by describing the **skills and abilities of the individual**. It describes how well the individual is able to perform certain activities. In the field of vision, the term *functional vision* is used to distinguish this aspect from the previous one *(visual functions)*. Each descriptor for this aspect must have two parts: one specifying the activity and the other specifying the ability to perform it. In ICIDH-80 ability loss was described as *dis-ability*. Its successor, ICIDH-2 discourages the use of negative terms and changed the heading for this aspect to the *'Activities'* aspect. In the AMA *Guides,* the term '*impairment*' refers to organ function, while the term *'impairment rating'* refers to the functional vision aspect, i.e. an estimate of the ability to perform generic activities of daily living. Note that the concept of ability describes how well an individual *can* perform a certain activity. This is distinct from whether the individual actually *does* perform the activity.

TABLE 2 – Use of Visual Function Measurements

ASPECTS:	Structural change, Anatomical change	Measurement of Organ Function	Ability to perform Activities (ADL)	Social, Economic Consequences

Diagnosis of underlying condition	Estimate of functional consequences
ERG, VEP are useful diagnostic tools.	*ERG, VEP do not predict ADL performance.*
Accurate acuity measurement below 20/100 adds little to differential diagnosis.	*Accurate measurement below 20/100 is critical to predict magnification need.*
Ishihara test detects minimal genetic color vision defects.	*D15 test detects only color defects with possible functional significance.*

Legend: Different tests serve different purposes *(see text)*.

Societal and Economic Consequences

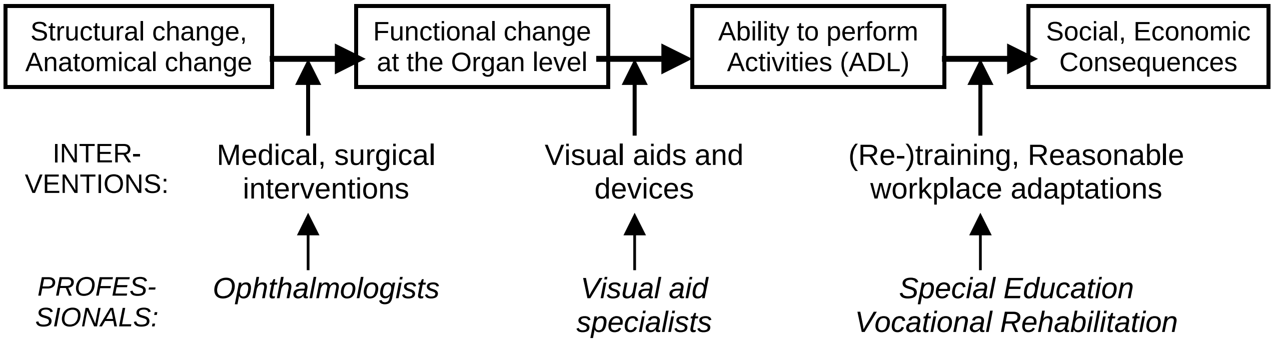
The fourth and last aspect describes the societal and economic consequences for the individual caused by an impairment or by a loss of ability. This aspect is also referred to as *Quality of Life.* Whether one's quality of life is considered satisfactory or not depends in part on personal and societal expectations and demands. In ICIDH-80 this aspect was described as *handicap* and measured in terms of *loss of independence*; in ICIDH-2 it is described under the heading *participation,* which lists a variety of higher-order social functions. These terms describe two sides of the same coin: handicap refers to the barriers that need to be overcome, participation to the success in overcoming them. Here, again, it is important to differentiate between how well an individual *can* participate and how well the individual *does* participate. The story of Helen Keller is one example of how some people can achieve full participation in spite of extraordinary handicaps. Yet, it is clearly not realistic to expect such performance from all individuals with a similar handicap.

The AMA scales aim at providing generalizable scales, based on the estimated ability to perform generic daily living skills. They do not extend to quality of life issues and to the environmental adaptations that can be made to improve the quality of life (including employability) of an individual. This does not mean, however, that such factors should not be mentioned in an evaluator's report.

INTERVENTIONS for REHABILITATION

The four aspects of vision loss are not independent. There is a chain of cause and effect, running from the left to the right, but the links are not rigid. The fact that rehabilitation is at all possible is a direct result of this flexibility. *The art of rehabilitation is manipulating each of these links so that a given disorder results in the least possible handicap or the greatest possible participation.* Different professionals must contribute their expertise at various steps, as shown in Table 3.

TABLE 3 – Various Interventions



Legend: The links between the various aspects are flexible and can be influenced by various external interventions *(see text).*

The first link, from anatomical changes to their functional effects, can be changed by medical and surgical interventions. For vision, this is the domain of the ophthalmologist. The AMA *Guides* discuss mainly 'permanent impairment', i.e. residual impairment after maximal medical intervention. The scales, however, could be used to characterize transient impairment as well.

The next link, from visual functions to functional vision, can be influenced by the use of various vision enhancement and vision-substitution devices. The most obvious form of vision enhancement is the use of magnification to restore reading ability. What constitutes effective vision enhancement may not be the same for all persons; some patients benefit from higher illumination levels, others, with glare sensitivity, do better with reduced light levels. For more severe vision loss, vision substitution skills may be needed, such as the use of Braille and talking books or the use of a long cane for mobility. This is the domain of visual aid specialists.

The last link, from the skills and abilities of the individual to their social and economical consequences can be influenced by modifying the physical environment. Examples include curb cuts for wheel chair users, better lighting and contrast for individuals with vision loss, and 'reasonable workplace adaptations' as required in the Americans with Disabilities Act (ADA). Another option is education, aimed at changing the individual's capabilities and/or societal expectations; this may include retraining of the individual and/or job adaptations. This is the domain of special educators, counselors and vocational specialists.

Recognizing the flexibility of the links shown in Table 3 is crucial for an understanding of disability and rehabilitation. Not only is it this flexibility that makes rehabilitation possible, the variable effect of rehabilitative interventions also makes it impossible to simply predict one aspect from the other in any individual case. Two patients with similar impairments (acuity, field) will have different abilities with regard to Activities of Daily Living, if one has access to visual aids and the other has not. Two patients with equal ability losses will achieve different levels of participation if one has access to a workplace where "reasonable accommodations" (as required by the ADA) have been made, and the other has not. The best we can do when producing tables like those in the AMA *Guides* is to make statistical estimates. Magnus realized this, a century ago, when he named his work "… rules for estimation …".

The wide array of possible interventions makes it mandatory that rehabilitation involves a team of different professionals. Table 3 also makes it clear that the effects of their interventions must be measured with different yardsticks. Measurement of visual acuity and other visual functions can be used as an outcome measure for medical and surgical interventions. For the prescription of visual aids and other vision enhancement techniques, visual acuity and visual field are the starting point; the effect of these interventions must be measured by recording improved performance of Activities of Daily Living (ADL). Unfortunately, scales to do this have not yet been developed very well, although various efforts are under way. Retraining and job modifications may result in greater participation. Changes in this area (except earning potential) are even harder to measure objectively.

DISABILITY EVALUATION

The different points of view that can be used in disability evaluation, will affect the relative emphasis that is placed on the evaluation of different aspects.

The Social Security Act (SSA) defines disability as the inability to engage in 'Substantial Gainful Activities' (SGA), because of a medical impairment. This definition clearly addresses the economic consequences by evaluating the earning potential (aspect #4). It is a very reasonable definition for the purpose of the law. Yet, one should realize that the use of different terminologies may give rise to seemingly contradictory statements. E.g.: Helen Keller certainly had profound 'handicaps' (in the sense of ICIDH-80), yet she achieved full 'participation' (in the sense of ICIDH-2) and would not have been considered 'disabled' (for the purpose of the SSA).

Rehabilitation specialists and educators who prepare an Individual Rehabilitation Plan are most interested in evaluating the various skills of the individual (aspect #3), so that rehabilitation efforts can be concentrated on those skills in which the individual is deficient. For this purpose, creating a *'visual ability profile'* is more useful than collapsing all information into a single number. This approach stresses the differences between individuals and takes into account the adjustments they have made already

An administrator, on the other hand, who needs to assign a disability compensation package for vision loss, may not be so interested in the adjustments different individuals have made. For benefit purposes it may be more desirable to give individuals with the same loss the same compensation, so that individuals who have made good adjustments do not get penalized with lesser benefits. This approach is best served by calculating a single number that estimates the average impact on daily living skills (aspect #3), based on the measurement of visual acuity and visual field (aspect #2). The advantage of this approach is that the measurement of visual acuity and visual field can be much more objective than the direct assessment of vision-related daily living skills.

The difference in the two approaches is summarized in Table 4. The AMA *Guides* were constructed to support last approach. As discussed above, the fact that individual skills and skill differences are ignored means that the approach of the AMA *Guides* cannot be used for the determination of individual rehabilitation needs.

The AMA approach makes the assignment of benefits a two-step procedure. The first step is the medical measurement of the impairment. This is the responsibility of the physician. The second step is the assignment of benefits. This is the responsibility of the plan administrator. This two-step procedure is different from Snell's visual efficiency scale, which tried to establish a direct link from visual acuity to employability in 1925.

Since two or more parties will be involved, it is of the utmost importance that they understand each other's responsibilities and the differences involved in the various approaches. Although the physician's primary responsibility is to accurately measure the impairment and to apply the formulas provided in the AMA *Guides*, the physician may also be asked about rehabilitation and employment options, and should therefore have a basic familiarity with those issues as well.

TABLE 4 – Rehabilitation Needs vs. Eligibility for Benefits

ASPECTS:	Structural change, Anatomical change	Functional change at the Organ level	Ability to perform ADL Activities	Social, Economic Participation
REHABILITATION NEEDS Based on individual assessment of various abilities, since successful adaptations reduce the need for additional Rehabilitative Care.			**Ability and Participation Profile** → Need for Rehabilitative Care	
ELIGIBILITY for BENEFITS Based on statistical estimates of generic abilities. Individual variations are ignored, since successful adaptations should not be penalized by a reduction in benefits.		**Impairment Measurement** →	<u>Step 1</u> Estimate of generic Ability *using tables as in AMA Guides* →	<u>Step 2</u> Assignment of Benefits *based on applicable program rules*

Legend: Disability evaluation for different purposes may choose to look at different aspects *(see text).*

Administrative decisions for the same impairment may or may not be the same for different plans. A plan aimed at compensation for work-related injuries may pay a disability compensation, even if the individual is still gainfully employed. A plan aimed at providing compensation for loss of earnings would deny the claim of the same individual, because he/she is still gainfully employed.

TERMINOLOGY

To help various professionals to have an understanding of each other's roles and and the use of shared terminology. This section will list various terms and the way in which they are used in various contexts.

Impairment – In this chapter we will use the term impairment to refer to functional changes at the organ level (visual functions). Eg.: a cataract is an anatomical change, the resulting visual acuity loss is the impairment. Other texts, however, may also extend the term impairment to anatomical changes.

Impairment rating is used in the AMA *Guides* to indicate the impact of the impairment on the ability to perform daily living skills (functional vision). In the vision chapter, the estimated impact is primarily derived from the impairment measurement (visual acuity, visual field.

Disability – In the draft for ICF (ICIDH-2), the use of this term was avoided, partly because it is a negative term and partly because it can be used with many different meanings. *Having a disability* may be used as a synonym for 'having an impairment' (aspect #2). *Being dis-abled* may refer to the fact that the individual is unable to perform certain activities of daily living (aspect #3). *Being 'on disability'* may indicate that the individual receives benefits, one of the possible social consequences of an ability loss (aspect #4).

Disablement was used in ICIDH-2 (the draft for ICF) to avoid the term disability. Curiously, its counterpart, **enablement,** which is the basis of rehabilitation, was never used. The final publication of ICF *(International Classification of Functioning, Disability and Health)* went back to using the term disability.

Visual Efficiency was the name given to Snell's scale, which was used up to 4th edition of the AMA *Guides*. It aimed at providing a direct translation of visual acuity values to employability in 1925. Use of this scale is discontinued in the current, 5th edition.

Visual Acuity Score, Visual Field Score – In the 5th edition, these scores are used to translate the (non-linear) results of visual acuity and visual field measurement to linear scores that can be used in calculations. They refer to the measurements made for each eye separately.

Functional Acuity Score, Functional Field Score – These scores refer to the Functional Vision of the individual, rather than to the eye. They are calculated from the visual acuity score and visual field score. They estimate the impact of vision loss on daily living skills, i.e. on reading skills for the functional acuity score and on orientation and mobility skills for the functional field score. Since normal vision is binocular vision, the calculation of the functional scores is weighted heavily in favor of binocular visual acuity and the binocular field.

The calculation of these estimates is distinct from the direct assessment of various visual abilities. Direct assessment would result in a *Visual Ability Profile* as would be needed for individual rehabilitation plans *(see Table 4)*. Efforts are under way in various quarters to construct scales for the latter purpose, but there is no consensus yet on their validity and applicability.

Functional Vision Score – This score is a theoretical construct and provides a composite of the acuity and field score for those situations where it is desirable to collapse the multifaceted reality of vision into a single number [12]. A conversion table between the old Visual Efficiency scale and the Functional Vision Score is offered in Table 11 in the Appendix.

Table 8 (page 14) summarizes the relationship between these scores.

The scores mentioned above are *ability* scores; i.e. higher numbers represent better function. The *impairment* scales and *impairment rating* scales used in the AMA *Guides* indicate loss; i.e. higher numbers represent poorer function. The AMA scales are obtained by subtracting the various scores from 100.

UNIFORM MEASUREMENT SCALES

Different organ functions are measured in very different units. Visual acuity is measured in terms of visual angle, hearing loss is measured in dB, lung function is measured in volume/minute. Such disparate measurements obviously cannot be compared directly. We have seen, however, that one of the reasons for measuring organ function is to predict the performance of daily living skills. Regardless of the specific skill involved, the ability to perform most skills can be expressed on a uniform scale as shown in Table 5.

This scale has six main ranges (seven if exceptional ability is added). In the top three, performance is normal or near-normal, in the lower three it is restricted. The ranges can easily be fitted with a 10- or 100-point score and can be applied to any ability, as is demonstrated in the following discussion with examples from the mobility and locomotion domain.

Exceptional Performance
Some individuals have exceptional abilities. *E.g.: the person is an Olympic runner.*
(Note that this range could not be covered by an impairment scale, where normal = 0)

Range of Normal Performance
Most human functions have a reserve capacity. *E.g.: the person can run and walk.*

Mild Ability Loss
In this range the reserve is lost, but everyday performance is not yet significantly compromised. *E.g.: the person can walk, but not run.*

Moderate Ability Loss
In this range the disabling effect can still be overcome with appropriate performance enhancing aids. *E.g.: the person can walk with the support of a cane.*

Severe Ability Loss
In this range performance starts to fall below normal and endurance is limited, even with assistive devices. *E.g.: the person can move around with a walker.*

Profound Ability Loss
In this range, the options for enhancement are limited. Performance must rely equally on substitution skills. *E.g.: the person can move around in a wheelchair, substituting arm power for leg power.*

Near-total or Total Inability
In this range, the original skills, if any, have become unreliable and may at most serve as an adjunct. *E.g.: the person must be wheeled around passively.*

Note that this scoring system is expressed in points, rather than in any specific measurement unit or in percentages of a measurement unit. The impairment (and the impairment rating in the AMA *Guides*) can then be expressed in percentages of this point scale.

TABLE 5 – GENERAL ABILITY RANGES

RANGE descriptors	ABILITY RANGES		**POINT SCORE**	Impair-ment	TYPE of AIDS for REHABILITATION
Above normal		*Exceptional ability*	*>110*	- -	
Normal	Normal or Near-normal performance	Has reserves	**100** ± 10	0	No aids required
Mild loss		Lost reserves	**80** ± 10	20	↓
Moderate Loss		Needs some aids	**60** ± 10	40	Enhancement aids
Severe Loss	Restricted performance	Restricted with aids	**40** ± 10	60	Enhancement aids
Profound Loss		Marginal with aids	**20** ± 10	80	↓
(Near-)total Loss		(Near-)impossible	**0** – 10	100	Substitution aids

VISUAL ACUITY SCALES

How can these principles be applied to visual acuity measurement? Traditional visual acuity charts often had an irregular progression of letter sizes, uneven spacing and a different number of letters on different lines. Newer, standardized charts have a geometric progression of letter sizes, proportional spacing and 5 letters on each line [13, 14, 15]. These charts, often referred to as ETDRS-type charts (because they were used in the Early Treatment of Diabetic Retinopathy Study), allow for more consistent accuracy at all levels of visual acuity.

Table 6 offers the opportunity for various comparisons.

The left side of the table shows the ranges of visual acuity defined in ICD-9-CM, the official U.S. Health Care classification. Each range covers four lines on a standard, ETDRS-type chart.

The center section of the table indicates the Visual Acuity Score (VAS) for each visual acuity level. The AMA Impairment rating is obtained by subtracting the VAS from 100. Note that the

VAS is an ability scale and extends beyond “100”, since normal acuity is better than the 20/20 standard. The impairment scale is truncated at 20/20.

The right side of the table presents ranges of reading ability. It assumes that the patient is literate and that reading is only limited by the visual impairment.

This layout allows several comparisons. Comparing the VAS scale to the ICD-9-CM ranges, it is seen that each line read counts for five points. Since each line on a standard chart has five characters, the VAS can simply be interpreted as a count of the total number of letters read correctly, with the 20/2000 line counting as 0. The 20/2000 level is a convenient and appropriate baseline, since this level of acuity normally exists far into the periphery.

Comparing the VAS scale to the reading ability ranges, it is seen that the VAS scale also fits the general ability ranges in Table 5.

Finally, the reading ability ranges need to be compared to the acuity ranges. For this purpose, the visual acuity values on the left side of the Table are expressed in three ways. The first column shows the standard U.S. notation for 20 ft, the preferred testing distance for normal and near-normal vision *(see AMA Guides, section 12.2b.1)*. The next column shows the notation for 1-meter testing, which is the preferred testing distance for the Low Vision range *(see AMA Guides, section 12.2b.2)*. The third visual acuity column indicates the distance at which 1 M print (average newsprint) would be recognizable. This column can serve the last comparison because it indicates the focal length of glasses or magnifiers needed at each acuity level.

Table 6 – Visual Acuity Ranges *(See also AMA Guides, Table 12.2)*

Impairment Ranges (*ICD-9-CM*)		**Visual Acuity**			**Visual Acuity Score**	**Impairment Rating**	**Estimated Reading Ability**
		US notation	1 m notation	1M print read at			
(Near-) Normal Vision	Range of Normal Vision	20/12.5	1/0.63	160 cm	110	…	Normal reading speed Normal reading distance Reserve capacity for small print
		20/16	1/0.8	125 cm	105	…	
		20/20	1/1	100 cm	100	0%	
		20/25	1/1.25	80 cm	95	5%	
	Near-Normal Vision	20/32	1/1.6	63 cm	90	10%	Normal reading speed Reduced reading distance No reserve for small print
		20/40	1/2	50 cm	85	15%	
		20/50	1/2.5	40 cm	80	20%	
		20/63	1/3.2	32 cm	75	25%	
Low Vision	Moderate Low Vision	20/80	1/4	25 cm	70	30%	Near-normal with reading aids Uses low power magnifier or large print books
		20/100	1/5	20 cm	65	35%	
		20/125	1/6.3	16 cm	60	40%	
		20/160	1/8	12.5 cm	55	45%	
	Severe Low Vision	20/200	1/10	10 cm	50	50%	Slower than normal with reading aids Uses high-power magnifiers
		20/250	1/12.5	8 cm	45	55%	
		20/320	1/16	6.3 cm	40	60%	
		20/400	1/20	5 cm	35	65%	
	Profound Low Vision	20/500	1/25	4 cm	30	70%	Marginal with aids May use magnifiers for spot reading, but may prefer talking books
		20/630	1/32	3.2 cm	25	75%	
		20/800	1/40	2.5 cm	20	80%	
		20/1000	1/50	2 cm	15	85%	
(Near-) Blindness	Near-Blindness	20/1250	1/63	1.6 cm	10	90%	No visual reading Uses non-visual sources, talking books, Braille
		20/1600	1/80	1.25 cm	5	95%	
		20/2000	1/100	1 cm	0	100%	
	Total Blindness	No light perception					

As long as the viewing distance for 1M print is 30 cm or more (i.e. in the normal or near-normal range), no significant difficulty in reading newsprint should be encountered. In the Moderate Low Vision range, the viewing distance becomes 25 cm or less. (Note that 25 cm is the distance to which the magnification of magnifiers is referenced.) In the Severe Low Vision range (20/200 or less), the viewing distance becomes 10 cm or less, a distance at which binocular vision, even with prisms is no longer possible. In the Profound Low Vision range, the viewing distance for newsprint becomes less than 5 cm (less than 2”). With this magnification requirement, visual reading becomes marginal.

Since each of these comparisons shows a good fit, we may conclude that the VAS can be used as a reasonable estimate of the reading ability loss caused by visual acuity loss.

> See section 12.1 and 12.2 of the AMA *Guides* for more detailed instructions on visual acuity measurement.
>
> Footnote: The listed distance indicates the minimum power for high plus reading glasses or for magnifiers held close to the eye. Magnifiers held at a distance from the eye are somewhat less effective and need to be somewhat stronger. Also, letter chart acuity refers to threshold acuity, while comfortable reading may require some additional magnification (stronger lenses).

CHANGING PERCEPTIONS and “LEGAL” BLINDNESS

Table 6 shows that the ICD-9-CM category for “Severe Vision Loss” corresponds to what in various U.S. statutes is described as “Legal Blindness”. The term “Legal Blindness” is a regrettable misnomer, since 90% of the people who are so labeled, are not *blind,* but have residual vision. The continued use of the term “legal blindness” supports the popular misconception of a black-and-white dichotomy between those who are “legally sighted” and those who are “legally blind”. The reality is that there is a gradual transition with a large gray area of individuals with “Low Vision”. The word *low* indicates that these individuals have less than normal vision, the word *vision* indicates that they are not blind. Describing a person with a severe vision loss as “legally blind” is as preposterous as describing a person with a severe heart ailment as “legally dead”.

The term legal blindness dates from the depression years, when it replaced the earlier, more descriptive term of industrial or economic blindness. At that time, little attention was given to the use of residual vision. Children with vision loss were placed in schools for the blind, where they were blindfolded and taught blind skills. Indeed, the concept of “sight-saving” classes treated vision like money in the bank that was best preserved by not using it. It was not until the early 1950’s that the first Low Vision Rehabilitation services were opened at the Industrial Home for the Blind and at the Lighthouse in New York.

Snell’s visual efficiency scale dates from this early era. It gave 20/200 acuity an efficiency value of “20”. His scale left little room for differentiation among those with less than 20/200 acuity. Today we realize that those with 20/200 may have lost 80% of their employability in 1925, but certainly not 80% of their vision. In accordance with the general ability scale in Table 5, the new scale places 20/200 at "50", thus preserving as much room for differentiation above as below this level. See Table 11 for a more detailed comparison.

Attention should also be paid to the psychological effect of the term “(legal) blindness”. When we tell a person that he or she *is* blind, we have categorized that person with the unspoken implication that “nothing more can be done” (about the underlying disorder). When we tell a person that he or she *has* low vision, the implication is that they *have* a problem. The next question then is what can be done about the problem. The answer is that many things can still be done to preserve and enhance that person’s quality of life.

VISUAL FIELD SCALES

Table 7 provides scales for Visual Field Loss. Its layout is similar to Table 6. It will be seen that the traditional assumption that a visual field loss to a 10° radius (20° diameter) is equally disabling as a visual acuity loss to 20/200 is maintained. Both receive a score of 50. Also maintained are the ICD-9-CM definitions for Profound and Near-total visual field loss (10° and 5° diameter). ICD-9 and ICD-9-CM had no definitions for lesser losses.

The 4th edition of the AMA *Guides* offered several methods of visual field assessment that were incompatible with each other and with the common definition of legal blindness. The AMA formula gave the same value to central field loss as to peripheral field loss and to the upper and lower half fields; it gave a score of "20" to field loss to a 12.5° radius. Esterman introduced the use of pre-printed overlay grids. His grids gave different weights to different areas and gave the lower half field twice the weight of the upper half field. The monocular version of his grid gave a score of "20" to a 15° radius; the binocular version gave that same score to a 20° radius (twice the legal definition).

The new formula can be implemented manually or with an overlay grid. The use of pre-printed grids is possible, but not needed, since the layout is so simple that the grids can be constructed by hand. The new layout gives 50% of the weight to the central 10°; which is consistent with the fact that this area corresponds to 50% of the visual cortex. The new layout gives 50% extra weight to the lower half field, which is a reasonable compromise between the AMA and the Esterman approach. The new layout scores a left or right hemianopia as a 50 point loss (equivalent to tunnel vision to a 10° radius), loss of the upper half field is a 40 point loss, loss of the lower half field is a 60 point loss. This is more appropriate than the old scale, where only a loss of more than three quadrants would qualify as "legal" blindness.

Implementation

The new layout is implemented by drawing ten meridians, two in each of the upper quadrants and three in each of the lower quadrants. Along each meridian 1 point is counted for every 2° up to a 10° radius and 1 point per 10° beyond the 10° radius. Thus, a 60° radius scores 10 points. The upper and nasal meridians will not reach 60°, but the lower and temporal meridians will extend further; thus, a normal field will score 100 points. This is summarized in the following diagrams:

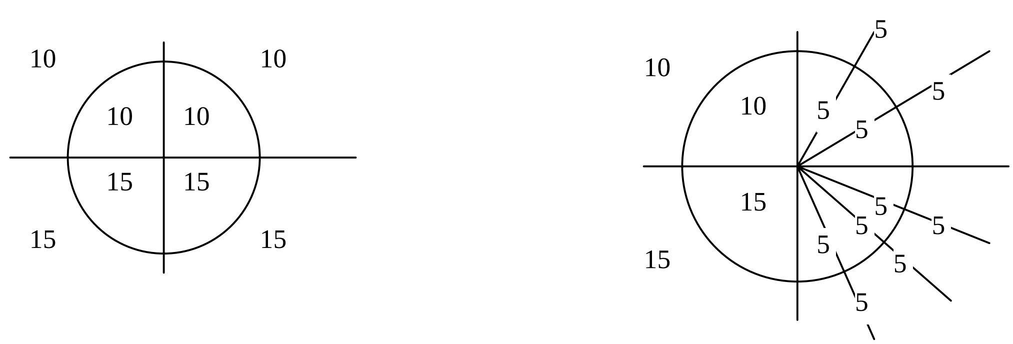


Figure 1
Arrangement of the measurement points for visual field scoring. Note that the arrangement of the meridians within the quadrants avoids the need for special rules for hemianopias.

Table 7 – Visual Field Ranges *(See also AMA Guides, Table 12.5)*

Impairment Ranges (*ICD-9-CM*)		**Special Conditions**	**Average Radius (Concentric)**	**Visual Field Score**	**Impair-ment Rating**	**Estimated Ability for Visual Orientation and Mobility (O + M)**
(Near-) Normal Vision	Range of Normal Vision		 65° 60° 55°	110 105 100 95	… … 0% 5%	Normal visual orientation Normal mobility skills
	Near-Normal Vision	Loss of one eye	50° 45° 40° 35°	90 85 80 75	10% 15% 20% 25%	Normal O + M performance Needs more scanning Occasionally surprised by events on the side
Low Vision	Moderate Low Vision	Lost upper field	30° 25° 20° 15°	70 65 60 55	30% 35% 40% 45%	Near-normal performance Requires scanning for obstacles
	Severe Low Vision	Hemianopia Lost lower field	10° 9° 8° 7°	50 45 40 35	50% 55% 60% 65%	Visual mobility is slower than normal Requires continuous scanning May use cane as adjunct
	Profound Low Vision		6° 5° 4° 3°	30 25 20 15	70% 75% 80% 85%	Must use long cane for detection of obstacles May use vision as adjunct for identification
(Near-) Blindness	Near-Blindness		2° 1°	10 5	90% 95%	Visual orientation unreliable Must rely on long cane, sound, guide dog, and other blind mobility skills
	Total Blindness	No visual field		0	100%	

Legend: See section 12.3 of the AMA *Guides* for more detailed instructions on visual field measurement.

ESTIMATING FUNCTIONAL VISION

Having measured the visual functions (visual acuity, visual field), we need to calculate an estimate of the overall functional vision of the person. This process is summarized in Table 8.

Since normal vision is binocular vision, the formula for converting the Visual acuity/field scores for each eye to Functional acuity/field scores for the person is heavily weighted in favor of the binocular function. The formula is: (OD + OS + 3x OU) / 5. This is different from the formula used in prior editions; that formula did not consider binocular function; it first combined visual acuity and visual field for each eye separately and then combined the two eyes as if they were independent organs.

Binocular visual acuity is routinely measured. The binocular field, however, is not easily measured. Existing visual field equipment has no means of monitoring fixation when the head is centered and no means of ensuring that the two eyes converge the appropriate amount for the short viewing distance in the field-testing bowl. Therefore, it is recommended that monocular visual fields be obtained in the usual way and that the binocular field is constructed from an overlay of the two monocular fields.

Table 8A – From Impairment Measurement to Ability Estimate

(See AMA Guides, Table 12-1)

Measured Impairment (of each eye)	**Estimated Functions (of the person)**	**Global Impairment of the Visual System**
Visual Acuity Score – OD Visual Acuity Score – OS Visual Acuity Score – OU	→ **Functional Acuity Score** (FAS)	→ **Functional Vision Score** (FVS) **Visual Impairment Rating** = 100 – FVS
Visual Field Score – OD Visual Field Score – OS Visual Field Score – OU	→ **Functional Field Score** (FFS)	↑
Other visual functions (if significant)	→	Individual adjustments

Alternatively, this may be diagrammed as follows:

Table 8B – From Impairment Measurement to Whole Person Impairment

See:	**Measured Visual Functions** *(how the eyes function)*		**Estimated Visual Abilities** *(how the person functions)*	*See:*
Tbl 12-1	**V**isual **A**cuity **S**core (VAS) = count of letters recognized	→	**F**unctional **A**cuity **S**core (FAS) combines: 60% OU + 20% OD + 20% OS	*Tbl 12-2*
Tbl 12-5	**V**isual **F**ield **S**core (VFS) = count of points detected	→	**F**unctional **F**ield **S**core (FFS) combines: 60% OU + 20% OD + 20% OS	*Tbl 12-6*
Txt 12-4b	Optional adjustment for other vision problems	- - →		
		↓	**F**unctional **V**ision **S**core (FVS) estimates general visual ability as: FAS x FFS / 100, (other losses)	*TXt 12-4*
		↓	Visual System Impairment (VSI) estimates visual ability loss as: VSI (AMA) = 100 – FVS	*Txt 12-4c* *Tbl 12-10*
		↓	Whole Person Impairment (WPI)	
Chapter 1-2	Using the WPI calculation and other factors to determine monetary compensation is a separate, administrative decision, beyond the scope of the AMA Guides.			

INTERPRETATION OF THE FUNCTIONAL SCORES

At this point it may be appropriate to repeat what the Functional Scores (Functional Acuity Score, Functional Field Score, Functional Vision Score) do and do not provide.

They are called “Scores” since they are directly derived from a scoring system for visual acuity and visual field (number of letters seen on a standard chart, number of dots seen on a standard field plot). No individual judgements enter into this calculation. The term “Rating”, on the other hand, leaves room for some individualized judgement. In the AMA *Guides (section 12.4 and* *table 12-10)* this adjustment room is provided in converting the Functional Vision 'Score' to an Impairment 'Rating' *(see Table 10).*

Since the Functional Score calculations are based on visual acuity and visual field measurements, they are more reproducible than a direct assessment of vision-related skills and abilities would be. The visual system is fortunate in that visual functions can be quite accurately measured and that the results show a good correlation with functional vision *(see Tables 6 and 8)*. For other organ systems the correlation between measured organ function and estimated abilities may not be as obvious or as precise. For those organ systems some direct assessment of ADL abilities may be required.

The scores do not take into account that some individuals will have made better adaptations to vision loss than others. This has advantages for the assignment of benefits, since the judgement calls of the evaluator are reduced and since individuals who have made good adaptations are not penalized by a reduction of benefits. On the other hand, reducing the complex and multi-faceted reality of vision to a single number requires an enormous amount of oversimplification and thus may throw out significant information.

While the Functional Acuity Score is related to visual reading skills and the Functional Field Score is related to visual Orientation and Mobility skills, the Functional Vision Score, which combines the two, is a more abstract concept, no longer related to any particular real-life skill. When visual impairment ratings have to be combined with impairment ratings for other organ systems, the resulting value becomes even more abstract.

The relationship between letter chart acuity and reading ability, as expressed in Table 6, assumes the availability of glasses and some basic magnifiers. It also assumes literacy. If these conditions are not met, visual performance may be worse than expected.

Use of Braille, talking books and voice-output devices can compensate significantly for a loss of visual reading skills. Use of a long cane or a dog guide can compensate significantly for a loss of visual mobility skills. Since the objective of the scoring system is to assess the effects of vision loss, the scores do not take into account how these non-visual skills can enhance actual performance.

The relationships in Table 6 and Table 7 are based upon some general assumptions about the abilities needed for generic Activities of Daily Living (aspect #3). They specifically exclude additional job-related or environment-related demands *(see AMA Guides, chapter 1, 2)*. The vision requirements for navigating a mountain trail may be higher than those for navigating a sidewalk. The scores do not reflect such unusual demands. An extreme example may clarify this: a hobbyist working with an unprotected power tool lost some digits from his little finger. Even if this were his right hand, his loss of ADL abilities (aspect #3) would not be significant; if it were his left hand, it would be even less. However, if he is a professional violinist, he could still hold the bow with his damaged right hand, but even a partial loss of his left-hand function might signal the end of his career (aspect #4). Workmen's Compensation Insurance would not pay, since the loss was not work-related. However, a professional disability insurance might pay a significant amount.

COMMENTS on some of the PROCEDURAL STEPS

The following section will provide some comments and clarifications on selected procedural steps. They are referenced to the Vision chapter (chapter 12) in the AMA *Guides*.

Section 12.2 – Impairment of Visual Acuity.

Since the vast majority of cases of vision loss involve visual acuity loss, determination of bestcorrected visual acuity is never skipped. See section 12.3 regarding possible skipping of visual field tests.

Section 12.2b.1 – Testing in the normal range.
ETDRS type charts (geometric progression, proportional spacing, 5 letters per line) are preferred. If such charts are not available, traditional charts may be used.

If the visual acuity is around 20/200, the criterion "20/200 or less" should be interpreted as "less that 20/160" or as "less than 10/80" on a traditional chart, moved to 10 ft. Otherwise on traditional charts, the criterion "20/200 or less" effectively becomes "less than 20/100".

Section 12.2b.2 – Testing in the Low Vision range.
In this range testing at 1 meter is recommended over the use of vague estimates such as "count fingers" or "hand movements". Charts for use at this distance are available commercially [16].

Section 12.2b.2 – Monocular vs. Binocular Acuity.
The new rules specify testing of binocular acuity, rather than assuming that the binocular acuity equals the acuity of the better eye. For most practitioners testing of the binocular acuity already is a part of the routine eye exam.

Section 12.2c – Steps for Assigning a Visual Acuity-based Impairment Rating.
These steps have been discussed above. See Table 6 and Table 8.

Determination of reading acuity has been made optional. The reason is that most reading measurements are notoriously inaccurate. Most practitioners record only the print size read, without the exact distance. Furthermore, the commonly used Jaeger numbers have no numeric basis, while point sizes may differ with the type style (e.g. 8 pt Arial = 9 pt Times Roman). The progression of the reading efficiency scale in the old rules was very irregular. If reading acuity is to be considered, accurate measurement guidelines are provided in section 12.5.

Section 12.3 – Impairment of the Visual Field.
Impairment of the visual field is much less frequent than impairment of visual acuity. If there are no complaints that might point to visual field loss, and if the history and screening tests (such as a tangent screen test or confrontation test, or a central-30 automated field test) provide no suspicion of visual field loss, visual field testing might be skipped. In that case, the Functional Field Score is assumed to be 100 (no impairment) and the Functional Vision Score equals the Functional Acuity Score. The examiner should, of course, be prepared to defend this decision, if challenged.

Section 12.3a.4 – Automated Perimetry.
Although the Social Security Administration still prefers Goldmann-type testing, such tests are increasingly difficult to obtain. There is a theoretical concern that static and kinetic testing might not always give the same results (static-kinetic dissociation). Such discrepancies, however, are probably exceedingly rare. As in previous editions, the AMA *Guides* allow the construction of a pseudo-isopter from an automated field plot. *(see Example 12-9, Figures 12-8 and 12-9).*

Most automated plots are therefore limited to the central 30º (radius), since this area is the most informative for diagnostic purposes. For Orientation and Mobility the far periphery is more important. Any visual field test for disability evaluation should therefore test to 60º or beyond. A normal central 30º test may at best be used as supportive evidence in skipping field testing.

Although a commercial automated test sequence is not yet available, the feasibility of such a program has been demonstrated [17] and future development is expected.

Section 12.3a.5 – Binocular Fields.
As pointed out earlier, there is no equipment that allows reliable binocular field testing. Existing equipment does not allow fixation monitoring when the head, rather than the eye, is centered, and there is no way to ascertain that the patient maintains the proper amount of convergence

for the short viewing distance in the test bowl. It is recommended, therefore, that the binocular field be constructed by superimposing the monocular field plots. *(see Figures 12-10 and 12-11 for examples 12-10 and 12-11).*

Section 12.3b.1 – Testing Grid.
The construction of the testing grid is simple enough to be remembered and constructed by hand. Alternatively, pre-printed grids can be prepared.

Section 12.3c – Assigning a Field-based Impairment Rating
The Impairment Rating can be calculated or counted on an overlay grid as the number of dots within the criterion isopter. Especially when scotomata are present, use of the overlay grid is recommended.

Section 12.4 – Impairment of the Visual System.
The new system combines the Visual Acuity Scores for OD, OS and OU to a Functional Acuity Score and then combines that score with a similarly determined Functional Field Score. This is different from the old system which first combined acuity and field values for the better eye and than combined them with a similar value for the lesser eye, as if the two eyes were independent organs. The new system accounts better for the fact that good visual acuity in one eye can compensate for poor acuity in the other eye. A good field in one eye can compensate for field loss in the other eye. But visual acuity cannot compensate for field loss or vice versa.

Section 12.4a.1 – Basic rule.
The formula to combine the Visual Acuity/Field Scores to a Functional Acuity/Field Score calculates a weighted average. This formula produces the same result, whether applied to the Scores or to the Impairment Ratings (= 100 – score). By contrast, the formula used to combine the Functional Acuity Score with the Functional Field Score is a multiplication and will produce very different results when applied to the Scores or to the Impairment Ratings. The formula should be applied to the Scores, which are positive ability scales, rather than to the negative impairment scales. The difference in result is graphically illustrated in Table 9.

Table 9 – Multiplying Ability Scores vs. Multiplying Impairment Ratings.

Acuity Impair-ment		Impairment x Impairment
Acuity Score	Acuity Score x Field Score = Vision Score	
	Field Score	Field Impairment

Legend:
The Acuity Score (white) and the Acuity Impairment Rating (gray) add up to 100. So do the Field Score and the Field Impairment Rating.

Note that the effect of multiplying the Scores is entirely different from multiplying the Impairment Ratings.
The Functional Vision Score is represented by the white rectangle; the Impairment Rating of the Visual System (100 – FVS) is represented by the sum of the other three rectangles (gray), rather than by the impairment x impairment rectangle only.

Section 12.4a.2 – Additional Rules.
The new system treats visual acuity and visual field as independent variables, which they usually are. However, additional rules are needed to prevent the same loss from being counted twice, when the visual acuity loss and the visual field loss are not independent.

Section 12.4a.3 – Rule for Central Scotomata.
A central scotoma (a scotoma covering the point of fixation) causes both a visual acuity loss and a visual field loss. The Esterman grids solved this problem by ignoring any para central field losses. This is not appropriate since a peri-central ("doughnut") scotoma can be extremely debilitating, even if the central acuity for single letters is still reasonable.

The new system solves this dilemma by disregarding the central field loss when visual acuity loss is present. The greater the visual acuity loss, the greater the area of central field loss that is ignored *(see Table 12-9 and Examples 12-13, 12-14 and 12-15).* The field loss is ignored only for the calculation of the Functional Vision Score. Peripheral field loss is never ignored.

Section 12.4b – Individual Adjustments.
Although visual acuity loss and visual field loss account for most cases of visual impairment, other visual functions may also be impaired. In this case the Functional Vision Score may be adjusted downward and the Impairment Rating upward. The same rule as for central scotomata applies: The additional impairment is counted only to the extend that its effects exceed the effects of the concurrent visual acuity and/or visual field loss. The size of the adjustment is limited to 15 points. The need for such an adjustment must be well documented.

Contrast sensitivity is included in this group because its measurement is not yet well standardized and because it most often (but not always) is accompanied by visual acuity loss.

Section 12.4c – Impairment of the Whole Person.
Total blindness should be rated as a 100% Impairment of the Visual System. Yet, even totally blind persons can lead productive lives. Therefore, total impairment of the visual system does not equal total impairment of the Whole Person. The difference lies in the use of vision substitution skills. In the previous edition of the AMA *Guides* 100% visual impairment was equated with 85% Whole Person impairment. This equivalence is maintained. The 15-point difference is the same as allowed for additional impairments.

Table 10 – Converting Visual System Impairment to Whole Person Impairment

(See also AMA Guides, Table 12-10)

Range of normal vision	Near-normal vision (mild vision loss)	Moderate vision loss	Severe vision loss	Profound vision loss	(Near-) Total vision loss
Functional Vision Score (estimate of visual abilities)					
≥ 91 points	90 – 71 points	70 - 51 points	50 - 31 points	30 - 11 points	≤ 10 points
Visual System Impairment Rating (estimate of visual ability loss)					
0 – 9%	10 – 29%	30 – 49%	50 – 69%	70 – 89%	90 – 100%
Whole Person Impairment Rating (estimate of overall ability loss)					
0 – 9%	10 – 29%	30 – 49%	50 – 63%	64 – 77%	78 – 85%
Estimated ability to perform Activities of Daily Living					
Normal (or near-normal) performance			Restricted (or failing) performance		
Has reserve capacity	Lost reserve capacity	Need for vision enhancement aids	Slower than normal, even with enhancement aids	Marginal visual performance, even with aids	Cannot perform visually, needs substitution aids

Since the use of substitution skills hardly plays a role if the ability score is >50 *(see Table 5)*, the adjustment has been made only for the range of 50 – 0 ability (50% – 100% impairment). Table 10 compares the adjusted scales.

Section 12.5 – Reading Acuity.
As stated earlier, consideration of reading acuity is optional. If done in the context of a functional assessment it should be done with continuous text reading segments, rather than with a miniature letter chart.

Reading cards with a geometric progression and uniform, proportionally spaced reading segments are preferred, since they allow the assessment of reading rates. Such cards are available commercially in various languages [18]. Letter sizes should be given in M-units, since this is the only unit that allows comparison to letter charts and distance acuity values.

Section 12.5d – Modified Snellen Formula.
Use of a modified Snellen formula is recommended where the viewing distance is expressed in diopters (1/distance in m), rather than in cm. This converts the Snellen formula from a fraction to a multiplication and the viewing distance from a fraction-within-a-fraction to a whole number. This results in much easier calculations. It also provides a direct reference to the dioptric power of the reading add.

APPENDIX – Comparison to the 4th Edition

Changes from the 4th to the 5th edition are based on the scales and classifications of ICD-9-CM (1978) and ICIDH-80 (1980). They were elaborated in the *Guide for the Evaluation of Visual Impairment* (1999), prepared by an international working group for the International Society for Low Vision Research and Rehabilitation (ISLRR) [19].

Several changes were discussed earlier. Changes in the calculation procedure were indicated in Table 8.

The extra scale for **diplopia** was removed, because diplopia measurement is not standardized. Whether or not its presence is disturbing may depend on factors in the visual environment. If diplopia is disturbing and interferes with daily living skills, the Functional Vision Score and the Visual System Impairment rating may be adjusted, as it can be for other factors, indicated in section 12.4b.

The considerable extra impairment rating for **monocular aphakia** was removed. The extra rating was based on the fact that monocular aphakia with spectacle lens correction used to cause disturbing differences in image size between the yes. This problem was eliminated by the introduction of implant lenses, which are now the standard treatment. The extension to monocular pseudophakia was a mistake, introduced when lens implantation was still considered an experimental procedure.

The most obvious difference is the **change of scales**, where 20/200 acuity and a field of 10º radius were moved from “20” to “50” on the ability scale (from 80% to 50% on the impairment scale). A comparison with other chapters shows that the new scale fits better with the scales used for other organ systems. The new scales also allow for more differentiation in the lower ranges, an area that was considered unimportant in 1925 and is now the domain of Low Vision Rehabilitation programs. The new scales also give more appropriate representation to hemianopias.

Use of the new scales does not change any eligibility rules, except that SSA regulations that state that legal blindness is "equivalent to an 80% loss on Snell's Visual Efficiency scale" should now be read as "equivalent to a 50% loss on the Functional Vision scale".

Table 11 offers a more detailed comparison between the old Visual Efficiency scale and the new Functional Vision Score. They could be used to convert old ratings to the new score.

The table shows the inconsistencies that had crept in over various revisions. The visual efficiency scale for distance vision had little room for differentiation in the lower ranges. The visual efficiency scale for near vision stopped even sooner and shows values that do not correspond to the distance scale. Inexplicably, the near vision rating dropped from 90% to 50% for a one line difference from 20/40 (newsprint at 50 cm) to 20/50 (newsprint at 40 cm).

The visual field scores show similar discrepancies between the AMA formula and the Esterman monocular grid. Neither conformed to the common legal blindness definition, which states that field loss to a 10° radius is equivalent to an acuity loss to 20/200 (20 points on the visual efficiency scale).

Table 11 – FUNCTIONAL VISION SCORES vs Visual Efficiency Scores

VISUAL ACUITY

ICD-9-CM RANGES WHO / ICO		VISUAL ACUITY SCORE	Visual Efficiency DISTANCE	Visual Efficiency NEAR
Range of Normal Vision	20/125	110		
	20/16	105		
	20/20	100	100%	100%
	20/25	95	95%	100%
Near-Normal Vision	20/32	90	90%	95%
	20/40	85	85%	90%
	20/50	80	75%	50%
	20/63	75	65%	40%
Moderate Low Vision	20/80	70	55%	20%
	20/100	65	50%	15%
	20/125	60	40%	10%
	20/160	55	30%	5%
Severe Low Vision	20/200	50	20%	2%
	20/250	45		
	20/320	40	15%	
	20/400	35	10%	
Profound Low Vision	20/500	30		
	20/630	25		
	20/800	20	5%	
	20/1000	15		
Near-Blindness	20/1250	10		
	20/1600	5		
	20/2000	0		

Total Blindness	NLP			

VISUAL FIELD

Avg. radius (if loss is concentric)	VISUAL FIELD SCORE	Visual Efficiency (AMA)	Visual Efficiency (Esterman)
	110		
	105		
60°	100	96%	89%
55°	95	88%	83%
50°	90	80%	77%
45°	85	72%	69%
40°	80	64%	61%
35°	75	56%	53%
30°	70	48%	46%
25°	65	40%	35%
20°	60	32%	24%
15°	55	24%	15%
10°	50	16%	6%
9°	45	14%	
8°	40	13%	
7°	35	11%	
6°	30	10%	
5°	25	8%	0%
4°	20	6%	
3°	15	4%	
2°	10	2%	
1°	5		
0°	0	0%	

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[3] Snell AC. Visual efficiency of various degrees of subnormal visual acuity, its effect on earning ability. *JAMA*. 1925; 85(18):1367-1373.

[4] Snell AC, Sterling S. The percentage evaluation of macular vision. *Arch Ophthalmol*. Sept 1925;54:443-461.

[5] American Medical Association. *Guides to the Evaluation of Permanent Impairment*. Chicago. 1st ed, 1971; 2nd ed, 1984; 3rd ed, 1988; 3rd ed. rev, 1990; 4th ed, 1993.

[6] Colenbrander A,. *Dimensions of Visual Performance*, Low Vision Symposium, Amer. Academy of Ophthalmology, Transactions AAOO, 83:332-337, 1977.

[7] *International Classification of Impairments, Disabilities and Handicaps* (ICIDH-80), World Health Organization, Geneva, 1980.

[8] *International Classification of Diseases, 9th Revision (ICD-9).* World Health Organization, Geneva, 1977.

[9] *International Classification of Diseases, 9th Revision: Clinical Modification (ICD-9-CM).* First edition: Commission on Professional and Hospital Activities, Ann Arbor, 1978. Later editions: US Public Health Service, 1980 and others.

ICD-9-CM is the official US health care classification required for all diagnostic reporting. ICD-9-CM follows the international edition (ICD-9) but contains additional detail. The impairment ranges used in the AMA Guides are based on ICD-9-CM.

[10] *International Classification of Functioning, Disability and Health (ICF).* World Health Organization. Geneva, 2001. During development and beta-testing it was also known as ICIDH-2.

ICF is a companion classification to the ICD. The ICD classifies diseases and disorders; ICF classifies their functional consequences. They are part of the WHO's Family of Classifications.

[11] *Rehabilitation Codes. Classification of Impairment of Visual Function. Final report 1968.*

[12] Colenbrander A,. *The Functional Vision Score. A Coordinated Scoring System for Visual Impairments, Disabilities and Handicaps*. In: *Low Vision - Research and New Developments in Rehabilitation*, Kooijman et al. eds., Studies in Health Technology and Informatics, IOS Press, Amsterdam, 1994, pp. 552-561.

[13] Bailey IL, Lovie JE. New design principles for visual acuity letter charts. *Am J Optom Physiol Ophthalmol.* 1976;53:740-745.

Bailey and Lovie introduced the proportionally spaced layout with 5 letters/line that is now the standard.

[14] Ferris FL, Kassov A, Bresnick GH, Bailey I. New visual acuity charts for clinical research*. Am J Ophthalmol.* 1982; 94:91-96.

[15] National Eye Institute. *Measurement Guidelines for Collaborative Studies.* Bethesda, MD. 1982.

The NEI (ETDRS) guidelines popularized the standardized layout. The NEI rules specify a rating system similar to the Visual Acuity Score.

[16] *Low Vision Test Chart.* One side: letter chart from 50 M to 1 M (acuity: 1/50, 20/1000 to 1/1, 20/20), 1 m cord attached. Other side: reading segments from 10 M to 0.6 M, diopter ruler included, standardized segments for reading rate measurements. Available in English, Spanish, Portuguese, German, Dutch, Finnish, Swedish. Folds to fit a brief case. The reading segments are also available separately on 8½x11" cards. Precision Vision, 944 First Street, LaSalle, IL 61301. Fax: 815-223-2224.

[17] Colenbrander A, Lieberman MF, Schainholz DC. Preliminary implementation of the functional vision score on the Humphrey field analyzer. Proceedings of the International Perimetric Society. Kyoto, 1992. In: *Perimetry Update 1992/1993*, Kugler Publications; 1993:487-496.

[18] The reading segments of the *Low Vision Test Chart* are also available separately on 8½x11" cards. Precision Vision, 944 First Street, LaSalle, IL 61301. Fax: 815-223-2224.

[19] *Guide for the Evaluation of Visual Impairment*, prepared by an International working group for the International Society for Low Vision Research and Rehabilitation (1999).