THE ORGAN		THE PERSON	
Structural change, at the organ level	Functional change at the Organ level	Skills, Abilities (ADL) of the individual	Social, Economic Consequences
Eye Health	**Visual Functions**	**Functional Vision**	Quality of Life

(Near-)Normal Vision	Range of Normal Vision
	Mild Vision Loss
Low Vision	Moderate Vision Loss
	Severe Vision Loss
	Profound Vision Loss
(Near-) Blindness	**Near-Blindness**
	Blindness

VISUAL STANDARDS

ASPECTS and RANGES of VISION LOSS

with Emphasis on Population Surveys

Report prepared for the
International Council of Ophthalmology
at the 29th International Congress of Ophthalmology
Sydney, Australia, April 2002

Resolution adopted by the International Council of Ophthalmology
Sydney, Australia, April 20, 2002 (1)

WHEREAS lack of clarity about the appropriate use of the term "Blindness" has led to confusion about its definition and to varying reports about its prevalence and incidence and

WHEREAS the mission of ophthalmology and the International Council of Ophthalmology is not limited to the prevention of blindness, but also includes the prevention and remediation of lesser levels of vision loss, which do not fit under the term "blindness",

THEREFORE, be it resolved that the International Council of Ophthalmology, at its meeting in Sydney, Australia, April 2002

(A) Recommends to the World Vision Community the use of the following terminology **(2)**:

- **Blindness** – to be used only for total vision loss and for conditions where individuals have to rely predominantly on ***vision substitution*** skills.
- **Low Vision** – to be used for lesser degrees of vision loss, where individuals can be helped significantly by ***vision enhancement*** aids and devices.
- **Visual Impairment** – to be used when the condition of vision loss is characterized by a loss of visual functions (such as visual acuity, visual field, etc.) at the organ level. Many of these functions can be measured quantitatively.
- **Functional Vision** – to be used to describe a person's ability to use vision in Activities of Daily Living (ADL). Presently, many of these activities can be described only qualitatively.
- **Vision Loss** – to be used as a general term, including both total loss (Blindness) and partial loss (Low Vision), characterized either on the basis of visual impairment or by a loss of functional vision.

(B) For reporting the prevalence of vision loss in population studies and clinical research, reconfirms its earlier recommendation (Kyoto, 1978) to describe vision loss in more detail by classifying it into multiple ***Ranges of Vision Loss*** (based on visual acuity):

· **Normal vision**	>= 0.8		
· **Mild vision loss**	< 0.8	and	>= 0.3
· **Moderate vision loss**	< 0.3	and	>= 0.125
· **Severe vision loss**	< 0.125	and	>= 0.05
· **Profound vision loss**	< 0.05	and	>= 0.02
· **Near-total vision loss** (near blindness)	< 0.02	and	>= NLP
· **Total vision loss** (total blindness	NLP		

Recommends that, where such detailed reporting is not feasible, the categories defined in ICD-9 and ICD-10 of the World Health Organization be used as a minimum:

· **Low Vision**	< 0.3	and	>= 0.05
· **Blindness**	< 0.05	including	NLP

with additional detail where feasible.

(C) Recommends with reference to its ***"Visual Acuity Measurement Standard"*** (Kos, 1984),

- That the **ETDRS protocol** of the National Eye Institute, National Institutes of Health, USA, be adopted as the "gold standard" for visual acuity measurement in population studies and clinical research.
  The ETDRS charts are characterized by a proportional layout and a geometric) progression of letter sizes.
- That **deviations from that protocol** be spelled out if adherence to the complete protocol is not feasible.
- That the **geometric progression** be maintained to assure equal accuracy at all levels of vision loss, even if the full proportional layout is not feasible (as in projector charts).
  It is recognized that the use of the full ETDRS charts is often not practical in present clinical practice.
- That **measurement conditions** be specified, including (but not limited to) whether best-corrected acuity, presenting acuity, pinhole acuity, distance and/or near acuity are reported.
  The functional importance of near acuity is emphasized.

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(1) A full discussion of the rationale behind these recommendations can be found in the ICO report **"Visual Standards – Aspects and Ranges of Vision Loss, with emphasis on Population Surveys",** prepared by August Colenbrander, MD, for the 2002 meeting.
The report can be downloaded from the ICO web site: www.icoph.org/pdf/visualstandardsreport.pdf.

(2) This terminology does not preclude the possibility that the visual condition could subsequently be improved by medical, refractive or surgical intervention.

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The report can be downloaded in PDF FORMAT from the website of the International Council of Ophthalmology: www.icoph.org/standards.

Additional HARD COPIES are available from the Pacific Vision Foundation, San Francisco.
A donation of $5.00 per copy is requested for shipping and handling.

Please Fax the request to +1-415-346-6562 or e-mail to: beemstj@sutterhealth.org
and mention quantity, shipping address and a credit card number with expiration date.

SECTION 1 – **EXECUTIVE SUMMARY**

Statistics and surveys about the prevalence and incidence of vision loss are available from many different sources. Comparing the data is often hindered by a lack of uniform definitions. The goal of this report is to give a voice to emerging areas of consensus by providing guidelines for the uniform use of definitions, measurements and reporting methods.

This report was compiled at the request of the International Council of Ophthalmology (ICO) and their "Vision for the Future" plan and in cooperation with the World Health Organization (WHO), the International Agency for the Prevention of Blindness (IAPB) and their joint project "Vision 2020 – the Right to Sight".

Preservation of Vision or Prevention of Blindness

Recent decades have seen a gradual extension in the goals of population surveys from a study of the causes of truly "blinding" eye diseases to a study of lesser levels of vision loss and their social and economic consequences. These lesser levels of loss no longer fit under the term "blindness". This shift is acknowledged in the project title of "Vision 2020 – the Right to Sight" and in the recent publication of the International Council of Ophthalmology and the Academia Ophthalmologica Internationalis: "Vision for the Future – a Strategic Plan to Preserve and Restore Vision".

Appendix 1 contains the text of an editorial on this topic that appeared in the February 2002 issue of the American Journal of Ophthalmology. The sections that follow discuss a unified framework for reporting both aspects and ranges of vision loss, as summarized in Table 13.

Section 2 – **Aspects of Vision Loss**

Most events or conditions can be approached from different points of view. Thus, different observers will see different aspects. Some will see a glass as half empty, that others may see as half full. If these differences are not acknowledged, miscommunications may ensue.

To bring order among the many possible points of view when discussing the causes and consequences of Vision Loss, it is helpful to distinguish four main aspects of vision loss, as has been done in the WHO ***International Classification of Impairments, Disabilities and Handicaps*** (ICIDH-80, 1980) and its successor the WHO ***International Classification of Function, Disability and Health*** (ICF, 2000, also known as ICIDH-2 during its development). (See Table 1).

Two of the aspects refer to the **organ system**. The first aspect describes anatomical and structural changes, such as diseases, disorders and injuries. The second aspect is that of functional changes at the organ level. In the field of vision, the term **"visual functions"** is commonly used. Defects are described as impairments**.** The other two aspects refer to the **individual**. One aspect describes the skills and abilities of the individual to perform Activities of Daily Living (ADL). In the field of vision, the term **"functional vision"** is used. The last aspect points to the social and economic consequences. Defects are described as handicaps and as lack of participation. The various aspects and their interdependencies (Table 2) are discussed in the **Section 2. Appendix 2** points to the ambiguities that can result if it is not clear which aspect is the primary subject of study.

Section 3 – **Ranges of Visual Acuity Loss**

For each of the aspects of vision loss the loss can vary from mild to profound or to total. Since the emphasis of population studies is no longer limited to those who are totally blind, the simplistic dichotomy between those who are considered “legally blind” and those who are considered “legally sighted” is no longer satisfactory. A recent review of epidemiological surveys found that the vast majority reported on three ranges: **Normal Vision / Low Vision / Blindness**, using the definitions provided in ICD-9 and ICD-10. For many purposes, especially to describe the consequences of lesser degrees of vision loss, finer distinctions are desirable. The ranges first proposed in the 1970’s by the WHO and the International Council of Ophthalmology and published in ICD-9 and ICD-9-CM can serve this purpose. They are discussed in **Section 3** and summarized in Table 3. Additional details about specific ranges can be found in **Appendix 3**.

Section 4 – **Ranges of Ability Loss**
Similar ranges are needed to describe various degrees of ability loss. **Section 4** (Table 4) describes general ranges of ability loss. **Appendix 4** compares these ranges to ability ranges described elsewhere.

Section 5 – **Visual Acuity and Reading Ability**
Section 5 compares the visual acuity ranges, defined in section 3 with reading ability ranges, based on the ability ranges defined in section 4. The fit (Table 5) is remarkable. It should be emphasized, however, that the correlation is based on statistical averages. Individual performances may differ widely from the statistical average (Table 6). These correlations, therefore, cannot be used to predict individual performance.

Appendix 5 discusses the difference between reading ability (recorded as print size, without viewing distance), a measure of functional vision, expressing an important daily living skill, and reading acuity (based on print size and distance), a measure of a visual function, which can be compared to distance acuity and allows calculations of magnification need for Low Vision patients. A modification of Snellen’s formula is discussed, which simplifies such calculations.

Section 6 – **Ranges of Visual Field Loss**
Section 6 discusses similar ranges for visual field loss. The score presented in Table 7 is aimed at estimating the impact on performance, rather than at the differential diagnosis of underlying causes. **Appendix 6** explains how this visual field score is used in the Functional Vision Score (FVS) system that is part of the 5^{th} edition (2000) of the AMA ***Guides to the Evaluation of Permanent Impairment.***

Section 7 – **Visual Acuity Measurement**
Accurately defining visual acuity ranges is useless if the underlying visual acuity measurement is not standardized. **Section 7** discusses this issue. The **ETDRS protocol** of the National Eye Institute is widely accepted as the “gold standard”. This protocol combines a logarithmic progression of letter sizes (first proposed by Green in 1868) with a standardized, proportional layout proposed by Bailey and Lovie (1976). Table 8 compares the regular progression of ETDRS-type charts with the irregular progressions of various traditional charts. **Appendix 7** discusses additional details of visual acuity measurement.

Section 8 – **Reporting of Survey Results**
Section 8 summarizes the impact of these recommendations on the reporting of Survey results and contains a list of preferred **TERMINOLOGY** (Table 9). **Appendix 8** discusses how the choices made can influence the results and reduce the comparability of surveys using non-standard procedures. Table 13 provides an overall summary.

SECTION 2 – **ASPECTS of VISION LOSS**

Most events or conditions can be approached from different points of view. The same holds for vision loss. Consider a patient with a juxta-foveal lesion. The ophthalmologist needs to consider whether the lesion is treatable or too close to fixation. The office manager worries about insurance reimbursement. The patient wonders whether the treatment will be uncomfortable. The daughter agonizes about her mother continuing to live alone. If these differences in viewpoints are not acknowledged, miscommunications may ensue.

To bring order among the many possible points of view when discussing the causes and consequences of Vision Loss, it is helpful to distinguish four main aspects of vision loss [3], as has been done in the WHO ***Classification of Impairments, Disabilities and Handicaps*** (ICIDH-80, 1980 [4]) and its successor, the WHO ***Classification of Function, Disability and Health*** (ICF, 2000 [5], also known as ICIDH-2 during its development). These aspects are summarized in Table 1.

TABLE 1 – **ASPECTS OF VISION LOSS**

	THE ORGAN		**THE PERSON**	
ASPECTS:	Structural change, at the organ level	Functional change at the Organ level	Skills, Abilities (ADL) of the individual	Social, Economic Consequences
Neutral terms:	Health Condition	Organ Function	Skills, Abilities	Social Participation
Loss, Limitation:	Disorder, Injury	Impairment	Ability Loss (Dis-ability)	Handicap
Application to VISION:	Eye Health	**"Visual Functions"** measured quantitatively	**"Functional Vision"** described qualitatively	Vision-related Quality of Life
		Categorized as ranges of **"Vision Loss"**		
Performance Tests:		Performance on eye tests *E.g.: Visual Acuity*	Performance on ADL skills *E.g.: Reading ability*	Performance on job-related and social tasks
Ambiguous terms:		Disability = impairment as in "Americans with Disabilities Act" (ADA)	Dis-ability = ability loss as in "Disabled Veterans"	Disability = economic as in "Being on disability"

Two of the aspects refer to the **organ system**. The first aspect is that of anatomical and structural changes. Defects are described as diseases, **disorders** or injuries. The second aspect is that of functional changes at the organ level. Defects are described as **impairments.** The other two aspects refer to the **individual**. One aspect describes the skills and **abilities** of the individual. Defects are described as ability loss. The last aspect points to the social and economic consequences. Defects are described as **handicaps** and as lack of **participation**.

In the field of vision, the term **"visual functions"** is used to refer to the impairment aspect. Most visual functions (visual acuity, visual field, etc.) can be assessed quantitatively; they are usually measured for each eye separately. Abilities (reading ability, orientation ability, etc.), on the other hand, refer to the person, not to the eye. Although some aspects, such as reading speed, can be readily quantified, other aspects, such as reading enjoyment, cannot. The term

"functional vision" is used to refer to these visual abilities, as they are needed for the proper performance of Activities of Daily Living (ADL).

When evaluating clinical statements it is important to consider to which aspect they refer. Statements about reading vision, for instance, come in two flavors. A statement such as ***"the patient can read newsprint (1M)"*** is a statement about ***functional vision***. It tells us that the patient can meet an important ADL requirement. For patients in the normal or near-normal range, this statement may be sufficient. However, stating only the letter size does not tell us how and at what distance the patient does it, whether with the naked eye, with reading glasses, with a magnifier or even with a video-magnifier. A statement such as ***"the patient can read 1M at 50 cm"*** describes in quantitative terms the measurement of a ***visual function***, in this case, visual acuity. This allows us to calculate the reading performance for non-standard distances, to compare it to the patient's distance acuity and to estimate the amount of magnification required for Low Vision patients.

Eye care professionals typically describe the severity of a case in terms of impairment of visual function ***("visual acuity has dropped by two lines")***. The patient, on the other hand, will usually couch the complaint in terms of ability loss ***("Doctor, I am not able to read anymore")***.

Note that ambiguity may result if the same term is used to refer to different aspects. The term **Disability**, for instance, can be used for at least three of the aspects. In the "Americans with Disabilities Act" the term is synonymous with "impairment". In ICIDH-80 "dis-ability" was used to indicate a loss of ability, as it is in "Disabled Veterans". To be "on disability" refers to a socio-economic consequence. In this report the unqualified use of the term disability will be avoided.

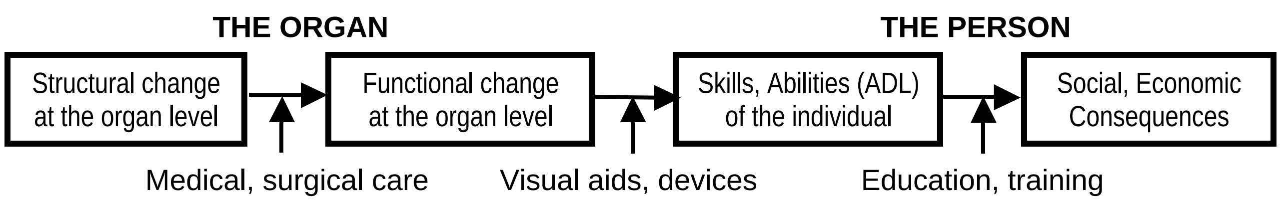
Cause and Consequences

The four aspects clearly are related, with causes being on the left of the diagram and consequences on the right. However, the links between the aspects are not fixed, but can be influenced by various interventions, shown in Table 2.

- Medical and surgical care can help to minimize the functional effect (impairment) of various disorders.
- For any given visual impairment, visual aids and devices can reduce the ability loss and improve the ability to perform various activities.
- Education and training and work place adaptations can reduce the social an economic impact of the ability loss.

The fact that such interventions can modify the links is what makes rehabilitation possible. The flexibility of the links also means that changes in one aspect cannot precisely predict changes in another aspect.

TABLE 2 – **VARIOUS INTERVENTIONS**



A further discussion of issues related to the assessment of different aspects of vision loss will be found in **Appendix 2**.

SECTION 3 – RANGES of VISUAL ACUITY LOSS

For each of the aspects of vision loss the loss can vary from mild to profound or to total. Various scales have been developed for this purpose.

Early in the 20th century the emphasis was on worker's compensation cases. For this purpose a continuous scale was needed with emphasis on what was lost. The importance of remaining vision was minimized by terms such as **residual vision** and **partial blindness**. Children with vision loss often were placed in schools for the blind, blindfolded and taught blind skills. From this time dates the Visual Efficiency Scale, which from 1925 to 1999 was used in the AMA ***Guides to the Evaluation of Permanent Impairment*** [9,10,11].

When social security systems developed, the emphasis shifted to eligibility, which requires a single cut-off point, rather than a continuous scale. This was the context in which the term **legal blindness** replaced the earlier terms of **economic blindness** or **industrial blindness**.

After WWII rehabilitation became important. The first Low Vision clinics were opened in New York in 1952. Rehabilitation, again, requires a continuous scale, this time with emphasis on what is still available. The term **Low Vision** replaced the earlier term partial blindness.

Considering these developments, the question arises how many different ranges or levels should be used to report the prevalence of vision loss in statistical surveys.

Two ranges
A simple dichotomous distinction between those who are considered **"legally sighted"** and those who are considered **"legally blind"**, while useful for simple eligibility rules, is clearly not satisfactory for more detailed reporting.

Three ranges
The smallest number of ranges suggesting a continuous scale is three. This is used for the scale: **Normal Vision / Low Vision / Blindness**.

In the 1970's this scale was introduced in ICD-9 [6] and ICD-9-CM [7] to replace the dichotomous blindness category in earlier ICD revisions. A recent review of 50 surveys of vision loss from a wide variety of sources showed that, a quarter century later, these recommendations have taken hold with 95% of the surveys reporting on the ICD-9 categories. Since the ICD is a classification of diseases, it does not provide a code for normal vision.

More ranges
For other purposes a distinction of three ranges is still too coarse. In the 1960's a WHO survey had found over 60 different definitions of "blindness" in various countries. This led a workgroup from the WHO and IAPB to define numbered sub-ranges of visual acuity loss for the categories of Low Vision and Blindness. The ICO Committee that was working with the WHO on the preparation of ICD-9 extended these ranges to the normal range and named them [8]. The numbered ranges became part of ICD-9 (and now ICD-10), while the named ranges became part of ICD-9-CM, the "Clinical Modification" of ICD-9, which is the official U.S. Health Care classification for all diagnostic reporting.

The basis for the WHO-IAPB recommendations had been the desire to accommodate as many as possible of the existing blindness definitions, which usually were based on socio-economic considerations and on eligibility rules. The ICD ranges were defined by listing the top and bottom value of each range (***"less than ___, but better than ___"***) and made no assumptions about the progression within each range.

The ICO recommendations were based on a logarithmic progression of visual acuity values and specified four visual acuity lines within each range. This progression, which conforms to Weber-Fechner's Law, was first used for a letter chart by Green in 1868 [14] and later recommended by various experts and committees. It became more widely used since the introduction of the ETDRS charts (to be discussed later). That socio-economic considerations and mathematical considerations led to the same set of ranges may be taken as validation and mutual reinforcement of the two approaches.

TABLE 3 – **RANGES of VISUAL ACUITY LOSS** in ICD-9, ICD-10 and in ICD-9-CM

Named Ranges of Vision Loss (ICO, 1978 and ICD-9-CM)		**Numbered ranges** (WHO, ICD-9)		**Commonly used Definitions of "BLINDNESS" and LOW VISION**	**Visual Acuity**			**Linear scales**	
					Decimal notation	U.S. notation	6 m notation	Letter count	Log MAR
(Near-)Normal Vision	Range of Normal Vision	(The ICD does not code normal conditions)			1.6	20/12	6/4	110	-0.2
					1.25	20/16	6/5	105	-0.1
					1.0	**20/20**	**6/6**	100	0
					0.8	20/25	6/7.5	95	0.1
	Mild Visual Impairment (near-normal vision)				0.63	20/32	6/10	90	0.2
					0.5	20/40	6/12	85	0.3
					0.4	20/50	6/15	80	0.4
					0.32	20/63	6/18	75	0.5
Low Vision	Moderate Visual Impairment	**Low Vision - WHO**	Group 1	**Special Education Benefits – USA**; **Low Vision – ICD-9, -10**; **Low Vision – ICD-9-CM**	0.25	20/80	6/24	70	0.6
					0.2	20/100	6/30	65	0.7
					0.16	20/125	6/36	60	0.8
					0.125	20/160	6/48	55	0.9
	(20/200) Severe Visual Impairment		(6/60) Group 2	**"Legal Blindness" Benefits – USA** / **Blindness – ICD-6, -7, -8**	**0.1**	**20/200**	**6/60**	**50**	**1.0**
					0.08	20/250		45	1.1
					0.063	20/300		40	1.2
					0.05	20/400	3/60	35	1.3
	Profound Visual Impairment	**Blindness - WHO**	Group 3	**Blindness – ICD-9, -10**	0.04	20/500		30	1.4
					0.032	20/600	2/60	25	1.5
					0.025	20/800		20	1.6
					0.02	20/1000		15	1.7
(Near-) Blindness	**Near-Blindness**		Group 4	**Blindness ICD-9-CM**	less	less	1/60 or less	10	1.8
								5	1.9
	Blindness		Group 5		0.0	NLP	NLP	0	2.0

See **Appendix 3** for a further discussion of this Table and the use of linear scales.

SECTION 4 – RANGES of ABILITY LOSS

The preceding table classified vision loss based on visual acuity, i.e. on organ function (the visual impairment / visual function aspect). It is also possible to classify vision loss based on individual abilities (the functional vision / visual ability aspect).

The definition of "Low Vision" as the condition of a person "who uses vision for the planning and execution of tasks" is a definition based on functional vision. Note that such definitions are much harder to quantify than definitions based on visual functions.

When considering a general classification for any ability loss, we must start with the recognition that Activities of Daily Living (ADL) are rarely performed at the limit of ones ability. The concept that normal ability includes a reserve capacity is not specific for vision, but can be applied to any ability, as is demonstrated in the following examples from the mobility domain.

Exceptional Performance
Some individuals have exceptional abilities. ***E.g.: the person is an Olympic runner.***

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 gradually 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 needs the support of a cane.***

Severe Ability Loss
In this range performance is below normal and endurance is limited. The person needs performance enhancing assistive devices. ***E.g.: the person can move with a walker.***

Profound Ability Loss
In this range, the options for enhancement become limited. Reliance gradually shifts from enhancement aids to substitution aids and skills. ***E.g.: the person can still move actively by using a wheelchair, substituting arm power for leg power..***

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

This classification is summarized in Table 4, which shows that it can be fitted with a point scale from 0 to 100. The resulting ability score is very similar to the more extensive Karnofsky scale [15], which has been used for cancer patients for over 50 years (see Appendix 4). Since the descriptors on which these scores are based are qualitative, rather than quantitative, no claim can be made that these are true numeric scales based on "ability units".

Note that "100" on this scale does not indicate the absolutely best possible performance, but rather a standard performance level within the normal range. Consequently, the scale does not need to be truncated at "100" and values above 100 can be used to denote performance that is better than the reference standard.

TABLE 4 – **GENERAL ABILITY RANGES**

RANGE	PERFORMANCE			ABILITY SCORE
		Exceptional ability		***> 100***
Normal	Normal or near-normal performance	Has reserves	No aids	**100** ± 10
Mild loss		Lost reserves	↓	**80** ± 10
Moderate Loss		Normal with aids	Enhancement aids	**60** ± 10
Severe Loss	Restricted performance	Restricted with aids		**40** ± 10
Profound Loss		Marginal with aids	↓	**20** ± 10
Near-inability		Near-impossible	Substitution aids	**0** – 10
Total Inability		Impossible		**0**

Gradual transitions

It is important to realize that these ranges do not represent stepwise changes in ability, but rather are segments of a continuous ability scale. If discrete visual acuity values are attached to these ranges, as in Table 3, they should be considered like mileposts along a road. The mileposts provide useful points of reference, but the landscape does not suddenly change when a milepost is passed. Rather, gradual changes of the landscape take place in the stretches between mileposts.

Eligibility rules are often tied to specific visual acuity levels. When a person's visual acuity changes from just better than 20/200 to just worse than 20/200, that person's abilities do not change significantly, but the eligibility for services in the USA changes dramatically (other countries may have different limits). Compare also: when crossing a state line, the risk involved in not wearing a seatbelt may not change, but the vigor of law enforcement may change significantly.

Emphasis on different ranges

Which ranges will receive the most emphasis will depend on the perspective of the user.

General clinicians will be most interested in the upper ranges. Differentiation in the lower ranges is not very important to them, since it adds little to the differential diagnosis. This is the reason that Snellen charts that truncate visual acuity measurement at 0.1 (20/200, 6/60) have remained in use for more than a century with only estimates such as "count fingers" and "hand movements" for the lower ranges.

Low Vision practitioners will be primarily interested in the middle ranges.

Providers of services for the blind are primarily interested in the bottom ranges. To them, differentiation in the upper ranges is of little interest, since individuals in these ranges have no need for rehabilitative services. Indeed, the WHO classification has no codes for the upper ranges (Table 3).

The set of ranges defined in this report provides a uniform framework to cover all users.

A further discussion of the general ability ranges and a comparison to other scales is given in **Appendix 4**.

SECTION 5 – **VISUAL ACUITY and READING ABILITY**

Since the Letter Count Score for visual acuity (Table 3, Appendix 3) and the General Ability Score (Table 4) both feature a scale from 0 to 100, we can compare the two, as is done in Table 5. The comparison is based on reading ability, the ADL ability that ranks highest on the wish list of most Low Vision patients, and the one that is most closely related to clinical visual acuity measured as letter recognition.

The close correlation between the visual acuity ranges and the reading ability ranges provides another confirmation for the validity of these ranges.

TABLE 5 – **RANGES of READING ABILITY**

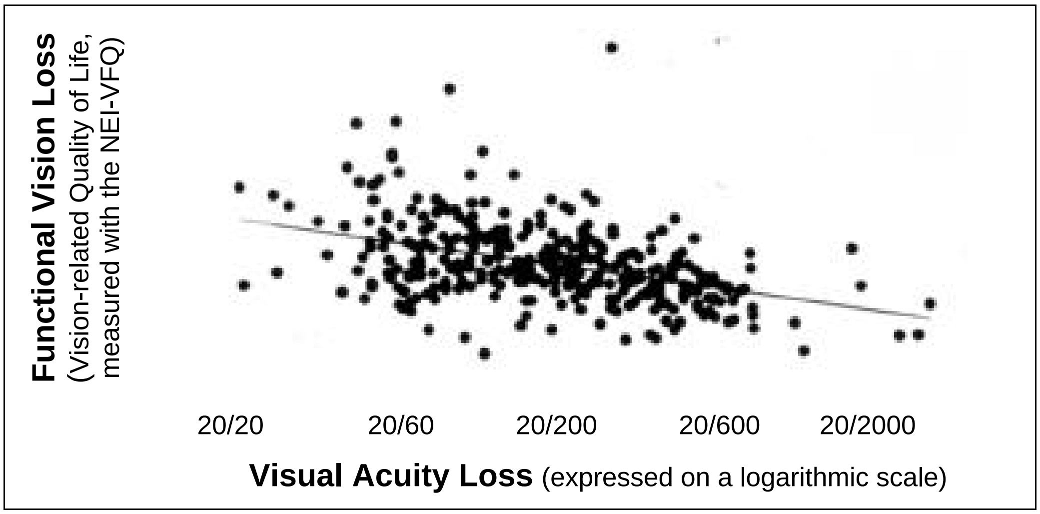
Ranges of Vision Loss	**Visual Acuity** (how the eye functions)			Statistical estimates of **Reading Ability** (how the person functions)		
	Decimal notation	Letter count	Reads 1 M at:	**Ability Ranges**	**Reading Ability**	**Comments**
Range of Normal Vision	1.6 1.25 **1.0** 0.8	110 105 **100** 95	160 cm 125 cm **100 cm** 80 cm	Has reserves (100 ± 10)	Normal reading speed Normal reading distance *Reserve capacity for small print*	Since newsprint is generally read at around 40 cm, this range has an ample reserve.
Minimal Impairment Mild Impairment	0.63 0.5 0.4 0.32	90 85 80 75	63cm 50cm 40cm 32cm	Lost reserves (80 ± 10)	Normal reading speed Reduced reading distance *No reserve for small print*	Individuals in this range have lost their reserve, but have no or only minimal vision rehabilitation needs. *(Driver's license and other criteria usually fall within this range.)*
Moderate Visual Impairment	0.25 0.2 0.16 0.125	70 65 60 55	25 cm 20 cm 16 cm 12.5cm	Normal with aids (60 ± 10)	Near-normal with appropriate reading aids *Low power magnifiers and large print books*	Reading at 25...12.5 cm requires strong reading glasses (4D to 8D) or moderate power magnifiers. *(In the U.S. students qualify for special education assistance.)*
Severe Visual Impairment	**0.1** 0.08 0.063 0.05	**50** 45 40 35	**10 cm** 8 cm 6.3 cm 5 cm	Restricted with aids (40 ± 10)	Slower than normal with reading aids *High power magnifiers (restricted field)*	Reading at < 10 cm precludes binocular vision. The small field of strong magnifiers slows reading. Vision substitution skills may be an adjunct to enhancement aids.
Profound Visual Impairment	0.04 0.032 0.025 0.02	30 25 20 15	4 cm 3.2 cm 2.5 cm 2 cm	Marginal with aids (20 ± 10)	Visual reading is limited *Uses magnifiers for spot reading, but may prefer talking books for leisure*	Use of non-visual skills increases as rehabilitation needs shift gradually from vision enhancement aids to vision substitution aids.
Near-Blindness Blindness	Less **0.0**	10 5 **0**	Less	(Near-) impossible (0 – 10)	No visual reading *Must rely on talking books, Braille or other non-visual sources*	In this range individuals must rely primarily on vision substitution skills. Any residual vision becomes an adjunct to the use of blind skills.

For ease of comparison, a column has been included which expresses visual acuity as the distance at which 1 M print (average newsprint) can be read. Expressed in meters, this distance is the same as the decimal visual acuity value.

Limited Predictive Value – Statistical Estimates vs. Individual Performance

The reading abilities listed in Table 5 refer to statistical averages. Individual performance may vary from this average. That individual performance may vary significantly from the statistical average is further demonstrated in the following graphic, which plots a Quality-of-Life score (derived from the NEI-VFQ, the Visual Functioning Questionnaire of the National Eye Institute) for individual subjects against their visual acuity loss expressed on a logarithmic scale (such as the letter count score or logMAR).

TABLE 6 – **QUALITY OF LIFE and VISION LOSS**



Data from Donald C. Fletcher, MD
Presentation by Robert W. Massof, PhD

The diagram demonstrates several points:

- The straight regression line validates the use of a logarithmic scale for visual functions.
- The smoothness of the regression line indicates that the relation between visual functions and functional vision is a continuous one and that there are no sudden or step-wise transitions. Other studies have shown similar results.

This means that the cut-off points used to define ranges of vision loss have to be based on other arguments than on strict psychophysical ones. Compare the earlier discussion of causes and effects, Table 2 and **Appendix 2**.

- The spread of individual points exceeds the slope of the regression line. While the regression line is ***statistically*** valid, it cannot provide the basis for any ***individual*** predictions.

SECTION 6 – **RANGES of VISUAL FIELD LOSS**

After visual acuity loss, visual field loss is the next major cause of visual deficits. Visual field loss can exist independent from visual acuity loss. Defining ranges of visual field loss requires significant data reduction, since visual field information is complex and two-dimensional where visual acuity can be expressed on a single scale.

In the context of surveys, a distinction must be made between visual field tests aimed at detecting **causes** of vision loss and those aimed at detecting consequences. To detect causes, such as glaucoma, information in the central field is most informative. A variety of tests and evaluation procedures are available. They will not be discussed in this report.

The **consequences** of visual field loss are most evident in Orientation and Mobility (O&M) performance. In this context diffuse sensitivity loss is not as significant as are localized, absolute or near-absolute defects in the periphery. To express the extent of such losses in a single score, grids have been used on which the points seen and not seen are recorded. Well known in the U.S. are the Esterman grids [16], which, unfortunately, are incompatible with each other and with legal U.S. definitions.

The new Vision chapter of the 5th edition (2000) of the AMA ***Guides to the Evaluation of Permanent Impairment*** [11] utilizes a **Visual Field Score (VFS)** [17], which avoids the earlier inconsistencies and is similar to the letter count score (visual acuity score, VAS), discussed earlier. Its aim is to estimate the consequences rather than the causes of visual field loss.

The Visual Field Score (VFS)

Like the VAS or letter count score, which increases by one point for every letter read on an ETDRS-type chart, the Visual Field Score (VFS) increases by one point for every point seen on a visual field grid. The grid assigns 100 points to a field with an average radius of 60°. The normal temporal field limits will be wider, but the nasal field will be narrower, so that an average normal field will score about 100 points.

Fifty points are assigned to the central area, up to 10° from fixation. This is justified since this area corresponds to 50% of the primary visual cortex. This assignment also maintains the traditional equivalence of a visual acuity loss to 0.1 (20/200, 6/60) (50 points, when rated on the letter count scale or VAS) with a field restriction to a 10° radius and extends this equivalence to hemianopias. The remaining 50 points are assigned to the area beyond 10°.

The grid points are located along ten meridians, two in each of the upper quadrants, three in each of the lower quadrants. This gives the lower quadrants 50% extra weight.

The denser grid close to fixation is justified because small scotomata close to fixation can interfere significantly with reading and other Activities of Daily Living. The lesser density in the periphery is justified because only larger peripheral defects will interfere with Orientation and Mobility.

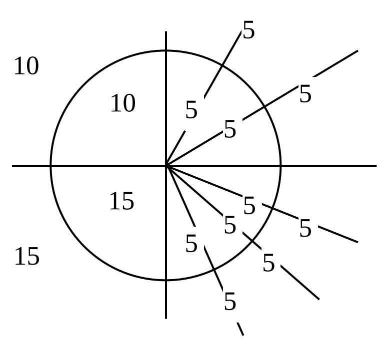
The severe, profound and near-total impairment ranges in Table 7 correspond to those defined in the ICD (20°, 10°, 5° diam.). The lesser impairment ranges are not defined in the ICD.

The table shows that the agreement that was found earlier between Reading performance and visual acuity as expressed in the Visual Acuity Score, also applies to the estimated O&M performance, and visual field loss as expressed in the Visual Field Score.

See **Appendix 6** for further details about the Functional Vision Score system.

TABLE 7 – **RANGES of FIELD LOSS and O&M ABILITY**

Ranges of Vision Loss	**Visual Field** (how the eye functions)		Statistical estimates of **O&M Ability** (how the person functions)		
	Average field radius (diam.)	**Grid score**	**Ability Ranges**	**Visual O&M Ability**	**Comments**
Range of Normal Vision	 **60° (120°)**	110 **100**	Has reserves (100 ± 10)	Normal visual orientation Normal Mobility skills	
Mild Visual Impairment	50° (100°) 40° (80°)	90 80	Lost reserves (80 ± 10)	Normal O&M performance Needs more scanning	*Occasionally surprised by events on the side*
Moderate Visual Impairment	30° (60°) 20° (40°) loss upper field hemianopia	70 60	Normal with aids (60 ± 10)	Near-normal performance	*Requires scanning for obstacles*
Severe Visual Impairment	**10° (20°)** 8° (16°) loss lower field	**50** 40	Restricted with aids (40 ± 10)	Visual mobility is slower than normal	*Needs continuous scanning* *May use cane as an adjunct*
Profound Visual Impairment	6° (12°) 4° (8°)	30 20	Marginal with aids (20 ± 10)	Limited visual mobility	*Needs cane to detect obstacles* *May use vision as adjunct for identification*
Near-Blindness **Blindness**	2° (4°) **0°**	10 **0**	(Near-) impossible (0 – 10)	Visual orientation unreliable or impossible	*Must rely on long cane, hearing, guide dog, other blind mobility skills*



The points of the field grid are located along ten meridians, two in each of the upper quadrants, three in each of the lower quadrants. Along each meridian, five points are located within 10° (2° apart), 10 points are located outside 10° (10° apart).

Since the meridians are located within the quadrants, special rules for hemianopic field boundaries along the principle meridians are not needed.

SECTION 7 – **VISUAL ACUITY MEASUREMENT**

The use of well-defined ranges of vision loss as discussed in the preceding sections is meaningless if the visual acuity measurement on which they are based is not standardized. This section will discuss guidelines for the measurement of visual acuity. It follows the recommendations of the ***Visual Acuity Measurement Standard*** adopted by the International Council of Ophthalmology in 1984 [18].

Visual Acuity refers to the ability to resolve detail in **foveal vision** or in the best available para-foveal area. It describes only one aspect of visual performance for one retinal area; however, since it is easily measured and since it is an effective screening tool it is the visual function that is measured most frequently.

The **visual acuity value** compares a subject's performance to the performance of a standard eye [19]. If the subject needs letters that are twice as large or twice as close, visual acuity is said to be one half. If the letters need to be five times closer or larger, visual acuity is one fifth, etc. This definition of visual acuity was proposed by Donders in 1861 and implemented in the design of the letter chart developed by his co-worker Snellen in 1862 [20].

Snellen used a pragmatic sequence of letter sizes with small steps in the range of normal vision and larger steps for poorer vision. He varied the letter spacing and the number of letters per line according to the available space. This design has persisted for clinical use to this date.

In 1868 Green, who had worked with Snellen in 1866, proposed a chart with a **geometric progression** of letter sizes and a layout based on **proportional spacing** [14]. He was too early; his chart did not gain acceptance. A century later, the proportional layout was re-invented by Bailey and Lovie (1976) [21], using British letters and a 6 m test distance. Their layout was subsequently adopted for the ETDRS charts of the National Eye Institute (1982) [23], using Sloan letters and a 4 m test distance.

The geometric progression of the Green / Bailey-Lovie / ETDRS charts has the advantage of a constant step size at all levels of vision. The proportional layout with equal numbers of letters on each line has the advantage that relative crowding and contour interaction remain the same for all lines, while only the magnification varies. All three designs use a step size of $10^{0.1}$ so that ten lines represent an increase in size of 10x, three lines 2x and one line 25%.

Table 8 compares the irregular progressions of various traditional charts with the logarithmic (geometric) progression of ETDRS-type charts. Note that the steps on traditional charts are too small in some areas and too large in others.

These irregularities can result in inaccurate measurements. For instance, the U.S. definition of "legal blindness" (20/200 or less) is equivalent to "less than 20/160" on an ETDRS-type chart, but to "less than 20/100" on a traditional chart.

For visual acuity values of less than 0.1 (20/200, 6/60) estimates such as "Count Fingers" and "Hand Motions" are often used. It is recommended that actual measurements at a shorter distance be used instead. Measurement at 1 meter provides the widest measurement range and the simplest Snellen fraction. The 1-m test distance can be maintained with a cord attached to the chart [26,27].

Additional information, including the use of abbreviated measurement protocols, can be found in **Appendix 7**. Near vision measurements are discussed in **Appendix 5**.

TABLE 8 – **VARIOUS CHART PROGRESSIONS**

Ranges of Vision Loss	Visual Acuity			Traditional Scales				Logarithmic Scales				
	Decimal notation	Letter count	Log MAR	Snellen 1862 (Par.ft.)	Snellen 5 m (1875)	USA	Decimal as --/10 fraction	Low Vision (1 m)	ETDRS (4 m)	6 m	USA	Decimal notation
	1.6	110	– 0.2			20/12	15/10		4/2.5	6/3.9	20/12.5	1.6
Range of Normal Vision	1.25	105	– 0.1			20/15	12/10		4/3.2	6/4.8	20/16	1.25
	1.0	**100**	**0**	**20/20**	**5/5**	**20/20**	**10/10**	**1/1.0**	**4/4**	**6/6**	**20/20**	**1.0**
							9/10					
	0.8	95	0.1			20/25	8/10	1/1.25	4/5	6/7.5	20/25	0.8
	0.63	90	0.2	20/30	5/6.6	20/30	7/10	1/1.6	4/6.3	6/9.5	20/32	0.63
							6/10					
Mild Visual Impairment	0.5	85	0.3	20/40	5/10	20/40	5/10	1/2.0	4/8	6/12	20/40	0.5
	0.4	80	0.4	20/50		20/50	4/10	1/2.5	4/10	6/15	20/50	0.4
	0.32	75	0.5		5/15	20/60	3/10	1/3.2	4/12.5	6/19	20/63	0.32
	0.25	70	0.6	20/70	5/20	20/70		1/4	4/16	6/24	20/80	0.25
						20/80						
Moderate Visual Impairment	0.2	65	0.7	20/100		20/100	2/10	1/5	4/20	6/30	20/100	0.2
	0.16	60	0.8		5/30			1/6.3	4/25	6/38	20/125	0.16
	0.125	55	0.9					1/8	4/32	6/48	20/160	0.125
	0.1	**50**	**1.0**	**20/200**	**5/50**	**20/200**	**1/10**	**1/10**	**4/40**	**6/60**	**20/200**	**0.1**
Severe Visual Impairment	0.08	45	1.1					1/12.5			20/250	0.08
	0.063	40	1.2					1/16			20/320	0.063
	0.05	35	1.3			20/400	3/60	1/20			20/400	0.05
	0.04	30	1.4					1/25			20/500	0.04
Profound Visual Impairment	0.032	25	1.5			CF 6 ft.	2/60	1/32			20/630	0.032
	0.025	20	1.6					1/40			20/800	0.025
	0.02	15	1.7					1/50			20/1000	0.02
Near-Blindness	Less	10	1.8			CF 3 ft.	1/60					
		5	1.9									
Blindness	NLP	**0**	**2.0**									

Snellen's original chart was calibrated in Parisian feet; in 1875 he adopted the metric system with charts for 5 m and 6 m. Compared to the ETDRS progression, the traditional U.S. chart has an extra line at 20/70, but lacks lines at 20/125 and 20/160. The traditional decimal chart has extra lines at 0.9 and 0.7, but lacks lines at 0.16 and 0.12.

SECTION 8 – **REPORTING of SURVEY RESULTS**

No standardized guidelines presently exist for the reporting of vision surveys. Since the purpose of publishing survey reports is to facilitate comparisons, it is essential that the survey methodology and the results are reported in such a way that meaningful comparisons are possible. This requires providing at least information on the following topics.

Selection methodology

Is the tested sample representative of a larger group? This topic is beyond the scope of this report, but is significant in establishing comparability.

Testing methodology

Ideally all tests should follow the ETDRS protocol. This clearly will not be feasible in all surveys. If the protocol is not fully followed, the deviations should be spelled out.

- What were the test distance, the optotypes, presentation mode, illumination?
- What was the letter size progression? Specify each step, if it was not logarithmic. Even if the proportional layout cannot be maintained (e.g. on projector charts), adherence to the logarithmic progression is strongly recommended.
- What methods were used if the subject could not read the smallest letters? Testing at a reduced distance, finger counting or other estimates?
- Under what conditions was visual acuity measured? Best-corrected, with presenting correction, with pinhole, uncorrected? These differences may significantly affect the prevalence figures for the better acuity ranges.
- Was near vision tested? If so, was reading ability recorded (letter size, no distance) or reading acuity (letter size and distance)?

Reporting categories

A sample of recent survey reports showed that almost all (92%) listed the prevalence of **"Blindness – WHO"**, i.e. profound impairment or worse (< 1/20, < 3/60, < 0.02, < 20/400).

Most (85%) also reported the prevalence of **"Low Vision – WHO"**, i.e. moderate or severe impairment (< 0.3, < 20/60). ***It would be desirable if these two levels were consistently reported in all surveys***.

A few surveys also reported on other impairment levels, but this was not done consistently. ***It would be desirable if all surveys reported additional detail, in accordance with the ranges outlined in this report.***

The last requirement is not impossible, since the information generally exist in the original measurement data. It is important since the causes as well as the consequences may differ significantly for different ranges of vision loss. For instance: a significant proportion of mild vision loss can be reduced by a better refraction, after which no further intervention may be necessary. Profound vision loss, on the other hand, may require surgery or may not be remediable and may require significant rehabilitative intervention.

Terminology

Table 9 lists the preferred use of various common terms.

TABLE 9 – TERMINOLOGY

Much confusion and ambiguity can be avoided by consistent use of terminology.

Blindness
This term should be reserved for individuals who are actually blind (no light perception) or who have so little vision that they must rely mainly on other senses (vision substitution skills), even though even mere light perception can still be an adjunct for Orientation and Mobility.

Since there are many different definitions of "blindness" that are used in different contexts, and since it is unrealistic to expect these to disappear soon, it is recommended that the term blindness when used in reports be followed by its definition. E.g. "blindness (<6/60)" in Australia, "blindness (<=20/200)" in the USA.

Low Vision
The word ***vision*** in this term indicates that the individual is not blind. The word ***low*** indicates that this vision is less than normal. Since these individuals have vision, they are best helped with vision enhancement aids (large print, magnifiers, illumination etc.).

Useful Vision
A term sometimes used in pediatric ophthalmology is not a very useful descriptor, since the usefulness is often in the eye of the beholder. It has been shown that infants, who at first seemed to have no useful vision, can behave visually when given appropriate stimuli in terms of size, contrast, movement, etc.

Visual Impairment
This term should be used when the vision loss is defined in terms of organ functions, such as visual acuity loss, visual field loss, etc. An individual can have a visual impairment in one eye, while the other eye is normal.

Functional Vision
This term should be used when the vision loss is defined in terms of the individual's abilities with regard to Activities of Daily Living (ADLs, reading ability, orientation and mobility, etc.). Functional vision applies to the individual, it cannot be applied to the eyes separately.

Vision Loss
Is a general term that can be applied to the impairment as well as to the ability or activity aspect, to total loss (blindness) as well as to partial loss (low vision).

Mild, Moderate, Severe, Profound vision loss
These terms should be used to refer to ranges of vision loss as defined in this report.

Visual Disability
In ICIDH-80 this term was used to describe a loss of visual abilities. The use of this term is discouraged, since the word disability can also be used with other meanings (see Table 1). The term ***"ability loss"*** is preferred.

Visual Handicap
This term was also used in ICIDH-80. In the ICF (ICIDH-2) this condition is described as a **barrier** to social **participation**.

APPENDIX 1

Preservation of Vision or **Prevention of Blindness ?**

American Journal of Ophthalmology – Editorial – February, 2002

The mission of Ophthalmology has often been described as "Prevention of Blindness". Prevention of blindness certainly deserves our best efforts. Yet, the question has been raised whether this characterization is not too restrictive. The recent publication "Vision for the Future" outlines a Strategic Plan to "Preserve and Restore Vision" [2]. It was prepared by the International Council of Ophthalmology (ICO) and the Academia Ophthalmologica Internationalis (AOI) ***(See the September editorial in this journal).*** Likewise the World Health Organization (WHO) and the International Agency for the Prevention of Blindness (IAPB) chose as the motto for their current global campaign "Vision 2020 – the Right to Sight" [1].

Prevention of Blindness and Preservation of Vision obviously go hand-in-hand. They are two sides of the same coin. There seems to be an evolving trend, however, regarding which side of the coin is presented first. Several reasons for this trend can be cited.

Epidemiological studies aimed at clarifying the prevalence of vision loss often run into difficulties because different groups define "blindness" in different ways. In the United States, for instance, it is estimated that 90% of the "legally blind" have residual vision. Hence, the old quote, which states, "More people are BLINDED by DEFINITION than by any other cause".

The term blindness has other problems. Eye care professionals must deal with all levels and degrees of vision loss, but the term blindness cannot be used with qualifiers such as "mild" or "moderate" blindness. How credible is a practitioner who tells patients with macular degeneration that they will never go blind, when the family brings a brochure from an authoritative source that lists macular degeneration as a "major cause of blindness"?

The word "blind" is used with the verb "to be", a verb that tends to label and categorize the subject. A statement like "You ***are*** blind" or "you ***are*** a problem" sounds definitive and invites the comment "There is nothing more we can do for you". "You ***have*** a visual impairment" or "you ***have*** a problem" leaves room for hope and invites the comment "What can we do to alleviate your problem?" The term "legal blindness" does not help either. It has been said that it is as preposterous to call someone with a severe vision loss ***"legally blind"*** as it would be to call someone with a severe heart ailment ***"legally dead".***

The argument heard most often, in favor of the term blindness, is that it is such a good fundraiser. Yet, many agencies have changed their name from "Agency for the Blind" to "Agency for the Visually Impaired" or similar names. The two major projects cited in the first paragraph have joined this trend. I have not heard of any group or project that went back to the previous name. Would any of the projects that in the past have been billed as "Elimination of Avoidable Blindness" have been any less successful if they had been presented as "Elimination of Avoidable Vision Loss"?

A recent study of employment trends in the 1980s and 1990s suggests that legally blind individuals may not have benefited from improvements in the business cycle to the extent that other disabilities have. Could it be that the word blindness has worked against us, because employers are as scared of blindness as are individual patients? [24]

There has been a move towards more standardized definitions. In the 1960's a WHO survey found that 65 different countries used almost as many different definitions of blindness. In the 1970's a WHO task force recommended to replace the dichotomous concept of blind vs. sighted with a series of ranges of vision loss that became part of ICD-9 [6]. The International Council extended these ranges to the range of normal vision [8], in which form they became part of ICD-9-CM, the official US Health Care classification [7]. A recent review of epidemiological surveys showed that, two decades later, the major subdivisions have taken hold. Of the various surveys 95% reported on the WHO definition of Low Vision (< 6/18 or < 20/60) and on the WHO definition of blindness (< 3/60 or < 20/400).

In the past the focus of blindness surveys has mainly been on the CAUSES of vision loss. For this purpose the exact cut-off was not very important. The last half-century has seen a much increased interest in Vision Rehabilitation. – The first Low Vision Clinics were opened in New York in 1952. – Today, the focus of surveys is extended to the social and economic CONSEQUENCES of vision loss. These consequences begin to be felt long before the blindness level is reached. An Australian study found that fully one half of the elderly who presented with < 20/40 visual acuity could be brought to >= 20/40 (driving vision) by a simple refraction [25]. The number of individuals with vision loss from under-corrected refractive error may thus equal or exceed the number suffering from cataracts and other causes traditionally associated with "Blindness". Even in evolving economies computer use and literacy are becoming much more important than they were half a century ago. Being a truck driver can be a major step up the economic ladder; loosing one's driver's license because of vision loss can be an economic disaster. While un-operated cataracts are still a major cause of severe vision loss, we are becoming more aware of the impact of less severe vision loss. Consequently we need to extend our surveys to levels that do not fit under the blindness label any longer.

What labels should be used instead? The generic term ***Vision Loss*** is applicable for a wide variety of situations and can be used with modifiers ranging from mild loss to total loss. Other terms may be used to refer to specific aspects of vision loss. The term ***Visual Impairment*** is appropriate when referring to a loss measured at the organ level. Visual Impairments include organ functions such as visual acuity loss, visual field loss, color vision loss, etc. (For congenital conditions the term defect or impairment is more appropriate than the word loss.) The term ***Visual Dis-ability*** has been used for the loss of visual abilities (reading ability, writing ability, orientation ability) measured as changes in the person's ability to perform certain daily living tasks. This aspect is also described by the term ***Functional Vision***, to distinguish it from ***Visual Functions*** (acuity, field, etc.)***,*** which are components of the impairment aspect. The term ***Visual Handicap*** refers to the social and economic consequences of such an ability loss [12,13].

For each of these aspects, ranges of mild, moderate, severe, profound and total loss can be defined. Visual Impairment is the aspect that is most easily measured and quantified. It is the preferred measure for statistical surveys. However, two individuals with the same impairment may exhibit differences in their ability to cope with the demands of daily living. Visual Ability Loss, therefore, is the aspect that needs to be addressed in individual rehabilitation plans.

The International Council of Ophthalmology, in cooperation with the WHO, and in concert with its "Vision for the Future" and the "Vision 2020 – Right to Sight" project wants to promote more detailed reporting in vision loss surveys through wider use of the ***Ranges of Vision Loss*** that were first defined in the 70's. When using these ranges, the term blindness should be reserved for those who are actually blind (total vision loss) or near-blind (near-total vision loss), i.e. for those who must rely primarily on vision substitution skills. For those with residual vision, i.e. those who can still benefit from vision enhancement aids, the ranges of mild, moderate, severe and profound vision loss or visual impairment are more appropriate.

Use of this terminology will not only benefit the profession through more accurate reporting; patients will benefit through the elimination of avoidable blindness labels that are unnecessarily threatening for those who actually have residual vision.

APPENDIX 2 – Aspects of Vision Loss

It is extremely important to be aware of the flexibility in Table 2 and of the ambiguity of terms such as “disability” in Table 1. If there were a one-to-one relationship between the aspects, administrators could accurately predict how much disability-defined-as-economic-consequence, might result from a certain amount of disability-defined-as-impairment. Awareness of the external factors makes it clear why different countries and different agencies have answered this question differently. If there were no flexibility, there would be no room for rehabilitation either.

Some people will have better skills than others with the same acuity loss. Some totally blind individuals are gainfully employed, while some normally sighted are not. Yet, while it is impossible to make individual predictions, statistical relations are present as shown in Table 6. Thus, a general statement like ***“on average individuals with vision loss are less employable than those with normal vision”*** may be possible, but a statement like ***“an individual with > 0.1*** *(> 20/200, > 6/60)* ***acuity is employable, while a person with < 0.1*** *(< 20/200, < 6/60)* ***is not”*** is not justifiable.

Aspects that are closer together in Table 2 will show a better correlation than aspects that are farther apart. Thus, visual acuity loss (aspect 2) will be a better marker for the presence of eye disease (aspect 1) than would be unemployment (aspect 4). Similarly, measurement of functional vision and various visual abilities (aspect 3) would be more appropriate to predict economic consequences (aspect 4) that would be visual acuity (aspect 2). However, the measurement tools for visual functions are so much better developed, more objective and more suited for statistical evaluation than are those for functional vision that the former are often used as a substitute for the latter.

Different Tests for Different Purposes

It is often overlooked that the purpose of the investigation may also influence the choice of test. For instance, electro-physiologic tests may be helpful to establish a differential diagnosis, but do little to predict the ADL consequences. Contrast sensitivity tests, on the other hand, can be helpful in explaining ADL complaints, but contribute little to the differential diagnosis. Some illustrative examples are discussed below and summarized in Table 10. Additional examples could be given for other tests. These differences should be remembered when selecting tests for a particular purpose and when drawing conclusions based on results from different tests.

Visual acuity Snellen’s original letter chart was meant for screening purposes, to detect underlying disorders and as an aid in refraction. The fact that the steps at the lower acuity levels (0.2, 0.1, 0.05) are very coarse is no problem for this use. The charts remained essentially unchanged for more than a century.

When vision rehabilitation became important, accuracy in the lower ranges became important. This led to the broader acceptance of charts with a logarithmic progression of letter sizes, such as the Bailey-Lovie and ETDRS-type charts, which provide equal steps at all levels.

For refractive use test distances of 5m, 6m or 20 ft are preferred to relax the accommodation. For Low Vision use a test distance of 1 meter is more useful, because it provides an expanded measurement range. It can also be argued that when only one measurement can be made or if only one number can be reported, the 1-meter distance might be more representative of ADL skills.

Color vision The Ishihara test is preferred to detect even minor genetic deficiencies. However, the D15 test is more appropriate for vocational tests.

Dark Adaptation For diagnostic purposes the endpoint of the DA curve is significant. However, in the context of Activities of Daily Living (ADL) the speed of initial adaptation when entering a dark room or when driving through a tunnel is more important.

Visual Fields For visual field tests the differences are marked. To arrive at a differential diagnosis the information in the central 30° and the exact quantification offered by automated static perimetry are most important. With regard to functional consequences, defects in the juxta-foveal area can interfere with reading and manipulation skills, while Orientation and Mobility (O&M) performance is more affected by gross peripheral defects, which require a full field test and often can be picked up even by a simple confrontation test.

TABLE 10 – **TESTS FOR DIFFERENT PURPOSES**

THE ORGAN		**THE PERSON**	
Structural change, at the organ level	Functional change at the Organ level	Skills, Abilities (ADL) of the individual	Social, Economic Consequences
Tests that explore causes ←		→ Tests that explore consequences	
Visual Acuity: 20/100, 20/200, 20/400 all indicate defects traditional charts are sufficient 5m, 6m, 20 ft preferred – relaxes accommodation		20/100, 20/200, 20/400 indicate different magnification needs ETDRS type charts are required 1m preferred – expanded coverage (and relevance to ADLs)	
Color Vision: Ishihara detects even minor congenital defects		D15 detects only potentially significant defects	
Dark Adaptation: endpoint after 30, 45 min. is important		Speed of change in first second(s) when moving from light to dark causes most ADL complaintst	
Visual Field: central 30° contains most information static tests allow for statistical analyses		The peripheral extent better predicts O&M performance Some prefer kinetic tests because O&M involves movement Even a simple confrontation field may be quite informative	

APPENDIX 3 – Ranges of Visual Acuity Loss

Visual Acuity notations

The visual acuity values in the Table 3 are listed in the decimal notation (commonly used in Europe), in the U.S. notation for 20 feet and in the 6-meter metric notation (commonly used in Britain). They can easily be converted to other notations, such as 5 meters (also used in Europe), 4 meters (for ETDRS charts), 3 meters (recommended to hold the attention of young children), 10 feet and 2 meters (sometimes used for low vision patients) or 1 meter (recommended for Low Vision, because of the extended range and easy conversion).

Linear scales for calculations

The table also lists two scales that convert the geometric progression of visual acuity values to a linear score, suitable for statistical calculations and for averaging. One is the **logMAR** scale, which is widely used in clinical research. Its decimal values and the fact that it is a scale of vision loss (standard vision = 0) do not make it particularly user-friendly for clinical use. The **letter count score** is more intuitive (standard vision = 100); it increases by one point for every letter read correctly on an ETDRS-type chart. Letter count scores with different starting values have been used in the ETDRS and other studies. Placing visual acuity 1.0 (20/20, 6/6) at "100" is intuitive and avoids negative scores for individuals who cannot read the top line on the chart. This version is also known as Visual Acuity Score (VAS) or as Visual Acuity Rating (VAR) (Bailey). The VAR applies only to visual acuity, the VAS is part of the Functional Vision Score (FVS) system [12] used in the new AMA ***Guides*** (5th edition, 2000), discussed in **Appendix 6**.

Normal Range

The first range, normal vision, extends beyond 1.0 (20/20, 6/6). It is important to realize that the visual acuity value of 1.0 (20/20, 6/6) is only a reference standard, defined in physical terms (five min. of arc letter height) and does not represent a population based average, let alone "perfect" vision. Donders and Snellen were well aware of this fact, but later generations have sometimes forgotten it.

Mild Loss

Special attention needs to be given to the second range. Compared to blindness, vision in this range may appear "near-normal" (a term used in the 1970's). For individuals in this range the term "mild loss" may appear more appropriate. This is a transitional range between fully normal vision and Low Vision. The histogram of visual acuity loss drops steeply in this range, so that minor changes in criterion can cause major prevalence changes.

Various eligibility criteria are within this range. Pilots may loose their license when visual acuity drops below 1.0 (20/20, 6/6). Many states set their driver's license requirement at 0.5 (20/40, 6/12). In the U.S. special education assistance becomes available at < 0.3 (< 20/60, < 6/18). Cataract surgeons may find 0.5 (20/40, 6/12) bad enough to consider it an indication for surgery, while refractive surgeons may count 0.5 (20/40, 6/12) among their satisfactory results. In recent years, several studies have included a criterion at this 0.5 level. The range may then be subdivided into **"minimal loss"** (0.63 and 0.5) and **"mild loss"** (0.4 and 0.32) (see Table 5).

The interpretation of such finer groupings should be treated with caution. It has been shown that half of the subjects in the 0.32, 0.4 group might move to the 0.5, 0.63 group with a better refraction. For myopes in this range the difference between near-vision and distance-vision has been shown to be important, with reduced near-vision generating more ADL complaints than reduced distance vision. Thus, the difference in presenting acuity between 4-m testing (ETDRS) and 6-m testing (traditional) might even have some effect.

The 0.1 (20/200, 6/60) level

The only discrepancy between the ranges defined for ICD-9 (ICD-10) and those defined for ICD-9-CM is the cut-off at 20/200 (see Table 3). ICD-9 uses "less than 0.1 (20/200, 6/60)", while ICD-9-CM uses the U.S. definition "20/200 (0.1, 6/60) or less" (as did ICD-6, -7 and –8).

The U.S. definition fits with the regular progression of ranges with four lines per range. However, the "20/200 or less" definition is ambiguous. On traditional charts with no lines at 20/16 (0.12, 6/48) and 20/125 (0.16, 6/38) it effectively becomes "less than 20/100", a difference of two lines. The ICD-9 definition "less than 0.1 (20/200, 6/60)" deviates from the "ideal" cut-off by only one line. On ETDRS-type charts (not yet available when the WHO/IAPB committee defined ranges for ICD-9) "20/200 or less" is unambiguously defined as "less than 20/160", so that the "ideal" sequence of four lines per range can be maintained.

If an ETDRS chart is not available, a traditional chart should be brought to 10 feet (3m) where "20/200 or less" (< 6/48) can be interpreted as "less than 10/80" (< 6/24). The new, 5th edition of the AMA ***Guides*** contains explicit instructions to this effect.

Measurement below 0.1 (20/200, 6/60)

Procedures for individuals who cannot read the top line (4/40 on an ETDRS chart) vary. Some protocols use estimates such as "Count Fingers". Others bring the chart closer, from 6 m to 3 m or from 4 m to 2 m or 1m. At 2 m the criterion for profound impairment (blindness-WHO) (2/40, 0.05, 3/60, 20/400) is just at the top of an ETDRS chart; at 1 m it is lower on the chart, which allows more reliable measurement. Therefore, bringing the chart to 1 meter is preferred. Using a special 1-meter chart with an attached measurement cord increases the accuracy and brings the measurement limit to 1/50 (0.2, 20/1000, 6/300) [26].

Test protocols should specify which method is used.

Profound Vision Loss (< 0.05, < 20400, < 3/60)

In this range the emphasis gradually shifts from vision enhancement aids to vision substitution skills (using senses other than vision). Vision may be used for some tasks (e.g. a magnifier for spot reading), vision substitution for others (e.g. talking books for recreational reading). Because of the remaining visual potential ICD-9-CM groups this range under Low Vision, because of the profound loss, ICD-9 and ICD-10 group it with "blindness".

APPENDIX 4 – Ranges of Ability Loss

Table 11 compares the ranges presented in Table 4 to the Karnofsky scale [15], which has been used to indicate the status of cancer patients for over 50 years.

TABLE 11 – **COMPARISON TO KARNOFSKI SCALE**

PERFORMANCE	ABILITY SCORE	**KARNOFSKI SCALE** for cancer patients [14]
Has reserves	**100** ± 10	100 - normal, no complaints, no evidence of disease
Lost reserves	**80** ± 10	90 - normal activity, minor signs or symptoms 80 - normal activity with effort, some signs or symptoms
Normal with aids	**60** ± 10	70 - cares for self, unable to carry on normal activity or work 60 - requires occasional care for most needs
Restricted with aids	**40** ± 10	50 - requires considerable assistance and frequent medical care 40 - disabled, requires special care and assistance
Marginal with aids	**20** ± 10	30 - severely disabled, hospitalization indicated, death not imminent 20 - very sick, hospitalization and active support treatment needed
Near-impossible	**0** – 10	10 - moribund, fatal processes progressing rapidly
Impossible	**0**	0 – dead

The general ability ranges also correspond reasonably well with the performance ranges in ICIDH-80 [4] and with the difficulty ranges in ICF (ICIDH-2) [5] as shown in Table 12.

TABLE 12 – **COMPARISON TO ICIDH and ICF SCALEs**

PERFORMANCE	ABILITY SCORE	**ICIDH-80** [4]	**ICF** (ICIDH-2) [5]
Has reserves	**100** ± 10	0 - Not disabled	0 - No difficulty
Lost reserves	**80** ± 10	1 - Difficulty in performance	
Normal with aids	**60** ± 10	2 - Aided performance	1 - Slight difficulty
Restricted with aids	**40** ± 10	3 - Assisted performance	2 - Moderate difficulty
Marginal with aids	**20** ± 10	4 - Dependent performance	3 - Severe difficulty
Near-impossible	**0** – 10	5 - Augmented inability	4 - Unable to carry out
Impossible	**0**	6 - Complete inability	(to be combined with an assistance modifier)

The ***Guides to Evaluation of permanent Impairment***, published by the American Medical Association (AMA) contain impairment ratings for many different organ systems. They all fit reasonably well with these general ability ranges. This is remarkable since the different scales were constructed by different committees and since the AMA does not provide a uniform guideline for these assignments. This finding further supports the general applicability of the general ability ranges.

APPENDIX 5 – Visual Acuity and Reading Ability

As indicated earlier, statements about near vision come in two flavors. A statement such as ***"the patient can read newsprint (1M)"*** is a qualitative statement about ***functional vision***. It tells us that the patient can meet an important ADL requirement. For patients in the normal or near-normal range, this statement may be sufficient. A statement such as ***"the patient can read 1M at 50 cm"*** describes the measurement of a ***visual function*** in quantitative terms. This allows us to calculate the reading performance for non-standard distances, to compare it to the patient's distance acuity and to estimate the amount of magnification required for Low Vision patients. The data in Table 5 refer to such measurements.

The fact that reading vision statements are often limited to qualitative ones (letter size only, no distance) can be explained by the fact that for the vast majority of patients magnification calculations and non-standard reading distances are not needed. Calculations are further hindered by the fact that many commonly used print references are not related to Snellen's formula and have no numerical meaning (E.g. Jaeger numbers refer to item numbers in a print catalogue in 1856) and, secondly, by the fact that the traditional Snellen formula becomes awkward when a reading distance of less than 1 m becomes a fraction-within-a-fraction.

The first problem can be overcome by using M-units for print size. 1 M-unit subtends 5 arc min at 1 meter = 1.454 mm ≈ 1/16 inch. M-units are the only letter size units that apply to distance tests as well as to reading tests. The unit was defined by Snellen, the name "M-unit" was proposed by Sloan.

The second problem can be overcome by a simple modification of Snellen's formula [27], which makes calculating near-visual acuity much easier:

If **V = m / M** ***m = viewing distance in meters, M = letter size in M-units***

then **1/V =** M / m = M x 1/m **= M x D** ***D = viewing distance in Diopters (1/m)***

or **V = 1 / MxD** ***E.g.: 2 M at 25 cm V = 1 / 2x4 = 1/8 = 0.125*** *(20/160)*

Recording the viewing distance in diopters not only simplifies the formula, it also provides a direct reference to the required reading add.

Preferably, best-corrected distance acuity and best-corrected near acuity will both be measured and reported. If this is not feasible, or if for other reasons a single value is needed that offers a compromise between distance and near acuity, a case can be made for using a single **1-meter measurement** of the presenting acuity. Charts for use at 1 meter are commercially available; they fold for portability and come with a cord and occluder attached to easily maintain the 1-meter distance [26]. At 1 meter, acuities from 1/50 (0.02, 20/1000) to 1/1 (1.0, 20/20) can be measured on the same chart. The resulting Snellen fraction (1/__) is as simple as possible and easily converted to any other notation.

APPENDIX 6 – The Functional Vision Score (FVS) system

The Visual Acuity Score (VAS) or letter count score and the Visual Field Score (VFS) or grid score are part of the Functional Vision Score (FVS) system [12]. This is a coordinated system for estimating the impact of vision loss. In the 5th edition (2000) of the AMA ***Guides to the Evaluation of Permanent Impairment*** [11] this system replaced the previously used Visual Efficiency scale of 1925 [9]. To derive a statistical estimate of functional vision, based on the measurement of visual functions takes several steps.

Step 1
The **Visual Acuity Score** (VAS) and **Visual Field Score** (VFS) convert the non-linear acuity and field measurements for each eye to a linear score suitable for subsequent calculations. See Tables 3 and 7.

Step 2
The **Functional Acuity** (FAS) Score and **Functional Field Score** (FFS) estimate the impact on the ADL skills of a person. The formula for acuity is: $FAS = (3x\ VAS_{OU} + VAS_{OD} + VAS_{OS})\ /5$.
The formula for visual fields is: $FFS = (3x\ VFS_{OU} + VFS_{OD} + VFS_{OS})\ /5$.

By design, these formulas are generic and ignore individual differences. They emphasize the importance of binocular acuity and the binocular field. Binocular acuity can be approximated by the acuity of the better eye, but the formula also accounts for monocular loss, since two equally good eyes are not quite equivalent to one good and one blind eye (although the function of the better eye is the same in both cases). Note that for visual fields the binocular field (constructed from an overlay of the monocular fields) can be quite different from the field of the better eye.

Step 3
The **Functional Vision Score** (FVS) combines the estimated impacts of visual acuity loss and visual field loss into a single number. The formula is: FVS = FAS x FFS / 100.

Remember, again, that the Functional Vision Score is a statistical estimate, not an individual prediction. The Functional Vision Score may be adjusted by up to 15 points for other functional losses that are not reflected in the acuity or field score.

The practical application of this information may include additional steps.

Step 4
The Functional Vision Score (FVS) emphasizes the functional vision that is still available ("The glass is half-full").

The AMA ***Guides,*** which are often used in workers compensation and similar cases, emphasize what is lost ("The glass is half-empty") and express this in **Impairment Ratings** (IR).
The **Visual System Impairment Rating** (VSI) is: 100 – FVS.

The VSI rating refers to the visual system. Since total impairment of the visual system is not equivalent to total impairment of the whole person (**Whole Person Impairment**, WPI), a further adjustment of up to 15 points for assumed use of vision substitution skills is made if the visual impairment rating is greater than 50. If VSI = 50, then WPI = 50. If VSI = 100, then WPI = 85.

Step 5
The WPI may be considered in eligibility and compensation decisions. Since the WPI is only a statistical estimate of the ADL-related aspect of vision loss, a separate step is needed to consider the aspect of "social-and-economic-consequences". This step should also consider the effect of external and environmental factors and of job requirements and is explicitly not covered in the ***Guides***.

APPENDIX 7 –Visual Acuity Measurement

Snellen's letter chart effectively defined the standard task for clinical visual acuity measurement as **character recognition**. Other forms of acuity such as grating acuity, detection (as used in perimetry), Vernier acuity, and separation acuity will not be discussed in this report.

Where prior tests had used existing type fonts, Snellen was the first to design special characters for this purpose. He called them "**optotypes**". Snellen defined the reference standard as the ability to recognize letters that are 5 min of arc high. He was well aware that most healthy adults can easily outperform this standard, as documented in a population study (1862) by one of Donder's doctoral students, using prototypes of the new test [28]. Average adult vision was found to decline with age and to drop to the standard or reference level (1.0, 20/20, 6/6) only by the age of 60 or 70. Modern data for unselected subjects found the same.

Snellen designed his optotypes as **letters-with-serifs** on a 5x5 grid. Others designed variations. In the U.S. the Sloan letter set is often used; it features **non-serif letters** on a 5x5 grid. The British standard also recommends non-serif letters, but on a 4x5 grid. For illiterate subjects **number** charts may be used. Today, the **Landolt C** test is recognized as the laboratory standard against which the recognizability of other tests should be calibrated [18]. **Tumbling E's**, however, are often preferred for clinical use with subjects who are not familiar with the Roman alphabet. The **LEA** test with four stylized pictures and the **HOTV** test with four letters are often used for children. **Pictures** are also used, but are hard to standardize.

ETDRS-type charts
The ETDRS chart (named after the Early Treatment Diabetic Retinopathy Study where it was first used [23]) is presently considered to be the "gold standard" for clinical acuity measurement. Charts with a similar layout are referred to as ETDRS-type charts. The essential features of these charts are the proportional layout (the letter spacing is equal to the letter or symbol width; the line spacing is equal to the height of the lower line) combined with a logarithmic progression. Since Bailey and Lovie introduced these two features simultaneously, the charts are sometimes referred to as "logMAR" charts, although the logarithmic progression is much older [14] and has also been used for charts without the proportional layout.

The ETDRS-type layout is not limited to the use of Roman letters [22]. Other symbols or non-Roman letters can be used. The 1984 Visual Acuity measurement Standard of the ICO [18] demands that all such symbols be calibrated against the Landolt C. In the absence of such calibration, the use of tumbling E's or other standard optotypes is preferred.

Table 8 compares the regular progression of ETDRS-type charts with the uneven progression of various traditional charts. The standardized steps and the fact that each line has five letters make the letter count score possible; visual acuity values measured on other charts could be translated to an ETDRS-type letter count equivalent.

The original ETDRS chart was made in three versions for testing of OD, OS and OU. The charts were designed for 4 m, so that they can easily be used at 2 m or at 1 m.

The chart should be presented with standard **illumination**. Front-lit as well as backlit versions (about 200 cd/m^2) are available. Moderate variations in illumination are acceptable. It is estimated that a doubling of illumination will make only a one-letter difference.

Some subjects may have reluctance to **guessing**. They should be encouraged to guess anyhow. Letters should not be pointed at or presented in isolation, since the task of recognizing an isolated letter is different from the task of recognizing a letter in a letter chart format.

Scoring

Scoring can be done on a line-by-line basis or on a letter-by-letter basis. When scoring on a **line-by-line** basis, a line is considered read if more than half of the letters (i.e. 3 of 5) are identified correctly. This type of scoring is traditionally used for one-time testing of patients in a clinical setting. The score may be made more precise by adding "- -", "-", "+" or "++". If this is done, the effect comes close to letter-by-letter scoring. The tables in this report use exact letter size values. For clinical naming (but not for calculations) the values may be rounded (e.g. 20/63 → 20/60, 20/32 → 20/30). The rounding error is equivalent to about one letter, whereas the standard error of one-time measurements is about two to three letters [29].

In **letter-by-letter** scoring the total number of letters read correctly is counted. Each letter read correctly adds one point to the score; each line adds five points. Under this protocol three letters read on one line and two on the next line get the same score as five on one line and none on the next. This method has been shown to provide greater accuracy when multiple measurements have to be averaged, compared, or otherwise statistically manipulated [29]. The letter count score can be converted to a line score by rounding to the nearest multiple of five.

Some protocols start counting at the top of the chart; this leads to negative scores if the top row cannot be read. The Visual Acuity Score (VAS), discussed earlier, avoids this by assigning a zero value to 0.01 (20/2000, 6/600), which results in 50 points for 0.1 (20/200, 6/60) and an easy-to-remember 100 points for 1.0 (20/20, 6/6). When the subject can read two lines without errors, credit may be given for the larger lines that were not actually read.

Visual acuity can be measured at any distance. For refractive purposes **distance acuity** is preferred, since accommodation is relaxed and since small changes in test distance result in negligible errors. However, since most **ADL activities** take place in the intermediate or close range, this may not be the best choice to establish the impact on daily living skills. Moderate myopia (whether from under-correction or from lack of correction) actually may be a desirable condition for many presbyopes, so that distance acuity would underestimate their ADL acuity. See also the comments in Appendix 5.

Use of Projector charts

Most ophthalmic offices use projector charts in a dark or semi-dark room. To estimate functional vision, the use of a printed chart in a lighted environment is preferred, since this better approximates daily living conditions.

Projector charts can follow a logarithmic progression of letter sizes, although many do not do so yet. Because of the screen size limitations, projector charts cannot handle the ETDRS layout with five letters on each line, except for the smallest letter sizes.

Similar considerations apply when optotypes are presented on a computer screen.

Abbreviated tests

Sometimes complete testing of best-corrected acuity on an ETDRS-type chart may not be feasible. Under such circumstances abbreviated tests may have to be used. One such abbreviated test might use tumbling E cards at only the 0.32 (20/63, 6/18) and the 0.05 (20/400, 3/60) level, to separate subjects into only three groups corresponding to the Normal / Low Vision / Blindness ranges. Pinhole correction might be used instead of full refractive correction. Such simplified tests will give less accurate results. This may not be a problem when only a gross classification is sought. For finer classifications and for differentiation within the range of mild vision loss such abbreviated tests are not recommended.

All test protocols should clearly indicate when and where such shortcuts from the optimal ETDRS-type protocol were utilized (see section 8).

APPENDIX 8 – Reporting and Interpretation of Survey Results

Influence of measurement conditions.

The distribution of vision loss in various surveys varies widely. In general the majority of the population will be found in the normal range, while prevalence rates for the lower ranges drop to single digit percentages or less. The histogram will thus show a precipitous drop-off in the mild range. The exact position of this drop-off may depend on the measurement conditions; it has been found that half of those who did not make the 0.5 (20/40, 6/12) cut-off with presenting correction would do so when best corrected. At the 0.1 (20/200, 6/60) level this was true for one quarter [25]. Thus, caution should be used when comparing prevalence data for different cut-offs, especially for the upper ranges. Apparent differences may indicate differences in eye health status; they might also reflect differences in accessibility of and demand for refractive eye care.

Many of those who would shift with a better refraction will be myopes for whom the deficit in near vision will be less than the deficit in distance vision. Near vision deficits may create a greater demand for refractive care, since they are more important for many ADLs. Unfortunately, many surveys report only reading ability rather than reading acuity (see Apppendix 5). If reading distances vary from 25 cm to 50 cm, this can account for a 2x (3 lines) difference, which may easily shift subjects from one category to the next.

Health Care priorities

When setting health care priorities, the tabulation of causes must be stratified by the various ranges. If this is not done, the prevalence of under-corrected refractive error in the large upper ranges may overpower more serious problems in the smaller lower ranges.

Influence of Diagnostic Criteria

When only severe vision loss (legal blindness-USA) and profound vision loss (blindness-WHO) are considered, the diagnosis as to the cause of the vision loss will generally not be controversial, although an issue may arise when two causes are found. Should both be reported, resulting in a list that exceeds 100%, or only the most significant one, resulting in under-reporting of the less significant condition?

When reporting is extended to moderate and mild vision loss, the prevalence data for causes can be influenced by measurement conditions, as indicated above, but also by where the line is drawn between a condition that is considered “within normal limits” and one that is considered an early sign of disease. To define the applicable criteria is beyond the scope of this report, but the issue should be considered when comparing prevalence data from different sources.

Test modalities

No consensus exists about the use of best-corrected, pinhole or presenting acuity in surveys.

When the purpose of the survey is to use visual acuity loss as a **marker for visual pathology** (excluding under-corrected refractive error), the use of best-corrected acuity clearly is in order. If an accurate refraction is not feasible, **pinhole** correction may be used as a substitute.

When the purpose of the survey is to use visual acuity loss as a **predictor of societal consequences** (which would include vision loss due to under-corrected refractive error), the recording of the presenting acuity would be more relevant. Where feasible, it is desirable to record both.

REFERENCES:

[1] Pararajasegaram R. ***Vision 2020 – The Right to Sight: from Strategies to Action.*** Am J Ophthalmol 1999; 128: 359-360.

[2] International Council of Ophthalmology and Academia Ophthalmologica Internationalis. ***The International Ophthalmology Strategic Plan to Preserve and Restore Vision – Vision for the Future.*** Los Angeles CA; 2001

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

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

[5] World Health Organization. ***International Classification of Functioning, Disability and Health*** (ICF), World Health Organization, Geneva, 2001.

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

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

[8] ***Proc. XXIII International Congress of Ophthalmology. – Kyoto, 1978***, pp 69-74. Elsevier, Amsterdam.

[9] Snell AC. ***Visual Efficiency of Various Degrees of Subnormal Visual Acuity, its Effect on Earning Ability,*** J AMA 85(18): 1367-1373, 1925.

[10] ***Report of the Committee on Compensation for Eye Injuries***, J AMA 85(2): 113-115, (July) 1925.

[11] ***Guides to the Evaluation of Permanent Impairment,*** American Medical Association, Chicago. 1st Ed., 1971; 2nd Ed., 1984; 3rd Ed., 1988; 3rd Ed.rev., 1990, 4th Ed., 1993; 5th Edition, 2000.

.[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***, Kooiman et al. (eds.), Studies in Health Technology and Informatics, IOS Press, Amsterdam, 1994, pp. 552-561.

[13] International Society for Low Vision Research and Rehabilitation. ***Guide for the Evaluation of Visual Impairment,*** Pacific Vision Foundation, San Francisco, 1999.

[14] Green J***. On a new series of test-letters for determining the acuteness of vision,*** Transact. Amer. Opth. Soc. 4th meeting (1868), p 68-71. ***Also:*** Green, Ewing. ***Test letters,*** St. Louis, 1886.

[15] Karnofsky DA, Burchenal JH. ***The Clinical Evaluation of Chemotherapeutic Agents in Cancer.*** In McLeod, C.M. (ed): Evaluation of Chemotherapeutic Agents. New York, Columbia University Press, 1949.

[16] Esterman B. ***Grid for Scoring Visual Fields. I – Tangent Screen***, Arch. Ophth. 77:780-786, 1967.
Esterman B. ***Grid for Scoring Visual Fields. II – Perimeter***, Arch. Ophth. 79:400-406, 1968.
Esterman B. ***III – Functional Scoring of the Binocular Field***, Ophthalmology, 89(11): 1226-34, (Nov.) 1982.

[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.

[18] International Council of Ophthalmology. ***Visual Acuity Measurement Standard*** (1984), in: Italian J. Opht., pp. 1-15, II/I, 1988.

[19] Colenbrander A. ***Measuring Vision and Vision Loss.*** Vol. 5, Ch. 51 in Duane's Clinical Ophthalmology, Tasman, Jaeger eds., Lippincot Williams and Wilkins, 2002 edition.

[20] Snellen H. ***Letterproeven tot Bepaling der Gezichtsscherpte***, Utrecht, Weyers, 1862 (Dutch edition), also many international editions as: ***Optotypi ad Visum Determinandum***.

[21] Bailey IL, Lovie JE. ***New Design Principles for Visual Acuity Letter Charts,*** Am J Optom & Physiol Opt 53:740-745 (1976).

[22] Taylor HR. ***Applying new Design Principles to the Construction of an Illiterate E chart,***. Am J Optom Physiol Optics 55:348-351 (1978).

[23] Ferris FL, Kassov A, Bresnick GH, Bailey I. ***New Visual Acuity Charts for Clinical Research,***. Am J Ophthalmol 94:91-96 (1982).

[24] Burkhauser RV, Daly MC, Houtenville AJ. ***How Working Age People with Disabilities Fared over the 1990s Business Cycle***. In Budetti P, Burkhauser RV, Gregory J, Hunt A (eds), ***Ensuring Health and Income Security for an Aging Workforce***. Kalamazoo, MI: W. E. Upjohn Institute for Employment Research.

[25] Weih L.M. et al. ***Age Specific Causes of Bilateral Visual Impairment.*** Arch Ophthalmol, 2000; 118:264-269.

[26] ***Low Vision Test Chart.*** One side: Letter chart from 50M to 1M, representing acuity values from 1/50 (20/1000, 0.02) to 1/1 (20/20, 1.0); 1m cord attached. Other side: standardized reading segments (10M to 0.6M) for reading rate measurements; diopter ruler included. Available in English, Spanish, Portuguese, German, French, Dutch, Swedish, Finnish. From: Precision Vision, 944 First Street, LaSalle, IL 61301, USA. Telefax: 1-815-223-2224.

[27] Colenbrander A, Fletcher DC. ***Visual Acuity Measurements in Low Vision Patients.*** Journal of Vision Rehabilitation, 4(1): 1-9 (1990).

[28] de Haan V. ***Onderzoekingen naar de invloed van de leeftijd op de gezichtsscherpte (Research on the influence of age on visual acuity),*** Doctoral Dissertation, Utrecht, 1862.

[29] Raasch TW, Bailey IL, Bullimore MA. ***Repeatability of Visual Acuity Measurement,*** Optom. And Vision Sci. 75(5): 342-348.

Table 13A – **ASPECTS and RANGES of VISION and VISION LOSS**
Visual Acuity and Reading Ability

Ranges of Vision	**Impairment Aspect** (how the eye functions)					**Ability Aspect** (how the person functions)		**Generic Ability Ranges**
	Visual Acuity			Linear scales		Reads 1M at:	**Reading Ability**	
	U.S. notation	Decimal notation	6 m notation	Letter score	Log MAR			
Range of Normal Vision	20/12.5 20/16 **20/20** 20/25	1.6 1.25 **1.0** 0.8	6/3.8 6/4.8 **6/6** 6/7.5	110 105 **100** 95	– 0.1 – 0.2 **0** + 0.1	160 cm 125 cm 100 cm 80 cm	Normal reading speed Normal reading distance *Reserve capacity for small print*	***Normal performance with reserve 100 ± 10***
Mild Vision Loss	20/32 20/40 20/50 20/63	0.63 0.5 0.4 0.32	6/9.5 6/12 6/15 6/18	90 85 80 75	0.2 0.3 0.4 0.5	60 cm 50 cm 40 cm 30 cm	Normal reading speed Reduced reading distance *No reserve for small print*	***Normal performance, lost reserves 80 ± 10***
Moderate Vision Loss	20/80 20/100 20/125 20/160	0.25 0.2 0.16 0.125	6/24 6/30 6/36 6/48	70 65 60 55	0.6 0.7 0.8 0.9	25 cm 20 cm 15 cm 12.5cm	Near-normal with appropriate reading aids *Low power magnifiers or large print books*	***Near-normal performance with aids 60 ± 10***
Severe Vision Loss	**20/200** 20/250 20/320 20/400	**0.1** 0.08 0.063 0.05	**6/60** 3/60	**50** 45 40 35	**1.0** 1.1 1.2 1.3	10 cm 8 cm 6 cm 5 cm	Slower than normal with reading aids *High power magnifiers (restricted field)*	***Restricted performance with aids 40 ± 10***
Profound Vision Loss	20/500 20/630 20/800 20/1000	0.04 0.032 0.025 0.02	2/60	30 25 20 15	1.4 1.5 1.6 1.7	4 cm 3 cm 2.5 cm 2 cm	Marginal with aids *Uses magnifiers for spot reading, but may prefer talking books for leisure*	***Marginal performance with aids 20 ± 10***
Near-Blindness	less	less	1/60 less	10 5 0	1.8 1.9 2.0	1 cm	No visual reading *Must rely on talking books, Braille or other non-visual sources*	***Must rely on substitution skills 0 – 10***
Blindness	0.0	NLP	NLP					

Table 13B – **ASPECTS and RANGES of VISION and VISION LOSS**
Handicap/Participation and Visual Field

Ranges of Vision	**Handicap / Participation Aspect** (how the person participates in society)					**Visual Field** (score based on new AMA grid)			**Generic Ability Ranges**
	Use of Aids	**Social Consequences**	**Broader ranges**			Grid score	Average rad.(diam.)	**O & M Abilities** (Orientation & Mobility)	
Range of Normal Vision	*No aids*	*Note that normal adult vision is better than 20/20 (1.0). Average acuity does not drop to 20/20 (1.0) until age 60 or 70.*	Legally Sighted – USA	*(no code)*	(Near-) normal	110 105 100 95	70° (140°) 60° (120°)	Normal Orientation Normal Mobility	***Normal performance with reserve 100 ± 10***
Mild Vision Loss		*Many functional criteria fall within this transitional range. (whether for a driver's license or for cataract surgery)*				90 85 80 75	50° (100°) 40° (80°)	Normal O&M performance *needs more scanning*	***Normal performance lost reserves 80 ± 10***
Moderate Vision Loss	*vision enhan-cement aids*	*In the U.S. children in this range qualify for special-education assistance.*		Low Vision – WHO	Low Vision – ICD-9-CM	70 65 60 55	30° (60°) 20° (40°)	Near-normal performance *must scan for obstacles*	***Near-normal performance with aids 60 ± 10***
Severe Vision Loss		*In the U.S. individuals in this range are considered "legally blind" and qualify for a tax break and for disability benefits.*	**"Legal Blindness" – USA**			**50** 45 40 35	**10° (20°)** hemianopia 8° (16°)	Visual mobility is slower than normal *may use cane as adjunct*	***Restricted performance with aids 40 ± 10***
Profound Vision Loss	*vision substi-tution aids*	*The WHO (ICD-9, -10) includes this range under "blindness". In ICD-9-CM it is considered profound Low Vision.*		**Blindness – WHO**		30 25 20 15	6° (12°) 4° (8°)	Must use cane for detection of obstacles *may use vision as adjunct for identification*	***Marginal performance with aids 20 ± 10***
Near-Blindness **Blindness**		*In this range residual vision becomes unreliable, but may still be used as an adjunct to vision substitution skills.*			**Blindness**	10 5 0	2° (4°) NLP	Visual orientation not reliable – *must use blind mobility skills, long cane, hearing, guide dog*	***Must rely on substitution skills 0 – 10***