Taming the Beast: Measuring Vision-Related Disability Using the International Classification of Functioning

Gerry E. Hendershot, Paul J. Placek, and Nanette Goodman

Abstract: This article reviews the way in which the complex phenomenon of vision-related disability is captured by an authoritative classification system: the International Classification of Functioning, Disability, and Health. Data from several major national surveys are used to illustrate how the classification system's codes referring to body function and structure, personal activities, social participation, and environmental factors relate to the surveys. Survey items specific to vision-related disability are considered in terms of codes in the International Classification of Functioning to show how the underlying conceptualization of survey questions maps to the classification system's domains. It is suggested that an understanding of the International Classification of Functioning can clarify the purposes and uses of survey questions dealing with vision-related disability. Efforts to develop standardized questions to improve comparability across surveys are encouraged.

Estimates of the prevalence of vision-related disability in the United States among adults over age 45 range from 3.4 to 16.5 million (Leonard, 2002; Shoemaker, 2002). A large part of the variation is a result of how visual impairment is measured by the data-collection instruments used in the variety of available sources. Some estimates are based on a purely "medical model," whereby vision-related limitation in functioning is viewed as the direct result of a physical condition intrinsic to the individual, such as poor visual acuity. Other estimates are based on a "social model" of disability, whereby vision-related limitation in functioning is viewed as the result of an interaction between the individual's physical condition and the environment, and is measured as limitations in activities caused by low vision or blindness, such as the inability to read a newspaper or drive a car.

The International Classification of Functioning, Disability and Health (ICF) (World Health Organization [WHO], 2001) provides a way to conceptualize disability wherein functioning and impairment—specifically, for present purposes, vision-related functioning and impairment—are viewed as complex interactions between a health-related condition of the individual and the contextual factors of the environment and personal characteristics. ICF is structured around

the following broad components: body functions, body structures, activities and participation, and environmental factors

With 1,494 codes, ICF is a comprehensive, detailed description and classification of a person's experience of health and disability, including environmental barriers and facilitators that have affect functioning. It is beginning to be used in the clinical, research, policy development, and public health fields. In itself, ICF is not a survey or clinical measurement instrument. Rather, it provides a structure to interpret results of existing measurement instruments and may lead to development of more appropriate measures.

The *Journal of Visual Impairment & Blindness (JVIB)* has published a number of articles using the ICF model and codes applied to vision (Crews & Campbell, 2001; Crews & Long, 1997a, 1997b; Long, Crews, & Mancil, 2000). These articles related vision to disabilities such as restrictions in mobility, self-care, or other usual activities. The present article provides a brief background and description of the ICF, and then, using ICF terminology and framework, describes how vision-related disability is conceptualized in several commonly cited prevalence estimates. Special attention is paid to the most commonly cited source for United States statistics on visual impairment—the National Health Interview Survey (NHIS), conducted by the National Center for Health Statistics, a unit of the Centers for Disease Control and Prevention.

ICF

WHO developed ICF in an effort to provide a unifying framework for classifying human function. It was approved in May 2001 after a decade-long international effort to revise its predecessor, the International Classification of Impairments, Disabilities, and Handicaps (WHO, 1980). The aims of ICF are for it to be relevant across cultures and age groups and to be useful in a variety of settings, recognizing special challenges such as its use with children or in relation to mental health issues. It has been translated into all the official WHO languages (English, French, Russian, Chinese, Spanish, and Arabic) and a number of nonofficial languages. It has been the subject of more than 200 journal articles since 2001 (North American Collaborating Center, 2006).

In ICF, disability is said to exist when a health condition (such as corneal astigmatism) gives rise to an impairment of body structure or function, a limitation in personal activity, a restriction in community participation, or a combination of two or more of these. ICF uses an alphanumeric system in which the letters *b*, *s*, *d*, and *e* are used to denote the following categories: Body Functions (b), Body Structures (s), Activities and Participation (d), and Environmental Factors (e). Numerical ICF categories are nested so that broader categories are defined to include more detailed categories. In addition, each category code can be assigned a modifier from 0 to 4 to indicate the severity of the impairment (none, mild, moderate, severe, and complete). Personal factors such as age and gender are recognized, but are not classified in ICF.

Body functions and structures

Body functions include the physiological and psychological functions of body systems, whereas body structures are defined by ICF as "anatomic parts of the body such as organs, limbs and their

components." For example, visual acuity is classified as a body function while impairments of the retina, cornea, vitreous body, and other structures of the eyes, which may cause poor visual acuity, are classified as body structures. The body structure codes are the closest ICF comes to identifying the etiology of an impairment, but ICF remains neutral as to etiology. For example, it does not make a distinction on the basis of what disease caused a structural impairment. Thus, it does not distinguish between an impairment of the retina resulting from diabetic retinopathy and the same impairment caused by age-related macular degeneration. This is not because the distinction is irrelevant for any purpose, but rather because ICF leaves this distinction to its companion publication, the *International Classification of Diseases* (WHO, 2005).

The vision functioning codes in ICF are found primarily in its b210–b229 code range—labeled as "seeing and related functions." For example, b210 is "seeing functions—sensory functions relating to sensing the presence of light and sensing the form, size, shape, and color of the visual stimuli." The category b210 includes within it 17 four- and five-digit categories such as b21001, "monocular acuity of distant vision," and b21021, "color vision." The b215 "body code" refers to functions of structures adjoining the eye, b220 refers to sensations associated with the eye and adjoining structures, and b229 is a residual category referring to seeing and related functions not included in the other codes.

Code s210 refers to structure of the eye socket; s220 refers to structure of the eyeball; and s230 refers to structures around the eye. As noted above, qualifiers are used to document severity of the impairment. These visual impairment and blindness codes were reviewed in more complete form in this journal by Hendershot & Crews (2006).

Activities and participation

The distinction between activity and participation, although sometimes obscure and unimportant, at other times is clear and valuable. The ICF authors allow users of the classification to decide whether or not to make the distinction. In general, activity refers to action undertaken at the conceptual level of the individual, whereas participation refers to action undertaken by people viewed conceptually as part of a social organization. If this distinction is made, activity codes are preceded by the letter *a* and participation codes by *p*. ICF divides its consideration of activity and participation into nine chapters: 1) learning and applying knowledge, 2) general tasks and demands, 3) communication, 4) mobility, 5) self-care, 6) domestic life, 7) interpersonal interactions and relationships, 8) major life issues, and 9) community, social, and civic life. More specific codes are nested within these groups.

The relevance of the ICF function categories is not necessarily limited to people with low vision or blindness. All of the categories can be affected by and interact with a wide range of diagnostic conditions—mental, physical, and sensory. Thus, accommodations for limitations and restrictions may also cross diagnostic boundaries: those that benefit individuals with motor impairments may also benefit people with visual impairments and people with cognitive impairments. By focusing on function, the distinctions imposed by diagnostic conventions and medical

specializations are removed. The redirection of thinking from condition-specific disability to function-specific disability moves problem-solving toward universal design that benefits individuals with many different types of disabilities and even those with no disabilities.

Environmental factors

By recognizing the essential role that environmental factors play in determining functional limitations, ICF turns the focus of the problem from the individual to the environment in which that individual functions. ICF includes a wide range of environmental factors, including products and technology, natural environment and human-made changes to environment, support and relationships, attitudes, and service systems and policies. For example, a substantial improvement in light quality (e2401) might ameliorate activity limitations, just as denial of access to specialized vision devices (e1251) might exacerbate activity limitations. Participation in the community may be increased by support of friends (e320) or impeded by negative societal attitudes (e460).

Clinical and survey applications

The detailed level of these codes suggests that ICF is precise enough to capture nuances in functions yet broad enough for a wide variety of clinical and survey applications. In a clinical setting, ICF has been used to identify specific function goals and to measure empirically the effectiveness of rehabilitative and intervention services (Beckung & Hagberg, 2002). In survey applications, the same versatility exists. For example, Crews and Campbell (2004) used ICF structure to compare the health, activities, and social roles of people aged 70 years or older with visual impairments, hearing loss, or both. Tannenbaum, Mayo, and Ducharme (2005) used ICF to develop a questionnaire measuring the health priorities of older women and their perceptions of whether health care providers were addressing these priorities.

The breadth of ICF work in visual impairment and blindness has demonstrated that ICF is a versatile tool that can serve different purposes and disciplines with validity. In the short time since its adoption, it has been shown that ICF can describe visual impairment in a comprehensive way with health covariates in a social context, and in a medically precise way with modifiers for degree of severity. In the following sections, we backcode U.S. visual impairment data (a process of classifying questionnaire items into a coding scheme created for purposes separate from those of the study containing the items) to ICF to gain an understanding of what has been measured.

National Health Interview Survey

NHIS is one of the best sources of ICF-compatible prevalence estimates of vision-related disability. In this section, we examine ICF codes for NHIS questions on vision-related disability in the annual core questionnaires and the 2002 Vision Supplement. Based on that supplement, and on the criteria we used, about 23% of the U.S. population is estimated to have a vision-related disability, a condition conceptualized as involving at least one of the following: having an impairment in at least one of several body structures or functions; limited in selected activities or participation; or using selected environmental modifications. These

criteria are discussed more fully in the following sections.

Design and methods

NHIS is an annual, cross-sectional survey that collects data by computer-assisted personal interview on about 100,000 people from 40,000 sample families, representing the civilian noninstitutionalized population of the United States. Standardized questionnaires are used to obtain information on a wide range of health characteristics. Three core questionnaires serve to gather information on 1) all family members, 2) a sample child, and 3) a sample adult.

Questions on visual impairment and blindness

In the family and sample child core questionnaires used in NHIS since 1996, no direct question is asked about visual impairment or blindness. However, the sample adult questionnaire has two questions on visual impairment and blindness, and several on visual impairment and blindness were added to the 2002 sample-adult questionnaire. Those questions are reproduced in Box 1.

The text in bold in Box 1 is read verbatim by the interviewer. Answers to the questions are recorded by the interviewer using the categories shown below each question; those categories appear on the interviewer's laptop computer screen, but are not seen by the respondent. However, where the answer categories in Box 1 are preceded by the words "Show Card," the interviewer hands the respondent a card on which the answer categories are printed. For those who cannot read English because of vision, cognitive, or language difficulties, the list is read aloud by the interviewer or an interpreter.

Questions on vision impairment and blindness from the National Health Interview Survey Core Questionnaire and 2002 Vision Supplement

1. Do you have any trouble seeing, even when wearing glasses or contact lenses?
(1) Yes (2) No (7) Refused (9) Don't know

2. Are you blind or unable to see at all?
(1) Yes (2) No (7) Refused (9) Don't know

3. Have you EVER been told by a doctor or other health professional that you had…
(1) Yes (2) No (7) Refused (9) Don't know

a. Diabetic retinopathy?
b. Cataracts?
c. Glaucoma?
d. Macular degeneration?

4. During the past 12 months, have you had . . . ?
a. Diabetic retinopathy?
b. Cataracts?
c. Glaucoma?
d. Macular degeneration?

5. Do you use any vision rehabilitation services, such as job training, counseling, or training in daily living skills and mobility?
(1) Yes (2) No (7) Refused (9) Don't know

6. Do you use any adaptive devices such as telescopic or other prescriptive lenses, magnifiers, large print or talking materials, CCTV, white cane, or guide dog?
(1) Yes (2) No (7) Refused (9) Don't know

7. Even when wearing glasses or contact lenses, because of your eyesight, how difficult is it for you . . .

[SHOW CARD (0) Not at all difficult (1) Only a little difficult (2) Somewhat difficult (3) Very difficult (4) Can't do at all (6) Do not do this activity (7) Refused (9) Don't know]

a. To read ordinary print in newspapers?
b. To do work or hobbies that require you to see well up close such as cooking, sewing, fixing things around the house, or using hand tools?
c. To go down steps, stairs or curbs in dim light or at night?
d. To drive during daytime in familiar places?
e. To notice objects off to the side while you are walking along?
f. To find something on a crowded shelf?

Box 1.

Assigning ICF codes to NHIS questions on vision-related disability

In Box 2, each of the NHIS questions in Box 1 is listed in the first column by question number and topic. Subsequent columns show the ICF domain, chapter, block of codes (if relevant), the most specific function category that applies to the question, and the level of functioning codes that could be constructed from the question. For instance, the first line combines questions 1 and 2, which appear in the standard sample adult questionnaire; the two questions were designed to go together—the first screens for any visual impairment, and the second distinguishes between low vision and blindness.

The information obtained by questions 1 and 2 is in the ICF domain "Body functions," in Chapter 2, "Sensory functions and pain." The categories of functioning within that chapter are grouped into "blocks" of related codes for ease of reference, and the information at hand is in a block of categories, b210–b229, labeled "Seeing and related functions." Finally, within that block, the most detailed category to which the information can be linked is b210, "Seeing functions." The letter "b" preceding the number code signifies "body function." There are more specific ICF function categories within b210—visual acuity, visual field, and quality of vision—and even more specific categories within each of those. But those more detailed codes require more information than is available from questions 1 and 2, so b210 is the most specific ICF function category that could be used.

The final column of Box 2 shows the level of functioning codes that could be created with the available information. The standard ICF scale of functioning has five numerically coded levels, as follows (the x's in Box 2 imply the code category that precedes the level value): 0 = no impairment; 1 = mild impairment (tolerable, present less than 25% of the time, rare over the last 30 days); 2 = moderate impairment (interfering with daily life, present less than 50% of the time, occasional over the last 30 days); 3 = severe impairment (partially disruptive, present more than 50% of the time, frequent over the last 30 days); and 4 = complete impairment (totally disruptive, present more than 95% of the time, occurring every day). Two additional codes, 8 = not specified and 9 = not applicable, are reserved for situations in which there is insufficient information or the designation of a code would be inappropriate.

In Box 2, a logical, albeit arbitrary, assignment links the NHIS function level information to an ICF function level code: a report of "blind or unable to see at all" is assigned level 4, reports of "trouble seeing" without mention of blindness are assigned the collapsed level of 1–4, and a report of no trouble seeing is assigned level 0; that is, three levels of function can be distinguished—no trouble seeing, a little to a lot of trouble seeing, and blindness.

Questions 3 and 4 ask about four conditions specific to the health of the eye: diabetic retinopathy, cataracts, glaucoma, and macular degeneration. Such diagnostic categories are in the realm of WHO's International Classification of Diseases and its Clinical Modification (National Center for Health Statistics, 2006); however, these conditions all involve some departure from the "normal" structure of a part of the eye, and therefore can also be classified in the ICF "body structure"

Mapping ICF codes to NHIS questions

NHIS question	ICF domain	ICF chapter	ICF block	ICF function category	ICF level of functioning
1. Trouble seeing	Body functions	2. Sensory functions and pain	b210–b229. Seeing and related functions	b210. Seeing functions	x.0, x.1–x.3, x.4
2. Blind or unable to see at all	Body functions	2. Sensory functions and pain	—	b210. Seeing functions	—
3a, 4a. Diabetic retinopathy	Body structure	2. The eye, ear and related structures	—	s2203. Retina	x.0, x.1–x.4
3b, 4b. Cataracts	Body structure	2. The eye, ear and related structures	—	s2204. Lens of eyeball	x.0, x.1–x.4
3c, 4c. Glaucoma	Body structure	2. The eye, ear and related structures	—	s2205. Vitreous body	x.0, x.1–x.4
3d, 4d. Macular degeneration	Body structure	2. The eye, ear and related structures	—	s2203. Retina	x.0, x.1–x.4
5. Rehabilitation services	Environmental factors	3. Support and relationships	—	e360. Other professionals	—
6. Adaptive devices	Environmental factors	1. Products and technology	—	e1151. Assistive products and technology for personal use in daily living	—
7a. Reading newsprint	Activities and participation	3. Communication	d310–d329. Communicating - receiving	d325. Written messages	x.0, x.1, x.2, x.3, x.4
7b. Close work	Activities and participation	6. Domestic life	d630–d649. House-hold tasks	d6300. Preparing simple meals; d6500. Making and repairing clothes; d6501. Maintaining dwelling and furnishings	x.0, x.1, x.2, x.3, x.4
7c. Descend stairs	Activities and participation	4. Mobility	d450–d469. Walking and moving	d4551. Climbing	x.0, x.1, x.2, x.3, x.4
7d. Daytime driving	Activities and participation	4. Mobility	d470–d489. Moving around using transportation	d4751. Driving motorized vehicles	x.0, x.1, x.2, x.3, x.4

Box 2.

domain, where there are straightforward categories for the eye structures affected. It should be noted that it is not the disease diagnosis that is being coded in ICF, but the abnormal structure related to the disease. Alterations to the same eye structures that are associated with different disease diagnoses would be assigned the same ICF codes.

Setting aside for the moment questions 5 and 6, which have a somewhat different character, question 7 brings into clearer focus the potential of the framework of ICF for describing and analyzing disability. Question 7 moves from the domains of body functions and structure to those of activities and participation, wherein three chapters—on communication, mobility, and domestic life—are relevant. The applicable ICF function categories include preparing simple meals, making and repairing clothes, caring for household objects, maintaining dwelling and furnishings, climbing, driving motorized vehicles, and walking around obstacles.

Although the other questions fall within the function domains of ICF, questions 5 and 6 pertain to what ICF calls "contextual factors"; that is, factors that are not within the domains of ICF per se, but provide a context that is crucial to understanding functioning. Two contextual factors—personal and environmental—are named by ICF. Although it does not delineate personal contextual factors, ICF does list environmental factors to suggest their scope, without providing a detailed classification.

Questions 5 and 6 ask general questions about the respondent's use of rehabilitation services and assistive devices. In Box 2, these have been assigned ICF numerical codes corresponding to broadly defined environmental factors, but there are no ICF codes corresponding to the "function level" codes of the ICF proper.

Prevalence of visual impairments using ICF codes and NHIS data

Table 1 shows estimates of the prevalence of impairments in ICF "seeing functions" at two levels of functioning: complete impairment (level 4) and partial impairment (levels 1–3 combined). Because questions 1 and 2 (see Box 1) are asked every year in the adult sample core questionnaire, data from two or more years can be aggregated to create larger sample sizes and more reliable estimates. For the estimates in Table 1, NHIS data from three years—2002, 2003, and 2004—were aggregated. In those years, the numbers of sample cases were 31,044, 30,852, and 31,326, respectively, for an aggregated sample size of 93,222. There were no survey design changes during those years that could be expected to have affected the results of the analyses presented here.

The estimates in Table 1 are shown for the total population and for the population classified by gender and age group. Also shown are the estimated sampling errors of the prevalence estimates. These data were computed using a program (Stata 7) that accounts for the complex sample design. According to Table 1, some 0.36% of U.S. adults report that they are blind or unable to see. The prevalence rate of blindness increases regularly with age—people over age 65 are 10 times more likely to be blind than those aged 18–29. The differences between men and women are not statistically significant overall or at any of the ages considered. The prevalence rate of partial impairment of vision

Table 1
Average annual prevalence (and standard errors of estimates) of impairment to "seeing functions" (ICF b210) per 1,000 U.S. persons according to level of functioning, sex, and age: 2002–2004.

	Complete impairment (ICF 4)			Partial impairment (ICF 1–3)		
Age	Both	Male	Female	Both	Male	Female
18 and over	3.6	3.4	3.7	85.9	70.7	100.0
	(0.2)	(0.3)	(0.3)	(1.4)	(1.6)	(1.8)
18–29 years	0.9	0.7	1.0	45.0	35.8	54.2
	(0.3)	(0.4)	(0.4)	(1.9)	(2.2)	(2.8)
30–44 years	2.3	2.7	1.9	56.2	47.4	64.7
	(0.3)	(0.5)	(0.4)	(1.8)	(2.3)	(2.3)
45–64 years	3.5	3.5	3.5	104.6	87.2	121.0
	(0.3)	(0.5)	(0.5)	(2.2)	(2.9)	(3.0)
65 years and over	9.9	9.0	10.5	159.8	139.1	175.1
	(0.8)	(1.2)	(1.1)	(3.7)	(4.9)	(4.8)

(a little to a lot of difficulty seeing, ICF levels 1–3) is more common (8.5%). The prevalence rate of partial impairment increases with age and is higher for women than for men at every age.

Table 2 shows the prevalence rate of three types of ICF body-structure impairments—to the retina (s2203), the lens (s2204), and the vitreous body (s2205). Those impairments are inferred from reports of having been diagnosed with four conditions—diabetic retinopathy, cataracts, glaucoma, and macular degeneration. These data are from 2002, the only year in which the questions on these conditions were asked. Because they are drawn from a single year of data, sampling errors are larger, on average, than in Table 1. For that reason, the rates are shown for each sex and for three age groups, but not for the much smaller groups found in combinations of sex and age subcategories. Prevalence rates increase many-fold with age, especially in the case of impairments of the lens (cataracts). Also, prevalence rates are higher among women than among men for all of the ICF impairment categories.

Table 3, also based on the 2002 NHIS, shows percent distributions of respondents by level of functioning for six vision-related activities. A summary column at the right ("Any difficulty") combines all levels (1–4) of limitation. Large majorities (87%–93%) of adults report having no limitation in each of the six activities; of those reporting any limitation, large majorities report only mild or moderate difficulty (levels 1 or 2). The activities with the largest proportions of the population reporting vision-related limitations are, in order: reading newsprint, doing close work, and walking down poorly lighted stairs.

Table 4 shows the proportion of respondents with visual impairments (reporting either difficulty seeing or having had diabetic retinopathy, cataracts, glaucoma, or macular degeneration) who also report using vision rehabilitation

Table 2
Prevalence (and standard errors of estimates) of selected body structure impairments and diagnoses per 1,000 U.S. persons, according to sex and age: 2002.

ICF body structure category (and code)	Medical diagnosis	Total	Sex		Age		
			Male	Female	18–44	45–64	65 and over
Retina (s2203)	*Either* diabetic retinopathy *or* macular degeneration*	20.6	16.7	23.6	3.8	16.8	72.3
		(0.8)	(1.1)	(1.1)	(0.5)	(1.3)	(3.4)
	Diabetic retinopathy*	8.4	7.8	8.9	2.4	11.2	20.3
		(0.5)	(0.8)	(0.7)	(0.4)	(1.1)	(1.8)
	Macular degeneration*	13.3	9.8	16.0	1.6	6.5	55.9
		(0.7)	(0.8)	(0.9)	(0.3)	(0.8)	(3.0)
Lens of eyeball (s2204)	Cataracts	99.3	75.9	117.3	5.5	56.2	421.9
		(1.7)	(2.3)	(2.4)	(0.6)	(2.4)	(6.5)
Vitreous body (s2205)	Glaucoma	23.4	19.7	26.2	3.4	20.2	82.3
		(0.9)	(1.2)	(1.2)	(0.5)	(1.4)	(3.6)

services or assistive devices for vision, the two ICF environment categories covered in the 2002 NHIS. Only very small numbers of respondents report that they are currently using rehabilitation services for visual impairments. About one-fifth of those with vision loss report using assistive devices for vision, but it is not clear whether or not this includes ordinary prescription eye glasses and contact lenses.

This examination of NHIS vision data and estimates of the prevalence of vision-related disability using the NHIS data coded to ICF categories indicates that the NHIS conceptualization of visual impairment is primarily in the realm of activity (seeing or performing specific functions related to seeing), although some NHIS supplements include items in the realm of body structure. NHIS is a large, representative, and periodic survey that provides a substantial range of data on vision-related disability; when enhanced by occasional special supplements, NHIS can meet many needs for national data in this area. There are other data sources, however, that add to our understanding of vision-related disability.

Other sources of vision data

Sources that are commonly cited in estimates of vision-related disability fall into two methodological categories—self-reports and clinical assessments. Self-reports tend to measure activity and community participation, whereas the clinical assessments are centered on body structures and functions.

In addition to NHIS, the main sources of vision data based on self-reports are the Survey of Income and Program Participation (SIPP), the Lighthouse Survey,

Table 3
Percent distribution (and standard errors) of U.S. adults by ICF level of vision-related functioning in selected activities: 2002.

NHIS	ICF level of function					
Question No. / Activity	0 (No difficulty)	1	2	3	4 (Unable)	Any difficulty
7a. Read newsprint	86.8	5.5	6.1	1.1	0.5	13.2
	(0.3)	(0.2)	(0.3)	(0.1)	(0.1)	(0.2)
7b. Do close-up work	88.5	4.4	5.9	0.9	0.4	11.5
	(0.3)	(0.1)	(0.3)	(0.1)	(0.0)	(0.2)
7c. Go down stairs in dim light	89.7	3.2	5.7	1.1	0.3	10.3
	(0.3)	(0.1)	(0.3)	(0.1)	(0.0)	(0.2)
7d. Drive in daylight in familiar place	93.0	1.7	4.6	0.5	0.2	7.0
	(0.3)	(0.1)	(0.3)	(0.0)	(0.0)	(0.2)
7e. Notice objects on side when walking	93.8	1.2	4.4	0.2	0.4	6.2
	(0.3)	(0.1)	(0.3)	(0.0)	(0.0)	(0.1)
7f. Find object on crowded shelf	92.5	2.1	4.8	0.5	0.2	7.5
	(0.3)	(0.1)	(0.3)	(0.1)	(0.0)	(0.2)

and the self-report portion of the National Health and Nutrition Examination Survey (NHANES). Data based on clinical assessments come mainly from the eye examination portion of NHANES.

This section will compare estimates of the prevalence rates of visual impairments based on various data sources and definitions of disability, and will briefly describe the basic structure of the source and its conceptual framework in terms of ICF. We have limited our focus to studies that provide estimates of visual impairment for a broad age group and across race and ethnicities.

We have not included a host of studies that produce prevalence estimates for only subpopulations, such as ethnic minorities or the elderly. These include the Established Population for Epidemiological

Table 4
Users of vision-related rehabilitation services and assistive devices per 1,000 U.S. persons with vision impairments (and standard errors of the estimates), according to sex and age: 2002.

ICF environment category (and code)	NHIS question number and subject	Sex			Age		
		Total	Male	Female	18–44	45–64	65+
Support and relationships, other professionals (e360)	5. Rehabilitation services	1.5 (0.2)	1.5 (0.4)	1.4 (0.2)	1.7 (0.5)	0.9 (0.3)	1.8 (0.3)
Assistive products and technology for personal use in daily living (e1151)	6. Assistive devices	22.3 (0.8)	21.3 (1.3)	22.9 (1.0)	17.7 (1.6)	23.7 (1.3)	23.7 (1.1)

Studies of the Elderly (EPESE), the Supplement on Aging to NHIS (with different questions from the 1994–95 Disability Supplement to NHIS conducted in the same period), Medicare Current Beneficiary Survey, and for Latino populations, the Hispanic EPESE, and the Hispanic Health and Nutrition Examination Survey, and a number of small population-based clinical screening studies.

Self reports

Survey of Income and Program Participation

SIPP is a multi-panel, longitudinal survey conducted by the U.S. Census Bureau since 1983 (although, at this writing, there is some doubt that the survey will continue due to budget limitations). The survey design is a continuous series of national panels in which the same households are interviewed every four months for periods ranging from 2½ to 4 years. The sample ranges in size from 14,000 to 36,700 interviewed households, and covers the civilian, noninstitutionalized population.

SIPP information falls into two categories: core socioeconomic and demographic information that is collected in every interview and in-depth information on specific subjects that is collected in special topical modules. These topical modules are asked of each panel at only one or two interviews. In the Functional Limitation and Disability module, adults are asked two questions about vision: 1) "Does [the respondent] have difficulty seeing the words and letters in ordinary newspaper print even when wearing glasses or contact lenses?" and 2) "Is [the respondent] able to see the words and letters in ordinary newsprint at all?" These questions are designed to measure visual disability at the activity level—specifically, the activity of reading. ICF classifies this as "undertaking a simple task."

Based on the 1996 panel, 28.4 per 1,000 adults over age 15 had difficulty seeing the words and letters in ordinary newsprint even when wearing corrective lenses. An additional 8.5 per 1,000 were unable to see the words and letters in ordinary newsprint at all (McNeil, 2001).

Lighthouse Survey

In 1994, Louis Harris and Associates and the Lighthouse Inc. collected data via telephone interviews with a nationally representative sample (N = 1,219) aged 45 and older. Respondents were classified as having self-reported visual impairment if they met any of the following criteria, even when wearing glasses or contact lenses: 1) blind in one or both eyes, 2) any other reported trouble seeing, 3) not able to see well enough to recognize a friend across a room, 4) not able to see well enough to recognize a friend at arm's length, 5) not able to see well enough to read ordinary newsprint, or 6) self-rated vision of "poor" or "very poor."

Criteria 1 and 2 replicated those used in NHIS. Criterion 5 addressed the issue of print disability that has been used to define severe visual impairment in several national surveys, including SIPP. The other criteria were included to capture intermediate and distance vision problems, as well as a global self-assessment of vision status (Horowitz, Brennan, & Reinhardt, 2005).

Although this survey takes a broader view of visual functioning than does the

SIPP, on the whole the questions do not line up neatly with ICF. Criterion 1 is a measure of visual acuity (b2100). Criteria 3 and 4 can be seen as measures of visual acuity with aspects of "quality of vision" (b2102) or they can be seen as measures of interpersonal interactions (d710). Criteria 2 and 6 may refer to any one of three ICF categories—body function, activity, or participation. Are the questions asking about visual acuity or are they asking whether the respondent's vision impedes their ability to carry out certain activities? The interpretation is left up to the respondent.

Seventeen percent of adults aged 45 and older self-reported vision-related disability in the Lighthouse survey. The percentage increased significantly with age from 14.4% of those aged 45–54 increasing to 26.5% of those aged 75 and older (Horowitz et al., 2005).

National Health and Nutrition Examination Survey

NHANES, another program of NCHS, has two major components: interviews and physical examinations. The program began in the early 1960s and has been conducted as a series of surveys focusing on different population groups and subtopics. In 1999, the survey became a continuous program and roughly 7,000 people in 15 communities per year are interviewed in their homes. The relevant items in the interview portion are set out in Box 3.

Vision-related interview items from the National Health and Nutrition Examination Survey

1. Self-rated eyesight, with glasses or contact lenses (excellent; good; fair; poor; very poor).
2. Amount of time respondent worries about eyesight.
3. Amount of difficulty (none; a little; moderate; extreme; unable to do because of eyesight; does not do for other reasons) doing the following activities while wearing glasses or contacts if they are usually worn:
   a. Reading ordinary print in newspapers.
   b. Doing work or hobbies that require respondent to see well up close, such as cooking, sewing, fixing things around the house, or using hand tools.
   c. Finding something on a crowded shelf.
   d. Going down steps, stairs, or curbs in dim light or at night.
   e. Noticing objects off to the side while walking.
   f. Driving during the daytime in familiar places.
4. Limited in how long the respondent can work or do other daily activities, such as housework, child care, school, or community activities because of vision.

Box 3.

NHANES includes a broader range of activities that are affected by reduced vision functioning than the Lighthouse survey. In terms of ICF, what distinguishes NHANES from the other surveys is its inclusion of a question that addresses ICF notion of "participation." Question 4 relates to the ICF domains of "domestic life" and "community, social, and civic life." In addition, NHANES addresses an "activity" that is not addressed in other surveys: questions 3d–3f fit the ICF category of "mobility."

Based on questionnaires administered between 1999 and 2004, 18.2% of the

population over 45 had "moderate" or "extreme difficulty" or are "unable to do because of eyesight" at least one of the six activities listed in question 3 above, and 3.4% are limited "most of the time" or "all of the time" in how long they can do other daily activities.

Clinical assessments

NHANES participants also undergo a comprehensive health examination in a mobile examination center. This includes collecting biological samples for laboratory tests and a variety of functional assessments, one of which tests visual acuity. Visual impairment is defined as presenting distance visual acuity of 20/50 or worse in the better-seeing eye when the participant is using usual distance vision correction (glasses or contacts). Based on exams conducted between 1999 and 2002, the clinical assessments indicate that a visual impairment is present in 6.4% of the population.

Comparison of sources

The data sources provide wide-ranging estimates of the percent of the population with visual impairments (see Table 5). For people over 65, the age group for which we have the most comparable data, the NHANES clinical evaluation estimate is less than half of the NHANES survey and the Lighthouse estimates and two-thirds as large as the SIPP estimate.

Each source measures a partial and different aspect of ICF. For example, the NHANES clinical evaluation measures limitations in body function, while SIPP focuses on a single simple activity and the Lighthouse and NHANES surveys include multiple activities and community participation (Table 6). None of these surveys explicitly accounts for the role of assistive technology.

As noted earlier, NHIS provides the widest range of ICF-related visual impairment variables among the currently available large, representative, national data systems. When its occasional vision supplements are included, NHIS provides at least some data on impairments, activity limitations, participation restrictions, and environmental barriers and facilitators.

Conclusion

The several surveys that have been examined here each approaches vision-related disability via a different ICF domain and

Table 5
Comparison of survey prevalence estimates of vision impairment (severe or non-severe) per 1,000 population for selected age groups.

Survey	45–64 yrs	65+ yrs
NHANES interview	151.7	221.3
Lighthouse	145.2	213.5
NHIS	108.1	169.7
SIPP	25.8[a]	120.9
NHANES clinical assessment	43.0[a]	88.0

[a]SIPP data refer to ages 25–64; NHANES clinical data refer to ages 40–59.
Sources: NHANES: authors' analysis of NHANES data; Lighthouse: authors' calculations based on Horowitz, Brennan, & Reinhardt (2005) and Census 2000 population estimates; SIPP: McNeil (2001); NHANES clinical: Vitale, Cotch, & Sperduto (2006).

Table 6
Comparison of ICF domains in various surveys used to identify people with vision-related disabilities (VRD) .

SIPP	Body Structure	Body Function	Activity/ Participation	Environment	Does not map to ICF category
Not able to see words and letters in ordinary newspaper print			x		
Lighthouse Survey*					
blind in one or both eyes		x			
any other reported trouble seeing					x
not able to see well enough to recognize a friend across a room,			x		
not able to see well enough to recognize a friend at arm's length,			x		
not able to see well enough to read ordinary newspaper print			x		
self-rated vision of "poor" or "very poor."					x
NHANES Survey					
Self-rated eye sight, with glasses or contact lenses					x
Amount of time the respondent worries about eyesight.					x
Amount of difficulty doing the following activities while wearing glasses or contacts if they are usually worn:					
Reading ordinary print in newspapers			x		
Doing work or hobbies that require respondent to see well up close such as cooking, sewing, fixing things around the house, or using hand tools			x		
Finding something on a crowded shelf			x		
Going down steps, stairs, or curbs in dim light or at night			x		
Noticing objects off to the side while walking			x		
Driving during the daytime in familiar places			x		
Limited in how long the respondent can work or do other daily activities such as housework, child care, school, or community activities			x		
NHANES Clinical Examination					
Visual Acuity		x			

*The Lighthouse Survey includes a variety of questions about body structure and environment. However, these questions are not used in the definition of whether a respondent has a VRD and are thus not included in the table.

from a seemingly incomplete perspective. None is comparable to the others in terms of content or level of functioning. Had ICF been used to frame these surveys, refine their questions, and delineate the level of functioning, greater conceptual clarity and statistical comparability could have been achieved.

ICF is important both for its theoretical framework and its detailed classification system. Its conceptual basis is consistent with what has come to be known as the "new paradigm of disability," referred to alternatively as the "social" or "environmental" model (National Institute on Disability and Rehabilitation Research, 2006). The older model regards the social consequences of disability as arising entirely from a medical condition; thus, problems such as lack of employment are to be dealt with by or under the direction of medical professionals. The new paradigm, although it may recognize a medical aspect of disability, places greater emphasis on the environment as a causal factor in a person's level of functioning and social participation.

In this view, it is not the medical diagnosis that determines a person's level of functioning; rather, the functioning of an individual with some degree of impairment is at least partly, and perhaps largely, determined by environmental barriers and facilitators. This shift in focus leads naturally to different approaches toward improving functioning. If the environment is a cause, then changing the environment is part of the solution. The move to social and environmental interventions brings into play a range of new and varied interdisciplinary explanations and modalities. Use of the ICF framework can encourage and support such changes, and provides a common language for their implementation.

But ICF is not just a conceptual structure. It also provides a system for classifying the type and level of functioning in considerable detail. If used as the classification system for major sources of disability data, ICF has the potential to re-cast that information in terms more suitable for application to issues of environmental accommodation. In this article we have tried to demonstrate that ICF classification can be used in conjunction with some of the major sources of U.S. data on vision-related disability. It should be noted, however, that at present the direct application of ICF to existing data sources is limited and imperfect. That may be due in part to deficiencies in ICF; it is, after all, a new system, parts of which are still in development.

The larger part of the problem, however, is that many existing systems dealing with data on visual impairment were designed under the old paradigm of disability. Those systems, established to serve the informational needs of public and private programs that often were themselves conceived under the old paradigm, do not systematically distinguish between bodily and environmental factors in functioning. Newer programs embody substantially different perspectives. Compare, for example, two major public policy initiatives—the Social Security disability benefits system and the Americans with Disabilities Act—and contrast their underlying assumptions about factors affecting the ability to work of people with a physical impairment. Obviously, the Social Security system relies on the determinism of medical conditions, whereas ADA invokes the need for environmental accommodation

and elimination of discrimination against people with impairments.

Data systems and the programs they serve are interdependent and mutually reinforcing, making it hard to change one without altering the other. Of the two, however, data systems are probably easier to transform than are service delivery programs. This provides some basis for optimism. Persistent application of ICF to data systems in the ways that have been outlined in this article, and the gradual adoption by major surveys and informational systems of questions more compatible with ICF, may pave the way for the implementation of the new paradigm in a wide range of programs for people with visual impairments and other disabilities.

References

Beckung, E., & Hagberg, G. (2002). Neuroimpairments, activity limitations, and participation restrictions in children with cerebral palsy. *Developmental Medicine and Child Neurology, 44,* 309–316.

Crews, J. E., & Campbell, V. A. (2001). Health conditions, activity limitations, and participation restrictions among older people with visual impairments. *Journal of Visual Impairment & Blindness*, *95*, 453–467.

Crews, J. E., & Campbell, V. A. (2004). Visual impairment and hearing loss among community-dwelling older Americans: Implications for health and functioning. *American Journal of Public Health,* May; 94, 823–829.

Crews, J. E., & Long, R. G. (1997a). Rehabilitation outcomes among adults who are blind and visually impaired: Conceptual and methodological issues. *Journal of Visual Impairment & Blindness, 92*, 117–130.

Crews, J. E., & Long, R. G. (1997b). Conceptual and methodological issues in rehabilitation outcomes for adults who are visually impaired. *Journal of Visual Impairment & Blindness, 92*, 117–130.

Hendershot, G. E., & Crews, J. E. (2006). Towards international comparability of survey statistics on visual impairment: The DISTAB Project. *Journal of Visual Impairment & Blindness, 100*, 11–25.

Horowitz, A., Brennan, M., & Reinhardt, J. P. (2005). Prevalence and risk factors for self-reported visual impairment among middle-aged and older adults. *Research on Aging. 27,* 307–326.

Leonard, R. (2002). *Statistics on visual impairment: A resource manual.* New York: Lighthouse International.

Long, R. G., Crews, J. E., & Mancil, R. (2000). Creating measures of rehabilitation outcomes for people who are blind and visually impaired: The FIMBA Project. *Journal of Visual Impairment & Blindness, 94*, 292–306.

McNeil, J. (2001). *Americans with disabilities.* Washington DC: U.S. Census Bureau Current Population Reports P70–73.

National Center for Health Statistics. (2006). *International classification of diseases, ninth revision, clinical modification.* Hyattsville, MD: National Center for Health Statistics, Centers for Disease Control and Prevention, U.S. Department of Health and Human Services.

National Institute on Disability and Rehabilitation Research. (2006). Long-range plan for fiscal years 2005–2009. *Federal Register, 71*, 8165–8200.

North American Collaborating Center. (2006). *ICF Clearinghouse message of January–February 2006* [Online]. Available: http://www.cdc.gov/nchs/about/otheract/icd9/icfhome.htm.

Shoemaker, J. A. (2002). *Vision problems in the United States: Prevalence of adult visual impairment and age-related eye disease in America.* Bethesda, MD: National Institutes of Health, National Eye Institute.

Tannenbaum, C., Mayo N., & Ducharme, F. (2005). Older women's health priorities and perceptions of care delivery: Results of

the WOW survey. *Canadian Medical Association Journal, 173,* 153–159.

Vitale S., Cotch, M. F., & Sperduto, R. D. (2006). Prevalence of visual impairment in the United States. *Journal of the American Medical Association*. *295*, 2158–2163 .

World Health Organization. (1980). *International classification of impairments, disabilities, and handicaps: A manual for classification relating to the consequences of disease.* Geneva: Author.

World Health Organization. (2001). *International classification of functioning, disability, and health.* Geneva: Author.

World Health Organization. (2005). International statistical classification of diseases and health-related problems [ICD-10, 2nd Ed.]. Geneva: Author.

Gerry E. Hendershot, Ph.D., *consultant on disability and health statistics; mailing address: 4437 Wells Parkway, University Park, MD 20782; e-mail: <ghendershot@earthlink.net>.* ***Paul J. Placek, Ph.D.,*** *consultant on disability and health statistics; mailing address: 103 Big Holly Court, Stevensville, MD 21666; e-mail: <pjplacek@verizon.net>.* ***Nanette Goodman, Ph.D.,*** *research associate, Cornell University Institute for Policy Research, 1341 22nd Street NW, Washington, DC 20037; e-mail: <ng54@cornell.edu>.*

