Eliminating Invisible Barriers: Web Site Accessibility

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The Ripple Effect

Abstract

One of the top reasons given for use of the internet is the ability to search for health information. However, much of the planning for web-based health information often fails to consider accessibility issues. If health care organizations and community agencies' web sites have the latest, most well-researched information on the health topics of the day, it is useless to those who cannot access it because of invisible technological barriers. Many flashy, high-tech sites were designed only to appeal to the needs of the mainstream population, with no consideration given to how people with disabilities must adapt their use of the web in order to access information. This article addresses issues of access specific to web site development, and will explore barriers to accessibility frequently experienced by web users with disabilities, requirements for ADA compliance, and how people with disabilities use the web. Web site accessibility guidelines, as well as simple evaluation tools, will be discussed. A thorough review of the article will enable even the least tech-savvy of health educators to enhance their skills in planning and evaluating web sites to promote access for people with disabilities.

Keywords: World Wide Web, web site design, web accessibility, disabilities

Introduction

Health educators and health communication specialists are highly skilled in developing content for web sites that is both informative and stimulating. However, much of the planning for web-based health information often fails to consider accessibility issues. Our web sites may have the latest, most well-researched information on the health topics of the day, but if a person with a disability cannot access it, to them it is useless. If health care organizations and community agencies plan for their web presence by planning only for the mainstream population, then we ourselves are guilty of advancing the very disparities we claim to be eliminating.

Accessibility is no accident, but requires a great deal of forethought and planning to eliminate the barriers that may be invisible to us, but are nonetheless real for a growing number of the population. Failure to provide accessible services is not only contrary to the ethics of health education as a profession, but is a violation of federal law—leaving health educators and their employers vulnerable to litigation. Health educators have been trained to be sensitive to the unique needs of people with disabilities, but sensitivity is not enough. Application of skills in planning and delivering accessible health education services is often lacking. Thus, we may alienate those whom we wish to serve out of our own ignorance.

Background

Computer technology and the Internet have a tremendous potential to broaden the lives and increase the independence of people with disabilities. Shut-ins can now log in and order groceries, shop for appliances, research health questions, participate in online discussions, catch up with friends, or make new ones. Blind people, who used to wait months or years for the information they needed to be made available in Braille or on audiotape, can now access the very same news stories, magazine articles, government reports, and information on consumer products at the very same time it

becomes available to the sighted population. People who have difficulty holding a pen or using a keyboard can use the latest speech recognition software to write letters, pay their bills, or perform work-related tasks (Kaye, 2000).

Web accessibility is often thought of in terms of enabling people who are disabled to access web sites just as easily as anyone else. However, the accessibility issue is much larger, as many people who do not fall under the legal definitions of "disability" also experience difficulty using certain web sites. The issue of web site accessibility affects people who may have difficulty reading or comprehending text; are unable to use a keyboard or mouse; have a text-only screen, a small screen, or a slow Internet connection; have language issues; or may be in a situation where their eyes, ears, or hands are busy or interfered with (e.g., driving to work, working in a loud environment, etc.); or may face limitations with their browser, or operating system (Chadwick, 2001).

Causes and Prevalence of Disability
The issue of access is not a concern of a small minority, as disability rates are on the rise. The findings of a 1992 National Health Interview Survey (NHIS) found prevalence rates of disability far surpassing expectations:

- Of the total U.S. non-institutionalized population in 1992, 15.0%, or 37.7 million people, report some activity limitation due to chronic health conditions: 1.6 conditions per person, on average, for a total of 61 million limiting conditions.

- Nineteen million people of working age (18-69) report some degree of limitation in working at a job or business, due to chronic health conditions. This group includes 6.6% of the working-age population (10 million people), who report being unable to work at all. An additional 3.9 % of working-age persons are limited in activities other than working at a job or business.

- Four percent, or about 9.2 million people over the age of 5, report some need for help in IADL (Instrumental Activities of Daily

Living: household chores, doing necessary business, shopping, or getting around for other reasons) or ADL (Activities of Daily Living: bathing, eating, dressing, getting around inside). Of people aged 18 and over, 3.2% need assistance in IADL only and 1.7 % need assistance in ADL. Of people with IADL assistance needs only, 48% are under age 65. Of people who need assistance in ADL, 42% are under age 65. Of the 1.5 million people of working ages who need assistance in ADL, 12.4 % state that they are able to work in some capacity (LaPlante & Carlson, 1996). Appendix A summarizes the prevalence rates and causes of specific disabilities.

The numbers of people with disabilities is fast increasing. In 1992, 37.7 million people, or 15.0% of the population, had some degree of limitation due to a disability (LaPlante & Carlson, 1996). In 1998, there were an estimated 48.9 million disabled people --19.4% of non-institutionalized civilians in the US (Waddell & Thomason, 1998). In 2001, that number has risen to 54 million Americans living with disabilities, representing 20% of the overall population. Almost half of these individuals have a severe disability, affecting their ability to see, hear, walk, or perform other basic functions of life. (New Freedom Initiative, 2001). One out of 5 non-institutionalized Americans has a disability (Waddell & Thomason, 1998). Appendix B summarizes prevalence rates of specific disabilities by age and gender in the non-institutionalized US population.

Disparities in Computer Access
Although the Americans with Disabilities Act (ADA) was passed eleven years ago, making it a violation of federal law to discriminate against a person with a disability, many buildings, and services remain inaccessible-- web sites among them.

Computer technology and the use of the Internet have enormous potential to broaden the lives and decrease the dependency of people with disabilities. Roughly half of people with disabilities say the Internet has significantly improved their quality of life, compared to 27 %

of the non-disabled population (New Freedom Initiative, 2001).

Roughly 168 million people in the US have web access, according to recent estimates; yet the computer and Internet revolution has not reached as many people with disabilities. Only 25% of people with disabilities own a computer, as opposed to 66% of U.S. adults. In addition, only 20% of disabled people have access to the Internet, compared to over 40% of U.S. adults.

A primary barrier to wider access is cost. Computers with adaptive technology can cost as much as $20,000, which is prohibitively expensive for many individuals (New Freedom Initiative, 2001). Half (50.3 %) of the disabled population has a total household income of less than $20,000 per year. For this group, the cost of purchasing a computer and paying the monthly fees of an Internet service provider may seem frivolous, compared to basic necessities of life.

Employment can make it financially feasible to buy a computer, and often computers and Internet access are provided in employment settings, along with training in how to use them. People with and without disabilities who are employed are significantly more likely to have computers and use the Internet if they than if they are not. Among employed people with disabilities, 42.6% have computers and 26.4% use the Internet, compared to 56.9 and 44.0 % of their non-disabled counterparts. Only three-tenths (28.9 %) of unemployed people with disabilities have computers, and only about one-tenth (10.8%) use the Internet (Kaye, 2000). Appendix C summarizes rates of computer ownership and Internet use by disability status, gender, employment status, educational attainment, and family income, ages 15 and over.

There has been much talk of late with regard to the Digital Divide: the web equivalent of the historic separation between the "haves and the "have-nots." Huge racial and ethnic gaps in access to electronic technologies in the U.S. have been documented; however, gaps in computer and Internet use based on disability

status are just as large as those based on race and ethnicity.

Only 15.1% of those with disabilities use the Internet, compared to 42.3% of people without a disability. The rate of computer ownership is more than half (55.6 %) of the non-disabled population, while only one-third (32.6 %) of persons with disabilities have computers in their homes. Moreover, only about half of those computer-owners with disabilities can access the Internet---15.8 % of the disabled population, compared to 33.9 % of the non-disabled. The ratio of Internet use is nearly 3 to 1 (Kaye, 2000).

Reasons for Internet Use for People with Disabilities
There are 2.1 million Internet users, and 1.4 million of whom are people with disabilities. People with disabilities use the Internet most often for e-mail (67.1%) and searching for information (1.3 million, or 62.8 %). These are also the two top-ranked reasons for Internet use among people without disabilities (Kaye, 2000).

Internet users with disabilities read the news online (39.0 %), check the weather forecast, or obtain sports scores; take courses over the web or use online resources to help with schoolwork (29.3 %); for shopping or paying bills (17.0 %); and 15.9 % use it to look for employment opportunities. One-quarter (26.2 %) of Internet users with disabilities use the web for job-related tasks, a significantly lower figure than the 43.1 % of non-disabled Internet, who are also more likely to have jobs (Kaye, 2000).

Why Is Web Site Accessibility Necessary?
Web site accessibility is more than simply an attempt at political correctness. Web sites that are inaccessible are in violation of the law. The Americans with Disabilities Act (ADA) of 1990 was not only designed to prohibit discrimination against people with disabilities, but also to mandate accessibility to all public services. According to a 1996 opinion letter from the Department of Justice, web sites are included under the ADA and must be accessible. Any firm with 15 or more employees must comply with the Act, according to the federal law (which

also applies to all states, although some states have since passed more stringent laws to protect people with disabilities). A disabled person who needs to access the firm's intranet or internet as an essential function of their job is entitled to request a reasonable accommodation at their place of employment. Also, any company receiving federal funds or considered a "public accommodation" under Title III is legally required to address issues of accessibility (Waddell &, Thomason, 1998).

Usability and Accessibility
When the accessibility issue is applied to web sites, it is often confused with usability. Usability and accessibility are similar, but not the same. Even if the technology is "accessible," there may still be serious usability problems that make it equally difficult for any person, disabled or non-disabled, to use it.

Usability refers to how intuitive and easy it is for all people to use. Consistent and simple- to-learn sites utilize usable designs. Usability and accessibility often go hand-in-hand.

Accessibility, however, refers to how barrier-free is the technology. Accessibility problems make it more difficult for persons with disabilities to use an application, web site or service than for a non-disabled person (Chadwick, 2001).

How People with Disabilities Use the Web
People with disabilities use various technologies to access the web. A brief discussion of each of the following disabilities will be covered: visual disabilities, deafness, motor disabilities, speech disabilities, attention deficit disorder, learning disabilities, impairments in intelligence, emotional or seizure disorders, and psychiatric disabilities.

Many blind individuals rely on screen readers -- software that read text on the screen (monitor) and outputs this information to a speech synthesizer and/or refreshable Braille display. Some people who are blind use text-based browsers such as Lynx, or voice browsers, instead of a graphical user interface browser plus screen reader. Some people with low vision

(poor acuity, tunnel vision, central field loss, clouded vision) use extra-large monitors, and increase the size of system fonts and images. Others use screen magnifiers or screen enhancement software. Those with color blindness (difficulty distinguishing between certain colors –red/green color blindness is the most common) use their own style sheets to override the font and background color choices of the author.

People who are Deaf or are hard of hearing rely on captions for audio content. They may need to toggle the captions on an audio file on or off as they browse a page.

People with motor disabilities affecting the hands or arms (such as involuntary movements, lack of coordination, or paralysis, carpal tunnel or joint problems, or missing limbs) may use a specialized mouse; a keyboard with a layout of keys that matches their range of hand motion; a pointing device such as a head-mouse, head-pointer or mouth-stick; voice-recognition software; an eye-gaze system; or other assistive technologies to access and interact with the information on web sites. They may activate commands by typing single keystrokes in sequence with a head pointer rather than typing simultaneous keystrokes ("chording") to activate commands. They may need more time when filling out interactive forms on web sites if they have to concentrate or maneuver carefully to select each keystroke.

People with speech disabilities use parts of the web that rely on voice recognition. Speech disabilities can include difficulty producing speech that is recognizable by some voice recognition software, either in terms of loudness or clarity. Someone with a speech disability needs to be able to use an alternate input mode, such as text entered via a keyboard.

People with attention deficit disorder (difficulty focusing on information) may need to turn off animations on a site in order to be able to focus on the site's content.

People with learning disabilities (difficulty processing written language or images when read visually, or spoken language when heard, or

numbers when read visually or heard) may rely on getting information through several modalities at the same time. For instance, someone who has difficulty reading may use a screen reader plus synthesized speech to facilitate comprehension, while someone with an auditory processing disability may use captions to help understand an audio track.

People with impairments of intelligence (mental retardation, developmental delays) may learn more slowly, or have difficulty understanding complex concepts. Individuals with memory impairments may have problems with short-term memory, missing long-term memory, or some loss of language. To use the Web, people with impairments of intelligence may take more time on a Web site, may rely on a consistent navigational structure throughout the site, may rely more on graphics to enhance understanding of a site, and may benefit from the level of language on a site not being unnecessarily complex for the site's intended purpose.

People with mental or emotional disabilities or seizure disorders may have difficulty focusing on information on a web site, or difficulty with blurred vision or hand tremors due to side effects from medications.

People with psychiatric disabilities may need to turn off distracting visual or audio elements, animations, blinking text, or certain frequencies of audio, or to use screen magnifiers (Brewer, 2000).

Barriers to Accessibility
Barriers on the web are much more than mere frustrations: in some instances, sites are impossible to access for specific disabilities, whereas some are more difficult, but still can be viewed to some degree. For example, a blind user may be using a screen reader that handles text well, but data tables that cannot be tabbed

through become barriers. A similar barrier might be experienced by a Deaf person visiting a web site with streaming audio without a text version. Fast-blinking buttons and animations can trigger seizures in web users with epilepsy, in which case they are more than an inconvenience, but pose a danger.

However, much can be done to make web sites accessible that does not require a tremendous investment of resources (New Freedom Initiative, 2001). One simple example: 1 out of every 12 men are color blind; red/green color blindness is the most common form. The use of these colors used on a web site may affect their ability to read it, particularly if these colors are applied to text. By using greater contrast or eliminating the use of these colors entirely, this barrier can be easily overcome (Chadwick, 2001).

Guidelines to Improve Web Site Accessibility
Brummel (1994), cautioned that web site design should not be geared only to the needs of mainstream web users: "Universal Design calls for the development of information systems flexible enough to accommodate the needs of the broadest range of users of computers and telecommunications equipment, regardless of age or disability" (Waddell, 1998).

Federal Guidelines for Web Site Accessibility
The Federal government has designed guidelines specific to the issue of web site accessibility under Section 508 of the Rehabilitation Act Amendments of 1998. These guidelines are largely derived from the W3C guidelines (to be discussed in a following section), however, there are five additional rules in Section 508 that differ from the Web Accessibility Guidelines 1.0; web sites that are covered under Section 508 must meet the additional five standards. Figure 1 summarizes the 16 federal rules for accessible web pages.

Federal Rules for Accessible Web Pages (Section 508)

1. Provide text alternatives to non-text elements.
2. Synchronize multimedia equivalents.
3. Make meaning independent of color.
4. Make pages style-sheet independent.
5. Include redundant text links for server-side image maps.
6. Use client-side image maps when possible.
7. Put row and column headers in data tables.
8. Associate all data cells with header cells.
9. Title all frames.
10. Avoid screen flicker at harmful frequencies.
11. Provide and update equivalents for dynamic content.
12. Make the site script independent.
13. Provide links to plug-ins or other required applications that can be used by assistive technology devices.
14. Make electronic forms accessible via assistive technology.
15. Provide an option to skip repetitive links.
16. Give users sufficient time to complete tasks.

Figure 1
Federal Rules for Accessible Web Pages (Section 508)

Web Accessibility Initiative Guidelines 1.0
The World Wide Web Consortium's (W3C) Web Accessibility Initiative (WAI) has developed the Web Content Accessibility Guidelines 1.0 W3C (1999), which has designated checkpoints to determine web site accessibility. Each checkpoint has a priority level assigned by the Working Group based on the checkpoint's impact on accessibility. Appendix D summarizes the WAI Guidelines.

Evaluating Web Sites for Accessibility
After having made the distinction between usability and accessibility, it is useful to note that while there are usability checklists, there are also accessibility checklists, as well: and several versions are available. The W3 Web Content Accessibility Guidelines serves as a checklist of sorts, but it can be a bit daunting for those of us who are not web designers. The Web Accessibility Initiative has developed a good resource on Evaluating Web Sites for Accessibility. Appendix E presents an adapted version of this document. For most health educators, a preliminary review would probably suffice; however, the more in-depth conformance evaluation probably requires the use of a highly skilled consultant, as well as many disabled reviewers, in addition to the web design team itself. An online checklist, the Accessibility Audit from InfoQuest!, is quite user-friendly, and very useful, although it would probably not be sufficient to ensure compliance.

Bobby 3.2
A free web accessibility diagnostic tool, Bobby® (http://www.cast.org/bobby), is available for web page authors to identify necessary design changes so that users with disabilities can more easily use their web pages. Created in 1996 by the Center for Applied Special Technology (CAST), Bobby makes specific recommendations for alteration of web design to make the web site more accessible, using the Web Content Accessibility Guidelines 1.0 as the evaluation standard. Bobby has since been upgraded many times to include improved page authoring guidelines, new features, technical enhancements, ease-of-use improvements, and complete documentation. Table 1 below are links to online resources.

Conclusion

While responsibility for web site content is often within the purview of health educators and health communication specialists, the actual task of web site design is often designated to other staff or consultants with high-tech skills. However, as with all health education material, the approach utilized in the delivery is often as important as the content itself. It is in the overall planning of web site development that health educators can have a crucial influence to advocate for accessibility, as is our ethical (and legal) mandate.

Table 1
Links to Online Resources

Online Resource	Web Address
Accessibility Guidelines & Design Tips	
Web Site Accessibility Initiative	http://www.w3.org/WAI
Quick Tips To Make Accessible Web Sites	http://www.w3.org/WAI/References/QuickTips/
Web Content Accessibility Guidelines 1.0	http://www.w3.org/TR/WAI-WEBCONTENT/
InfoQuest! Information Services	http://www.tbchad.com
Alliance for Technology Access	http://www.ataccess.org/rresources/webaccess.html
Designing More Usable Web sites (has links to some great tools)	http://www.trace.wisc.edu/world/web/index.html
Evaluation Tools and Checklists	
Evaluating Web sites for Accessibility	http://www.w3.org/WAI/eval/Overview.html
Accessibility Audit by InfoQuest! Information Services	http://www.tbchad.com
Bobby 3.2: Web-based tool to analyzes web page accessibility	http://www.cast.org/Bobby/Bobby311.cfm
Policy & Liability Issues	
New Freedom Initiative	http://www.whitehouse.gov/news/freedominitiative/freedominitiative.html
Is Your Site ADA-Compliant ...or a Lawsuit-in-Waiting?	http://www.icdri.org/CynthiaW/Is%20Your%20Site%20ADA-Compliant.htm
Applying the ADA to the Internet: A Web Accessibility Standard	http://www.rit.edu/~easi./law/weblaw1.htm

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Appendix A

Prevalence of specific disabilities follows (Causes are indicated where known):

Disability Category	Prevalence Rate in the US (General Population)
Blindness and low vision	1.3 million
Hearing impairments, including Deafness	1.2 million
Speech impairments	495,000
Impaired or lost sensation	141,000
Learning disability	216,000
Mental retardation	1.4 million
Absence or loss of an upper / lower extremity	358,000

Paralysis (quadriplegia, paraplegia, hemiplegia, cerebral palsy) limits 1.1 million people, usually the result of stroke.

Deformities (Spina bifida, deformities of the hip and/or pelvis, neck, trunk, shoulder, upper extremity, and structural deformities of the back) total 900,000 limiting conditions; a high proportion of cases are congenital.

Orthopedic impairments number 8.6 million activity-limiting conditions, of which about 44 % involve the back or neck. A large proportion are caused by injury. These conditions that involve pain or difficulty, though they do not include paralysis or specified deformities, but result in as limitation in motion, "stiffness", "instability", "weakness", "trouble", "pain", "swelling", etc.

Altogether, 16.3 million impairments are reported to cause activity limitation. *(LaPlante and Carlson, 1996)*

Appendix B

Prevalence of Disability and Activity Limitation, by Age and Gender: United States Civilian Non-Institutionalized Population, All Ages, 1992.											
Adapted from: Mitchell P. LaPlante, Ph.D. and Dawn Carlson, Ph.D. (1996). Disability in the United States; Prevalence and Causes, 1992 (7). Washington DC: U.S. Department of Education, National Institute on Disability and Rehabilitation Research.											

Condition Causing Limitation	All Ages		Under 18		18- 44		45- 69		70- 84		85+	
ALL LISTINGS	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
IMPAIRMENTS	10,922	28.9	1,681	41.5	4,429	41.5	3,393	23	1,130	16.7	290	19.5
Visual impairments	558	1.5	44	1.1	171	1.6	134	0.9	150	2.2	58	3.9
Blindness: both eyes	189	0.5	11*	0.3*	60	0.6	48	0.3	49	0.7	21*	1.4*
Visual impairment: both eyes	169	0.4	22*	0.5*	22	0.2	35	0.2	63	0.9	27	1.8
Blindness: one eye, visual impairment in other eye	33*	0.1	---	---	9*	0.1*	10*	0.1	14*	0.2*		
Blindness/visual impairment in one eye: good vision in other eye (or not known)	167	0.4	11*	0.3*	80	0.8	41	0.3	24	0.4	10*	0.7*
Hearing impairments	654	1.7	125	3.1	181	1.7	167	1.1	127	1.9	55	3.7
Deafness: both ears	127	0.3	12*	0.3*	26	0.2*	46	0.3	35	0.5	8*	0.6*
Hearing impairment: both ears	270	0.7	71	1.7	58	0.5	65	0.4	56	0.8	22*	1.4*
Deafness/hearing impairment-- one ear only	122	0.3	27	0.7	45	0.4	32	0.2	15*	0.2*	2*	0.2*
Deafness, unknown if in both ears	42	0.1	1*	---	29*	0.3*	---	---	6*	0.1*	6*	0.4*
Hearing impairment, unknown if in both ears	93	0.2	14*	0.4*	23*	0.2*	24*	0.2	15*	0.2*	17*	1.1*
Speech impairments	315	0.8	257	6.4	36	0.3	14	0.1	6	0.1	0	0
Stammering and stuttering	38	0.1	29	0.7	6*	0.1	2*	---	---	---	---	---
Other speech impairment	277	0.7	228	5.6	30	0.3	12*	0.1	6*	0.1*		
Loss or impairment of sensation	94	0.2	1*	---	57	0.5	33	0.2*	1*	---	2*	0.1*
Learning disability and mental retardation	1,389	3.7	863	21.3	418	3.9	95	0.6	10	0.1	2	0.1
Learning disability	191	0.5	155	3.8	25*	0.2*	10*	0.1*				
Mental retardation/Down's syndrome	1,198	3.2	708	17.5	393	3.7	85	0.6	10*	0.1*	2*	0.1*

Prevalence of Disability and Activity Limitation, by Age and Gender: United States Civilian Non-Institutionalized Population, All Ages, 1992.

Adapted from: Mitchell P. LaPlante, Ph.D. and Dawn Carlson, Ph.D. (1996). Disability in the United States; Prevalence and Causes, 1992 (7). Washington DC: U.S. Department of Education, National Institute on Disability and Rehabilitation Research.

Condition Causing Limitation	All Ages		Under 18		18- 44		45- 69		70- 84		85+	
ALL LISTINGS	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Absence or loss	477	1.3	13	0.3	103	1	216	1.5	127	1.9	18	1.2
upper extremity	57	0.2	2*	---	22*	0.2	25*	0.2	6*	0.1*	2*	0.1*
lower extremity	169	0.4	---	---	46	0.4	85	0.6	36	0.5	2*	0.1*
lung or kidney	42	0.1	9*	0.2*	7*	0.1	12*	0.1	14*	0.2*		
breast	13*	---	---	---	2*	---	7*	---	4*	0.1*	---	---
rib, bone, joint, or muscle of trunk (one or more)	196	0.5	2*	---	26*	0.2*	87	0.6	67	1	14*	0.9*
Paralysis	546	1.4	104	2.6	212	2	150	1	68	1	12	0.8
Quadriplegia (paralysis of entire body or four limbs)	42	0.1	1*	---	36	0.3	5*	---	---	---	1*	0.1*
Hemiplegia (paralysis of one side of body, including limbs)	36	0.1	1*	---	4*	---	21*	0.1*	7*	0.1*	3*	0.2*
Paralysis of upper extremities	18*	---	---	---	7*	0.1	5*	---	3*	---	2*	0.1*
Paraplegia (paralysis of both legs)	47	0.1	---	---	20*	0.2	21*	0.1*	6*	0.1*		
Cerebral palsy	181*	0.5	85*	2.1	79*	0.7	13*	0.1*	4*	0.1*		
Hemiparesis (partial paralysis of one side of body, including limbs)	61	0.2	2*	---	25*	0.2*	22*	0.2	12*	0.2*	---	---
Partial paralysis of upper extremity	30*	0.1	---	---	2*	---	15*	0.1*	10*	0.2*	2*	0.1*
Paraparesis (partial paralysis of both legs)	21	0.1	---	---	4*	---	9*	0.1	6*	0.1*	2*	0.1*
Other partial paralysis of lower extremity	22*	0.1	---	---	9*	0.1*	8*	0.1	5*	0.1*		
Paralysis of other sites, complete or partial	88	0.2	15*	0.4*	26*	0.2*	31	0.2	15*	0.2*	2*	0.1*
Deformities	628	1.7	112	2.8	315	2.9	158	1.1	38	0.6	6	0.4
Curvature of spine or back	312	0.8	36	0.9	174	1.6	78	0.5	18*	0.3	6*	0.4*
Spina bifida	52	0.1	17	0.4	27*	0.3	6*	---	2*	---	---	---
Congenital dislocation/deformity of hip and/or pelvis	33	0.1	10	0.2	17	0.2	4	---	2	---	---	---
lower extremity	160	0.4	42	1	61	0.6	43	0.3	14	0.2		
neck, trunk bones or shoulder or upper extremity	71	0.2	7*	0.2*	36	0.3	27*	0.2	2*	---	---	---

Prevalence of Disability and Activity Limitation, by Age and Gender: **United States Civilian Non-Institutionalized Population, All Ages, 1992.**												
Adapted from: Mitchell P. LaPlante, Ph.D. and Dawn Carlson, Ph.D. (1996). Disability in the United States; Prevalence and Causes, 1992 (7). Washington DC: U.S. Department of Education, National Institute on Disability and Rehabilitation Research.												
Condition Causing Limitation	**All Ages**		**Under 18**		**18- 44**		**45- 69**		**70- 84**		**85+**	
ALL LISTINGS	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Orthopedic impairments	6,111	16.2	115	2.8	2,876	26.9	2,399	16.3	588	8.7	135	9.1
back or neck	2,946	7.8	11*	0.3*	1,461	13.7	1,280	8.7	176	2.6	18*	1.2*
shoulder and/or upper extremity	775	2.1	9*	0.2*	409	3.8	301	2	53	0.8	4*	0.3*
hip and/or pelvis	332	0.9	5*	0.1*	79	0.7	99	0.7	101	1.5	48	3.2
lower extremity	1,920	5.1	84	2.1	871	8.2	675	4.6	239	3.5	51	3.5
other and ill-defined sites	138	0.4	6*	0.2*	56	0.5	44	0.3	19*	0.3	14*	0.9*
Other impairments	150	0.4	47	1.2	60	0.6	27	0.2	15*	0.2*	2*	0.1*
* Estimate has low statistical reliability (relative standard error > 30%). **--** **- No respondents in category**												

Appendix C
Prevalence of Disability and Activity Limitation, by Age and Gender: United States Civilian Non-Institutionalized Population, All Ages, 1992. Adapted from: LaPlante, M. P. & Carlson, D. (1996). Disability in the United States; Prevalence and Causes, 1992 (7). Washington DC: U.S. Department of Education, National Institute on Disability and Rehabilitation Research.

Condition Causing Limitation	All Ages		Under 18		18- 44		45- 69		70- 84		85+	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
IMPAIRMENTS	10,922	28.9	1,681	41.5	4,429	41.5	3,393	23	1,130	16.7	290	19.5
Visual impairments	558	1.5	44	1.1	171	1.6	134	0.9	150	2.2	58	3.9
Blindness: both eyes	189	0.5	11*	0.3*	60	0.6	48	0.3	49	0.7	21*	1.4*
Visual impairment: both eyes	169	0.4	22*	0.5*	22	0.2	35	0.2	63	0.9	27	1.8
Blindness: one eye, visual impairment in other eye	33*	0.1	---	---	9*	0.1*	10*	0.1	14*	0.2*		
Blindness/visual impairment in one eye: good vision in other eye (or not known)	167	0.4	11*	0.3*	80	0.8	41	0.3	24	0.4	10*	0.7*
Hearing impairments	654	1.7	125	3.1	181	1.7	167	1.1	127	1.9	55	3.7
Deafness: both ears	127	0.3	12*	0.3*	26	0.2*	46	0.3	35	0.5	8*	0.6*
Hearing impairment: both ears	270	0.7	71	1.7	58	0.5	65	0.4	56	0.8	22*	1.4*
Deafness/hearing impairment-- one ear only	122	0.3	27	0.7	45	0.4	32	0.2	15*	0.2*	2*	0.2*
Deafness, unknown if in both ears	42	0.1	1*	---	29*	0.3*	---	---	6*	0.1*	6*	0.4*
Hearing impairment, unknown if in both ears	93	0.2	14*	0.4*	23*	0.2*	24*	0.2	15*	0.2*	17*	1.1*
Speech impairments	315	0.8	257	6.4	36	0.3	14	0.1	6	0.1	0	0
Stammering and stuttering	38	0.1	29	0.7	6*	0.1	2*	---	---	---	---	---
Other speech impairment	277	0.7	228	5.6	30	0.3	12*	0.1	6*	0.1*		
Loss or impairment of sensation	94	0.2	1*	---	57	0.5	33	0.2*	1*	---	2*	0.1*
Learning disability and mental retardation	1,389	3.7	863	21.3	418	3.9	95	0.6	10	0.1	2	0.1
Learning disability	191	0.5	155	3.8	25*	0.2*	10*	0.1*				
Mental retardation/Down's syndrome	1,198	3.2	708	17.5	393	3.7	85	0.6	10*	0.1*	2*	0.1*
Absence or loss	477	1.3	13	0.3	103	1	216	1.5	127	1.9	18	1.2
upper extremity	57	0.2	2*	---	22*	0.2	25*	0.2	6*	0.1*	2*	0.1*
lower extremity	169	0.4	---	---	46	0.4	85	0.6	36	0.5	2*	0.1*
lung or kidney	42	0.1	9*	0.2*	7*	0.1	12*	0.1	14*	0.2*		
breast	13*	---	---	---	2*	---	7*	---	4*	0.1*	---	---
rib, bone, joint, or muscle of trunk (one or more)	196	0.5	2*	---	26*	0.2*	87	0.6	67	1	14*	0.9*
Paralysis	546	1.4	104	2.6	212	2	150	1	68	1	12	0.8

Condition Causing Limitation	All Ages		Under 18		18- 44		45- 69		70- 84		85+	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Quadriplegia (paralysis of entire body or four limbs)	42	0.1	1*	---	36	0.3	5*	---	---	---	1*	0.1*
Hemiplegia (paralysis of one side of body, including limbs)	36	0.1	1*	---	4*	---	21*	0.1*	7*	0.1*	3*	0.2*
Paralysis of upper extremities	18*	---	---	---	7*	0.1	5*	---	3*	---	2*	0.1*
Paraplegia (paralysis of both legs)	47	0.1	---	---	20*	0.2	21*	0.1*	6*	0.1*		
Cerebral palsy	181*	0.5	85*	2.1	79*	0.7	13*	0.1*	4*	0.1*		
Hemiparesis (partial paralysis of one side of body, including limbs)	61	0.2	2*	---	25*	0.2*	22*	0.2	12*	0.2*	---	---
Partial paralysis of upper extremity	30*	0.1	---	---	2*	---	15*	0.1*	10*	0.2*	2*	0.1*
Paraparesis (partial paralysis of both legs)	21	0.1	---	---	4*	---	9*	0.1	6*	0.1*	2*	0.1*
Other partial paralysis of lower extremity	22*	0.1	---	---	9*	0.1*	8*	0.1	5*	0.1*		
Paralysis of other sites, complete or partial	88	0.2	15*	0.4*	26*	0.2*	31	0.2	15*	0.2*	2*	0.1*
Deformities	628	1.7	112	2.8	315	2.9	158	1.1	38	0.6	6	0.4
Curvature of spine or back	312	0.8	36	0.9	174	1.6	78	0.5	18*	0.3	6*	0.4*
Spina bifida	52	0.1	17	0.4	27*	0.3	6*	---	2*	---	---	---
Congenital dislocation/deformity of hip and/or pelvis	33	0.1	10	0.2	17	0.2	4	---	2	---	---	---
lower extremity	160	0.4	42	1	61	0.6	43	0.3	14	0.2		
neck, trunk bones or shoulder or upper extremity	71	0.2	7*	0.2*	36	0.3	27*	0.2	2*	---	---	---
Orthopedic impairments	6,111	16.2	115	2.8	2,876	26.9	2,399	16.3	588	8.7	135	9.1
back or neck	2,946	7.8	11*	0.3*	1,461	13.7	1,280	8.7	176	2.6	18*	1.2*
shoulder and/or upper extremity	775	2.1	9*	0.2*	409	3.8	301	2	53	0.8	4*	0.3*
hip and/or pelvis	332	0.9	5*	0.1*	79	0.7	99	0.7	101	1.5	48	3.2
lower extremity	1,920	5.1	84	2.1	871	8.2	675	4.6	239	3.5	51	3.5
other and ill-defined sites	138	0.4	6*	0.2*	56	0.5	44	0.3	19*	0.3	14*	0.9*
Other impairments	150	0.4	47	1.2	60	0.6	27	0.2	15*	0.2*	2*	0.1*

Appendix D

Web Content Accessibility Guidelines 1.0 W3C (1999)

Priority 1--A Web content developer **must** satisfy this checkpoint. Otherwise, one or more groups will find it impossible to access information in the document. Satisfying this checkpoint is a basic requirement for some groups to be able to use Web documents. *Examples of items in this checkpoint include: applets, animations, images, graphical representations, frames, scripts, audio and video, etc..*

Priority 2--A Web content developer **should** satisfy this checkpoint. Otherwise, one or more groups will find it difficult to access information in the document. Satisfying this checkpoint will remove significant barriers to accessing Web documents. *Examples of items in this checkpoint include: color combinations, markup language, style sheets, headers, alternative presentations, allowing user controls, etc.*

Priority 3--A Web content developer **may** address this checkpoint. Otherwise, one or more groups will find it somewhat difficult to access information in the document. Satisfying this checkpoint will improve access to Web documents. *Examples of items in this checkpoint include: tab access through links and forms, keyboard shortcuts, navigation bars, consistency across pages, etc.*

Some checkpoints specify a priority level that may change under certain (indicated) conditions.

There are three levels of conformance to the Web Content Accessibility Guidelines 1.0:

- **Conformance Level "A"** -- all Priority 1 checkpoints are satisfied;
- **Conformance Level "Double-A"** -- all Priority 1 and 2 checkpoints are satisfied;
- **Conformance Level "Triple-A"** -- all Priority 1, 2, and 3 checkpoints are satisfied. This is the highest level of conformance possible, indicating that all barriers to web site accessibility have been adequately addressed.

Appendix E

Evaluating Web Sites for Accessibility

Adapted from Web Accessibility Initiative: *http://www.w3.org/WAI/eval/Overview.html*

Introduction
This review of Web site accessibility conforms to the Web Content Accessibility Guidelines 1.0 (http://www.w3.org/TR/WAI-WEBCONTENT/). Evaluation should take place both during development of web sites, and also in monitoring of established web sites.

There are a variety of tools and approaches for evaluating Web site accessibility. No single evaluation tool yet provides comprehensive information or captures all problems with regard to the accessibility of a site; therefore evaluation should involve a combination of approaches.

There are two types of review: Preliminary and Conformance evaluation. Preliminary review can identify general kinds of barriers on a web site. Conformance evaluation can: 1) catch major problems during development phase of a new site, and 2) determine the WCAG 1.0 conformance level for an existing Web site; and demonstrate its conformance.

Preliminary Review
A preliminary review may help to quickly identify the scope of problems on a Web site, but will not catch all of the problems on a site and should not be used to determine conformance level. A preliminary review does not include perspectives from a variety of users with disabilities nor does it touch or test every aspect of a site.

A preliminary review simply checks some representative pages of a Web site, using several semi-automatic accessibility checkers. Reviewers do not need to know web mark-up languages, but should be able to download software and familiarize themselves with some online tools, and change certain settings on their browser.

To conduct a preliminary review, complete ALL five steps below.

1. Select a representative sampling of different kinds of pages from the web site to be reviewed; must include entry page(s) ("welcome page" etc.)
2. Use a graphical user interface (GUI) browser (such as Internet Explorer, Netscape Navigator, or Opera) and examine the selection of pages while adjusting the browser settings as follows (NOTE: For reviewers who have disabilities, certain of the following steps may need to be done with another person who does not have the same disability.)
    A. turn off images, and make sure that the information is presented in an appropriate sequence relative to the visual presentation on the GUI site.
    B. turn off the sound, and make sure audio content is still available through text equivalents.
    C. change the font size (larger and smaller) in the browser, and observe whether the page is still readable.
    D. set screen resolution to 640 x 480 and observe whether or not this forces the page into horizontal scrolling
    E. change the display color to black and white (or print out page on black and white printer) and observe whether color contrast is adequate.
    F. put away the mouse and tab through the links and form controls on a page, making sure that you can access all links and form controls, and that the links clearly indicate what they lead to.

3.   Use a voice browser such as Home Page Reader (http://www-3.ibm.com/able/hpr.html) or a text browser such as Lynx (http://lynx.browser.org/) and examine the Web site while answering these questions (NOTE: experienced users of screen readers may substitute a screen reader for a voice or text browser, but if blind, may need a sighted partner to compare information available visually; if sighted, listen to it with eyes closed, then open eyes and confirm whether the information is equivalent)
    A.   is equivalent information available through the voice or text browser as is available through the GUI browser?
    B.   is the information presented in a similar logical order as when viewed through the GUI browser?

4.   Use two accessibility evaluation tools and note any problems indicated by the tools, for example:
- Bobby (http://www.cast.org/bobby), an online or downloadable accessibility checker which provides a semi-automated assessment of accessibility problems on a Web page or group of Web pages; it can identify many problems on sites, and lists problems which it is not able to evaluate automatically and which require manual review.
- A-Prompt (http://aprompt.snow.utoronto.ca), a tool which identifies potential accessibility problems and provides guided editing to correct the problems.

5.   Summarize results
    A.   summarize the types of problems encountered, as well as best practices that should be continued or expanded on the site
    B.   indicate the method by which problems were identified, and clearly state that this was not a full conformance evaluation
    C.   recommend follow-up steps, including full conformance evaluation which includes validation of markup and other tests, and ways to address any problems identified.

Conformance Evaluation to WCAG 1.0
A comprehensive evaluation combines semi-automatic, manual, and usability testing. Comprehensive evaluations require familiarity with Web mark-up languages; initial downloading and/or training on a variety of evaluation tools and approaches; configuration of browser settings; and coordination with reviewers with a variety of disabilities. Evaluation with users is important as it helps to identify problems in how the technical solutions are being applied.

A properly conducted comprehensive evaluation can identify potentially major problems during the development phase for a new site; determine what level of accessibility a Web site meets; and/or provide assurance that a Web site meets a required level of accessibility.