For All the World to Share:
Developing and Implementing Accessible Websites

Patricia Tuohy, National Library of Medicine, USA

Helen Garton, National Library of Medicine, USA

Julie Beeler, Second Story, USA

John Slatin, University of Texas at Austin, USA

Abstract

www.nlm.nih.gov/changingthefaceofmedicine

Using the National Library of Medicine's recent online exhibition *Changing the Face of Medicine: Celebrating America's Women Physicians* as a study, this paper will discuss issues of design, accessibility, and government responsibility.

The early pioneers of the internet created an open environment where users and developers freely shared ideas. This open and non-exclusive philosophy guided many of the successful innovations of the World Wide Web. The federal government has continued this egalitarian philosophy and, in 1998, the U.S. Congress amended the Rehabilitation Act to require federal agencies to make their electronic and information technology accessible to people with disabilities. Section 508 was then enacted to eliminate barriers in information technology, to make available new opportunities for people with disabilities, and to encourage development of technologies that will help achieve these goals. But what does that mean to users of the internet? To government agencies? To the creative community?

Introduction

In 2000, the National Library of Medicine at the National Institutes of Health in Bethesda, Maryland, committed to developing an exhibition about the history of America's women physicians. Through the use of biography, *Changing the Face of Medicine: Celebrating America's Women Physicians* illustrates the larger themes in the history of women in medicine. The Library's Exhibition Program worked with a twenty-five-member advisory group, comprised of representatives from the medical and history communities to nominate over 300 notable and accomplished women for inclusion in the exhibition.

The women's stories are exciting, moving, compelling, inspiring. There are stories about many different kinds of women practicing medicine in many different ways for different patients. The project team strove for diversity in all areas—wanting everyone to be able to find someone in the show with whom they could identify—and to be able to find that person in the Digital Portrait Gallery of physicians.

This commitment to diversity and access to the exhibition's content extended into the creative process. Working with Second Story—technically proficient, intellectually capable, conceptually innovative—working closely with the Library's information technology office—created a visually compelling website that provides an equivalent experience for all visitors.

Section 508 Background

Helen Garton prepared the background notes for Section 508 and outlined the National Library of Medicine's responsibility.

In 1998, Congress amended the 1973 Rehabilitation Act to require federal agencies to make their electronic and information technology (EIT) accessible to people with disabilities. Section 508 of the Rehabilitation Act was enacted to eliminate barriers in information technology because inaccessible technology can interfere with an individual's ability to obtain and use information quickly and easily.

Section 508 is vital, since according to the United States 2000 Census, there are approximately 50 million people with some type of disability. This number is expected to grow dramatically as the population ages. The 2000 Census further estimates there are 48.4 million people living in the United States who are 55 years of age or older, with this figure projected to skyrocket to over 100 million by 2025.

As this population ages, there will be a heavier reliance upon electronic and information technology to support information dissemination. The 1998 amendments to Section 508 directed the Architectural and Transportation Barriers Compliance Board (Access Board) to develop and publish standards and the technical criteria necessary for achieving accessibility to electronic and information technology by individuals with disabilities. The criteria for web-based technology and information are based on access guidelines developed by the Web Accessibility Initiative of the World Wide Web Consortium (W3C). Many of these provisions ensure access for people with vision impairments who rely on various assistive products to access web-based information, such as screen readers, which translate what's on a computer screen into automated audible output.

For those unfamiliar with accessibility issues pertaining to Web page design, the need for Section 508 compliance is clear – we must understand that many users may be operating in contexts very different from our own:

- Users may not be able to see, hear, move, or may not be able to process some types of information easily or at all.
- Users may have difficulty reading or comprehending text.
- Users may not have or be able to use a keyboard or mouse.
- Users may have a text-only screen, a small screen, or a slow Internet connection.
- Users may not speak or understand fluently the language in which the document is written.
- Users may have an early version of a browser, a different browser entirely, a voice browser, or a different operating system.

To accommodate users' different needs, as stated above, the National Library of Medicine is required to comply with Subpart B – Technical Standards, Section 1194.22 Web-based Intranet and Internet information and applications of the Section 508 final standards. In order to provide accessible design solutions for problems users with certain disabilities may encounter, the following are the 16 Access Board guidelines that must be followed by the National Library of Medicine's webmasters:

1. A text equivalent for every non-text element shall be provided (e.g., via "alt", "longdesc", or in element content).
2. Equivalent alternatives for any multimedia presentation shall be synchronized with the presentation.

3. Web pages shall be designed so that all information conveyed with color is also available without color, for example from context or markup.

4. Documents shall be organized so they are readable without requiring an associated style sheet.

5. Redundant text links shall be provided for each active region of a server-side image map.

6. Client-side image maps shall be provided instead of server-side image maps except where the regions cannot be defined with an available geometric shape.

7. Row and column headers shall be identified for data tables.

8. Markup shall be used to associate data cells and header cells for data tables that have two or more logical levels of row or column headers.

9. Frames shall be titled with text that facilitates frame identification and navigation.

10. Pages shall be designed to avoid causing the screen to flicker with a frequency greater than 2 Hz and lower than 55 Hz.

11. A text-only page, with equivalent information or functionality, shall be provided to make a web site comply with the provisions of this part, when compliance cannot be accomplished in any other way. The content of the text-only page shall be updated whenever the primary page changes.

12. When pages utilize scripting languages to display content, or to create interface elements, the information provided by the script shall be identified with functional text that can be read by assistive technology.

13. When a web page requires that an applet, plug-in or other application be present on the client system to interpret page content, the page must provide a link to a plug-in or applet that complies with §1194.21(a) through (l).

14. When electronic forms are designed to be completed on-line, the form shall allow people using assistive technology to access the information, field elements, and functionality required for completion and submission of the form, including all directions and cues.

15. A method shall be provided that permits users to skip repetitive navigation links.

16. When a timed response is required, the user shall be alerted and given sufficient time to indicate more time is required.

The intent of Section 508 is to ensure that federal employees and members of the public with disabilities have access to and use of electronic and information technology comparable to that of the employees and members of the public without disabilities. Since the National Library of Medicine is a federal agency that provides information to the public and to their employee's through their Websites, the Library must ensure that these sites are accessible to all people, including people with disabilities. That is why the National Library of Medicine is committed to the spirit of the Section 508 Law.

Dynamic design solutions

Julie Beeler prepared the following description of the design solutions for *Changing the Face of Medicine.*

Over the years, the Web community has defined 'standards' for creative developers to use in order to publish materials online. These standards serve as guidelines for developing accessible Websites and their content to people with disabilities; however, they are often left to 'subjective interpretation' as to how well the standards have been implemented and meet the checkpoints of the three priorities: Must, Should and May satisfy the requirements of Section 508. In developing the *Changing the Face of Medicine* exhibition Website for the National Library of Medicine the designers and programmers overcame a variety of challenges in order to realize the two main project goals:

1. Incorporate media-rich interactive experiences; including the creation of four Flash based games, over 40 documentary videos and five artifact interactives.

2. Create a Website that is compliant with Section 508 requirements.

Developing a Website that meets the requirements of Section 508 that also offers a variety of media-rich interactive experiences is a tremendous challenge because there is often a series of compromises or trade-offs that need to occur in order to meet both of these goals. There are two main reasons for creating Websites and they are to provide access to information as well as create an interactive experience. If all the developer needed to do was to just provide access to information, the creation of a Website that is compliant with Section 508 requirements would be much easier to implement. In this scenario, developers are often creating page based content that is comprised of a series of templates and text based information that uses HTML, XML and CSS programming languages to create a series of Web pages that function as a 'publishing tool' *(fig. 1).* The challenge arises when you try to take this content and put it in context of a time

based, dynamic interactive experience. Creating an immersive, engaging, cinematic experience through Web publishing is very challenging because it takes advantage of media rich graphics, audio, video, animation and in essence layers information together over a period of time *(fig. 2).*

In order to reach the largest audience possible the Website needs to employ an overall information architecture that makes the content understandable and navigable. The interface design needs to accommodate a high degree of flexibility so that users with assistive products can customize the viewing of the content specific to their needs. This is our challenge: to design a controlled graphic rich, visual interface with the flexibility of an ever changing environment that can adapt to any tools and technology being used by the end user to view the Website. There are a variety of programming languages and checklists in place to help aid developers in creating accessible Websites that ensure graceful transformation so that content remains accessible and visual graphics and layout retain a level of graceful integration across all pages, browsers and platforms.

- Integration of graphic images and alt 'identification' tags for all artwork
- Use of color that allows for the highest contrast and visibility
- Use of flexible fonts that can be adjusted to a variety of sizes
- Creating external style sheets that let users define their own styles according to their unique needs
- Providing keyboard commands for navigating the Website and making meta navigation language clear and understandable, along with the use of headers and footers at the top and bottom of each page

- Creating pages that do not rely on one type of hardware or software to better serve a variety of visitors such as those who do not use mice, have small screens, view in low resolution, or possibly does not view content with a screen at all and only have text output.

The exhibition team at the National Library of Medicine provided early concept documents and content outlines that revealed graphically rich interfaces with animations and illustrations that communicated highly complex concepts and game like environments to engage and educate students and users of all ages. Immediately it was clear that these objectives could not be met in a traditional page based Web interface using standard programming languages such as HTML, XML, etc. Rather than clicking from page to page to have access to information the user needed to navigate through a variety of time based content that layered information based on the user input (their unique options and choices) for completing the activity. The development of these concepts required the use of the Flash Player which is a Plug-in that can be used in a variety of Web browsers. Although some of the latest Web browsers are distributed with the Flash Player it is still viewed as an additional requirement for viewing the Website, thus a technological barrier to accessing information. This challenge requires the development of multiple, alternate versions of the content in order to be accessible to the largest possible audience and to fulfill the priorities of Section 508 compliance. However, the degree to which one develops and accommodates the highest priority of Section 508 requirements undermines the overall development costs. In terms of development it is technically possible to achieve the highest compliance amongst Section 508 requirements for media-rich, time based interactive experiences; however, it is not cost effective. Often

in developing these types of interactive experiences a series of goals, objectives and specifications need to be outlined before the concepts are further defined and the programming has been implemented. This allows all team members to review and assess the alternative options that will need to be developed in order to satisfy the priorities of Section 508 compliance.

The creation of the Educational Activities, Video Documentaries and Artifact Interactives all required content to be presented in a time based environment and either required development authoring using Macromedia Flash or Apple QuickTime. As developers one must ensure graceful transformation across the alternative options as well as employ the standard page based Section 508 compliance checklist. The levels of complication begin to multiply and additional programming and scripting was implemented to allow the Educational Activities *(fig. 3)* to be functional for visitors that do not use mice and/or use E-Readers for the Web browser. An alternate text only option was made available to visitors who prefer not to view graphics, animations or other interactive content *(fig. 4).* With the newer versions of QuickTime (4.1-6.5) videos were authored to display 'in-line' captions which are accessible on demand through activating system links *(fig. 5)* and for visitors that prefer not to view and download videos text only transcripts were made available *(fig. 6).* The Artifact Interactives were developed as kiosks for the exhibition and each kiosk is placed directly in front of a physical exhibition artifact and via computer run touch screen monitors. Visitors can bring to life each artifact in ways that can not be done to the real artifact since they site enclosed in a glass case. These Artifact Interactives had to be modified from the kiosk versions in order to be presented on the Web to meet Section 508 compliance *(fig. 7)* and since they require the Flash Player

specific programming scripting was put into place to prompt visitors and offer a text only alternate *(fig. 8).* The role that the 'presentation' plays in the contextualization of content is often very important and although these alternate options and versions that have been provided tend to strip the content of its context there is often little that can be done about this issue due to the types of tools and technologies available for development. These alternative options provide the opportunity to reach the largest, diverse audience possible and ensure graceful transformation of all media-rich, time based, dynamic interactive experiences so that they are accessible to people with disabilities. As the tools and technologies continue to evolve there will be greater strides towards developing more powerful technology in order to deliver accessible Web content to people with disabilities.

Evaluation of the accessibility of *Changing the Face of Medicine*

The evaluation of the *Changing the Face of Medicine* exhibition, in relation to how well it meets Section 508 requirements, was conducted by John Slatin.

I've examined three specific pages from *Changing the Face of Medicine* to evaluate the merits of two different approaches to interactive multimedia used in the online exhibition. I looked at:

1. the home page,
2. an Activities Interactives page, and
3. the biography page for Dr. M. Joycelyn Elders.

I also looked at two of the four activities linked from the Activities Interactives page, "The Doctor Is In" and "Sickle-Cell Anemia."

My review included three steps: testing with an automated tool (Bobby Worldwide), manual compliance checking (to follow up on the Bobby report), and an expert review in which I compared my own sense of the pages as I experienced them through the JAWS screen reader against the results of the automated review and the compliance checks. This third component was where things got more complicated (and more interesting). Before I discuss my findings, however, let me say a few words about screen readers.

Screen readers are *the* essential tools for people who are blind. In case you've never encountered one, let me say that in essence, screen readers do what the name suggests: they read the screen aloud. (It's actually a good deal more complicated than that, but this will do for present purposes.) Reading starts at the top of the page and proceeds left to right, line by line, until it comes to the end or the user stops it. If there's text on the page, the screen reader speaks it aloud in a synthetic voice. It also identifies different types of links, including graphical links, image map links, and "this-page links" to other locations on the current page. Screen readers also indicate the presence of graphics and other elements such as tables, lists, frames, headings, and forms. Some screen readers, including JAWS, can also handle multimedia and animation created with Macromedia Flash.

It's worth noting that it isn't easy to pass both automated tests and what Bobby calls "user checks," as these pages do. Passing these tests and meeting Section 508 requirements means, for example, that every image element has an alt attribute to provide something for screen readers to use in place of the image. It also means something I'm

willing to stipulate—that color isn't used as the only means of conveying information—an important thing for people with color deficient vision, which includes most seniors and people whose monitors don't display color.

The pages still make sense without style sheets, too. Cascading Style Sheets (CSS) are the best way to control everything from font- and color-selection to spacing and layout, but there are people who use browsers that display only "plain vanilla" text while other people substitute style sheets that meet their own special needs. Moreover, screen readers ignore visual effects created by style sheets (including the visual order of text and images). Section 508 requires that pages make sense under these circumstances.

The video clip of Dr. Elders speaking about her life meets all the Section 508 requirements, too: the window in which it appears includes a link to turn on captions (these text equivalents for audio are essential for people who are deaf or hard of hearing, important also for people who aren't native speakers, students who are developing readers, and people viewing the site in a facility that doesn't provide speakers such as many school libraries). There's even a text transcript so that people who use those text-only browsers and people who are deaf-blind can read what Dr. Elders has to say. Finally, there's also a link to download the QuickTime player needed to watch the video, another Section 508 requirement. The Activities Interactives page meets this same requirement with a link to download the Macromedia Flash player, which is needed to take full advantage of the interactive aspects of the learning activities

In addition, every page on the site has a Skip navigation link. This isn't visible to the naked eye: its purpose is to allow people using screen readers (which also drive the refreshable Braille displays that some blind users prefer) to jump over tall navigation

blocks at a single bound. That is, the Skip navigation link lets you avoid listening to all the navigational links that appear across the top and down the left side of the pages on this site (and most other sites on the Web). This may seem like a small thing, but remember that screen readers read from left to right and top to bottom: Without the Skip navigation link, people using screen readers will hear all those links *first* on every page, *before* they hear the real substance of the page; this takes over 40 seconds, according to my stopwatch. By contrast, most users who are sighted don't even notice those navigation bars are there until they want to move on: part of the point of good visual design is to draw the eye smoothly to important material; the navigation bars are at the periphery. Skip navigation links help provide a similar experience for users who are blind.

But there are flies in the ointment, too. One set of issues involves things that appear at first to be 508-compliant but turn out not to be. Another set of concerns involves what are best described as usability issues whose impact on people with disabilities is disproportionately greater than it is for people who don't have disabilities.

The list of things that appear to be 508-compliant but really aren't includes the following:

- graphical links on the Joycelyn Elders page that have "empty" alt attributes where empty alt attributes aren't allowed;

- images in the Photo Gallery that have redundant alt text but don't have extended descriptions as they should; and

- text-only versions of learning activities that don't really provide "equivalent alternatives" to the activities as implemented in Flash.

On the usability side of the ledger, there is some confusion about link text (including alt text for graphical links); there are duplicate (and not-quite-duplicate) links; and there are links that open without warning in new browser windows (this *is* an accessibility issue under the World Wide Web Consortium's Web Content Accessibility Guidelines 1.0, however). The 14 photographs of women physicians that appear at the top of each page and change whenever a page is loaded or reloaded pose a potential distraction for people listening to the constantly-changing alt text and for users with learning disabilities or cognitive impairments. I won't have room to discuss the usability issues here, but mention them in hopes that readers will work to avoid confusing link text and needless duplicate links on their own sites.

Alt text is text associated with the images on a Web page via the alt attribute of the <img> element; alt text is what screen readers read when they encounter an image, and what text-only browsers display. The Joycelyn Elders page includes a Photo Gallery consisting of five images. Three thumbnail-sized photographs and a link that says, "Launch Photo Gallery (five images)." The first time I visited the page, I was sure that the alt text for some of the images was missing. Here's what JAWS said when it got to the Photo Gallery section:

Link graphic gallerythumb/098_01

Link graphic gallerythumb/098_02

Link graphic gallerythumb/098_05

Launch Photo Gallery (5 images)

Link graphic img/icon_gallery

When JAWS says *Link graphic gallerythumb/098_01* or *Link graphic img/icon_gallery,*

I'm hearing a filename—what JAWS reads by default when an image has no alt text. This

is why I ran Bobby. The program is very good at uncovering images without alt text, so I

was sure it would find these four—but it didn't find anything wrong. I looked at the

source code. Sure enough, each image had an alt attribute that read *alt=""*. This is called

"empty alt text"; it's designed to force screen readers to skip over images that don't carry

meaning, like the spacers used to create white space on the page or decorative frames for

images. JAWS should have ignored those images. What was going on?

That was when it hit me: all four of these images (the three thumbnail photos and the icon

that links to the Photo Gallery) are *links*. They may be graphical links, but they're links.

And graphics that serve as links *must not have empty alt attributes.* A graphic that serves

as a link *does* carry information—about the destination of the link. Therefore, there must

be *meaningful* alt text on all graphical links; the screen reader speaks the alt text

whenever it encounters the image, for example when the user tabs to the image or brings

up a list of all the links on the page. (The link shows up in the links list even when the alt

text is empty; the screen reader has to say *something*, so by default it reports the filename.

At best this is ugly; at worst it's confusing and nullifies the user's ability to navigate the

site.)

But there are cases where it's acceptable to put empty alt text on a graphic that serves as a

link. As a case in point, there are actually two links to launch the Photo Gallery—a text

link ("Launch Photo Gallery") and an adjacent icon that goes to the same place. Sighted

users see them as a unit; and in fact both the text and the icon could have been treated as

part of the same HTML element—in which case it would have been OK to make empty

alt text for the icon! (The code would look something like this: <a

href="photogallery.html">Launch Photo Gallery<img src=" img/icon_gallery"

alt=""/>).)

The empty alt attribute (alt="") could also have been used to good effect in the Photo

Gallery itself. The gallery contains five images, shown one at a time; the user can select

them by number or simply use the "Next" link each time to go through the sequence.

There is a caption beneath each image, and the alt text is identical to the caption; people

using screen readers hear the same thing twice. This redundancy could have been avoided

by setting the alt text to empty and allowing the onscreen caption to do the work for

everybody. And if these images convey more information than the caption (or alt text)

could reasonably provide, then an additional description should be provided, either on the

same screen as the image or on a linked page.

Let's turn now to the Activities Interactives. As I noted earlier, there are actually two

versions of each activity—the Flash version (which is the main one, the "real" one) and

the text-only version, provided for those who don't or can't use Flash. This may sound

like a good solution, but in fact it's not. Section 508 explicitly says that text-only variants

may be provided only as a last resort, when the page cannot be made accessible in

another way; the text-only variant must then provide as nearly equivalent an experience

as possible. I don't believe this standard has been met, at least in the case of "The Doctor

Is In" and "Sickle Cell Anemia." That is, I believe that an accessible version of these

activities could be provided that would include both images and text and allow for user

interaction as well.

Central to both activities are images that reveal additional information when the student user mouses over them. Text on the screen calls the student's attention to specific aspects of those images ("See the orange areas?" for example). The text-only versions contain exactly the same text, right down to the (now very rhetorical) question ("See the orange areas?"). In other words, the text-only versions don't make sense unless students can see the images; in order to meet the 508 standard, there would have to be additional descriptions of the images equivalent to what students who are sighted can see. The text-only versions aren't interactive, either: whereas the Flash activities comprise a sequence of screens, the text-only version is a single file that isn't linked to anything else.

It needn't have been so flat. The graphics could just as easily have been .gifs or .jpegs (the most widely used image formats). Each image might actually consist of several smaller images (though sighted users would perceive just one); a detailed text description could be associated with each of these constituent images. This could be done using an attribute called longdesc, designed expressly for people who use screen readers, or via an explicit link on the screen (which would make the descriptions available to anyone who wanted them). All students could step through the sequence using the "Next" and "Previous" buttons. And so forth.

Are these violations of Section 508 fatal? No. Users can ignore the thumbnail images and use the text link to launch the Joycelyn Elders photo gallery, though in the absence of long descriptions users who can't see those images will learn less than they might otherwise. By the same token, students reading the text-only versions of the Activities Interactives won't have quite as rich an experience as peers who get the Flash versions, though much of the core *information* is there. But there's the rub: learning isn't just about

information. If we imagine a classroom full of middle schoolers whose teacher is introducing them (as often happens these days) to the idea of a career. The teacher especially wants to give the girls in the class reasons for keeping up with their work in science and math now that they're reaching the age when a lot of girls start to fall out of the sciences; she sends them to visit *Changing the Face of Medicine* and suggests that they find out about Dr. Elders and check out some of the things doctors do. The class includes a girl who is blind and another with cerebral palsy who doesn't use a mouse. What will be the quality of *their* experience compared to the experience of their classmates? How will the difference affect them?

Conclusion

So. How does this case study answer the questions: What does this mean to users of the internet? To government agencies? To the creative community?

These are big questions. And questions we all have to answer these questions for ourselves. The goals for this paper were to raise the issue, to spark a debate, to assist in creating a change or, in some cases, to simply reconfirm the status quo.

As the person in charge of the Exhibition Program at the National Library of Medicine and the project director for *Changing the Face of Medicine*—I am all about access. The Exhibition Program is part of a public institution whose mission includes organizing and disseminating information to a world audience. Our visitors and patrons matter a great deal to us and we try to respond to each person's individual questions and specific needs. I also want to gain recognition and respect for the quality of our projects within the

different communities in which we work—the scholarly community, the creative, the technical, and the education communities, as well.

Changing the Face of Medicine then became a vehicle to push these goals, for our program, to a new level. We wanted a dynamic and sophisticated approach to our website—not the standard government issue design. We didn't want a two-website solution—one portal for" them," one portal for "you." We strove for an equal and different experience for all our visitors. And, overall, we succeeded.

The questions John Slatin raises at the end of his comments about the website focus on precisely the kind of review and evaluation the project team experience for the entire website. And I made decisions to compromise on the experience we would offer the young girl who is blind and the student with cerebral palsy. Looking back, knowing what I know now, would I make that same decision—I don't know. I don't know if I can put myself in that state of being again—weighing administrative pressures, financial limitations, schedule issues, personality crisis. Sometimes the visitor's needs seemed a distant reality. For our next online exhibition, though, we will plan more carefully so we will have the time to consider more deeply how we can develop equal and different content when something is going to be lost during the transition between different technologies and formats.