

**Assessing the Understanding and Opinions of
Electronic Health Record System Analysts Towards
Software Accessibility for Disabled Inpatient Nurses
and the Application of Accessibility Design
Principles in Inpatient Electronic Health Records**

by

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Certificate of Approval

This is to certify that the Capstone Project by

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“Assessing the Understanding and Opinions of
Electronic Health Record System Analysts Towards
Software Accessibility for Disabled Inpatient Nurses and
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Inpatient Electronic Health Records”

Has been approved

Capstone Advisor

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Abstract

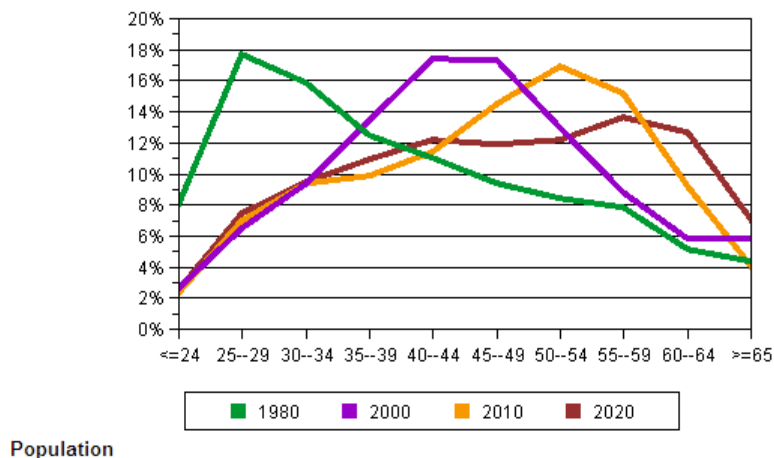
U.S. hospitals are facing the worst nursing shortage in 50 years due in part to an aging workforce. Discussions concerning the impact of the aging nursing workforce have focused on the vacancies that will be created by retirement. However, a less considered impact is that disability prevalence increases with age. Concurrently, the passage of American Recovery and Reinvestment Act of 2009 will accelerate electronic health record (EHR) adoption making the EHR as necessary as the stethoscope in providing patient care. The convergence of these forces should motivate hospitals to better understand electronic health record software accessibility. The motivation should come from a desire to satisfy the “reasonable accommodations” requirement of the Americans with Disabilities Act and to avoid having nurses leaving the workforce prematurely. This study will examine two issues: the understanding and opinions of Inpatient EHR system analysts towards software accessibility and the extent to which three major inpatient electronic health records have accessibility design principles incorporated into the software. The study will begin to shed light on an area of disability accommodation that has yet to be researched. The knowledge gained from this study will inform and guide future research.

Introduction and Background

“Hospitals are held together, glued together, enabled to function ... by nurses.”¹

However, U.S. hospitals are facing the worst nursing shortage in 50 years.¹ The shortage that began in 1998 continues to escalate. A November 2007 report by the U.S. Bureau of Labor Statistics projected that “one million new and replacement nurses will be needed by 2016.” The Bureau also projected a 23.5 percent increase in new nursing positions by 2016.^{2,3} The increased demand for nurses is due in part to the increased age of the nursing workforce.⁴ Prior to the late 1980s, the average age of registered nurses (RN) held steady around 38 years but by 2006, the average increased to 43.7 years. Analysts project that the average age will continue to increase before it peaks at 44.6 years in 2015.^{1,5}

Figure 1: Average Age of Nurses Across Time⁵



Sources: 1980 and 2000 SSRN; NSM projections for 2010 and 2020.

Discussions concerning the impact of the aging nursing workforce have focused on the vacancies that will be created by retirement.^{6,3} Another impact of the aging nursing workforce is the increased prevalence of disability with age.⁷ This is significant when you consider the findings of a 2002 survey of registered nurses. Of the 2.2 million nurses surveyed, approximately 154,000 indicated they were employed in positions other than nursing because of a disability and/or illness.⁸

Additionally, the Americans with Disability Act (ADA) of 1990 requires private employers and state and local government employers to make reasonable accommodations to employees with disabilities.^{9,10} The ADA defines disability as “a physical or mental impairment that substantially limits one or more major life activities of such individual; a record of such an impairment; or being regarded as having such an impairment.” Examples of major life activities include: seeing, hearing, standing, learning, reading, concentrating, thinking, communicating and working.⁹

The requirement of reasonable accommodation includes “any change or adjustment to a job or work environment that permits a qualified ... employee with a disability ... to perform the essential functions of a job, or to enjoy benefits and privileges of employment equal to those enjoyed by employees without disabilities.”¹⁰ Recent studies reveal that more could be done in the workplace to accommodate the needs of nurses with disabilities. Matt considered the self-reported experiences of nurses with disabilities and concluded hospitals could do more to comply with the accessibility mandates of the

ADA.⁸ These findings harmonized with the Guillett et al. study that found more barriers than facilitators for nurses with disabilities in finding and keeping nursing jobs.^{8,11}

This paper begins to explore an area of disability accommodation that will increasingly impact nurses: that area of disability accommodation is software accessibility. Software accessibility has been defined as “the quality of a product that makes it possible for people to use the product even when they are functioning under limiting conditions or constraints.”¹² To date there has been no research on this topic as it relates to the nursing profession. Given the recent passing of the American Recovery and Reinvestment Act of 2009, which allocates \$19.2 billion for health information technology, it is important to consider how the emergence of technology will impact the disabled nurse and how these technologies do or do not address accessibility. The Congressional Budget Office estimates the financial incentives will dramatically increase hospital EHR adoption. They are projecting an EHR adoption rate of 70% by 2019 as compared to 45% without the incentives.^{13,14,15} If the projections are realized, the EHR will become as much a tool for the nurse as the stethoscope or blood pressure cuff. When using an EHR becomes fundamental to performing the duties of nurse, addressing software accessibility will become imperative for hospitals to promote nurse retention and ADA compliance.

Hospitals that want guidance on how to address software accessibility can look to Section 508 of the Rehabilitation Act. Section 508 requires that electronic and information technology (EIT) developed, procured, maintained, or used by a Federal agency must be

equally accessible and usable for individuals with disabilities as it is for individuals without disabilities. Although the provisions are only applicable to Federal agencies, the impact extends to those software vendors and manufactures that market their products to Federal agencies.^{16,17} Section 508 clearly outlines core characteristics of accessible software design. An example of accessible design is that color coding is not the only means of conveying information, indicating an action, prompting a response, or distinguishing a visual element.¹⁸ Accessible design couples color with texture, symbols or other visual element to address the needs of individuals with color perception deficits.

Considering the emergence of the EHR, the experiences of nurse with disabilities, and the nursing shortage it is imperative that disability accommodation for nurses through software accessibility be explored. This study will begin the exploration by examining two issues:

- The understanding and opinions of Inpatient EHR System Analysts towards software accessibility and
- The extent to which three major inpatient electronic health records (EHR) have accessibility design principles incorporated into the software.

The knowledge gained from this study will inform and guide future research.

Method

The researcher employed qualitative study design, using a purposive sample. Semi-structured interviews and an EHR accessibility checklist (Appendix A) were used to

address the aims of the project. Study participation was extended to 19 system analysts with one or more years of experience supporting one of three software vendors, Millennium PowerChart, EpicCare Inpatient, or CPRS. Four (19%) individuals agreed to participate in interviews all of whom were female and supported EpicCare Inpatient (3) or CPRS (1). The EHR Accessibility Checklist was completed by 6 (29%) study participants: 2 (33.3%) CPRS analysts; 3 (50%) EpicCare Inpatient analysts; and 1 (16.7%) system unknown analyst (the participant did not indicate which system was being evaluated).

Site Selection

Three sites in Washington State were selected for the study. They included Seattle Children's Hospital (Children's), MultiCare Health System (MHS), and Veteran's Affairs Puget Sound (VA). These sites were selected because each uses one of three major inpatient electronic health records (Millennium PowerChart, EpicCare Inpatient, and Computerized Patient Record System (CPRS)).

Seattle Children's Hospital

Seattle Children's is a 250 bed primary pediatric referral center serving Washington, Alaska, Idaho, and Montana. Children's has implemented several components of the Millennium® PowerChart® suite including PowerOrders® (Cerner Corporation); PharmNet®; limited clinical documentation; results review; and admission, discharge and transfer. Millennium PowerChart is a suite of applications designed to support an enterprise wide EHR. All applications are displayed to users through a graphical user interface which contains menus and toolbars. Once in the patient's chart, users can

access information and complete tasks by selecting various tabs that run across the top of the screen. The tabs can be considered a metaphor for the tabs found in the paper chart.

Beyond Children's use of PowerChart, they are an appealing study site because they have received recognition (2007 Large Non-profit Employer of the Year by Washington State's Governor's Committee on Disability Issues and Employment) for excellence in placing individuals with developmental disabilities in entry-level positions throughout the hospital. The significance of this award, as it relates to this study, is that it may indicate a climate of disability awareness that could impact the understanding and opinions of EHR analysts concerning software accessibility for disabled nurses.

MultiCare Health System (MHS)

MHS is an integrated delivery network with four community hospitals serving Washington's South Puget Sound Region with its main campus located in Tacoma. In 2008, MHS implemented Epic Systems' EpicCare Inpatient Clinical System® at its three Tacoma hospitals. They went live with full clinical documentation and computerized provider order entry (CPOE).

EpicCare Inpatient is accessed by users through a role-based graphical user interface termed Hyperspace. Menus and a tool bar within Hyperspace allow users to navigate between all the Epic applications being used by MultiCare. Once in the patient record, users have multiple options for how they review the patient's chart and complete tasks. They can use any combination of menus, activity buttons, or navigators. Activity buttons

are essentially quick links to individual items from a menu. A navigator combines reports, links and actions that are designed to guide the user through a desired workflow.

VA Puget Sound

The third study site is the VA Puget Sound with locations in Seattle and Tacoma. The VA provides a robust array of inpatient and outpatient services including psychiatric, rehabilitation, oncology and surgical care. The VA Puget Sound has used the CPRS application, which is a component of the Veterans Health Information System and Technology Architecture (VistA) since 1999 when use was mandated nationally.¹⁹

Unique to the VA is that it is required to comply with Section 508 of the Rehabilitation Act of 1973. In response to this requirement, the VA Puget Sound installed two CPRS 508 Compliant versions of the software. One version has a graphical user interface that allows the user to navigate the EHR using keyboard shortcuts. The other version is a “roll-and-scroll” text version that can be interfaced with a speaker device and is used by blind users.

Participant Recruitment

Information Technology leaders at the three sites were contacted by phone or email and informed of the purpose of the study, what types of individuals were being recruited and what would be of asked of study participants. In some cases the leaders agreed to provide contact information for qualified candidates and in other cases they agreed to forward the study information on behalf of the investigator to qualified candidates. All potential study participants received a recruitment letter and a study information sheet.

Interviews

Analysts that agreed to be interviewed were asked to complete the EHR Accessibility Checklist prior to the interview. The purpose of having the checklist completed prior to the interview was to establish a common definition between the analyst and researcher of “software accessibility design principles” for the purpose of the study. Interviews were conducted in person and over the phone in a variety of settings. Two of the four occurred in the analysts’ office (one in person and one over the phone); one occurred in the analyst’s home (over the phone) and one occurred in a conference room (in person).

At the beginning of each interview the researcher explained the purpose of the interview, her relationship to the study, and asked for permission to record the interview. The analysts were asked four structured questions (Table 1) aimed at uncovering the analysts’ understanding and opinions of software accessibility, including its importance and what could be done differently to improve software accessibility. The questions were not asked verbatim or in the same order. Follow-up questions were asked to further develop or clarify analyst responses. The interviews lasted 15 to 20 minutes each.

Table 1: Structured interview questions

1.	Prior to completing the EHR Accessibility Checklist, had you been exposed to examples of software accessibility features?
2.	On a scale of 1 to 5, 5 being very important, how important do you think software accessibility is and why?
3.	Have you ever encountered a situation with a nurse, where their use of the software was hindered by the absence of an accessibility feature or enhanced by the presence of an accessibility feature?
4.	What could be done to improve software accessibility for users?

Checklist

The purpose of the EHR Accessibility Checklist was to gauge the extent to which the EHR vendors incorporated software accessibility design principles into their products. The checklist consisted of twenty-five statements and four questions, adapted from the Accessibility Checklist published by the U.S. Department of Justice (Appendix B), describing software accessibility design principles.¹⁸ The researcher modified the

Department of Justice checklist in the following ways:

- Eliminated the “Person filling out this Checklist” section to maintain study participant anonymity,
- Modified the “Software application under review” section to only include the name of the software and the software version,
- Altered the sentence wording to create statements instead of using the question format,
- Modified the response list to match the statement format and allow for more precise responses,
- Eliminated question number five because it was virtually the same as question number four,
- Added examples to help clarify statements when examples were not provided, and
- Eliminated question 27 through 29 because they did not address aspects of software accessibility but topics related to software.

The revised checklist also included questions to capture the analyst’s years of experience as an analyst in general and years of experience with the EHR just evaluated. Analysts were required to respond to statements 1 through 25 by indicating Always, Sometimes, Never, Uncertain or Not Applicable. The responses were defined in the instructions section of the checklists as follows:

- Select Always if the design principle is true for every use case in the software.
- Select Sometimes if the design principle is used in some cases but not others.

- Select Never if the design principle is never used in the software.
- Select Uncertain if you are not sure whether there are any applicable use cases.
- Select N/A (not applicable) if there no use cases in which the design principle would apply.

Participants received the warning, “This question requires a response” for required statements to which there were no responses. The checklist was administered using an online survey tool.

Data Analysis

The transcribed interviews were read and reread by the researcher in order to obtain a sense of the content as it related to the aims of the study. Next the interview data was coded for important themes. The themes were divided into categories and subcategories that described system analyst understanding and opinions of software accessibility. The checklist responses were collected using the online survey tool, SurveyMonkey. Descriptive statistics were used to illustrate the degree to which each EHR vendor had incorporated accessibility design principles into their software. The checklist results that did not include the system being assessed were not included in the data analysis.

Results

The Interviews

Four (19%) individuals agreed to participate in interviews all of whom were female and supported EpicCare Inpatient (3) or CPRS (1). The researcher was unable to recruit any participants from Seattle Children’s, which is attributed to a significant staffing shortage. Interview analysis resulted in the identification of five main categories: importance;

awareness; exposure to the need for accessible design; improvements; and barriers. The categories and subcategories are summarized in Appendix D.

Importance

Level of importance, Reason for importance, and Response relative to level of importance:

The EHR analysts unanimously agreed that software accessibility is very important.

When asked why they felt it was important, they brought up concerns related to patient safety, the potential of nurses leaving bedside care prematurely, and the importance of making accommodations for nurses with disabilities.

“The medication admin [administration] instructions are very very small, this [nurse not being able to read instructions] can lead to an error”

“We do have a few blind users...they need to interact with the electronic record to get up to speed with the patient that is coming in and to be able to write progress notes.”

“We had a few [nurses] leave and I don’t think it was just because they were scared of computers but a combination of that they couldn’t see so well or hear so well...”

“I just feel it is important that if there are users out there with a disability we should do what we can to accommodate their needs.”

They also agreed that the relative priority accessibility receives, related to all other kinds of user requests, was not consistent with the level of importance they felt it should receive.

“I think... it [software accessibility] does not get enough attention.”

“[I] don’t think it has been addressed enough.”

One respondent when asked if the level of priority was appropriate emphatically replied “No, absolutely not.” Three respondents attributed this in part to the lack of understanding about software accessibility and disability accommodation among EHR analysts.

Awareness

Level of awareness and Generating awareness:

The level of awareness varied among the analysts and was on a spectrum of vaguely aware to aware. The analysts expressed little confidence that any significant level of awareness exists among EHR analysts as a whole. The only exception is the CPRS analyst who believes Section 508 effectively generated awareness among CPRS analysts but believes there is less awareness in the private sector.

“[I] don’t think there has been enough education about what that [software accessibility] means and that you need to take these kinds of things into consideration.”

“I think people were just not aware of the issues the disabled...care providers...faced. I just don’t think people were aware of what a challenge it would be to get through the day without tools.”

The sources of awareness for the others were personal experience and previous jobs.

Three of the four respondents commented on how participation in the study generated a new level of awareness for them. So much so that they were considering what action steps they could take to generate more awareness.

“It just reminded me that I need to focus on that [software accessibility] so when I’m going to things like user groups I can bring up...the disabled and how we are going to meet their needs.”

“I mean it has really made me think,

“It makes me want to go talk to Epic and ergonomics to find out what’s available.”

There was consensus among the analysts that a critical action step was following up with the vendor to determine all the accessibility features that exist within the EHR.

Exposure to the need for accessible design

Visual impairments and physical impairments:

When asking the analysts if they had encountered situations where the nurses’ use of the software was hindered by the absence of an accessibility feature the immediate response was yes, the inability to increase the font size.

“I would say when I was rounding on the wards that [font too small] would come up... several times among some of the older staff.”

“The most common thing I have heard from nurses, and we are in kind of an interesting situation because we have long term staff and many of them are reaching their retirement years and no necessarily ready to retire either, is that the fonts are not big enough for them.”

In all cases the analysts made mention of the older nurse. Analyst experiences varied in terms of how they could respond to the issue of the small font. The CPRS analyst described a feature that allows the end user to increase the font size at will. Additionally, the 508 compliant versions of CPRS were built to accommodate blind caregivers.

The EpicCare Inpatient Analysts described instances where the font size could be adjusted and in other instances where it could not. In the cases where the software could not be modified, the analysts were unable to offer any alternative solutions to the nurses. However, some expressed the ability to submit an enhancement request to the vendor.

“I’ve not been able to see where I can just make that modification [increase the font]...it is what it is for everybody...being able to bold something would help but we are not necessarily able to do that either”

“I did talk to Epic about that and there is a way of changing the font.”

In addition to helping nurses with visual impairments, two of the analysts shared their experiences working with physically impaired user where the impairment was the result of arthritis and amputation. In the case of the nurse with arthritis in her hands, no accommodations were made but the analyst indicated the nurse could have benefited from more mouse driven interaction and less keyboard interaction. The amputee’s needs were accommodated through the use of touch screen functionality.

“I know that we ...had to have the system changed because she had to touch the screen because she couldn’t use the keyboard.”

“We need to find out what is available to address issues [physical impairments], both through the software and from ergonomics”

Improvements

Education, Flexible design, and Collaboration and standards development

The main theme, in response to the question about what could be done to improve software accessibility, was education. All of the analysts cited the need for more education on the specifics of software accessibility. This included learning from the vendors and developers what accessibility features existed in the software and the needs those features were intended to meet. Additionally, there was an expressed need to understand more about the types of disabilities and how one might go about addressing those disabilities.

“What I think the improvement would be is that we do get some education on what the system can do for individuals with impairments.”

Two respondents stressed the importance that any accessibility improvement would include flexible design: design that would allow accessibility features to be turned on and

turned off at the user level. They felt this was important so that users not needing the accommodations would have a choice to use or not use the accessibility features.

“...if we don’t have standard features that you can turn-off and on then you can’t meet the needs of the other people [without disability]”

One EHR analyst stressed the importance of software and hardware vendor collaboration and the development of accessibility standards. Collaboration was seen as a way to improve accessibility by ensuring compatibility between the software and the hardware specifically concerning adaptive technologies. This theme of collaboration extended to the development of accessibility standards. The analyst felt it would be valuable for EHR vendors to identify the top three to five accessibility features per impairment that would become standard components of all EHRs. In the same way users can expect what to find under the File menu in any Microsoft Office application, nurses should be able to expect what to find under the Accessibility menu in every EHR.

“EHR vendors in general...need to be...more collaborative with hardware vendors.” “How is your [the vendor’s] particular application going to play with a particular hardware.”

“...are there the top three to five kinds of things [software accessibility features] that can be implemented in every EHR.”

Barriers

Pace of change, competing priorities, multipurpose and multi-user workstations, and lack of awareness

Although the analysts were not specifically questioned about barriers to accessibility, it emerged as a prominent theme. The CPRS analyst pointed out that the base software changes rapidly in response to the need for enhanced functionality. Bringing the new features into the 508 compliant versions of the software can take a couple of years.

“It [software] changes very quickly...there’s always new functionality coming out”

“the 508 compliance changes lag behind the general updates to the software ...a good couple of years.”

This long delay was attributed in large part to the existence of competing priorities.

“...putting it all into perspective, it is kind of hard to prioritize that issue [accessibility issue] above something else that might be really important to the patient.”

Two EpicCare Inpatient analyst discussed barriers created by the use of multipurpose or multi-user workstations. The multipurpose workstations present a problem because the accessibility features of the operating system may be supported by the EHR software but may not be supported by other software on the workstation. This may require the features to be disabled. Multi-user workstations present a barrier when nurses need to use an adaptive technology. The adaptive technology must be portable as the nurse moves from workstation to workstation. Additionally, this requires that any software accessibility features be set at the user level and not at the workstation.

“...we have so many different kinds of software on our desktops it is not easy to just up and change the display for a particular application”

All the analysts cited lack of awareness as a barrier to software accessibility. They not only mentioned a lack of software accessibility awareness as a barrier but also lack of awareness concerning the presence of disabilities among nurses.

“Unless you have the person with the disability you don’t think about it”

“We need to be more aware of that [software accessibility] so that anybody that does have a challenge is able to use the system”

“I don’t think we are the most innovative in that (accessible design) as other VAs...because they were forced to because they have more disabled providers.”

The Checklist

To ensure inclusion of only valid checklist results, data were excluded if the system under evaluation was not captured. After data exclusion, five EHR Accessibility Checklists were available for analysis. Appendix C contains the combined detailed results for each question. Out of the twenty-five questions, there were 8 questions (5.33%) where all the EHR analysts either indicated the design principle was always or sometimes. Those were questions 1, 4, 5, 6, 12, 13, 14, and 17. (Table 2)

Table 2: Design Principles Rated as Always or Sometimes Present

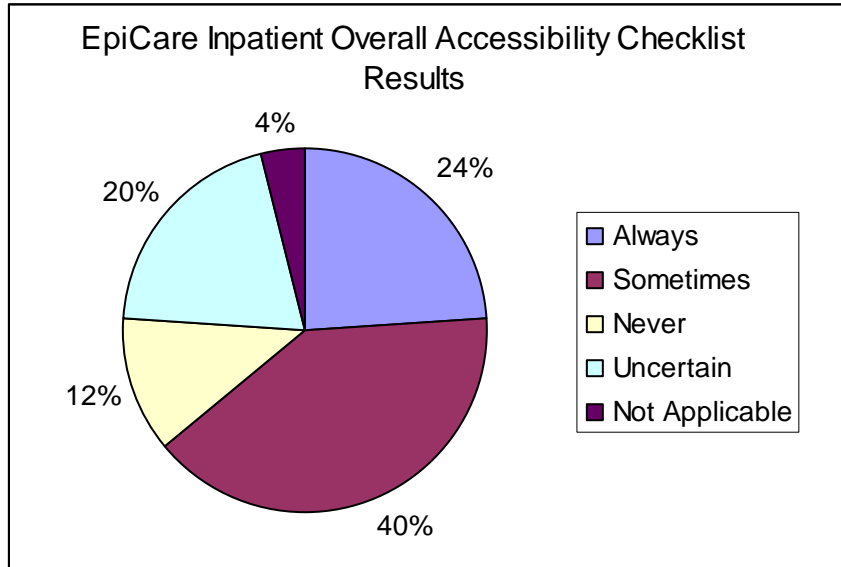
No.	Question
1.	The software provides keyboard equivalents for all mouse actions, including buttons, scroll windows, text entry fields, and pop-up windows.
4.	The software has a logical tabbing order among fields, text boxes, and focal points.
5.	There are well-defined focal points that move with keyboard navigation? (e.g., can you use the arrow keys to navigate through a list followed by pressing the ENTER key or space bar to select the desired item).
6.	Shortcut keys are provided for all pull-down menus.
12.	Every window, object, and control has a clearly named label.
13.	The software application uses standard controls rather than owner-drawn or custom controls. (e.g., standard icons in the upper right corner to minimize, maximize/restore down and close)
14.	The software has a user selectable option to display text on icons, <u>i.e.</u> , text only icons or hover help.
17.	The software ensures that color-coding is never used as the only means of conveying information or indicating an action.

EpicCare Inpatient Results

All analysts indicated they had between 2 to 5 years experience supporting the EpicCare Inpatient EHR. Three EpicCare Inpatient analysts completed the checklist producing 75

responses. Appendix D contains the detailed results for each of the questions. Overall, 64% (48/75) of the time at least one EHR analyst indicated the design principles were Always (24%) or Sometimes (40%) present. (Figure 2)

Figure 2: EpicCare Inpatient Accessibility Checklist Summary Results



However, there were only five instances (Questions 1, 4, 6, 13, and 17) where all analysts either responded with Always or Sometimes. In two cases (Questions 7 and 22), all analysts responded with Uncertain. (Table 3) Overall, there was analyst agreement on 28% (7/25) of the questions.

Table 3: EpicCare Inpatient Analyst Response Agreement

No.	Question	Response
1.	The software provides keyboard equivalents for all mouse actions, including buttons, scroll windows, text entry fields, and pop-up windows.	Sometimes
4.	The software has a logical tabbing order among fields, text boxes, and focal points.	Sometimes
6.	Shortcut keys are provided for all pull-down menus.	Sometimes

7.	The software supports existing accessibility features built into operating systems (e.g., sticky keys, slow keys, repeat keys in Apple Macintosh OS or Microsoft Windows OS).	Uncertain
13.	The software application uses standard controls rather than owner-drawn or custom controls. (e.g., standard icons in the upper right corner to minimize, maximize/restore down and close)	Always
17.	The software ensures that color-coding is never used as the only means of conveying information or indicating an action.	Always
22.	The software supports the "show sounds" feature where it is built into the operating system.	Uncertain

Keyboard

Analysts rated the use of keyboard design principles as Always or Sometimes 76% (16/21) of the time. All analysts were uncertain about whether EpicCare Inpatient supports accessibility features built into the computer operating system. For questions 2 and 3, concerning the existence and availability of keyboard shortcut instructions, one analyst responded Never in both cases as opposed to the Always and Sometimes response of the other analysts.

Display

Analysts rated the use of Display design principles as Always and Sometimes 56% (5/9) of the time. For questions 9 and 10, concerning the ability to override default fonts and disable moving displays, one analyst responded Never in each case. Additionally, there was a response of N/A for question 10.

Screen Elements

Screen Elements was the only section in which each analyst rated all design principles as either Always or Sometimes.

Icons

Analysts rated the use of Icon design principles as Always or Sometimes 77.8% (7/9) of the time. The remaining two responses were both Never: one such response was assigned

to question 15 (icons are used consistently) and question 16 (menus with text equivalents are provided for all icon functions) respectively.

Color & Size

The analysts agreed that the design principles of questions 17 (color-coding is never used as the only means to convey meaning) and 18 (system supports user defined color settings) were Always or Sometimes in use. For questions 19 and 20, concerning the inversion of color and the software picking up the user's Control Panel settings, 66.7% of the response were either Never or Uncertain.

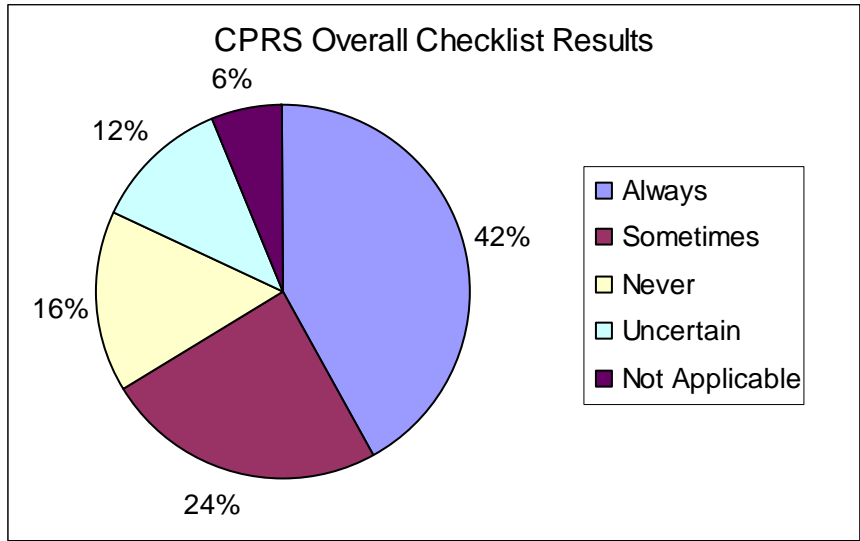
Sound & Timing

Analysts rated the use of Sound & Timing design principles as Sometimes 20% (3/15) of the time and Uncertain 60% (9/15) of the time. The remaining 20% of the responses were either Never or N/A.

CPRS Results

All analysts indicated they had more than 5 years experience supporting the CPRS electronic health record. Two CPRS analysts completed the checklist producing 50 responses. Appendix E contains the detailed results for each of the questions. Overall, 66% (33/50) of the time at least one CPRS analyst indicated the design principles were Always (42%) or Sometimes (24%) used. (Figure 3)

Figure 3: CPRS Accessibility Checklist Summary Results



However, there were only eight instances (Questions 2, 3, 4, 8, 9, 16, 17, 20) where all analysts either responded with Always or Sometimes. In one case (Question 21), all analysts responded with Never. (Table 4) Overall, there was analyst agreement on 36% (9/25) of the questions.

Table 4: CPRS Analyst Response Agreement

No.	Question	Response
2.	The program provides clear and precise instructions for use of all keyboard functions as part of the user documentation.	Sometimes
3.	Instructions regarding keyboard use widely available for all users.	Sometimes
4.	The software has a logical tabbing order among fields, text boxes, and focal points.	Always
8.	The software application is free of patterned backgrounds used behind text or important graphics.	Always
9.	A user can override default fonts for printing and text displays.	Always
16.	Menus with text equivalents are provided for all icon functions or icon selections on menu, tool, and format bars.	Always

17.	The software ensures that color-coding is never used as the only means of conveying information or indicating an action.	Always
20.	The software picks up the size settings that the user has selected in the Control Panel.	Always
21.	Audio alerts are coupled with visual cues.	Never

Keyboard

Analysts rated the use of Keyboard design principles as Always or Sometimes 93% (13/14) of the time. There was one response of Uncertain for question 7 (software supports operating system accessibility features).

Display

Analysts rated the use of Display design principles as Always or Sometimes 71% (5/6) of the time. There was one response of Uncertain for question 10 (ability to disable moving displays).

Screen Elements

Analysts rated the use of Screen Element design principles as Always or Sometimes 71% (5/6) of the time. There was one response of Uncertain for question 11 (descriptions or labels for fields are to the left of the field).

Icons

Icons was the only section in which each analyst rated the design principles as either Always or Sometimes present.

Color & Size

The analysts agreed that the design principles of questions 17 (color-coding is never used as the only means to convey meaning) and 20 (software picks up the size settings of control Panel) are Always present. For questions 18 and 19, concerning the support of user-defined color settings and the software picking up the user's Control Panel settings, the responses were either Never or Uncertain.

Sound & Timing

Analysts rate the use of Sound & Timing design principles as Never 60% (6/10) of the time. The remaining responses were N/A (3/10) and Uncertain (1/10).

Discussion

The findings of this study have the potential of generating needed dialogue and research in the area of EHR software accessibility. One aim of the study was to examine the understanding and opinions of inpatient EHR analysts towards software accessibility. An encouraging conclusion from this portion of the study is that all the analysts felt that software accessibility was very important. Their responses reveal a positive disability climate, which establishes an environment where disability accommodation can be embraced. Additionally, their expressed desire to gain a better understanding of software accessibility and the types of disabilities impacting nurses reveals an opportunity to advance disability awareness and responsiveness among EHR system analysts.

Increasing awareness and responsiveness is essential given the concerns that arose out of the interviews. There was significant discussion about the many older nurses dealing with a level of visual impairment: an issue that will increase in prevalence as the average age of nurses continues to rise. Not all electronic health records are equipped to accommodate poor visual acuity. In some cases, this represents a significant risk to patients because important information, like medication administration instructions, may be unreadable. Furthermore, the lack of accommodation concerning the EHR may be contributing to some nurses' decisions to leave bedside care prematurely. This is distressing in light of the present nursing shortage. The requirements of the ADA further reinforce the need for action in the area of EHR software accessibility. Hospitals risk the

possibility of violating the requirements of the ADA when reasonable accommodations are not made to address poor visual acuity or other impairments that create barriers for nurses in their use of EHR.

Hospitals have the most at risk if EHR accessibility is not addressed. Therefore, hospitals should be motivated to educate system analysts and work with EHR developers to make targeted software improvements. Education is the quick win for hospitals. In many interviews, the analysts indicated that software accessibility was not addressed during their system training. This creates the real possibility that more could be being done for disabled nurses if analysts had adequate training on the software accessibility features and how the features were intended to accommodate a person with disabilities. The results of the EHR Accessibility Checklist support this position as seen through the level of disagreement between analyst responses. Such training should be augmented by general software accessibility training and disability awareness training. Together, these three elements could prepare analysts to understand the challenges, analyze the options, and implement solutions.

Developers and vendors also have a responsibility and opportunity to improve software accessibility. This first responsibility is to create systems that employ software accessibility principles consistently throughout the application and allow user level control for many features. Some examples are giving users the ability to change the font size, color settings and sound controls. This is essential in the hospital environment where workstations are shared among many users and the workstations support several

software applications. User level settings will ensure portability as the nurse moves between multiple workstations. Furthermore, it eliminates the need to test all other applications on the workstation when features are implemented at the application level instead of residing at the operating system level.

The second aim of the study was to evaluate the extent to which three major inpatient EHR incorporate accessibility design principles. Given the degree of variability between analyst responses; the small sample size; and no evaluation of Millennium PowerChart, this aim of the study was only partially achieved. However, the responses do reveal that many of the design principles may be present but potentially are not applied consistently throughout the application. The results reinforce the need for analyst training and documentation of where within the application features are available.

Limitations

Despite the many insights gained from this study, there are a number of study limitations. First, the study information was obtained from a purposive sample. It is possible that the study participants have greater concern for disabled nurses than a “typical” EHR analyst. The sample size was small and may mean the results are not generalizable. Another limitation was the completion of the EHR Accessibility Checklist by system analysts, instead of system developers. The system analysts served as proxy evaluators due to time and resource limitations. Lastly, the absence of any Millennium PowerChart analyst participation limited the researchers ability evaluate the second aim of the study: the extent to which three major inpatient electronic health records have accessibility design principles incorporated into the software.

Conclusions and Implications

This study has revealed positive attitudes toward software accessibility that are motivated by a desire to address the needs of disabled nurses and prevent patient harm that could result from a lack of accommodation. Analysts desire a better understanding of software accessibility and specifically how these design principles can be used to address the needs of disabled nurses. The EHR Accessibility Checklist demonstrated disparity between analysts as it relates to their knowledge of what design principles exist and at what frequency they are present in the software.

Furthermore, this study reveals a need for additional research in the area of EHR software accessibility. More should be done to understand the actual experiences of nurses with impairments, as it relates to EHR use, to ascertain the extent to which nurses believe accommodation has been made and how this impacts their ability to provide bedside care. Investigation into whether lack of accommodation presents a real patient safety risk is critical given that EHR use will soon be ubiquitous. Evaluation of the extent to which inpatient electronic health records include software accessibility design principles should be considered further and include participation from software developers. Lastly, there is opportunity to develop curricula aimed at increasing understanding of software accessibility and disability accommodation among EHR system analysts.

Appendices

Appendix A: EHR Accessibility Checklist

Instructions:

Please respond to each of the following statements with regard to the inpatient electronic health record you support by selecting Always, Sometimes, Never, Uncertain or N/A (not applicable).

- Select Always if the design principle is true for every use case in the software.
- Select Sometimes if the design principle is used in some cases but not others.
- Select Never if the design principle is never used in the software.
- Select Uncertain if you are not sure whether there are any applicable use cases.
- Select N/A (not applicable) if there no use cases in which the design principle would apply.

This checklist has been adapted from U.S. Department of Justice Software Accessibility Checklist, available at <http://www.usdoj.gov/crt/508/archive/oldsoftware.html>

	Keyboard Access	Always	Sometimes	Never	Uncertain	N/A
1.	The software provides keyboard equivalents for all mouse actions, including buttons, scroll windows, text entry fields, and pop-up windows.					
2.	The program provides clear and precise instructions for use of all keyboard functions as part of the user documentation.					
3.	Instructions regarding keyboard use widely available for all users.					
4.	The software has a logical tabbing order among fields, text boxes, and focal points.					
5.	There are well-defined focal points that move with keyboard navigation? (e.g., can you use the arrow keys to navigate through a list followed by pressing the ENTER key or space bar to select the desired item).					
6.	Shortcut keys are provided for all pull-down menus.					

	Keyboard Access	Always	Sometimes	Never	Uncertain	N/A
7.	The software supports existing accessibility features built into operating systems (e.g., sticky keys, slow keys, repeat keys in Apple Macintosh OS or Microsoft Windows OS).					
	Display					
8.	The software application is free of patterned backgrounds used behind text or important graphics.					
9.	A user can override default fonts for printing and text displays.					
10.	A user can adjust or disable flashing, rotating, or moving displays.					
	Screen Elements					
11.	All descriptions or labels for fields are positioned immediately to the left or directly above the field and they end in a colon.					
12.	Every window, object, and control has a clearly named label.					
13.	The software application uses standard controls rather than owner-drawn or custom controls. (e.g., standard icons in the upper right corner to minimize, maximize/restore down and close)					
	Icons					
14.	The software has a user selectable option to display text on icons, <u>i.e.</u> , text only icons or hover help.					
15.	The use of icons consistent throughout the application.					
16.	Menus with text equivalents are provided for all icon functions or icon selections on menu, tool, and format bars.					
	Color & Size					
17.	The software ensures that color-coding is never used as the only means of conveying information or indicating an action.					

	Keyboard Access	Always	Sometimes	Never	Uncertain	N/A
18.	The application supports user-defined color settings application-wide.					
19.	Highlighting is also viewable with inverted colors. (e.g., light highlighting inverted to dark highlighting)					
20.	The software picks up the size settings that the user has selected in the Control Panel.					
	Sound & Timing					
21.	Audio alerts are coupled with visual cues.					
22.	The software supports the "show sounds" feature where it is built into the operating system.					
23.	Users can disable or adjust sound volume.					
24.	Information provided in an audio format, is also capable of being displayed by the user in a visual format.					
25.	The software allows the user to modify the timing parameters of any required timed responses.					

Other:

26. What EHR did you just evaluate?

- PowerChart
- EpicCare Inpatient
- VistA

27. What is the version of the EHR you just evaluated _____?

28. How many years have you been a systems software analyst?

- Less than a year
- 1 to 2 years
- 2 to 5 years
- More than 5 years

29. How many years have you worked as a systems analyst on the inpatient EHR you just evaluated?

- Less than a year
- 1 to 2 years
- 2 to 5 years
- More than 5 years

Appendix B: U.S. Dept. of Justice Software Accessibility Checklist

Person filling out this Checklist:

Component/Agency:

Name:

Title:

Telephone:

Fax number:

E-mail address:

Software application under review:

Title/Version:

Developer (give full name, no acronyms):

Customization: choose the most appropriate description:

- (a) commercial off-the-shelf software (used "as is")
- (b) commercial software, but modified for agency use
- (c) custom software developed under contract
- (d) custom software developed in-house

Description: choose the most appropriate:

- (a) word processor
- (b) spreadsheet
- (c) database
- (d) groupware
- (e) e-mail
- (f) Internet browser
- (g) other Internet access
- (h) online database access
- (i) other (describe):

Used by approximately _____ members of the public and _____ Federal employees on a weekly basis.

Category	Question	Y	N	N/A
Keyboard Access	1. Does the software provide keyboard equivalents for all mouse actions, including buttons, scroll windows, text entry fields, and pop-up windows?			
Keyboard Access	2. Does the program provide clear and precise instructions for use of all keyboard functions as part of the user documentation?			

Category	Question	Y	N	N/A
Keyboard Access	3. Are instructions regarding keyboard use widely available for all users in your component?			
Keyboard Access	4. Does the software have a logical tabbing order among fields, text boxes, and focal points?			
Keyboard Access	5. When navigating screens and dialog boxes using the keyboard, does the focus follow a logical tabbing order?			
Keyboard Access	6. Is there a well-defined focal point that moves with keyboard navigation? (e.g., can you use the arrow keys to navigate through a list followed by pressing the ENTER key or space bar to select the desired item)?			
Keyboard Access	7. Are shortcut keys provided for all pull-down menus?			
Keyboard Access	8. Does the software support existing accessibility features built into the operating system (e.g., sticky keys, slow keys, repeat keys in Apple Macintosh OS or Microsoft Windows 95)?			
Timing	9. If timed responses are present, does the software allow the user to modify the timing parameters of any required timed responses?			
Screen Elements	10. Are all descriptions or labels for fields positioned immediately to the left or directly above the control, and do they end in a colon, so that it is easy for screen reading software to associate the labels with the corresponding fields?			
Screen Elements	11. Does every window, object, and control have a clearly named label?			
Screen Elements	12. Does the software application use standard controls rather than owner-drawn or custom controls?			
Icons	13. Does the software have a user selectable option to display text on icons, <u>i.e.</u> , text only icons or bubble help?			
Icons	14. Is the use of icons consistent throughout the application?			

Category	Question	Y	N	N/A
Icons	15. Are menus with text equivalents provided for all icon functions or icon selections on menu, tool, and format bars?			
Sounds	16. If there are audio alerts, are visual cues also provided? Note: Most operating systems handle this issue in the client/server environment; the question is most relevant in a dumb terminal environment.			
Sounds	17. Does the software support the "show sounds" feature where it is built into the operating system?			
Sounds	18. Can the user disable or adjust sound volume?			
Sounds	19. If information is provided in an audio format, is it also capable of being displayed by the user in a visual format?			
Display	20. Is the software application free of patterned backgrounds used behind text or important graphics?			
Display	21. Can a user override default fonts for printing and text displays?			
Display	22. Can a user adjust or disable flashing, rotating, or moving displays?			
Color	23. Does the software ensure that color-coding is never used as the only means of conveying information or indicating an action?			
Color	24. Does the application support user-defined color settings system-wide?			
Color	25. Is highlighting also viewable with inverted colors?			
Size	26. If the software application draws its own screen elements, does it pick up the size settings that the user has selected in the Control Panel?			
Documentation	27. Are all manuals and documentation provided in electronic format as well as ASCII text files, including text descriptions of any charts, graphs, pictures, or graphics of any nature?			

Category	Question	Y	N	N/A
Documentation	28. Can a user choose to have any report generated by the software made available in a "print to ASCII file" format?			
Training	29. Is special training provided for users with disabilities that will enable them to become familiar with the software and learn how to use it in conjunction with assistive technology provided as an accommodation?			

30. After you have evaluated this application using the Checklist, test it by running the application with a sampling of the common assistive technologies used by persons with disabilities (including, at a minimum, screen readers, and, if possible, alternate input devices, screen enlargement software, and voice recognition software and devices). Describe the accessibility successes and problems you encountered during these testing exercises, as well as your plans for addressing any problems:

Appendix D: Categories and subcategories resulting from interview analysis

Importance	
Level of importance	“Very high, very important”
Reason for importance	<p>“The medication admin [administration] instructions are very very small, this [nurse not being able to read instructions] can lead to an error”</p> <p>“We had a few [nurses] leave and I don’t think it was just because they were scared of computers but a combination of that they could see so well or hear so well...”</p> <p>“I just feel it is important that if there are users out there with a disability we should do what we can to accommodate their needs.”</p>
Response relative to level of importance	“I think... it [software accessibility] does not get enough attention.”
Awareness	
Level of awareness	“I think people were just not aware of the issues the disabled...care providers...faced. I just don’t think people were aware of what a challenge it would be to get through the day without tools.”
Generating awareness	“It just reminded me that I need to focus on that [software accessibility] so when I’m going to things like user groups I can bring up...the disabled and how we are going to meet their needs.”

Exposure to the need for accessible design	
Visual impairments	<p>“The most common thing I have heard from nurses, and we are in kind of an interesting situation because we have long term staff and many of them are reaching their retirement years and no necessarily ready to retire either, is that the fonts are not big enough for them.”</p> <p>“I’ve not been able to see where I can just make that modification [increase the font]...it is what it is for everybody...being able to bold something would help but we are not necessarily able to do that either”</p>
Physical impairments	<p>“I know that we ...had to have the system changed because she had to touch the screen because she couldn’t use the keyboard.”</p> <p>“We need to find out what is available to address issues [physical impairments], both through the software and from ergonomics”</p>
Improvements	
Education	<p>“What I think the improvement would be is that we do get some education on what the system can do for individuals with impairments.”</p>
Flexible design	<p>“...if we don’t have standard features that you can turn-off and on then you can’t meet the needs of the other people [without disability]”</p>

<p>Desire for collaboration & standards development</p>	<p>“EHR vendors in general...need to be...more collaborative with hardware vendors.” “How is your [the vendor’s] particular application going to play with a particular hardware.”</p> <p>“...are there the top three to five kinds of things [software accessibility features] that can be implemented in every EHR.”</p>
<p>Barriers</p>	
<p>Pace of change</p>	<p>“It [software] changes very quickly...there’s always new functionality coming out”</p> <p>“the 508 compliance changes lag behind the general updates to the software ...a good couple of years.”</p>
<p>Competing priorities</p>	<p>“...putting it all into perspective, it is kind of hard to prioritize that issue [accessibility issue] above something else that might be really important to the patient.”</p>
<p>Multipurpose & multi-user workstations</p>	<p>“...we have so many different kinds of software on our desktops it is not easy to just up and change the display for a particular application”</p>
<p>Lack of awareness</p>	<p>“unless you have the person with the disability you don’t think about it”</p> <p>“We need to be more aware of that [software accessibility] so that anybody that does have a challenge is able to use the system”</p>

Appendix D: Combined EHR Checklist Results

	Keyboard Access	Always	Sometimes	Never	Uncertain	N/A
1.	The software provides keyboard equivalents for all mouse actions, including buttons, scroll windows, text entry fields, and pop-up windows.	2 (33.3%)	4 (66.7%)	0	0	0
2.	The program provides clear and precise instructions for use of all keyboard functions as part of the user documentation.	1 (16.7%)	4 (66.7%)	1 (16.7%)	0	0
3.	Instructions regarding keyboard use widely available for all users.	2 (33.3%)	3 (50.0%)	1 (16.7%)	0	0
4.	The software has a logical tabbing order among fields, text boxes, and focal points.	3 (50.0%)	3 (50.0%)	0	0	0
5.	There are well-defined focal points that move with keyboard navigation? (e.g., can you use the arrow keys to navigate through a list followed by pressing the ENTER key or space bar to select the desired item).	3 (50.0%)	3 (50.0%)	0	0	0
6.	Shortcut keys are provided for all pull-down menus.	2 (33.3%)	4 (66.7%)	0	0	0

7.	The software supports existing accessibility features built into operating systems (e.g., sticky keys, slow keys, repeat keys in Apple Macintosh OS or Microsoft Windows OS).	2 (33.3%)	0	0	4 (66.7%)	0
Display						
8.	The software application is free of patterned backgrounds used behind text or important graphics.	4 (66.7%)	1 (16.7%)	0	1 (16.7%)	0
9.	A user can override default fonts for printing and text displays.	3 (50.0%)	2 (33.3%)	1 (16.7%)	0	0
10.	A user can adjust or disable flashing, rotating, or moving displays.	2 (33.3%)	1 (16.7%)	1 (16.7%)	1 (16.7%)	1 (16.7%)
Screen Elements						
11.	All descriptions or labels for fields are positioned immediately to the left or directly above the field and they end in a colon.	3 (50.0%)	2 (33.3%)	0	1 (16.7%)	0
12.	Every window, object, and control has a clearly named label.	4 (66.7%)	2 (33.3%)	0	0	0

13.	The software application uses standard controls rather than owner-drawn or custom controls. (e.g., standard icons in the upper right corner to minimize, maximize/restore down and close)	5 (83.3%)	1 (16.7%)	0	0	0
Icons						
14.	The software has a user selectable option to display text on icons, <u>i.e.</u> , text only icons or hover help.	3 (50.0%)	3 (50.0%)	0	0	0
15.	The use of icons consistent throughout the application.	3 (50.0%)	2 (33.3%)	1 (16.7%)	0	0
16.	Menus with text equivalents are provided for all icon functions or icon selections on menu, tool, and format bars.	4 (66.7%)	1 (16.7%)	1 (16.7%)	0	0
Color & Size						
17.	The software ensures that color-coding is never used as the only means of conveying information or indicating an action.	6 (100%)	0	0	0	0
18.	The application supports user-defined color settings application-wide.	2 (33.3%)	2 (33.3%)	1 (16.7%)	1 (16.7%)	0
19.	Highlighting is also viewable with inverted colors. (e.g., light highlighting inverted to dark highlighting)	1 (16.7%)	1 (16.7%)	2 (33.3%)	2 (33.3%)	0

20.	The software picks up the size settings that the user has selected in the Control Panel.	4 (66.7%)	0	1 (16.7%)	1 (16.7%)	0
Sound & Timing						
21.	Audio alerts are coupled with visual cues.	1 (16.7%)	1 (16.7%)	2 (33.3%)	2 (33.3%)	0
22.	The software supports the "show sounds" feature where it is built into the operating system.	1 (16.7%)	0	1 (16.7%)	3 (50.0%)	1 (16.7%)
23.	Users can disable or adjust sound volume.	1 (16.7%)	1 (16.7%)	1 (16.7%)	1 (16.7%)	2 (33.3%)
24.	Information provided in an audio format, is also capable of being displayed by the user in a visual format.	1 (16.7%)	0	1 (16.7%)	2 (33.3%)	2 (33.3%)
25.	The software allows the user to modify the timing parameters of any required timed responses.	1 (16.7%)	1 (16.7%)	2 (33.3%)	2 (33.3%)	0

Appendix E: EpicCare Inpatient EHR Checklist Results

	Keyboard Access	Always	Sometimes	Never	Uncertain	N/A
1.	The software provides keyboard equivalents for all mouse actions, including buttons, scroll windows, text entry fields, and pop-up windows.	0	3 (100%)	0	0	0
2.	The program provides clear and precise instructions for use of all keyboard functions as part of the user documentation.	0	2 (66.7%)	1 (33.3%)	0	0
3.	Instructions regarding keyboard use widely available for all users.	1 (33.3%)	1 (33.3%)	1 (33.3%)	0	0
4.	The software has a logical tabbing order among fields, text boxes, and focal points.	0	3 (100%)	0	0	0
5.	There are well-defined focal points that move with keyboard navigation? (e.g., can you use the arrow keys to navigate through a list followed by pressing the ENTER key or space bar to select the desired item).	1 (33.3%)	2 (66.7%)	0	0	0
6.	Shortcut keys are provided for all pull-down menus.	0	3 (100%)	0	0	0

7.	The software supports existing accessibility features built into operating systems (e.g., sticky keys, slow keys, repeat keys in Apple Macintosh OS or Microsoft Windows OS).	0	0	0	3 (100%)	0
Display						
8.	The software application is free of patterned backgrounds used behind text or important graphics.	1 (33.3%)	1 (33.3%)	0	1 (33.3%)	0
9.	A user can override default fonts for printing and text displays.	0	2 (66.7%)	1 (33.3%)	0	0
10.	A user can adjust or disable flashing, rotating, or moving displays.	1 (33.3%)	0	1 (33.3%)	0	1 (33.3%)
Screen Elements						
11.	All descriptions or labels for fields are positioned immediately to the left or directly above the field and they end in a colon.	1 (33.3%)	2 (66.7%)	0	0	0
12.	Every window, object, and control has a clearly named label.	2 (66.7%)	1 (33.3%)	0	0	0

13.	The software application uses standard controls rather than owner-drawn or custom controls. (e.g., standard icons in the upper right corner to minimize, maximize/restore down and close)	3 (100%)	0	0	0	0
Icons						
14.	The software has a user selectable option to display text on icons, <u>i.e.</u> , text only icons or hover help.	1 (33.3%)	2 (66.7%)	0	0	0
15.	The use of icons consistent throughout the application.	1 (33.3%)	1 (33.3%)	1 (33.3%)	0	0
16.	Menus with text equivalents are provided for all icon functions or icon selections on menu, tool, and format bars.	1 (33.3%)	1 (33.3%)	1 (33.3%)	0	0
Color & Size						
17.	The software ensures that color-coding is never used as the only means of conveying information or indicating an action.	3 (100%)	0	0	0	0
18.	The application supports user-defined color settings application-wide.	1 (33.3%)	2 (66.7%)	0	0	0
19.	Highlighting is also viewable with inverted colors. (e.g., light highlighting inverted to dark highlighting)	0	1 (33.3%)	1 (33.3%)	1 (33.3%)	0

20.	The software picks up the size settings that the user has selected in the Control Panel.	1 (33.3%)	0	1 (33.3%)	1 (33.3%)	0
Sound & Timing						
21.	Audio alerts are coupled with visual cues.	0	1 (33.3%)	0	2 (66.7%)	0
22.	The software supports the "show sounds" feature where it is built into the operating system.	0	0	0	3 (100%)	0
23.	Users can disable or adjust sound volume.	0	1 (33.3%)	0	1 (33.3%)	1 (33.3%)
24.	Information provided in an audio format, is also capable of being displayed by the user in a visual format.	0	0	0	2 (66.7%)	1 (33.3%)
25.	The software allows the user to modify the timing parameters of any required timed responses.	0	1 (33.3%)	1 (33.3%)	1 (33.3%)	0

Appendix F: CPRS EHR Checklist Results

	Keyboard Access	Always	Sometimes	Never	Uncertain	N/A
1.	The software provides keyboard equivalents for all mouse actions, including buttons, scroll windows, text entry fields, and pop-up windows.	1 (50%)	1 (50%)	0	0	0
2.	The program provides clear and precise instructions for use of all keyboard functions as part of the user documentation.	0	2 (100%)	0	0	0
3.	Instructions regarding keyboard use widely available for all users.	0	2 (100%)	0	0	0
4.	The software has a logical tabbing order among fields, text boxes, and focal points.	2 (100%)	0	0	0	0
5.	There are well-defined focal points that move with keyboard navigation? (e.g., can you use the arrow keys to navigate through a list followed by pressing the ENTER key or space bar to select the desired item).	1 (50%)	1 (50%)	0	0	0
6.	Shortcut keys are provided for all pull-down menus.	1 (50%)	1 (50%)	0	0	0

7.	The software supports existing accessibility features built into operating systems (e.g., sticky keys, slow keys, repeat keys in Apple Macintosh OS or Microsoft Windows OS).	1 (50%)	0	0	1 (50%)	0
	Display					
8.	The software application is free of patterned backgrounds used behind text or important graphics.	2 (100%)	0	0	0	0
9.	A user can override default fonts for printing and text displays.	2 (100%)	0	0	0	0
10.	A user can adjust or disable flashing, rotating, or moving displays.	0	1 (50%)	0	1 (50%)	0
	Screen Elements					
11.	All descriptions or labels for fields are positioned immediately to the left or directly above the field and they end in a colon.	1 (50%)	0	0	1 (50%)	0
12.	Every window, object, and control has a clearly named label.	1 (50%)	1 (50%)	0	0	0

13.	The software application uses standard controls rather than owner-drawn or custom controls. (e.g., standard icons in the upper right corner to minimize, maximize/restore down and close)	1 (50%)	1 (50%)	0	0	0
	Icons					
14.	The software has a user selectable option to display text on icons, <u>i.e.</u> , text only icons or hover help.	1 (50%)	1 (50%)	0	0	0
15.	The use of icons consistent throughout the application.	1 (50%)	1 (50%)	0	0	0
16.	Menus with text equivalents are provided for all icon functions or icon selections on menu, tool, and format bars.	2 (100%)	0	0	0	0
	Color & Size					
17.	The software ensures that color-coding is never used as the only means of conveying information or indicating an action.	2 (100%)	0	0	0	0
18.	The application supports user-defined color settings application-wide.	0	0	1 (50%)	1 (50%)	0
19.	Highlighting is also viewable with inverted colors. (e.g., light highlighting inverted to dark highlighting)	0	0	1 (50%)	1 (50%)	0

20.	The software picks up the size settings that the user has selected in the Control Panel.	2 (100%)	0	0	0	0
Sound & Timing						
21.	Audio alerts are coupled with visual cues.	00	0	2 (100%)	0	0
22.	The software supports the "show sounds" feature where it is built into the operating system.	0	0	1 (50%)	0	1 (50%)
23.	Users can disable or adjust sound volume.	0	0	1 (50%)	0	1 (50%)
24.	Information provided in an audio format, is also capable of being displayed by the user in a visual format.	0	0	1 (50%)	0	1 (50%)
25.	The software allows the user to modify the timing parameters of any required timed responses.	0	0	1 (50%)	1 (50%)	0

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