Impact of Training Methods on Task Completion Time and Error Rates: Implications for caBIG®

W. Baxter Webb BSPH[1], Hank Head BS[1], Chris Leithe BS[1], Susan Doan MBA[1], Surya Singh, MD[1,2]

1 Proventys, Inc. Durham, NC 2 Division of General Internal Medicine, Brigham and Women's Hospital, Boston, MA

Background

Proventys' clinical decision support platform, the Proventys PDx System™, is designed to deliver validated predictive tests and other tools at the point of care. The system functions as a stand-alone, Web-2.0 browser-based application or can be integrated with an EMR or other IT platform to facilitate use by clinicians. The Proventys PDx System™ also allows for the collection of data at the point of care to inform the development and validation of future models as treatment protocols evolve and predictive factors change. Proventys PDx Oncology 1.0 contains the company's first predictive test, the FN PDx (. The FN PDx uses demographic, PMH, laboratory, and treatment factors to estimate the likelihood of a patient's personalized risk of developing febrile neutropenia from cancer chemotherapy.

When deployed through a graphical user interface, personalized clinical decision support tools such as the FN PDx require a development process that incorporates user-centered design (UCD), with its intensive user testing and revision, to ensure ease of use and optimization of the tool's utility. This is especially true when the tool uses new technologies or presents information in an new format as does the FN PDx (and some potential caBIG® tools). In this study, we examine the impact of UCD-based system optimization and the benefit of various training methods through an analysis of time on task and error rates.

Methods

Participants were recruited from Boston area academic and community oncology practices. Each subject was randomized to no training, user manual training or video based training and asked to complete a series of tasks for the same six patient cases. Briefly, these tasks included:

- inputting simulated patient data into the system from a mock medical record
- assigning a predefined chemotherapy regimen
- calculating a percentage score for the risk of febrile neutropenia (using the FN PDx)
- interpreting the score and guidelines, and deciding on the optimal course of action.

Error rates including error type (incorrect data entry, missed data entry, unable to locate item, and missed score interpretation) and time on task were recorded for each case completed by each participant. Descriptive statistics were used to compare the average time on tasks and error rates between different versions of the user interface: pre-optimization (Design 1), after one revision (Design 2), and after optimization (Design 3). Descriptive statistics were also used to determine any differences between the various training measures employed.

Results

Prior to the start of the study, the system was optimized to reduce errors and improve time on task through two previous rounds of usability testing and hazard analysis. The untrained user working in the earliest prototype (Design 1) took, on average, 296.4 seconds [95% CI: 196.5 – 396.3 s] to complete the task and made a mean 1.14 errors per patient case. Figure 1 shows the impact of user interface optimization on the average time on task for the clinical cases presented.

After optimization, 13 of the 14 study participants completed all six cases and were included in this analysis. Mean time on task was 79.8 seconds [95% CI: 55.0 – 104.6 s}, 79.0 seconds [95% CI: 51.1 – 106.9 s] and 72.0 seconds [95% CI: 59.0 – 85.0 s] for no training, user manual training, and video training respectively. Figure 2 shows the average time on task for each arm of the study. Aside from typographical mistakes, no errors (of those in the categories listed above) were made by users in any of the three groups.

Discussion

Studying clinician interaction with a clinical decision support system has profound implications for task completion time and error rates. For this predictive model and tool designed for use by oncologists, usability testing identified features that were inefficient or difficult for the clinical end-users to complete accurately. This allowed for modification to the tool's design and ultimately allowed improvements that both dramatically decreased the time required to complete tasks and led to reductions in the number of errors made.

The difference between the various training methods was negligible, but there was an observed decrease in the time it took to perform more complex cases with training (cases 4 and 5). Based on these results, video training may provide some advantage in driving the adoption of conceptually new informatics tools such as the Proventys PDx Oncology and those contemplated by caBIG®.

Figure 1: Average Time on Task by UI Design

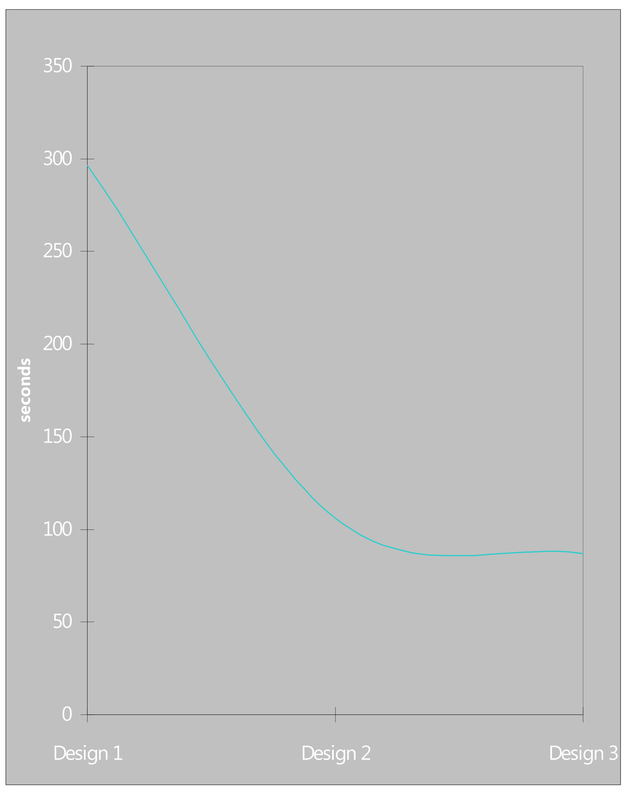
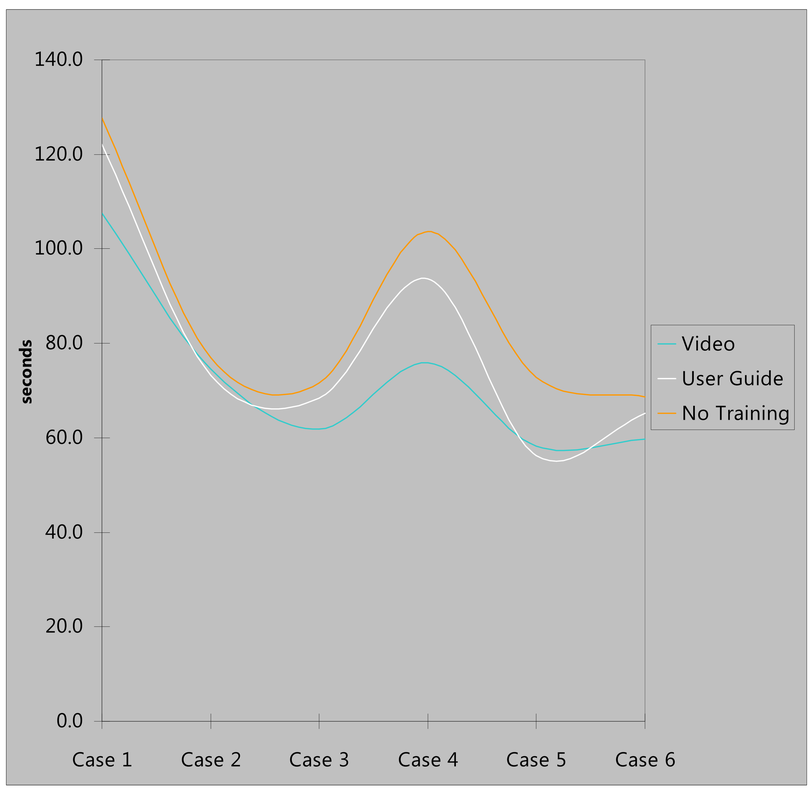


Figure 2: Time on Task by Training Method



* CAUTION -- Investigational device. Limited by Federal law to investigational use)