

Applying Visual Analytics to Support Clinical Competency Assessment for Internal Medicine Residents

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Introduction

Clinical Competency Committees (CCCs) are groups that use a variety of clinical and educational data to make formative and summative assessments^{1,2}. These include decisions about a resident physician's progress, growth, and readiness to practice unsupervised. One way to evaluate the large and varied datasets that come from medical education programs is by using visual analytics techniques such as dashboard development. A preliminary systematic scoping literature review by this author (to be presented as a poster at the 2022 AMIA Annual Symposium) found that the field currently lacks recommendations for best practices when developing a visual analytics solution for a medical education problem like competency assessment. Our prior work conducted qualitative analysis of interviews with CCC members to generate four design recommendations: 1) CCCs designing dashboards should integrate quantitative and qualitative feedback into their design, 2) dashboards should create multiple views to display data based on user roles, 3) programs should work with designers to create a usable, interpretable dashboard, and 4) teams must develop a strong informatics pipeline to manage the system. Now, this system demonstration shares the visual analytics techniques we used, what functionality we included, and how our system design could be generalized to other programs or specialties looking to develop their competency assessment programs.

Methods

The dashboard was developed using Python 3.8³ and the *Flask* framework⁴ following user-centered design principles⁵ and agile software development⁶. This allows for the CCC members that serve as "reviewers" on the committee to track a resident's progress through the years that they are involved with the program. A core team was formed to develop the project including a medical informatician, the Internal Medicine program director, multiple members from the CCC, a professional designer with user interface and experience (UI/UX) skills, a visualization expert, and students from the corresponding author's lab (Wu). The dashboard was developed in a user-centered manner and refined iteratively beginning in October 2021 and continuing through the time of submission of this abstract (9+ months). Significant effort was placed on the creation of a data pipeline that could handle monthly updates, processing, and storage of the dataset. The new dashboard was preliminarily evaluated through observation of domain experts (including CCC members) utilizing the system and comparing results to the old dashboard.

Results

The dashboard visualizes the data using line charts, spider charts, heatmaps, and other visualizations at the individual resident level (Figure 1). The choice of which visualizations to include in this system is supported by experts in the Clinical Competency Assessment domain⁷. Several challenges arose when developing the data pipeline that handles this data. These include the creation of identifiers amid constant changes of residents and evaluation forms, the standardization of the current data processing protocol, and the organization of database schema to remove duplicate entries while maintaining the speed of querying such a large dataset. At the time of submission, we were able to develop several webpages for access control, resident selection, and visualizations. Three CCC review sessions were observed in November 2021, February 2022, and August 2022 (2-3 hours each meeting) to collect the context of use of the old system and to confirm the facial validity of the new system.

Discussion

We followed the four recommendations from our previous work to create dashboard that is more flexible, intentionally designed, and strongly supported by an informatics team. This new dashboard also allows for the CCC at the University of Cincinnati College of Medicine to access multiple data sources, one of their main concerns about their original system. This is important because fully integrated, data driven competency assessment dashboards are rare among residency programs. It is our goal to design the dashboard in a generalizable manner so that it can be expanded to other residency programs both within and outside of our institution. Our future work includes conducting more rigorous usability testing, integrating EHR performance metrics and patient outcomes, and designing role specific views of the dashboard.

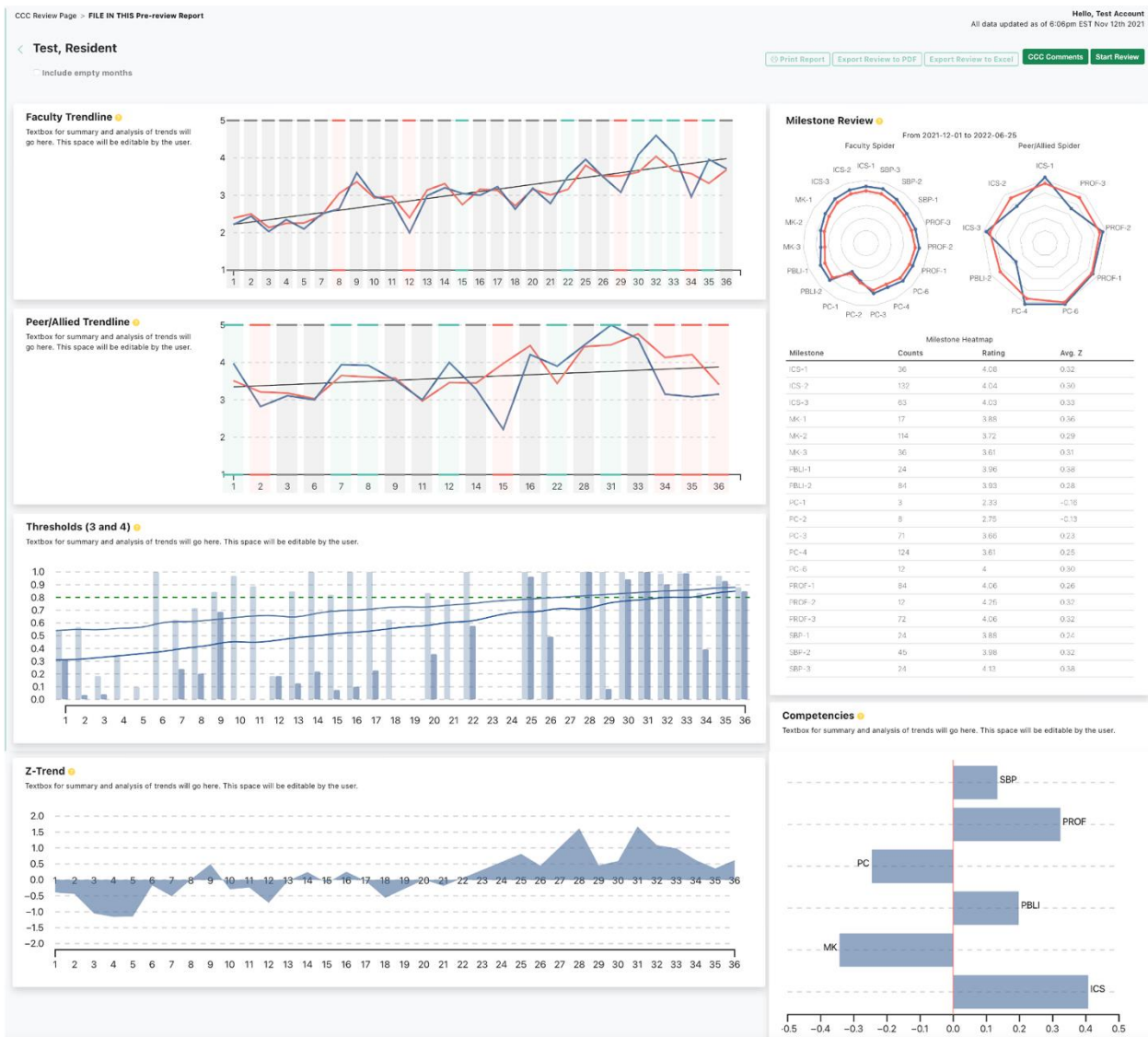


Figure 1. Resident Page on the Redesigned Dashboard Interface. Visualizations include trendlines showing the average actual (blue lines) and expected (red line, from a regression model) entrustment ratings per month. Also on this chart is a black best fit line and colored bars to show when the z-score is above or below a predefined threshold. Next, there are spider charts to show average score (both actual in blue and expected in red) by competency as well as a table to show this information another way. Finally, there is a combination bar and line chart to show the percentage of ratings at/or above levels 3 and 4, a z-trend graph to show the average z-score of the ratings per month, and a competencies bar chart to show the overall z-score by competency being assessed.

References

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Abstract (50-75 words)

Clinical Competency Committees (CCC) assess the progress and readiness to practice of medical residents in their programs. Working with the CCC at our institution, we employed user-centered design to implement an interactive dashboard that would assist their competency assessment process. In this system demonstration poster, we discuss the dashboard that we have built and how visual analytics can be used to improve the resident competency assessment process.