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User-Centered Data Display for Clinicians to Diagnose and Manage Hypertension

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Abstract. The accurate diagnosis and effective treatment of hypertension are hindered by challenges stemming from limited access to comprehensive blood pressure (BP) data and the need for clinical context surrounding BP readings. Using handwritten tables for home-monitored BP exacerbates issues related to integration of electronic health records (EHRs) and trend analysis. This study employs user-centered design principles to develop prototypes for BP data visualization, with the primary goal of harmonizing disparate BP data sources to empower clinicians in precise hypertension diagnosis and management.

Keywords. User-centered design, blood pressure, hypertension, data visualization, electronic health record

1. Introduction

Hypertension management faces obstacles such as sporadic at-home blood pressure monitoring and uncertainties during medical consultations [1,2,3]. Accurate blood pressure data acquisition from home settings is pivotal. However, prevailing methods, such as handwritten annotations, hinder healthcare practitioners' ability to discern patterns[4,5]. Presenting BP data alongside EHRs is vital. Discussions around current EHR systems revolve around data integration and visualization optimization [1,2,3]. Seamlessly integrating BP measurements from home with EHRs remains a significant challenge. In addressing this complexity, our team employed a user-centered design and an external data visualization approach to prototype synthesized BP readings with relevant clinical data, aiming to enhance hypertension diagnosis and treatment efficiency and precision.

2. Methods

A graphical representation of systolic and diastolic BP tailored to clinicians' needs was selected. Interactive dual-line graphs were created using Tableau to show longitudinal data patterns, trends, and relationships. Guided by the Task, User, Representation, and Functionality (TURF) model [6] and Gestalt Theory [7], this visualization aimed to

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externally represent BP values and facilitate crucial relational data displays for hypertension diagnosis and management.

3. Results

A user-centered design (UCD) iteration of the Tableau display was generated to assist clinicians in diagnosing and managing hypertension. The visualization featured dual line graphs with color-coded systolic and diastolic BP values, while heart rate and cholesterol data were represented separately. A tabular format displayed height, weight, and blood pressure values, supplemented by timely alerts and personalized annotations for enhancing clinician decision-making. This UCD approach ensured an organized and efficient presentation, reducing cognitive strain and providing a user-friendly experience. The visualization utilized authentic health record data, emphasizing visual elements like color palettes, layout, proportions, and simplicity to expedite decision-making.

4. Conclusions

The significance of the UCD approach was prominently manifest in the iterative enhancement of the visualization framework, aimed at guaranteeing optimum clinician satisfaction and seamless usability. This iterative optimization process is subject to rigorous evaluations extending beyond controlled laboratory environments, most notably within authentic real-world clinical practice settings. Notwithstanding inherent limitations, the present study underscored the practicability and inherent merits associated with the strategic utilization of visualization tools in the domain of hypertension diagnosis and management. Aligning with other BP visualization projects [1,2,3], this effort is poised to benefit clinicians in effectively addressing hypertension challenges.

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