

Jointly Visualizing Patient-Generated and Clinic Blood Pressure Readings

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Introduction

Advances in consumer health informatics (CHI) technologies have increased the possibilities for information sharing, and potentially more thoughtful dialogue, between patients and clinicians¹. However, the effective integration of diverse CHI technologies – and related patient-generated data – into clinical care is challenging. In particular, the direct inclusion of patient-generated data in the EHR may cause apprehension, with clinicians voicing concerns about the reliability and meaningfulness of the data². The goal of the visualizations described below was to jointly display patient-generated and clinic blood pressure readings to clinicians. The visualizations maintain data *reliability* by clearly differentiating between patient-generated and clinic readings, and ensure the data are *meaningful* by showing changes over time and mapping readings to known hypertension severity categories³.

Data and Visualization Design

The data in the visualizations come from an intervention titled CONtrolling Disease Using Inexpensive Information Technology – Hypertension in Diabetes (CONDUIT-HID), aimed to develop and implement a technology-supported model of care to manage the hypertension among diabetic patients⁴. As a part of CONDUIT-HD, patient-generated blood pressure (BP) data for a pool of diabetic, hypertensive patients (n=99) were integrated with clinical data in the patients' EHR flowsheets. Based on our experience in the project, and the limitations of the EHR, we are designing a prototype dashboard (Tableau, Seattle, WA) for clinicians to view and explore these data. The dashboard, once finalized, could be replicated by EHR vendors or built as a FHIR app.

The dashboard (Figure 1) contains two high-level views, which users can easily navigate between using the buttons at the top of the screen. We start by showing systolic and diastolic BP readings for all patients, based on Shneiderman's "overview first, zoom and filter, then details-on-demand" framework, and potential use for population management⁵. The displayed time range is customizable; in the examples below we show data before and after patient-generated data started being included in the EHR. The left visualization focuses on reading types (clinic, home), using color to clearly differentiate between patient-generated (home) and clinic readings, a priority for clinicians. The goal ranges for each parameter – for treated hypertensive patients (as opposed to normal patients) – are shown using the green horizontal bands. The right visualization focuses on the clinical significance of the readings, mapping each reading to one of four hypertension categories (Normal, Prehypertension, Stage 1, Stage 2)³. Patient-generated and clinical readings are still differentiated, but using marker shape instead of color.

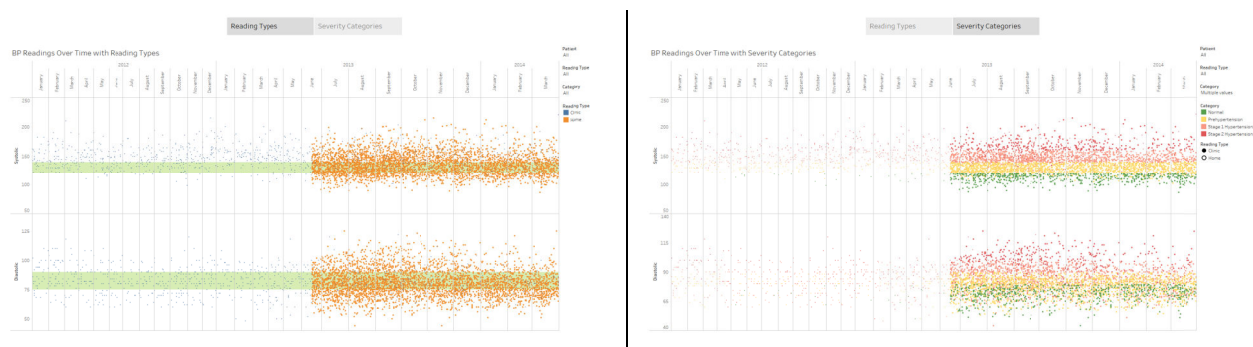


Figure 1. Two Dashboard Views Showing All Patient Data

Users can filter readings by: 1) Patient, showing readings for one or more specific patients, 2) Reading type, showing home and/or clinic reading locations, and 3) Category, showing readings for one or more severity level. Users can zoom in on a specific time range, or hover over a data points to display a tool tip with the Patient ID, SBP/DBP values, Category, Reading Type, and Reading Date. We did not overlay trend lines on the visualizations, as doing so distracts from the irregularity and variability of the data, and the human mind is capable of overlaying a rough trend line of the data. Figure 2 shows filtered visualizations for three different patients, demonstrating the value of one of the three filtering options, and how the filtered data appear in the two different views.

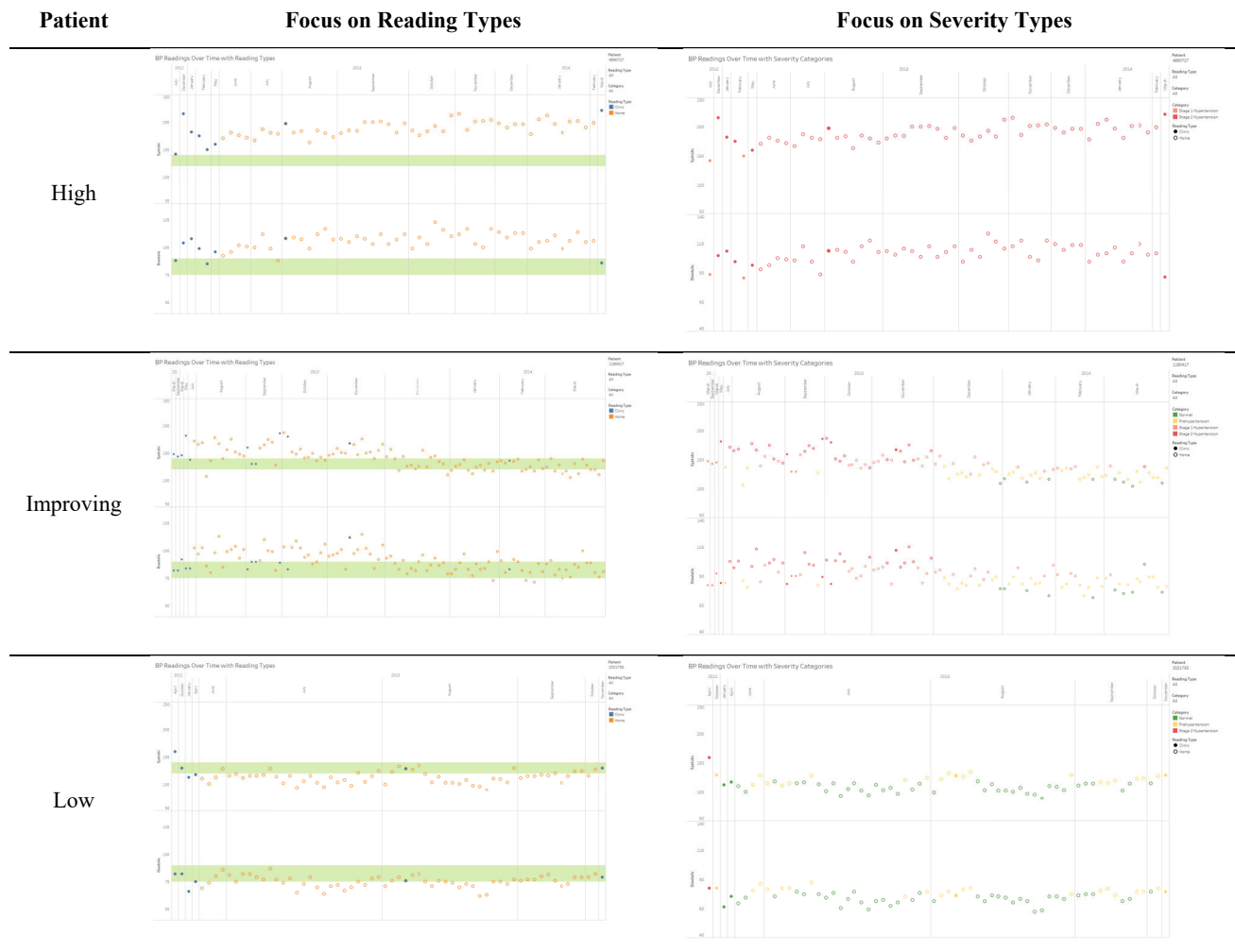


Figure 2. Filtered Views for Three Patients' Readings

Conclusion

By making thoughtful visualization design decisions, we have created a dashboard that allows clinicians to jointly view longitudinal patient-generated and clinic blood pressure data, in a way that supports the reliability and meaningfulness of the data. This approach could be extended to other types of patient-generated data.

References

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