

Case Study 7: Design of Display of Patient Vital Signs in EHR of a Large Hospital

Purpose: Draft a new information visualization design for patient vital signs data from an EHR system used by a large hospital.

Requirements: Must help both clinicians and patients to learn more from patient vital signs data:

- 1) heart rate (normal range: 60-140 beats/min);
- 2) blood pressure (normal range: 90/60-120/80 mmHg);
- 3) Temperature (normal value: 98.6 degrees Fahrenheit);
- 4) Lab Results (phosphorus levels, normal range 2.5-4.3 mg/dL)

Data visualization: simple line graphs will easily show trends in the specific patient vital signs against the date of the tests (specified vital sign vs date range).

Values Outside of the Normal Range: values will be **bold** and in **red** when presented in a tabular format.

Temporal trends in Values: for the purposes of this simplistic data, the data is displayed over time of all the available data points. Filtering data sets is a functionality that is valuable on larger, more complex data sets.

Seasonal trends in Values: there is a dropdown Seasonal Trends menu to display on the graph, a color shaded region under the trend line over the months that cover the selected season.

Season	Color (font and shading)	Months
Winter	Medium blue	December, January, February
Spring	Medium purple	March, April, May
Summer	Pastel pink	June, July, August
Fall	Dark orange/brown	September, October, November

Results: Mockups were created using Balsamiq with 27 callouts to show a working draft of the design for a page in the EHR for the Patient Vital Signs.

Callouts 1 to 27

1: A profile picture of the patient for a quick visual to ensure the patient record corresponds to the same person you as the clinician is talking to. Addresses patient safety.

2: Patient header is in bold and blue, a different color to visually pop against the black and gray of the page. Addresses patient safety.

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3: "LAST NAME, First Name, Middle Name (Patient ID: xxxxxxx)" is displayed as a link and clicks to the home page for the patient's EHR. Listing all of that data is important to check the patient being seen is the same patient as the displayed patient record. Addresses patient safety.

4: Each of the 4 Patient Vital Signs are displayed as a folder tab: Heart Rate, Blood Pressure, Temperature, Lab Results. The Heart Rate tab displays as the default.

5, 6, 7: A clickable menu is displayed of <Details>, <Past Results>, <Graph of Past Results>. Each selection displays a page of the relevant information.

8, 9: The <Details> menu displays the "Comments from the Doctor's Office" with a personalized message from the doctor or doctor's office. This information is the first thing displayed and more pertinent as it is the interpretation of results or comments that the clinician wishes to convey.

10: Component Results header displays the table of the patient's vitals for the Heart Rate, the value taken, and the standard range.

11: This section is a general description of the Patient Vital Sign and basic information for the patient. The patient vital sign type is displayed based on the folder tab that has been selected. Heart Rate folder tab will display general heart rate information in the right column. Blood pressure folder tab will display general blood pressure information in the right column. Temperature folder tab will display general information about the body temperature in the right column.

12: <Past Results> menu displays in a table format the name of the result, the standard range of normal, the date the vital was taken, and the result.

13: <Graph of Past Results> displays a line graph of the patient vital (in this example, heart rate: beats/min) charted over time. This display should have only **ONE** line. The standard line graph Balsamiq uses contains 2 lines.

14: A drop down menu to select the season to view the data over seasons. Multiple season selections are allowed. The default view is "All". If default view or "All" is selected, there is no shading that is visible. All shading is removed.

The dropdown Seasonal Trends menu displays on the graph, a color shaded region under the trend line over the months that cover the selected season. Refer to **Seasonal trends in Values** mentioned in the beginning of this report for details.

15: High range of normal is indicated by a solid green line. Quick visual reference addresses a lightening of the cognitive load on the clinician and an instructional reference tool for the patient.

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16: Low range of normal is indicated by the dotted green line. Quick visual reference addresses a lightening of the cognitive load on the clinician and an instructional reference tool for the patient.

17: Each data point has the ability to display the data point when hovered over. Mouseover allows for a quick reference of a data point by the clinician. Quick visual reference addresses a lightening of the cognitive load on the clinician and an instructional reference tool for the patient.

18: The <Blood Pressure> folder tab displays the <Details> menu with the Comments from the Doctor's Office and the Component Results.

19, 19a: There can be additional tips or health information in this section by the doctor for the patient. Here is an example of "Tips to control blood pressure". The right arrow can be clicked and an accordion section opens up to display the 8 listed tips. The arrow can be clicked again to collapse the Tips display. Quick visual reference functions as an instructional reference tool for the patient.

20: <Past Results> menu displays the relevant information of the Blood Pressure data over time in a tabular format.

21: <Graph of Past Results> displays a line graph of the patient vital (in this example, blood pressure: mmHg) charted over time. This display should have only **ONE** line. The standard line graph Balsamiq uses contains 2 lines. Same functionality exists across all Patient Vitals folder tabs and <Graph of Past Results> menu selection.

22: The <Temperature> folder tab displays the <Details> menu with the Comments from the Doctor's Office and the Component Results. There is the option to select from the menu <Past Results> or <Graph of Past Results>.

23: The <Lab Results> folder tab displays the <Details> menu with the Comments from the Doctor's Office and the Component Results.

24: In the Component Results table, 5.1 is out of normal range, so it should be displayed in bold and in red. Quick visual reference addresses a lightening of the cognitive load on the clinician and an alert for both the clinician and the patient.

25: <Past Results> menu displays the relevant information of the Phosphorus level for each date the vital information was taken.

26: Since the 5.1 is out of normal range, that is displayed in bold and in red. Quick visual reference addresses a lightening of the cognitive load on the clinician and an alert for both the clinician and the patient.

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27: <Graph of Past Results> displays a line graph of the patient vital (in this example, blood pressure: mmHg) charted over time. This display should have only **ONE** line. The standard line graph Balsamiq uses contains 2 lines. Same functionality exists across all Patient Vitals folder tabs and <Graph of Past Results> menu selection.