Design Document

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Strategy

The project objective is to improve user understanding of publicly reported HAI data. Specifically:

1. Improve understanding when showing data for one hospital
2. Improve understanding when comparing hospitals

The potential users of this interface are members of the general public who are interested in understanding HAI data but have no special expertise or training.

The user needs the high-level benefits users can expect from the project. Specifically:

1. Users should be able to determine whether a given hospital has HAI rates that are significantly better or worse than expected.
2. Users should be able to make accurate comparisons among hospitals using HAI data.

The primary focus of the interface design is on the data presentation method. A website (haicompare.org) will be created to showcase this data presentation method.

Scope

This section identifies *functional and content requirements* for the interface based on the project objectives and user needs.

For the HAI data presentation method, the *functional requirements* described below using user stories. A user story is a method for making abstract user needs more concrete. It is a scenario written about a specific hypothetical user that embodies what that user needs out of the interface.

1. Compare HAI data for hospitals in a specific geographic region
    a. User story: Alice is choosing a hospital for her ailing mother, who has an indwelling urinary catheter, and she is worried about CAUTI. She wants to find a hospital with low CAUTI rates in her area.
    b. User story: Bob is getting knee replacement surgery. He is concerned about surgical site infections. He is trying to choose between the three best hospitals in his state, and wants to see how they compare on SSI rates. (Note: the data presentation method is the same for both CAUTI and SSI.)

2. View HAI data for a single specific hospital
    a. User story: Carol's doctor referred her to Hospital X, and she wants to see how this hospital compares to the state average for HAIs. She is interested in HAIs as a proxy for overall quality of care.

The *content requirements* for the HAI data presentation method are primarily formed by the HAI data that are publicly available for hospitals in the United States. These data are:

- Number of observed infections per hospital (e.g. number of CAUTI)
- Number of person-days observed per hospital (e.g. catheter-days)
- Number of predicted infections
- SIR, with 95% confidence interval

Thus, the content for the data presentation method is limited to these variables or variables derived from them.

Structure

This section defines how the functional and content requirements fit together in a cohesive interface.

For the HAI data presentation method, this means generally specifying how the user will interact with the interface and how information will be organized.

- HAI data for multiple hospitals must be able to be viewed on the same page in a way that facilitates comparisons among the hospitals.
- Based on observations during Aim 1 interviews and the Aim 1 data, we hypothesize that displaying all the available HAI data (as is currently done on CMS Hospital Compare) may be confusing to users. Thus, we will display a summary of the data, while employing “details-on-demand” from the Visual Information Seeking Mantra (37) to show additional data contextually. This means that the user can view additional data directly from the summary, and without losing their place.
- Understanding the relevance of HAI data requires understanding medical terminology like “urinary tract infection” and “catheter”. Our interface should also provide definitions and additional information about any medical terminology contextually.

We will assess the following during user testing:

- Can users easily compare hospitals using the data summary as presented, including information presented in “details-on-demand”?
- “Details-on-demand” interface elements
    - Is the interface for displaying details intuitive?
    - Do the data details complement or contradict the data summary?
    - How important are the data details in the process of interpreting the data?

- Contextual additional information (essentially “more info” buttons)
    - Is the interface for displaying these intuitive?
    - Do users feel these are helpful in understanding the data?

Skeleton

This section identifies the specific user interface elements needed for implementing what is described in the previous sections. It leads to a “wireframe” or mockup of the interface that specifies the location and type of user interface elements, but ignores visual polish and color choices.

Possible data presentation methods fall on a continuum from words to graphics:

- Text (sentences or paragraphs)
- Text-tables (short sentences or sentence fragments aligned in a table)
- Tables
- Graphics

Comparisons among hospitals will likely be difficult without some structure imposed by the website design. For example, a paragraph of sentences describing HAI data for five hospitals would make it difficult to compare the first hospital to the fifth hospital. A purely graphical presentation method will also likely prove difficult to interpret without substantial interactive explanation. Thus, the starting point for the skeleton will be table-based.

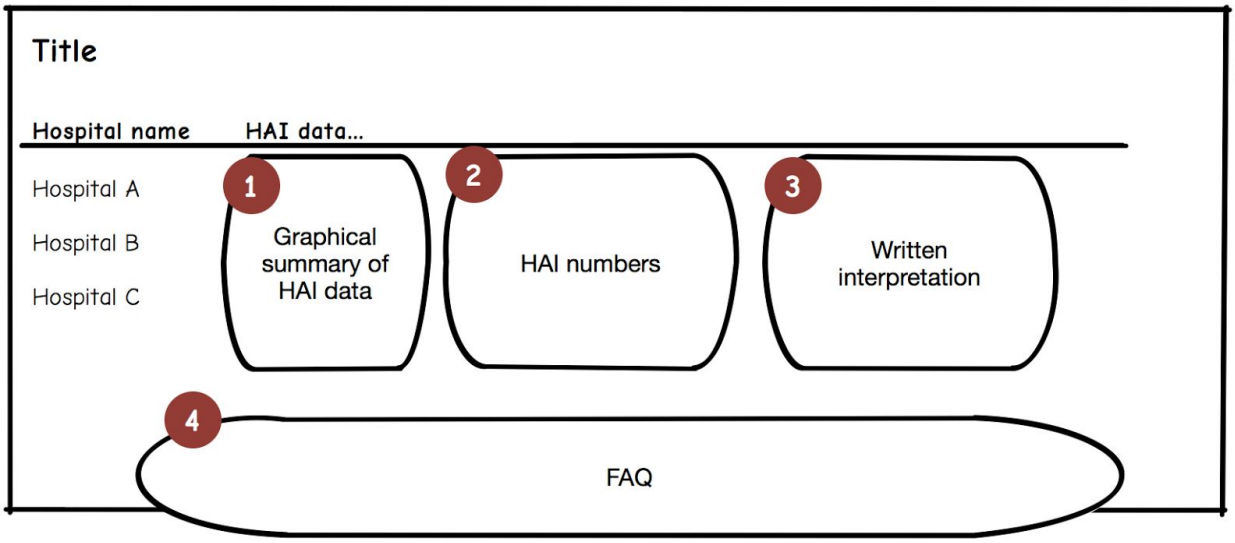
At this point, it is instructive to examine the current CMS Hospital Compare website. This website provides two table-based HAI data presentation methods and a graph-based presentation method. The default “simple” table displays only a written summary of the SIR in the form “[Better than/Worse than/The same as] the U.S. National Benchmark”. This avoids the problem of encouraging users to directly compare SIRs, but provides very little information: a hospital with a SIR of 1.1 could potentially look the same as a hospital with a SIR of 10 due to overlapping confidence intervals.

The other table-based presentation method on CMS Hospital Compare provides the number of infections observed, the denominator (e.g. catheter-days), the expected number of infections, the SIR, and the written summary of the SIR. Based on Aim 1 data, it was difficult for users to determine how these data relate to each other, though this is explained in the table’s column headings. Because of this, users found it difficult to know which column(s) to compare. When presented with data that, without a full understanding of how the columns related, made the columns appear to contradict themselves (e.g. two hospitals with very different denominators and similar SIRs), users were unable to reliably identify the better-performing hospital.

Based on this analysis, the new data presentation interface must strike a balance between the two types of tables on CMS Hospital Compare. Specifically, it must provide some information beyond CMS Hospital Compare’s written SIR summary, but should not provide

so much information that it is confusing to users. Additionally, it should not encourage a direct comparison between SIRs. Ideally, it should incorporate the 95% confidence interval for the SIRs, which is not shown in either CMS Hospital Compare table, as this is necessary to truly evaluate hospital performance.

Figure 1. Wireframe for new HAI data presentation method.



This wireframe uses the same general design of the CMS Hospital Compare table, but completely changes the content and its positioning. Each of the numbered regions is explained below:

①This is a “small multiple” style graphic showing the 95% confidence interval for the SIR. By making it physically small, I hope to avoid issues around directly comparing SIRs by making only large differences stand out. Presumably, shifting-base distortion is worse for SIRs that are close in value; large differences are less likely to be impacted by any bias.
②These are the numbers used to make the area marked with ①.
③This is an interpretation of ① and ② similar to the written SIR interpretation on CMS Hospital Compare. The goal is to guide the user’s interpretation of ① and ②. It is placed to the right of ① and ② so users will not start with it and then ignore the other information in the table.
④This is space for contextual information about the data in the table. User testing will determine what is included here.

We will assess the following during user testing:

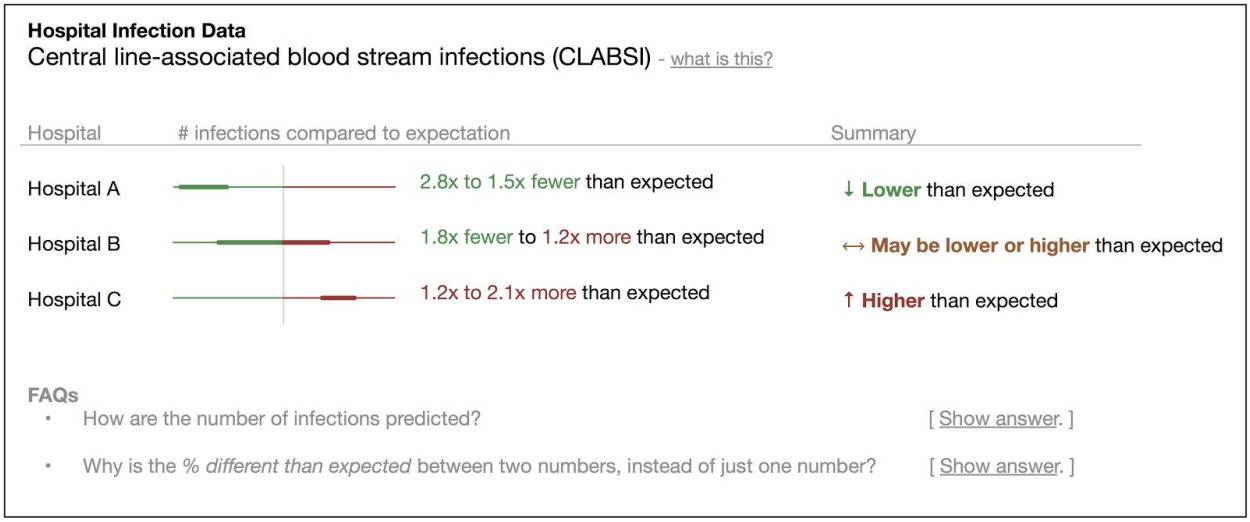
- Do users use need ② to interpret ①, or can ① stand alone?
- Do users default to ③ without looking at ① and ②?

- What information should be included in ④ and in other contextual help?

Surface

This section describes the polished design prior to the start of user testing.

Figure 2. The initial design comprehensive ("design comp") of the new data presentation method.



Features of the initial design comp include:

- "Small multiple" graphics share an axis with a size based on the SIRs of the hospitals displayed. Figure 2 shows an axis that ranges from 3x fewer to 3x more infections than expected.
- Rather than a SIR, we use "times-different than expected" calculated from the SIR. We hypothesize that this will be much easier for users to interpret. Hospital A in Figure 2 corresponds to a SIR 95% confidence interval of 0.36 to 0.65.
- This interface de-emphasizes the point estimate for the SIR in favor of the 95% confidence interval. The reasoning behind this is that we hypothesize users will fixate on the point estimate and ignore the statistical uncertainty, which could lead to inaccurate conclusions.
- A red-orange-green color scheme is used to indicate SIRs above, equal to, and below 1. The color scheme also ties together the elements of the table.

We will assess the following during user testing:

- Is the color scheme effective?
- Are the confidence intervals interpreted correctly?
- Is the microcopy understandable? What elements of the interface need contextual help?

- Is it necessary to add axis labels to the small multiple graphs (e.g. “← better than expected | worse than expected →”)?