COVID Gowns: Breaking Scales with an Unknown End

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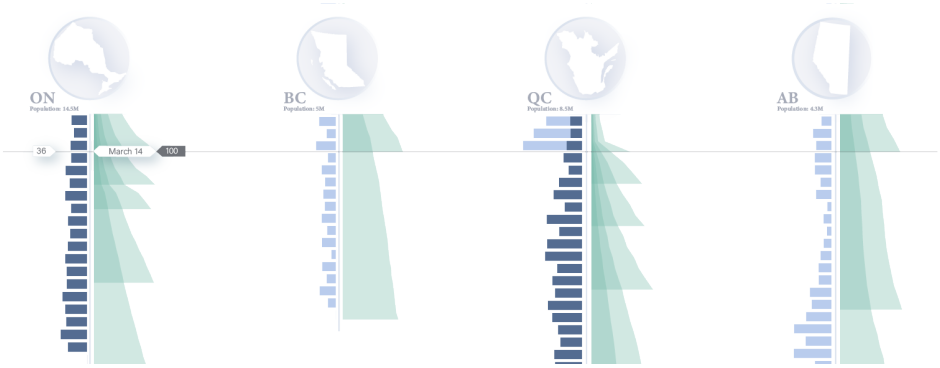

Figure 1: Each *Gown* represents a Canadian province and compares regional progression of the pandemic using cumulative case numbers(right) and daily new confirmed cases(left). The *Gowns* align at 100 cumulative cases, marking the first scale break.

ABSTRACT

We describe challenges and solutions for designing an interactive visualization that accommodates a continual addition of temporal data, allows scrubbing through time, and provides a flexible alignment of time to explore trends.

1 INTRODUCTION AND DESIGN CONSIDERATIONS

Early on in the pandemic, we collaborated with a team of public health researchers and data scientists who were part of supporting a province-wide response to COVID-19. Our visualization was intended for a public-facing website that reported on provincial, national and international COVID-19 data for local decision-makers and an informed public. The design we present is intended to visualize temporal data such as number of new cases, cumulative cases, testing, and hospitalizations. Visitors were seeking daily updates and examining potential relationships with policy interventions aimed at reducing regional case numbers. We identify key design considerations and in-progress solutions.

Initially, new cases were printed at the top of the page and temporal data was viewed with time on the x-axis and case numbers on the y-axis (see Fig. 3), providing a long-term trend view. We aimed to combine these and identified opportunities for improving the data representation in the context of an evolving pandemic.

1.1 Adding not Warping

When the graph (Fig. 3) was updated with new data daily the height and width of the graph stayed fixed, while the x-axis condensed daily and the y-axis condensed based on the highest number of cases. Over time this created a warping effect on the graph from one day to the next. The compressing of the data on expanding axes also decreased the level of detail over time.

1.2 Looking to Flatten the Curve

When comparing the same data in logarithmic and linear views (as seen in Fig. 3) perceptual problems emerged. For example, low visibility of small case numbers on the linear scale, particularly in the early stages of the pandemic, and regional comparisons with a large variance of case numbers. While a logarithmic scale resolves issues of large variance, the scale of the variance is visually reduced. The concept of “flattening” or ”bending” the curve was widely popular and we were concerned a logarithmic scale could be misinterpreted as ”flattening the curve” – as seen when comparing the same data in Figure 3 left and right.

1.3 Many Valuable Zeros

The graph (Fig. 3) represents time by the number of days since the 10th COVID-19 case. This reference point is useful to eliminate outliers, such as isolated travellers, and study trends in the early stages. However, other reference points, such as first case or the first 100 cases, could also provide useful views for trend comparison.

2 TECHNIQUES USED IN COVID *Gowns*

The design solution we are calling *Gowns*, is presented here (Fig. 1) showing comparisons between four Canadian provinces. On each *Gown*, time is displayed by day on the y-axis, while daily new cases and cumulative cases are on the x-axis and shown on the left and right sides respectively. The design utilizes a hybrid logarithmic scale, by layering semi-transparent linear scale graphs on top of each other. Each graph is sized to fill the column and ends when case numbers reach a certain value, which here (Fig. 1) is doubling.

Interacting with the visualization, visitors can select provinces they wish to compare and, using hover (or touch), display the exact date, the number of daily cases, and cumulative cases. Visitors can preview when case numbers are the same across the *Gowns* and opt to realign the *Gowns* according to those case numbers. The

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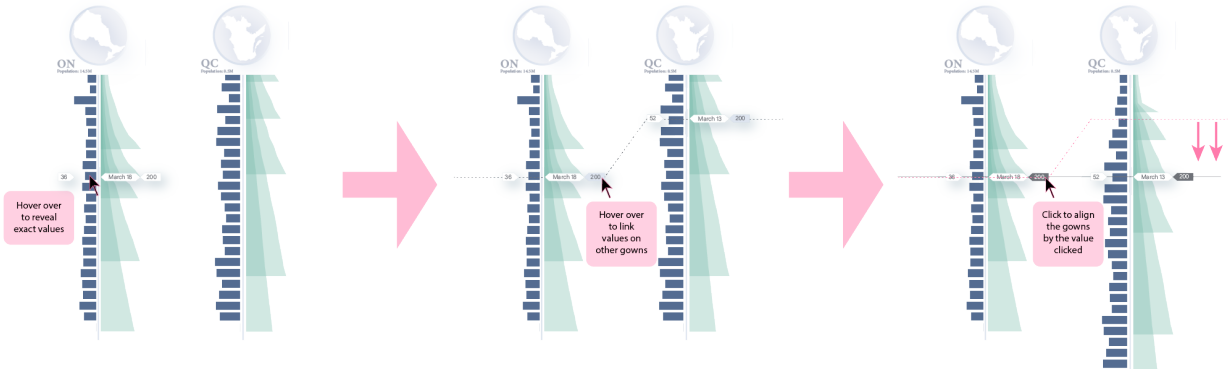

Figure 2: Interaction with *Gowns* is compatible with mouse and on touch devices, and allows for revealing details, linking, and alignment.

following aspects of the *Gowns* reflect our design challenges and build on previous techniques.

2.1 Vertical Timeline

While there are many possible timelines [1] [**?**], our *Gown* design shows data on a vertical timeline beginning with the most recent data and scrubbing through time by scrolling. By showing a flexible subset of the timeline, we enabled visitors to see daily changes and explore past data without warping the visualization (see section 1.1). We integrated a vertically oriented timeline for a more seamless interactive experience on web page and mobile scrolling interaction. The vertical orientation on mobile devices provides enough space to monitor the local region, while on a personal computer the horizontal space allows the user to position several provinces to compare trends across regions.

2.2 Scale Break and Overlap

Charts with different linear scales are intended to enable the visitor to concurrently see both small and large numbers while mitigating the perceptual concerns we identified with the logarithmic scale (section 1.2); this was identified by the visualization community [1] as well. It is useful for viewing the overall trend and early stages of an individual region and for viewing and comparing regions with more disparate case numbers. Overlapping the charts enabled a more compact design that can be used on mobile and for comparing multiple regions. Perin et al. [3] utilize a similar technique when balancing detail. Their technique causes a large variance in data to result in a layering of the data. Our approach differs in that we layer distinct graphs and we ensure that the ends of the graph are still visible. We discovered that the scale breaks can be utilized to visualize interval lengths between doubling cumulative cases, which is useful for epidemiological studies [2].

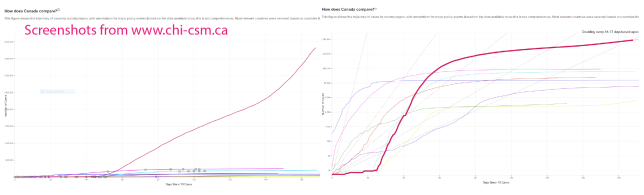

Figure 3: Compare linear (left) and logarithmic (right) scale showing cumulative case numbers in the USA (red) and other countries.

2.3 Alignment Interaction

The design accounts for many valuable zeros (section 1.3) by allowing the user to interactively compare case numbers and realign the *Gowns*. By default the *Gowns* are aligned by day to facilitate the most recent data snapshot. Hovering over the gown will reveal the date and exact values on the graph as interactive elements. Hovering over those values will reveal a dotted line that links to the place where the same value occurs on the other *Gowns*. Clicking on those values will prompt the *Gowns* to realign their positions to where the corresponding values occur in other *Gowns*. This interaction provides flexibility in how the visitor wishes to align the *Gowns*, along with a view of the data before and after that alignment.

3 Lessons Learned and Future Work

The *Gown* design integrates detail and overview and allows the viewers to scrub through time. However, the technique of overlapping graphs, on the right hand side, displays a visually distinct break for scale break, while this change is less evident in the bar charts where there is more variability in the data. The overlapping of graphs and vertical orientation of time are uncommon and demand time to learn how to read. However, the design offers flexibility in configuring comparisons between regions and the effects of policy interventions. Our next steps with this design are to apply policy intervention data into the visualization and to provide more regional options from local to global views.

Acknowledgments

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