STATISTICALLY Speaking

# The ElderSmile TimeMap: Benefits of Connecting Statistics With Time and Place

Community-based programs are critical for locally targeted public health education and accessible service delivery. Deriving useful information from such programs is important for their own evaluation and improvement and may facilitate research collaboration with partners and experts. Here we present an interactive Web-based application designed for a community-based oral health outreach program called ElderSmile to demonstrate how data can be summarized, filtered, compared, and visualized by time and place to inform program planning, evaluation, and research. The ElderSmile TimeMap (http://www.acsu.buffalo.edu/~smetcalf/resources/timemap.html) is an emergent product of a US National Institutes of Health–funded collaboration of knowledge sharing among multidisciplinary team members at the University at Buffalo, Columbia University, and New York University.

## BACKGROUND

The ElderSmile program, an initiative of the Columbia University College of Dental Medicine and its partners, has been providing educational workshops on oral health care topics and conducting oral health screenings for older adults at senior centers in northern Manhattan, New York, since 2006.[1] The motivation for the ElderSmile TimeMap was to identify trends over time in the participation by older adults in the ElderSmile workshops and screenings, as contextualized by the timing and location of the events. Representing events in time and place is increasingly recognized as critical for place-based research, especially in conducting spatial analyses and building spatially explicit simulation models. Moreover, interactive reporting of statistics and visualizations by the timing and location of events are useful to program staff and partners in assessing program coverage and impact. The data for the ElderSmile TimeMap presented here were derived from 140 events held at 56 locations between 2006 and 2013.

## FEATURES

The ElderSmile TimeMap is a multiplatform (i.e., Windows, Mac OS X, iOS, Android) application built with JavaScript and HTML that can produce user-defined maps, charts, and tables within a Web browser. Recommended Web browsers for clear viewing are Firefox, Chrome, and Safari. This application was designed specifically for the ElderSmile program but uses several libraries and plugins that can be incorporated into any Web-based application. The map view uses the TimeMap library to integrate an application for embedding interactive timelines into Web sites with online maps,[2] whereas the chart view uses the Highcharts library to generate different chart types.[3] The table view uses the tablesorter plugin to sort and filter data.[4] (Further details about the ElderSmile TimeMap architecture are available at http://www.ajph.org as a supplement to the online-only version of the article to support the application of the TimeMap features to other projects.)

The map, chart, and table views are not linked; they each produce independent outputs based on what the user has defined within the selected view. Each view addresses particular inquiries and suggestions made by our reseaarch team during the development process. The 2 main indicators are the number of workshop participants (WP in the TimeMap) and the number of patients screened (PS in the TimeMap). From 2006 to 2013, there were 3146 WP and 2137 PS. Figure 1 shows the ElderSmile TimeMap interface and highlights the map view features.

In the map view, the placemark in the map represents the location (center) that hosts ElderSmile workshops and screenings (events). The interactive timeline is used to define the placemarks displayed on the map; placemarks only appear for center names shown in the timeline. The time interval can be set to months, years, or the entire time period for which data are available. When a placemark is selected, information about the selected center will be displayed: the total number of events held, total WP and PS summed over all event dates, and a table and bar chart of WP and PS for each event date.

In the chart view, charts can be created to

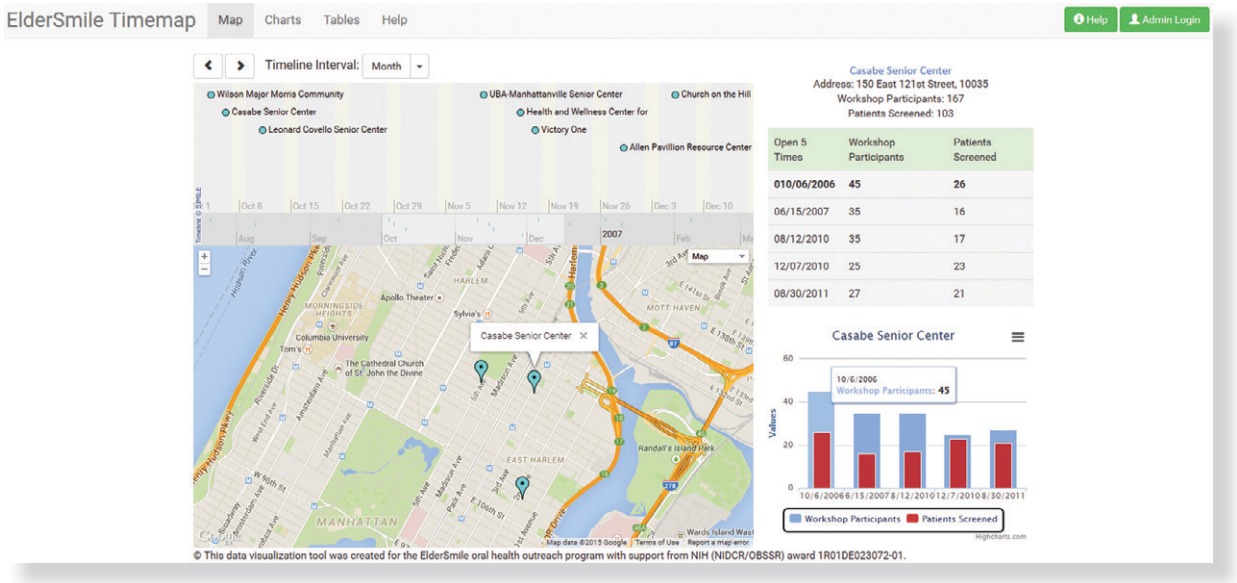


**FIGURE 1—The map view of the ElderSmile TimeMap, an interactive Web-based data visualization application for summarizing, filtering, comparing, and visualizing data from ElderSmile, a community-based program operated by the Columbia University College of Dental Medicine.**

compare WP and PS, either within a single center or for several centers. The total number of events held ("Open"), the total number of WP ("Workshop Participants"), and the number of participants per event ("Utilization") have been computed and displayed for each of the centers to assist with the selection of centers for comparison. Details about the different chart types and options to display indicators are available using "Help." Any of the charts generated within the application can be saved as an image for use in other documents.

In the table view, data can be sorted and filtered. The "Center Table" summarizes data by center, whereas the "Event Table" summarizes data by event dates. In addition, data can be sorted in ascending or descending order. User-defined expressions can be entered to filter by center names, WP, PS, number of events (for "Event Table" only), and event date (for "Center Table" only). Finally, data can also be filtered by "neighborhoods" and the "category" of center type. Multiple filters can be applied to obtain a subset of selected records. For selected records, summary statistics (i.e., minimum, maximum, mean, median, and sum) of WP, PS, and the total number of events held can be computed with "Show Statistics."

## SUMMARY

The University at Buffalo modeling team initially processed the ElderSmile program data to create maps and characterize event patterns by time and place. An earlier version of the map view was developed as part of the modeling process for our portfolio of simulation models.[5] The visualization elicited inquiries about additional ways of leveraging this rich program data set. Features were added and modified in response to these inquiries and additional suggestions from project team members at Columbia University and New York University. While collectively discussing ways to summarize, filter, compare, and visualize data, the TimeMap fostered communication and understanding among our multidisciplinary team members. The research team has used the maps to discuss program coverage, the charts to address data discrepancies in participation levels, and the tables for filtering events to assess participation levels by neighborhood and center type. The application has the potential to be extended via the "Admin Login" button for uploading and editing data. The ElderSmile TimeMap serves as an example of an interactive solution for summarizing, filtering, comparing, and visualizing data to produce useful information that encapsulates the knowledge and objectives of a multidisciplinary team in advancing public health. ■

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*This article was accepted April 20, 2015.*
*doi:10.2105/AJPH.2015.302730*

## Contributors

S.S. Kum led the writing. H. Wang provided edits and interpretation. P. Wang designed the TimeMap. Z. Jin provided modeling expertise. L. De La Cruz provided the program data and interpretation. M.E. Northridge contributed to the writing and provided public health expertise. C. Kunzel provided research support. S.E. Marshall supervised the clinical program. S.S. Metcalf provided overall conceptual design and supervision and contributed to the writing. All authors approved the final version of the article and take responsibility for its content.

## Acknowledgments

The authors were supported in the research, analysis, and writing of this article by grant R01DE023072 from the National Institute for Dental and Craniofacial Research and the Office of Behavioral and Social Sciences Research of the US National Institutes of Health.

## Human Participant Protection

All appropriate University at Buffalo, Columbia University, and New York University institutional review board and Health Insurance Portability and Accountability Act safeguards were followed. The study was approved by the institutional review boards of the University at Buffalo, Columbia University, and New York University.

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