National Respiratory Surge Forecasting with Combined Pharmacy and Public Health Data

EPH101
- Epidemiology & Public Heath
- Respiratory-related disorders

Liang Feng, PhD; Edward A. Witt, PhD; Heather Kirkham, PhD; Brian Strong, PharmD

Walgreen Co., Deerfield, IL, USA

BACKGROUND

Our current external-facing Walgreens Respiratory Index® longitudinally tracks positivity based upon on-site COVID & Flu testing results.[1] A lesson learned from COVID-19 pandemic is that, to prevent or mitigate future, similar events, we need not only respiratory illness surveillance, but also the ability to forecast trends on a national scale.

OBJECTIVE

This research explored opportunities to use pharmacy and publicly available health data to predict future surges.

METHODS

The datasets utilized in this study included location-specific testing results for respiratory viruses (influenza viruses and SARS-COV-2), anti-viral prescription volume (nirmatrelvir/ritonavir for treating COVID-19 and oseltamivir for treating influenza), over-the-counter (OTC) treatment sales (specific for respiratory symptom – cold & cough) , and SARS-COV-2 viral level detected in nationwide wastewater monitoring data collected by CDC.[2] One year of each dataset was collected except CDC wastewater data to build an individual time series predictive model in SAS Enterprise Guide. The data for the post-period was forecasted and compared to the pre-period using each predictive algorithm to determine if there was a projected surge for each dataset. Finally, results were combined across data sources to determine whether there was an imminent surge in the coming month at each location after the viral level changes in nearby wastewater sites were added to the algorithm (see **Figure 1**).

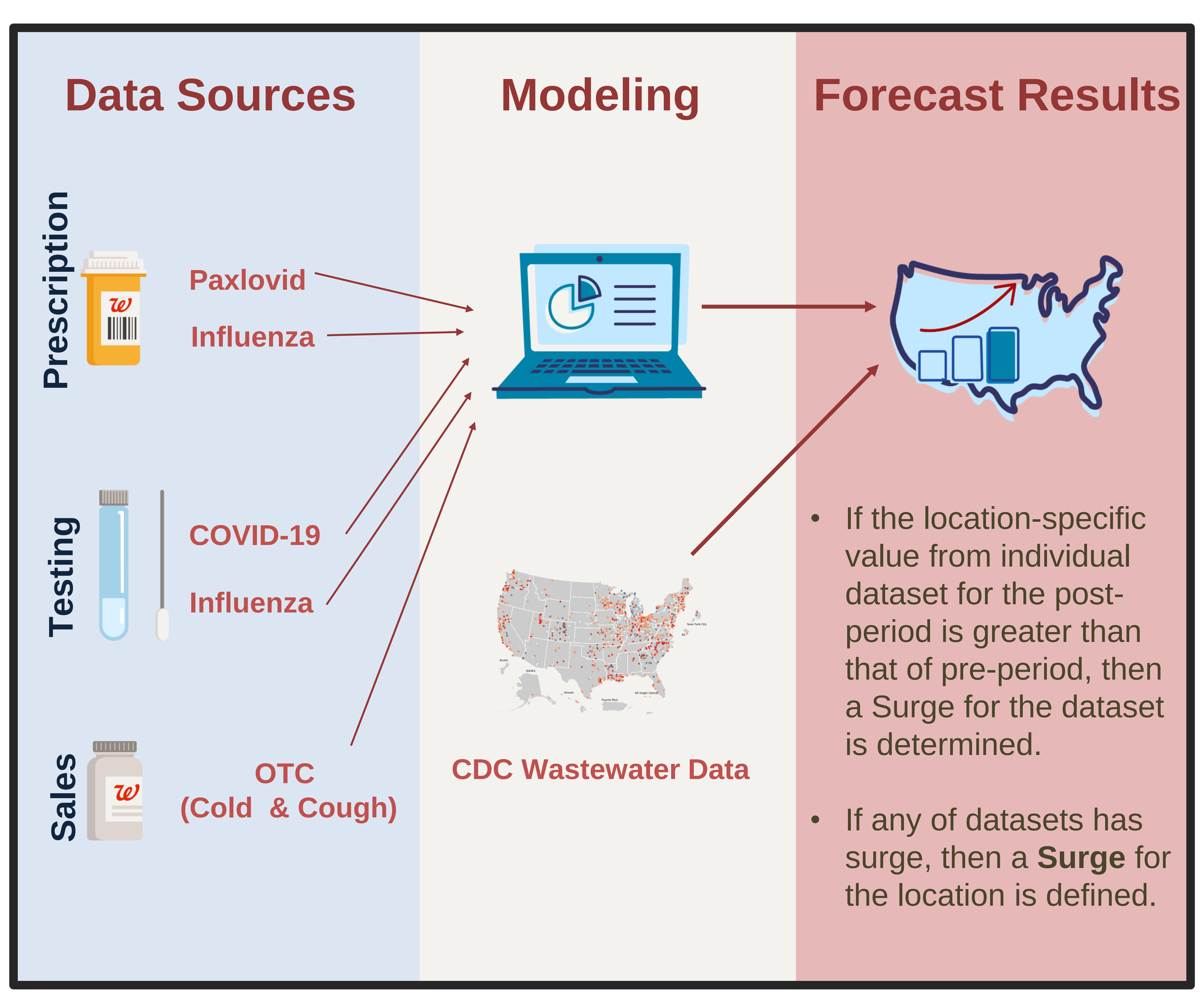

Figure 1. Data sources applied in modeling implementation

RESULTS

Each individual data source revealed a specific seasonal pattern: in general, nirmatrelvir/ritonavir claims (**Figure 2A**) and COVID-19 positivity (**Figure 2B**) displayed two major peaks in late summer and winter, which aligned with the viral levels in wastewater (**Figure 2C**). Oseltamivir claims (**Figure 2D**) and OTC sales (**Figure 2E**) shared the similar pattern with a peak in winter. Our results showed that the forecasting accuracy (true positive and true negative cases out of total cases) for COVID-19 positivity reached 87% (81% for oseltamivir fills in **Figure 2D**, 77% for OTC sales in **Figure 2E**, and 61% for nirmatrelvir/ritonavir claims).

After combining each data source together with CDC wastewater information, the accuracy was improved to 97% (**Figure 3**).

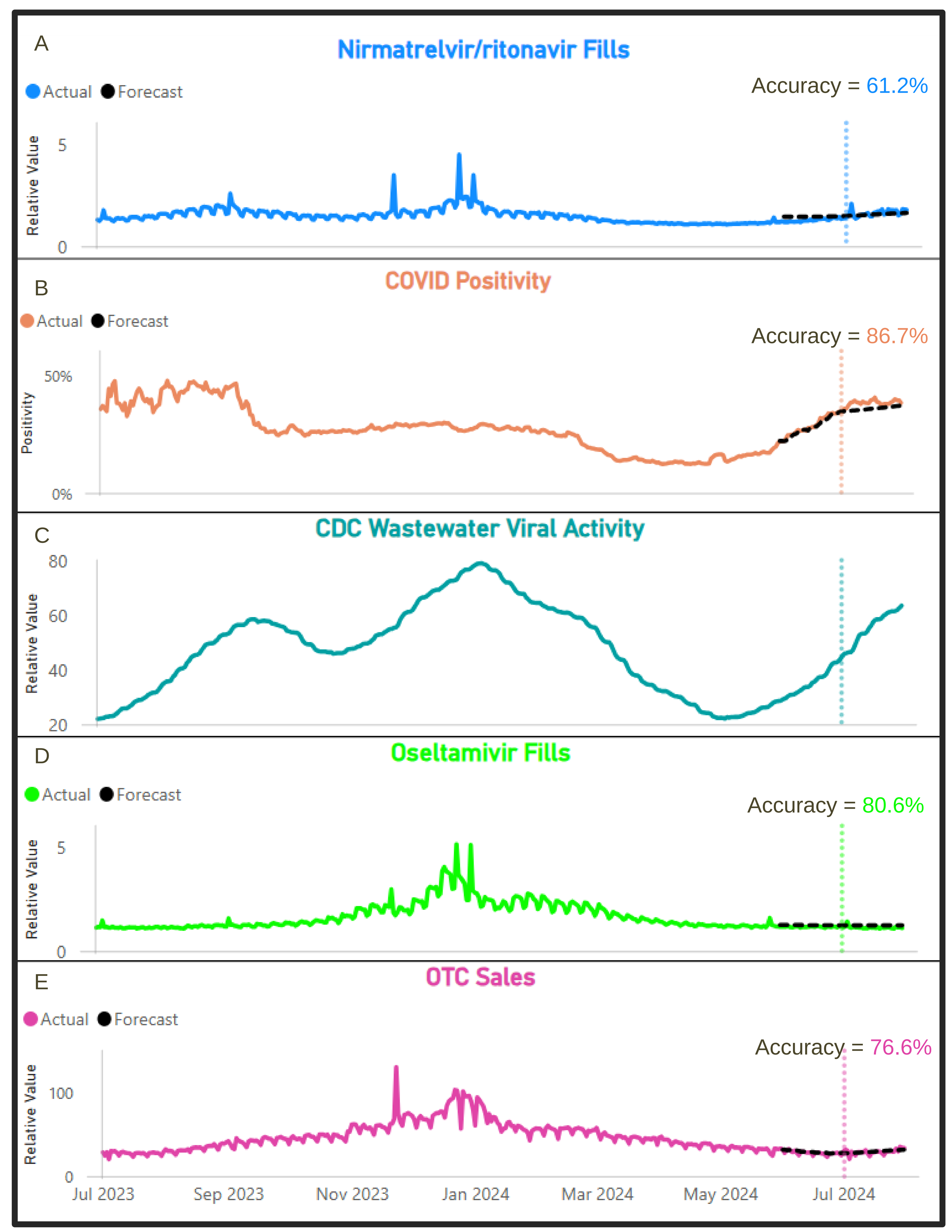

Figure 2. Comparison between actual data and forecasted data from each data source

The solid-colored curves in 2A-2E represent one-year trend from each dataset. In this example, June 2024 was set as pre-period and July 2024 is post-period, split by dotted vertical line. The predicted value generated from predictive algorithm for each dataset was labeled via a dash curve in each chart (except 2C, which was derived from CDC website. [2])

RESULTS (CONTINUED)

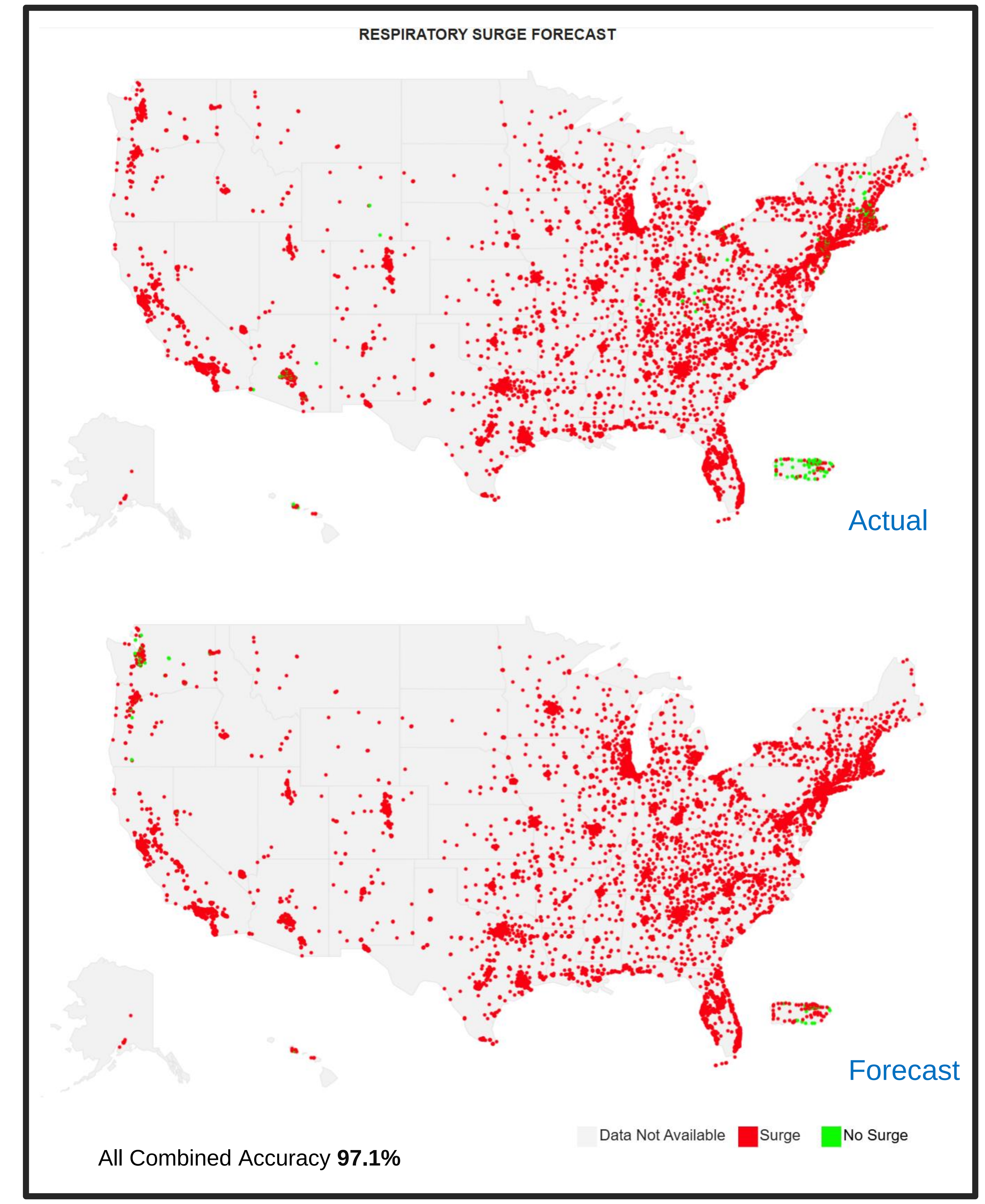

Figure 3. The accuracy from combined data sources between actual and forecasted surge data at granular level

Surge status determined by combined data sources for each geographic location was shown via a national map (Top: actual value; bottom: forecasted value).

CONCLUSIONS

Our model successfully leveraged multiple data sources in forecasting the respiratory illness trends on a national level. The high accuracy of the model means it can proactively inform geographic variation of impending surges for public awareness and seasonal planning.

REFERENCES

1. https://www.walgreens.com/healthcare-solutions/covid-19-index
2. https://data.cdc.gov/Public-Health-Surveillance/NWSS-Public-SARS-CoV-2-Wastewater-Metric-Data/2ew6-ywp6/about_data

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