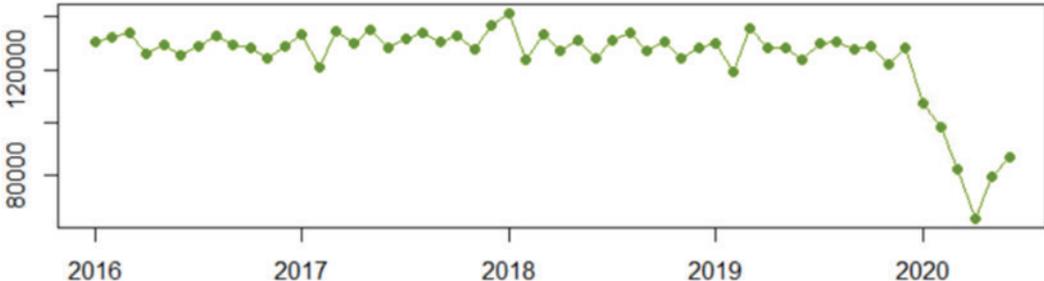


HQI Sentinel Signal Detection Systems Report

This is the first report of alerts from HQI’s sentinel signal detection systems. These alerts automatically detect abnormal changes (i.e., signals) in the incidence of diagnosis codes from hospital discharge records uploaded to the Hospital Quality Improvement Platform. It also includes term frequencies from safety reports, which are submitted to the Collaborative Healthcare Patient Safety Organization (CHPSO). The signal detection methodologies are described [here](#). The purpose of this report is to alert member hospitals of these emerging conditions so they can act to stop the spread of disease or harmful conditions and decrease the risk of additional harm to patients.

The COVID-19 epidemic resulted in a large net drop in California hospital visits during 2020, particularly for elective surgeries/procedures. Total discharges were about 25% lower when comparing the first quarter of 2019 to the first quarter of 2020. The reduction was even larger — about a 40% decline — when comparing the second quarter of 2019 to the second quarter of 2020.

Figure 1. Total hospital discharges per month: Jan. 2016-June 2020 among Hospital Quality Improvement Platform participants.



The massive change in the underlying number of discharges made it much more challenging to identify true signals because so many changes occurred, both quantitatively — as discussed above — and qualitatively. To account for the variation in overall discharges over time, proportional series (the proportion of discharges each month that had each 3-digit ICD-10 diagnosis code or proportion of safety reports each month containing a particular term or analogue) were analyzed by the signal detection system. In addition, simple counts were calculated for monthly discharges that had each 3-digit ICD-10 diagnosis code or safety reports that had each term. Analysis of the proportional series was necessary because counts of most diagnosis codes and terms decreased simply due to fewer people visiting California hospitals during the epidemic.

UNDERSTANDING THE TABLES AND FIGURES

In the tables that follow, the “ICD” column shows 3-digit ICD-10 diagnosis codes for which a signal was detected for discharges. Alternatively, the “Term” column shows the word or combination of words for which a signal was detected for safety reports. The “Signal” column indicates the percentage change of outlier effects from January 2020 to June 2020 for discharges and February 2020 to September 2020 for safety reports. The “%” and “#” columns indicate whether increases (↑), decreases (↓), or stable trends were detected for the proportional and raw count series, respectively. The “Commentary” column presents HQI/CHPSO clinicians’ classification of each signal after further review.

The plots below display selected time series of the proportional counts that were discussed above for illustrative purposes. The “Original” line in the plots shows the actual proportion of discharges each month that had each 3-digit ICD-10 diagnosis code. The “Adjusted” line shows the proportion each month that was expected based on how often each code was used historically (the fitted time series model). The “Outlier Effects” plot highlights the big differences between the reality and expectation, which is to say, the detected signal.

SIGNAL DETECTION RESULTS FOR SAFETY REPORTS

Table 1 shows selected safety report terms with a signal detected from February 2020 to September 2020 (inclusive). Figures 2 and 3 show the time series of proportional term frequency for the terms “COVID” and “prone”.

Key Findings

- Increased safety reports related to COVID-19 diagnosis, testing, and treatment (terms in parenthesis):
 - Concerns about mask/PPE use, availability/hoarding (e.g., mask, PPE)
 - Potential exposure of patients/staff (e.g., cough, isolation, precaution, swab, against medical advice (AMA))
 - Pressure ulcer incidence (e.g., prone, coccyx, lip, cheek)
 - Glucose management adverse events (e.g., critical glucose)

Table 1: Term Signals Detected in Safety Reports, February 2020-September 2020 (inclusive)

Term	Description	Signal	%	#	Commentary
COVID	Disease name & variants	3.40	↑	↓	COVID-19 Diagnosis, Testing, Treatment Safety Events
Isolation	To prevent disease spread	2.27	↑	↓	COVID-19 Diagnosis, Testing, Treatment Safety Events
Mask	Both a noun (PPE) and verb	1.64	↑	↓	COVID-19 Diagnosis, Testing, Treatment Safety Events
Precaution	To prevent disease spread	0.81	↑	↓	COVID-19 Diagnosis, Testing, Treatment Safety Events
Swab	Used to gather test samples	0.75	↑	↓	COVID-19 Diagnosis, Testing, Treatment Safety Events
PPE	Personal protective equipment	0.72	↑	↓	COVID-19 Diagnosis, Testing, Treatment Safety Events
Cough	COVID-19 symptom, also method of disease spread	0.59	↑	↓	COVID-19 Diagnosis, Testing, Treatment Safety Events
AMA	Against Medical Advice – usually patient leaving care	0.34	↑	stable	COVID-19 Diagnosis, Testing, Treatment Safety Events
Coccyx	Tailbone, common pressure ulcer location	0.35	↑	↓	COVID-19-Related Pressure Ulcers
Prone	Patient position for improved oxygenation	0.21	↑	↓	COVID-19-Related Pressure Ulcers
Cheek	Face and buttocks, pressure ulcer location	0.34	↑	stable	COVID-19-Related Pressure Ulcers
Lip	Location for pressure ulcers	0.22	↑	stable	COVID-19-Related Pressure Ulcers
Critical Glucose	Type 2 diabetes out of range glycemic values	0.35	↑	↓	COVID-19-Related Adverse Glycemic Events

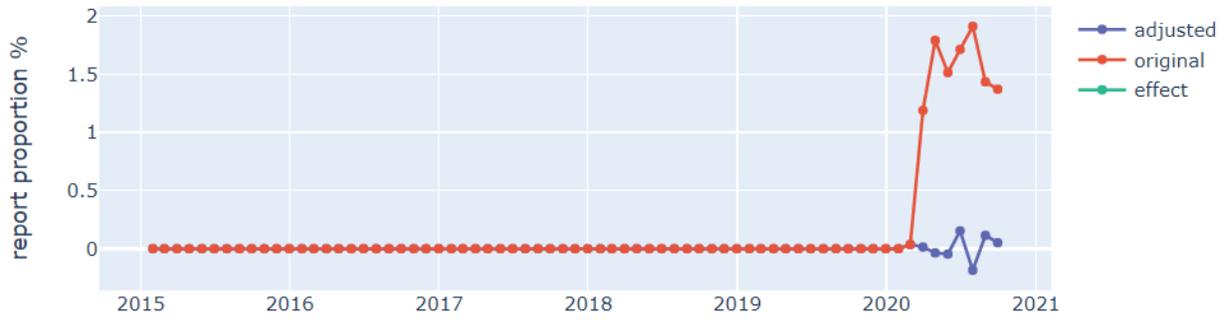


Figure 2. Proportional time series plot for safety report term “COVID”.

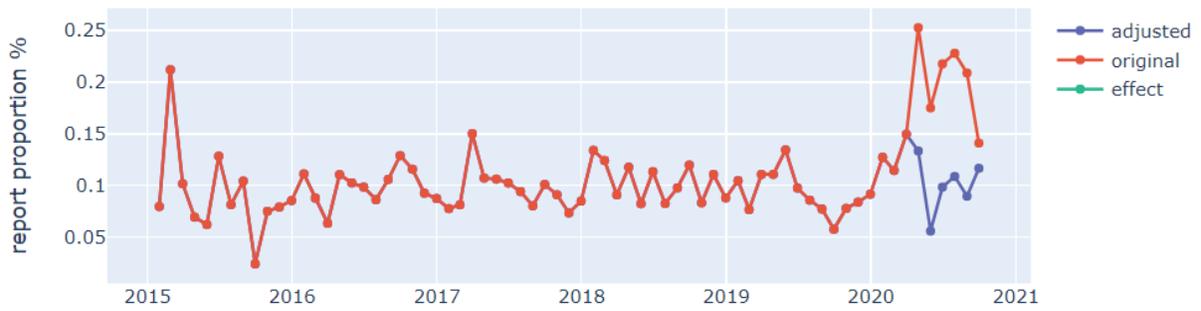


Figure 3. Proportional time series plot for safety report term “Prone”.

SIGNAL DETECTION RESULTS FOR HOSPITAL DISCHARGE DIAGNOSIS CODES

Table 2 shows all 3-digit ICD-10 diagnosis codes with a signal indicating a 100% or larger effect (the difference between original and adjusted) change from January 2020 to June 2020 (inclusive) among Hospital Quality Improvement Platform participating hospitals.

Key Findings

- Increased proportion of discharges related to COVID-19 diagnosis, testing, and treatment:
 - Higher proportion and number of discharges with COVID-19 diagnoses and surrogates (e.g., Z11, Z20, Z03, U07)
 - Higher proportion, but mixed numbers of discharges with COVID-19 symptoms, conditions, and related disorders (e.g., R05, R06, J96, E87, E03, R07, E86, D68, A41, R65, N39)
 - Higher proportion, but decreased numbers of patients with severe COVID-19 risk factors, including several lesser-known ones (e.g., E78, I10, I25, N18, E11, J44, Z95, I48, D64, Z87, I11, G93, D63, D69, Z68, E83, F03, I13, I12, D62, K21)
- Higher proportion and stable numbers of discharges related to drug/alcohol treatment (e.g., F15, F10, F12)
- Mixed results for mental health treatment:
 - Higher proportion and stable numbers for severe mental health issues (e.g., R45, F20),
 - Higher proportion, but decreased numbers for other, possibly less severe mental health issues (e.g., F41, F31, G47)
- Higher proportion, but decreased numbers of in-hospital births (e.g., Z37, Z3A, O70, Z38)
- Higher proportion, but generally decreased numbers of visits for continuing, urgent, and preventative care (e.g., Z91, Z88, Z79, X58)
- Lower proportion and numbers for cancer screening (Z12), immunizations (Z23), and other elective surgeries/procedures (e.g., K64, K57)

Table 2: Diagnosis Code Signals Detected, January 2020 to June 2020 (inclusive)

ICD	Description	Signal	%	#	Commentary
Z11	Encounter for screening for infectious and parasitic diseases	14.75	↑	↑	COVID-19-Related Diagnosis
Z20	Contact with and (suspected) exposure to communicable diseases	5.34	↑	↑	COVID-19-Related Diagnosis
Z03	Encounter for medical observation for suspected diseases and conditions ruled out	3.64	↑	↑	COVID-19-Related Diagnosis
U07	Emergency use of U07	2.44	↑	↑	COVID-19-Related Diagnosis
R05	Cough	2.45	↑	↑	COVID-19 Symptom
E87	Other disorders of fluid, electrolyte and acid-base balance	5.93	↑	↓	COVID-19 Symptom
R07	Pain in throat and chest	1.91	↑	↓	COVID-19 Symptom
E86	Volume depletion	5.93	↑	↓	COVID-19 Symptom

ICD	Description	Signal	%	#	Commentary
R06	Abnormalities of breathing	2.80	↑	stable	COVID-19 Symptom
F10	Alcohol related disorders	1.62	↑	stable	Drug/Alcohol Treatment
F12	Cannabis related disorders	1.43	↑	stable	Drug/Alcohol Treatment
F15	Other stimulant related disorders	1.80	↑	stable	Drug/Alcohol Treatment
E03	Other hypothyroidism	2.07	↑	↓	COVID-19-Related Disorder
N39	Other disorders of urinary system	1.26	↑	↓	COVID-19-Related Disorder
D68	Other coagulation defects	1.34	↑	stable	COVID-19-Related Disorder
E78	Disorders of lipoprotein metabolism and other lipidemias	4.35	↑	↓	COVID-19 Risk Factor
I10	Essential (primary) hypertension	3.70	↑	↓	COVID-19 Risk Factor
I25	Chronic ischemic heart disease	3.38	↑	↓	COVID-19 Risk Factor
N18	Chronic kidney disease (CKD)	3.29	↑	↓	COVID-19 Risk Factor
E11	Type 2 diabetes mellitus	2.45	↑	↓	COVID-19 Risk Factor
J44	Other chronic obstructive pulmonary disease	1.93	↑	↓	COVID-19 Risk Factor
Z95	Presence of cardiac and vascular implants and grafts	1.68	↑	↓	COVID-19 Risk Factor
I48	Atrial fibrillation and flutter	1.65	↑	↓	COVID-19 Risk Factor
D64	Other anemias	1.59	↑	↓	COVID-19 Risk Factor
Z87	Personal history of other diseases and conditions	1.48	↑	↓	COVID-19 Risk Factor
I11	Hypertensive heart disease	1.48	↑	↓	COVID-19 Risk Factor
G93	Other disorders of brain	1.48	↑	↓	COVID-19 Risk Factor
D63	Anemia in chronic diseases classified elsewhere	1.47	↑	↓	COVID-19 Risk Factor
D69	Purpura and other hemorrhagic conditions	1.47	↑	↓	COVID-19 Risk Factor
Z68	Body mass index	1.34	↑	↓	COVID-19 Risk Factor
E83	Disorders of mineral metabolism	1.18	↑	↓	COVID-19 Risk Factor
F03	Unspecified dementia	1.15	↑	↓	COVID-19 Risk Factor
I13	Hypertensive heart and chronic kidney disease	1.09	↑	↓	COVID-19 Risk Factor
I12	Hypertensive chronic kidney disease	1.03	↑	↓	COVID-19 Risk Factor
D62	Acute posthemorrhagic anemia	1.01	↑	↓	COVID-19 Risk Factor

ICD	Description	Signal	%	#	Commentary
K21	Gastro-esophageal reflux disease	1.64	↑	↓	COVID-19 Risk Factor
Z3A	Weeks of gestation	1.44	↑	↓	In-Hospital Births
O70	Perineal laceration during delivery	1.29	↑	↓	In-Hospital Births
Z37	Outcome of delivery	2.14	↑	↓	In-Hospital Births
Z38	Liveborn infants according to place of birth and type of delivery	2.24	↓	↓	In-Hospital Births
F41	Other anxiety disorders	2.14	↑	↓	Mental Health Treatment
F31	Bipolar disorder	1.05	↑	↓	Mental Health Treatment
G47	Sleep disorders	1.58	↑	↓	Mental Health Treatment
F20	Schizophrenia	1.16	↑	stable	Mental Health Treatment
R45	Symptoms and signs involving emotional state	1.84	↑	stable	Mental Health Treatment
A41	Other sepsis	1.93	↑	↓	COVID-19-Related Condition
R65	Symptoms and signs specifically associated with systemic inflammation and infection	1.06	↑	↓	COVID-19-Related Condition
J96	Respiratory failure, not elsewhere classified	1.82	↑	stable	COVID-19-Related Condition
Z91	Personal risk factors, not elsewhere classified	2.51	↑	↓	Continuing and Preventative Care
Z88	Allergy status to drugs, medicaments and biological substances	1.72	↑	↓	Preventative Care
Z79	Long term (current) drug therapy	1.99	↑	↓	Continuing Care
X58	Exposure to other specified factors	1.52	↑	↓	Urgent
Z12	Encounter for screening for malignant neoplasms	1.31	↓	↓	Cancer Screening
Z23	Encounter for immunization	2.78	↓	↓	Prophylactic inoculations
K64	Hemorrhoids and perianal venous thrombosis	1.47	↓	↓	Digestive Disorder
K57	Diverticular disease of intestine	1.27	↓	↓	Digestive Disorder

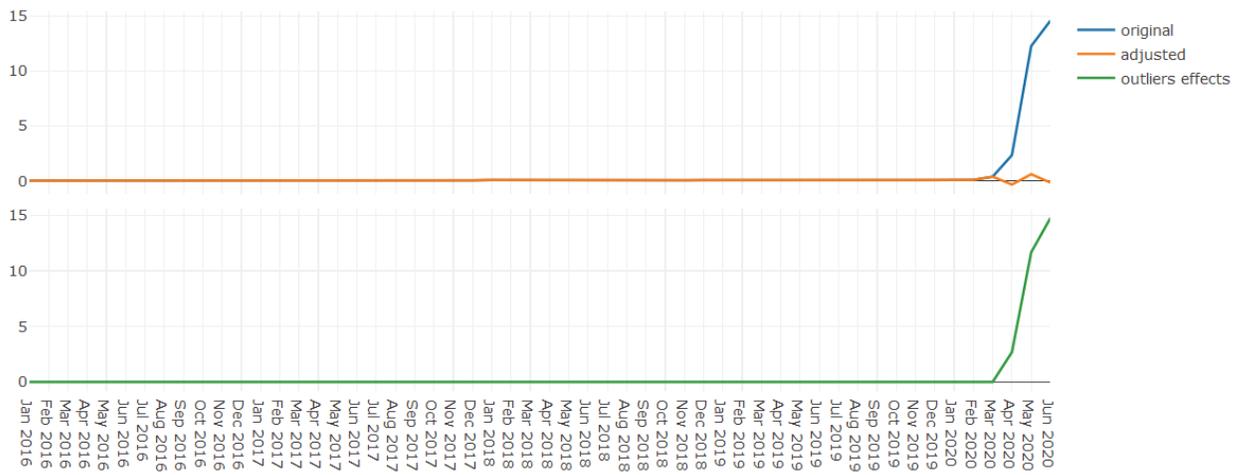


Figure 4. Proportional time series plot for diagnosis code Z11: Encounter for screening for infectious and parasitic diseases.

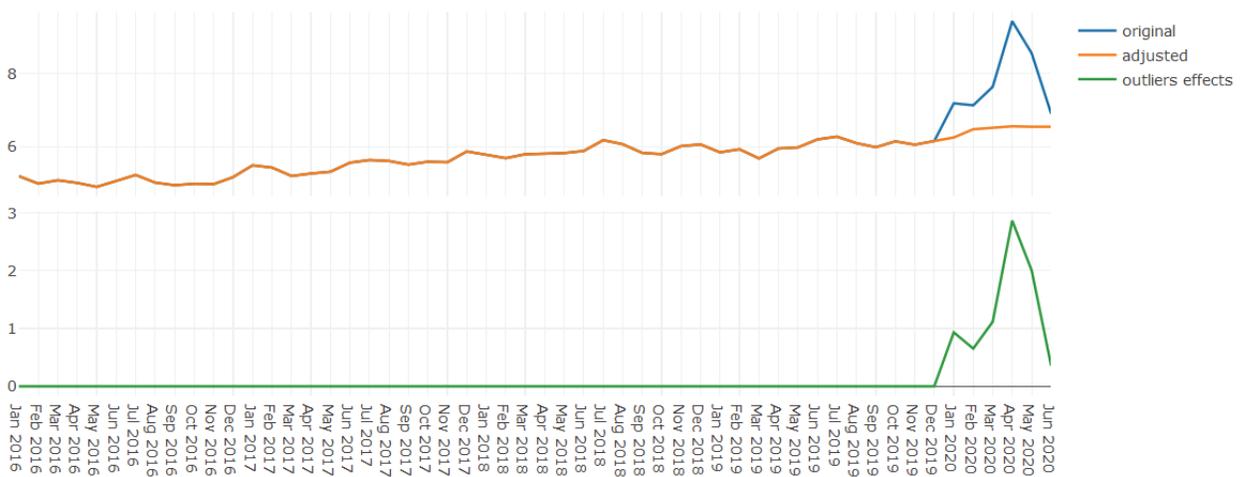


Figure 5. Proportional time series plot for diagnosis code E87: Other disorders of fluid, electrolyte and acid-base balance.

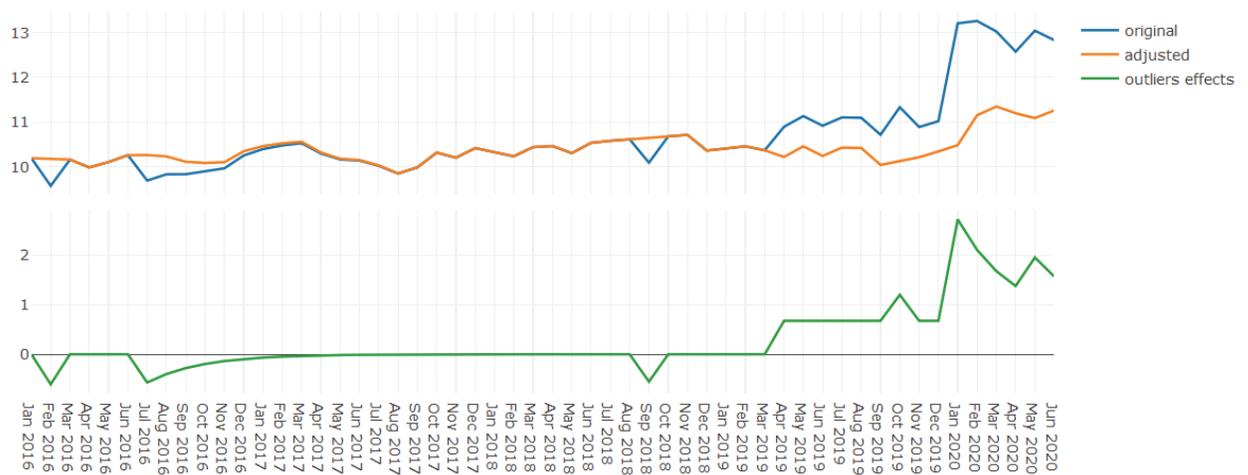


Figure 6. Proportional time series plot for diagnosis code E78: Disorders of lipoprotein metabolism and other lipidemias.

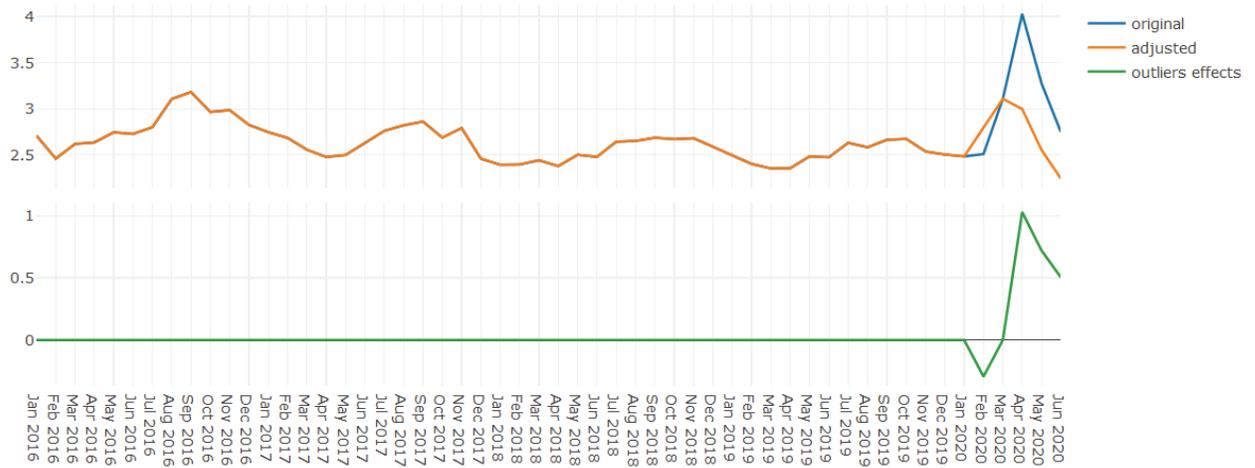


Figure 7. Proportional time series plot for diagnosis code Z37: Outcome of delivery.

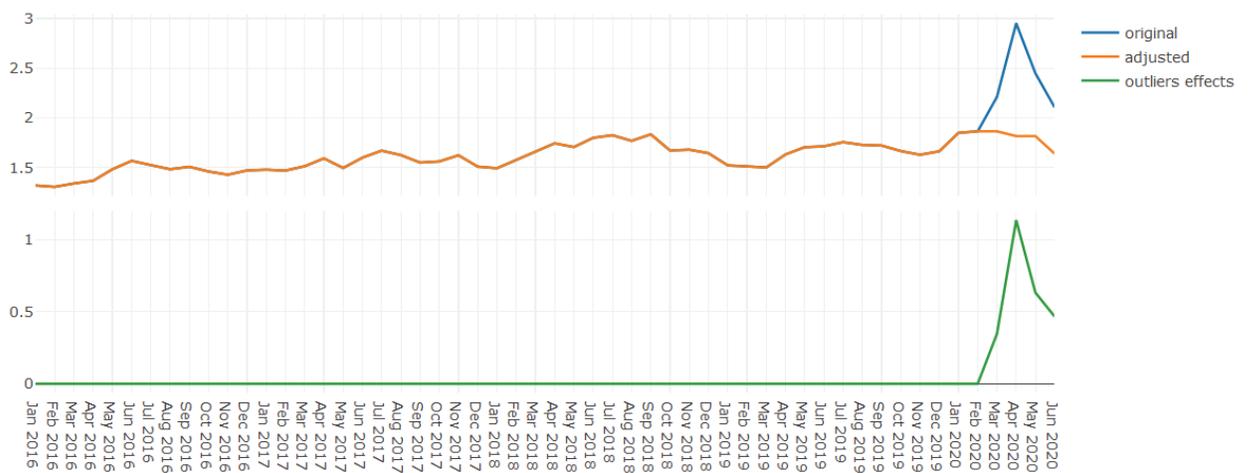


Figure 8. Proportional time series plot for diagnosis code F15: Other stimulant related disorders.

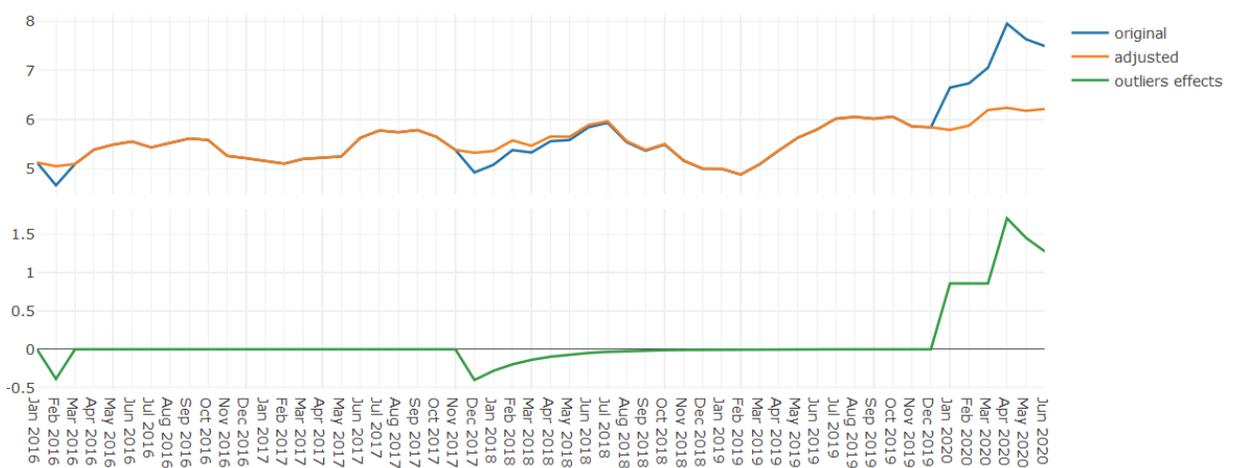


Figure 9. Proportional time series plot for diagnosis code R45: Symptoms and signs involving emotional state.

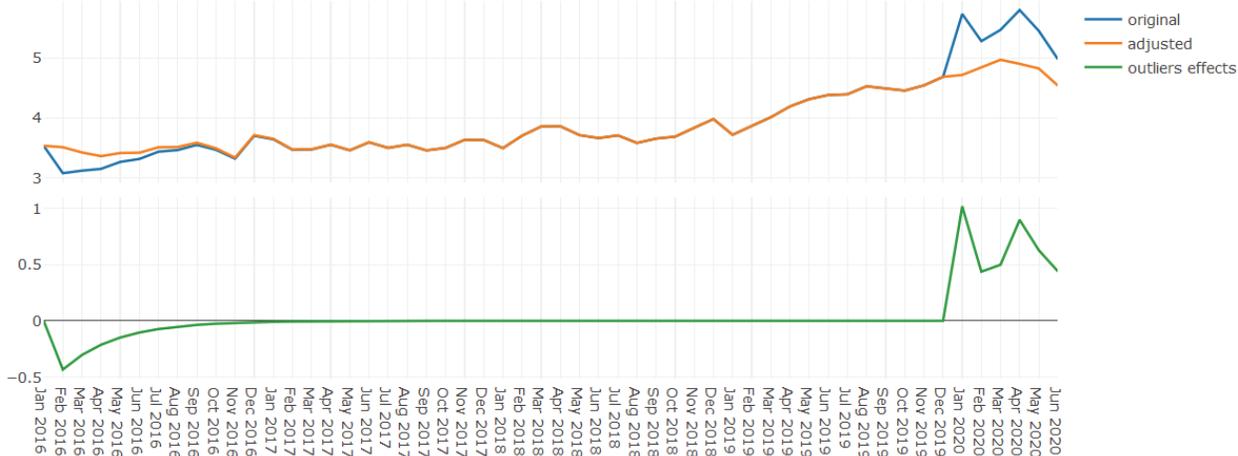


Figure 10. Proportional time series plot for diagnosis code Z91: Personal risk factors, not elsewhere classified.

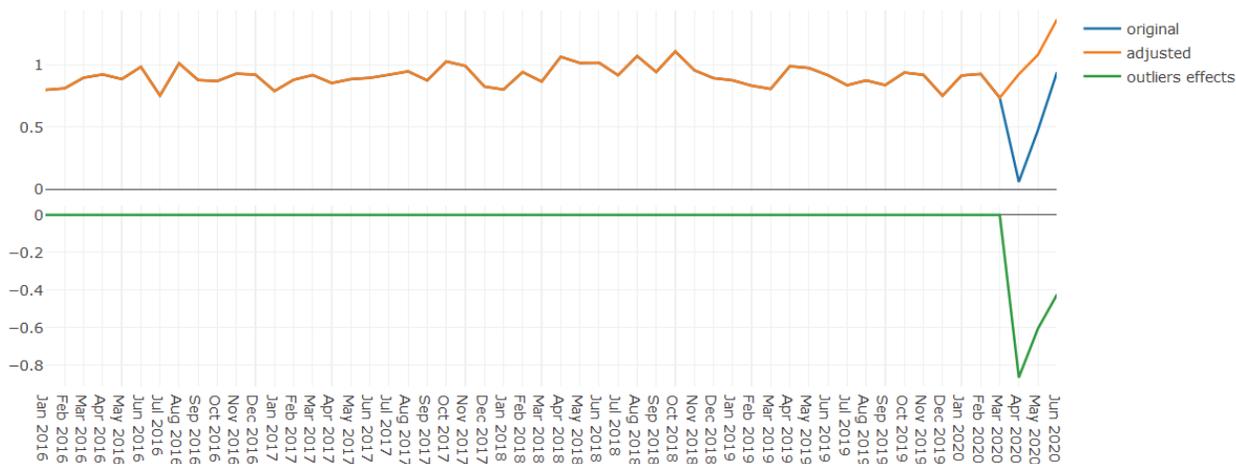


Figure 11. Proportional time series plot for diagnosis code Z12: Encounter for screening for malignant neoplasms.

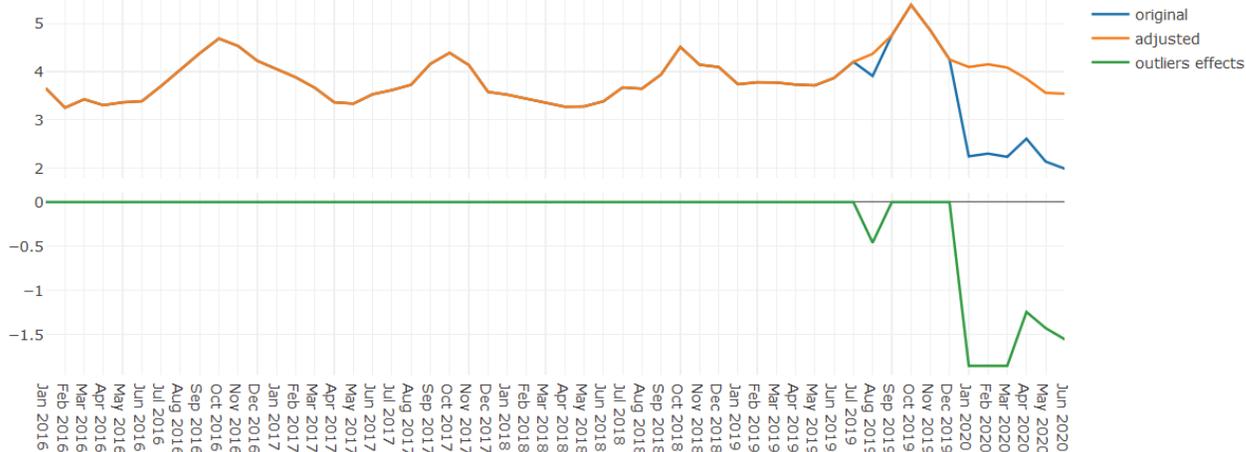


Figure 12. Proportional time series plot for diagnosis code Z23: Encounter for immunization.