CLINICAL RESEARCH

Pandemic Profiteering at a Time of Crisis: Using Python to Detect Fraud in COVID-19 Testing and Treatment Payments

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ABSTRACT

BACKGROUND

During the pandemic, the Centre for Medicare and Medicaid Services (CMS) introduced waivers and rule flexibilities to address rising COVID-19 cases. This included expanding telehealth services to urban areas, along with various testing options such as surveillance testing, school and workplace testing, self-tests, and more inpatient settings such as nursing homes. The federal and state governments also covered COVID-19 testing, vaccination and treatment for the uninsured population, creating opportunities for fraud and unnecessary testing, double billing, kickbacks, and deceased billing, mainly for monetary gain, by unscrupulous healthcare providers.

AIM

The study aims to safeguard the integrity of public health resources as well as government preparedness in the wakeup of future unforeseen crises.

METHODOLOGY

The study adopted an unsupervised learning approach. Using Python programming, the study employed the use of Isolation Forest to detect healthcare providers who had anomalies in the payment for COVID-19, treatment and vaccination by the HRSA. The study also adopted an official search enquiry into official U.S. Government websites such as the FBI, USDOJ, and HHS-OIG for schemes relating to COVID-19 testing and treatment.

RESULTS

The isolation forest algorithm, set at a 5% contamination level, identified 1,890 healthcare providers (7.64% of total claims) as having anomalies. These providers had an average total claim amount of approximately 7.5 million. The highest anomaly claim amounted to 646 million, primarily attributed to "Claims Paid for Testing". These results support the recommendations given to the HRSA by the Office of Inspector General of the

Department of Health and Human Services (HHS-OIG), emphasizing the need for identifying and addressing improper payments.

CONCLUSION/RECOMMENTDATION

Protecting public health resources requires preventing fraud in the healthcare industry. Strong education programs for healthcare workers are crucial, as are vigilant oversight and collaboration between federal and state agencies. Additionally, this study emphasizes how crucial it is to use official government resources—such as the FBI, HHS-OIG, USDOJ, and CDC—to efficiently detect and prevent fraudulent activities. By putting these suggestions into practice, healthcare programs such as COVID-19 testing can be made more reliable, and public health resources will not be misused.

KEYWORDS

Medical information; Anomaly detection; COVID-19 testing; Fraud; Waste and abuse; Healthcare fraud

INTRODUCTION

When lives were in jeopardy due to a global crisis, some people seemingly saw opportunity, while others saw despair. Through pandemic profiteering, whereby laboratories capitalized on sorrow for their own benefit, potentially billing for the spirits of the afflicted and non-existent people, my research uncovers a potentially unsettling reality." Coronavirus disease 2019 (COVID-19) was named by the World Health Organization (WHO) on February 11, 2020, because of the illness caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection. Compared to other countries in the world, the United States reported the most COVID-19 cases and fatalities in 2020 [1]. During the course of the year, there were three pandemic waves: (1) a spring outbreak in a small number of primarily urban areas following the introduction of the virus; (2) a summer wave that primarily affected the southern half of the country; and (3) an autumn-winter wave that persisted until the spring of 2021 [2]. On January 20, the same day as the first case was reported in South Korea, the State of Washington reported its first COVID-19 case (confirmed by a serological test) in the U.S. [3]. Twelve weeks later, on April 11, the US surpassed Italy as the country with the most reported COVID-19 deaths (approximately 24,000), while South Korea had 10,450 deaths on that date [4]. On April 11, twelve weeks later, the US surpassed Italy as the nation with the most COVID-19 deaths documented (approximately 24,000, compared to South Korea's 10,450 at that time).

In the wake of increasing COVID-19 cases and death tolls, the Center for Medicare and Medicaid Services (CMS) released many waivers and allowed for flexible rules during the Public Health Emergency. Some of these waivers and flexible systems include telehealth expansion services to include not only rural areas but also urban areas. Some flexible tests with respect to COVID-19 testing included surveillance testing in schools and workplaces, self-tests, drive-through testing, community-based testing, and weekly testing in nursing homes. Medicaid and Medicare mostly paid for these Covid tests. This gave room for fraud, waste, and abuse in addition to COVID-19 testing, but it also gave room for unscrupulous providers to provide medically unnecessary tests as well as fake COVID-19 results to increase monetary gains [5,6]. Some of the medically unnecessary tests included respiratory pathogen tests and genetic tests in addition to Covid tests [7]. These tests usually have little or no influence or outcome on the confirmation of the presence of COVID-19 antibodies. To bill Medicare and Medicaid as well as

private insurance for covid-19 testing, treatment, and vaccination, you need to use current ICD-10 Current Procedural Terminology (CPT) codes and diagnostic codes such as U0003, U0004, U0005, G2023, 87426, K1034, 87798, 0202U, 87581, 87486, 87426, 87811, 87634, 87636, and 87637. G2023 is a code used to bill for specimen collection, while U0005 is used to bill where under the guidance of the Center of Medicaid Services (C.M.S.), the test was performed with high-throughput technology, and the test was produced within 2 business days.

Background on Covid-19 Testing in the USA

The Centers for Disease Control and Prevention (CDC) issued guidelines for COVID-19 testing eligibility from the beginning of the outbreak to March 2020. The criteria for testing were as follows:

recent travel to certain countries, severe respiratory illness requiring hospitalization, or contact with a confirmed corona virus-infected person. The results of the COVID-19 test are used to determine disease incidence, recommend preventative measures (such as when to begin and end isolation and quarantine), and offer information about exposure and transmission risks [8].
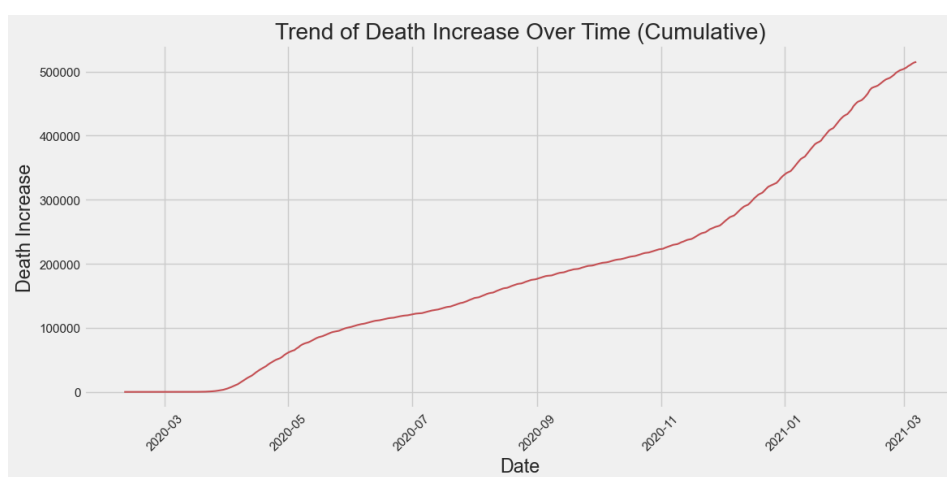

Figure 1: Source: COVID-19 Tracking Project. Available at Link.

A graphical representation of the cumulative death counts reveals a consistent upward trend from March 2020 to March 2021, with a notable and steep increase observed between December 2020 and March 2021.

IMPACTS OF FRAUD, WASTE AND ABUSE ON COVID-19 TESTING

Lab tests are essential for delivering vital diagnostic data so that patients and clinicians can choose the best course of action [9]. As of the CMS publication dated December 15, 2021, health expenditures experienced the greatest growth rate since 2002, owing to the impact of the COVID-19 pandemic. According to the same publication, federal spending on public health ($114.9 billion), which included funding for COVID-19 testing, vaccine development, and health facility preparedness; financial assistance to providers to compensate for lost revenue through the Provider Relief Fund ($122 billion in 2020); and the Paycheck Protection Program ($53 billion in 2020), were the main drivers of the rapid increase in health care spending in response to the pandemic. Consequently, in 2020, the federal government's growth in health care spending grew by 36.0% (CMS, 2021).

Federal and state officials, such as the Federal Bureau of Investigations (FBI), issued public alerts about coronavirus testing frauds that preyed on the country's overburdened testing infrastructure and left Americans with false test results, erroneous medical bills, and expensive at-home tests [10-12]. The virus has been the subject

of fraud ever since the pandemic began, but the quick spread of the Omicron variant provided possibilities for con artists to take advantage of the increased demand for tests [13].

According to the CDC, black, indigenous, and people of color (BIPOC) populations have shown an exceptionally rapid increase in COVID-19-related morbidity and mortality. As of January 2021, the CDC reported that there were 20,558,489 cases of COVID-19 and 350,664 deaths in the U.S. as a result of the illness [14].

FRAUD SCHEMES IN COVID-19 TESTING

An official search of the U.S. Government website revealed a number of fraudulent cases related to COVID-19 testing and treatment. This deep search included federal agency websites such as the Department of Healthcare and Human Services - Office of Inspector General (HHS-OIG), the Federal Bureau of Investigations (FBI), the United States Department of Justice (USDOJ), the Food and Drugs Authority (FDA) and the Centers for Disease Control (CDC).

42 U.S.C. § 1320a-7b(b) contains the Anti-Kickback Statute (AKS), a criminal statute that forbids the exchange of "remuneration" to influence patient referrals or business development under Federal healthcare programs. This encompasses a variety of noncash types of compensation as well as Medicare and Medicaid services. Both parties are subject to the AKS when giving or receiving kickbacks, and a key factor in assessing responsibility is intent. Rewarding people who recommend you for business is appropriate in certain sectors. However, it is illegal to pay for referrals under Federal Health Care Programs [11]. Kickback and collusion schemes in COVID-19 testing and treatment might involve two or more labs or providers having large numbers of shared members or seeing the same members on the same date of service for the same procedure codes. Collusion schemes are common among laboratories that share the same or a close geographic location. If 50% of Lab A's members are also seen by Lab B, there could be a possibility of kickback or collusion between these two labs that might warrant further investigation, such as requesting and reviewing medical records. Kickbacks or collusions might also violate physician self-referral, often known as stark law (Social Security Act 42 U.S.C 1395nn). Kickbacks in COVID-19 testing can also arise between healthcare professionals and individuals. In an enforcement action against a Mercer County man and his conspirators, the United States attorney Philip R. Sellinger stated that "clinical laboratories and health care professionals are on notice: paying kickbacks to steer tests to a lab may break the law" [15]. The conspirators demanded payments in return for supplying COVID-19 test samples to Metpath Laboratories, a clinical laboratory in Parsippany, New Jersey. Path laboratories tested samples taken from specific patients to determine whether COVID-19 was present. For the referrals of COVID-19 test samples, MetPath paid bribes. After that, the individuals were billed to Medicare and other health care benefit programs.

Billing for services not rendered, including stealing social security and phantom billing of state insurance programs, is another fraudulent scheme. Providers sometimes use social media platforms, fake websites, or click baits to entice members to sign up for services they end up not receiving. The providers then use these social security numbers to bill Medicare, Medicaid, and private insurance for services they did not render. A public alert on potential identity theft to charge Medicare and Medicaid for services not rendered was issued by HHS-OIG throughout the pandemic. These con artists put beneficiaries at risk of harm by using COVID-19-related needs and services for their own financial gain. Medical identity theft and fraudulent billing of federal health care programmes are two possible uses for gathering personal information [12]. Billing for services not rendered can

also be evident in scenarios where two labs or providers bill for the same members on the same date of services for the same procedure code. It is likely that one provider actually performed the service, and the other provider did not render the service but rather provided the bill Medicare and Medicaid separately. Billing for services not rendered can also be extended to scenarios where a lab or provider performs a COVID-19 test but the member or recipient never receives the results. Unusual spikes in claims billed by a lab or provider over a short period of time might also represent billing for services not rendered. A high number of affordable tests performed in a single day might also indicate that these tests were not actually performed.

Upcoding is one of the most common fraud schemes. Upcoding in COVID-19 testing and treatment involves billing for a higher CPT code than the code actually performed. Examples of upcoding in COVID-19 testing schemes include billing for high-throughput technology codes and performing the test with simple technology. On October 15, 2020, the CMS announced that on effective January 1, 2021, Medicare would be paying $100 for laboratories that perform COVID-19 tests using high-throughput technology and provide COVID-19 test results within two calendar days [16,17]. For providers who continue to perform COVID-19 tests using simple laboratory technology and providers who produce COVID-19 results in more than two calendar days, Medicare will be paying only $75. The rationale for this policy modification was to increase the accuracy of the COVID-19 results and to expedite the COVID-19 test results. The add-on COVID test code was U0005 when performed via high throughput within two calendar days. If a lab performs a COVID-19 test with simple technology or produces results in more than two calendar days and bills Medicare using the U0005 add-on, the provider or lab has upcoded her services. The correct procedure billing code is U0003 for 75$. Adding the U0005 code means that the lab or provider has charged an extra 25$ for using high-throughput technology within 2 calendar days for a service for which he used simple technology. Labs or providers also billing in-lab codes for COVID self-tests or over-the-counter tests also represent upcoding. Between April 4, 2022, and May 11, 2023, Medicare Part b paid for over-the-counter tests.

Excessive COVID-19 testing is usually linked to the overutilization of COVID-19 tests, such as billing a member with more than 10 COVID-19 tests in a week. Unusual spikes and increases in Covid test billing can also represent services not rendered in some circumstances. The detection of excessive COVID-19 can lead to outlier detection in comparison to that of peers. Repetitive testing of the same members can also represent excessive COVID-19 testing. If a lab performs an antigen test and then a PCR test on the same member on multiple occasions, this could also represent excessive COVID-19 testing mainly targeted at state insurance programs for more money. Excessive testing is usually observed during mass testing in community-based programs, testing in nursing homes and schools, and workplace testing. The frequency of carrying out these tests is usually excessive. An inappropriate number of services provided to recipients is one way to detect excessive COVID-19. For example, if a provider bill 50 COVID tests for 2 members in a week, the service-to-recipient ratio will be 25 (50/2). Twenty-five tests in a week for a member might indicate excessive testing.

Duplicate billing can be evidenced when a visit is billed more than once. For example, billing an office visit and a telehealth visit for the same member on the same date of service. Duplicate billing in COVID-19 testing can occur when a lab bills two separate COVID-19 testing codes for the same tests and for the same member and date of service. When a lab or provider collects a single specimen and bills Medicare or Medicaid more than once using the specimen collection code G2023, this could be considered duplicate billing. When a laboratory performs

an antigen test and charges more than once for the test, it could be indicative of susceptible duplicate billing. Duplicate billing is also evident when two providers bill the same members on the same date of service for the same procedure code or COVID-19 test. Shared members between two providers billing on the same date of service can also represent susceptive double billing.

The Division of Clinical Laboratory Improvement and Quality within the Center for Medicate and Medicaid Services regulates the laboratory through the provision of a Clinical Laboratory Improvement Amendment (CLIA). CLIA ensures that laboratories are operating in accordance with quality acceptable standards [18]. A lab registered with CMS as a certificate of waiver lab bills for a procedure code such as U0005 could be considered a violation against policy and a fraud, waste, or abuse scheme in COVID-19 testing because U0005 code is a high-throughput code and not a simple technology code. Another FWA in COVID-19 testing related to CLIA is labs or providers with expired CLIA certification billing Medicare and Medicaid. A CLIA certification is good for 2 years and subject to renewal. The CMS maintains a website for checking the type and validity of a CLIA certificate just by entering the name of the lab or their CLIA number.

Different brands of COVID-19 vaccine were provided to the same member on the same date of service. One rare scheme in COVID-19 testing is when providers bill the same member on the same date of service for administering different variants of COVID-19. Some of the COVID-19 brands approved by the FDA include Pfizer-BioNTech, Moderna, and Novavax. The CMS also provided additional guidance and payments for administering the COVID-19 vaccine in patients' homes. This leaves room for fraudulent waste and abuse where a lab bills for COVID-19 vaccine administration in patients' homes even though it was performed in the laboratory or during an office visit. When the vaccine was administered in a Medicare patient home, the HCPCS level II code was used (M0201). When the COVID-19 vaccine was administered in the medical care patients' homes, the patients were paid $36 for this additional payment.

Postmortem billing basically involves billing COVID tests on recipients who are dead. According to Rozen [19], some unscrupulous fraudsters billed Medicare and Medicaid to send COVID-19 test kits to deceased people, which has led the U.S.OJ. to determine the breadth of this scheme. A way to catch this fraudulent scheme using data analytics might be to run the date of service when the COVID-19 test was performed against the date of death database. A case in which any COVID-19 test was performed after the date of death might indicate suspected billing. The Centers for Disease Control's Coronavirus Disease Death Data and Reporting as well as the National Death Index might be useful databases.

METHODOLOGY/DATA COLLECTION AND ANALYSIS

This research employed a mixed-method approach. There are numerous data mining strategies available for detecting healthcare fraud, waste and abuse. Generally, unsupervised, supervised or combined methods have been used by experts to detect healthcare fraud. To find outliers in healthcare fraud, Massi et al. [20] employed an unsupervised clustering technique on administrative databases. To construct a health model that automatically identifies fraudulent cases from Saudi Arabian health insurance claims, Nabrawi & Alanazi [21] employed supervised machine and deep learning analysis techniques such as random forest, logistic regression, and artificial neural networks to construct a predictive analytic model.

A review of the literature reveals that several specific approaches employed to identify possible healthcare fraud

include link analysis (using neural networks to detect interrelationships among two or more providers—to catch possible shared members and potential kickback schemes); rule-based audits (such as desk audits to identify providers who do not have the right certification type to perform a particular type of test but are paid for those tests); outlier detection (usually providers who receive higher reimbursement in relation to their peers or procedure code or an inappropriate number of services to recipients); predictive modeling; time-dependent billing (such as providers billing improbable hours per day - more than 24 hours in a day for a time-dependent procedure code); and postmortem billing (providers who bill after a member is deceased).

The first part of the methodology focused on detecting providers who might be outliers in the claims reimbursement data paid to health facilities and providers by the Health Resources and Services Administration (HRSA) for covid testing, vaccine administration and covid treatment of the uninsured population between February 4, 2020, and March 2022. To achieve this anomaly detection method, this study employs an unsupervised learning method using an isolation forest, first at a 5% contamination level and then at a 1% contamination level, to detect extreme outliers. Payment for claims reimbursement for the uninsured population was made by the HRSA through the Covid-19 Coverage Assistance Fund (CAF) and other funds such as the Provider Relief Fund. To be eligible for reimbursement, the provider must ensure that the patient or recipient has no Medicare, Medicaid, or any private insurance. The provider must also be willing to be paid the current Medicare fee - for - service rates. It is important to note that detecting outliers does not automatically mean the perpetration of fraud. Identifying red flags means that claims payments to those providers need further investigation. Further investigations might include recording reviews, interviewing recipients, procedural code analysis, and identifying interrelated or shared members among these providers (link analysis).

TOOL USED

In this analysis, the authors utilized Python, a versatile programming language, along with essential libraries, including Pandas for data manipulation, NumPy for numerical operations, Seaborn and Matplotlib for data visualization, and Scikit-Learn for implementing the Isolation Forest algorithm. These tools collectively allowed for effective data exploration, trend identification, and anomaly detection in the COVID-19 dataset.

DATA ANALYSIS

Description of Dataset and Statistics

Table 1: Description of Dataset and Statistics

Column Name	Description	Type
Provider Name	Provider name associated with the billing TIN to whom the payment was issued.	Plain Text
State		Plain Text
City		Plain Text
Claims Paid for Testing	Uninsured claims paid for Testing	Number
Claims Paid for Treatment	Uninsured claims paid for Treatment	Number
Claims Paid for Vaccine	Uninsured claims paid for Vaccine	Number
Georeferenced Column	Point derived from City and State	Point

Parameter	Statistic
Number of States	55
Total Paid Providers	50,244
Total Unique Paid Providers	24,792
Total Paid Claims for Covid Testing	11,362,068,129
Total Paid Claims for Covid Vaccines	1,617,170,645
Total Paid claims for Covid treatment	5,805,583,459
Total Paid Claims	18,784,822,233

There are a total of 50,244 healthcare providers who received claim reimbursement from the HRSA for providing COVID-19 testing, vaccination, and treatment to the uninsured population. Of these 50,244 providers, 24,792 are unique or distinct. The total number of claims paid over the period spanning from February 2020 to March 2022 is more than 18 billion (18,784,822,233) claims paid to these providers from 55 states. It is worth noting that some of these providers who were paid claims reimbursement were outside of the United States, such as in Guyana.
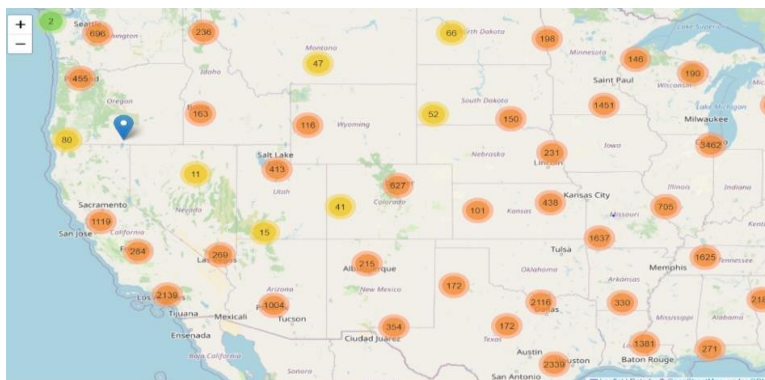

Figure 3: Source: Centers for Disease Control and Prevention (CDC) - Claims reimbursement to health care providers and facilities COVID-19 data. Available at Link.

The map chart above shows the city location and frequency of times providers were paid for providing COVID-19, COVID-19 and COVID-19 treatment for the uninsured population between February 2020 and March 2022. This map chart was constructed from the latitudinal and longitudinal information (geo-referenced information) provided in the claims data reimbursement data found on the Centers for Disease Control (CDC) website. From this map chart, providers located between San Antonio and Houston were paid 2339 times between February 4, 2020, and March 2022, 2020, to provide COVID-19, vaccination and treatment for the uninsured population.
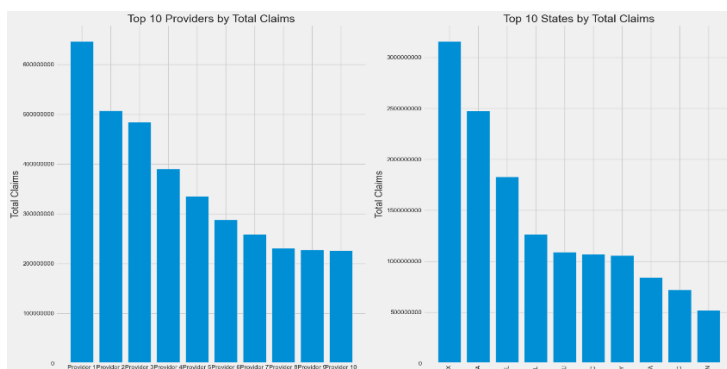

Figure 4: COVID-19 vaccination and COVID-19 treatment for the uninsured population.

Table 3: Claims reimbursement to health care providers and facilities.

Provider Name	Total Claims Paid
Provider 1	646,140,450
Provider 2	507,386,938
Provider 3	484,273,848
Provider 4	390,459,241
Provider 5	334,978,320
Provider 6	288,067,592
Provider 7	258,721,942
Provider 8	230,669,547
Provider 9	227,691,475
Provider 10	226,616,685
Grand Total	3,595,006,038

Table 4: Claims reimbursement in several states.

State	Total Claims Paid
TX	3,155,980,164
CA	2,476,068,809
IL	1,828,846,889
FL	1,263,421,953
NJ	1,089,381,037
NC	1,068,332,131
NY	1,057,754,828
GA	842,556,358
DC	720,286,528
TN	518,850,701
Grand Total	14,021,479,398

Source: Centers for Disease Control and Prevention (CDC) - Claims reimbursement to health care providers and facilities COVID-19 Data. Available at Link.

The bar chart and tables above show the top 10 providers based on total claims paid by the HRSA for COVID-19, COVID-19 vaccination and COVID-19 treatment for the uninsured population. The top provider (Provider 1) was paid 646,140,450 claims over the period, followed by 507,386,938 in total claims for Provider 2. On a state level, Texas was the number 1 with the highest paid claims for COVID-19 testing, COVID-19 vaccination, and COVID-19 treatment for the uninsured population. Providers in TX were paid more than 3B claims (3,155,980,164), followed by California (2,476,068,809). Illinois follows with close to 2B claims (1,828,846,889).

Anomaly Detection with Isolation Forest

The isolation forest (iForest) algorithm is a tree-based algorithm that isolates anomalies by randomly selecting a feature and a random split value. It creates a tree structure and measures how many splits are required to isolate a data point. Anomalies require fewer splits to be isolated, making them stand out. iForest is effective at identifying anomalies because it separates them from the majority of normal data points in fewer steps. In the context of total claims, iForest can identify providers with unusually high or low claims compared to the majority. Unusually high claims payments might signal that those services were not actually rendered and might need further review.

The objective of this analysis is to identify providers with unusually high claims reimbursement, which are considered anomalies in the context of COVID-19 claims. The study employs the isolation forest algorithm for this purpose. The providers flagged as having anomalies according to the isolation forest algorithm are candidates for further investigation. These providers may have received significantly higher or lower reimbursements than expected based on the total claim's patterns of the majority.
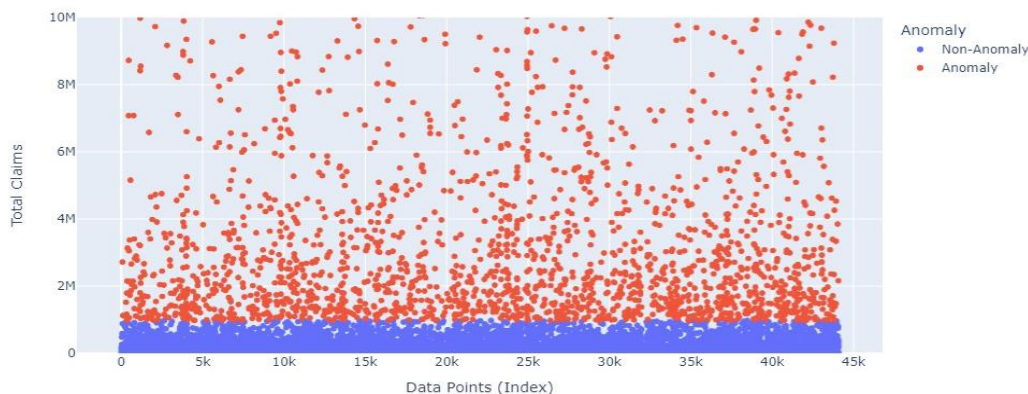

Figure 5: Interactive Scatter Plot of total Claims with anomalies hghlighted.
Source: Centers for Disease Control and Prevention (CDC) - Claims Reimbursement to Health Care Providers and Facilities COVID-19 Data. Available at Link.

Findings and Interpretation of the Isolation Forest

The isolation forest algorithm, with a contamination level of 5%, identified 1,890 healthcare providers, representing 7.64% of the total claims, as anomalies. Providers classified as having anomalies had an average total claim amount of 7,543,562.66. The highest anomaly claim amounted to 646,137,850.00. Among the anomalies, the highest claim was attributed to "Claims Paid for Testing," with an amount of 586,931,650.00.

Interpretation

The isolation forest algorithm identified a small percentage of providers (7.64%) as having anomalies. These provider anomalies exhibited a wide range of total claims paid, with some providers receiving exceptionally high reimbursements. Among the anomalies, claims paid for testing had the highest individual claim, contributing to the high total claims paid.

To further drill down the identified outliers associated with the 5% contamination, we reduced the contamination level from 5% to 1% and found a total of 350 providers out of the total unique providers of 24,792, as shown below.
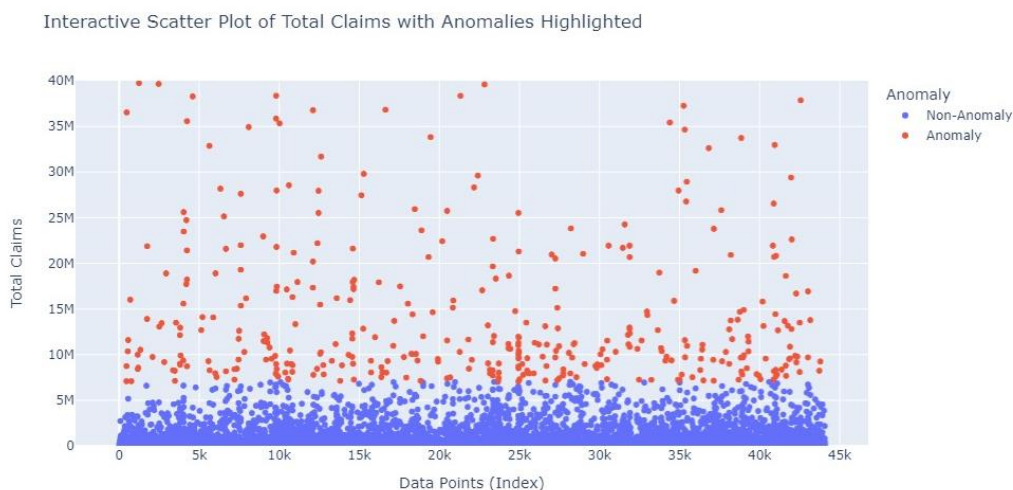
Source: Centers for Disease Control and Prevention (CDC) - Claims Reimbursement to Health Care Providers and Facilities COVID-19 Data. Available at Link.

CONCLUSION

Protecting public health resources and protecting the integrity of testing programs require the identification of various fraudulent schemes in COVID-19 testing. It is clear that dishonest providers may try to take advantage of the system for financial gain, whether through kickback and collusion schemes, upcoding, or postmortem billing. The detection and prevention of fraudulent operations depend heavily on vigilant oversight, education, and cooperation between federal and state agencies.

RECOMMENDATION

Protecting the validity of COVID-19 testing requires the application of a complex strategy. This involves performing routine, in-depth audits of provider claims using cutting-edge analytics to find abnormalities and possible fraud. Furthermore, it is critical to establish thorough education programs for healthcare professionals, providing instruction on how to handle complex billing situations and guarantee compliance. Additionally, improving the detection and punishment of fraudulent providers is crucial for protecting public health resources and maintaining the integrity of COVID-19 testing programs. To do this, federal, state, and law enforcement

agencies must work more closely together. To stop unauthorized testing, strict control measures must be implemented, including adherence to Clinical Laboratory Improvement Amendment (CLIA) standards.

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