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EXAMINING THE UNFORESEEN FINANCIAL AND CLINICAL IMPACT OF COVID-19

Leveraging Iodine Software's Cognitive Emulation approach to better understand current and future state

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OVERVIEW

Iodine Software is a healthcare AI company that has pioneered a new machine learning approach—**Cognitive Emulation**—to help healthcare finance leaders build resilient organizations. To date, Iodine has partnered with over 600 hospitals in the United States to create a large and diverse clinical data set that can provide insights into the COVID-19 pandemic.

Iodine's Cognitive Emulation approach analyzes the full clinical record for each patient much the way a clinician would, but on a massive scale. Coupled with proprietary technology that forecasts diagnosis-related groups (DRGs) for every patient still in the hospital, Iodine is able to look in real time at trends emerging in this data set without having to rely on final coded data that is typically only available post-discharge, after a considerable delay.

For this report, Iodine reviewed more than 60,000 COVID-19 cases from over 600 hospitals—spanning cases from the entire country, including both infection hot spots and emerging areas of concern. Using the Iodine CognitiveML™ engine and Iodine Forecast™ product, the Iodine Data Science team identified likely COVID-19 patients and predicted the DRG for recently discharged, but not final-coded, cases. Both structured and unstructured data were leveraged to generate this analysis. The timeframe for this analysis is from March 4 through May 3, 2020. Within this data set, 50.1% of patients were male and 49.9% were female.

This information is meant to help healthcare providers nationwide more accurately forecast their resource needs (including staff, ICU beds, ventilators and other critical care equipment) and understand the demographics most vulnerable to COVID-19, as well as support healthcare finance leaders in determining the right strategies to ensure financial resilience both in the near- and long-term.

FINANCIAL IMPACT OF COVID-19

Even prior to handling an appreciable volume of COVID-19 patients, hospitals were already experiencing an approximate 30% dip year-over-year in expected reimbursement.

In anticipation of increased admissions due to COVID-19 and the potential risk of transmission to other patients, as well as per CMS' April 7 recommendation to limit elective surgeries and procedures, facilities across the country cancelled elective surgeries and postponed non-urgent procedures. These actions drove a significant drop in expected overall reimbursement.

Further, hospital finance leaders can expect to see additional shifts in reimbursement as the payer mix shifts away from commercial coverage due to rising unemployment, and providers turn to telehealth as an alternative to inpatient visits.

Both now and post COVID-19, finance leaders are exploring solutions that not only mitigate downward margin pressure short-term, but also create resiliency in the long-term. As hospitals navigate these challenges, many are realizing that business as usual will no longer be enough.

COVID-19 PATIENT IMPACT ON REVENUE

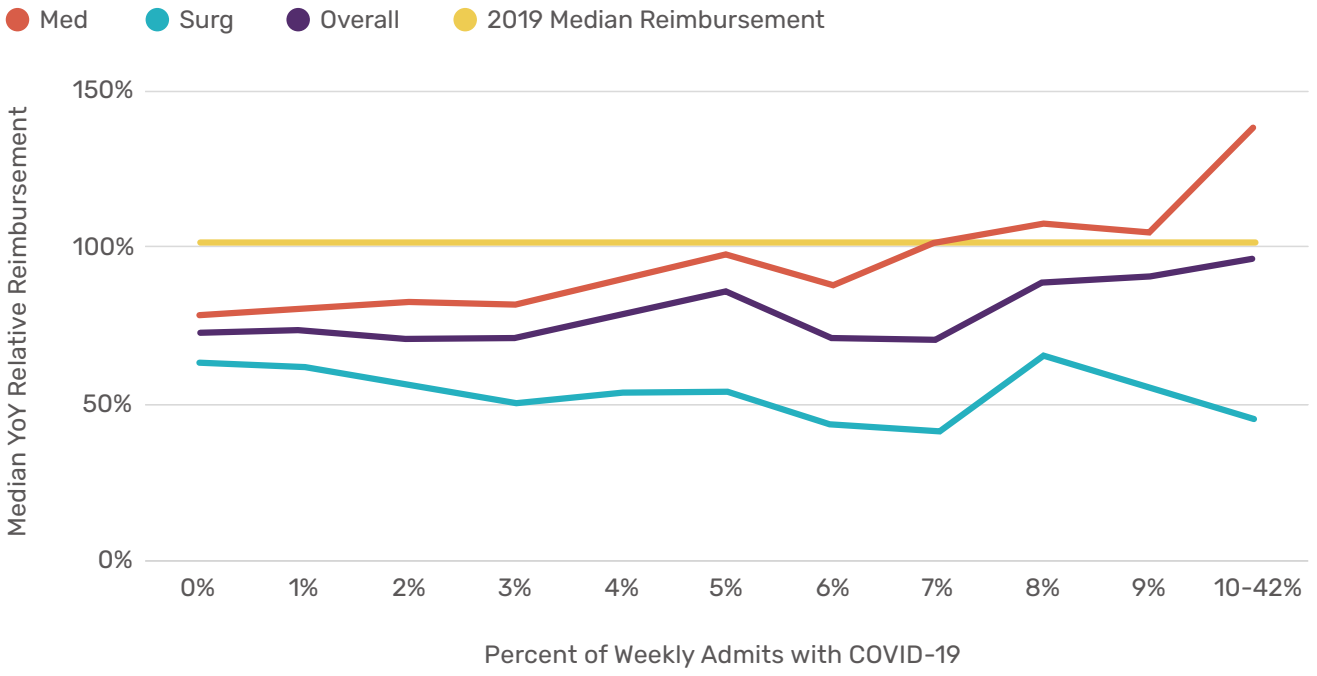
This analysis shows the impact on year-over-year weekly reimbursement an average hospital would expect as it cares for an increasing volume of COVID-19 patients.

Although we see overall reimbursement rising as hospitals treat higher volumes of COVID patients, surgical reimbursement continues to be suppressed. This could be worrisome as hospitals exit the pandemic, as medical dollars are expected to go down as COVID admissions decrease. Unless surgical volumes appreciably recover, we expect overall reimbursement to sink once more.

Note: This analysis only shows the expected reimbursement impact as COVID-19 admissions rise, and does not directly imply what a post-pandemic recovery may look like. Also this analysis does not account for additional expected reimbursement provided by the CARES Act, which increases Medicare reimbursement for COVID-19 cases.

Relative Reimbursement by % of Weekly Admits With COVID-19

Data from Iodine Software study performed in May 2020. Measured from March 4th until each facility's peak week of COVID admissions.



THE FIGURE ABOVE SHOWS THE FOLLOWING:

- Overall reimbursement starts off steeply lower than 2019 levels with a 30% YoY decline.
- This depressed level of reimbursement remains fairly consistent until COVID-19 patients account for 7% of weekly admissions.
- Reimbursement begins to recover as the volume of COVID-19 patients surpass 7% new weekly admissions. We have found that two scenarios contribute to this recovery:
    - For a certain number of facilities, the volume of medical admissions during COVID-19 is similar to their historical volume, but case mix index (CMI) increased dramatically due to a higher percentage of COVID-19 cases. The medical CMI increase of 30%-70% on a per-facility basis has lessened the depression in year-over-year reimbursement.
    - A smaller number of facilities also experienced an increase in medical case volume due to more COVID-19 admissions. In this situation, the total medical admissions increase coupled by a rise in medical CMI drives significant medical reimbursement improvement.
- Reimbursement reaches about 100% of the previous year's reimbursement level when the volume of COVID-19 patients reaches 10% of weekly admissions. However, this is only possible due to the influx of medical admissions. During this period, surgery reimbursement significantly drops to only 45% of the previous year's surgery reimbursement level.

BREAKDOWN BY MDC

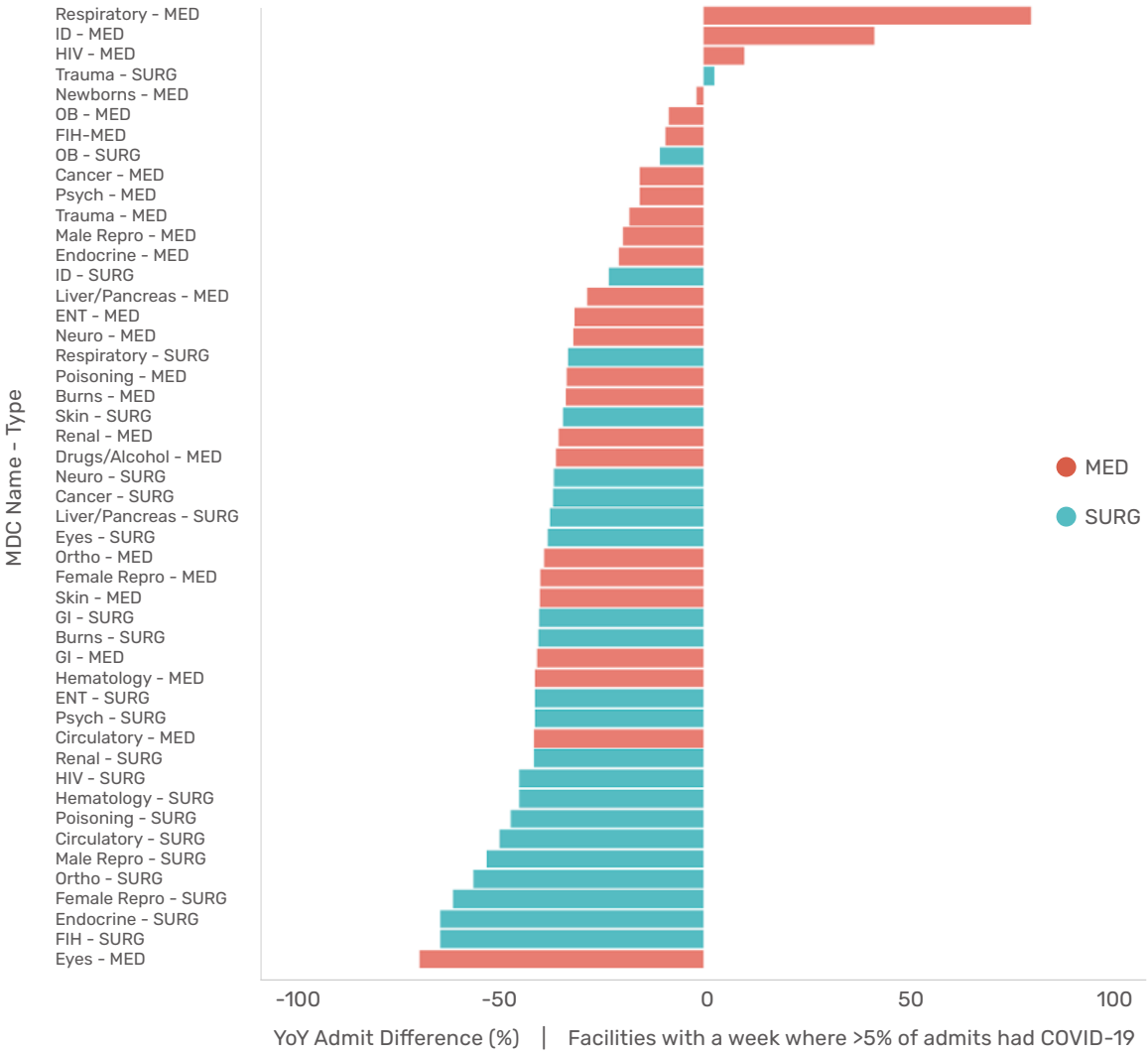
The figure below shows the observed year-over-year change in admission volume percentage, broken down by Major Diagnostic Category (MDC), for COVID facilities, for March and April, 2019 and 2020.

Note: This figure defines a COVID facility as a facility where COVID-19 admissions represent at least 5% of the total admission for that month. Reference to a non-COVID facility is defined as a facility where COVID-19 admissions represent less than 5% of the total admissions for the month.

At COVID facilities, while most other MDCs experienced a decline in volume as expected, Respiratory and Infectious Disease admissions volumes are up, about 90% and 70% respectively. Trauma Surgery volume is up about 20%.

Year-Over-Year MDC Admit Difference in Facilities With Numerous COVID-19 Cases

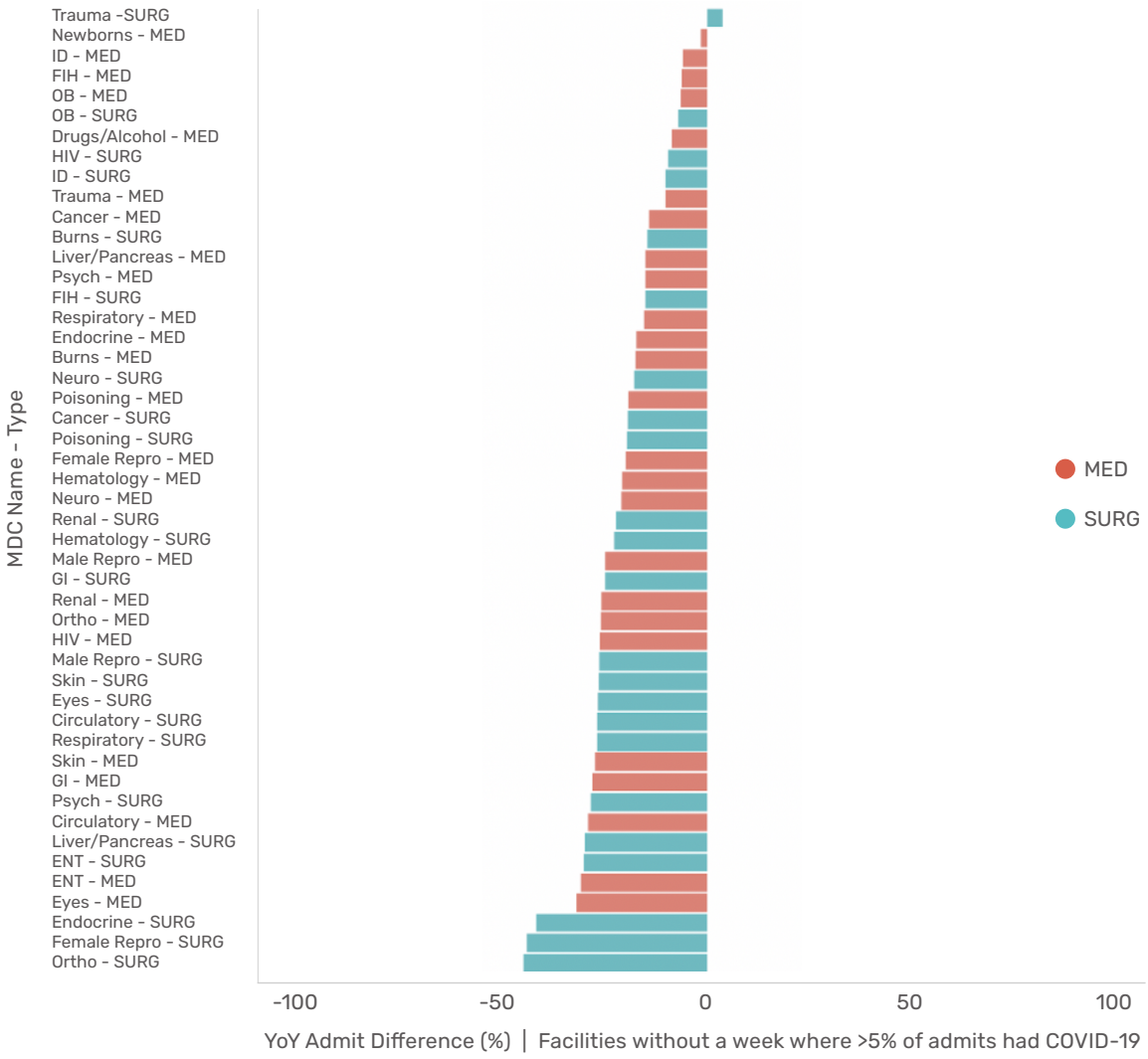
March 1 through May 7, 2020 Compared to March 1 through May 7, 2019



The next figure shows the same analysis for facilities where COVID-19 admission volume represents less than 5% of the hospital's total admissions in a month. In anticipation of a COVID-19 case surge, and per CMS recommendations, facilities not immediately impacted by COVID cases had an overall reduction in admission volume across almost all MDCs. Trauma (Surgical) was the only MDC with any volume increase, and it only increased by 3.9%

Year-Over-Year MDC Admit Difference in Facilities Without Numerous COVID-19 Cases

March 1 through May 7, 2020 Compared to March 1 through May 7, 2019



A comparison of the two figures also shows that at COVID facilities, the average MDC surgical volume decreased by 41%, while at non-COVID facilities, the average MDC surgical volume only decreased by 23%.

DOCUMENTATION IS CRITICAL

Prior to COVID-19, health systems were already operating on generally thin margins, with many finance leaders acknowledging that a significant root cause was leakage from their mid-revenue cycle and that "average performance" was still well below optimal results.

With health systems now facing an unexpected reimbursement decline of up to 30% YoY, accurate documentation becomes increasingly critical.[1] CDI creates resiliency through greater integrity in the patient record, which in turn improves revenue integrity, both in times of hardship and normalcy.

Today, the chart review process is highly inefficient and results in significant mid-cycle leakage. The right technology helps improve revenue capture by identifying which patient records are most likely to contain gaps between clinical evidence and narrative documentation.

[1] https://www.advisory.com/-/media/Advisory-com/Research/HCAB/Events/Webconference/2020/040220_HCAB.pdf#page=34

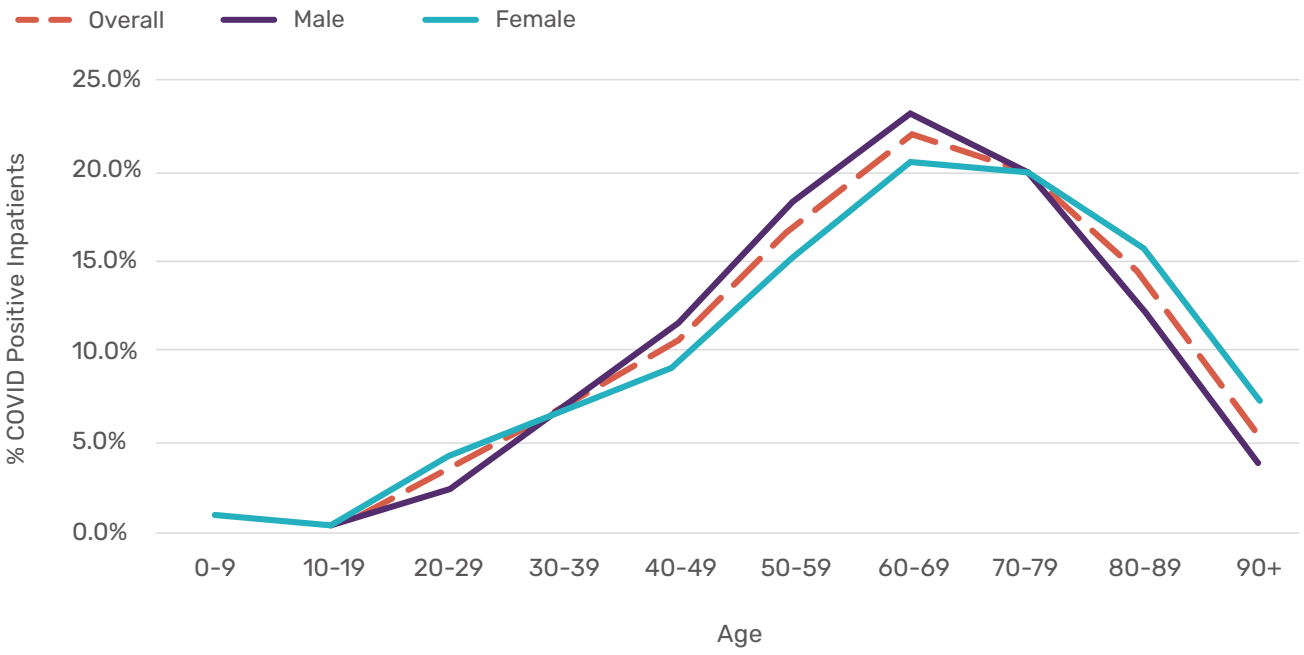
CLINICAL IMPACT OF COVID-19

In light of COVID-19, hospitals and health systems across the country adapted quickly to meet the needs of their communities. After learning major pain points of our partner hospitals, the Iodine Data Science team applied the CognitiveMLTM engine to review more than 60,000 total COVID-19 cases across admission status, mortality, and length of stay.

ADMISSION STATUS

Inpatients accounted for 56% of the 60,000 total COVID-19 admissions in Iodine's data set. These 34,000 cases were analyzed by age and gender, as shown in the figure below.

Percentage of COVID-19 Positive Inpatients by Age Range
From the May 2020 Iodine Software study of 34,000+ inpatients

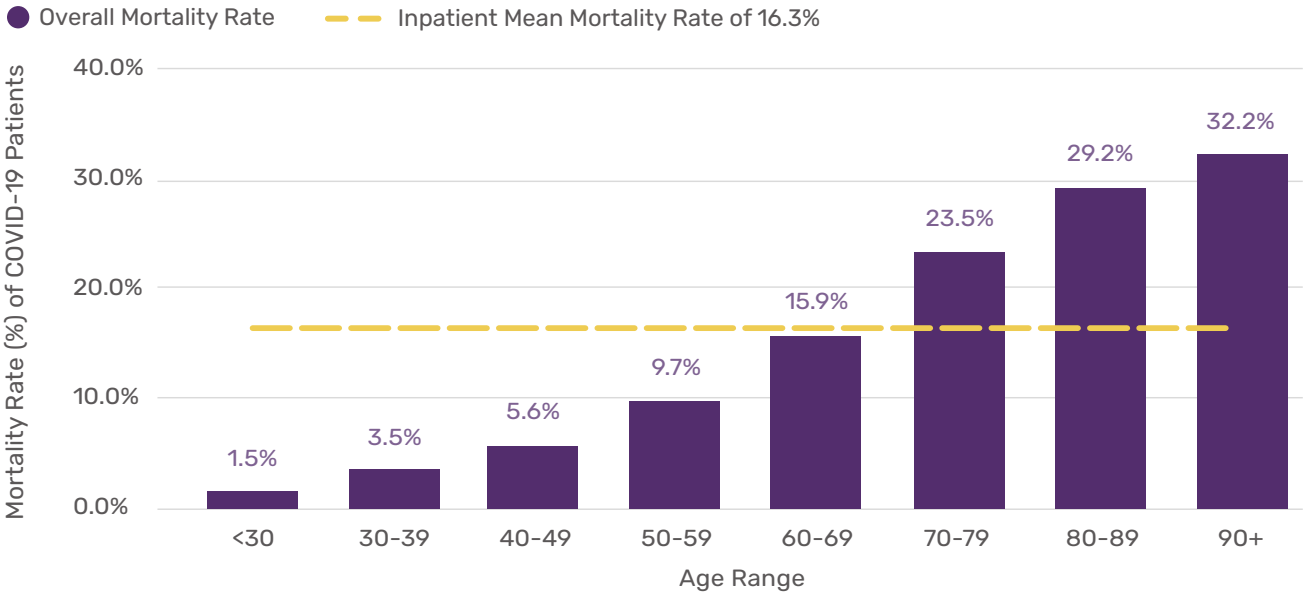


MORTALITY RATE BY AGE GROUP

Iodine assessed the relative likelihood of mortality by age group of admitted inpatients with COVID-19, as shown in the graph below. The mean mortality rate was 16.3% across all inpatients, while the mean mortality rate for all inpatients on ventilators was 38.6%. Additionally, individuals aged 90+ had a mortality rate that was **nearly 2x** the mean mortality rate for all COVID-19 patients in an inpatient hospital setting.

Inpatient Mortality Rate By Age Group

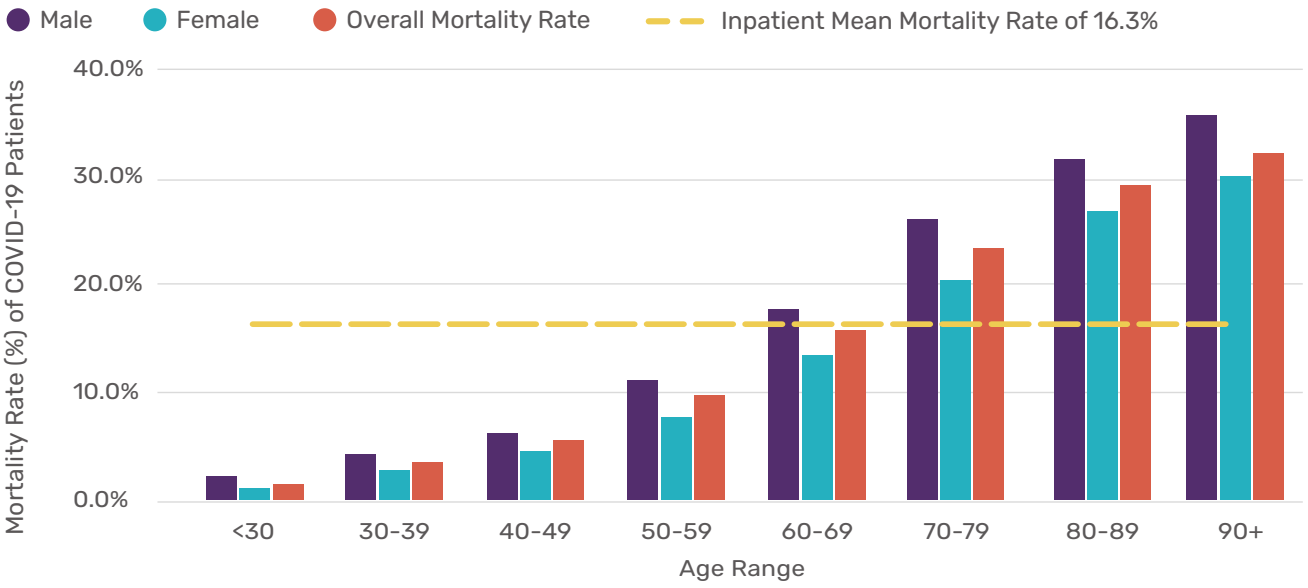
From the May 2020 Iodine Software study of 34,000+ inpatients



The graph below assesses the relative likelihood of mortality by age group and gender of admitted inpatients with COVID-19. Across all age group males had a higher rate of mortality than females.

Inpatient Mortality Rate By Age Group and Gender

From the May 2020 Iodine Software study of 34,000+ inpatients

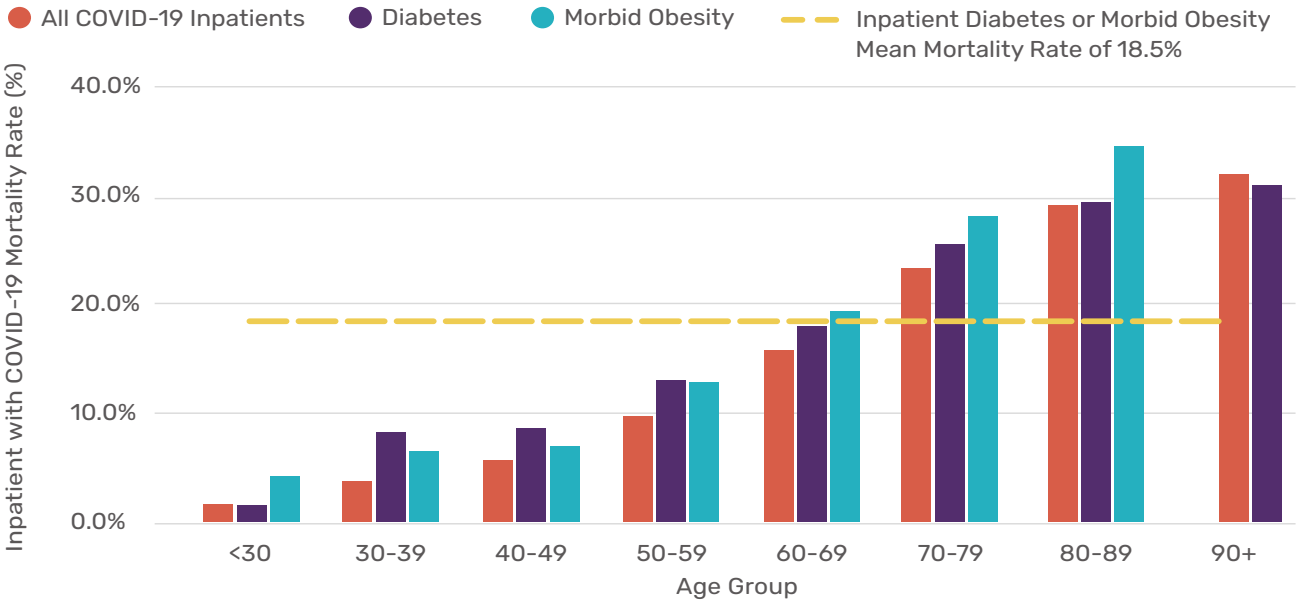


RISK OF MORTALITY BY COMORBIDITIES

Certain pre-existing conditions placed COVID-19 patients at higher risk for severe illness. Two conditions, diabetes and morbid obesity (BMI of 40 or greater), were analyzed in greater detail. Overall, the mortality rate for COVID-19 patients with either of these conditions was **18.5%**, compared to the overall rate of 16.3% across all age groups.

Inpatient COVID-19 Mortality Rate Per Condition by Age Group

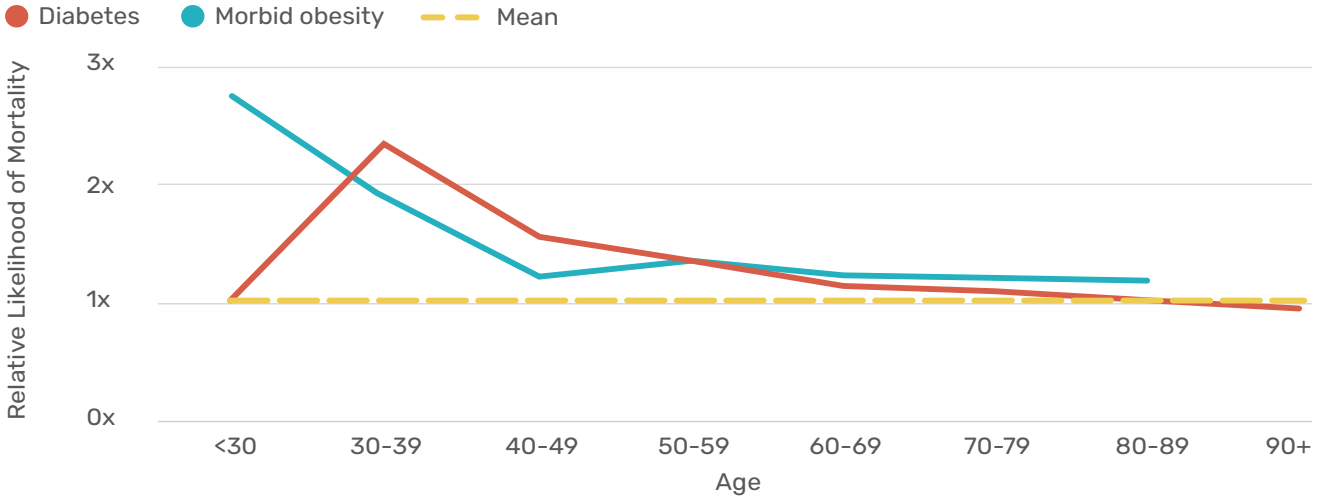
From the May 2020 Iodine Software study of 34,000+ COVID inpatients.
90+ Morbid Obesity excluded for small sample size.



The figure below shows that, as age increased, the relative likelihood of mortality due to obesity and diabetes decreased, suggesting that other factors were more likely to drive mortality for older COVID-19 patients.

Relative COVID-19 Mortality Rate for Obesity and Diabetes Comorbidities by Age

From the May 2020 Iodine Software study of 34,000+ inpatients



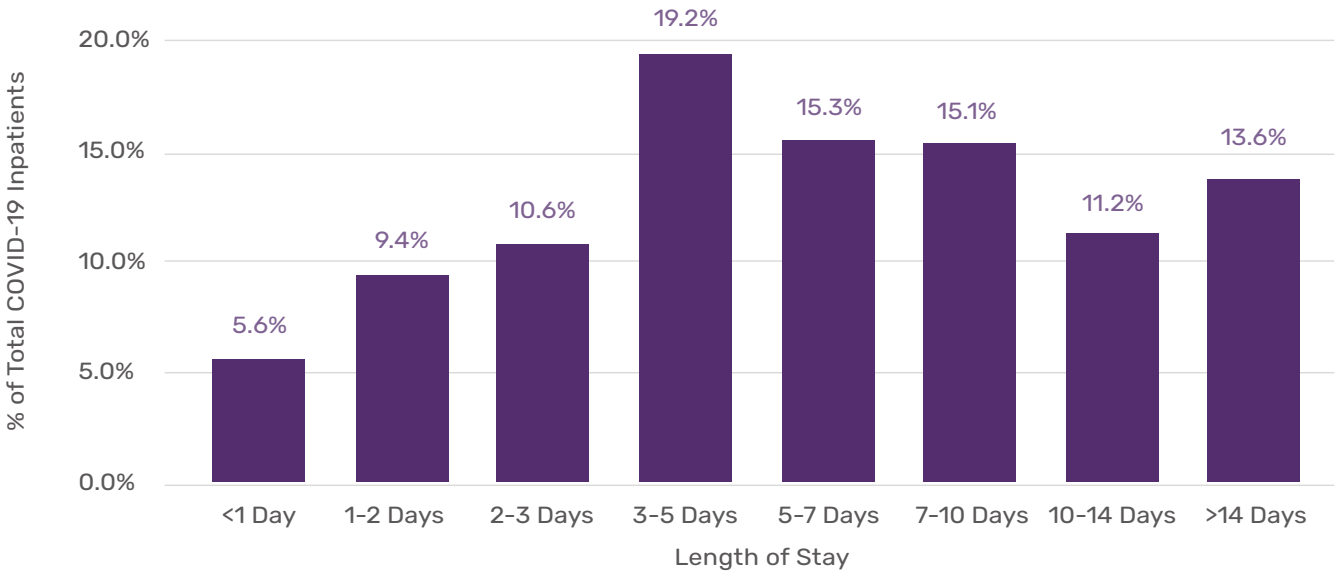
Note: All mortality stats are in reference to admitted inpatients with COVID-19

LENGTH OF STAY

Inpatients accounted for 56% of the 60,000 total COVID-19 admissions in Iodine's data set. These 34,000 cases were analyzed by length of stay (LOS). The first figure shows that 19.2% of people have an average length of stay between 3-5 days, and interestingly, the second figure shows the average length of stay by age group. On average, **a COVID-19 inpatient was admitted for a length of stay of 7.6 days.**

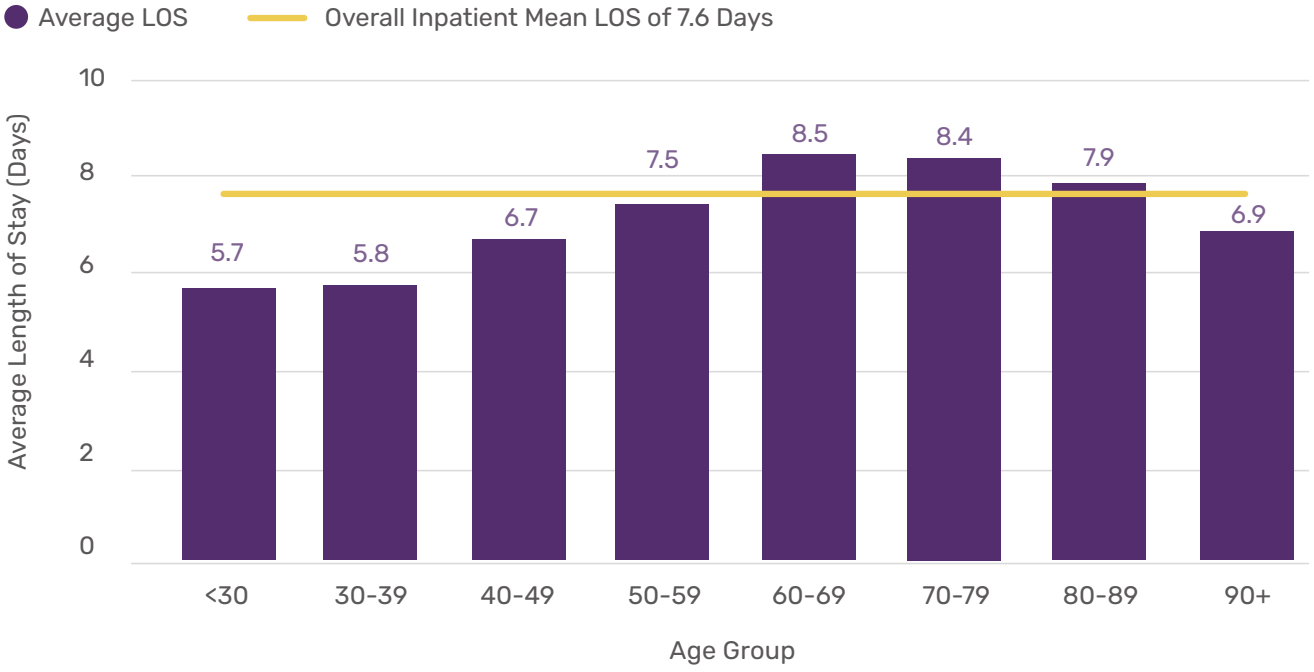
Percentage of Inpatients by Length of Stay

From the May 2020 Iodine Software study of 34,000+ inpatients



Inpatient Average Length of Stay by Age Group

From the May 2020 Iodine Software study of 34,000+ inpatients

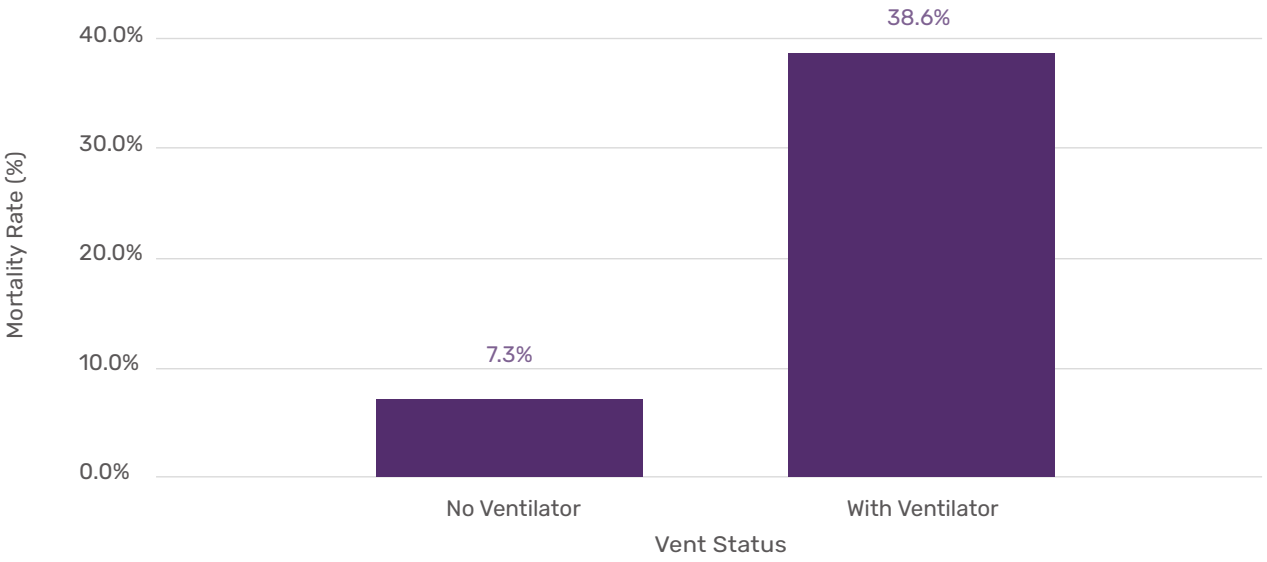


VENTILATOR DEMAND

The mortality rate of inpatients who were on a ventilator at some point during the inpatient stay is more than **5x higher** than an inpatient who was never on a ventilator during their hospital stay (38.6% mortality rate for those on a ventilator compared to 7.3% mortality rate for those not on a ventilator).

Mortality Rate vs. Vent Status

From the May 2020 Iodine Software study of 34,000+ inpatients



CLOSING

What Iodine has found to date ranges from verification of trends seen on far smaller data sets to seemingly new insights; and we've only just begun. Subsequent analyses will provide week-by-week updates, as well as extension of this analysis into clinical, financial, and epidemiological questions.

CFOs and Revenue Cycle departments need to be aware of current and future lost revenue opportunities due to COVID-19, and come up with both short- and long-term strategies to ensure resiliency. Iodine welcomes collaboration to accelerate the mutual understanding of this disease and to help hospitals cope with the challenges it presents them.