Temporal Trends in Emergency Department Utilization for Opioid Use Disorder in Baltimore, Maryland

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Objectives

Opioid use disorder (OUD) is common in Baltimore, Maryland and is associated with decreased longevity. The availability of pharmacotherapies that prevent OUD-associated emergencies has increased steadily. Thus, we hypothesized that Baltimore OUD-emergency department (ED) events have decreased longitudinally over a period defined by greater availability of OUD therapies.

Methods

The frequency of OUD-associated ED visits involving ambulance transportation occurring daily in the University of Maryland System (UMMS), which includes two hospitals in Baltimore City, was analyzed retrospectively between January 1, 2016-June 30, 2024. We started by analyzing daily encounter counts for OUD-associated ED visits, applying a 30-day moving average (Figure 1) and subsequently extracting seasonal, trend, and residual components1. This decomposition was performed for cases involving and not involving ambulance transportation, providing an overview of temporal patterns of OUD encounters (Figure 2).

The Seasonal Autoregressive Integrated Moving Average with eXogenous factors model (SARIMAX), which incorporates both non-seasonal and seasonal factors2, was used to process data from 2016-2023 and predict OUD-ED visits in January-June 2024. Data are presented as mean ± standard error (SE), and differences in event frequency between years were calculated using the Mann-Whitney U test. The mean absolute percentage error (MAPE) was used for SARIMAX prediction.

Results

Compared to 2016, we observed a steady and significant annual increase in daily OUD-ED encounters through 2019 (1.56 ± 0.07 vs. 2.05 ± 0.09 vs. 2.48 ± 0.1 vs. 2.52 ± 0.1 encounters, p_values < 0.05). We observed a subsequent, sharp decline in which the annual OUD-ED rate was 1.92 ± 0.07, 1.73 ± 0.07, and 1.38 ± 0.07 for 2020, 2021, and 2022, respectively, coinciding with the COVID-19 pandemic (Figure 3).

However, a recurrent rise in daily OUD-ED incidence was observed beginning late 2022 and increased continuously to an average of 1.69 ± 0.08 in late 2023. There was strong concordance between our SARIMAX prediction and the observed daily incidence rate of OUD-ED for January-June 2024 (2.02±0.02 vs. 2.03±0.1; MAPE=6.1%).

We also conducted a comprehensive analysis of ED-only encounter billing, adjusting for inflation to capture the precise increase over time, and observed an overall rising trend—except for 2022, likely due to the pandemic, shorter ED stays, and high inflation rate (Figure 4).

Figure 1:
Daily and 30-day Moving Average of Overdose Encounters by Ambulance

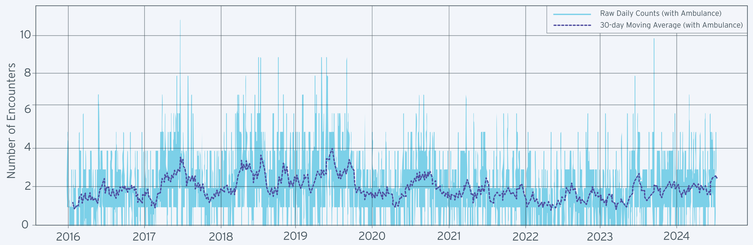


Figure 2:
Comparative Analysis of Overdose Encounter

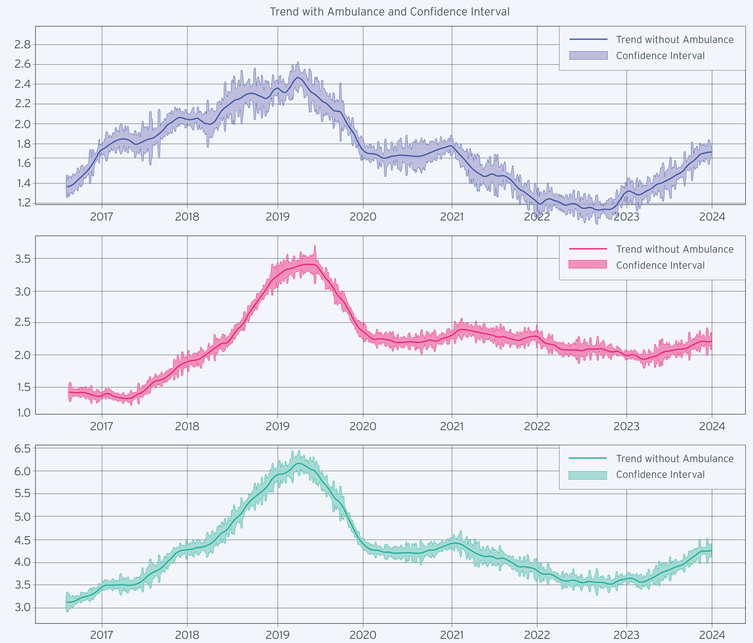


Figure 3:
Daily Trends of Overdose Encounters by Ambulance from 2020 to 2024 (7-day Moving Average)

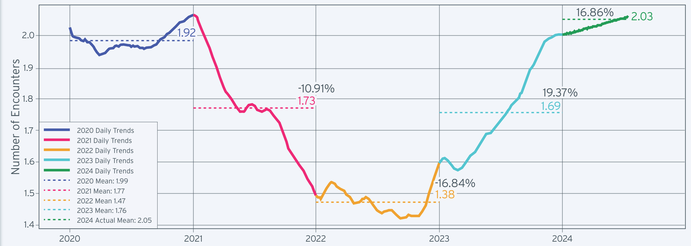
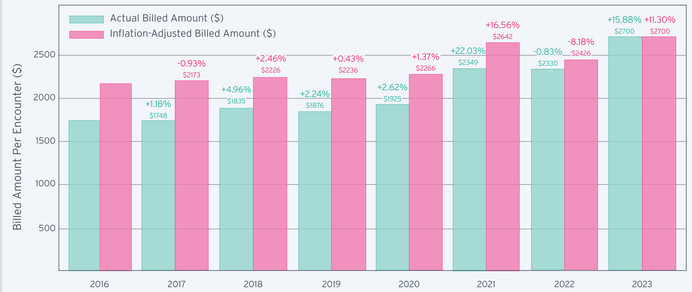


Figure 4:
Annual Billed vs. Inflation-Adjusted Amount Per ED Encounter



Conclusions

We observed a progressive increase in OUD-ED events in Baltimore from 2016 through 2024, which was disrupted temporarily during COVID-19 years. These data suggest that prospective strategies focusing on city-wide implementation of pharmacotherapies to prevent OUD emergencies in Baltimore are warranted.

References

1. Seabold S, Perktold J. Statsmodels: econometric and statistical modeling with python. SciPy. 2010 Jun 28;7(1):92-6.

2. Alharbi FR, Csala D. A seasonal autoregressive integrated moving average with exogenous factors (SARIMAX) forecasting model-based time series approach. Inventions. 2022 Oct 16;7(4):94.

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