8/6/2025

Reducing Emergency Room Wait Times: An Analysis and Operational Recommendation

By: Armaan Patel

Table of Contents:

8/6/2025

Database: https://www.kaggle.com/datasets/rivalytics/er-wait-time
Description of Database:
Database uses synthetic data to realistically represent real-world emergency room dynamics.

(Description taken straight from Kaggle)
About Dataset
This dataset was inspired by real-world emergency room dynamics and healthcare industry reports to provide a realistic simulation of patient visits. The data reflects insights from studies on ER wait times, patient outcomes, and satisfaction metrics, incorporating key factors such as urgency levels, seasonal trends, and time-of-day variability.

Sources of inspiration include reports from the Agency for Healthcare Research and Quality, studies on nurse-to-patient ratios, and published statistics on average ER wait times across urban and rural regions. The dataset was designed using a Python-based simulation, with input from ChatGPT to ensure logical relationships between variables and alignment with domain knowledge.

While entirely simulated, the dataset serves as a practical tool for learning data analysis, visualization, and statistical modeling in the context of healthcare operations..

Files:
ER Wait Time Dataset.csv

8/6/2025

Deliverables:
Understand Dataset
Answer Analytical Questions
Create Dashboard

Project Goals:
What factors contribute to increased ER wait times?

How can we reduce ER wait times?

Will reduced wait times increase customer satisfaction?

Tools:
Jupyter, Tableau

Libraries:
Pandas, NumPy, Matplotlib, and Seaborn

8/8/2025

Project Summary:

After analyzing the synthetic data that closely represents real world ER wait times. It seems to be that a variety of factors affect wait times in the ER.

The key findings section will go over interesting things found and/or possible reasoning for issues.

A possible solutions section is provided to combat the issues seen in the key findings section.

Obviously, a deeper analysis and more research is required to get a better understanding of exact causes and proper solutions, but for now this is a good start in understanding the issue and potential solutions.

Key Findings and Possible Explanations:

- Higher urgencies have less wait times.
    - This is possibly due to the fact that patients that are critical or close to critical need immediate attention as not getting treatment in time could lead them to die.
- Mondays have the highest wait times.
    - Possible causes:
        - The higher wait times could suggest unmotivated staff
        - Patients may engage in riskier behaviors due to post-weekend fatigue.
- Sundays have the lowest wait times.
    - Possible causes.
        - Lower wait times could suggest less people are doing risky activities since Sundays are generally a more calm and relaxed day of the week.
        - Staff may be more refreshed on Sundays.
- Patient satisfaction increases as wait times decrease.
    - This was very clear in the graphs that were made for the analysis.
- Winters have longer wait times than other seasons.
    - This could be possibly caused by people being more likely to get injured when they are doing winter activities.
    - The longer wait time may correlate that medical staff might be less motivated during the winter.
- Falls have shorter wait times than other seasons.
- Evenings have longer wait times than other times of the day.
    - Possibly because people are more active in injury prone activities towards the end of the day.
- Early mornings have shorter wait times than other times of the day.
    - Possibly due to more people not doing injury prone activities.
- High wait times for medium and low urgency patients tend to make patients leave without being seen.
    - This is definitely a problem as patients need to be seen as conditions can worsen, especially without a proper checkup.

    - Due to high wait times patients might not want to wait to be seen and tend to leave without being checked.
- What hospital a patient goes to does not matter, whether it is rural or urban for ER wait times.

Possible Solutions:

- Having more staff to deal with higher patient counts can help especially on Mondays, evenings, and winters.
- Staff motivation can help.
- Possibly pushing for more public awareness on avoiding injuries.
    - Brochures.
    - Stretching recommendations.
    - Fitness days.
- Possibly using better triage tools to better prioritize patients.

Future of project:

The analysis of the synthetic data gives a good idea of issues and possible solutions to the issues leading to longer ER wait times for treatment. It is important that ER wait times go down so patients are able to receive the treatment they need. While this analysis provides valuable insight using synthetic data, future work should include validation with real-world ER data and collaboration with medical professionals and researchers to propose implementable solutions for decreasing ER wait times and increasing patient satisfaction.

Documentation:
Use “python -m jupyterlab” to access jupyter lab through cmd

8/7/2025: Accomplished Analysis Deliverable
Used JupyterLab to analyze datasets with Pandas, NumPy, Matplotlib, and Seaborn libraries.

- Read data in.
- Checked data structures.
- Checked null values for datasets.
- Converted Visit Date column into datetime format.
- Graphed Wait Time Distribution.
    - Learned that most ER wait times are between 10 and 25 minutes.
- Created a Correlation Heatmap of numerical features.
    - Learned what columns are related to one another.
- Created box plot of ER Wait Time by Urgency Level.
    - Learned that the higher the urgency level the less the wait time.
- Created a box plot of ER Wait Times by the Day of the Week.
    - Learned that Sundays have lower ER wait times than the other days of the week.
    - Learned that Mondays and Fridays have higher wait times than the rest of the days of the week.
- Created a box plot of Wait Time vs Patient Satisfaction.
    - Clear correlation is seen that higher patient satisfaction has lower wait times.

8/7/2025: Accomplished Dashboard
Used Tableau to create worksheets.

- Created bar graph of Average Wait Time per Day of Week and Season.
    - Learned that Sundays have the least average wait times out of the days in the week.
    - Learned that Mondays have the most average wait times out of the days in the week.
    - Learned that Winters have the most average wait times of the seasons.
    - Learned that Falls have the least average wait times of the seasons.
- Created bar graph of Average Wait Time per Urgency Level and Time of Day
    - Learned that the more urgent a case is, the less the wait is.
    - Learned that evenings have longer wait times than other times of the day.
    - Learned that early mornings have shorter wait times than other times of the day.
- Created bar graph of Average Wait Times per Hospital and Region.
    - Learned that hospital and region of hospital do not affect the ER wait times by any marginal extent.
- Created bar graph of Average Wait Times vs Patient Outcome and Urgency Level.
    - Learned that ER patients that have medium and low urgency levels and experience high wait times tend to leave without being seen.
- Created bar graph of Average Wait Time vs Patient Satisfaction and Urgency Level
    - Clear correlation can be seen that lower wait times lead to better patient satisfaction.

    - Only high and critical cases were able to achieve fives for their patient satisfaction rating.
    - Low cases were not able to get more than a three satisfaction rating.
    - Only high was able to be on all patient satisfaction ratings.
- Created bar graph of Average Wait Time vs Specialist Availability and Region.
    - Learned that the number of specialists does not matter, the difference is marginal.

Used Tableau to create dashboard