Optimizing Emergency Department Operations: Analyzing Patient Flow, Capacity, and Resource Allocation

A Final report for the BDM capstone Project

Submitted by

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Contents

1 Executive Summary

California's emergency department system serves millions of patients annually, functioning as a critical safety net for urgent medical care. However, EDs face mounting operational challenges including **patient overcrowding, extended wait times, capacity constraints, and uneven resource distribution across facilities.** These inefficiencies directly impact **patient outcomes, staff burnout, and overall healthcare costs.** This report analyzes comprehensive ED data from the California Department of Health Care Access and Information (HCAI) to identify critical bottlenecks and propose data-driven solutions for California's healthcare system by addressing two problem areas:

1. **Analyzing Year-Over-Year Emergency Department Utilization Trends:** This analysis examines temporal trends in ED visit volumes from 2012 to 2024 to identify growth patterns, COVID-19 impact, and long-term capacity planning needs. By studying facility-level growth rates and geographic demand patterns, we identify high-growth facilities requiring urgent capacity expansion and declining facilities at closure risk.
2. **Assessing ED Capacity Gaps and Operational Bottlenecks:** This section examines the relationship between ED encounter volumes and available treatment capacity to identify supply-demand mismatches. Using burden ratio analysis (visits per treatment station), we quantify operational strain, identify facilities operating above recommended thresholds, and pinpoint geographic regions facing systemic capacity crises.

Through our analysis, we derive **actionable insights for improving California's ED capacity planning**, resource allocation, and operational efficiency. These insights support **evidence-based decisions** for infrastructure investment, staffing optimization, and strategic expansion to benefit patients, healthcare providers, and hospital administrators.

In conclusion, this report identifies critical capacity constraints affecting California's emergency care system and proposes targeted strategies to address bottlenecks. The findings reveal that 15.7% of facilities operate above recommended capacity, with 18 facilities at critical burden levels requiring immediate intervention. By leveraging comprehensive utilization data and capacity metrics, California policymakers can prioritize investments to strengthen emergency care delivery statewide.

2 Proof of Originality

In this project, I have utilized publicly available datasets from the California Department of Health Care Access and Information (HCAI) to conduct a comprehensive analysis of emergency department operations, capacity constraints, and utilization patterns across California hospitals.

2.1 Hospital Emergency Department Encounters by Facility (2012-2024)

- Link: https://data.chhs.ca.gov/dataset/hospital-emergency-department-encounters-by-facility
- **Description**: This dataset provides comprehensive facility-level data on ED utilization across California from **2012 to 2024**. It includes annual aggregates of ED encounters covering **440 unique facilities** across **56 counties**. Each record contains facility identification, county location, ER service level classification (Basic, Comprehensive, Standby), encounter type (ED_Visit or ED_Admit), and total encounter counts. This dataset enables analysis of year-over-year utilization trends, identification of high-growth and declining facilities, geographic demand patterns, and COVID-19 pandemic impact on emergency department services. It is valuable for understanding long-term demand trajectories, facility-level growth patterns, and strategic capacity planning needs across California's healthcare system.

2.2 Emergency Department Volume and Capacity (2021-2023)

- Link: https://data.chhs.ca.gov/dataset/emergency-department-volume-and-capacity
- **Description**: This dataset captures detailed operational metrics for California emergency departments from **2021 to 2023**. It includes facility-level information on total ED visits, number of treatment stations, calculated burden ratios (visits per station), geographic classification (urban/rural/frontier), and hospital ownership type. The dataset is especially valuable for analyzing supply-demand mismatches, identifying facilities operating above recommended capacity thresholds, and examining operational bottlenecks. By exploring these patterns, the dataset enables insights into capacity gaps, infrastructure needs, and resource allocation disparities across urban and rural regions, supporting evidence-based recommendations for capacity expansion and operational efficiency improvements.

By using these datasets, this project aims to acquire a comprehensive understanding of California's emergency department operations, identify critical capacity constraints and utilization trends, and offer actionable insights. These insights are intended to enhance strategic capacity planning, optimize resource allocation, and improve emergency care delivery across the state's healthcare system.

3 Metadata and Descriptive Statistics

3.1 Metadata

The California Emergency Department Encounters dataset provides comprehensive facility-level data on ED utilization across the state. The dataset was obtained from the California Department of Health Care Access and Information (HCAI) and underwent standard preprocessing procedures.

The ED-facility-encounters dataset includes annual aggregates of ED encounters from **2012 to 2024**, covering **440 unique facilities** across **56 California counties**. Each row contains facility identification, county location, ER service level classification, encounter type (ED_Visit or ED_Admit), and total encounter counts.
Below is the metadata summary for key variables in the cleaned dataset:

Variable Name	Description	Data Type	Range / Values
Year	Year of encounters	Integer	2012-2024
Facility Name	Hospital facility name	String	440 unique facilities
County Name	County location	String	56 counties
ER Service Level Desc	ER service level	Category	BASIC, COMPREHENSIVE, STANDBY
Type	Encounter type	Category	ED_Visit, ED_Admit
Count	Number of encounters	Float	1 to 155,329

Table 1: Metadata for California ED Encounters Dataset

The Emergency Department Volume and Capacity dataset provides detailed operational metrics for California emergency departments from **2021 to 2023**. The dataset was obtained from the California Department of Health Care Access and Information (HCAI) and includes facility-level information on patient volumes, treatment capacity, and operational efficiency. The dataset encompasses 12,849 facility-year observations covering 315 unique emergency departments facilities across California. Each record contains facility identification, geographic classification (urban/rural/frontier), total ED visits, number of treatment stations, and calculated burden ratios (visits per treatment station).

Below is the metadata summary for key variables in the cleaned dataset:

Variable Name	Description	Data Type	Range / Values
Year	Year of reporting	Integer	2021-2023
Facility Name	Hospital facility name	String	315 unique names
County Name	County location	String	53 counties
UrbanRuralDesi	Geographic classification	Category	Urban, Rural, Frontier
Tot ED NmbVsts	Total ED visits	Integer	0 to 146,799
ED Stations	Number of treatment stations	Integer	1 to 114
Visits Per Station	Burden ratio (visits/station)	Float	0 to 4,714

Table 2: Metadata for California ED Volume and Capacity Dataset

3.2 Descriptive Statistics

The ED-facility-encounters comprises 8,488 records representing 180,943,607 total ED encounters across the 13-year study period. Table 3 presents summary statistics for key variables:

Statistic	Encounter Count	ED_Visits Count	ED_Admits Count
Mean	21,595	37,527	5,968
Std Dev	24,246	25,670	5,001
Min	1	164	1
25%	4,262	17,890	2,070
Median	11043	33033	4,932
75%	32,738	52,511	8,578
Max	1,55,329	1,55,329	27,937

Table 3: Descriptive Statistics for ED facilities Encounters Dataset

The data shows substantial variability in facility-level encounter volumes, with a standard deviation of 24,246 encounters. The median facility experiences 11,043 annual encounters, while the largest facility handles 155,329 encounters per year.

The volume-capacity-dataset comprises 12,849 records. Table 4 presents summary statistics for key operational metrics:

Statistic	**Total ED Visits**	**Treatment Stations**	**Burden Ratio (Visits/Station)**
Mean	39,642	28.6	138
Std Dev	26,917	20.76	376
Min	511	1	0
25%	18,962	12	5.11
Median	33,711	24	22.87
75%	54,542	40	84.27
Max	1,46,799	114	4,714

Table 4: Descriptive Statistics for ED Capacity Dataset

All the code with JupyterNotebooks for this analysis is available at:
https://github.com/annimukherjee/BDM-Project

4 Analytical Approach and Methodology

The analysis employed a systematic approach combining temporal trend analysis, facility-level growth calculations, and geographic comparisons.

Year-over-year analysis calculated total statewide encounters by year and computed growth rates using the formula:

$$CAGR = \left(\frac{Ending\ Value}{Beginning\ Value}\right)^{\left\{\frac{1}{years}\right\}} - 1$$

Facility-level analysis identified high-growth and declining facilities by calculating compound annual growth rates for all facilities with at least 5 years of continuous data. This approach captured 361 facilities representing 95% of total encounters.
Geographic analysis aggregated encounters by county and computed regional growth rates. Counties were classified as urban (Los Angeles, San Diego, Orange, Santa Clara, San Francisco, Alameda, Sacramento, Contra Costa) or rural based on population density and metropolitan status.

For Volume and Capacity, the analysis employed a systematic approach to quantify ED capacity gaps using the burden ratio metric:

$$Burden\ Ratio = \frac{\text{Total ED Visits}}{\text{Number of Treatment Stations}}$$

This metric provides a normalized measure of operational intensity, allowing comparison across facilities of different sizes. Industry research suggests 2,000 visits per treatment station annually as a sustainable operational threshold.

Facilities were categorized into four burden levels based on empirical thresholds:

Burden Level	Threshold (visits/station)	Description
Critical	>3000	Severe overcrowding with significant patient safety and quality concerns
High	2000-3000	Above recommended capacity; operational strain likely
Moderate	1000-2000	Near optimal capacity; some efficiency opportunities
Adequate	<1000	Well below capacity; potential underutilization

Table 5: Categorization of facilities based on operational intensity.

Geographic analysis examined capacity gaps across three dimensions:
1. County-level aggregation to identify regional hotspots
2. Urban-rural-frontier classification to assess geographic equity

All analyses were conducted using Python 3.11 with pandas for data manipulation and matplotlib/seaborn for visualization. Burden thresholds were validated against published emergency medicine literature and ACEP (American College of Emergency Physicians) guidelines.

5 Results and Findings

5.1 Overall Trend: Are ED Visits Increasing or Decreasing?

California ED encounters grew **24.69%** from 2012 to 2024, increasing from 12,406,843 encounters to 15,470,603 encounters. This represents a compound annual growth rate (CAGR) of 1.86% per year. Figure 1 illustrates the year-over-year trend and annual growth rates.

Key Statistics (2012-2024):

- Starting encounters (2012): 12,406,843
- Ending encounters (2024): 15,470,603
- Total growth: +24.69%
- Average annual growth rate: 1.86% CAGR

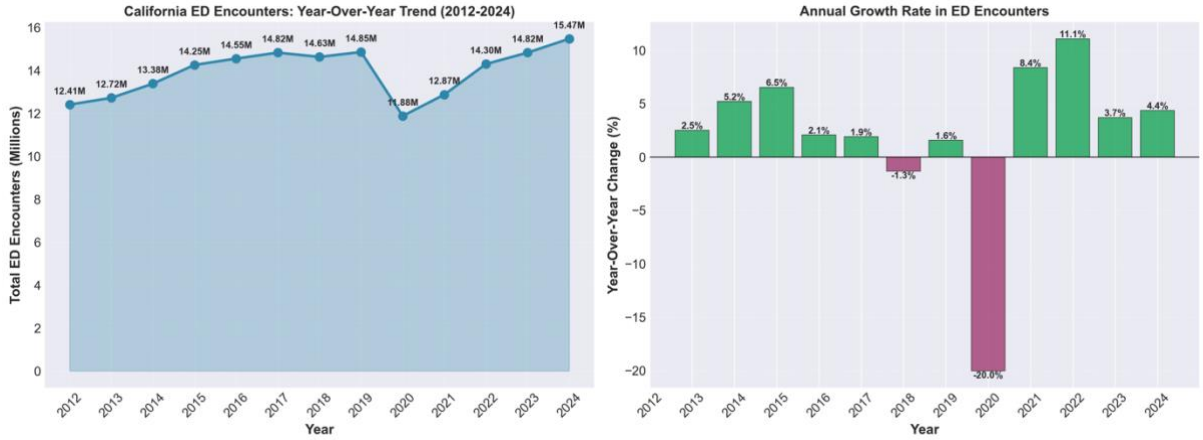

Figure 1: Left panel shows total ED encounters by year with value annotations. Right panel displays year-over-year percentage changes, highlighting the 2020 COVID-19 impact (red bar) and subsequent recovery (green bars). The overall trend indicates sustained growth despite the pandemic disruption.

Admission Patterns: ED visits and admissions both grew proportionally over the study period. The overall admission rate remained stable at **14.00%**, ranging from 13.08% to 15.59% annually. The 2020-2021 period showed elevated admission rates (15.59% in 2020, 15.25% in 2021), likely reflecting higher-acuity pandemic-related presentations.

The growth trajectory was disrupted significantly by the COVID-19 pandemic. In 2020, ED encounters dropped **20.05%** to 11,875,714 encounters—the lowest point in the study period. The system showed recovery in 2021 with an 8.37% increase, though full pre-pandemic levels were not reached until 2022.

5.2 Geographic Analysis: Regional Growth Patterns

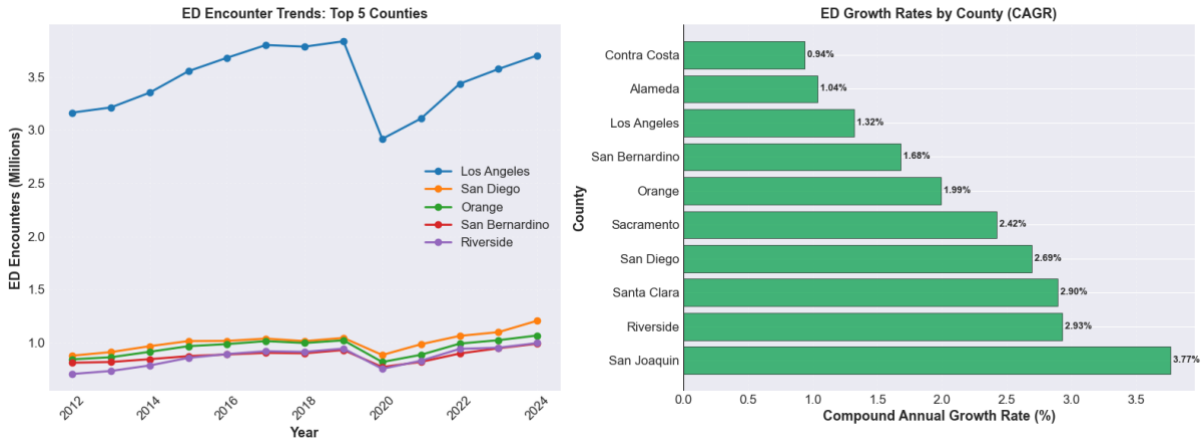

Figure 2: Left panel shows ED encounter trends for the top 5 counties by volume. Right panel displays compound annual growth rates, demonstrating that smaller counties like San Joaquin and Riverside are growing faster than large urban counties.

Geographic analysis reveals substantial heterogeneity in ED utilization growth across California counties. Table 6 presents growth rates for the top 10 counties by total encounter volume. Table 7 presents the top 10 Counties by total ED encounters.

County	Starting (2012)	Ending (2024)	Total Growth (%)	CAGR (%)
San Joaquin	279,386	435,415	55.8	3.77
Riverside	703,597	994,861	41.4	2.93
Santa Clara	483,055	680,411	40.9	2.9
San Diego	876,205	1,205,294	37.6	2.69
Sacramento	502,928	670,188	33.3	2.42
Orange	841,620	1,066,134	26.7	1.99
San Bernardino	809,630	988,701	22.1	1.68
Los Angeles	3,164,141	3,702,649	17	1.32
Alameda	581,819	658,369	13.2	1.04
Contra Costa	363,469	406,542	11.9	0.94

Table 6: ED Growth Rates for Top 10 Counties by Volume

SNo	County	Total ED Encounters	% of State
1	Los Angeles	45,126,242	24.94
2	San Diego	13,103,997	7.24
3	Orange	12,372,520	6.84
4	San Bernardino	11,376,604	6.29
5	Riverside	11,206,815	6.19
6	Alameda	7,896,343	4.36
7	Sacramento	7,724,529	4.27
8	Santa Clara	7,429,690	4.11
9	Contra Costa	4,687,950	2.59
10	San Joaquin	4,686,465	2.59

Table 7. Top 10 California counties by total ED encounters from 2012 to 2024. Percentages represent each county's share of all statewide encounters.

San Joaquin County exhibited the fastest growth at **3.77% CAGR**, while Los Angeles—accounting for **24.94%** of all statewide encounters—grew at a more modest 1.32% CAGR. The three largest urban counties (Los Angeles, San Diego, Orange) collectively represent **39.02%** of all California ED encounters.

County-level analysis reveals that a small number of counties account for the majority of ED encounters. Counties experience varying rates of ED utilization growth and some regions show substantially higher growth rates, indicating shifting demand patterns.

5.3 Facility-Level Analysis: Fastest Growing and Declining Facilities

Analysis of 361 facilities with sufficient longitudinal data identified substantial variation in facility-level growth patterns. The distribution ranged from a maximum CAGR of **171.4%** to a minimum of **-56.9%**.

The fastest growing emergency departments in California highlight where capacity expansion is most urgent. **Loma Linda University Children's Hospital in San Bernardino** recorded the highest growth, with a **171.4 percent** compound annual growth rate, increasing from just 2 encounters in 2014 to 43,381 in 2024, reflecting major new pediatric ED capacity. **Foothill Regional Medical Center** in Orange grew at 150.4 percent CAGR, from 5 encounters in 2016 to 7,720 in 2024, consistent with its role as a newer facility serving rapidly growing suburban areas of Orange County. **Adventist Health Tulare** in Tulare posted 37.8 percent CAGR, with encounters rising from 4,947 in 2018 to 33,923 in 2024, as it serves an expanding agricultural region in the Central Valley. **Adventist Health Howard Memorial** in Mendocino grew at 25.4 percent CAGR, from 2,034 encounters in 2015 to 15,565 in 2024, indicating its growing importance as a rural access point. **Temecula Valley Hospital** in Riverside, located in a high-growth Inland Empire suburb, recorded 23.9 percent CAGR, with encounters increasing from 4,368 in 2013 to 46,004 in 2024.
In contrast, several facilities show steep declines in ED encounters that warrant investigation. **Madera Community Hospital** in Madera experienced a negative 56.9 percent CAGR, falling from 42,246 encounters in 2012 to just 4 encounters in 2023, indicating a near-complete cessation of ED services and very high closure risk. **Los Angeles Community Hospital** at Bellflower saw encounters drop from 10,924 in 2012 to 86 in 2019, a negative 49.9 percent CAGR, raising questions about its operational status. **Gardens Regional Hospital and Medical Center**, also in Los Angeles County, declined from 8,377 encounters in 2012 to 277 in 2017 (negative 49.4 percent CAGR), which may reflect market consolidation or service reconfiguration. **St. Vincent Medical Center** in Los Angeles recorded a negative 32.5 percent CAGR, with encounters decreasing from 14,501 in 2012 to 623 in 2020, suggesting potential closure or conversion of services. Finally, **Sharp Mary Birch Hospital for Women and Newborns** in San Diego declined from 30 encounters in 2012 to 1 encounter in 2021 (negative 31.5 percent CAGR), consistent with its role as a specialized maternity and neonatal facility rather than a general ED.

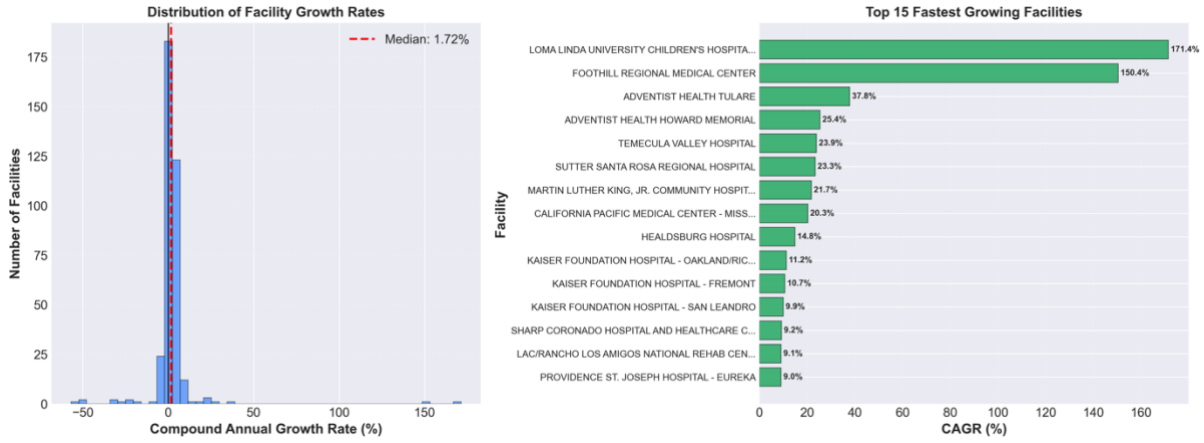

Figure 3: Left panel shows the distribution of facility-level growth rates. The median facility experienced 1.89% CAGR (red dashed line). Right panel displays the top 15 fastest-growing facilities by CAGR, highlighting substantial heterogeneity in facility-level demand dynamics.

Size Category	Definition	Facility Count	Percent
Small	<10K/year	39	8.90%
Medium	10-30K/year	12	2.70%
Large	30-60K/year	21	4.80%
Very Large	>60K/year	368	83.60%

Table 8: Categorization of facilities by their size.

Across all hospitals in the dataset, the average emergency department handled about **411,235** encounters per year, while the median facility saw **305,097** encounters per year, indicating a right-skewed distribution driven by a subset of very high volume centers. In terms of size categories, **8.90** percent of facilities are small, with fewer than **10,000** encounters per year, and **2.7** percent fall into the medium band of **10,000 to 30,000** encounters per year. Large facilities with **30,000 to 60,000** encounters account for **4.8 percent** of the total, and very large facilities with **more than 60,000** encounters per year make up the **remaining 83.6 percent**, highlighting a substantial concentration of demand in higher volume hospitals.

5.4 Overall Capacity Status: System-Wide Burden Analysis

15.7% of facilities in California's emergency department operate above recommended capacity on average. The state has a mean burden ratio of 1,487 visits per treatment station.

Key Statistics (2021-2023 Combined):

- **Total ED visits**: 29,963,114
- **Total treatment stations**: 21,607
- **Average burden ratio**: 1,487 encounters/station

Burden Category Distribution:

Burden Category	Number of Facilities	% of Total
Critical (>3000)	18	2.38%
High (2000-3000)	101	13.36%
Moderate (1000-2000)	485	64.15%
Adequate (<1000)	152	20.11%

Table 9: Burden Category Distribution amongst facilities

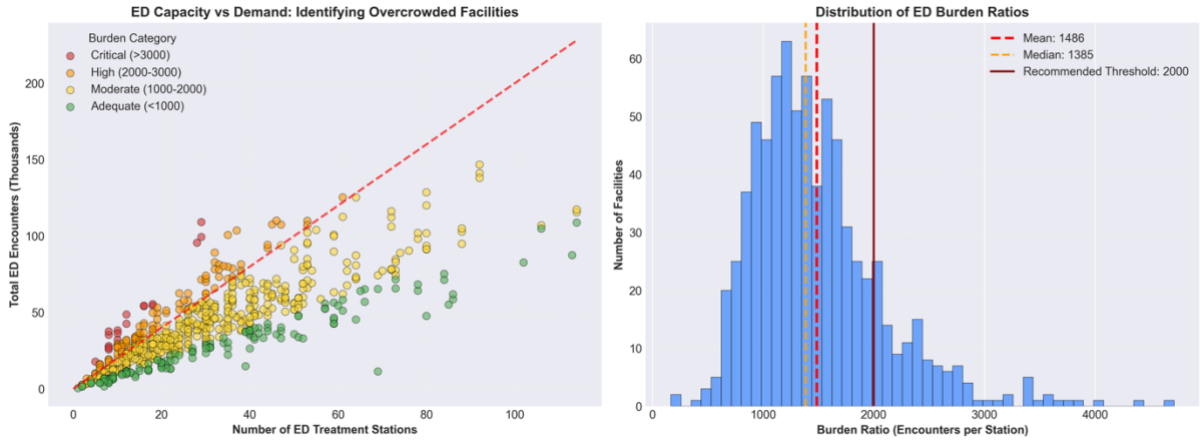

Figure 4: Left panel shows scatter plot of total ED visits vs. treatment stations, with color-coded burden categories. The red dashed line represents the 2,000-visit recommended threshold. Right panel displays the distribution of burden ratios, highlighting that many facilities exceed recommended capacity.

5.5 Critical Facilities: Top 20 Most Burdened Emergency Departments

Analysis identified 20 facilities operating under extreme capacity constraints, with burden ratios ranging from 2,880 to 4,714 visits per treatment station. These facilities require immediate intervention to address patient safety concerns.

SNo	Facility	County	Year	Annual Encounters	Treatment Stations	Encounters per Station	Urban or Rural	Bed Size Group
1	St. Louise Regional Hospital	Santa Clara	2023	37712	8	4714	Rural	50–99
2	St. Louise Regional Hospital	Santa Clara	2022	35422	8	4428	Rural	50–99
3	John F. Kennedy Memorial Hospital	Riverside	2022	48677	12	4056	Urban	100–149
4	Adventist Health Reedley	Fresno	2022	38319	10	3832	Rural	1–49
5	Martin Luther King, Jr. Community Hospital	Los Angeles	2023	109217	29	3766	Urban	100–149
6	Adventist Health Reedley	Fresno	2023	36422	10	3642	Rural	1–49
7	Monterey Park Hospital	Los Angeles	2023	17931	5	3586	Urban	100–149
8	John F. Kennedy Memorial Hospital	Riverside	2021	42578	12	3548	Urban	100–149
9	Palomar Medical Center Poway	San Diego	2022	28128	8	3516	Urban	200–299
10	Martin Luther King, Jr. Community Hospital	Los Angeles	2022	99493	29	3431	Urban	100–149
11	Antelope Valley Hospital	Los Angeles	2021	95597	28	3414	Urban	300–499
12	Salinas Valley Health Medical Center	Monterey	2023	54470	16	3404	Urban	200–299
13	Salinas Valley Health Medical Center	Monterey	2022	54157	16	3385	Urban	200–299
14	St. Louise Regional Hospital	Santa Clara	2021	27007	8	3376	Rural	50–99
15	Adventist Health Reedley	Fresno	2021	32277	10	3228	Rural	1–49
16	Palomar Medical Center Poway	San Diego	2021	25717	8	3215	Urban	200–299
17	Community Hospital of San Bernardino	San Bernardino	2023	55451	18	3081	Urban	300–499

18	Community Hospital of San Bernardino	San Bernardino	2022	54577	18	3032	Urban	300–499
19	Memorial Hospital of Gardena	Los Angeles	2022	29497	10	2950	Urban	150–199
20	Children's Hospital of Orange County	Orange	2022	100831	35	2881	Urban	300–499

Table 10: Top 20 Most Burdened Emergency Departments

Critical Observations:
Burden levels are consistently extreme: 18 of 20 entries exceed 3,000 encounters per station, and 9 exceed 3,500 (range: 2,881 to 4,714).

Chronic, repeat strain drives the list: **only 11 unique facilities account for the 20 entries**, with several appearing across multiple years, signaling persistent capacity deficits rather than one time spikes.

St. Louise Regional Hospital (Santa Clara, Rural) is the clearest sustained outlier, ranking #1 in 2023 (4,714 per station) and remaining severely overburdened in 2022 (4,428) and 2021 (3,376). Geographic concentration is pronounced: **Los Angeles County accounts for 5 of the 20 entries, indicating a major regional hotspot** within the highest burden group.

High volume facilities are also operating above safe throughput levels, including Martin Luther King, Jr. Community Hospital (109,217 encounters in 2023) and Children's Hospital of Orange County (100,831 encounters in 2022), reinforcing that this is a system capacity issue, not a small facility issue.

Capacity Expansion Requirement:
To reach a planning benchmark of 2,000 encounters per station, these 20 entries require an estimated 224 additional treatment stations in total, with the largest single site gaps at **Martin Luther King, Jr. Community Hospital (2023: +26)** and **Antelope Valley Hospital (2021: +20).**

5.6 Geographic Patterns- County-Level Capacity Gaps

Geographic analysis reveals significant variation in capacity constraints across California counties. Table 11 presents the 15 counties with highest average burden ratios:

Rank	County	Facilities (Count)	Total Encounters	Total Treatment Stations	Average Encounters per Station
1	Merced	2	249,085	108	2383
2	Monterey	4	420,635	196	2374
3	Kings	1	266,956	122	2202
4	Imperial	2	110,281	52	2170
5	Santa Clara	7	1,121,187	690	2059
6	Santa Cruz	2	123,644	64	2037
7	Tehama	1	84,875	42	2021
8	Madera	2	261,480	130	1976
9	Lake	2	112,475	60	1952
10	San Joaquin	7	926,666	520	1887
11	Stanislaus	4	661,001	351	1837
12	Mariposa	1	18,852	11	1758
13	Yolo	2	133,812	84	1753
14	San Bernardino	17	1,759,004	1065	1732
15	Amador	1	72,075	42	1716

Table 11: Top 15 Counties by Average ED Burden Ratio

Merced and Monterey counties show the highest county level capacity pressure, averaging 2,383 and 2,374 encounters per treatment station, both above the 2,000 planning benchmark and signaling sustained strain across multiple facilities. Seven of the top 15 counties exceed 2,000 encounters per station (Merced, Monterey, Kings, Imperial, Santa Clara, Santa Cruz, Tehama), indicating that elevated burden is widespread rather than isolated to a single region. Central Valley counties appear repeatedly in the high burden group (Merced, Kings, Madera, San Joaquin, Stanislaus), suggesting a regional infrastructure gap relative to demand. San Bernardino stands out for scale, with 17 facilities and 1.76 million encounters, and a lower average burden (1,732 per station), implying broad system load that still warrants expansion planning due to sheer volume.

5.7 Geographic Patterns- Urban vs. Rural Disparities

Analysis of geographic classification reveals counterintuitive patterns in capacity distribution:

Urban-Rural Burden Comparison:

Area Type	Facilities (Count)	Total Encounters	Total Treatment Stations	Average Encounters per Station	Encounters per Facility	Stations per Facility
Frontier	11	89889	91	1042.8	8171.7	8.3
Rural	58	3003224	2006	1567.6	51779.7	34.6
Urban	246	26870001	19510	1483.9	109227.6	79.3

Table 12: Urban-Rural ED Capacity Disparities

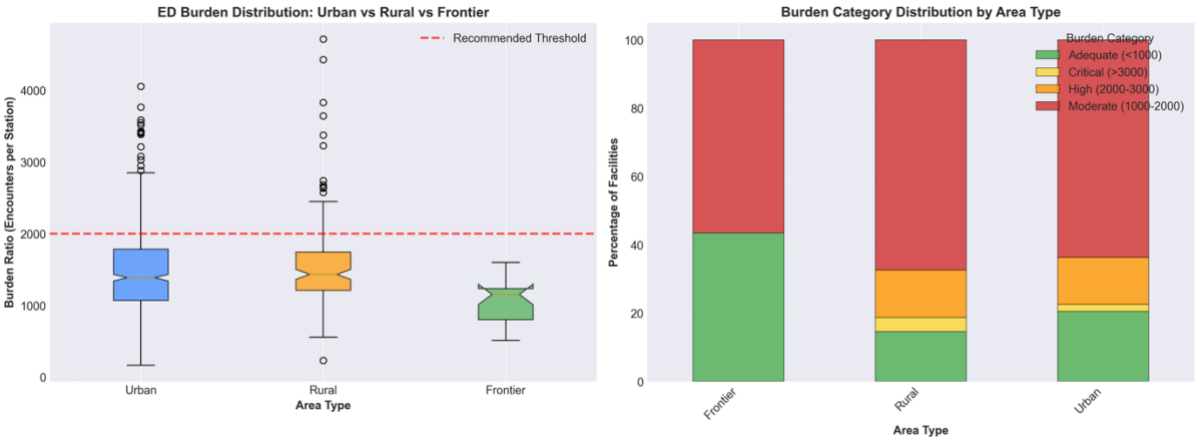

Figure 5: Left panel shows box plots comparing burden ratio distributions across urban, rural, and frontier facilities. Urban facilities show higher variability. Right panel displays stacked bar chart of burden category composition by geographic type.

6 Interpreting Results and Recommendations

Problem 3.1: Analyzing Year-Over-Year ED Utilization Trends

- **Result**: California ED encounters grew 24.69% from 2012 to 2024 (CAGR 1.86%), with significant COVID-19 disruption in 2020 (-20.05%) followed by strong recovery. Analysis identified five high-growth facilities exceeding 20% CAGR requiring immediate capacity expansion: Loma Linda Children's Hospital (171.4%), Foothill Regional Medical Center (150.4%), Adventist Health Tulare (37.8%), Adventist Health Howard Memorial (25.4%), and Temecula Valley Hospital (23.9%). Geographic analysis revealed fastest growth in San Joaquin County (3.77% CAGR), while five facilities showed severe decline patterns (Madera Community Hospital at -56.9% CAGR). The system demonstrated resilience during COVID-19 but faces continued demand pressure, with 2024 reaching the highest utilization on record (15.5M encounters).
- **Recommendation**
    - Target the top 5 fastest-growing facilities for immediate capacity assessment and expansion feasibility studies, including emergency staffing augmentation and infrastructure planning.
    - Prioritize regional infrastructure investment in high-growth counties (San Joaquin, Riverside, Santa Clara) where demand growth outpaces the state average.
    - Investigate the 5 facilities with severe volume declines (particularly Madera Community Hospital at -57% CAGR) for closure risk assessment and potential service reallocation to address regional access gaps.
    - Develop flexible surge capacity protocols to handle 15-20% demand fluctuations based on COVID-19 experience and support pandemic/disaster preparedness planning.

Problem 3.2: Assessing ED Capacity Gaps and Operational Bottlenecks

- **Result**: 15.7% of California's emergency departments operate above recommended capacity, with a statewide mean burden ratio of 1,487 visits per treatment station. Analysis identified 18 facilities at critical burden levels (>3,000 visits/station) and 101 facilities at high burden (2,000-3,000 visits/station) requiring intervention. The top 20 most burdened facility-years are dominated by just 11 unique facilities appearing repeatedly, indicating chronic structural deficits rather than temporary surges. St. Louise Regional Hospital (Santa Clara) is the most severe outlier, sustaining burden ratios of 4,714, 4,428, and 3,376 across 2021-2023. Los Angeles County accounts for 5 of the top 20 entries, signaling a regional crisis. County-level analysis revealed Central Valley counties (Merced, Monterey, Kings, Madera, San Joaquin, Stanislaus) consistently exceed recommended thresholds. Rural facilities show higher average burden (1,567.6/station) than urban facilities (1,483.9/station), revealing a counterintuitive access disparity. An estimated 224 additional treatment stations are needed across the most burdened facilities to reach the 2,000 visits/station planning benchmark.

- **Recommendation**
    - Prioritize immediate capacity expansion at the 18 critical-burden facilities, with St. Louise Regional Hospital, Martin Luther King Jr. Community

Hospital, and Adventist Health Reedley requiring urgent infrastructure investment.

- Allocate funding for approximately 224 additional treatment stations across the top 20 most burdened facility-years, with largest allocations to Martin Luther King Jr. Community Hospital (+26 stations) and Antelope Valley Hospital (+20 stations).
- Establish a Central Valley regional infrastructure initiative targeting Merced, Monterey, Kings, and surrounding counties where county-level averages exceed the 2,000 visits/station benchmark.
- Create a chronic-strain watch list for the 11 facilities appearing repeatedly in the top 20, implementing quarterly capacity reviews and mandatory expansion planning timelines.
- Form a Los Angeles County emergency department task force to coordinate capacity expansion across the 5 critically burdened facilities concentrated in the region.
- Address rural capacity disparities by directing targeted investment to high-burden rural facilities, where smaller scale masks higher per-station strain compared to urban counterparts.