



RESEARCH ARTICLE

Trends in Emergency Department Capacity and Utilization (2005 -2022): An Update from California, Pre- and Post-COVID-19

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ABSTRACT

This study investigates long-term trends in hospital emergency department (ED) capacity and utilization in California, focusing on the impact of the COVID-19 pandemic. Utilizing data from the California Department of Health Care Access and Information (HCAI) and the U.S. Census Bureau, we analyzed trends over an 18-year period (2005-2022), segmented into pre-pandemic (2005-2019), pandemic (2020-2021), and post-pandemic (2022) phases. Adjusting for population growth, our findings indicate a 7.3% decrease in total admissions and a 14.0% reduction in total inpatient days. Conversely, ED visits increased by 16.1%. Despite an 8.5% decrease in the number of hospitals with EDs, ED treatment stations expanded by 36.3%. The average number of ED visits per treatment station decreased by 10.2%, suggesting improved capacity utilization. Additionally, the number of hospitals with designated trauma centers increased by 11.5%.

The COVID-19 pandemic significantly disrupted these trends, initially causing sharp declines in ED visits and total admissions in 2020. However, by 2022, ED visits and inpatient days rebounded close to pre-pandemic levels. The pandemic also accelerated the adoption of telehealth, which partially offset the burden on EDs. Despite this, the average inpatient length of stay increased, indicating more complex or severe cases requiring longer hospitalization.

Overall, our study highlights the critical role of EDs in hospital operations, with a growing reliance on EDs for hospital admissions, which rose from 43% in 2005 to 68% in 2022 for non-maternity patients. These findings underscore the need for strategic planning to enhance ED capacity and efficiency, ensuring resilience against future public health emergencies. The economic implications of rising healthcare costs and the essential nature of ED services in contract negotiations with commercial health plans are also discussed, emphasizing the strengthened bargaining position of hospitals due to the indispensable nature of emergency services. Further research is needed to explore alternative care models and payment schemes to improve efficiency and reduce healthcare costs.

Introduction

Studying long-term trends in hospital emergency department (ED) supply, capacity, and utilization in the USA and the role that EDs play in the overall healthcare system is crucial for several reasons. Understanding these trends aids in healthcare planning and resource allocation across the entire healthcare system and allows policymakers and healthcare administrators to ensure access to needed hospital-based emergency services. In addition, as evidenced during the recent COVID-19 pandemic, understanding the management of hospital ED capacity and utilization during the pandemic also plays a vital role in understanding emergency preparedness, providing insights into the system's ability to respond to emergencies such as natural disasters, pandemics, or mass casualty events. Furthermore, examining trends in ED capacity can inform planners and policy makers regarding issues such as ED overcrowding, which can lead to longer wait times, reduced quality of care, and increased patient morbidity and mortality, is essential for developing strategies to improve patient flow and optimize resource use. Globally, studying these trends can highlight practices for managing high patient volumes and integrating EDs with other healthcare services to ensure comprehensive emergency care, thus enhancing global health security and resilience.

Previous research has shown several impacts of the pandemic on hospital EDsⁱ and ED utilizationⁱⁱ. During the pandemic, there was a notable decrease in non-COVID-19-related ED visitsⁱⁱⁱ. Patients avoided EDs due to fear of contracting the virus, leading to a reduction in visits for conditions such as heart attacks, strokes, and minor injuries^{iv}. Additionally, the pandemic led to significant operational and staffing challenges for EDs. Healthcare workers faced high levels of stress, burnout, and exposure to the virus, resulting in staffing shortages^v. The pandemic accelerated the adoption of telehealth and alternative care models to reduce the burden on EDs. Many healthcare systems implemented virtual consultations and remote monitoring for patients with mild symptoms or chronic conditions, helping to manage patient loads and minimize the risk of virus transmission^{vi}.

At the same, it is important to study the long-term trends in hospital ED capacity and utilization in the USA preceding the shock of the COVID-19 pandemic and to assess the extent to which the post-COVID trends appear to be returning to pre-COVID levels or if there continue to be lingering and/or longer-term effects from the COVID-19 pandemic.

Study Aim

This study provides a comprehensive analysis of hospital ED capacity and utilization trends in California over an 18-year period that includes three periods: Pre COVID-19 pandemic (2005-2019) to assess long-term pre-COVID-19 pandemic, 2020-2021 to assess the effects of pandemic shock and the early post-pandemic period (2022) to assess potential lingering and/or long term effects of the pandemic on future trends in ED capacity and utilization.

Materials and Methods

All California hospitals are required to submit detailed capacity, utilization and financial data to California Department of Health Care Access and Information (HCAI). HCAI data are considered among the most reliable public healthcare data sources and are widely used by academic researchers. We accessed the public use files from the HCAI website and downloaded data for the years 2005 through 2022 from the Annual Utilization Reports database^{vii}. In addition, we downloaded California population data from The California State Data Center, accessing tabulations from data files released by the U.S. Census Bureau^{viii}. Our study sample included all hospitals reporting data for a given year and our analysis was conducted at the hospital level.

We analyze trends in hospital capacity and utilization, including hospital emergency department capacity and utilization, over the 18-year study period using descriptive analysis methods. Studying this long time period allows for a greater understanding of long-term trends and assessment of short and long-term impacts of the COVID-19 pandemic. We calculated the total for each year across all reporting hospitals and then calculated the percentage changes over different the time periods for aggregate hospital-level totals. Capacity measures included: total hospital beds (all hospitals and all types of beds), hospitals with emergency departments (EDs), hospitals with designated emergency Trauma Centers (TCs), emergency department treatment stations (defined as a specific space within the emergency department adequate to treat one patient at a time^{ix}). Utilization measures include: inpatient utilization (inpatient admissions, inpatient days, and average length of inpatient stay), ED visits (total and ED visits resulting in an inpatient admission and ED visits without inpatient admission), and ED visits per ED treatment station.

Results

Figure 1 summarizes trends in hospital capacity and utilization over an 18-year period (2005 through 2022) that include data both pre and post the COVID-19 pandemic. For the 15 years preceding the COVID-19 pandemic (2005 to 2019), California's population grew steadily by 10.1%, from 35.8 million to 39.4 million, reflecting a consistent upward trend. During this period, the total number of hospital beds remained relatively stable, increasing slightly by 0.5%, from 86,775 to 87,221. However, total hospital admissions decreased by 0.9%, from 3.443 million to 3.413 million, and total inpatient days fell by 4.2%, from 19.586 million to 18.759 million. The average inpatient length of stay remained stable, fluctuating slightly around 5.5 days. Total emergency department (ED) visits increased significantly by 31.2%, from 11.336 million to 14.880 million, while the number of hospitals with EDs decreased slightly from 330 to 327. The number of ED treatment stations saw a substantial growth of 41.3%, from 5,921 to 8,362, and the number of hospitals with designated trauma centers increased from 65 to 79. The average number of ED visits per treatment station remained relatively stable, showing a slight decrease from 1,666 to 1,780.

Post-2019, the impact of the COVID-19 pandemic is evident. By 2020, the population had slightly increased to 39.5 million but then declined to 39.041 million by 2022. The number of hospital beds slightly increased to 87,656 by 2022, reflecting a possible response to increased healthcare demand. Total admissions experienced a sharp decline during the pandemic, dropping to 3.085 million in 2020 before partially recovering to 3.225 million by 2022. Total inpatient days also saw a decline, reaching a low of 18.322 million in 2020 before increasing to 19.376 million in 2022. The average inpatient length of stay increased significantly to 6.01 days by 2022, indicating longer hospitalizations

during the pandemic. ED visits dropped sharply to 11.861 million in 2020 but rebounded to 14.345 million by 2022. The number of ED treatment stations continued to increase, reaching 8,795 by 2022, reflecting efforts to expand emergency care capacity. The number of hospitals with designated trauma centers remained stable at 79. The average number of ED visits per treatment station decreased significantly to 1,360 in 2020 but increased to 1,631 by 2022, indicating reduced utilization during the peak of the pandemic and subsequent recovery.

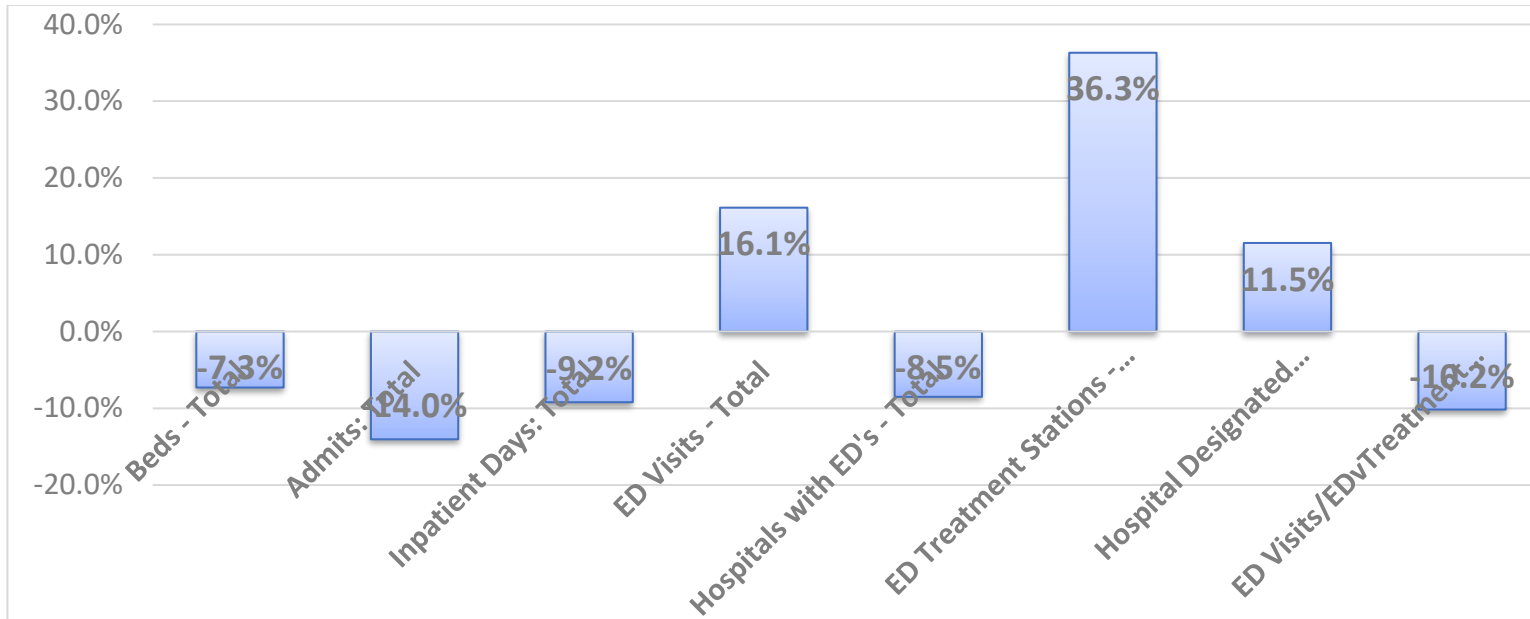
Figure 1: Trends in Hospital Capacity and Inpatient and ED Utilization, 2005 – 2022

	<u>2005</u>	<u>2010</u>	<u>2015</u>	<u>2016</u>	<u>2017</u>	<u>2018</u>	<u>2019</u>	<u>2020</u>	<u>2021</u>	<u>2022</u>	% Change: 2005 to 2022
CA Population (mil.)	35.828	37.320	38.904	39.149	39.338	39.437	39.438	39.503	39.145	39.041	9.0%
Beds: Total	86,775	88,374	88,490	88,993	89,231	86,672	87,221	87,366	86,711	87,656	1.0%
Admits: Total	3.443	3.542	3.408	3.420	3.457	3.366	3.413	3.085	3.170	3.225	-6.3%
Inpatient Days: Total	19.586	19.120	18.322	18.595	18.644	18.400	18.759	18.322	18.965	19.376	-1.1%
Inpatient Length of Stay - Average	5.69	5.40	5.38	5.44	5.39	5.47	5.50	5.94	5.98	6.01	5.6%
ED Visits - Total	11.336	13.659	14.198	14.567	14.929	14.782	14.880	11.861	12.945	14.345	26.5%
Hospitals with ED: Total	330	339	338	334	333	331	327	327	325	329	-0.3%
ED Treatment Stations: Total	5,921	6,991	7,878	7,889	8,056	8,152	8,362	8,723	8,667	8,795	48.5%
Hospitals with Designated Trauma Center: Total	65	72	76	79	82	80	79	79	79	79	21.5%
ED Visits per Treatment Station: Average	1,666	1,686	1,802	1,846	1,853	1,813	1,780	1,360	1,494	1,631	-2.1%

Source: California of Health Care Administration and Information, Annual Utilization Reports; California Office of Management and Budget

Figure 2 displays data on the trends in selected capacity and utilization measures after adjusting for population growth over the study period. Total admissions adjusted for population growth decreased by 7.3%, while total inpatient days fell by 14.0%. ED visits increased significantly by 16.1 %. While the number of hospitals with EDs decreased by 8.5% after adjusting for population growth, the number of ED treatment stations expanded substantially in the hospitals that continued to operate their EDs. The data show a substantial increase – 36.3% -- in the number of ED stations after adjusting for population growth. At the same time, while population-adjusted ED visits increased over the period, the average number of ED visits per treatment station decreased by 10.2%. The number of hospitals with designated trauma centers increased by 11.5%, after adjusting for population growth.

Figure 2: Hospital Capacity and Utilization - Percentage Change, 2005 and 2022: Adjusted for CA Population Growth (9%)

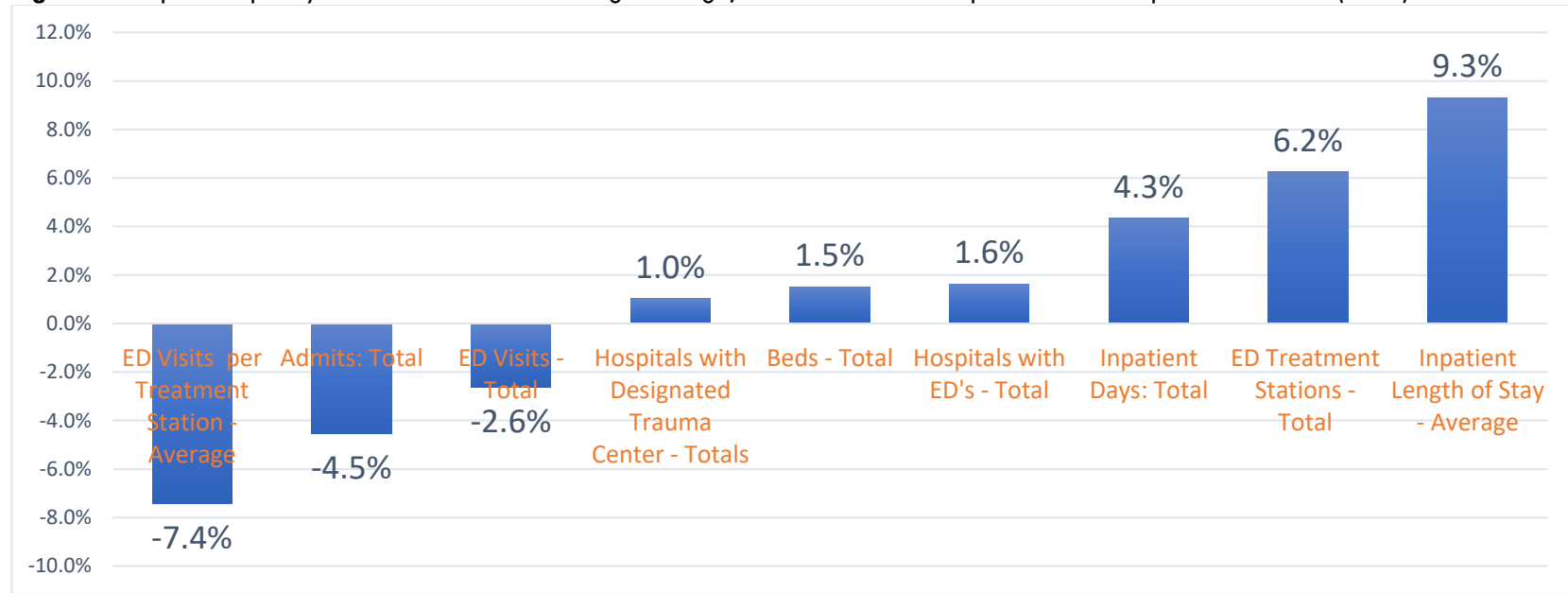


Source: California of Health Care Administration and Information, Annual Utilization Reports

Figure 3 compares data for 2019 and 2022, pre and post-COVID-19. Six of the measures showed values at or above their 2019 pre-COVID-19 levels. There were notable increases in several areas. The average inpatient length of stay increased by 9.3%, indicating that patients required longer hospitalization periods. Some reports of increased length of stay

are due in part to the inability of hospitals to transfer inpatients out of the hospital to step-down nursing facilities^x. Total inpatient days rose by 4.3%, despite a decline in total admissions by -4.5%. The number of ED treatment stations grew by 6.2%. Notably, there were decreases in ED visits per treatment station by -7.4%, total admissions by -4.5%, and total ED visits by -2.6%.

Figure 3: Hospital Capacity and Utilization - Percentage Change, 2019 and 2022: Adjusted for CA Population Growth (+1%)

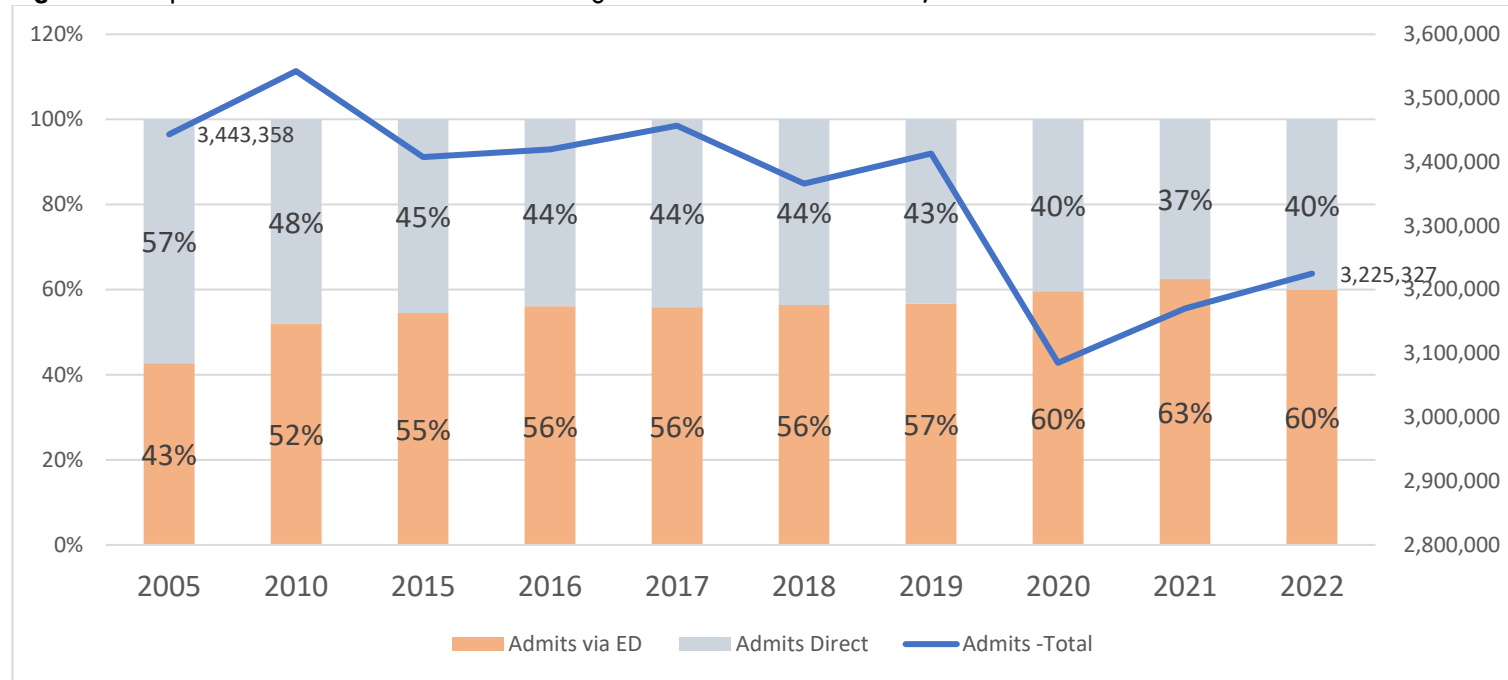


Source: California of Health Care Administration and Information, Annual Utilization Reports

Figure 4 examines trends in the source of hospital admissions over the 18-year study period. From 2005 to 2019, the total number of hospital admissions saw a slight decrease, with admissions via the ED increasing from 43% to 57%, and direct admits decreasing from 57% to 43%. This indicates a growing reliance on EDs for hospital admissions. In 2020, during the pandemic, admissions via EDs increased sharply to 60% as direct admits

decreased to 40%, reflecting the emergency nature of healthcare needs during COVID-19. By 2022, the percentage of admissions via EDs remained high at 60%, while direct admits stabilized at 40%, suggesting a possible continuation of the long-term trend of EDs generating an increasing share of total hospital inpatient admissions.

Figure 4: Hospital Admissions: Total and Percentage Via ED and Direct Admits, 2005 - 2022

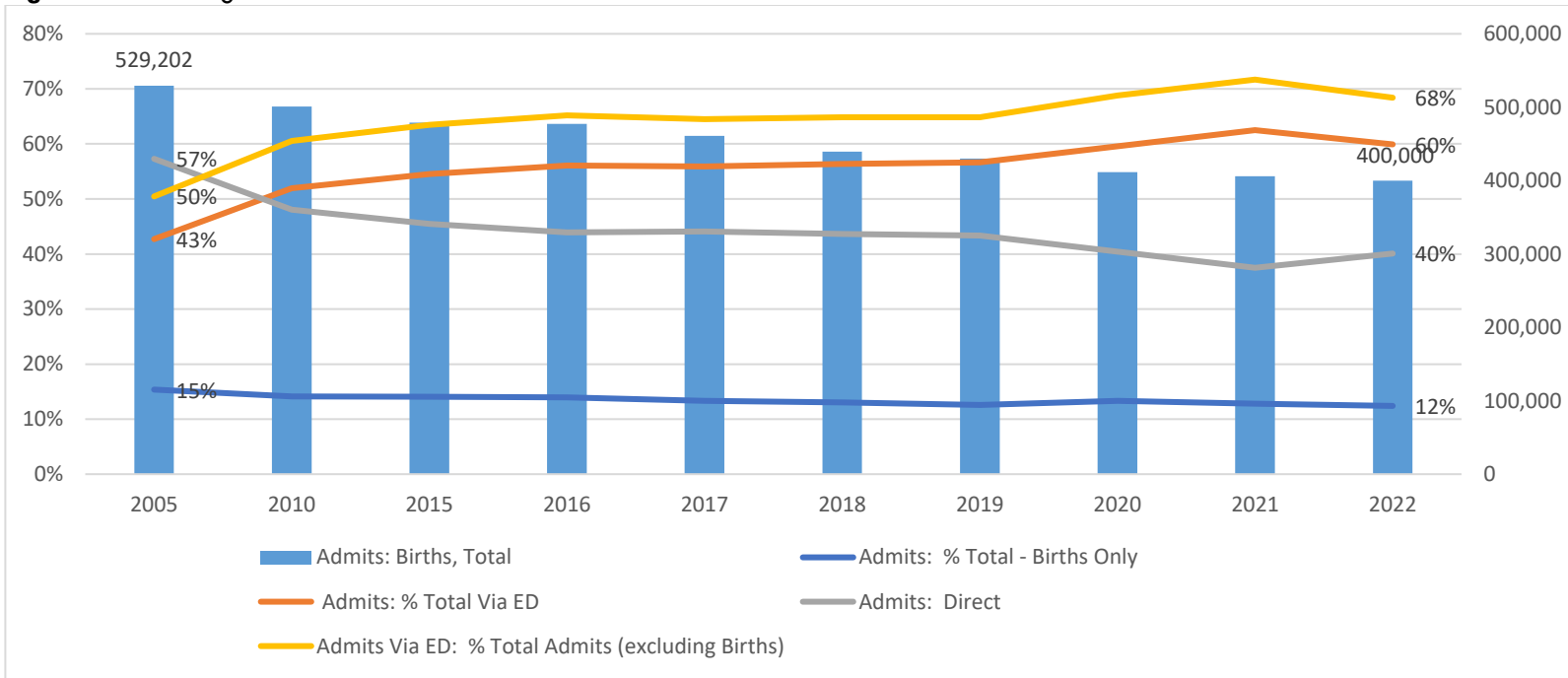


Source: California of Health Care Administration and Information, Annual Utilization Reports

Figure 5 displays trend data for patients admitted via the ED as a share of total hospital admissions, adjusting for admissions related to births/maternity. The percentage of total non-birth admissions via EDs increased from 43% in 2005 to 68% in 2022. This trend highlights the growing role of EDs in hospital admissions over the years. The impact of COVID-19 is evident with a significant increase to 63% in 2020, indicating a higher

reliance on EDs during the pandemic. This reliance continued post-pandemic, with the percentage remaining high at 68% in 2022. The data reflect a notable shift towards using EDs for non-birth admissions, likely driven by the urgent nature of healthcare needs during the pandemic and the subsequent adaptation of hospital admission practices.

Figure 5: Percentage of Total Non-Birth Admissions Via EDs



Source: California of Health Care Administration and Information, Annual Utilization Reports

Discussion

The overall trends indicate a slow-growing population with relatively stable hospital bed availability. After adjusting for population growth, total admissions decreased by 7.3%, while total inpatient days fell by 14.0%. In contrast, emergency department (ED) visits increased significantly by 16.1%. Although the number of hospitals with EDs decreased by 8.5%, the number of ED treatment stations expanded substantially by 36.3% in the hospitals that continued to operate their EDs. Despite the rise in population-adjusted ED visits, the average number of ED visits per treatment station decreased by 10.2%. Additionally, the number of hospitals with designated trauma centers increased by 11.5% after adjusting for population growth.

Our findings have important implications in several areas. The long-term effects of the COVID-19 pandemic appear to be limited. While total admissions and ED visits have not fully returned to pre-COVID levels, there has been a significant increase in inpatient length of stay, contributing to an increase in total inpatient days above the pre-COVID trend. One of the documented hospital responses to COVID-19 was the implementation of telehealth^{xi} and other interventions designed to reduce the number of patients requiring hospital-based ED services^{xii}. This raised the possibility that ED visit volumes would not return to pre-COVID levels if these programs were successful in providing effective substitutes for in-person ED visits. Our data indicate that while ED visit volume in 2022 had not returned to 2019 levels, the difference was only -2.6% and it has been trending upward since the initial decline in 2020. This suggests that these alternatives have not been fully established as a permanent substitute for hospital-based ED services.

The changes in ED visits, both with and without admission, and the varying trends in visit acuity levels reflect the impact of the pandemic on healthcare-seeking behavior. The decline in minor and low/moderate acuity visits suggests that patients avoided EDs for less severe issues, possibly due to fear of infection or the availability of telehealth and urgent care alternatives. Conversely, the increase in severe acuity visits indicates that only more critical cases sought ED care, potentially leading to delayed treatment and worse outcomes for non-COVID-19 conditions. This highlights the importance of maintaining accessible and safe ED services for all acuity levels to prevent delayed care and ensure timely medical intervention.

Overall, we find that there has been a continued expansion of ED services, including the growth of ED treatment stations and hospital-based trauma centers, and increased utilization of hospital-based EDs. The percentage of hospital inpatient admissions via EDs for non-maternity patients reached 68% in 2022, up from 50% in 2005. These findings underscore a long-term

trend of an expanded role for emergency services in US hospitals and the healthcare system, with significant economic and health system implications. While our data are from California, a large and diverse state, national data sources report similar trends.

An important aspect of the US healthcare system is the reliance on competitive market forces to control healthcare prices and spending. More than 200 million Americans are covered by private health insurance plans that negotiate with hospitals to provide services to their enrolled members^{xiii}. Per capita spending on hospital care in California increased by 126% between 2005 and 2020, while median incomes rose by 48% during the same period^{xiv}. This differential is putting increasing financial pressure on employers and families to afford health insurance.

Our findings show that hospitals with EDs are an increasingly important component of the US healthcare system. Hospital EDs are the main source of inpatient admissions and provide indispensable life-saving services. This aspect of emergency care strengthens hospitals' bargaining positions in contract negotiations with commercial health plans. Hospital-based emergency services tend to have inelastic demand, reducing health plans' leverage to direct patients to alternative providers. Hospitals with significant emergency admissions can negotiate more favorable contract terms, such as higher per diem rates, bundled payments, or specific add-on payments for high-acuity cases. They may also secure volume guarantees to ensure revenue streams and reduce financial risk. Given the critical nature of emergency services, commercial health plans are more likely to include these hospitals in their preferred provider networks, maximizing hospital utilization rates.

Conclusions

Our findings and implications suggest the need for further policy development and research. Rising healthcare spending in the US is creating increasing pressure on both public and private budgets. It is crucial to explore how to provide services currently offered in hospital-based EDs in alternative settings or under alternative payment schemes that encourage greater efficiency^{xv}. Finally, while our data are from California, national data sources generally report similar trends, underscoring the relevance of our findings to the broader US healthcare system^{xvi}.

Conflicts of Interest Statement: None

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