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Impact on the Short-Term Hospital Outcomes From COVID Pandemic Among Older Adults With Sepsis

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Abstract

Objective: This study evaluates clinical characteristics, hospitals outcomes, and mortality determinants in older sepsis patients before and during COVID-19. **Methods:** Retrospective of sepsis cases (aged 65+) from nine hospitals (2018–2020) using ICD codes. Multivariate logistic regression was used to analyze mortality predictors. **Results:** Of 4635 sepsis patients, 515 (11.1%) passed in-hospital, with mortality rising to 13.9% during the pandemic from 10% prior ($p < .01$). Pandemic admissions had more racial minorities and severe comorbidities. Patient safety indicator events decreased during the pandemic (14.8% vs. 17.9%, $p < .01$), while home discharge rates remained consistent. Pandemic admission and lack of insurance correlated with increased mortality, alongside advanced age, ICU admission, and opioid and sedative use. **Conclusion:** COVID-19 pandemic admission and socioeconomic factors heightened mortality risks in older sepsis patients, highlighting the need for targeted care strategies.

Keywords

sepsis, older adults, COVID-19, health disparities

What this paper adds

- Increased mortality during COVID-19. The study highlights a rise in in-hospital mortality among older sepsis patients during the COVID-19 pandemic, from 10% to 13.9%.
- Exacerbated disparities. Socioeconomic disadvantages, including lack of medical insurance and increased mortality among racial minorities during the pandemic, are emphasized.
- Changes in patient safety and medication use. The research documents decreased patient safety events and changed medication use patterns.

Applications of study findings

- Enhanced care strategies. The findings suggest the need for better care strategies and resource allocation for older sepsis patients during health crises.
- Policy development. The study supports policies to reduce healthcare disparities by improving access to medical insurance and services for vulnerable populations.
- Research and practice. Insights into medication use and patient safety provide a basis for optimizing treatment protocols and improving safety measures for older sepsis patients during pandemic.

Introduction

Sepsis affects approximately 1.7 million U.S. adults are diagnosed with sepsis annually, positioning it as a leading cause of in-hospital mortality (Rhee et al., 2019). Before COVID-19, adverse outcomes were linked to advanced age, race, and comorbidities (Mankowski et al., 2020). The pandemic exacerbated sepsis dynamics, with an estimated of 36,000 excess deaths in 2020 from underdiagnosed COVID-19-related sepsis (Oud & Garza, 2023a). Up to 78% of critical COVID-19 cases met sepsis criteria, though early underreporting was common (Karakike et al., 2021).

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Comparative data on sepsis patients' pre-and during the pandemic are limited. This study analyzes clinical characteristics, hospitalization trends, and mortality to better understand COVID-19's impact on older sepsis patients with a group already at high risk.

Methods

Study Design

This retrospective study analyzed electronic health records from nine private community hospitals across two U.S. states within a single healthcare system. The study period spanned from January 1st, 2018 to December 31st, 2020.

Participants

Inclusion criteria were adults aged 65 and older with a primary or secondary diagnosis of sepsis, identified using the International Classification of Diseases, 10th Revision, Clinical Modification (ICD-10-CM) with diagnoses of sepsis (A40 and A41). Exclusion criteria involved incomplete demographic or clinical records, such as missing vital signs, lab results, or medication information. Patients readmitted with sepsis within the study period were also excluded to maintain data integrity. Therefore, patients with a prior diagnosis requiring admission were removed. The Institutional Review Board granted exemption, with STROBE guidelines ensuring methodological rigor (Cuschieri, 2019).

Variables

Demographic Variables. The study assessed demographic variables, including age, gender, ethnicity, race, primary medical insurance coverage, and body mass index (BMI), to understand their influence on sepsis outcomes.

Comorbidity Assessment. The Charlson comorbidity index (CCI) quantified comorbidity burdens and predicted 1-year mortality (Bannay et al., 2016).

Hospital-Acquired Adverse Events. Patient Safety Indicators (PSIs) were used to assess care quality (Rajaram et al., 2015). These indicators are crucial for evaluating the quality of care and patient safety within hospital settings.

Medication Analysis

High-risk medication classes were documented based on the United States Pharmacopeia (USP) Drug Classification System (Haight et al., 2020), emphasizing those included in the Beers Criteria for older adults. Medications of interest included opioids, sedatives, antipsychotics, and anticoagulants (Marcantonio, 2017). Opioid doses were standardized using morphine milligram equivalents (MME) following CDC guidelines for comparability across patients (Pommerening et al., 2020).

Outcome Variable

The primary outcomes of interest post-hospitalization were in-hospital mortality and discharge destination, distinguishing between community discharge and facility-based post-acute care. These outcomes are pivotal in understanding the broader impacts of sepsis on patient mortality and post-discharge care requirements.

Statistics

Descriptive statistics were computed to summarize the demographic and clinical characteristics of the study population. Chi-square tests were used to analyze relationships between categorical variables, particularly to assess differences across demographic groups and comorbidities pre- and during the pandemic.

To identify factors associated with in-hospital mortality, multivariate logistic regression analyses with separate models for pre-pandemic and pandemic periods were used to capture potential shifts in risk factors. Mortality (coded as 0 for survivors and 1 for non-survivors) served as the binary outcome variable. The analyses were adjusted for age, gender, comorbidity score (CCI), ICU admission, use of high-risk medications, and adverse events. The analyses were conducted using SAS version 9.4 (SAS Institute Inc., Cary, NC) and STATA version 18, leveraging these platforms' robust capabilities for handling complex statistical computations and data management.

Results

Of the 4635 patients included, patients' average age ±standard deviation of all patients was 77 ± 7.8 years (range of 65–90) with 47.5% being female. After the average length of stay of 11.3 days, 45.1% (n = 2091 of 4635) were discharged home. 515 patients (11.1%) expired during hospital stay. As shown in Table 1, the pandemic cohort exhibited higher proportions of racial minorities (33.4% vs. 39.7%, $p < .0001$), and greater medical comorbidities (7.1 vs. 6.6 on CCI, $p < .0001$), with mortality increasing from 10% pre-pandemic to 13.9% during COVID-19 ($p < .0001$). Home discharge rates were stable (48.9% vs. 40.0%, $p < .0001$).

Opioid use was common among patients pre-pandemic (n = 2894, 62.4%), but showed a modest decline during COVID-19. Other medication pattern shifted, with increased use of subcutaneous heparin and antipsychotics during the pandemic, while H2 blockers and fentanyl use decreased (see Table 2).

Racial and insurance-based disparities in mortality were notable. Patients categorized as "other" races faced increased mortality odds during the pandemic (OR = 1.10; 95% CI [.67–1.81]) compared to white patients, a reversal from pre-pandemic trends. Additionally, public insurance coverage was associated with higher mortality during the pandemic (OR = 3.09, 95% CI [1.02, 9.28], $p < .05$), but not pre-pandemic (see Table 3).

Table 1. Demographic and Clinical Characteristics of Older Patients With Sepsis Before and During COVID Pandemic.

	Total (N = 4635)	Pre-COVID-19 (n = 3340)	COVID-19 (n = 1295)	p-Value
Age group				.65
65–75	1975 (42.6)	1420 (42.5)	555 (42.9)	
75–85	1650 (35.6)	1181 (35.4)	469 (36.2)	
Over 85	1010 (21.8)	739 (22.1)	271 (20.9)	
Gender (reference female)	2203 (47.5)	1608 (48.1)	595 (46.0)	.17
Body Mass index	27.1 ± 6.78	26.99 ± 6.68	27.4 ± 7.02	.07
Race and ethnicity				<.001
Asian	498 (10.74)	353 (10.57)	145 (11.2)	
Black	333 (7.18)	219 (6.59)	114 (8.8)	
White	3007 (64.9)	2226 (66.7)	255 (19.6)	
Other	797 (17.2)	542 (16.2)	255 (19.69)	
Insurance				
Government	4422 (95.4)	3184 (95.33)	1238 (95.6)	
Private	179 (3.86)	128 (3.83)		
Uninsured	29 (.63)	23 (.69)	6 (.46)	
Other	5 (.11)	5 (.15)	51 (3.94)	
comorbidity index	6.75 ± 2.77	6.62 ± 2.74	7.09 ± 2.83	<.001
ICU stay	1954 (42.16)	1321 (39.55)	633 (48.88)	
Days in ICU M (range)	4.2 (2.1, 9.4)	4.2 (2.1, 9.4)	4.3 (2.1, 9.2)	.75
Hospital length of stay in days	11.3 ± 12.7	11.5 ± 13.6	10.6 ± 10.1	.64
Patient safety indicator events	789 (17.0)	598 (17.9)	191 (14.8)	.01
In-hospital mortality	515 (11.1)	335 (10.0)	180 (13.9)	<.001
Discharge destination				.09
Home	2091 (45.1)	1532 (45.87)	559 (43.17)	
Hospice	263 (5.7)	157 (4.7)	263 (5.67)	
Skilled nursing facility	1350 (29.1)	1010 (30.24)	1350 (29.13)	
Inpatient rehabilitation units	260 (5.6)	205 (6.14)	260 (5.61)	
Transfer	126 (2.7)	81 (2.43)	126 (2.72)	
Against medical advice	30 (.7)	20 (.6)	20 (.65)	

Note. Valid percentage reported.

Table 2. Frequently Used Medications Used During Hospitalization Among Older Patients With Sepsis.

	Total (N = 4635)	Pre COVID-19 (n = 3340)	COVID-19 (n = 1295)	p-Value
H2 blockers	3404 (73.44)	2527 (75.66)	877 (67.72)	<.001
Subcutaneous heparin	3196 (68.95)	2255 (67.51)	941 (72.66)	.001
Opioids	2894 (62.44)	2131 (63.83)	762 (58.84)	.002
Oral morphine milligram equivalent (MME) at admission, milligram	112.6	119.2	95.6	<.001
Fentanyl	931 (20.1)	705 (21.1)	226 (17.5)	.005
Sedatives	1605 (34.63)	1187 (35.54)	418 (32.28)	.03
Anticonvulsants	828 (17.86)	611 (18.29)	217 (16.76)	.22
Antipsychotics	329 (7.1)	220 (6.59)	109 (8.42)	.02

Note. Valid percentage reported.

Discussion

This study found that sepsis admissions among older adults during 2020 were associated with elevated in-hospital mortality rates, even after adjusting for known risk factors like ICU admissions, comorbidity burden, and hospital-acquired complications. This increase aligns with prior research suggesting that undiagnosed COVID-19 in sepsis patients likely contributed to heightened mortality in the pandemic's early phase (Azar et al., 2020a; Oud & Garza, 2023b). These findings underscore the importance of enhanced care strategies for older sepsis patients, particularly those from economically disadvantaged backgrounds or admitted under healthcare system strains.

Socioeconomic factors, particularly healthcare coverage disparities, on in-hospital mortality among older adults with sepsis during the COVID-19 pandemic. The lack of medical insurance coverage emerged as a significant independent predictor of increased mortality, even after controlling demographic and clinical variables. This study's findings align with prior research showing that uninsured COVID-19 patients were less

Table 3. Multivariate Logistic Regression Analysis of the Relationship of In-Hospital Mortality.

	Pre-COVID (n = 3,338)[a]		During COVID (n = 1,295)[b]	
	OR	95% CI	OR	95% CI
Mortality				
Length of stay	.97*	.96, .98	.95*	.93, .98
White versus Black	.82	.45, 1.49	.63	.26, 1.50
White versus other	.69*	.50, .95	1.10	.67, 1.81
LOS*black	1.01	.98, 1.04	1.03	.98, 1.08
LOS*other	1.01*	1.00, 1.02	1.01	.98, 1.05
Age +85[c]	1.04	1.02, 1.05	1.05*	1.03, 1.07
Insurance public versus other	1.14	.63, 2.07	.92	.38, 2.19
Insurance public versus private	1.06	.09, 11.43	—	—
Insurance public versus uninsured	3.09*	1.02, 9.28	2.85	.39, 20.66
BMI	.94*	.93, .96	.97*	.94, .99
Charlson comorbidity index	1.18*	1.14, 1.22	1.14*	1.08, 1.20
ICU	3.49*	2.77, 4.39	4.26*	3.06, 5.92
Patient safety indicator event	1.71*	1.51, 1.94	1.75*	1.42, 2.17
Opioids	1.97*	1.53, 2.53	1.64*	1.18, 2.27
Sedatives	1.66*	1.34, 2.05	1.89*	1.38, 2.59
Corticosteroid	1.59*	1.29, 1.97	2.02*	1.49, 2.75
Subcutaneous heparin	1.12*	.88, 1.43	.93*	.66, 1.31
Anticonvulsants	.73*	.56, .97	.70*	.46, 1.07

Note. *$p < .05$.
[a]Pseduo R2 = .21.
[b]Pseduo R2 = .21.
[c]Reference group = 65–75.

likely to be hospitalized and faced worse outcomes when admitted (Azar et al., 2020b). Racial disparities in outcomes also mirrored trends observed in patients with Medicated or Medicare (e.g., Michigan and South Carolina) (Giannouchos et al., 2023)

The intersection of social determinants, such as race and insurance, further influenced access to care and outcomes. Studies have shown that racial minorities on Medicaid or Medicare faced higher odds of hospital admission for COVID-19, while commercially insured counterparts experienced fewer barriers (Walls et al., 2023). This study similarly indicates that non-white patients were more likely to face adverse health outcomes, emphasizing the compounded effects of socioeconomic and racial disparities on sepsis and COVID-19 outcomes.

To mitigate these disparities, healthcare providers and institutions can improve access to social services, enhance patient advocacy, and integrate screening for social determinants of health into clinical practices (Baumann & Cabassa, 2020). Additionally, policy-driven solutions, such as expanding healthcare coverage and incorporating community health workers, can address systemic vulnerabilities (Saraswathy, 2021). Framework for health equity, which focuses on structural determinants and equity-driven interventions, provide practical tools to make healthcare more accessible to vulnerable populations during crises (Woodward et al., 2021).

Interestingly, the study noted a reduction in patient safety indicator (PSI) events during the pandemic, likely due to fewer elective surgeries (Mattingly et al., 2021). This does not account for the rise in hospital-acquired COVID-19 infections, indicating a gap in patient safety metrics (Bhakta et al., 2022). Moreover, the association between opioid use and mortality, despite a decline in opioid usage during COVID-19, highlights a critical area for intervention. Strategies to minimize opioid use in this population could positively affect patient outcomes (Ao et al., 2022).

Overall, these findings highlight the multifaceted challenges faced by older adults with sepsis during the COVID-19 pandemic. The advocate for holistic, patient-centered approaches that integrate medical, social, and systemic factors is to improve care and prepare healthcare systems for future crises.

Limitations

This study's generalizability is limited by its focus on community hospitals within a single for-profit healthcare system in Nevada and California, which may not reflect broader healthcare settings. The reliance on electronic health records raises concerns about potential coding inaccuracies, particularly for ICD-10-CM codes. Additionally, the absence of detailed pre-admission functional status data limits insights into post-discharge outcomes.

Within demographic information, the reporting of the maximum patient age as 90, in compliance with HIPPA privacy regulations, restricts specific analysis of outcomes for patients over 90. Furthermore, racial minorities other than Black were grouped into a single "other" category due to small sample sizes, which may limit conclusions about individual racial and ethnic groups. However, this aggregation was necessary to maintain statistical power and reliability, enabling more robust comparisons (Bornstein et al., 2013). The study's primary focus on broader socioeconomic disparities, such as healthcare access and insurance status, still highlights relevant challenges faced by racial minority populations. Despite these limitations, the findings provide important insights into interventions targeting socioeconomically disadvantaged groups, supporting future research and policy reforms. While similar methodologies have been used in healthcare disparity research (Giannouchos et al., 2023), future studies should aim to disaggregate racial groups to capture more nuanced effects.

Conclusion

The pandemic heightened mortality risks for older adults with sepsis, particularly those facing socioeconomic disadvantages.

These findings suggest the need for targeted care strategies to protect vulnerable populations in the future crises, emphasizing healthcare system readiness to address social determinants and disparities.

Declaration of Conflicting Interests

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Ethical Statement

Ethical Approval

The current study was reviewed and approved as exempt by the Institutional Review Board (IRB) at the author's institution and the patient consent was waived by the IRB as this study used a de-identified dataset. The study findings are in accordance with STROBE guidelines.

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