

The impact of the COVID-19 pandemic on hypertension management in southeastern Poland

Challenges and adaptations for emergency medical teams

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Abstract

The coronavirus disease 2019 (COVID-19) pandemic introduced unprecedented challenges to healthcare systems, disrupting the management of chronic conditions such as hypertension. This study examines the impact of the COVID-19 pandemic on hypertension management by emergency medical teams (EMTs) in southeastern Poland. A retrospective analysis was conducted using medical emergency activity cards from EMTs in southeastern Poland. The study included 1795 cases of primary hypertension (International Classification of Diseases, 10th Edition: I-10), comparing data from the pre-pandemic period (April 1, 2019–March 31, 2020) to the pandemic period (April 1, 2020–March 31, 2021). Demographic characteristics, blood pressure measurements, pharmacological interventions, and transport decisions were analyzed using Chi-square tests for categorical variables and t-tests for continuous variables. The frequency of hypertension-related emergency calls remained stable between the pre-pandemic and pandemic periods ($P = .805$). Women accounted for 68.6% ($N = 1232$) of cases, and the mean age of patients was 63.4 years ($SD = 15.2$), with no significant age or sex differences between the 2 periods. The mean initial systolic blood pressure (SBP) was significantly higher before the pandemic (189.85 mm Hg) compared to during the pandemic (185.57 mm Hg, $P < .001$). The proportion of patients with severe hypertension ($SBP \geq 180$ mm Hg) decreased from 70.7% to 66.1%, while mild hypertension cases increased from 5.3% to 7.1% ($P = .046$). The administration of hydroxyzine increased significantly (38.2% vs 45.1%, $P = .003$), reflecting a greater focus on managing anxiety-related symptoms. Additionally, EMTs treated more patients at the scene rather than transporting them to the emergency department (76.1% vs 62.4%, $P < .001$), indicating a shift in EMT decision-making to reduce hospital exposure and optimize resource allocation. The COVID-19 pandemic significantly altered the prehospital management of hypertension, leading to lower initial SBP readings, increased anxiolytic use, and reduced hospital transport rates. Age and sex distribution remained stable across both periods. These findings highlight the need for flexible emergency response protocols that integrate mental health considerations and enhance on-site hypertension management. Future research should assess the long-term outcomes of these adaptations and explore strategies to improve prehospital hypertension care in future public health emergencies.

Abbreviations: COVID-19 = coronavirus disease 2019, DBP = diastolic blood pressure, ED = emergency department, EMTs = emergency medical teams, SBP = systolic blood pressure.

Keywords: blood pressure, COVID-19, emergency medical teams, healthcare adaptation, hypertension, retrospective study, therapeutic interventions, transport decisions

1. Introduction

Hypertension, or high blood pressure, represents a critical public health issue globally, affecting a significant portion of the adult population.^[1] It stands as one of the most crucial modifiable risk factors

for a variety of severe health conditions, notably cardiovascular diseases, which remain leading causes of morbidity and mortality worldwide.^[2] The pervasive impact of hypertension necessitates continuous efforts in monitoring, managing, and developing effective treatment strategies to mitigate its detrimental effects.^[3]

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The datasets generated during and/or analyzed during the current study are not publicly available, but are available from the corresponding author on reasonable request.

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In Poland, hypertension affects approximately 10 million individuals, posing a significant burden on the healthcare system. Before the coronavirus disease 2019 (COVID-19) pandemic, emergency medical teams (EMTs) played a key role in managing hypertensive emergencies, providing prehospital interventions, and deciding whether patients required hospitalization. EMTs operated within a structured healthcare framework where hospital-based care was readily accessible for hypertensive crises.^[4]

The COVID-19 pandemic, which began in late 2019, brought unprecedented challenges to healthcare systems worldwide.^[5] The sudden surge in COVID-19 cases strained medical resources and facilities, leading to significant disruptions in routine healthcare services. Patients with chronic conditions, such as hypertension, faced new barriers to accessing timely medical care.^[6] Lockdowns, social distancing measures, and the overwhelming focus on COVID-19 cases forced many healthcare providers to defer nonurgent consultations and procedures.^[6] This shift placed additional burdens on emergency medical services, which had to adapt rapidly to the evolving situation.

Emerging studies have shown that the pandemic exacerbated health disparities, particularly for those with chronic conditions like hypertension. For instance, research conducted in the United States and Italy indicated a substantial decline in hospital admissions for hypertension and other chronic conditions during the early months of the pandemic due to fear of contracting the virus in healthcare settings.^[7,8] Additionally, a study in the United Kingdom highlighted delays and disruptions in receiving care for chronic conditions, which negatively impacted patient outcomes.^[9]

EMTs found themselves at the forefront of the healthcare response during the pandemic, dealing not only with COVID-19 patients but also ensuring that individuals with other urgent medical needs, including hypertension, received appropriate care. EMTs had to navigate increased call volumes, implement stringent infection control protocols, and manage the added complexity of treating patients in a high-risk environment.^[10] These challenges necessitated significant adjustments in their operational procedures and decision-making processes.

The pandemic significantly affected the frequency and nature of hypertension-related emergency calls. There was a need to understand how the heightened pressure on healthcare systems influenced the epidemiology of hypertension and the approaches EMTs took in their therapeutic interventions.^[11] Additionally, decisions regarding whether to transport patients to hospitals or treat them on the scene had to be reconsidered in light of the risks associated with COVID-19 exposure and hospital capacity constraints.^[12]

Recent studies have also highlighted the psychological impact of the pandemic, contributing to increased stress and anxiety levels, which can adversely affect blood pressure control.^[13] The increased use of anxiolytics during the pandemic has been noted, suggesting a direct link between the psychological burden of the pandemic and the management of hypertension.^[14]

The aim of this study was to analyze the impact of the COVID-19 pandemic on the epidemiology of hypertension, the therapeutic interventions, and the decisions made by EMTs in southeastern Poland, providing insights that can inform strategies to enhance the resilience of emergency medical services globally. Specifically, the study sought to address how the pandemic affected the frequency of hypertension-related emergency calls and what changes occurred in the therapeutic approaches and transport decisions by EMTs during this period. By comparing data from before and during the pandemic, the study provides a detailed examination of the adaptations in emergency medical responses to hypertension amid a global health crisis.

Southeastern Poland was chosen as the focus of this study due to its unique healthcare infrastructure and EMT operational framework. Unlike previous studies conducted in larger metropolitan areas, this study examines the impact of the pandemic

on a region with more decentralized healthcare services, where EMTs play a particularly crucial role in providing timely care for hypertensive emergencies. This regional perspective offers new insights into how emergency medical services adapted to the pandemic in nonmetropolitan settings and highlights potential lessons for similar healthcare environments globally.

The findings from this research are intended to contribute to the broader understanding of the pandemic's effects on healthcare systems and to provide valuable lessons for improving emergency medical services in future public health emergencies. By examining the specific case of southeastern Poland, this study also offers insights that may be applicable to other regions with similar healthcare infrastructures. The ultimate goal is to enhance the resilience and effectiveness of healthcare delivery in times of crisis, ensuring that patients with chronic conditions like hypertension receive the care they need despite the challenges posed by such unprecedented events.

2. Materials and methods

2.1. Study design, setting, and period

This study was designed as a retrospective analysis of medical documentation, specifically focusing on medical emergency activity cards completed by members of the EMT. The research was conducted in the southeastern region of Poland and spanned a 2-year period from April 1, 2019, to March 31, 2021.

The study period was selected to reflect both the pre-pandemic and pandemic phases. In Poland, the first confirmed case of COVID-19 was reported on March 4, 2020, and the country declared a state of epidemic on March 20, 2020, implementing widespread public health measures. The state of epidemic emergency officially ended on May 16, 2022. The study defined the pre-pandemic period as April 1, 2019–March 31, 2020, and the pandemic period as April 1, 2020–March 31, 2021, aligning with the timeline of significant healthcare disruptions due to the pandemic.

2.2. Inclusion and exclusion criteria

The study focused on adult patients (aged 18 and above) who were diagnosed with primary hypertension (International Classification of Diseases, 10th Edition: I-10) by EMTs during prehospital care. The inclusion criteria required that emergency interventions occurred within the study period (April 1, 2019–March 31, 2021) and that medical records contained at least one noninvasive blood pressure measurement. The study did not distinguish between first-time and previously diagnosed cases of hypertension, as the diagnosis was based on EMT assessment during emergency intervention. Patients were excluded if they were minors, had a systolic blood pressure (SBP) below 140 mm Hg, or had incomplete medical records, including those missing essential clinical data necessary for analysis.

2.3. Data collection

Primary data were collected retrospectively from medical emergency activity cards filled out by EMT personnel during their interventions. A total of 1795 cases were included in the study, each involving a patient diagnosed with primary hypertension. Since a hypertension diagnosis by an EMT required at least one recorded blood pressure reading, all included cases had documented noninvasive blood pressure measurements performed using a monitor-defibrillator during the intervention.

To ensure data quality, a systematic review process was conducted. All medical records were independently verified by 2 researchers to confirm the presence of key variables, including patient demographics, blood pressure readings, therapeutic

interventions, and transport decisions. Discrepancies were resolved through discussion, and cases with missing or unclear information were excluded from the dataset to maintain the integrity of the study findings.

2.4. Analyzed variables

The analysis considered several variables to evaluate the impact of the COVID-19 pandemic on emergency calls related to hypertension. These included demographic data (age and gender), blood pressure measurements (systolic and diastolic blood pressure, SBP and DBP) recorded during EMT interventions, pharmacological interventions (use of captopril, furosemide, and hydroxyzine), and EMT transport decisions (whether patients were transported to the emergency department (ED) or left at the scene). These variables were compared between the pre-pandemic period (April 1, 2019–March 31, 2020) and the pandemic period (April 1, 2020–March 31, 2021) to assess changes in hypertension management.

To ensure alignment with the study objectives, the analysis focused on differences in patient characteristics, blood pressure values at the scene, medications administered, and EMT transport decisions before and during the pandemic. Additionally, EMT transport decisions were examined in relation to initial SBP and control SBP following EMT intervention to assess variations in patient management.

Initial Blood Pressure (Initial BP) was defined as the first blood pressure measurement recorded by EMTs at the scene upon patient assessment before any medical intervention. Control Blood Pressure (Control BP) referred to the last recorded blood pressure measurement taken before the EMT completed the intervention, either before transport to the hospital or before leaving the patient at the scene. These measurements provided insight into the immediate effects of EMT-administered treatment and changes in blood pressure management strategies during the pandemic.

2.5. Data management and security

All data were stored in secure, restricted-access systems to ensure confidentiality and data integrity. Only authorized personnel had access to the data, which were used exclusively for scientific purposes. The data management protocols adhered to strict guidelines to protect patient privacy and ensure compliance with ethical standards.

2.6. Statistical analysis

Statistical analyses were conducted using IBM SPSS Statistics version 29.0.0. Given the large sample size of 1795 cases, normal distribution of quantitative variables was assumed. However, to verify this assumption, data distribution was assessed using the Kolmogorov-Smirnov test and Shapiro-Wilk test for normality. Additionally, histograms and Q-Q plots were visually inspected to confirm the distribution pattern. The study groups included patients from the pre-pandemic period (April 1, 2019–March 31, 2020) and the pandemic period (April 1, 2020–March 31, 2021).

Categorical variables (e.g., sex distribution, medication use, and EMT transport decisions) were analyzed using Pearson Chi-squared test. For 2×2 contingency tables, Chi-squared test with continuity correction was applied.

Continuous variables (e.g., SBP and DBP) were analyzed using the independent samples t-test to compare mean differences between the 2 study periods.

To assess potential interactions between the pandemic period and EMT transport decisions, a two-way ANOVA (2×2 factorial design) was conducted to examine its effects on initial SBP and controlled SBP following EMT intervention.

To assess the adequacy of the study's sample size, a post hoc power analysis was performed to determine whether the sample size was sufficient for detecting meaningful differences between study groups. The power analysis ensured that the study had a high probability of identifying statistically significant differences where they existed. A significance level of $P < .05$ was adopted for all statistical tests.

2.7. Ethical considerations

This study adhered to ethical guidelines to ensure participant protection and research integrity. Informed consent was obtained from all participants, and confidentiality was strictly maintained. Ethical approval for the current research was obtained from the Bioethics Committee at the Medical University of Lublin (decision number: KE-0254/150/06/2022), following the Declaration of Helsinki and relevant ethical standards.

3. Results

The study included a total of 1795 cases of emergency calls related to hypertension, with 902 calls recorded before the pandemic and 893 calls during the pandemic. Statistical analysis showed no significant difference in the number of hypertension-related EMT interventions between the 2 periods ($P = .832$), indicating that the overall demand for emergency hypertension management remained stable despite the challenges posed by COVID-19.

3.1. Participant characteristics and blood pressure levels

The analysis of demographic data showed that women comprised 68.6% ($N = 1232$) of all patients, with no statistically significant difference in sex distribution between the pre-pandemic and pandemic periods ($P = .805$). However, there was a significant shift in age distribution. During the pandemic, the proportion of patients aged < 40 and 40 to 59 years increased, while the proportion of those aged ≥ 60 years decreased ($P = .003$) (Table 1).

A statistically significant change was also observed in hypertension severity categories. The proportion of patients with severe hypertension ($SBP \geq 180$ mm Hg) decreased from 70.7% before the pandemic to 66.1% during the pandemic, while cases of mild and moderate hypertension increased slightly ($P = .046$), indicating that more patients were attended by EMTs with lower blood pressure levels during the pandemic.

In terms of blood pressure measurements, the mean initial SBP was significantly higher before the pandemic (189.85 mm Hg) than during the pandemic (185.57 mm Hg, $P < .001$). Mean DBP also decreased significantly during the pandemic ($P = .003$). After EMT intervention, mean control SBP and DBP were likewise lower during the pandemic ($P < .001$ and $P = .002$, respectively), as shown in Table 1.

3.2. Medication administration and EMT transport decisions

The Analysis of pharmacological interventions revealed no statistically significant changes in the administration rates of captopril ($P = .089$) or furosemide ($P = .210$). However, a significant increase was observed in the administration of hydroxyzine, rising from 38.2% before the pandemic to 45.1% during the pandemic ($P = .003$), indicating a greater focus on managing anxiety-related symptoms (Table 2).

EMT transport decisions also changed significantly during the pandemic. The proportion of patients left at the scene increased from 62.4% to 76.1%, while the number of patients transported to EDs decreased accordingly ($P < .001$). This

Table 1**Participant characteristics and blood pressure levels before and during the COVID-19 pandemic.**

Variable	Before COVID-19 (N = 936)	During COVID-19 (N = 859)	P-value
Women, n (%)	640 (68.4%)	592 (68.9%)	.805
Men, n (%)	296 (31.6%)	267 (31.1%)	
Age < 40 years, n (%)	150 (16.0%)	160 (18.6%)	
Age 40–59 years, n (%)	320 (34.2%)	340 (39.6%)	
Age ≥ 60 years, n (%)	466 (49.8%)	359 (41.8%)	.003
Mild Hypertension (SBP 140–159 mm Hg), n (%)	50 (5.3%)	61 (7.1%)	
Moderate Hypertension (SBP 160–179 mm Hg), n (%)	224 (23.9%)	230 (26.8%)	
Severe Hypertension (SBP ≥ 180 mm Hg), n (%)	662 (70.7%)	568 (66.1%)	.046
Initial SBP, mean ± SD (mm Hg)	189.85 ± 24.36	185.57 ± 21.35	<.001
Initial DBP, mean ± SD (mm Hg)	98.5 ± 15.2	95.3 ± 13.9	.003
Control SBP, mean ± SD (mm Hg)	179.57 ± 25.72	172.12 ± 22.3	<.001
Control DBP, mean ± SD (mm Hg)	92.1 ± 14.6	88.5 ± 12.7	.002

COVID-19 = coronavirus disease 2019, DBP = diastolic blood pressure, SBP = systolic blood pressure.

suggests a strategic shift in prehospital management to reduce unnecessary hospital exposure during the COVID-19 crisis (Table 2).

3.3. Two-way ANOVA: impact of period and SBP on EMT transport decisions

A two-way ANOVA was conducted to examine the effect of the pandemic period (before vs during COVID-19) and SBP level (initial and control SBP) on EMT transport decisions (transported to ED vs left at the scene).

3.3.1. Initial SBP. The A two-way ANOVA revealed that there was a statistically significant interaction between the effects of pandemic period and EMT transport decision on initial SBP ($F(1, 1791) = 4.11, P = .043$).

Simple main effects analysis showed that the pandemic period had a statistically significant effect on initial SBP ($F(1, 1791) = 10.21, P = .001$), with lower initial SBP during the pandemic.

EMT transport decision also had a significant main effect ($F(1, 1791) = 81.36, P < .001$), with higher initial SBP observed among patients who were transported to the ED compared to those left at the scene.

3.3.2. Controlled SBP. A similar pattern was observed for control SBP. A two-way ANOVA revealed a significant interaction between pandemic period and EMT transport decision ($F(1, 1138) = 7.61, P = .006$).

Simple main effects analysis showed that the pandemic period had a statistically significant effect on control SBP ($F(1, 1138) = 9.02, P = .003$), with lower post-intervention SBP during the pandemic.

EMT transport decision also significantly influenced control SBP ($F(1, 1138) = 357.93, P < .001$), with lower values in patients left at the scene than in those transported to the ED.

Descriptive statistics for these comparisons are presented in Table 3 and visualized in Figure 1.

4. Discussion

This study aimed to evaluate the impact of the COVID-19 pandemic on the prehospital management of hypertension by EMTs. By comparing data from the pre-pandemic and

Table 2**Medication administration and EMT transport decisions before and during the COVID-19 pandemic.**

Variable	Before COVID-19 (N = 936)	During COVID-19 (N = 859)	P-value
Captopril (Administered), n (%)	573 (61.2%)	560 (65.2%)	.089
Furosemide (Administered), n (%)	400 (42.7%)	379 (44.1%)	.210
Hydroxyzine (Administered), n (%)	358 (38.2%)	387 (45.1%)	.003
Left at the Scene, n (%)	584 (62.4%)	654 (76.1%)	<.001
Transported to ED, n (%)	352 (37.6%)	205 (23.9%)	

COVID-19 = coronavirus disease 2019, ED = emergency department, EMTs = emergency medical teams.

pandemic periods, several key findings emerged. First, the overall frequency of hypertension-related emergency calls remained stable, suggesting that the need for emergency hypertension care persisted despite healthcare disruptions. Second, while gender distribution remained unchanged, there were notable shifts in patient age, with a greater proportion of younger individuals seeking EMT interventions during the pandemic. Third, initial SBP was lower during the pandemic, and a higher proportion of patients presented with lower blood pressure categories. Fourth, the administration of hydroxyzine significantly increased, indicating a greater focus on managing anxiety-related symptoms. Finally, fewer patients were transported to hospitals, reflecting adaptations in EMT triage and decision-making to minimize hospital exposure and optimize resource allocation.

The stable frequency of hypertension-related emergency calls suggests that hypertension remained a persistent and urgent condition requiring EMT intervention, despite pandemic-related healthcare disruptions. This finding aligns with studies conducted in the United States, where the number of hypertension-related ED visits remained stable throughout the pandemic.^[15] However, while the overall call volume remained unchanged, it is possible that individual healthcare-seeking behaviors shifted. In particular, older adults, who were at higher risk of severe COVID-19 outcomes, may have been more hesitant to seek emergency care due to fear of infection, leading to a relative increase in younger patients requiring EMT assistance. This aligns with findings from previous research, which indicated that older populations delayed or avoided medical visits during the pandemic.^[16] The absence of significant sex-related differences in EMT calls may suggest that both men and women were equally affected by pandemic-related stressors and access limitations, a finding that contrasts with studies reporting gender disparities in healthcare utilization during the pandemic. Future research should explore potential differences in health-seeking behaviors between men and women during public health crises.

A significant shift in blood pressure levels and hypertension severity was observed during the pandemic. Specifically, initial SBP values recorded by EMTs were lower compared to the pre-pandemic period. This is somewhat unexpected, as delays in healthcare-seeking behavior and elevated psychological stress – both common during the pandemic – would typically be associated with increased SBP at the time of emergency intervention. However, a concurrent rise in cases involving mild to moderate hypertension (SBP 140–179 mm Hg) and a decrease in severe hypertension (SBP ≥ 180 mm Hg) suggest that EMTs were dispatched more frequently to patients with less critical blood pressure levels. One possible explanation is that pandemic-related changes in EMT dispatch protocols broadened the scope of emergency responses, allowing for earlier intervention. Additionally, individuals may have sought help at earlier stages due to heightened anxiety and increased public awareness of

health risks. While previous studies have linked social isolation, financial pressure, and stress-induced hypertension to worsening cardiovascular outcomes,^[17,18] the pattern observed here suggests that EMTs encountered a wider clinical spectrum of hypertension during the pandemic. These findings are consistent with international reports indicating a similar shift in patient severity levels during emergency responses^[19] and highlight the need for further research into how such prehospital triage adaptations may affect long-term patient outcomes.

The increased administration of hydroxyzine, an anxiolytic medication, during EMT interventions highlights the growing recognition of psychological distress as a factor in emergency hypertension management. This trend aligns with broader findings indicating a surge in anxiolytic and antidepressant prescriptions during the pandemic, suggesting that stress and anxiety played a significant role in cardiovascular health deterioration.^[20] The psychological burden of the pandemic – driven by social isolation, financial instability, and fear of infection

– has been widely documented as a contributor to worsening hypertension control.^[21] The stable use of captopril and furosemide suggests that core antihypertensive management strategies remained unchanged, with EMTs adapting primarily by incorporating additional anxiolytic treatment to address pandemic-related stress responses. These findings underscore the importance of integrating mental health support into emergency hypertension management protocols, particularly during global health crises.

A major change observed in this study was the shift in EMT transport decisions during the pandemic. EMTs were more likely to leave patients at the scene rather than transport them to EDs, with the proportion of non-transported patients rising from 62.4% before the pandemic to 76.1% during the pandemic. This shift likely reflects efforts to reduce hospital exposure risks, manage ED capacity, and implement updated triage protocols. When comparing patients left at the scene, mean initial and control SBP values were slightly lower during the pandemic (184.98 mm Hg vs 181.45 mm Hg initial SBP; 151.54 mm Hg vs 149.12 mm Hg control SBP), indicating a trend toward attending to patients with less severe hypertension outside of the hospital. Similarly, among patients transported to the ED, both initial and control SBP values decreased during the pandemic (197.93 mm Hg vs 191.81 mm Hg initial SBP; 179.57 mm Hg vs 172.12 mm Hg control SBP), suggesting a broader shift in EMT intervention thresholds. These changes are consistent with findings from other countries where emergency medical systems adapted their care strategies during the pandemic to accommodate shifting resource availability and patient risk levels.^[22–24] The observed reductions in SBP within each transport category highlight how EMTs responded to evolving demands while continuing to manage hypertensive patients effectively in both prehospital and hospital-directed care pathways.

Additionally, analysis of the interaction between SBP levels, the pandemic period, and EMT transport decisions provided further insights into emergency care adaptations. Before the

Table 3
Mean SBP Values by EMT transport decision and pandemic period (two-way ANOVA results).

SBP type	Period	EMT decision	Mean \pm SD
Initial SBP	Before COVID-19	Left at the scene	184.98 \pm 21.70
		Transported to ED	197.93 \pm 26.33
	During COVID-19	Left at the scene	181.45 \pm 20.5
		Transported to ED	191.81 \pm 24.2
Control SBP	Before COVID-19	Left at the scene	151.54 \pm 16.08
		Transported to ED	179.57 \pm 25.72
	During COVID-19	Left at the scene	149.12 \pm 15.3
		Transported to ED	172.12 \pm 22.3

COVID-19 = coronavirus disease 2019, ED = emergency department, EMTs = emergency medical teams, SBP = systolic blood pressure.

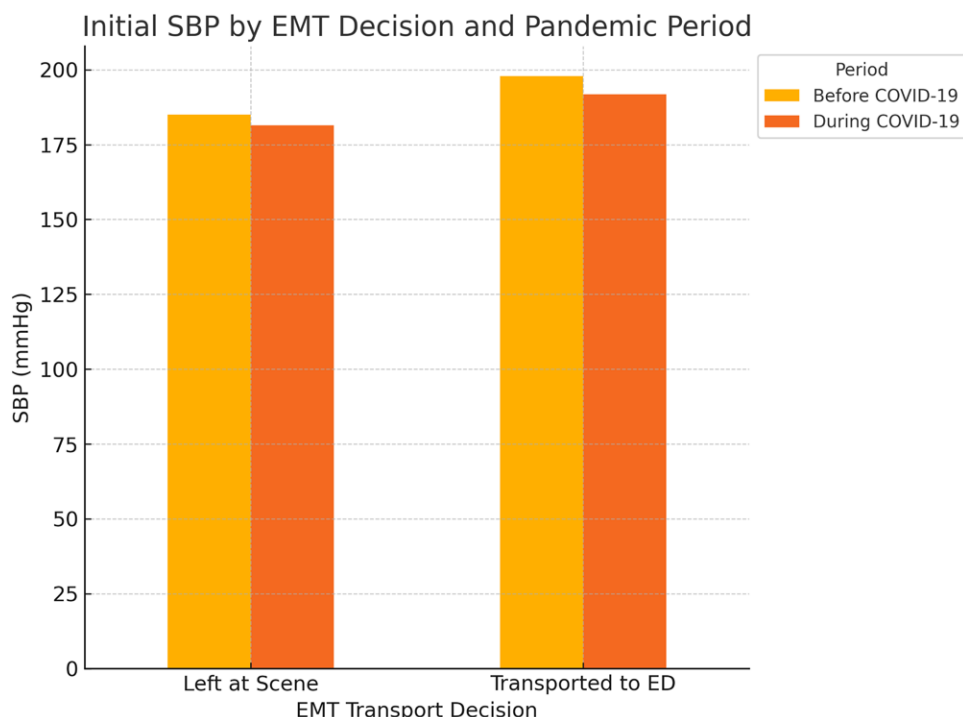


Figure 1. Initial SBP levels by EMT transport decision and pandemic period. This figure illustrates the differences in SBP levels recorded by EMTs before and during the COVID-19 pandemic. SBP values are displayed based on EMT transport decisions, comparing patients who were left at the scene versus those transported to the ED. The figure highlights a significant shift in SBP levels across both transport groups, reflecting changes in prehospital hypertension management during the pandemic. COVID-19 = coronavirus disease 2019, ED = emergency department, EMT = emergency medical team, SBP = systolic blood pressure.

pandemic, patients transported to the ED had significantly higher initial SBP compared to those left at the scene. During the pandemic, while this trend persisted, overall SBP values were lower. This suggests that EMTs continued to use SBP severity as a key determinant for hospital transport but may have adjusted hospitalization thresholds based on evolving healthcare constraints. A similar pattern was observed in controlled SBP levels, where EMT-administered interventions resulted in significant reductions in posttreatment SBP, particularly for patients transported to the ED. These changes likely reflect modifications in EMT triage criteria, allowing a broader range of hypertensive patients to be managed on-site rather than being sent to the hospital. This aligns with global efforts to enhance prehospital care and minimize unnecessary hospital visits during the pandemic.^[25] Figure 1 provides a visual representation of these interaction effects, illustrating the shift in SBP levels across different EMT decisions before and during the pandemic.

The findings of this study contribute to the growing body of evidence on emergency medical service adaptations during global health crises, reinforcing the need for resilient, data-driven policies that ensure continuity of care for chronic conditions even during periods of extreme healthcare disruption.

5. Strengths and limitations

This study has several notable strengths. It is among the first to comprehensively evaluate hypertension management by EMTs before and during the COVID-19 pandemic, utilizing real-world emergency intervention data. The large dataset ensures robust statistical power, allowing for the identification of significant trends in prehospital hypertension care. Additionally, this study provides detailed insights into EMT transport decisions and pharmacological interventions, aspects that are often overlooked in emergency hypertension research.

Another strength is the inclusion of interaction analyses between SBP levels, EMT decisions, and the pandemic period, offering a nuanced understanding of how emergency care adapted under crisis conditions. These findings contribute to a broader understanding of prehospital emergency system adaptations and underscore the importance of ensuring continuity of care for chronic conditions during public health crises. Future research should expand data collection across multiple regions, incorporate longer follow-up periods, and integrate patient outcomes into the analysis to further assess the impact of these adaptations.

Despite these strengths, the study has some limitations that should be acknowledged. Firstly, the retrospective design relies on existing medical records, which may not capture all relevant details or may contain inconsistencies. The quality of data was dependent on the accuracy of EMT documentation, which could have led to over- or underestimation of findings in cases where subjectivity influenced reporting. However, this limitation was mitigated by applying strict inclusion criteria, ensuring that only complete and verifiable medical records were analyzed.

Another limitation is the variability in data completeness across cases. While blood pressure measurements were recorded, the precise timing of these measurements relative to interventions was inconsistent, which may affect comparisons. Additionally, comorbidities and long-term patient outcomes were not systematically documented, limiting the ability to assess broader health implications beyond emergency care. Future studies should incorporate prospective designs with standardized data collection to improve consistency.

Differences in EMT documentation practices represent another limitation. Variability in experience, training, and workload could have introduced information bias, affecting how therapeutic actions and clinical decisions were recorded. This variability may have resulted in underreporting or

misclassification of treatment details. Future research should consider standardized EMT reporting protocols and digital documentation systems to enhance data accuracy.

The regional focus on southeastern Poland also limits the study's generalizability. While the findings provide insights into local EMT adaptations, they may not fully apply to healthcare systems with different infrastructures and emergency response strategies. Expanding future studies to multiple regions with diverse healthcare models would improve the generalizability of findings.

6. Conclusions

Despite the challenges of the COVID-19 pandemic, the demand for EMT interventions in hypertension remained unchanged. However, the findings highlight important shifts in EMT protocols, including expanded on-site care, increased use of anxiolytics, and reduced hospital transports. These adaptations reflect a broader evolution in emergency care strategies, underscoring the need for flexible response systems. Continued development of EMT procedures is essential to ensure safe and effective prehospital care during future public health emergencies.

7. Recommendations for future emergency medical practices

Building on the study findings, we propose the following recommendations to enhance emergency medical responses for chronic conditions in future public health crises. This study reinforces the growing body of evidence that emergency medical services must adopt resilient, data-driven strategies to ensure continuity of care – even during large-scale disruptions such as the COVID-19 pandemic.

To support this goal, we outline 5 key areas for improvement:

1. **Enhancing Adaptive Emergency Protocols**
Healthcare systems should develop flexible protocols that allow EMTs to effectively manage chronic conditions like hypertension during crises while minimizing unnecessary hospital admissions.
2. **Strengthening Prehospital Care and Training**
Expanding EMT training programs in the management of hypertensive emergencies and integrating mental health support strategies could improve patient outcomes and reduce pressure on EDs.^[26–28]
3. **Longitudinal Research on Emergency Adaptations**
Investigating the long-term effects of pandemic-driven adaptations on patient care and health outcomes would help refine prehospital treatment strategies.^[29,30]
4. **Addressing Psychological Factors in Hypertension Management**
Given the increased use of anxiolytics during the pandemic, further studies should explore the psychological burden of crises on chronic disease patients and its influence on healthcare-seeking behaviors.
5. **Optimizing Patient Transport Decision Frameworks**
Future research should assess the impact of modified EMT triage decisions on patient safety and healthcare system efficiency, ensuring that on-site management strategies remain evidence-based and effective.

By implementing these strategies, emergency medical systems can enhance their preparedness for future public health emergencies, ensuring that chronic disease patients receive timely, high-quality care, regardless of external pressures.

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