Original Article

Shock in the Emergency Department: Incidence, Etiology, and Mortality

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Background: Shock is a common life-threatening condition at emergency departments (ED). However, knowledge concerning the incidence of shock as well as etiology and mortality in the emergency setting is limited.

Objective: To study incidence of shock, distribution of shock amid each etiology, and treatment and outcomes among patients exhibiting shock at the ED of a tertiary care university hospital.

Materials and Methods: This was a retrospective cohort study. Patients presenting themselves at the ED from January 2017 to December 2018 were screened. We included adult patients at the ED with systolic blood pressure <90 mmHg or mean arterial pressure (MAP) <65 mmHg and ≥1 organ failure definition. After enrollment, patients were categorized into six etiologies of shock according to ED discharge diagnoses.

Results: A total of 113,651 adult patients attended the ED during the study period. Incidence of shock was 876 of 113,651 individuals (7.7/1,000 visits; 95% CI 7.2, 8.2). All patients had ≥1 organ failure, and 414 patients (47.3%) displayed at least 3 organ failures. 594 (67.8%) exhibited septic shock, 229 (26.1%) hypovolemic shock, 25 (2.9%) cardiogenic shock, 22 (2.5%) distributive shock, 5 (0.6%) obstructive shock, and 1 (0.1%) neurogenic shock. Among patients who received fluid therapy at the ED, crystalloid solutions remained the fluid of choice for patients across all groups. Norepinephrine was the most frequently applied vasopressor. Meanwhile, overall 7-day and 28-day all-cause mortality rates were 7.9% and 15.6%, respectively.

Conclusion: The incidence of shock at our ED was not uncommon (7.7/1,000 visits). Septic shock displayed the greatest prevalence, while hypovolemic shock and cardiogenic shock came in second and third, respectively.

Keywords: Shock at an emergency department, Incidence of shock, Etiology of shock

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Shock, the clinical syndrome of circulatory failure, causes global tissue hypoperfusion induced imbalance between oxygen requirements and substrate which results in cellular dysfunction[1,2]. If left untreated, the result is multiorgan dysfunction and death. The true incidence and mortality of shock in the emergency department (ED) worldwide is unknown. A recent population-based cohort study in Denmark reported the incidence of shock at an ED to be 53.8 to 80.6 cases per 100,000 persons along with a 90-day mortality rate of 40.7%[3]. Therefore, patients exhibiting shock attending the ED need to be recognized and treated promptly so as to prevent unnecessary mortality.

A diagnosis of shock is usually accompanied by three components. First, hypotension, defined as systolic blood pressure (SBP) <90 mmHg, or Mean arterial pressure (MAP) <65 mmHg. Second, the clinical feature of tissue hypoperfusion, and third, hyperlactatemia - an elevated blood lactate concentration >1.5 mmol/L[1,4,5]. Shock is commonly categorized into six etiologies according to cause and pathophysiology. Distributive (septic) is the most frequent shock-type followed by hypovolemic shock, cardiogenic shock, distributive (non-septic), obstructive shock, and neurogenic shock respectively[6,7]. Notwithstanding, the distribution of each type of shock was dependent upon the population served by the ED. To our knowledge, the epidemiology and etiology of shock as well as treatment outcomes are not well described. Thus, this study aimed to report incidence of shock, distribution of shock amid each etiology, and treatment and outcomes relating to shock among ED patients at a tertiary care university hospital.

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Materials and Methods

Study design

With approximately 70,000 annual ED visits, a retrospective cohort research was carried out at a tertiary care university hospital ED in Khon Kaen, Thailand. All patients visiting the ED from January 2017 to December 2018 were enrolled. Study protocol was approved by the Khon Kaen University Institutional Review Board

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Selection of participants and definitions

In terms of eligibility, adult ED patients (≥18 years of age) exhibiting systolic blood pressure (SBP) <90 mmHg or mean arterial pressure (MAP) <65 mmHg were included. Excluded were those patients who (1) presented cardiac arrest (2) were referred from another hospital (3) displayed hypotension without organ failure, and (4) those missing clinical data. A patient was considered to be in shock if SBP <90 mmHg or MAP <65 mmHg and whether they met greater than or equal to one organ failure definition. The authors categorized organ failure into 7 systems adopted from sequential organ failure (SOFA) score and previous studies[3,8] including (1) respiratory system failure defined as patients intubated and receiving mechanical ventilation at the ED (2) hematologic system failure was defined as platelet count <100,000 per microliter in a patient whose previous platelet count >100,000 per microliter, or had no previous results, (3) hepatobiliary system failure was defined as total bilirubin level >2.0 mg/dL in patients with no previous results or an increase in total bilirubin ≥2 mg/dL in those with previous total bilirubin >2.0 mg/dL (4) cardiovascular system failure was defined as Shock Index (ratio of the heart rate and systolic blood pressure) ≥1 (5) central nervous system was defined as a decrease in the Glasgow Coma Scale (GCS) ≥3 from baseline (6) renal system was defined as an increase in serum creatinine level ≥0.3 mg/dl from prior results or a serum creatinine level ≥2 mg/dL in patients with no prior results (7) hyperlactemia was defined as serum lactate level >1.5 mmol per liter[1].

Data collection and outcomes

Patients' data were collected from the hospital ED database comprising of age, sex, mode of arrival, Charlton Comorbidity Index (CCI), hemodynamic parameter at triage area (SI, SBP, DBP, oxygen saturation, GCS), and laboratory results (i.e., serum creatinine level, serum total bilirubin level, serum lactate). Additional clinical data including type of shock, fluid therapy, organ support (i.e., vasopressors, mechanical ventilator), and patient outcomes were derived from medical records. Moreover, we employed ED discharge diagnoses in order to assign each patient into the respective six etiologies of shock, namely distributive shock (septic), distributive (non-septic), cardiogenic shock, hypovolemic shock, obstructive shock, and neurogenic shock. As the initial definition of shock in our research was hypotension plus at least one system of organ failure, the authors thus included sepsis-induced hypotension within the distributive shock (septic) group even if the patient did not meet the sepsis-3 definition[9].

Statistical analysis

Categorical variables were described as frequencies and percentages. Continuous data were presented as median (min-max). The probability of 90-day survival in each category of shock was portrayed via Kaplan-Meier plot and compared with a log-rank test. All collected data were computed and analyzed using Stata version 10 (StataCorp).

Results

Participants and patient characteristics

A total of 113,651 adult patients presented themselves at the ED during the study period. Of those, 1,448 patients met the inclusion criteria. After reviewing patients' data, 572 were excluded due to cardiac arrest (n = 327), referred from another hospital (n = 186), hypotension devoid of organ failure (n = 46), and missing clinical data (n = 13). Hence, 876 remaining subjects underwent analysis as shown in Figure 1. The overall incidence of shock at the ED was 7.7/1,000 visits (95% CI 7.2, 8.2). Median age was 63 years and 494 (56.4%) were male. Median SBP was 83 mmHg and median MAP stood at 60 mmHg. All patients exhibited one or more organ failure and half of all patients (47.3%) had at least 3 organ failures. The most common organ failure was cardiovascular system failure which occurred in 805 (91.9%) patients with a median SI of 1.14. In this study, 784 patients (89.5%) had serum lactate results taken at the ED. Of those, 629 (80.2%) showed a serum lactate level of >1.5 mmol/L.

Type of shock

Septic shock, n = 594 patients (67.8%) was the major type of shock found in the present study, followed by hypovolemic shock, n = 229 (26.1%), cardiogenic shock, n = 25 (2.9%), distributive (non-septic) shock, n = 22 (2.5%), obstructive shock, n = 5 (0.6%) and neurogenic shock, n = 1 (0.1%). Among patients presenting hypovolemic shock, 199 (86.9%) presented non-hemorrhagic shock, and 30 (13.1%) patients displayed hemorrhagic shock, as shown in Figure 2.

Treatment of shock

Among patients who received fluid therapy at the ED, median volume of fluid bolus was 1,250 ml. Of those, crystalloid solutions remained the fluid of choice for patients in all groups. Of note, half of the patients received vasopressor treatment at the ED. Norepinephrine was the most frequently applied vasopressor in our study, followed by epinephrine and dopamine. The entirety of patients was admitted to the hospital. However, only 450 (51.4%) were admitted to intensive care, as shown in Table 2.

Outcomes regarding patients exhibiting shock

Overall 7-day and 28-day all-cause mortality rates were 7.9% and 15.6%, respectively. Median length of stay was 7 days. Furthermore, 90-day all-cause mortality was most prevalent in the hypovolemic shock group (28%) followed by cardiogenic (20%) and septic shock (18.5%), as shown in Figure 2.

Discussion

The present study explored the incidence and etiology of shock at the ED as well as treatment outcomes. We found the incidence of shock at the ED to be 7.7/1,000

Table 1. Patient characteristics among each etiology of shock

Variable	All patients n = 876	Distributive (septic) n = 594	Distributive (non-septic) n = 22	Hypovolemic n = 229	Cardiogenic n = 25	Obstructive n = 5	Neurogenic n = 1
Age in years, median (min - max)	63 (18 to 97)	65 (18 to 97)	38 (20 to 87)	60 (18 to 97)	66 (30 to 94)	54 (18 to 69)	53 (53 to 53)
Male, n (%)	494 (56.4)	336 (56.6)	10 (45.5)	131 (57.2)	15 (60)	1 (20)	1 (100)
CCI, median (min - max)	4 (0 to 13)	4 (0 to 13)	0 (0 to 5)	3 (0 to 11)	4 (0 to 8)	1 (0 to 2)	1(0 to 1)
Type of patient, n (%)							
Non-trauma	865 (98.7)	594 (100)	18 (81.8)	223 (97.4)	25 (100)	4 (80)	1 (100)
Trauma	11 (1.3)	0 (0)	4 (18.2)	6 (2.6)	0 (0)	1 (20)	0 (0)
Hemodynamic parameter, median (min - max)							
Shock index	1.14 (0.31 to 2.46)	1.16 (0.55 to 2.46)	1.09 (0.81 to 1.33)	1.1 (0.60 to 2.14)	1.03 (0.32 to 2.17)	1.07 (1.05 to 1.66)	1.36 (1.36 to 1.36)
SBP (mmHg)	83 (47 to 123)	83 (51 to 123)	81 (66 to 89)	83 (47 to 89)	81 (56 to 89)	85 (65 to 89)	63 (63 to 63)
DBP (mmHg)	48 (13 to 73)	47 (13 to 70)	42 (27 to 61)	50 (30 to 73)	47 (28 to 66)	55 (34 to 67)	37 (37 to 37)
MAP (mmHg)	60 (31 to 77)	60 (31 to 77)	54 (47 to 70)	61 (37 to 77)	58 (40 to 70)	65 (44 to 74)	46 (46 to 46)
Oxygen saturation (%)	97 (40 to 100)	97 (40 to 100)	97 (89 to 100)	98 (67 to 100)	97 (90 to 100)	99 (74 to 100)	90 (90 to 90)
GCS	15 (3 to 15)	15 (3 to 15)	15 (9 to 15)	15 (6 to 15)	15 (5 to 15)	15 (3 to 15)	13 (13)
	n = 784	n = 576	n = 5	n = 178	n = 21	n = 3	n = 1
First lactate, mmol/L	2.5 (0.1 to 28.3)	2.6 (0.1 to 28.3)	6.5 (1.9 to 3.1)	2.3 (0.6 to 24.1)	2.6 (1.0 to 14.8)	1.7 (1.0 to 1.9)	2.9 (2.9 to 2.9)
Lactate >1.5 mmol/L, n (%)	629 (80.2)	467 (81.1)	5 (100)	136 (76.4)	18 (85.7)	2 (66.7)	1 (100)
Lactate>2.0 mmol/L, n (%)	504 (64.3)	384 (66.7)	4 (80.0)	100 (56.2)	15 (71.4)	0 (0)	1 (100)
Number of organ failure, n (%)							
1	123 (14.0)	72 (12.1)	0 (0)	44 (19.2)	6 (24.0)	1 (20.0)	0 (0)
2	339 (38.7)	197 (33.2)	19 (86.4)	106 (46.3)	14 (56.0)	3 (60.0)	0 (0)
≥3	414 (47.3)	325 (54.7)	3 (13.6)	79 (34.5)	5 (20.0)	1 (20.0)	1 (100)
Site of organ failure, n (%)							
Cardiovascular	805 (91.9)	568 (95.6)	22 (100)	189 (82.5)	20 (80.0)	5 (100)	1 (100)
Hyperlactemia	629 (71.8)	485 (81.6)	22 (100)	187 (81.7)	22 (88.0)	4 (80.0)	1 (100)
Hematologic	161 (18.4)	106 (17.9)	0 (0)	53 (23.1)	1 (4.0)	1 (20.0)	0 (0)
Respiratory	134 (15.3)	114 (19.2)	0 (0)	14 (6.1)	4 (16.0)	1 (20.0)	1 (100)
Hepatobiliary	175 (20.0)	154 (25.9)	21 (95.5)	0 (0)	0 (0)	0 (0)	0 (0)
Central nervous	80 (9.1)	66 (11.1)	1 (4.6)	11 (4.8)	1 (4.0)	1 (20.0)	0 (0)
Renal	209 (23.9)	154 (25.9)	2 (9.1)	51 (22.3)	2 (8.0)	0 (0)	0 (0)

CCI = Charlson comorbidity index, DBP = diastolic blood pressure, MAP = mean arterial pressure, SBP = systolic blood pressure, GCS = Glasgow Coma Scale

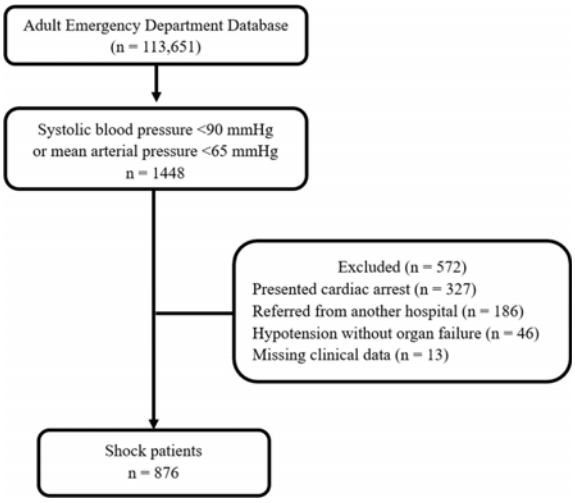

Figure 1. Study population.

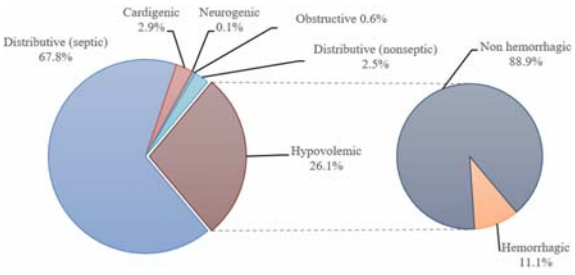

Figure 2. Etiology of shock among the study population.

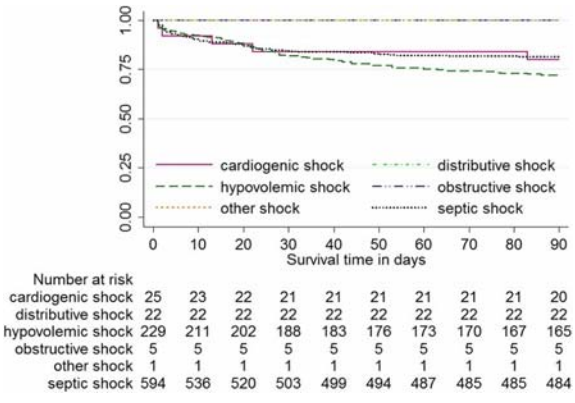

Figure 3. Kaplan-Meier estimates of the probability of survival from ED visit through to day 90. Graph detailing Kaplan-Meier estimates regarding survival probability among shock patients amid six shock etiologies. Log-rank test was employed to calculate *p*-value.

visits. Of note, septic shock was the most frequent type of shock in our study, followed by hypovolemic shock, and cardiogenic shock.

Shock is a life-threatening condition commonly present at the ED. Nonetheless, knowledge pertaining to incidence of shock is limited. A systematic review by Holler et al[4] noted that ED prevalence of hypotension with or without shock was 4 to 13/1,000 contacts. Our study is consistent with these figures, thus our results observed an incidence of shock of 7.7/1,000 visits. In terms of shock-etiology, results derived from previous studies have reported that the most frequent type of shock at EDs is varied. Numerous researches mention that septic shock is the most prevalent kind of shock at EDs[6,10,11], which notably, was in-line with our findings. Notwithstanding, this finding differs slightly from those by Holler et al, who reported that hypovolemic shock was the most common shock-type before septic shock[7]. Hemorrhagic shock incidence was rare in regards to our findings. Moreover, further analysis revealed that the most frequent cause of hemorrhagic shock was upper gastrointestinal bleeding caused by variceal bleeding, not trauma. This is because most trauma patients arrive via ambulances and receive fluid resuscitation prior to ED visit, resulting in increased blood pressure at the triage station.

Fluid resuscitation is currently considered as a mainstay therapy in relation to hypovolemia and shock. Isotonic crystalloids are recommended as the fluid of choice for initial resuscitation amid all types of shock[9,12-14]. In the present study, crystalloids remained the preferred choice of fluid consistency in accordance with guidelines. Of note, fluid resuscitation amount is different according to each shock-etiology. For example, the median amount of fluid applied for septic shock at the ED was 1,500 ml, while a lower median amount of fluid (200 ml) was utilized amid cardiogenic shock. Interestingly, patients in this study were rarely treated with colloid amid resuscitation. Several reasonable hypotheses explain the limited use of colloid in this study. First, recent international guidelines recommend that physicians should minimize the use of hydroxyethyl starch which was previously popular, amid resuscitation in septic shock[9]. After this recommendation was proposed, it affected physicians' practice worldwide-which includes this study setting. Second, another kind of colloid fluid available in Thailand is albumin. However, albumin is relatively expensive and not a treatment of choice in low-middle income countries such as Thailand due to its lack of cost-effectiveness[15]. Last, the authors discovered that according to the new concept of early vasopressor strategies[16,17], physicians tended to adopt the concept of their early use, i.e. prescribing norepinephrine instead of performing a fluid challenge.

Strengths and limitations

The present study exhibits several strengths. To our knowledge, this is the first study in the Asian population to explore the epidemiology and etiology of shock at an ED. Second, our data which was derived from electronic medical

Table 2. Treatment of patients among each etiology of shock

Variable	All patientsn = 876	Distributive (septic) n = 594	Distributive (non-septic) n = 22	Hypovolemic n = 229	Cardiogenic n = 25	Obstructive n = 5	Neurogenic n = 1
Fluid Therapy, median (min - max)							
Amount of fluid	1,250 (0 to 5000)	1,500 (0 to 4,000)	500 (0 to 2,500)	1,000 (200 to 5,000)	200 (0 to 2,000)	1,500 (500 to 3,100)	1,500 (1,000 to 2,000)
Type of fluid							
Crystalloid	1,200 (0 to 4,000)	1,500 (0 to 4,000)	500 (0 to 2,500)	1,000 (0 to 4,000)	200 (0 to 2,000)	1,500 (500 to 2,500)	1,500 (1,000 to 2,000)
Colloid	0 (0 to 0)	0 (0 to 0)	0 (0 to 0)	0 (0 to 0)	0 (0 to 0)	0 (0 to 0)	0 (0 to 0)
Blood	0 (0 to 2,000)	0 (0 to 400)	0 (0 to 0)	0 (0 to 2,000)	0 (0 to 0)	0 (0 to 600)	0 (0 to 0)
Vasopressors, n (%)							
Norepinephrine	435 (49.7)	389 (65.5)	0 (0)	33 (14.4)	10 (40.0)	2 (40.0)	1 (100)
Epinephrine	26 (3.0)	22 (3.7)	2 (9.1)	2 (0.9)	0 (0)	0 (0)	0 (0)
Dopamine	16 (1.8)	9 (1.5)	0 (0)	0 (0)	7 (28.0)	0 (0)	0 (0)
Dobutamine	3 (0.3)	1 (0.2)	0 (0)	0 (0)	2 (8.0)	0 (0)	0 (0)
None	396 (45.2)	173 (29.1)	20 (90.9)	194 (84.7)	6 (24.0)	6 (60.0)	0 (0)
Mechanical ventilator, n (%)	134 (15.3)	114 (19.2)	0 (0)	14 (6.1)	4 (16.0)	1 (20.0)	1 (100)
Disposition, n (%)							
Ward	426 (48.6)	234 (39.4)	22 (100)	160 (69.9)	8 (32.0)	1 (20.0)	1 (100.0)
Intensive care	450 (51.4)	360 (60.6)	0 (0)	69 (30.1)	17 (68.0)	4 (80.0)	0 (0.0)

Table 3. Patient outcomes among each etiology of shock

Variable, n (%)	All patients n = 876	Distributive (septic) n = 594	Distributive (non-septic) n = 22	Hypovolemic n = 229	Cardiogenic n = 25	Obstructive n = 5	Neurogenic n = 1
7-day mortality	69 (7.9)	50 (8.4)	0 (0)	17 (7.4)	2 (8.0)	0 (0)	0 (0)
28-day mortality	137 (15.6)	92 (15.5)	0 (0)	41 (17.9)	4 (16.0)	0 (0)	0 (0)
In hospital mortality	120 (13.7)	99 (16.7)	0 (0)	18 (7.9)	3 (12.0)	0 (0)	0 (0)
90-day mortality	179 (20.4)	110 (18.5)	0 (0)	64 (28.0)	5 (20.0)	0 (0)	0 (0)
LOS	7 (0 to 161)	8 (0 to 161)	1 (0 to 2)	5 (0 to 69)	6 (0 to 32)	5 (1 to 24)	63 (63 to 63)
Ever ICU transfer	492 (56.2)	408 (68.7)	0 (0)	73 (31.9)	6 (24.0)	4 (80.0)	1 (100)

ICU = intensive care unit, LOS = length of stay

records was rigid and reliable, with minimal missing data. Nevertheless, there were some limitations to this study. Principally, patients were being screened via hypotension criteria at ED triage, meaning some patients developing shock post-triage were missed. Second, we included sepsis-induced hypotension in the septic shock group even if the patient failed to meet the sepsis-3 definition[9] which is congruent with previous studies. Third, these results represent patient characteristics at a tertiary care hospital in Thailand. Besides that, shock epidemiology may vary according to the population served by the ED. Finally, we categorized shock-etiology into six main groups; though, in daily practice, shock-etiology is always mixed - not solely one type.

Conclusion

In conclusion, the incidence of shock in our ED was not uncommon (7.7/1,000 visits). With regard to the six-leading shock-types, hypovolemic shock, cardiogenic shock, and distributive (non-septic) shock came after septic shock which was the utmost prevailing shock-type. Conversely, obstructive shock and neurogenic shock were rare conditions. The overall 7-day and 28-day all-cause mortality rates were 7.9% and 15.6%, respectively.

What is already known on this topic?

Shock is a life-threatening condition commonly present at EDs. However, knowledge concerning the incidence of shock is limited.

What this study adds?

The present study explored shock epidemiology at an ED located at a tertiary care hospital in Thailand. Consequently, incidence of shock at the ED was 7.7/1,000 visits. Septic shock was the most common type of shock. Among patients who received fluid therapy at the ED, crystalloid solutions remained the fluid of choice for patients in all groups. Meanwhile, norepinephrine was the most frequently employed vasopressor in our study, followed by epinephrine and dopamine.

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Potential conflicts of interest

The authors declare no conflict of interest.

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อุบัติการณ์ สาเหตุและอัตราตายของผู้ป่วยที่มีภาวะช็อกที่ห้องฉุกเฉิน

ปริวัฒน์ ภู่เงิน, สว่างวรัช พิยะไพศาล, แพรว โคตรุฉิน, กมลวรรณ เอี้ยงฮง, ฐปนวงศ์ มิตรสูงเนิน, กรกฎ อภิรัตน์วรากุล

วัตถุประสงค์: เพื่อศึกษาอุบัติการณ์ สาเหตุและอัตราตายของผู้ป่วยที่มีภาวะช็อกที่ห้องฉุกเฉินในโรงพยาบาลระดับสูงกว่าตติยภูมิ

วัสดุและวิธีการ: งานวิจัยนี้เป็นงานวิจัยแบบเก็บข้อมูลย้อนหลังจากเวชระเบียนอิเล็กทรอนิกส์ ตั้งแต่วันที่ 1 มกราคม พ.ศ. 2560 ถึง วันที่ 31 ธันวาคม พ.ศ. 2561 ผู้ป่วยที่เข้าเกณฑ์ ภาวะช็อกได้แก่ มีความดันโลหิตซิสโตลิก <90 มิลลิเมตรปรอทหรือความดันโลหิตเฉลี่ย <65 มิลลิเมตรปรอท ร่วมกับเข้าเกณฑ์ระบบอวัยวะล้มเหลวอย่างน้อย 1 ข้อ ผู้ป่วยในกลุ่มวิจัย จะถูกจัดกลุ่มตามการวินิจฉัยที่ห้องฉุกเฉินเป็น 6 กลุ่ม ตามสาเหตุของภาวะช็อก

ผลการศึกษา: ในช่วงระยะเวลาที่ศึกษามีผู้ป่วยเข้ารักษาห้องฉุกเฉิน 113,651 ราย ผู้ป่วยมีภาวะช็อก 876 ราย คิดเป็นอุบัติการณ์ 7.7 รายต่อผู้ป่วย 1,000 ราย ผู้ป่วยทุกรายมีระบบอวัยวะล้มเหลวอย่างน้อย 1 ข้อ และ 414 ราย มีอวัยวะล้มเหลวอย่างน้อย 3 ข้อ สาเหตุของภาวะช็อกส่วนใหญ่เกิดจากภาวะพิษเหตุติดเชื้อรุนแรง 594 ราย (ร้อยละ 67.8) รองลงมามีภาวะช็อกจากการสูญเสียน้ำหรือเลือด 229 ราย (ร้อยละ 26.1) และภาวะช็อกจากโรคหัวใจ 25 ราย (ร้อยละ 2.9) ภาวะช็อกที่พบได้น้อยได้แก่ ภาวะช็อกจากการอุดกั้นนอกหัวใจจาก 5 ราย (ร้อยละ 0.6) และภาวะช็อกจากจากระบบประสาท 1 ราย อัตราตายที่ 7 วันและที่ 28 วัน ของผู้ป่วยทั้งหมดคิดเป็นร้อยละ 7.9 และ 15.6 ตามลำดับ

สรุป: อุบัติการณ์ของภาวะช็อกที่ห้องฉุกเฉินคิดเป็น 7.7 รายต่อผู้ป่วย 1,000 ราย สาเหตุของภาวะช็อกส่วนใหญ่เกิดจากภาวะพิษเหตุติดเชื้อรุนแรง ภาวะช็อกจากการสูญเสียน้ำหรือเลือด และภาวะช็อกจากโรคหัวใจ ตามลำดับ