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Clinical characteristics and factors associated with shorter length of hospital stay among deceased COVID-19 patients in Cambodia

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ABSTRACT

Background: The length of hospital stay (LoS) among COVID-19 patients is influenced by multiple factors. This study aimed to identify factors associated with LoS among deceased Cambodian patients with confirmed SARS-CoV-2 infection.

Methods: We analyzed a total of 106 deceased patients with confirmed SARS-CoV-2 infection reported between March 11 and May 1, 2021, and publicly shared on the Ministry of Health's Facebook page. A zero-inflated Poisson regression model was used to identify factors associated with LoS. Maximum likelihood estimates, and incidence rate ratios (IRRs) were calculated, and model goodness of fit was assessed.

Results: The mean LoS to death was 4.39 days (standard deviation, SD = 5.17). Factors associated with a shorter LoS included critical respiratory symptoms ($p = .011$), being dead on arrival ($p < .0001$), advanced age ($p = .003$), residence in a province ($p = .004$), presence of multiple chronic conditions ($p = .0006$), and receiving care at a non-designated COVID-19 treatment facility ($p = .005$). In contrast, each additional day between SARS-CoV-2 diagnosis and hospital admission was associated with an approximately 9% increase in LoS (95% CI 1.07, 1.10).

Conclusions: Despite substantial efforts by the Cambodian government to control the pandemic, many COVID-19 patients died shortly after hospital admission. The findings highlight important patient characteristics and underscore the need for improved patient education, strengthened healthcare infrastructure, and enhanced public preparedness for future pandemics.

Key words: Length of hospital stay; length of diagnosis; COVID-19; Zero-inflated Poisson model; Cambodia

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Consent for publication: Not applicable.

Availability of data and material: The case death announcements used in this study were obtained from publicly shared on the Ministry of Health of Cambodia's Facebook page. These records were retrieved in PDF format and securely stored on a personal computer for analysis. Data were subsequently extracted and entered into a worksheet for processing. Partial raw data (e.g., up to 30 cases) may be made available upon reasonable request.

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Introduction

The virus that causes coronavirus disease 2019 (COVID-19) was first identified in Wuhan, China, in December 2019 and has since spread rapidly across the globe. As of October 2025, the pandemic has resulted in 779 million reported cases and 7.1 million deaths worldwide. Following infection, COVID-19 patients typically present with flu-like symptoms [1]. However, a subset of patients may progress to severe disease, requiring timely diagnosis and early clinical intervention [2, 3].

The length of hospital stay (LoS) among COVID-19 patients varies widely across healthcare settings and is influenced by multiple factors. A review by Rees et al. [4] reported that the median LoS ranged from 4 to 53 days in China and was generally shorter in other countries. Notably, patients who were discharged alive tended to have longer LoS than those who died during hospitalization.

A recent meta-analysis reported a mean LoS of 14.5 days [5]. This finding also suggests that LoS varies depending on several factors, including patient age and the availability of healthcare resources within a country.

Among deceased COVID-19 patients, LoS is generally shorter. In the United States, LoS was reported to be two days longer than in Italy and five days shorter than in Germany, with respective ranges of 2–10 days, 1–6 days, and 5–19 days [6].

Evidence indicates that LoS among patients who died during hospitalization was associated with factors such as age, hypertension, and pulmonary impairment [7]. Additionally, elevated neutrophil-to-lymphocyte ratios and higher C-reactive protein-to-albumin ratios have been shown to influence LoS among patients who died, particularly among those with comorbidities such as diabetes mellitus [8].

During the pandemic, Cambodia was significantly affected by COVID-19 [9]. The first confirmed SARS-CoV-2 case was reported on January 27, 2020, in a traveler from Wuhan, China. By September 2025, a total of 139,326 confirmed cases had been reported. Initially, the number of deaths increased slowly, with the first death recorded on March 11, 2021. The death toll peaked at 3,056 confirmed deaths, and has remained stable since April 21, 2022 [10].

The COVID-19 pandemic in Cambodia can be broadly divided into two major waves [11]. The first wave, driven by the Alpha variant, began on February 12, 2021, and led to the closure of schools and public places. The second wave, driven by the Delta variant, started on May 24, 2021, and prompted the implementation of curfews in several provinces along the Northern border with Thailand.

Currently, detailed information on the LoS among patients with confirmed SARS-CoV-2 infection, both survivors and those who died, remains limited in Cambodia. Therefore, this study aimed to identify factors associated with shorter LoS among deceased Cambodian patients with confirmed SARS-CoV-2 infection. The specific objectives were:

1. To describe the demographic characteristics and clinical presentations of deceased hospitalized patients with confirmed SARS-CoV-2 infection; and
2. To determine the factors associated with shorter LoS among patients who died from COVID-19 during the first wave of the pandemic.

Understanding the factors influencing LoS in COVID-19 patients may assist the Ministry of Health (MoH) in developing effective public health strategies. The findings of this study are expected to provide valuable insights into patient management, improve clinical outcomes, and inform preparedness for future pandemics.

Methods

Data and variables

Between March 11 and May 1, 2021, the MoH publicly posted death announcements of patients who died from COVID-19 in Cambodia on its Facebook page. A volunteer (PCT) collected all of the death announcements during this period. Then, a volunteer with a medical background (MSL) reviewed the reports, extracted relevant variables, and entered the data into an Excel spreadsheet in English under the supervision of the lead investigator (PS) for analysis.

Key variables extracted from each death announcement included demographic variables (e.g., age, sex, and place of residence); clinical variables, including patient status at the time of seeking care (e.g., COVID-19–related symptoms or dead on arrival) and underlying medical conditions (e.g., diabetes and hypertension); and healthcare access (e.g., government-designated hospitals, non-government-designated hospitals, and private clinics).

Event-related variables were also collected, including the dates of diagnosis, hospitalization, resuscitation, referral, and death. Time intervals between each event and death were calculated in days. For example, the length of diagnosis (LoD) was defined as the number of days from the date of diagnosis to the date of death, while the LoS was defined as the number of days from the date of hospitalization to the date of death.

Informed consent was not obtained because the study used publicly available data and did not involve any biological specimens or identifiable personal information, such as names or social security numbers.

Analyses

Descriptive statistics, including frequencies, proportions, means and (standard deviations, SD) were reported as appropriate. Correlation analyses were also performed. A zero-inflated Poisson (ZIP) regression was conducted to evaluate factors associated with shorter LoS among deceased COVID-19 patients in Cambodia. Maximum likelihood estimates, and incidence rate ratios (IRRs) were calculated. Model goodness of fit was assessed using the Pearson Chi-square (χ^2) statistic (i.e., Pearson χ^2/degree-of-freedom), the Akaike Information Criterion (AIC), and the Bayesian Information Criterion (BIC). Kaplan-Meier estimators were generated for non-censored cases for visualization purposes.

Sensitivity analyses were conducted to examine the robustness of the association between LoS and LoD, to assess the influence of extreme values or outliers on the results, and to evaluate the stability of the regression model.

Results related to LoS were reported as parameter estimates (β coefficients with standard error, SE), and IRRs. Statistical significance was determined using 95% confidence intervals (CIs) and a p-value threshold of $< .05$. All analyses were performed using SAS OnDemand for Academics, version 9.4.

Results

Patients' demographics

This cohort includes all deceased patients (N = 106) between March 11 and May 1, 2021. The mean age was 57.39 years (SD = 15.19), ranging from 23 to 93 years, with fewer than half (46.23%) aged 60 years or older. Nearly half were female (45.28%), and 67.92% resided in the capital city of Phnom Penh (Table 1). Among patients living in the capital, the mean distance from their commune of residence to the treatment facility was approximately 11.63 km (SD = 4.59), ranging from 5.6 to 25.5 km.

Patients' clinical patterns and access to care

Figure 1 presents the distribution of LoS and LoD among deceased patients. The mean LoS was 4.39 days (SD = 5.17), ranging from 0 to 26 days. The mean LoD was 4.63 days (SD = 6.28), ranging from –1 to 41 days.

Table 1. Characteristics of 106 deceased COVID-19 patients.

Characteristics	N (%) or Mean (SD)
Demographic characteristics	
Age	57.39 (15.19)
23-59 years	57 (53.77)
≥ 60 years	49 (46.23)
Sex	
Female	48 (45.28)
Male	58 (54.72)
Ethnicity	
Khmer	101 (95.28)
Other†	5 (4.72)
Residence	
Phnom Penh	72 (67.92)
Provinces	34 (32.08)
Distance from a resident to the care facility (N = 72)	10.08 (6.77)
Patient status at the time of seeking care±	
COVID-19–related symptoms (e.g., cough, fever)	52 (49.06)
Critical respiratory symptoms (e.g., severe shortness of breath)	33 (31.13)
Dead on arrival	16 (15.09)
Other	5 (4.72)
Underlying medical conditions	
Diabetes	20 (18.87)
Hypertension or heart disease	8 (7.55)
More than one chronic health conditions⊦	12 (11.32)
Unknown	66 (62.26)
Access to treatment facilities	
Government-designated facilities	
Khmer-Soviet Friendship Hospital	47 (44.34)
Luang Mè Hospital†	17 (16.04)
Non-government-designated facilities‡	35 (33.02)
Other facilities§	7 (6.60)
Time to deaths variables (days)	
Length of diagnosis	4.63 (6.28)
Length of hospital stay (N = 102)	4.39 (5.17)
Length of resuscitation (N = 61)	3.21 (4.76)

† Chinese = 3, French = 1, Korean = 1.
± Patients' symptoms at presentation included shortness of breath (SOB) (24.53%), SOB with cough and/or fever (46.53%), and unknown symptoms (11.32%). Nineteen patients (17.92%) who arrived deceased were excluded from this analysis.
⊦ Chronic health conditions included diabetes, hypertension, liver disease, chronic kidney disease, and/or obesity.
† One patient was admitted to The Great Duke Centre.
‡ Non-government-designated facilities included National Hospitals or Health Centres [Calmette Hospital (N = 2), Cambodia-China Friendship Preah Kossamak Hospital (N = 3), National Center for Tuberculosis and Leprosy (CENAT) (N = 3), Chak Angre Krom Health Center (N = 6), and Borey 100 Knong Health Center (N = 1)], as well as Provincial Referral Hospitals (PRH) [Chey Chumneas Hospital (N = 2), Sihanouk PRH (N = 7), Svay Rieng PRH (N = 4), Prey Veng PRH (N = 3), and Cambodia-China Friendship Tboung Khmum PRH, Kampong Chnang PRH, Kampong Speu PRH, Kep Hospital (N = 1 each)].
§ Other facilities included private hospitals or clinic facilities [Sensok 1 / Sensok Polyclinic (N = 3) and Cho Rey Phnom Penh Hospital (N = 1)], as well as patients who died at home (N = 3).

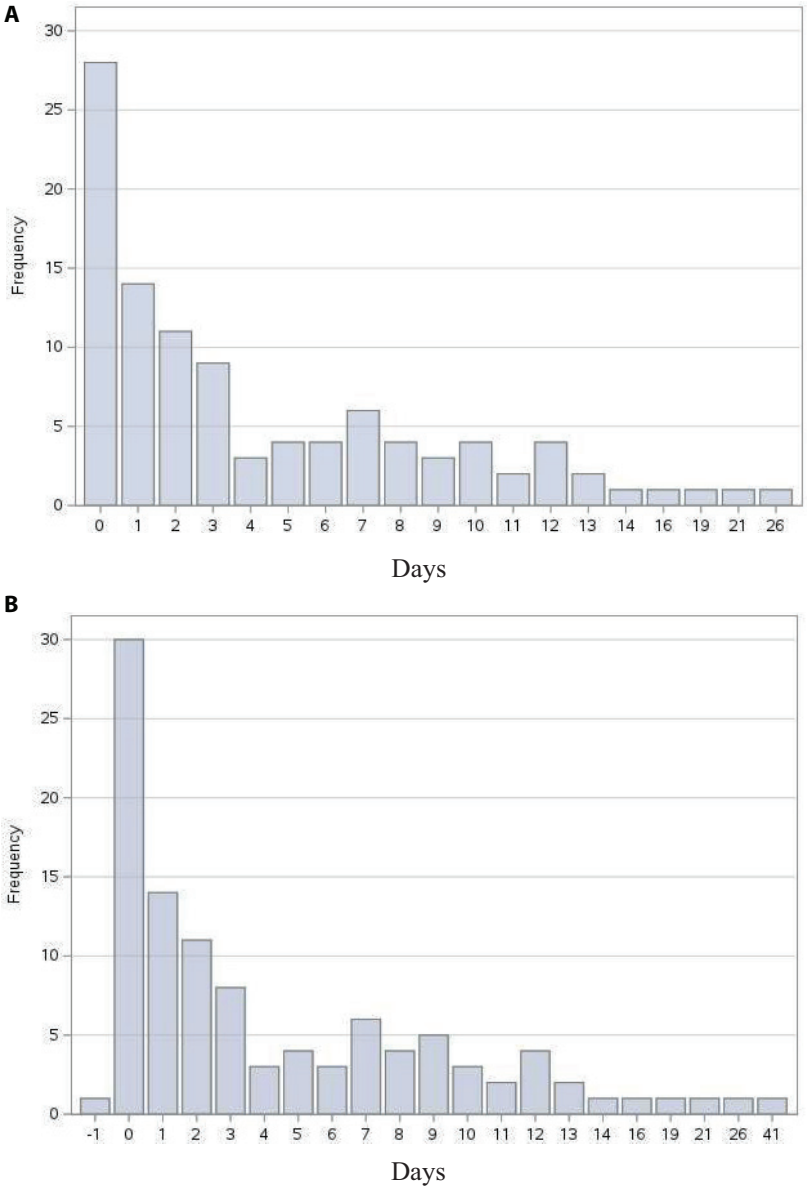

Figure 1. Distribution of the length of hospital stay (A) and the length of diagnosis† (B) to death. †One patient was diagnosed with COVID-19 posthumously.

Twenty-eight patients died on the same day of hospitalization, 14 died on day one, 11 died on day two, and nine died on day three. Regarding LoD, one patient tested positive for SARS-CoV-2 *post-mortem*, while 30 patients tested positive upon arrival for emergency care.

Approximately half of the patients (49.06%) presented with at least one symptom consistent with COVID-19. More than a third (33.13%) presented with critical respiratory symptoms, such as severe shortness of breath. Among the 73 patients with available symptom data, 63.01% reported experiencing cough, fever, and severe shortness of breath prior to or at the time of seeking care.

Underlying medical conditions were also documented, including diabetes (18.87%), hypertension or heart disease (7.55%), obesity (1.89%), chronic kidney disease (3.77%), and chronic hepatitis or liver cirrhosis (2.83%).

Most patients (78.3%) were reported to have severe pneumonia in both lungs or COVID-19–related acute respiratory distress syndrome. Additionally, 15.09% of the deceased patients were reportedly dead on arrival.

Regarding access to care, 44.34% of patients received treatment at Khmer-Soviet Friendship Hospital and 16.04% at Luang Mè Hospital, both of which were government-designated treatment centers. Over one-third of patients (33.02%) sought care at various non-government-designated treatment facilities, including public hospitals or health centers in the capital city or provinces, as well as private clinics (Table 1).

Pearson correlation between event-related variables

A Pearson correlation matrix was generated to examine linear relationships between age and other event-related variables (Table 2). A very strong positive correlation was observed between LoD and LoS ($\rho = 0.85$, $p < .0001$). Similarly, strong positive correlations were found between resuscitation days and LoS ($N = 61$, $\rho = 0.75$, $p < .0001$) and between referral days and LoS ($N = 9$, $\rho = 0.87$, $p = .002$).

Factors affecting shorter length of hospital stay

Kaplan-Meier estimator visualizations (Figure 2) indicated that patient status at the time of seeking care was associated with LoS ($p < .0001$). However, LoS did not differ significantly according to patients' underlying medical conditions or the type of treatment facility accessed.

After adjusting for covariates (Table 3), factors associated with a shorter LoS included being aged ≥ 60 years ($p = .003$), residing in a province ($p = .004$), having more than one underlying chronic health condition ($p = .0006$), presenting with critical respiratory symptoms ($p = .011$), being dead on arrival ($p < .0001$), and accessing care at non-government designated facilities ($p = .005$). In contrast, a longer interval between SARS-CoV-2 diagnosis and hospital admission was associated with a longer LoS ($p < .0001$).

Interpretation of the results

To facilitate interpretation, IRRs were calculated from the ZIP regression model (Table 2). Each additional day between SARS-CoV-2 diagnosis and hospital admission was associated with an approximately 9% increase in LoS (IRR = 1.09, 95% CI 1.07–1.10).

In contrast, Patients aged 60 years and older, as well as those residing in a province, experienced shorter LoS, with reductions of 27% (95% CI 0.59–0.9) and 33% (95% CI 0.51–0.88), respectively. Those presenting with critical respiratory symptoms had a 52% shorter LoS (IRR = 0.48, 95% CI 0.27–0.84). Patients with more than one chronic health condition had a 50% shorter LoS (95% CI 0.33–0.74).

Table 2. Pearson correlation matrix of age, residential distance, and event-related variables.

	1	**2**	**3**	**4**	**5**	**6**	**7**
1 Age	1						
2 LoD	.48	1					
3 LoS	.1	.85±	1				
4 Resuscitation§	.02	.64±	.75±	1			
5 Referral§	.21	.78⊢	.87⊥	.72⊢	1		
6 Sankat*	.0	.13	.09	.2	.-28	1	
7 Khan*	.-07	.12	.11	.26	.-19	.86±	1

p-values: ± < .0001; ⊥ < .001; ⊢ < .05

LoD, length of diagnosis; LoS, length of hospital stay.

§ Represents the number of days from hospitalization to the resuscitation date (N = 61) or the referral date (N = 9).

* Represents approximate distance (km) between the patient's residence and the treatment facility in the capital city of Phnom Penh using Sankat/commune postal codes (N = 69) or Khan/district postal codes (N = 72).

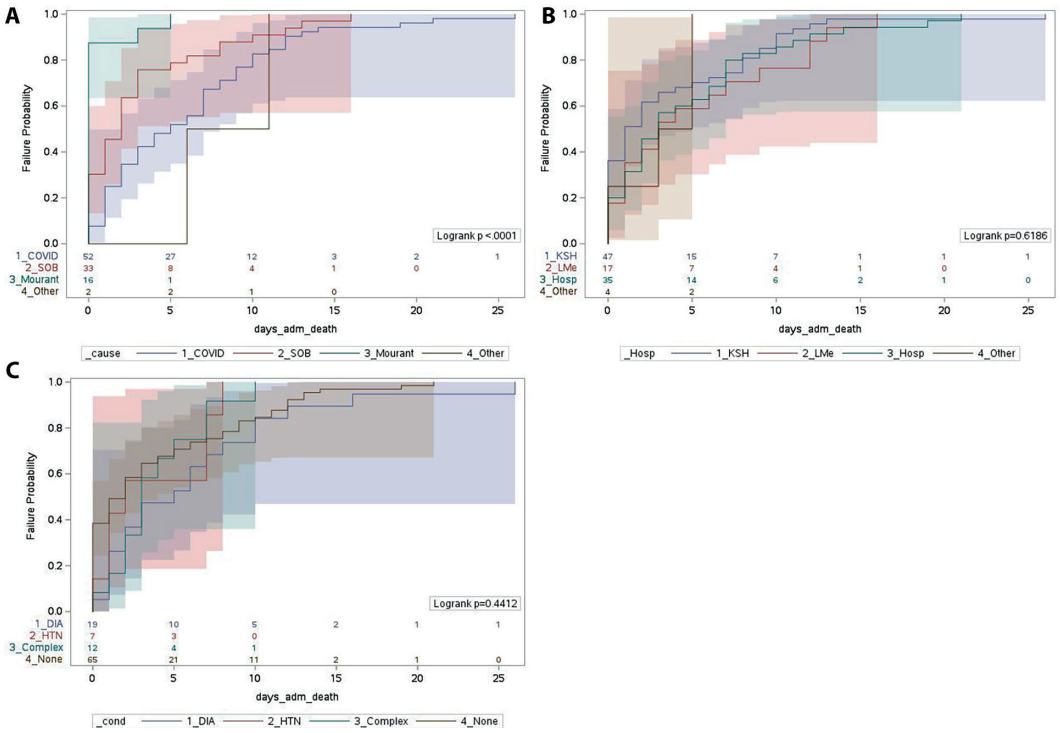

Figure 2. Kaplan-Meier analysis for the length of hospital stay (LoS) without censoring (N = 106). Kaplan–Meier product-limit estimates were calculated without censoring, as all patients were deceased. Each vertical step in the curve indicates one or more events (i.e., deaths).

A) Patients who were dead on arrival status had a shorter LoS compared with those presenting with COVID-19–related illness or critical respiratory symptoms (e.g., shortness of breath). The log-rank test indicates a significant difference between the LoS curves ($p < .0001$).

B) There was no significant difference in LoS based on underlying health conditions ($p = .619$).

C) Similarly, LoS did not differ significantly by type of treatment facility accessed ($p = .441$).

Additionally, being dead on arrival was associated with a markedly shorter LoS, reduced by 91.6% (IRR = 0.08, 95% CI 0.03–0.21). Receiving care at a non-designated treatment facility was also associated with a 58.9% shorter LoS (IRR = 0.41, 95% CI 0.22–0.76).

Discussion

During the COVID-19 pandemic, Khmer-Soviet Friendship Hospital, and Luang Mè Hospital were designated as governmental treatment centers in Phnom Penh, the capital city with a population of over 1.5 million. To our knowledge, this study is the first to investigate the LoS among patients who died from COVID-19 in Cambodia. We analyzed 106 publicly reported death announcements from various care facilities nationwide, shared on the MoH Facebook page between March 11 and May 1, 2021. No additional publicly available death records were identified beyond this period.

We found that the mean LoS in this cohort was relatively short, at approximately 4.4 days. This finding is consistent with a study conducted in the United States that reported similarly short LoS among patients who died from COVID-19 [6], but it is shorter than estimates reported in studies that accounted for censoring [4]. Earlier reports from the initial phase of the pandemic indicated substantially longer hospital stays. For example, the median LoS among COVID-19 patients with pneumonia was 22 days, ranging from 9 to 46 [12].

In the current study, a shorter LoS was significantly associated with several factors, including

Table 3. Zero-inflated Poisson regression model for length of hospital stay.*

Parameters	β (SE)	95% CI	p-value	IRRs (95% CI)
Intercept	2.68 (0.46)	1.78, 3.57	<.0001	-
Length of diagnosis (LoD)	0.08 (0.01)	0.07, 0.1	<.0001	1.09 (1.07, 1.10)
Demographic characteristics				
Age ≥ 60 years	-0.32 (0.11)	-0.53, -0.11	.003	0.73 (0.59, 0.9)
Female	0.1 (0.12)	-0.14, 0.34	.429	1.1 (0.87, 1.4)
Khmer ethnicity	0.0 (0.23)	-0.45, 0.45	.995	1.0 (0.64, 1.57)
Residing in a province	-0.4 (0.14)	-0.67, -0.13	.004	0.67 (0.51, 0.88)
Patient status at the time of seeking care				
COVID-19–related symptoms	-0.54 (0.28)	-1.08, 0.0	.051	0.58 (0.34, 1.0)
Critical respiratory symptoms	-0.73 (0.29)	-1.30, -0.17	.011	0.48 (0.27, 0.84)
Dead on arrival	-2.48 (0.46)	-3.39, -1.57	<.0001	0.08 (0.04, 0.21)
Other	Ref.	Ref.	Ref.	1.0
Underlying health conditions				
Diabetes	0.12 (0.13)	-1.13, 0.36	.366	1.12 (0.87, 1.44)
Hypertension or heart disease	0.01 (0.22)	-0.43, 0.44	.978	1.0 (0.65, 1.55)
More than one chronic health conditions	-0.7 (0.2)	-1.1, -0.23	.0006	0.5 (0.33, 0.74)
Unknown	Ref.	Ref.	Ref.	1.0
Access to treatment facilities				
Government-designated facilities				
Khmer-Soviet Friendship Hospital	-0.54 (0.30)	-1.14, 0.05	.074	0.58 (0.32, 1.05)
Luang Mè Hospital	-0.48 (0.31)	-1.09, 0.13	.124	0.62 (0.34, 1.14)
Non-government-designated facilities‡	-0.89 (0.32)	-1.51, -0.27	.005	0.41 (0.22, 0.76)
Other facilities§	Ref.	Ref.	Ref.	1.0
Model Fit Statistics				
Pearson Chi-square (df = 86)	135.25	-	-	-
Log likelihood	417.59	-	-	-
AIC	464.91	-	-	-
BIC	509.70	-	-	-

IRRs, incident rate ratios.
* Three patients died at home (ID 21, 42, and 78) were excluded.
‡ Non-government-designated facilities included National Hospitals or Health Centres [Calmette Hospital, Cambodia-China Friendship Preah Kossamak Hospital, and National Center for Tuberculosis and Leprosy (CENAT), Chak Angre Krom Health Center, Borey 100 Knong Health Center], as well as Provincial Referral Hospitals (PRH) [Chey Chumneas Hospital, Sihanouk PRH, Svay Rieng PRH, Prey Veng PRH, Cambodia-China Friendship Tboung Khmum Hospital, Kampong Chnang PRH, Kampong Speu PRH, and Kep Hospital].
§ Other facilities included private hospital or clinic facilities [Sensok 1/Sensok Polyclinic and Cho Rey Phnom Penh Hospital], as well as patients who died at home.

age ≥ 60 years, residence in a province, presence of critical respiratory symptoms, dead on arrival, more than one chronic health condition, and receiving care at a non-government-designated COVID-19 treatment facility. This pattern likely reflects greater disease severity among these patients, which may lead to rapid clinical deterioration and earlier mortality, resulting in shortening the duration of hospitalization. Our findings are broadly consistent with the literature, which has reported that LoS among patients who died during hospitalization is associated with age, hypertension, and pulmonary impairment [7]. A recent systematic

review and meta-analysis found that COVID-19 death rates are high in Africa, where hospitalized patients often experience shorter LoS [5].

As expected, patients aged 60 years and older in our cohort had a shorter LoS, experiencing a 29% reduction compared to their younger counterparts. This finding is consistent with prior studies demonstrating an association between older age and shorter LoS among deceased patients [5, 7, 13]. Advanced age is often linked to age-related immune decline and a higher burden of comorbidities, both of which can complicate infection management and lead to poorer clinical outcomes [14].

Over two-thirds of our patients were reportedly diagnosed with severe bilateral pneumonia, accompanied by symptoms such as fever, cough, and shortness of breath. These findings are consistent with previous studies [15]. Severe pneumonia in COVID-19, resulting from lung inflammation and injury, can lead to pyroptosis of alveolar epithelial cells, cytokine storm, and thromboinflammatory processes [16], which may have been the primary cause of death in our cohort. This pathophysiology may explain the short LoS observed, which decreased by 52% among patients presenting with critical respiratory symptoms.

Previous studies have documented cases of unconsciousness or prolonged unconsciousness in severely ill patients with COVID-19 [17, 18]. In the current study, approximately one in seven patients (15.09%) was classified as dead on arrival with no vital signs recorded. The LoS in this group was markedly reduced by 92%. The term "dead on arrival" has been described in the literature [19], and rare cases of dead on arrival among patients with COVID-19 have also been reported [20].

We were unable to obtain additional clinical information for these patients. However, our findings suggest the possibility of delayed care-seeking among this group. Future research is needed to identify barriers to timely healthcare access and to examine the relationship between delayed care-seeking and testing during a pandemic.

Our findings also indicate that patients with more than one underlying medical conditions reduced LoS about 50%, consistent with previous studies [13, 21].

Additionally, accessing a non-designated COVID-19 treatment facility and residing in a province were both associated with shorter LoS. These findings highlight potential disparities in healthcare access and quality across settings and underscore the need for further investigation to better understand these differences and inform targeted interventions.

Notably, among deceased patients, LoS increased by approximately 9% for each additional day between SARS-CoV-2 diagnosis and hospital admission. However, this finding should be interpreted with caution. It does not imply that individuals suspected of having COVID-19 should delay SARS-CoV-2 testing. Rather, patients diagnosed earlier before hospitalization may have initially presented with milder illness, which could have contributed to a longer LoS. It is also important to note that this cohort consisted of non-censored data. Sensitivity analyses were conducted to ensure that the results were not driven by a single *post-mortem* case or by mathematical artifacts.

Direct comparisons with other studies are limited. A large observational cohort of COVID-19 hospitalizations in England found that patients who eventually died tended to have shorter times from symptom onset to hospital admission, suggesting that earlier admission may reflect greater disease severity, which in turn can influence LoS patterns [22]. Similarly, a smaller observational study found that later symptom onset was associated with shorter hospital LoS in patients lacking clear epidemiological exposure, indicating that the timing of symptom recognition relative to disease progression may be related to inpatient stay duration [23].

Nonetheless, approximately one-third of the patients had undergone COVID-19 testing at the time of seeking care, suggesting that testing may have been underutilized by the public. Many of these patients appeared to seek care only after developing severe illness. Despite the tireless efforts of the Cambodian MoH, our findings raise concerns about potential gaps in public awareness regarding COVID-19 testing and possible barriers to access. Further research is needed to better understand the challenges in delivering and accessing COVID-19 testing information among the public, as well as to evaluate strategies to strengthen prevention and treatment efforts in preparation for future pandemics.

Limitations

Several limitations should be considered when interpreting the findings of this study. First, the publicly available death announcement from the MoH did not include detailed clinical information, such as laboratory results (e.g., complete blood count), imaging reports (e.g., chest radiography), ultrasound findings, or resuscitation procedures. This limitation restricted our ability to compare our findings with studies conducted in other countries [7, 12] or in the region [24, 25]. Previous research has shown that elevated neutrophil-to-lymphocyte ratio, C-reactive protein-to-albumin ratio [8] and the abnormalities in oxygen saturation, D-dimer, lactate dehydrogenase, and ferritin levels can influence LoS among patients with COVID-19 [21].

Second, the data did not allow differentiation between LoS in intensive care unit and non-intensive care settings, which has been examined in other studies [4].

Third, due to the lack of detailed clinical and contextual data, we were unable to examine the association between LoS and other potential predictors, such as time to death following resuscitation, time to death prior to referral, or the geographic distance between patients' residences and treatment facilities. Finally, this study did not estimate point or overall mortality incidence among hospitalized COVID-19 patients or the overall mortality rate in Cambodia, as these objectives were beyond the scope of our research. In contrast, studies from other Southeast Asian countries have reported mortality rates ranging from 0.1% to 4.0% [26].

Despite these limitations, this study has several strengths. Although it was based on publicly available data and a relatively small sample size (N = 106) with no censored observations, the findings identified clinical characteristics and factors associated with LoS that are consistent with results from larger studies [8, 27, 28]. The use of a ZIP regression model, which is well-suited for count data with excess zeros, allowed for appropriate modeling of shorter LoS. The results remained robust across sensitivity analyses, supporting the reliability of our findings despite the inherent limitations of the dataset. Importantly, the findings of the current study may inform the MoH and its partners in strengthening pandemic response strategies and healthcare system planning for future public health emergencies.

Implications

Lesson learned

Our findings highlight the need for targeted interventions for high-risk groups, including older adults and patients with severe symptoms. They also underscore the importance of timely care-seeking, especially in provincial settings where access to healthcare services may be more limited. Strengthening COVID-19 treatment capacity, enhancing early diagnosis, and promoting prompt care-seeking behaviors are critical strategies that could improve outcomes in future outbreaks.

Future research

Larger studies are needed to identify barriers to timely care-seeking and COVID-19 testing, as well as to evaluate challenges in the delivery and accessibility of public health messaging. Future research should also examine a broader range of clinical and contextual factors influencing LoS and patient outcomes. Access to comprehensive clinical data, including laboratory parameters, imaging findings, ultrasound results, and resuscitation procedures, would enable more accurate assessment of disease severity and hospitalization patterns.

Scholarly opportunity

This study demonstrates that publicly available data, such as MoH Facebook announcements, can be effectively leveraged for scientific research. It provides a model for Cambodian scholars in epidemiology and public health and establishes a foundation for future investigations, particularly in resource-limited settings.

Conclusions

During the early stages of the second COVID-19 wave in Cambodia, driven by the Delta variant, 106

COVID-19 patients died shortly after hospitalization. A shorter LoS was significantly associated with older age, residence location, underlying medical conditions, patient status at admission, and access to treatment facilities. In contrast, a longer interval between SARS-CoV-2 diagnosis and hospital admission was associated with an increase in LoS in this non-censored dataset. These findings carry important implications for public health practice and underscore the need to strengthen preparedness and response strategies for future pandemics.

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