EPIDEMIOLOGICAL CHARACTERISTICS OF COVID-19 PATIENTS WHO DIED IN HANOI IN 2021

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Objectives: This study aims to describe certain characteristics of COVID-19 patients who died in Hanoi in 2021.

Subjects and methods: A cross-sectional descriptive study was conducted using retrospective data collected from a list of cases managed by Hanoi Center for Disease Control. The study's subjects are individuals who contracted COVID-19 and were documented within the community in Hanoi city from January 1st to December 31st, 2021 based on the Ministry of Health's instruction. In total, there were 59,639 confirmed cases of COVID-19, including 409 deaths.

Results and conclusions: In 2021, Hanoi recorded a total of 59,639 cases of COVID-19, including 409 deaths; The case fatality rate (CFR) is 0.68%. Among 409 COVID-19 patients who died, 52% of them were female (male/female ratio is 1/1.08); 92% of the deceased COVID-19 patients were aged 60 and above. With the average age at time of death is 79 years old, female's average age is statistically significantly higher than male's; 69% of deceased patients were recorded in urban areas. The average time from onset to death was 14.6 days (median 11 days). 77% of the deaths had not received vaccination, and 81% of them had at least one underlying medical condition. Hypertension and diabetes are two most common underlying medical conditions with rates of 54.5% and 29.3%, respectively.

Keywords: *COVID-19, Death, Hanoi.*

INTRODUCTION

On 11 March 2020, the World Health Organization (WHO) has declared the coronavirus disease 2019 (COVID-19) outbreak caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) a pandemic since it was first reported in Wuhan, China in December 2019. It has had severe impacts on the community's health and healthcare systems all over the world as its number of cases and deaths increases rapidly and uncontrollably. As of December 31st, 2021, over 286 million COVID-19 confirmed cases and over 5.4 million deaths had been reported globally. In Vietnam, at the same time, there were over 1.7 million confirmed cases and over 32,000 deaths, with the majority of cases and deaths recorded in the fourth wave of the outbreak starting on April 27th, 2021[1].

The clinical features and severity of COVID-19 vary among individuals, based on multiple factors, such as age and associated comorbidities. Evaluating the epidemiological characteristics of the group of deceased patients provides crucial information for healthcare managers to devise appropriate management strategies and determine priority target groups for intervention, thereby reducing the mortality rates. Many studies conducted worldwide have demonstrated that factors such as advanced age, male gender, the presence of underlying comorbidities and non-vaccination against COVID-19 are associated with an increased risk of mortality in COVID-19 patient[2-9]. However, at the moment, there is only a

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limited number of officially published studies on this issue in Vietnam, especially in Hanoi.

Hanoi is one of the first provinces to be heavily affected following the fourth wave of the outbreak starting on April 27, 2021. During this fourth wave, the number of COVID-19 deaths in the city has been increasing rapidly since the implementation of Government Resolution 128/2021/NQ-CP on "Safety, flexibility, and effective control of COVID-19 epidemic". This study aims to provide additional scientific evidence for managers in planning pandemic prevention, as well as organizing COVID-19 patient management and treatment. Its goal is to describe certain epidemiological characteristics of COVID-19 patients who died in Hanoi in 2021.

SUBJECTS AND METHODS

Subjects: All of COVID-19 confirmed cases diagnosed by real-time RT-PCR or SARS-CoV-2 antigen rapid test in Hanoi in 2021 based on the Ministry of Health's instruction and managed by the Hanoi Center for Disease Control (CDC).

- **Selection criteria:** Individuals diagnosed with COVID-19 through real-time RT-PCR testing or rapid antigen testing for SARS-CoV-2 with an onset date between January 1 to December 31, 2021 while isolation, studying, living, and working in Hanoi according to the regulations of the Ministry of Health.

- **Exclusion criteria:** One of the following three cases:

+ Patient who is immediately quarantined upon entry into Vietnam.

+ Patient who have a permanent residence in Hanoi but is diagnosed and isolated for treatment in other provinces or cities.

+ Patient who haven't reported and is not under the management of the Hanoi CDC.

Methods: A cross-sectional descriptive study was conducted using retrospective data collected from a list of cases managed by Hanoi CDC.

- Time and location: The study was conducted from October 2022 to April 2023 at Hanoi CDC.

- Sample size: All COVID-19 confirmed cases meeting the research criteria were selected. In total, there were 59,639 COVID-19 confirmed cases meeting the criteria, including 409 deaths and 59,230 convalescents.

Variables and indices

- The collected variables include: age, gender, residential address or quarantine location, living area, diagnostic method, onset date, date of sample collection for testing, date of death, symptomatic status, vaccination status, number of vaccine doses received, presence of underlying health conditions, number of underlying health conditions, type of underlying health conditions.

- The indices are as follows: male/female ratio, case fatality rate (CFR), incidence rate per 100,000 population, time from onset to death, vaccination rate, rate of comorbidities.

Statistical analysis: The data were analyzed using STATA 17 software and maps were created using ArcGIS 10.8 software. Descriptive statistical methods were applied to calculate the mean values, standard deviations, interquartile ranges to describe quantitative variables, and percentages to describe qualitative variables. Time series charts illustrating the disease trend over time and maps demonstrating relationship between disease incidence rate per 100.000 population and the number of deaths were generated. Statistical tests were conducted with a significance level of $\alpha = 0.05$.

Research ethic: The research has been approved by the Hanoi CDC to use data for research purposes; the information collected from research subjects is only used for research purposes and completely guaranteed for data confidentiality; the research only involves collecting and analyzing existing data without performing any invasive procedure on the research subjects nor affecting their health.

RESULTS

From January 1 to December 31, 2021, Hanoi CDC recorded a total of 59,772 confirmed COVID-19 cases in Hanoi. With the exclusion of 133 (0.2%) imported cases, there were 59,639 confirmed cases eligible for this study, including 409 deaths and 59,230 convalescents. The case fatality rate (CFR) is 0.68%.

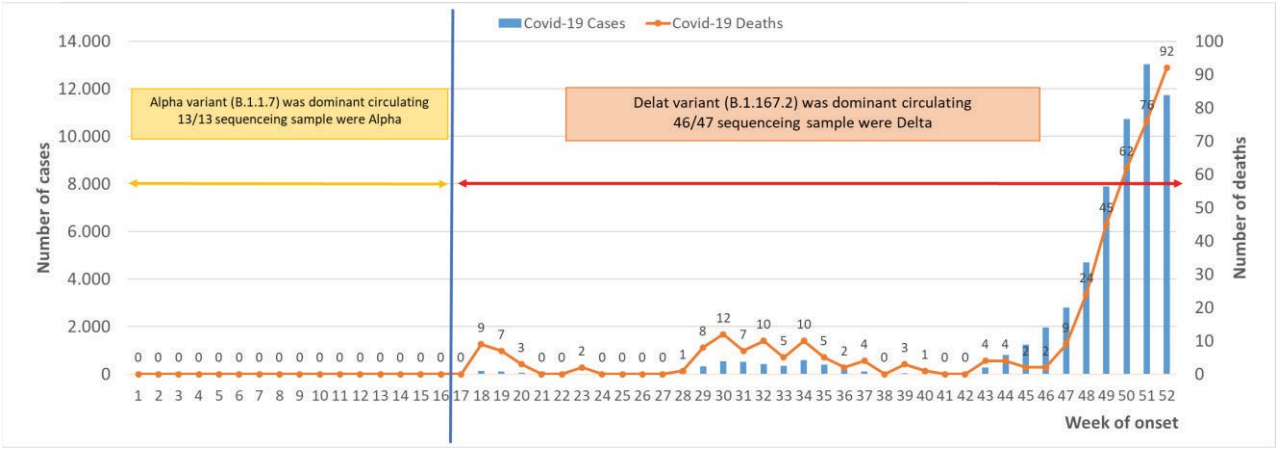

Figure 1. Weekly report on COVID-19 situation in Hanoi in 2021

In 2021, before the implementation of Government Resolution 128/NQ-CP on " Safety, flexibility, and effective control of COVID-19 epidemic", the COVID-19 situation in the city was essentially well-controlled with low numbers of cases and deaths. However, since October 12, 2021 (week 41) when Resolution 128/NQ-CP was implemented, there has been a significantly increasing trend in the number of cases and deaths (due to the gradual lifting of disease preventive measures, which created favorable conditions for traveling and disease transmission). The data on figure 1 showed that in December 2021, the weekly number of new cases fluctuated between 12,000 and 14,000 cases per week, and the number of deaths also increased to 92 cases per week by week 52. The deceased patients were only recorded during the fourth wave of the outbreak when the Delta variant of SARS-CoV-2 virus became dominant in circulation (genomic sequencing result indicated that 46 out of 47 tested samples were of the Delta variant). In comparison, no deaths were recorded in the previous wave of the outbreak which was associated with Alpha variant (100% sequencing samples were of the Alpha variant).

In 2021, only 2 out of 30 districts (Thanh Oai and My Duc) did not recorded any COVID-19 deaths while the remaining 28 districts had reported cases of death, mainly concentrated in urban areas which have higher population density. Specifically, the highest numbers of fatalities were reported in Dong Da (58 cases), Hai Ba Trung (54 cases), Ba Dinh (34 cases), Hoang Mai (31 cases), Long Bien (29 cases), and Hoan Kiem (27 cases). The analysis results indicate that most districts with higher incidence rates per 100.000 people also had higher numbers of deaths (Figure 2).

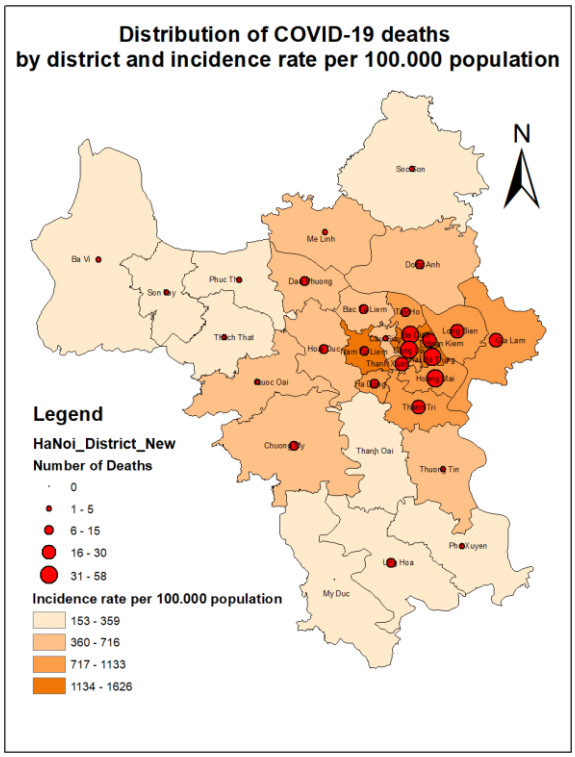

Figure 2: Distribution of COVID-19 deaths by district and incidence rate per 100.000 population.

Table 1. Eipdemiological characteristics of COVID-19 deaths in Hanoi in 2021 (n = 409)

STT	Characteristics	Number of deaths (n)	Proportion (%)
1	**Gender**		
	Male	196	47.92
	Female	213	52.08
2	**Age group, years**		
	< 60	33	8.07
	> = 60	376	91.93
3	**Living area**		
	Suburban area	127	31.05
	Urban area	282	68.95
4	**Diagnostic methods**		
	RT-PCR	318	77.75
	SARS-CoV-2 antigen rapid test	91	22.25
5	**Symptoms at time of diagnosis**		
	Yes	385	94.13
	No	24	5.87

Among the 409 deaths, the majority were females, accounting for 52%. The vast majority of deceased patients were aged 60 and above (91.93%), with those in the 80 - 89 age group representing the highest percentage at 36.67%. Approximately 69% of the deceased patients resided in urban area districts. Almost

all the dead patients were diagnosed with COVID-19 by real-time RT-PCR method (77.75%), the rest 22.25% were diagnosed using the antigen rapid test. Most of the deceased patients showed symptoms at the time of diagnosis (94.13%).

Table 2. Differences between time from onset to death and mean age by gender among deceased COVID-19 patients in Hanoi in 2021

Characteristics	Male (n = 196)	Female (n = 213)	Total (n = 409)	p*
Time from onset to death (days)				
Mean ± Standard deviation	15.3 ± 15.4	14.0 ± 11.3	14.6 ± 13.5	p = 0.708
Min-Max	0-105	1-64	0-105	
Median	11	11	11	
Interquartile Range (IQR)	7 - 18	6 - 18	7 - 18	
Age at time of death (years)				
Mean ± Standard deviation	74.6 ± 11.9	77.0 ± 12.9	75.9 ± 12.5	p = 0.015
Min-Max	36 - 99	22 - 103	22 - 103	
Median	76,5	80	79	
Interquartile Range (IQR)	66 - 84	69 - 86	67-85	

**MannWhitney test*

Among deceased COVID-19 patients, the mean time from onset to death was 14.6 days (ranging from 0 - 105 days, Median = 11 days, IQR = 7 - 18 days). In our study, we recorded 3 cases of unexplained deaths at home, which were later found positive for SARS-CoV-2 upon testing (with an onset-to-death time of 0 days). On the other hand, there were 37 cases with an onset-to-death time of over 30 days, including 7 cases with a time of over 60 days (1 case with a time of 89 days and 1 case with a time of 105 days); there was no statistically significant difference in the time from onset to death between genders (p = 0.708). The mean age of deceased patients was 75.9 years (ranging from 22 to 103 years, with a median age of 79 and IQR of 67 - 85 years); the median age of female patients was significant higher than that of male patients with p = 0.015

Table 3. Distribution of deceased patients in Hanoi in 2021 by gender, vaccination status and number of comorbidities

Characteristics	Male (n,%)	Female (n,%)	Total (n,%)	p*
Number of comorbidities	196 (100%)	213 (100%)	409 (100%)	
0	33 (16.84%)	45 (21.13%)	78 (19.07%)	0.541
1	64 (32.65%)	67 (31.46%)	131 (32.03%)	
≥ 2	99 (50.51%)	101 (47.42%)	200 (48.90%)	
Vaccination status	196 (100%)	213 (100%)	409 (100%)	
Unvaccinated	142 (72.45%)	172 (80.75%)	314 (76.77%)	0.02
1 dose	9 (4.59%)	14 (6.57%)	23 (5.62%)	
≥ 2 doses	45 (22.96%)	27 (12.68%)	72 (17.60%)	

**X2 test*

The proportion of deceased patients with at least one underlying health condition is 80.93%. There were only 19.07% of deceased patients who identified as healthy people. There was no statistical significance

between mortality rate by gender (p = 0.541). Among deceased patients, the unvaccinated accounted for nearly 77%, while only 5.62% and 17.60% of deceased patients had received one dose and at least two doses of the vaccine recommend by the Ministry of Health respectively. There is a statistically significant difference in vaccination rates between genders with p = 0.02.

Table 4. Distribution of deceased COVID-19 patients in Hanoi in 2021 by underlying medical conditons group (n = 409)

STT	Underlying medical condition group	Number of deaths (n)	Proportion (%)
1	Hypertension	223	54.52
2	Diabetes	120	29.34
3	Cerebrovascular diseases	79	19.32
4	Cardiovascular diseases	49	11.98
5	Chronic renal diseases	35	8.56
6	Malignancy	28	6.85
7	Neuropathy (including dementia)	21	5.13
8	Obesity	21	5.13
9	Chronic liver diseases	20	4.89
10	COPD and any lung diseases	16	3.91
11	using corticosteroids or immunosuppressant	15	3.67
12	Chronic hematological diseases	6	1.47
13	Asthma	5	1.22

Hypertension and diabetes were the two most prevalent underlying medical conditions among deceased COVID-19 patients, with proportions of 54.52% and 29.34% respectively. Next are cerebrovascular diseases (including stroke and other cerebrovascular diseases) and cardiovascular diseases (including heart failure, cardiac muscle diseases, and coronary artery diseases) with proportions of 19.32% and 11.98% respectively.

Other underlying medical conditions groups such as chronic renal diseases, carcinoma, neuropathy (including dementia), obesity, chronic liver diseases, chronic obstructive pulmonary diseases and other lung diseases, using of corticosteroids or immunosuppressive drugs, chronic hematological disease, and asthma each accounted for less than 10%.

DISCUSSIONS

About COVID-19 situation in Hanoi in 2021

In 2021, the COVID-19 situation in Hanoi was generally well-controlled before October 12, 2021. During the third wave from January 27 to April 26, 2021, Hanoi recorded only 35 local cases with no reported deaths. The virus strain in this period was the Alpha variant, as confirmed by all 13 tested sequencing samples collected from outbreak areas in the city. This result was consistent with the overall national and global context, as the Alpha variant had dominant circulation during this period. In addition, the third outbreak was also detected after a migrant worker from Hai Duong had tested positive for the Alpha variant upon arrival in Japan. The fact that no deaths were reported during this period was consistent with the relatively low number of cases recorded. The first deaths in Hanoi were only recorded after the fourth wave had started on April 27, 2021.

The fourth wave of the outbreak in Hanoi was first recorded at two major hospitals, namely the National Hospital for Tropical diseases (NHTD) in Kim Chung and Vietnam National Cancer Hospital in Tan Trieu (Hospital K Tan Trieu). At that time, many patients

with various underlying health conditions were being treated at these 2 hospitals, being contracted COVID-19 would increased their risk of mortality. This situation was similar to the second wave that had occurred in Da Nang, where the epicenter of the outbreak was in several hospitals such as Hospital C, Da Nang Hospital and Da Nang Orthopedics and Rehabilitation Hospital. Surveillance results had shown that the dominant circulating variant during this period was the Delta variant. This variant was assessed to be more virulent and able to spread 60% faster compared to the Alpha variant. It was also associated with increased disease severity and higher viral load. Therefore, after the implementation of Government Resolution 128/NQ-CP, the noticeable increase of COVID-19 patients' mortality was inevitable.

Regarding certain epidemiological characteristics

Most of deceased COVID-19 patients were aged 60 and above, accounting for 91.93% of cases. The average age at the time of death was 75.9 years, ranging from 22 to 103 years. The median age of females was higher than that of males, being 77 years and 74.6 years respectively, with $p < 0.05$. These findings aligned with other studies conducted worldwide as well as in Vietnam. A retrospective study conducted at the COVID-19 Intensive Care Unit in Ho Chi Minh City of Bach Mai Hospital in August 2021 revealed that the average age of deceased patients in this period was 64 years, with age group over 60 years accounting for 65.1%[2]. Another cross-sectional descriptive study conducted at a hospital in India from March 1st to May 17th, 2021 also showed an average age of 67.3 years among deceased COVID-19 patients[9]. Data analysis in the US and Italy with large sample size also showed that the average age of deceased COVID-19 patients in the US and Italy is 78 years and 80 years, respectively[3,4]. In the US, during the period from February 12th to May 18th, 2020, the percentage of patients aged 65 and above accounted for 79.6% of deceased COVID-19 patients[4].

The male-to-female ratio in our study was 1/1.1, which is consistent with the results of several cross-sectional studies in Vietnam. For example, a study conducted at Binh Duong Field Hospital-3 reported a ratio of 1 to 1.6[8], while the study at COVID-19 Intensive Care Unit in Ho Chi Minh showed a ratio of 1/2.3[2]. Nevertheless, many studies worldwide have indicated that the COVID-19 mortality rate among males is higher than that among females, with males having a higher risk of mortality compared to females[4,5,7,9]. This difference may be attributed to the fact that in Vietnam, as well as in Hanoi in 2021, the prevalence of disease was higher among females[10].

In our study, the majority of deceased COVID-19 patients were diagnosed using the real-time RT-PCR method (77.25%), and most of the them lived in the urban area (accounting for 68.95%). This result is consistent with the fact Hanoi was only authorized by the Ministry of Health to diagnose COVID-19 cases based on rapid test results as of December 13, 2021 according to Official Letter No.10526/ BYT-KCB dated December 12, 2023 (applicable nationwide from December 29, 2021). On the other hand, while the number of urban district was 12 out of 30, their population already made up 44% of the total population of the city, hence a higher population density in the urban areas compared to the suburban areas. Consequently, the incidence and mortality rates of COVID-19 were elevated in the urban areas.

Our study shows that the majority of deceased patients were unvaccinated (77%) and had at least one underlying medical condition (81%). These findings align with some studies, which have consistently shown a significantly higher risk of death among unvaccinated individuals with underlying medical conditions. A study conducted at the COVID-19 intensive care unit of Bach Mai Hospital in Ho Chi Minh City revealed that 61% of deceased patients were unvaccinated and 75% had at least one underlying medical condition.[2] Similarly, early-stage studies in India during the Delta variant outbreak also found that the majority of deaths occurred among unvaccinated group and those with comorbidities, with rates of 66% and 61%, respectively[9]. Large-scale data analysis in Italy and the United States has yielded similar results. In Italy, out of over 8,000 analyzed death cases, 97% had underlying health conditions[3], while in the analysis of over 10,000 death cases in the US,

this percentage was 76.4%[3]. These results suggests that having underlying health conditions and being unvaccinated are two risk factors related to severe illness and death of COVID-19 patients. Therefore, an urgent solution to minimize the mortality rate is to increase vaccine coverage and implement protective measures for high-risk individuals with underlying health conditions. In Hanoi, prior to the implementation of Government Resolution 128/NQ-CP, the city had taken advantage of the golden opportunity during the strict enactment of social distancing, lockdown, and rapid contact tracing to mitigate the transmission of the disease beyond the community and rapidly increase the coverage rate of COVID-19 vaccines. According to statistics from the Hanoi Center for Disease Control, as of October 11th, 2021, the entire city has administered approximately 7,5 million doses of vaccines to individuals over 18 years old (with a first dose vaccination rate of 85% and a second dose vaccination rate of 38%); as of December 31st, 2021, these rates had reached 99.9% and 95% respectively. As a result, Hanoi's mortality rate (0.68%) is much lower than the national average (1.9%) and that of some southern provinces such as Ho Chi Minh City, Binh Duong,...

The average time from onset to death in our study was 14.6 days (median: 11 days, IQR: 7-18 days), which is consistent with other studies. A study at Binh Duong Field Hospital-3 also showed that the average time from onset to death is 9 days (IQR: 8-18 days)[8]. Another study at the COVID-19 Intensive Care Unit of Bach Mai Hospital in Ho Chi Minh City in August 2021 yielded results with an average time of 16 days (ranging from 12-22 days)[2]. Data analysis in Italy also yielded similar results with an average time of 15 days[3]. Therefore, it's evident that most COVID-19 patients succumbed to the disease within 20 days from onset, and this period can vary greatly between different countries and healthcare facilities due to a variety of factors such as healthcare system's capacity, the expertise of healthcare professionals, treatment regimens, medical equipment availability, the patient's health condition. This shows us that efficient decentralization in treatment and adequate preparedness of medical equipment is essential to minimize the mortality rate. In this regard, the Ho Chi Minh City Department of Health proactively proposed to the Ministry of Health to allow home isolation and treatment for mild or asymptomatic COVID-19 patients from early August 2021 when the COVID-19 situation in Ho Chi Minh City had been escalating rapidly. This measure helped alleviate the overloading of hospitals during the tense period of the pandemic in Ho Chi Minh City. Hanoi also adopted a similar approach in the beginning of December 2021, as the Hanoi Department of Health had also provided clear guidelines for COVID-19 patients triage based on risk categories. The appropriate decentralization combined with a high vaccination coverage rate prevented the healthcare system in Hanoi from becoming overwhelmed, unlike the situations in Ho Chi Minh City and Binh Duong during the peak of the outbreak, thus significantly reducing the COVID-19 mortality rate in the city.

CONCLUSIONS

In 2021, Hanoi recorded 409 deaths, with female patients accounting for 52% (male/female ratio of 1/1.08). 92% of the deceased were over 60 years old (with an average age of 79 at the time of death, and statistically significant differences between genders); 69% of the deceased were identified in the urban area; the average time from onset to death was 14.6 days (with a median of 11 days); 77% of the deceased were unvaccinated and 81% had at least one underlying medical condition. Hypertension and diabetes were two most common underlying health conditions among deceased COVID-19 patients.

RECOMMENDATION

To minimize the mortality rate, in addition to preparing an adequate supply of medicines, chemicals, machinery, equipment, and hospital beds for treatment, it is crucial and necessary to implement proactive disease prevention measures such as vaccination and tiered treatment. High-risk groups such as individuals over 60 years old or those with underlying medical conditions should be prioritized for vaccination and immediate monitoring at healthcare facilities when diagnosed with the disease.

As for healthy individuals or asymptomatic patients, it is important to apply home isolation and treatment options to reduce the burden on hospitals.

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