Original Article

Changes in Inpatient Hospital Services During the COVID-19 Pandemic in Thailand: A Descriptive and Costing Study

Tuangrat Phodha PhD[1,2], Win Techakehakij PhD[3], Noppcha Singweratham PhD[4], Kednapa Thavorn PhD[5,6], Onwipa Rochanathimoke PhD[7,8], Thanawat Wongphan MD[9,10]

[1] Drug Information and Consumer Protection Center, Faculty of Pharmacy, Thammasat University, Rangsit Campus, Pathum Thani, Thailand; [2] Center of Excellence in Pharmacy Practice and Management Research, Faculty of Pharmacy, Thammasat University, Rangsit Campus, Pathum Thani, Thailand; [3] Department of Social Medicine, Lampang Hospital, Lampang, Thailand; [4] Faculty of Public Health, Chiang Mai University, Chiang Mai, Thailand; [5] School of Epidemiology and Public Health, University of Ottawa, Ottawa, Ontario, Canada; [6] Ottawa Hospital Research Institute, Ottawa, Ontario, Canada; [7] Faculty of Pharmacy, Mahidol University, Bangkok, Thailand; [8] Division of Pharmacology, Department of Premedical Sciences, Faculty of Medicine, Bangkok Thonburi University, Bangkok, Thailand; [9] International Health Policy Program (IHPP), Ministry of Public Health, Nonthaburi, Thailand; [10] Division of Health Economics and Health Security, Ministry of Public Health, Nonthaburi, Thailand

Background: The COVID-19 pandemic forced policy makers to find solutions to protect hospitals from revenue shortfalls and provide high quality of care for COVID-19 and other patients. In Thailand, hospitals have adjusted the hospital services arrangement to new normal hospital services to prevent the spread of coronavirus while maintaining essential hospital services for non-COVID-19 patients.

Objective: To describe the COVID-19 patient flow and estimate the costs of the new normal hospital services implemented in six public hospitals across Thailand.

Materials and Methods: The authors conducted a cross-sectional study to describe the COVID-19 patient flow in each participating hospital between January and November 2020, representing the first wave of the COVID-19 outbreak in Thailand. Data were collected from hospital staff interviews, hospital historical budget review, and hospital databases. The hospital costs of the new normal hospital services were estimated using an activity-based costing approach from the provider's perspective.

Results: The COVID-19 patients could access the new normal hospital services through three channels including 1) walk-in, 2) transfer from other hospitals, and 3) active surveillance from communities. The ratio of costs of the new normal hospital services during the COVID-19 outbreak and the normal situation were one to two times and one to five times for patients with mild infection admitted to secondary and tertiary care hospitals, respectively, but one to three times for those with moderate-to-severe infection admitted to tertiary care hospitals.

Conclusion: The COVID-19 pandemic imposed additional costs to Thai hospitals. The magnitude of the incremental costs depended on COVID-19 severity and hospital level.

Keywords: Cost; COVID-19; Hospital services; New normal; Thailand

Received 14 March 2022 | Revised 27 September 2022 | Accepted 11 October 2022

J Med Assoc Thai 2022;105(11):1075-83

Website: http://www.jmatonline.com

The World Health Organization Director General has declared the coronavirus disease (COVID-19) outbreak a Public Health Emergency of International Concern (PHEIC)[1] and a global pandemic[1]. Since the detection of the first Thai COVID-19 case on January 8, 2020[2], the number of new COVID-19 patients kept rising[2]. Thailand declared COVID-19 as a dangerous communicable disease under the Disease Control Act, B.E. 2558 in late February 2020, to intensify active surveillance and control the disease[3]. The Ministry of Public Health (MOPH) has also issued the safety guidance for patients and health personnel[2].

The new normal hospital services have arisen to ascertain the high infectious control standard in hospital departments during the COVID-19 outbreak, including the inpatient department (IPD), which is among the major functions of the hospitals. Measures

Correspondence to:

Phodha T.

Drug Information and Consumer Protection Center; and Center of Excellence in Pharmacy Practice and Management Research Unit, Faculty of Pharmacy, Thammasat University, Rangsit Campus, 99 Paholyothin Road, Khlong Nueng, Khlong Luang District, Pathum Thani 12120, Thailand.

Phone: +66-2-9869214-19 ext. 4407, **Fax**: +66-2-5643156

Email: tuangrat25@tu.ac.th

How to cite this article:

Phodha T, Techakehakij W, Singweratham N, Thavorn K, Rochanathimoke O, Wongphan T. Changes in Inpatient Hospital Services During the COVID-19 Pandemic in Thailand: A Descriptive and Costing Study. J Med Assoc Thai 2022;105:1075-83.

DOI: 10.35755/jmedassocthai.2022.11.13695

Table 1. Characteristics of participating hospitals

Level of hospital	Hospital	Province	Region	No. of bed
CentralCentral Hospital (A)	Sunpasitthiprasong Hospital	Ubon Ratchathani	North-east	1,188
CentralCentral Hospital (A)	Saraburi Hospital	Saraburi	Central	700
General Hospital (S)	Pattani Hospital	Pattani	South	504
General Hospital (M1)	Sena Hospital	Ayuthaya	Central	208
Community Hospital (M2)	Sansai Hospital	Chiang Mai	North	150
Community Hospital (F1)	Panomprai Hospital	Roi-et	North-east	30

A=Advance level (excellence center); S=Standard level/specialize level (tertiary care); M1=Middle level 1/expert level (tertiary care); M2=Middle-level 2 (secondary care with >120 beds); and F1=First level (secondary care with 60 to 120 beds)

introduced to enhance the quality of infectious control for IPD include the management of hospital service congestion as well as hospital facility. Results of such measure was reflected in a study that indicated that the COVID-19 pandemic reduced hospital admissions[4].

Owing to the massive investment and reduction in the number of inpatient services to meet the new normal requirement, the prospect of the increase in the total costs per inpatient care may be inevitable. The information about the cost of new normal hospital services for IPD is essential, particularly for the reimbursement purpose. Despite this, its financial impact in the Thai hospital setting has never been formally examined. The present study aimed to describe the flow of COVID-19 patients and estimate the costs of the new normal hospital services implemented in six public hospitals across Thailand.

Materials and Methods

Study design and data collections

The authors conducted a cross-sectional study utilizing a mixed method approach to understand the trajectory of hospital care and associated hospital costs of suspected and confirmed COVID-19 cases in six public hospitals in Thailand. The authors randomly selected a list of participating hospitals from three levels of hospital settings, central, general, and community hospitals, as demonstrated in Table 1. The authors interviewed hospital staffs, reviewed hospital historical budgets, and obtained retrospective utilization data from hospital databases between January and November 2020, representing the first wave of the COVID-19 outbreak in Thailand.

The authors tracked the patient flow since they arrived at each participating hospital until they were admitted to the isolation room for patient under investigation (PUI) cases and to the cohort ward or airborne infection isolation room (AIIR) for the confirmed COVID-19 cases. The new normal hospital services for IPD were defined as hospital reactions to prevent the spread of coronavirus for PUI or confirmed cases while maintaining essential hospital services and protecting the health of health care workers. A cost analysis of the new normal hospital services was done by using an activity-based costing[5,6] approach from the provider's perspective. The full hospital costs were composed of labor costs (LC), material costs (MC), and capital costs (CC). LC comprised of salary and other financial benefits of the hospital's staff. MC consisted of the costs of materials used to provide services. CC were the costs of buildings, construction, and equipment. Costs of the services provided were identified, measured, and valued in the present study and were retrieved from the Thai Case Mix Center[7].

Although the policy from the local administration may somehow affect the costs of services, the main costs were consistently driven by the national protocol for COVID-19 cases management endorsed by the Department of Medical Services, the Ministry of Public health, Thailand[8]. In response to the variability within the samples due to different local policies, the authors provided the upper and lower bounds of results in the present study, which represented the range of output.

The present study was reviewed and approved by the following Research Ethic Boards, 1) the Committee on Human Rights Related to Research Involving Human Subjects of the Institute for the Development of Human Research Protection (IHRP), No. 113-2563 and COA No. IHRP2020118, 2) the Committee on Human Rights Related to Research Involving Human Subjects of the Ethic Committee of Sunpasitthiprasong Hospital, No. 055/63 5 and COA No. 070/2563, and 3) the Committee on Human Rights Related to Research Involving Human Subjects of the Ethic Committee of Saraburi Hospital, No. SRBR63-050 and COA No. EC051/2563

Data analysis

The total costs of the hospital were categorized with respect to the cost centers. The accounting cost approach was employed to estimate LC, MC, and CC. Top-down costing method was used in the cost analysis, which consisted of four steps, as follows, 1) cost center identification, 2) direct cost determination, 3) indirect cost determination, and 4) total cost determination[7]. The authors estimated the costs under three scenarios, 1) full capacity of hospital preparation plan for COVID-19 patients, 2) actual services provided to COVID-19 patients during the study period, and 3) only one patient or none of COVID-19 patient admitted during the study period. The authors estimated the ratio of full hospital costs for those scenarios of new normal situation relative to the full cost for a normal situation, or the pre-COVID-19 pandemic period.

The unit cost of LC for scenario (1) and (2) were estimated as shown in equation (1) and (2), respectively.

Unit cost of scenario (1)
= LC/(number of preparation bed × 365 days) ---(1)

Unit cost of scenario (2)
= LC/(number of occupied bed × 365 days) ---(2)

The unit cost of MC for scenario (1) and (2) were estimated the same way as the unit cost of LC. The unit cost of CC was estimated for all three above mentioned scenarios and shown in equation (3), (4), and (5), respectively.

Unit cost of scenario (1)
= CC/(number of preparation bed × 365 days) ---(3)

Unit cost of scenario (2)
= CC/(number of occupied bed × 365 days) ---(4)

Unit cost of scenario (3)
= CC of full cost of the particular ward ---(5)

The costs of new normal hospital services were estimated regarding the confirmation of COVID-19, either PUI or confirmed COVID-19 cases, and the severity of illness as mild or moderate-to-severe, according to the differences of their health needs. The authors also performed subgroup analyses by the hospital level.

The authors inflated all cost data to the base year 2020 using consumer price indices (CPI)[9]. All costs were reported in US Dollar (1 USD=31.198 Baht as of April 2021)[10].

Assumptions for a costing study

1. Hospital costs were estimated based on the annual patient volumes from each hospital.

2. MC was estimated based on health services provided for patients in a normal situation but did not include special apparatus such as the PPE that were required during the COVID-19 pandemic.

Table 2. Number of PUI cases and confirmed COVID-19 cases who were added to the participating hospitals

Hospital	Total PUI	Total COVID-19	Total cases
Sunpasitthiprasong Hospital	64	4	68
Saraburi Hospital	103	5	108
Pattani Hospital	71	18	89
Sena Hospital	32	0	32
Sansai Hospital	104	3	107
Panomprai Hoapital	8	0	8
Total	382	30	412

PUI=patient under investigation

Results

New normal hospital services

The present study showed that a suspected or confirmed COVID-19 case could access care at hospitals through three channels, including 1) walk-in, such as screening at Outpatient Department (OPD), Emergency Room (ER), Labor Room (LR) or Delivery Room, 2) transfer from other hospitals, and 3) transfer from active surveillance from communities. Table 2 reported the number of PUI and confirmed COVID-19 cases admitted to the six participating hospitals between January and November 2020. The total number of PUI and confirmed COVID-19 patients were 382 and 30 cases, respectively. The number of PUI cases admitted was the highest at the Sansai Hospital, although these cases included Thai and non-Thai patients, such as Chinese and Burmese. Sansai Hospital is a community hospital level (M2) but at that time, it was assigned to be a temporary facility to accommodate a potential surge of COVID-19 patients, which was also known as a field hospital, from the general Nakornping Hospital, in Chiang Mai Province. Despite being a community hospital, Sansai Hospital has the capacity to perform the RT-PCR tests to detect genetic material of coronavirus. There was no confirmed COVID-19 case at Sena Hospital and Panomprai Hospital during the study period.

Characteristics of the new normal hospital services varied by the level of participating hospitals. The Hospital's capacity and network is reported in Table 3. There were four tertiary care hospitals that operated as a principal care facility, one secondary care hospital level M2 was assigned as a field hospital, and one secondary care hospital level F1 was used as

Table 3. Hospital's capacity and network

Hospital	Type of patient						Service network		
	PUI			COVID-19			FH	SQ	CH
	Mild	Moderate	Severe	Mild	Moderate	Severe			
Sunpasitthiprasong Hospital	✓	✓	✓	✓	✓	✓	✓	✓	
Saraburi Hospital	✓	✓	✓	✓	✓	✓			✓
Pattani Hospital	✓	✓	✓	✓	✓	✓	✓	✓	
Sena Hospital	✓	✓	✓	✓	✓	✓			
Sansai Hospital	✓	Refer	Refer	✓	Refer	Refer			
Panomprai Hoapital	✓	Refer	Refer	✓	Refer	Refer			

PUI=patient under investigation; FH=field hospital; SQ=state quarantine; CH=community hospital

Table 4. New normal hospital services arrangement in participating hospitals

Hospital	Service area	Room type				Services in normal situation	Services during outbreak	Note
		General	V.I.P.	Negative pressure	Modified AIIR			
Sunpasitthiprasong Hospital	5th floor social security ward, Prata-Prawor Building		14	2			PUI/COVID	
	Field Hospital					New building	PUI/COVID	
Saraburi Hospital	5th floor ICU infectious disease		6	3			PUI/COVID	
	4th floor ICU infectious disease				12		PUI/COVID	
	3rd floor V.I.P. social security ward		12				PUI/COVID	
	2nd floor V.I.P. ward		12				Closed	Buffer area
	1st floor Cancer center						Chemotherapy	
Pattani Hospital	4th floor		5	2			PUI/COVID	
	3rd floor		7				PUI/COVID	
	2nd floor		7				PUI/COVID	
	1st floor		7				Rest area for healthcare workers	
	Field hospital					Provincial office building	COVID	
Sena Hospital	Internal Medicine ward for male	24	4			Closed	PUI/COVID	
	ICU		12	2			PUI/COVID	
Sansai Hospital	1st floor of the old building	28	6			Closed	PUI/COVID	
	2nd floor of the new building		12				PUI/COVID	
	5th floor of the new building		12				PUI/COVID	
Panomprai Hoapital	General V.I.P. ward		6				PUI	Plastic separation
	2 beds in general ward		1				COVID	Plastic separation

AIIR=airborne infection isolation room; ICU=intensive care unit; PUI=patient under investigation

a service point. According to the new normal hospital services arrangement, Sena Hospital and Panomprai Hospital modified their V.I.P. ward to be isolated rooms for both PUI and confirmed COVID-19 cases. Only Saraburi Hospital had an isolated ward for infected patients and closed the whole floor to keep a distance between an infectious ward and a cancer ward to provide essential services for cancer patients during the outbreak. Sansai Hospital modified its old hospital building for the admission of PUI and confirmed COVID-19 cases. Sunpasitthiprasong Hospital used the new building for pediatric-patient to place together a cohort of COVID-19 patients. Sunpasitthiprasong and Pattani hospitals served as quarantine accommodations for arriving international visitors due to proximity to the border. Table 4 shows the new normal hospital services arrangement in each hospital.

Costs of new normal hospital services

The estimated unit costs of the new normal hospital services among six Thai hospitals are shown in Table 5. The unit costs ranged from 0.35 to 585.97 and 4.04 to 578.72 USD for treatment of a PUI case

Table 5. Unit costs of new normal hospital services, in an inpatient department (USD/bed/year)*

Hospital	Unit costs in USD								
	PUI			COVID-19					
				Mild			Moderate-to-severe		
	No case	Actual	Full capacity	No case	Actual	Full capacity	No case	Actual	Full capacity
Tertiary care hospitals									
Sunpasitthiprasong Hospital (A)	88.08	73.49	366.88	88.08	73.49	366.88	89.30	379.38	1,517.11
Saraburi Hospital (A)	166.26	132.89	194.33	166.26	360.53	1767.03	166.26	981.72	1,767.03
Pattani Hospital (S)	0.35	585.96	585.96	0.35	585.96	585.96	0.35	423.90	659.40
Sena Hospital (M1)	168.24	147.34	294.31	168.24	147.15	294.31	105.96	254.15	507.82
Secondary care hospitals									
Sansai Hospital (M2)	297.99	193.08	578.72	297.99	193.08	578.72	N/A	N/A	N/A
Panomprai Hospital (F1)	0.19	4.03	11.987	4.29	4.29	145.52	N/A	N/A	N/A

PUI=patient under investigation

* 1 USD=31.198 Baht as of April 2021

or a moderate-to-severe confirmed COVID-19 case at tertiary care hospitals and secondary care hospitals, respectively. Moreover, the unit costs ranged from 73.49 to 1,767.03 and 4.29 to 578.72 USD for treatment of a mild confirmed COVID-19 case at tertiary care hospitals and secondary care hospitals, respectively.

Figure 1 demonstrates unit costs for three patient groups by the hospital levels. The estimated unit costs were dependent on the variable costs (MC) and the semi-variable costs (LC).

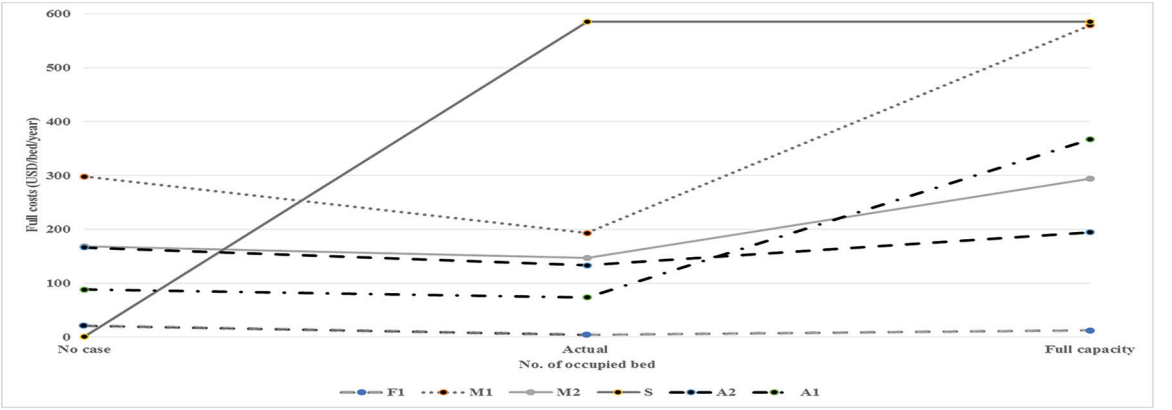
Figure 2 illustrates the results from the sensitivity analysis of the proportion of total costs for the three scenarios. The proportion of total costs of the first scenario, which was the hospital preparation plan, to normal situation were 100% to 516.53%, 134.46% to 516.53%, and 79.43% to 275.24% for PUI, mild confirmed COVID-19, and moderate-to-severe confirmed COVID-19, respectively. The proportion of total costs of the second scenario, which was the actual services provided, to normal situation were 118.62% to 516.53%, 83.90% to 198%, and 73.12% to 270.54% for PUI, mild confirmed COVID-19, and moderate-to-severe confirmed COVID-19, respectively. The proportion of the total costs in the third scenario, which was with no or only one case, to normal situation were 0.08% to 100%, and 2.86% to 86.14% for tertiary care hospital and secondary care hospital, respectively.

Discussion

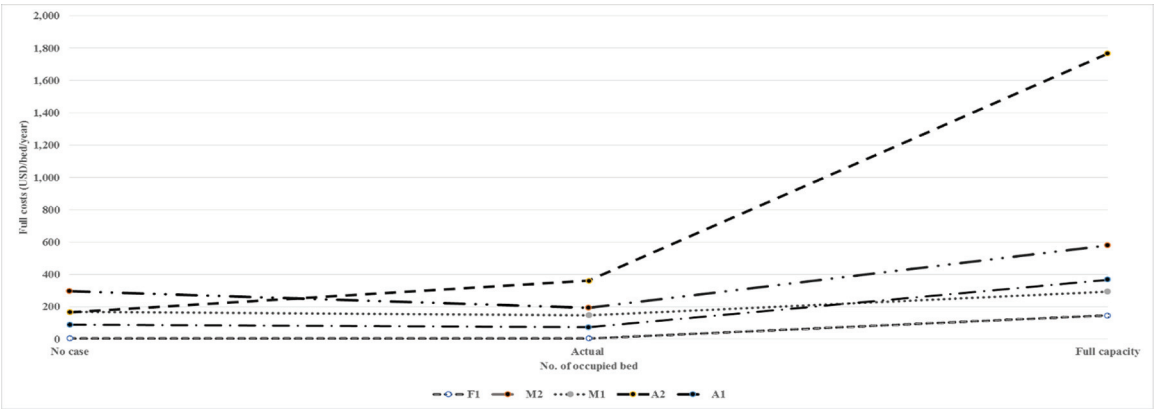
The COVID-19 pandemic drives increasing needs for health services. The new normal hospital services are the measures that hospitals in several countries have implemented to contain the spread of the coronavirus while maintaining hospital service functions.

To the authors' knowledge, this is the first preliminary study that described the care pattern and the hospital costs of providing the new normal hospital services to COVID-19 patients who required acute care in Thailand. The present study highlighted that those hospitals must renovate the general wards to accommodate PUI and confirmed COVID-19 cases. The hospital strategy to allocate buildings and utilized space for PUI and COVID-19 cases has become essential to determine the hospital costs. Moreover, the deployment of medical personnel for possible COVID-19 cases also considerably affects the hospital costs. This is as the shift pay would consequently increase when the hospital administrators decide to provide on-call staff for all departments ready for cases. In addition, the number of PUI or confirmed COVID-19 cases admitted to the hospital is another key driver of the hospital costs. These findings are consistent with that reported in the national[11] and international studies[12-15]. Another issue worth mentioning is concerning the demands for hospital beds and needs for isolation to prevent and control disease spreading were rapidly increasing during the COVID-19 outbreak or the surge capacity.

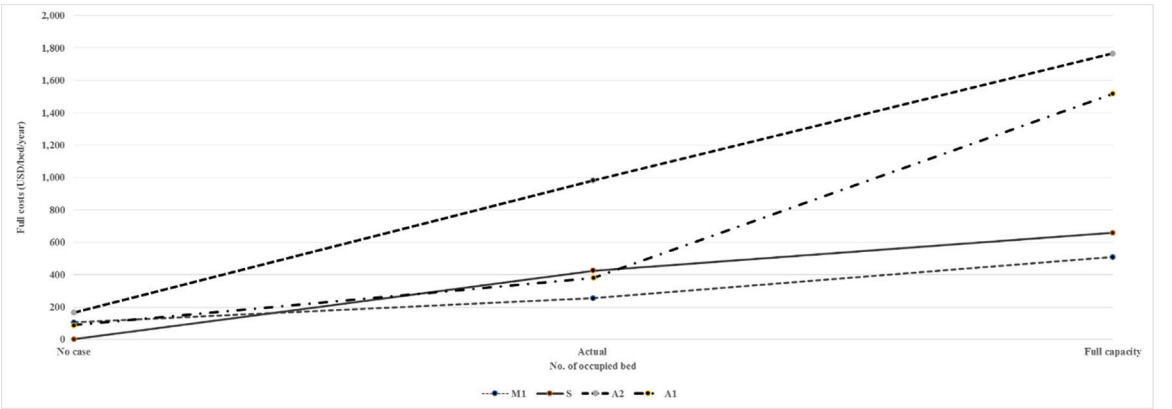
Three scenarios varied in the present study sensitivity analysis. There was only CC for the third scenario since the hospital preserved the area for providing the new normal hospital services. The variation of total unit costs among six hospitals were explained by the size and useful life of the building. It was 0.35 USD for Pattani Hospital since they used only the fourth floor of the building, and the building



PUI case



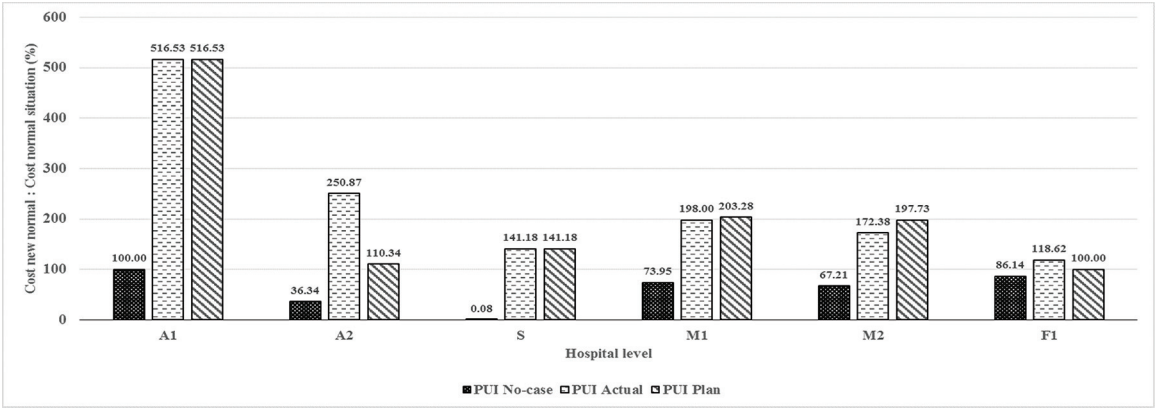
Mild confirmed COVID-19 case



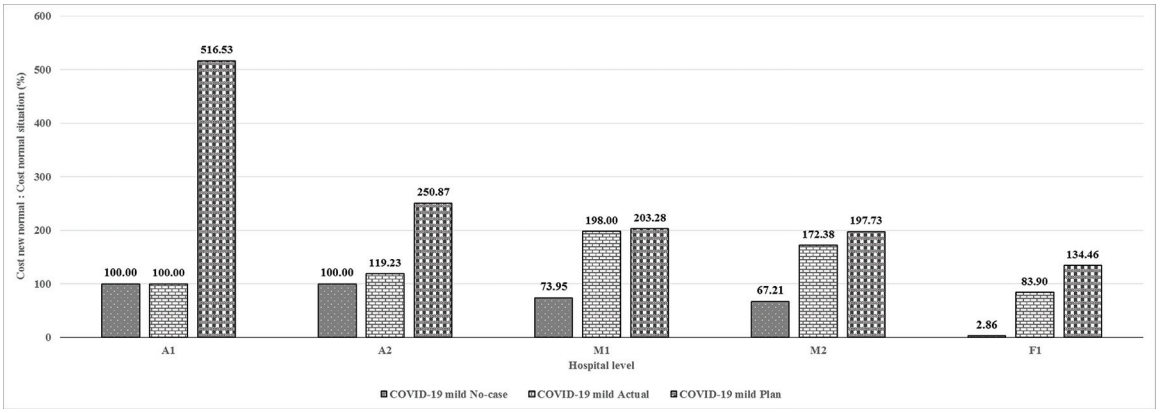
Moderate-to-severe confirmed COVID-19 case

Figure 1. Characteristics of total unit costs for 3 patient groups (1 USD=31.198 Baht as of April 2021).

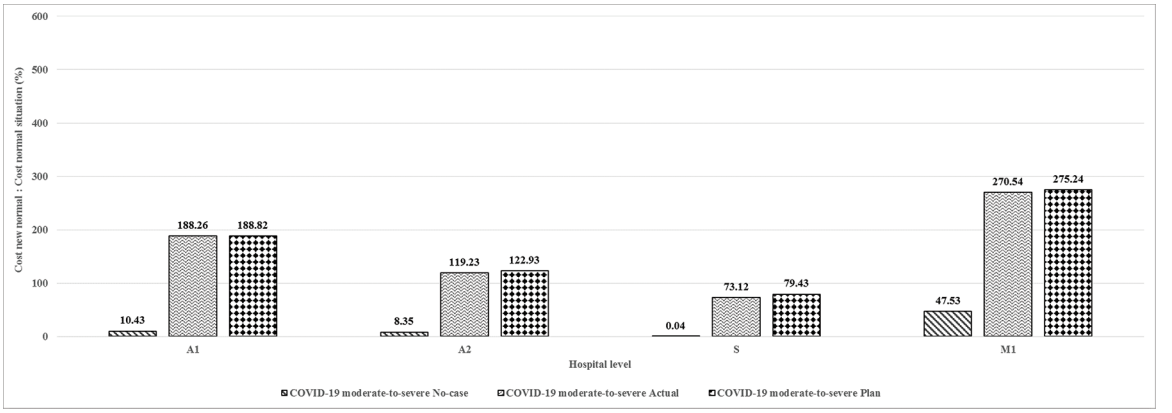
was old. The estimated unit cost was the highest for Sena Hospital because it used the newer building and reduced the number of beds from 14 to 2 beds to keep the distance between patients. In addition, the patients in ICU ward were moved to the other general ward to preserve the area for PUI or confirmed COVID-19 cases. The present study findings are consistent with the findings from Edejer et al who reported that costs of case management were the highest proportion at 18.59% to 54.1%, followed by costs of maintaining essential services at 7.39% to 22.4%, and costs of investigation, surveillance, and rapid response at 6.7% to 18.3%[16]. Based on the other two scenarios, the total unit costs were driven by the number of patients admitted to the hospital. The ratio between cost of the new normal hospital services during outbreak



PUI case



Mild confirmed COVID-19 case



Moderate-to-severe confirmed COVID-19 case

Figure 2. Proportion of total costs for 3 scenarios.

situation and normal situation were one to five times and one to two times for PUI or mild confirmed COVID-19 case admitted to tertiary care hospital and secondary care hospital, respectively. However, the ratio would be one to three times if the new normal hospital services provided for PUI or moderate-to-severe confirmed COVID-19 case admitted to tertiary care hospital.

Limitation

Results from the present study should be interpreted with cautions due to the following limitations. First, the hospital unit costs reported in the present study may be underestimated as the authors did not include all CC, MC, and LC. For CC, cost of installment of durable articles for air changing control and communication with patients such as

intercom phone were not included. The authors were unable to allocate these costs to the pandemic due to limited details of when this equipment was purchased. For MC, high-cost materials such as high price medicines and PPE, were not included in the present study because there was no patient admitted at the participating hospitals at the time of the study. In addition, some materials were provided as in-kind contributions from other organizations, this limited the ability to estimate their costs. For LC, costs of health professional training, surge capacity of the workforce for running the new normal works but not impact the normal work, and other special compensation such as risk allowance, were not included in the present study, because the authors could not retrieve the detail of the labor cost for running these activities. Second, the present study was based on a small sample of six public hospitals in Thailand. The study results might not be generalizable to other settings. However, the present study provided detailed descriptions of services and associated costs, which can be used to inform future pandemic responses. Future prospective studies are needed to assess whether the costs of the new normal services are dependent on hospital location and patient characteristics.

Conclusion

The new normal hospital services implemented to respond to the COVID-19 outbreak imposed additional costs to public hospitals in Thailand. Based on these studied scenarios, the costs to operate the new normal hospital services depended on the severity of COVID-19 and the level of hospitals. Findings from the present study can be used to inform the decisions makers regarding the financial impact of implementing new normal services in other hospitals. Furthermore, the results from this study could help the insurance reconsider the value of the existing hospital services for suspected or confirmed COVID-19 cases for reimbursement.

What is already known on this topic?

Owing to the massive investment and reduction in the number of inpatient services to meet the new normal requirement, the prospect of the increase in the total costs per inpatient care may be inevitable.

The information about the cost of the new normal hospital services for IPD is essential, particularly for the reimbursement purpose.

What this study adds?

The hospital service changed following the public health measures during the COVID-19 pandemic, which were called the new normal hospital services.

The COVID-19 pandemic imposed additional costs to Thai hospitals. The magnitude of the added costs depended on COVID-19 severity and hospital type.

The results from this study could help the insurance reconsider the value of the existing hospital services for suspected or confirmed COVID-19 cases for reimbursement.

Acknowledgement

The authors gratefully thank to the Division of Health Economics and Health Security, Ministry of Public Health, Thailand for supporting and facilitating the study. The authors would like to express their appreciation to Adjunct Professor Dr. Thaworn Sakunphanit, advisor of Ministry of Public Health, for his valuable advice to perform the present study. Furthermore, the authors thank all healthcare personnel of those six hospitals for their times and hard work on data collection and the Thai Case Mix Center (TMC) for providing the full cost data of four hospitals.

Authors' contributions

All authors contributed to the study conception and design. Material preparation, data collection, and analysis were performed by TP, WT, NS, KT, OR, and TW. The first draft of the manuscript was written by TP and all authors commented on every version of the manuscript. All authors read and approved the final manuscript.

Funding disclosure

Funding was provided by the Division of Health Economics and Health Security, Ministry of Public Health, Thailand (0210.04/99).

Conflicts of interest

The funding source had no role in the present study. The views expressed in the present manuscript are those of the authors and are not endorsed by the funding source. None of the funding source, professional and personal relationships influenced the conduct, analysis, and writing of this work.

References

1. World Health Organization. COVID 19 Public Health Emergency of International Concern (PHEIC). Global research and innovation forum: towards a research roadmap [Internet]. 2020 [cited 2021 May 10].

Available from: https://www.who.int/publications/m/item/covid-19-public-health-emergency-of-international-concern-(pheic)-global-research-and-innovation-forum.
2. Ministry of Public Health, Thailand. Thailand's experience in the COVID-19 response. Nonthaburi: Department of Disease Control, Ministry of Public Health, Thailand; 2020.
3. Office of the Council of State, Ministry of Public Health, Thailand. Notification of the Ministry of Public Health Re: Designation and main symptoms of dangerous communicable diseases (Issue 3). Royal Thai Government Gazette 2020 February 29. Volume 137, Special Section 48. p. 1-2.
4. Birkmeyer JD, Barnato A, Birkmeyer N, Bessler R, Skinner J. The impact of the COVID-19 pandemic on hospital admissions in The United States. Health Aff (Millwood) 2020;39:2010-7.
5. Drummond MF, Sculpher MJ, Torrance GW, O'Brien BJ, Stoddart GL. Methods for the economic evaluation of health care programmes. Oxford: Oxford University Press; 2015.
6. Riewpaiboon A. Cost analysis in health systems development. Bangkok, Thailand: Saksopakarnpim; 2018.
7. Thai CaseMix Center. Unit cost per disease analysis phase 1 Year 2. Bangkok: Health System Research Institute; 2019.
8. Department of Medical Services, Ministry of Public Health Thailand. The national protocol for managing COVID-19 cases [Internet]. Nonthaburi: Department of Medical Services; 2020 [cited 2020 Aug 20]. Available from: https://covid19.dms.go.th/.
9. Bureau of Trade and Economic Indices, Ministry of Commerce. Report for consumer price index of Thailand [Internet]. 2020 [cited 2020 Aug 20]. Available from: http://www.price.moc.go.th/price/cpi/index_new_all.asp.
10. Bank of Thailand. Foreign exchange rates [Internet]. 2021 [cited 2021 Apr 30]. Available from: https://www.bot.or.th/English/Statistics/FinancialMarkets/ExchangeRate/_layouts/Application/ExchangeRate/ExchangeRate.aspx.
11. Sriratanaban J, Witvorapong N, Woratanarat T, Ngamkiatphaisan S, Wimuttichai V, O-charot L, et al. The preparedness and responses of the health services system to the COVID-19 crisis in Thailand: Hospital operation and economic and social impacts within the boundary of the health services system. Nonthaburi: Health System Research Institute; 2021.
12. Zhang Y, Sun Z, Latour JM, Hu B, Qian J. Hospital response to the COVID-19 outbreak: The experience in Shanghai, China. J Adv Nurs 2020;76:1483-5.
13. Khalil M, Mataria A, Ravaghi H. Building resilient hospitals in the Eastern Mediterranean Region: lessons from the COVID-19 pandemic. BMJ Glob Health 2022;7(Suppl 3):e008754.
14. Stennett J, Hou R, Traverson L, Ridde V, Zinszer K, Chabrol F. Lessons learned from the resilience of Chinese hospitals to the COVID-19 pandemic: scoping review. JMIRx Med 2022;3:e31272.
15. Marmo R, Pascale F, Diana L, Sicignano E, Polverino F. Lessons learnt for enhancing hospital resilience to pandemics: A qualitative analysis from Italy. Int J Disaster Risk Reduct 2022;81:103265.
16. Tan-Torres Edejer T, Hanssen O, Mirelman A, Verboom P, Lolong G, Watson OJ, et al. Projected health-care resource needs for an effective response to COVID-19 in 73 low-income and middle-income countries: a modelling study. Lancet Glob Health 2020;8:e1372-9.