



## Assessing the opportunity costs of Covid-19 patients in hospitals

### Running title: The opportunity cost of Covid-19 patients

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#### Abstract

**Background and objective:** The utilization of hospital beds were changed during coronavirus pandemic. A number of beds were blocked and non-Covid-19 patients have to be rejected. It led to revenue foregone and opportunity costs for hospitals as well. Assessing the opportunity cost of admitting Covid-19 patients in the first-wave peak from the hospital perspective to help policymakers for decision making or managing the budget impact was the aim of the present study.

**Method:** It was a cross-sectional study. The net benefit of admitting non- Covid-19 patients in comparison with Covid-19 patients was considered as opportunity costs of hospitals decision in the first-wave peak of the Covid-19 crisis (March to July 2020). So, a financial analysis was performed. A number of three Iranian hospitals based on convenience sampling were included.

**Results:** Admitting Covid-19 patients had US\$ 57 benefits for selected hospitals while non-Covid-19 patients had US\$ 69 loss for them, on average. Overall, the benefit of Covid-19 cases was higher than non-Covid-19 in the profitable hospitals, and the Covid-19 patients' losses were less than those of non-Covid-19 patients in loss-making hospitals.

**Conclusion:** Admitting the Covid-19 patients did not have the opportunity costs for hospitals. Responding to the stochastic demand is recommended to hospitals in crisis.

**Key words:** Covid-19, Hospital, Opportunity Cost, Stochastic Demand

#### Background and objective

Opportunity costs are one of the economic concepts that were neglected, especially in the health sectors that the reason was attributed to the non-commercial view of the health services because of humanity. It is considered that health should be made available regardless of costs for all people<sup>1,2</sup>, while the health sector providers, especially hospitals are faced with resource limitations and have to cover therapeutic mission and financial goals parallel<sup>3</sup>. Considering opportunity costs help a hospital manager to focus on both of them and have the best decision for service portfolio. It is important in economic evaluation analysis to define the optimal decisions because of resource scarcity. Different definitions of opportunity cost have been proposed. Considering the best alternative regarding the low costs and high revenues, “the value of the next best alternative” forgone or given up were considered as opportunity costs<sup>4-6</sup>. The concept has been applied in hospitals to identify the best combination of services<sup>7</sup>.

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It helps to pharmaceuticals decisions, determine the number of patients based on the diagnosis-related group (DRG), or decision on hygiene schemes<sup>8</sup>. It was more pronounced in hospitals during the Covid-19 crisis because of the high costs of Covid-19 patients especially in the first-wave peak<sup>9,10</sup>. Covid-19 has spread across the world in 2019 that was first reported in Wuhan, China, and causing many problems, both clinically and economically<sup>11-13</sup>.

Admitting the Covid-19 cases led to high costs for hospitals because of trials<sup>14-16</sup> and non-admission of other patients because of the high transmissibility of the Covid-19 virus and occupancy of beds as the secondary outcome which led to a reduction of hospital revenues<sup>17</sup>. So, it is expected that admitting Covid-19 cases had opportunity costs for the hospitals. It was estimated that without an increase in reimbursement premiums for services provided to Covid-19 patients, given the worst-case scenario, about 97 percent of health care system revenue (= \$ 2,800 per patient) would be lost. A loss of \$ 1 million per day due to the admission of Covid-19 patients was estimated for hospitals, to which governments must support them<sup>18</sup>. The average treatment costs for Covid-19 patients were about US\$20 in the US and it was more than the treatment of other patients<sup>19</sup>. It was 2094 Yuan per patient in China and US\$3755 in Iran<sup>20,21</sup>. Although the treatment costs of Covid-19, the revenue and net benefit of them assessing the opportunity costs as well as make decisions for hospital managers is unclear. The aim of the present study was to assess the opportunity cost of admitting Covid-19 patients with a focus on their costs and revenues to Iranian hospitals. The results can help policymakers and hospital managers for decision making and opt for the best strategy for presenting the hospital's services, especially in health shocks.

## Methods

### Study design

It was a cross-sectional study conducted in three general hospitals in Iran. We used the convenience sampling method. The selected hospitals admitted the Covid-19 patients during the study period (March 2020 to July 2020), voluntarily.

Although the approaches for estimating the opportunity costs were different. Some pointed out the costs and some just focused on revenues<sup>6</sup>, the present study was considered a comprehensive one and assessed both of costs and revenues of admitting inpatients cases for hospitals. So, a financial analysis was performed.

Costs were estimated by hospital perspective. So, for estimating the costs, the direct medical costs of Covid-19 cases as well as non-Covid-19 cases and overhead costs of hospitals were considered. All of cases that admitted in March to July 2020 in the selected hospitals were considered.

To calculating the revenues, out of pocket of patients and all of payments by insurance companies for all of hospital cares and services to Covid-19 and non-Covid-19 patients in the study period were considered.

The net benefit of admitting per Covid-19 patients and other patients, and opportunity costs of hospitals were the main output of the present study.

### Data collection

The data on direct medical costs of Covid-19 and non-Covid-19 cases were extracted from the information health system of the selected hospitals and the data on overhead costs as well as revenues were extracted by reviewing accounting documents.

## Data analysis

A number of five phases were defined as follows:

- 1- We focused on opportunity costs of beds and considered two options for hospitals by expert panels as follows:
  - Admitting Covid-19 cases
  - Admitting other cases (non-Covid-19 cases)
- 2- For the second step, the hospital resources that were used for patients as direct medical costs were identified.
  - The medical expenditures for procedures and services, such as physician visits, medicines, hospital stays, consumables, supplies, imaging services, and diagnostic tests were included direct medical costs.
  - Costs of masks, shields, alcohol and disinfectant liquids, energy, building depreciation costs, repair and purchase of equipment costs, and payments to non-clinical staff were considered as overhead costs for hospitals that adjusted by the bed-day of cases in the study period.
- 3- Out of pocket of patients and all of payments by insurance companies were estimated as the revenues.
- 4- Finally, the net benefit of Covid-19 patients, as well as non-Covid-19 patients, was estimated by the difference of the costs from the revenues. The costs and revenues were estimated as per patient.

$$\pi_k = TR_k - TC_k$$

$\pi$  is the net benefit of patients, TR is total revenues, and TC is the total costs. K is regarding the Covid-19 and other patients as well.

To assessing the opportunity costs for hospitals the net benefit per Covid-19 patients and other patients was compared.

$$|OC| = \pi_i - \pi_j$$

OC is the opportunity costs,  $\pi_i$  is the net benefit of admitting a Covid-19 patient, and  $\pi_j$  is the net benefit of admitting a non-Covid-19 patient for selected hospitals. The admitting Covid-19 patients led to opportunity costs for hospitals if their net benefit was less than other patients.

Data were analyzed from March to July 2020, during the first-wave peak of Covid-19 in Iran. The analyses were performed by Excel 2007 software. All costs, revenues, and benefits were converted into US dollars using the 2020 mean exchange rate (the US \$1= 202021 IRR)<sup>22</sup>.

## Ethical considerations

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## Results

The three hospitals were included in the study, namely B, R, and G. The B and G were general hospitals and R was an educational one. The selected hospitals admitted the Covid-19 cases voluntarily during the period of study. Overall, they admitted both Covid-19 and non-Covid-19 patients in the coronaviruses crisis and allocated separate wards for Covid-19 patients.

Hospital B, R, and G were admitted 1312, 390, and 225 Covid-19 cases in the study period, respectively. The number of non Covid-19 cases were 1025, 3494, and 233 cases for hospital B, R, and G, respectively.

Reviewing the financial documents of the hospitals showed that, the hospitals R and G

were profitable, while the hospital B faced financial losses in the period of study.

Assessing the costs, revenues, and net benefit of the Covid-19 and the other patients showed that the average net benefit per Covid-19 patient was US\$57 while admitting the other patients led to a loss of about US\$ 69 per patient.

The net benefit of patients was estimated monthly (March to July 2020) that is presented in Table 1. The hospital B faced with the loss of admitting the patients. The average loss of admitting Covid-19 cases was US\$ 144 that was less than the loss of other patients. In May 2020 the Covid-19 patients were profitable for hospital B. The

Covid-19 patients had more revenue for the hospital in the study period.

The costs per Covid-19 patient and non-Covid-19 patients were more than US\$ 500 and the costs were closed together while the Covid-19 cases' revenues were more than non-Covid-19 cases, except in April. On average, admitting the Covid-19 cases had a US\$ 56 gain while the other patients lost about US\$ 70 per patient. So, hospitals could gain US\$ 56 per patient by admitting Covid-19 cases that refused it by admitting the other patients in coronavirus crisis. They could have services just to Covid-19 patients and convert to dirty hospital and would cover the hospital costs as well.

**Table 1:** Net benefit (US\$) of Covid-19 patients and other patients, monthly

		per Covid-19 patient (US \$)			per non-Covid-19 patient (US \$)		
		Costs	Revenues	Loss/benefits	Costs	Revenues	Loss/benefits
B	March	524	251	-272	530	53	-477
	April	408	221	-187	285	168	-117
	<b>May</b>	454	588	134	272	107	-165
	June	739	435	-304	252	175	-77
	July	471	380	-91	223	179	-44
	Average	519	375	-144	312	136	-176
R	March	666	627	-38	1,205	267	-938
	April	372	324	-48	710	530	-180
	<b>May</b>	716	887	172	506	637	131
	June	681	685	4	238	399	161
	July	505	603	98	303	628	325
	Average	568	625	56	592	492	-100
G	March	134	352	218	234	159	-75
	April	113	483	370	277	206	-71
	May	247	464	217	109	261	152
	June	118	484	366	79	257	178
	July	143	367	224	61	220	159
	Average	151	430	279	152	221	69
Average of the hospitals		419	477	57	352	283	-69

**Table 2:** descriptive statistic of the selected hospitals

	Number of covid-19 patients	Number of bed-days	Number of beds	Average occupancy rate before coronavirus crisis	Average occupancy rate after coronavirus crisis
B	1312	6135	201	57%	42%
G	390	3320	392	49.7%	39.08%
R	225	2311	168	67%	36%

## Discussion

In the present study, the opportunity cost of admitting the Covid-19 patients to Iranian hospitals was estimated. The financial analysis was performed and all of the resources, as well as revenues of Covid-19 and non-Covid-19 cases, were estimated and compared. Based on the results, the net benefit of admitting Covid-19 cases were more than the others for profitable hospitals and the loss of admitting them was less than the other patients for loss hospitals. So, hospitals could gain by admitting more cases of Covid-19 patients, although the hospitals should decision making on their goals. If minimization of the costs or maximizing the benefits would be a hospital's goals, the decision may be different. Based on the present study the Covid-19 patients had more medical costs compare with other cases that were attributed to the lots of trials for identifying the best treatment strategies because of unknowing the virus, especially in the first wave peak. Because of the high treatment costs of the patients, admitting the Covid-19 patients were not recommended for the hospitals by cost minimum strategy while it was the best option for hospitals by maximization the net benefit.

To our knowledge, it is the first study that addressed the opportunity costs of Covid-19 patients as an example of a crisis and health shocks, although a number of studies addressed the concepts in the health care

system<sup>3,23-28</sup> and a study was assessed the opportunity cost of COVID-19 pandemic from the health economics perspective and used supply and demand model of hospital ICUs bed days. Based on the results, because of excess hospital ICU bed demand opportunity costs were generated for non-Covid-19 cases<sup>29</sup>. The results were in contrast to ours and the difference was attributed to the study perspective. The Covid-19 viruses were a shocked and stochastic demand in the health care system that had different effects on hospitals, patients, and insurance systems. Because of resource scarcity, although a number of hospitals increased their beds especially ICUs, the non-Covid-19 patients faced with late delivery service, and priority was for Covid-19 patients. So, it led to opportunity costs for non-Covid-19 patients, while the hospitals could get more gain because of the conditions have arisen and increased their bed occupancy rates and did not include the opportunity cost as a service provider.

Sandmann et al were estimated the opportunity costs of admitting the norovirus-associated gastroenteritis in England. The disease was prevalent in England. Hospital beds were occupied and hospitals had to refuse of admitting the other kind of patients. The opportunity costs were estimated by calculating the net benefit of the patients and based on the results, admitting the norovirus-associated gastroenteritis patients led to opportunity



costs for hospitals but since the admission of these patients could not be burdened, the cost management was recommended<sup>30</sup>.

Hübner et al were assessed the opportunity costs of admitting patients with multidrug-resistant organisms (MRSA) in hospitals. They estimated the net benefit of admitting the patients and expected the number of patients that refused to admit because of MRSA patients. In this regard, the traffic density was used. Based on the results although the patients had more length of stay and used due to isolation, the opportunity costs did not impose for hospitals that a reason was attributed to the bed occupancy rates of the hospitals that were lower than 85% in usual time<sup>8</sup>. The present study was conducted in the same way. The selected hospitals did not face the traffic density because people decrease their elective demand in the Covid-19 crisis. As the study, the occupancy of the selected hospitals was lower than 85%, so despite the allocating of some wards just for Covid-19 patients, they did not face opportunity costs. The Covid-19 crisis was an opportunity for hospitals to use their outpatient capacities, although the crisis led to a decrease in elective hospital services.

### Limitation

Although the study was considered the costs and revenues of Covid-19 and non-Covid-19 cases by hospital perspective, considering just three hospitals as the sample size was the study limitation that makes generalization difficult.

### Conclusion

The selected hospitals could make a profit by admitting more Covid-19 cases and fulfilling their therapeutic and human mission, too. Unprofitable hospitals could also face lower losses by admitting more Covid-19 patients, even if they did not make

a profit. Thus, the preferred option in the coronaviruses crisis and similar ones is a dirty hospital and attracting the stochastic demand, although the final decision depends on the cost minimization or maximization of the benefits goals of the hospitals.

### Author contributions:

All authors listed have made a substantial, direct and intellectual contribution to all the parts of this research, and approved the final manuscript for publication.

### Conflict of interest:

The authors reported no conflicts of interest.

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