

Inpatient Hospitalizations during the First Wave of COVID-19 in Portugal

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Keywords

COVID-19 · Hospitalizations · Access to care · Health services · Portugal

Abstract

The objective of this study was to analyze the impact of the pandemic on inpatient hospital admissions during the first wave in Portugal. Data from hospital admissions in mainland Portugal from 2008 to 2017 were used to forecast inpatient hospital admissions for March to May 2020. The observed number of hospitalizations and their characteristics were compared to forecasted values. Variations were compared by hospital and region. Statistical analysis was used to investigate whether patterns of variations existed according to hospital characteristics. There were 119,315 fewer hospitalizations than expected during March to May 2020 in Portugal, which represented a 57% reduction. Non-COVID-19 hospitalizations had a higher mean length of stay and proportion of inpatient deaths than forecasted values. Differences between observed and forecasted values varied greatly among regions and hospitals. These variations were not associated with COVID-19 hospital admissions, region, forecasted number of hospitalizations, type of hospital, or occupation rate. The impact on inpatient hospital admissions for each hospital was not consistent or proportional to the expected use across Portugal, as indicated by variations be-

tween forecasted and observed values. The appropriate planning of future responses may contribute to improving the necessary balance between the level of hospital admissions for usual health needs of the population and the response to COVID-19 patients.

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Internamentos hospitalares durante a primeira vaga de COVID-19 em Portugal

Palavras Chave

COVID-19 · Internamentos · Acesso aos cuidados de saúde · Serviços de saúde · Portugal

Resumo

O objetivo deste estudo foi analisar o impacto da pandemia na produção de internamento hospitalar durante a primeira vaga em Portugal. Os dados dos internamentos hospitalares em Portugal Continental de 2008 a 2017 foram utilizados para a previsão da produção hospitalar de internamentos de março a maio de 2020. O número de internamentos observado e as suas características foram comparados com os valores previstos. As variações foram comparadas por hospital e região. A análise estatística foi

utilizada para aferir se existiam padrões de variação de acordo com as características de cada hospital. Houve menos 119.315 internamentos do que o previsto durante o período de março a maio de 2020 em Portugal, o que representou uma redução de 57%. Observou-se que os internamentos não-COVID-19 registaram um tempo médio de estadia e uma proporção de mortes em doentes internados maiores do que os valores previstos. As diferenças entre os valores observados e previstos variaram de forma significativa entre as regiões e hospitais. Essas variações não foram associadas a internamentos hospitalares por COVID-19, região, número previsto de internamentos, tipo de hospital ou taxa de ocupação. O impacto na produção de internamento de cada hospital não foi consistente ou proporcional à utilização esperada em Portugal, conforme indicado pelas variações entre os valores previstos e observados. O planeamento adequado de respostas futuras pode contribuir para melhorar o equilíbrio necessário entre o nível de produção hospitalar para as necessidades usuais de saúde da população e a resposta aos pacientes com COVID-19.

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Introduction

The urgency of the COVID-19 pandemic and the uncertainties over the epidemiological growth of cases led to nationwide measures being quickly implemented in Portugal, as in many other countries, aimed at reducing the spread of the SARS-CoV-2 virus and at strengthening the capacity of the health system. A state of emergency in Portugal was declared on March 18, accompanied by a nationwide lockdown. Measures started to be lifted in May, along with a gradual resumption of activities.

The rapid increase of COVID-19 patients, combined with unprecedented lockdown measures, led to changes in utilization patterns in different levels of health care in many countries. Hospitals implemented measures to prepare for a potential COVID-19 surge, in which the number of patients requiring care would go beyond the capacity of the health system. In Portugal, elective surgeries were cancelled or delayed, so resources such as health professionals could be reallocated to the treatment of COVID-19 patients [1–3], supported by legal determination/orientation [4]. Health care delivery was also impacted by changes in health-seeking behaviors, as patients did not seek health care for many reasons, such as the fear of COVID-19 infection, the lack of information regarding mitigation measures adopted at health facilities, and the physical limitations resulting from

stay-at-home orders [5, 6]. Given the level of contagiousness of the SARS-CoV-2 virus, infected patients must be treated in isolation, which led to several strategies adopted to prevent in-hospital COVID-19 transmission, including the redesign of treatment pathways and the establishment and/or repurposing of hospitals and facilities dedicated exclusively to COVID-19 [7–11].

At the same time health systems had to care for COVID-19 patients, there was also the concern of meeting the needs of non-COVID-19 populations during the pandemic. A balance between care for COVID-19 and non-COVID-19 patients could lead to fewer losses of non-COVID-19 use. The absence or postponement of care has significant implications for health services delivery in Portugal and it is reasonable to assume the same for other countries.

It is crucial to understand the impacts of the pandemic on the health care delivery system, such as in-hospital care, to design recovery plans and actions. Hence, the aim of this study was to analyze the volume of inpatient hospital admissions in the first 3 months of the pandemic in Portugal and compare this to forecasted hospital admissions. As a secondary objective, we sought to investigate whether variations in the volume of hospital admissions was consistent across the country and hospitals according to the demand of COVID-19 patients.

Methods

Data Source

The Portuguese Central Administration of the Health System (ACSS) provided episode-based hospitalization data in the public health system of Portugal, for the years 2008–2017, and aggregated data on the number of hospitalizations for each hospital for March to May of 2020. Episode-based data from 2008 to 2017 were then aggregated by hospital.

All hospitalizations from March to May 2020 were separated into 2 categories: COVID-19 or other conditions. The variables provided for this period were the total number of hospitalizations, the number of patients by sex and by age group, the mean total length of stay (in days), and the number of inpatient deaths. The number of confirmed cases in Portugal and per region by May 31 were extracted from the Situation Report of the Directorate-General of Health [12].

Exclusion Criteria

Initially, there were data for 60 hospitals. The exclusion criteria for hospitals were as follows: (i) not in mainland Portugal; (ii) start of operations after 2008; (iii) irregular time series due to fusion of 2 or more hospitals or other organizational changes; (iv) less than 50 monthly hospitalizations for more than 6 months between 2008 and 2017. Criteria ii–iv were applied to reduce the uncertainty during the forecast. Therefore, the final sample included 42 hospitals,

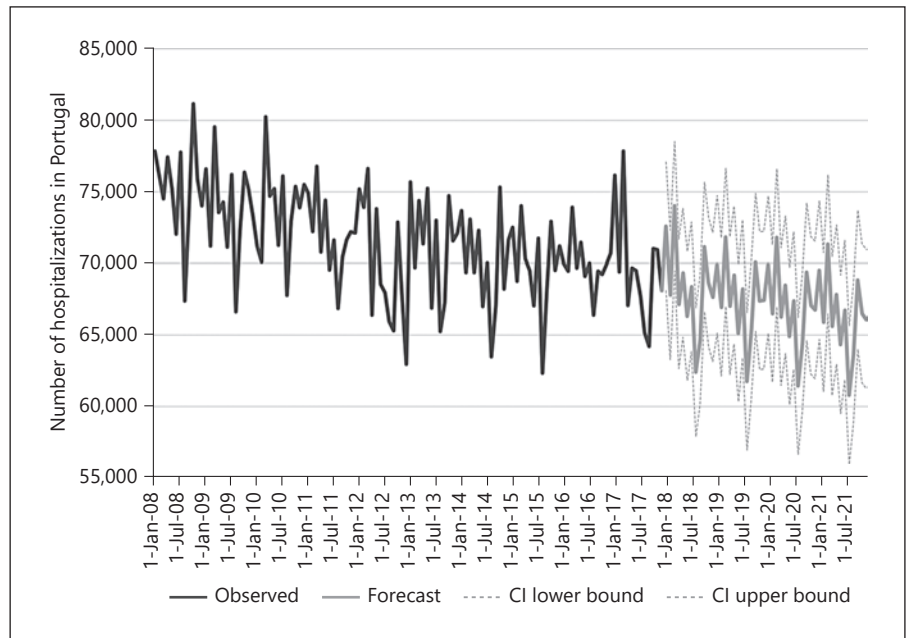


Fig. 1. Forecasted values for the monthly number of hospitalizations, 2008–2021.

Table 1. Number of forecasted and observed hospitalizations and differences in %, March to May 2020, Portugal

	Hospitals, <i>n</i>	Forecasted hospital admissions March to May 2020, <i>n</i> (95% CI)	Observed hospital admissions non-COVID-19 March to May 2020, <i>n</i>	Difference (forecast – observed), <i>n</i> (reduction in %)	Hospital admissions COVID-19 March to May 2020, <i>n</i>	Hospitalizations not occurred (difference forecast – observed)/(hospital admissions COVID-19)	Confirmed cases of COVID-19, <i>n</i> (rate per 100,000 habitants)
Portugal	42	206,571 (192,169–220,983)	87,256	119,315 (–57.8)	4,247	28.09	32,473 (331.4)
Alentejo	5	12,705 (11,489–13,921)	5,447	7,258 (–57.1)	75	96.77	259 (36.8)
Algarve	1	7,832 (4,049–11,615)	4,910	2,922 (–37.3)	192	15.22	372 (84.9)
Centro	9	38,351 (27,802–48,900)	14,931	23,420 (–61.1)	384	60.99	3,747 (169.0)
LVT	11	66,246 (55,477–77,014)	21,896	44,350 (–66.9)	1,049	42.28	11,335 (395.9)
Norte	16	88,449 (77,391–89,505)	40,072	48,377 (–49.0)	2,547	18.99	16,760 (468.8)

accounting for approximately 76% of the total hospital admissions for the past 10 years in the NHS according to Statistics Portugal [13].

Forecasting and Statistical Analysis

The ARIMA model was used to forecast the total number of hospitalizations for Portugal and each region for January 2018 to May 2020, considering the historical data from 2008 to 2017 for each hospital. Diagnostic checks of the residuals were performed to assess the fit of the model.

We compared the observed and forecasted total number of hospitalizations and their characteristics for Portugal and by region from March to May 2020.

We calculated the difference between the forecasted estimate and the number of observed non-COVID hospitalization. We then divided the difference by the number of observed COVID hospitalizations. We denominated this indicator “hospitalizations not occurred,” which indicates how many hospitalizations did not occur per each hospitalization for COVID-19.

We then investigated if characteristics of hospitals were associated to variations in the number of non-COVID hospitalizations. We calculated Spearman’s correlation between the variation in hospitalizations and the mean occupation rate in 2019 of each hospital (available at the NHS Transparency Portal). We also compared the mean percentage variation and hospital type – hospital, hospital centers, public-private partnerships, institute of oncology, psychiatric hospital, local health units – using the Kruskal-Wallis test.

Microsoft Office Excel 2017 was used for data tabulation and descriptive analysis. R version 3.6.2 was used for forecasting, and IBM SPSS version 26 for statistical hypothesis testing.

Results

Between 2008 and 2017 the number of hospitalizations that occurred in the 42 analyzed hospitals of Portugal ranged from 62,000 to 81,000 per month (Fig. 1). The data

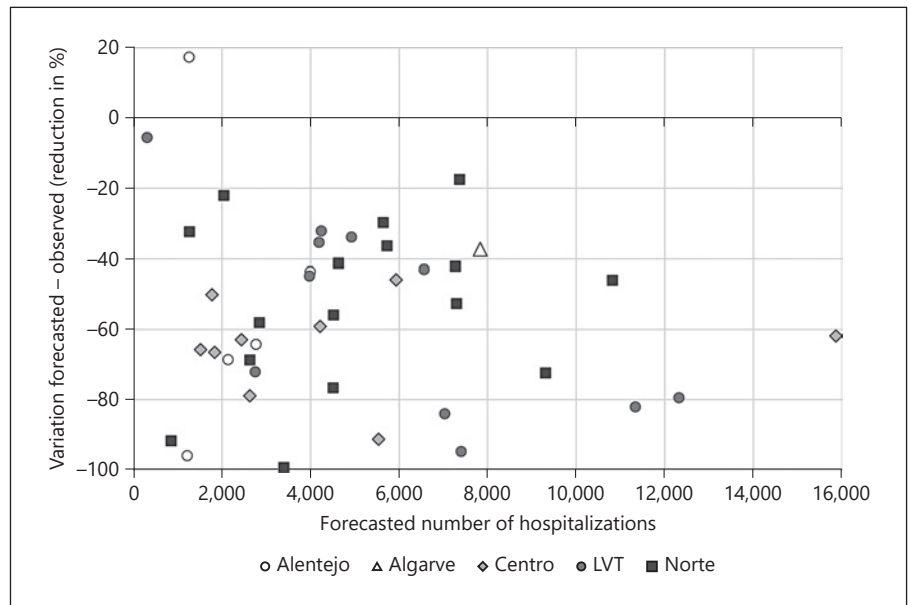


Fig. 2. Variation between the forecasted and observed number of hospitalizations per hospital.

Table 2. Characterization of forecasted and observed hospitalizations, by age group, length of stay, and inpatient deaths, March to May 2020, Portugal

	Sex, %		Age group, %					Mean length of stay, days	Inpatient deaths, % of total hospitalizations
	male	female	<18 years	18–60 years	61–70 years	71–80 years	>80 years		
Forecasted	45.8	54.2	13.2	34.0	14.9	17.6	20.3	7.19	5.4
Observed	44.3	55.7	15.2	33.7	12.7	15.8	22.6	8.76	8.2

indicate a descending trend in the number of hospitalizations over the period 2008 to 2017 (mean number of hospitalizations in 2008 vs. 2017 = 75,233 vs. 69,736), and a stabilization between 2014 and 2017 (mean number of hospitalizations in 2014 vs. 2017 = 70,041 vs. 69,736).

Between March and May 2020, the included hospitals registered 87,256 hospitalizations for all conditions except COVID-19. According to the forecasts, there were 119,315 fewer hospitalizations than expected during March to May 2020, which represented a 57% reduction (Table 1).

Mainland Portugal and all the regions observed reductions. Lisboa e Vale do Tejo (LVT) had the highest percentage decrease in the number of hospitalizations (-66.9%). More than half of all COVID-19 confirmed cases and hospitalizations were registered in hospitals in the Norte region (60.0%); this region experienced a 49% reduction. Alentejo had the lowest rate of COVID-19 confirmed cases per 100,000 inhabitants (36.8), the lowest number of COVID-19 hospitalizations, but still present-

ed a 57% reduction of observed hospitalizations compared to the forecasted estimates.

In Portugal, for each COVID-19 hospitalization there was an estimate of 28 fewer hospitalizations for other conditions. The “hospitalizations not occurred” varied greatly between regions: 18 for Norte, 42 for LVT, and 97 for Alentejo; these values indicate how many hospitalizations did not occur per each COVID-19 hospitalization, therefore they represent the proportionality of decrease in inpatient hospital admissions to the demand for hospital care by COVID-19 patients.

Table 2 shows the characteristics of forecasted and observed hospitalization for March to May 2020, for the variables sex and age group, mean length of stay (in days) and deaths in the hospital (presented as the proportion of all hospitalizations). There was a higher proportion of patients aged under 18 and over 80 years old in observed values, compared to forecast proportions (<18 years: 15.2 vs. 13.2%, >80 years: 22.6 vs. 20.3%). The observed mean

length of stay and hospitalizations that ended with inpatient death were higher than the forecasted values (8.8 vs. 7.2 days and 8.2 vs. 5.4%, respectively).

Figure 2 shows the variations between the forecasted and observed number of hospitalizations per hospital. Out of the 42 analyzed hospitals, 24 had a percentage reduction between 40 and 80%. The observations per region were scattered across the graph with no clear pattern between regions and variations. The reductions in hospital admissions were not associated with the forecasted number of hospitalizations ($p = 0.822$). We also found no significant associations of reductions in hospital admissions with the occupation rate ($p = 0.116$) or with the type of hospital ($p = 0.217$).

Discussion

The results of this study show that: (i) there were fewer hospitalizations between March and May 2020 than expected in mainland Portugal, representing a 57% reduction from forecasted values; (ii) all regions observed reductions; (iii) for each hospitalization for COVID-19, it was estimated that 28 hospitalizations for other causes did not occur; (iv) there were higher proportions of patients aged under 18 years and over 80 years old than the forecasted values; (v) the mean length of stay and proportion of inpatient death for non-COVID-19 hospitalizations were higher than forecasted values, and (vi) there were no clear patterns regarding variation in hospital admissions and region, forecasted number of hospitalizations, type of hospital, or occupation rate. The results presented here agree with previous studies that indicate disruption of health care services during the COVID-19 pandemic [10, 14–17] and show that such disruptions in Portugal were not related to hospital characteristics or the regions in which they are located.

The population's mobility was restricted during this period, influencing their movements to the hospital. The economic impact of the pandemic and the measures implemented may have led to financial difficulties that also affected attendance that, combined with the costs of transportation, may have created greater barriers to access health care. People may also have avoided health services out of fear of COVID-19 infection. On the supply side, the Portuguese health services' attention was directed to COVID-19, as a measure implemented by the government [4]; access to primary care and referral to surgical appointments was also hindered as a result of these political and public health measures. It could be hypothesized that the reduction in inpatient episodes during the

first months of the pandemic in Portugal was balanced by an increase in ambulatory surgery in the same period; this however was not the case, as ambulatory surgery also experienced reductions in volume during this period [18].

There was a significant drop in the rate of emergency service use in March 2020 in Portugal, in all regions and for all levels of urgency, with a decrease in non-urgent episodes [14]. For hospital admissions, our study found increases in the mean length of stay, which could indicate that the non-COVID-19 hospitalizations that occurred were more serious than those expected for the period, and therefore that the number of less severe hospital admissions decreased. This hypothesis is also supported by the increase in inpatient deaths as a percentage of total hospitalizations, which was also found for hospitalizations in the USA [19]. The observed proportion of patients aged 80 years or older was higher than forecasted values; this age group is more likely to require urgent and unavoidable inpatient hospital care.

The overall reductions represent a substantial risk for the future use of health care services: complications and severity associated with delayed/unmet care can arise/increase, and the hospital admissions not observed during the pandemic can accumulate, generating an additional burden for health professionals, creating challenges for health managers and policy makers responsible for planning the provision of health services. Our findings indicate that disruptions to inpatient hospital care were not proportional to the spatial distribution of the severity of the pandemic across Portugal, with different and random variations per institution. There were no patterns identified for the analysis per characteristics of hospitals either. In hindsight, it could be argued that better planning, organization, and allocation of resources could have contributed to a smaller impact in the hospital admissions. There was a generalized response to the pandemic that did not consider the different needs and epidemiological risk in the different regions of the country. The results suggest that the hospital response during the first wave led to unused installed bed capacity, which varied according to the individual response of each hospital. An unmeasured external force on the demand side refers to the role nationwide government measures had in health-seeking behavior by patients in the fast-changing, highly uncertain, and seemingly catastrophic scenario of the first months of the pandemic.

If in the first wave the measurement of the risk associated with the pandemic may have led to a cautious approach, the appropriate planning of future responses may contribute to improving the necessary balance between

the level of admissions presented by hospitals over time and the response to COVID-19 patients. It is important to acknowledge that Portugal and other countries were facing an unprecedented, uncertain, and urgent situation. The health systems of most high-income countries were not entirely prepared to face such an emergency [20]. The World Health Organization conducted a key informant survey to assess the impact of the COVID-19 pandemic on essential services, with nearly all of the 105 responding countries reporting disruptions of essential health services [21].

Our study has some limitations regarding both data and statistical analysis. The data only included public hospitalizations; the activity in the private sector was not included in the analysis due to data unavailability. It was not possible to analyze which type of hospitalization by diagnostics experienced the most severe disruptions. For the forecasting methods employed: as full data of hospital utilization was only available up to 2017, the forecasting was made for 4 years. In this case, the confidence intervals were broad, reflecting the uncertainty associated with the forecasts.

Conclusion

Portugal experienced substantial reductions in inpatient hospital services induced by the COVID-19 pandemic. As these reductions varied greatly by region and institutions, and without a clear pattern or proportional to hospitalizations for COVID-19, it was unclear how supply and demand factors interacted in each context. Given the uncertainty surrounding the pandemic, it is unclear how health services will respond to the accumulation of “hospitalizations not occurred,” the increased

needs associated with potentially more severe/complicated health conditions, and the second wave of the pandemic. Understanding what happened in the first stages of the pandemic can assist in planning the delivery of health services to respond appropriately to emergency situations.

Statement of Ethics

Consent to participate is not applicable since anonymized patient-level data was used in the study. The data was provided by the Central Administration of the Health System (Administração Central do Sistema de Saúde- ACSS) and its use approved for this study.

Conflict of Interest Statement

The authors declare that they have no competing interests.

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Author Contributions

Conceptualization: J.R., R.M., A.D., and R.S. Methodology: J.R., P.S., C.F., S.L., and J.S. Validation: R.M., A.D., and R.S. Formal analysis: J.R., P.S., and C.F. Investigation: J.R., P.S., C.F., M.T., I.F., and D.M. Writing original draft: J.R., P.S., and C.F. Supervision: R.S. All authors critically reviewed the paper and read and approved the final version.

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