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COVID-19 temporal dynamic as a hospital management method: Case study of the Martorell Hospital

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Abstract

Introduction: The COVID-19 pandemic has triggered a better preparation of primary care, hospitalization, and emergency health services. The current investigation of COVID-19 dynamics was carried at the Hospital Fundació Sant Joan de Deu de Martorell (FHSJDM). This research aims to analyse the COVID-19 time series in FHSJDM.

Methods: The time series of COVID-19 were analized for 2020-2021. To measure seasonality, the Dicky-Fuller test was obtained. The analysis of the results was performed in R-Studio software.

Results: Three peaks of cases are observed for January, April, and July 2021. These peaks of hospital cases are correlated with the new cases in the municipality and also with the new cases in Catalonia. The result of the seasonality test has a p-value >0.05, and thus it is accepted that the series is not seasonal for the registry of hospital cases.

Discussion: The study of COVID-19 dynamics is relevant to preparing health services. Each peak observed in the 2021 period affected the health services in the hospital FHSJDM, having an increase for new cases, hospitalized patients and total cases for COVID-19.

Keywords: COVID-19; Pandemic Dynamic; Time Series; Epidemiology

1. Introduction

SARS-CoV-2 is a new type of coronavirus (a broad family of viruses that normally affect only animals) that can affect people and causes COVID-19. It was detected for the first time in 2019/12 in the city of Wuhan (China). Coronaviruses produce clinical conditions ranging from the common cold to more serious diseases, for instance, the coronavirus that caused severe acute respiratory syndrome (SARS-CoV) a few years ago and the coronavirus that causes the Middle East respiratory syndrome (MERS-CoV) (1,2). COVID-19 has affected multiple countries on all continents. SARS-CoV-2 is highly infectious and can be transmitted through person-to-person contact and through direct contact with respiratory droplets generated when an infected person coughs (3).

In Spain there were a total of 1,928,265 cases in 2020 and 6,294,745 cases in 2021. This directly impacts the functioning of health services. It is relevant to study the dynamics of each region so that authorities and health institutions can prepare and generate preventive measures (4). The information of COVID-19 dynamics in healthcare institutions is

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limited. Some studies related the increase in community incidence with an increase in the intensity of hospitalization and intensive care cases. Consequently, this can impact the management of human resources and the availability of beds in healthcare centres.

This study aimed to compare the incidence in Martorell city and the COVID-19 dynamics in the hospital during 2020-2021.

2. Material and methods

2.1. Area of Study

In the current investigation, the COVID-19 dynamics was studied at the Hospital 'Fundació Sant Joan de Deu de Martorell' (FHSJDM). Hospital FHSJDM is a medium complexity care centre, and it is in Martorell (Spain). The hospital covers a population of 160,000 inhabitants and has 127 beds for hospitalization and emergencies. The care centre is part of the "Xarxa d'Hospitals d'Utilització Pública" (XHUP) and this is a hospitals network in the public area of Catalonia, Spain (5).

Martorell has a population of 28,667 inhabitants, and it is a municipality in the Baix de Llobregat region. The capital of the region is “Sant Feliu de Llobregat” and has a population of 45,463 inhabitants (6,7). In Martorell there were a total of 2,036 cases in 2020 and 5,149 cases in 2021. It important to highlight that Martorell is a town with high traffic of transport services and industrial activity. Therefore, it is an interesting analyse how the community incidence affects COVID-19 dynamic in the Hospital FHSJDM.

2.2. Methodology of analysis.

The time series of COVID-19 were analized for the period 2020-2021 by weekly new cases. The analysis considered from January to September for Hospital FHSJDM and Martorell in both years. New cases and total cases treated, hospitalized, and discharged patients were studied for the Hospital FHSJDM. The data of Martorell and Sant Feliu de Llobregat was obtained from “Dades COVID” which is an open data platform of the "Generalitat de Catalonia"(8). The Dicky-Fuller test was obtained for variables of studie in Hospital FHSJDM. The analysis of the results was performed in the R-Studio software (v 4.0.2) and the graphs were performed with the package 'ggplot2'. The code is avaible in Github cloud (9)

3. Results

Martorell is a municipality of Baix Llogrebat region in Catalonia (figure 1). The flow of patients from the hospital FHSJDM is determined by four counties: Baix de Llobregat, Alt Penedes, Anoia and Valles Occidental. The new cases of COVID-19 were analysed in two-time series, for 2020 and 2021 (Figure 2). The range of the time series was from January to September for each year. The time series of 2020 ($\bar{x}$= 21; min= 3; max= 61) show less new cases than time series of 2021 ($\bar{x}$= 49; min= 6; max= 147).

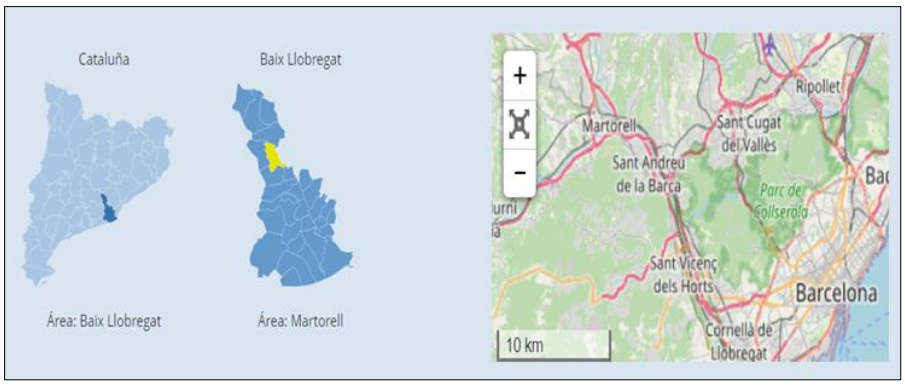

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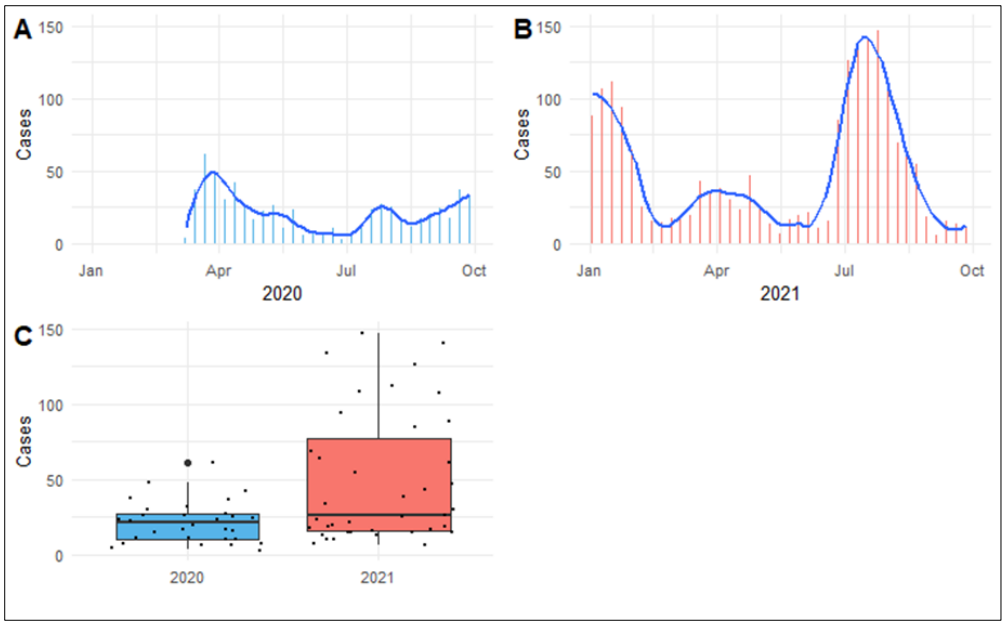
Figure 1 Map of Catalonia, Baix Llobregat and Martorell in Spain

The dynamic of COVID-19 was studied in Hospital FHSJDM. The variables of new cases, total cases treated, hospitalized patients, and discharged patients were studied for the period January-September 2021.

The maximum number of cases was observed in the wave of infections in July 2021 for new cases (n= 52, week= 07/18/2021) and total cases attended variables (n= 100, week= 07/18/2021). On the other hand, the maximum number of cases observed for the variables patients hospitalized (n=95, week=01/24/2021) and discharged patients (n=26, date= 01/24/2021) was in January 2021 (figure 3).



A. New Cases of COVID-19 in Martorell in 2021 (January-September). **B**. New Cases of COVID-19 in Martorell 2022 (January-September). **C**. Boxplot comparison of new Cases of COVID-19 in Martorell (2020-2021).

Figure 2 Time Series comparison for weekly new cases in 2020 - 2021 in Martorell

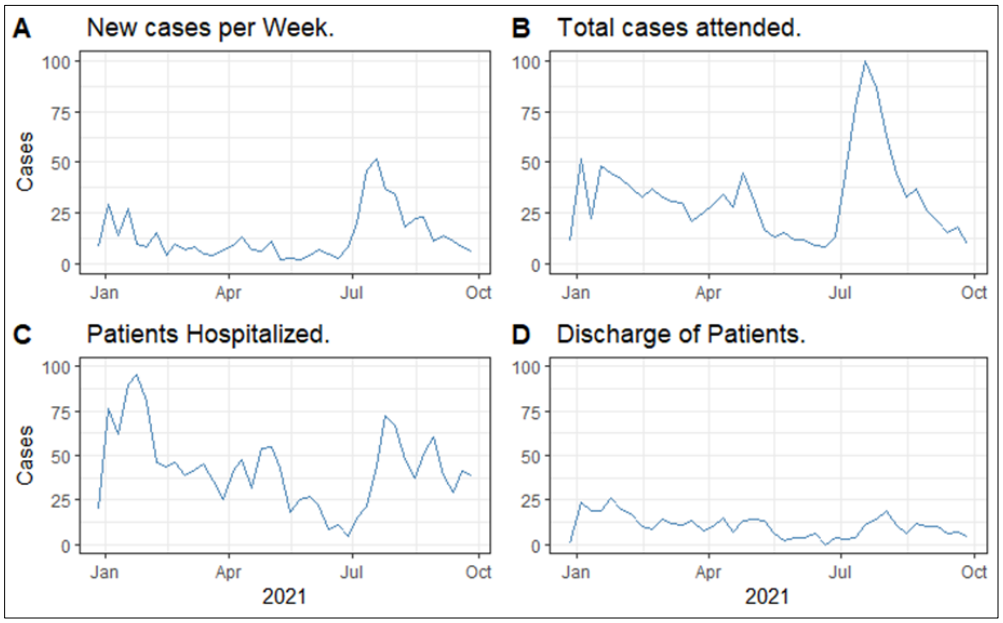


Figure 3 Time Series of the Hospital " Fundació Sant Joan de Deu de Martorell" (FHSJDM) in 2021 for new Cases, Total Cases treated, Hospitalized Cases and Patient Discharges

The new cases diagnosed in the hospital are related to the number of new cases in the municipality (Figure 4). The registry of new cases includes cases diagnosed in primary care, hospitals, and private medical centres. Three waves of increased cases were observed in January (Hospital = 29; Martorell= 112), April (Hospital= 13; Martorell = 47) and July

(Hospital= 52, Martorell = 147). In the case of Sant Feliu de Llobregat, the waves contagion peak was observed with 227 new cases in January, 65 new cases in May and 288 in July 2021.

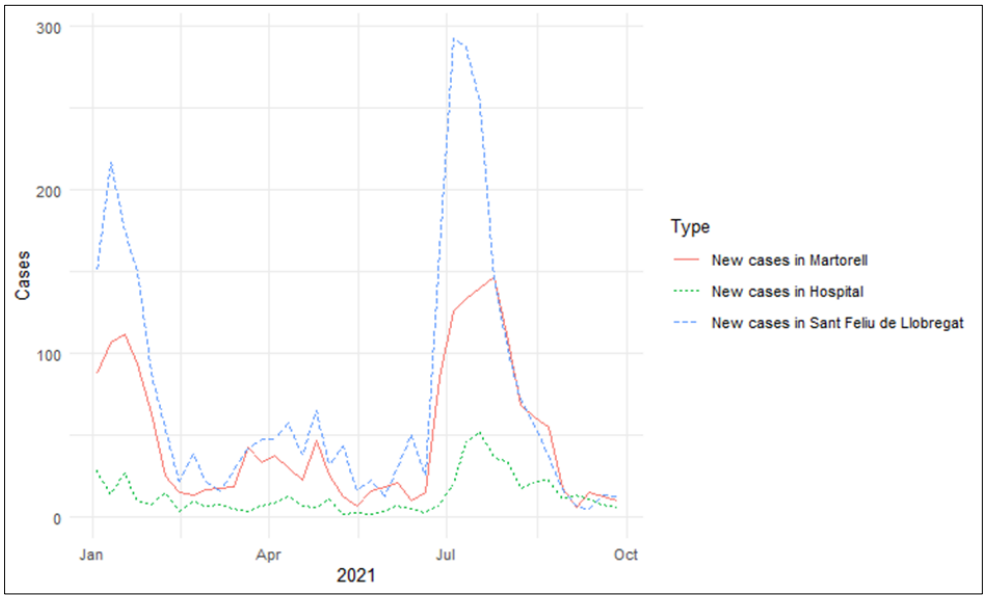


Figure 4 Comparison of time series 2021 for weekly new cases in the Hospital, Martorell and Sant Feliu de Llobregat

The Dicky-Fuller test was obtained for variables of Hospital FHSJDM to study the seasonality. The p-value for the variables Cases Attended (p-value= 0.0442), Hospitalized patients (p-value= 0.3567), Discharged patients (p-value=0.2485) and New Cases (p-value= 9.2678) are greater than p-value 0.05, therefore the hypothesis that there is no seasonality in the selected data is accepted.

Table 1 Seasonality study for the Time Series of Hospital "Sant Joan de Deu" of Martorell in the period 2021

Variable	Dickey-Fuller Test	p-value
Cases attended	-2.3294	0.4442
Hospitalized patients	-2.5523	0.3567
Discharged patient	-2.8281	0.2485
New Cases	-2.7789	0.2678

4. Discussion

SARS-CoV-2 is a highly transmissible virus in the population. On September 30, 2021, there were 67,526,405 total cases and 768,681 deaths from COVID-19 in Europe (10). Faced with this scenario, the dynamics of COVID-19 in towns and hospitals are relevant to study because it provides information useful for all levels of care. An increase in weekly cases could explain an increase in primary healthcare, hospitalizations, and emergencies cases (11–13)

Despite advances in preventive measures and vaccination, the spread of COVID-19 has remained active during 2021. Vaccines have helped reduce critical cases and treatments in intensive care units, but contagion is still high in the community. The COVID-19 variant of concern in Spain for 2021 was the Delta variant which has greater transmissibility and greater pathogenicity than the Alpha and Beta variants. In addition, this variant of concern can infect people who are already vaccinated. This may explain the waves of infection for the year 2021 that far exceed the new cases of the year 2020 in Spain and Europe. The return of normality, the high mobility of people and activities that involve migration may increase the spread of the COVID-19 infection (14,15). In addition, the restriction measures in 2021 only included the use of a mask and restriction of the max number of people in meetings. This scenario also occurred in Martorell.

The new cases in the municipality coincide with the increase in new cases in the hospital for January, April, and July. The dynamic of new-cases-peak of the waves of contagion are also observed in Martorell and Sant Feliu de Llobregat,

which is the capital of the region. A similar situation is observed in Barcelona and Catalonia (8). The increase in cases of COVID-19 saturated care activity in primary care and hospitals (16). Furthermore, when the total of population or population density increases, the transmission of the virus also increases (17, 18) . According to this, Sant Feliu de Llobregat registered more new cases than Martorell Sant Feliu.

The hospitalization of patients could depend on the number of new cases in the community, risk factors and the number of vaccines received (19–21)

According to the study of seasonality with the Dicky Fuller Test, none of the variables has a seasonal behaviour. Some studies affirm that the virus has better viability at lower temperatures (12, 22, 23). A study concluded that the first two waves of COVID-19 worldwide would have a seasonal behaviour depending on weather conditions (24). However, this postulate could not be generalized.

It is important to assess seasonality, since there is evidence regarding influenza and seasonal gastroenteritis, and it has allowed better preparation of preventive policies. (25). Future studies could incorporate predictive analyses of time series and it could be useful for hospital services and the community. Probabilistic and predictive models should consider, in this case, seasonality.

5. Conclusion

In conclusion, COVID-19 has significantly affected care services in multiple establishments worldwide. In this study, new cases, hospitalized cases, and total cases treated have been directly affected by the waves of contagion from the COVID-19 pandemic.

An increase in cases is observed in each wave of contagion, as well as experiences from other healthcare centres. The waves of contagion of COVID-19 in 2021 are bigger than 2020 in comparable time series. Furthermore, total population of cities could explain more infections than smaller cities.

Compliance with ethical standards

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Disclosure of conflict of interest

All authors have no conflict of interest to declare.

Statement of ethical approval

This study has the approval of the bioethics committee of the University of Barcelona and the Hospital 'Fundació Sant Joan de Deu de Martorell'. This observational study was based on population, and no measures have been taken on the clinical record by researchers.

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