

The spread of COVID-19 in Italian provinces. Focus on Lombardy and the province of Bergamo.

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ABSTRACT

This paper tries to shed light on the now existing coronavirus disease. A simple descriptive statistics approach is applied to give a visual inspection of the national context. In particular the attention is focused on the evolution over time of the contagions: from the very beginning (since the first case was recorded) to 31st March 2020. Moreover, we analysed the last day of our period in Lombardy and in the province of Bergamo. At 31st March 2020 there are about 102440 contagions in Italy, around 44283 in Lombardy and about 8803 contagions in the province of Bergamo. The most affected province at national level is Milano and the less one is Isernia with only 9 cases.

KEY WORDS: COVID-19, Coronavirus, Italy, provinces, Lombardy, Bergamo.

INTRODUCTION

The initial coronavirus epidemic was originated in China, in the Hubei region with the epicentre in the city of Wuhan.

On February 21st the first case in Italy is recorded: the patient 1 is in Codogno in the province of Lodi^[1].

On March 11th, the World Health Organization (WHO) Director-General Tedros Adhanom Ghebreyesus declared that COVID-19 can be characterised as pandemic^[2].

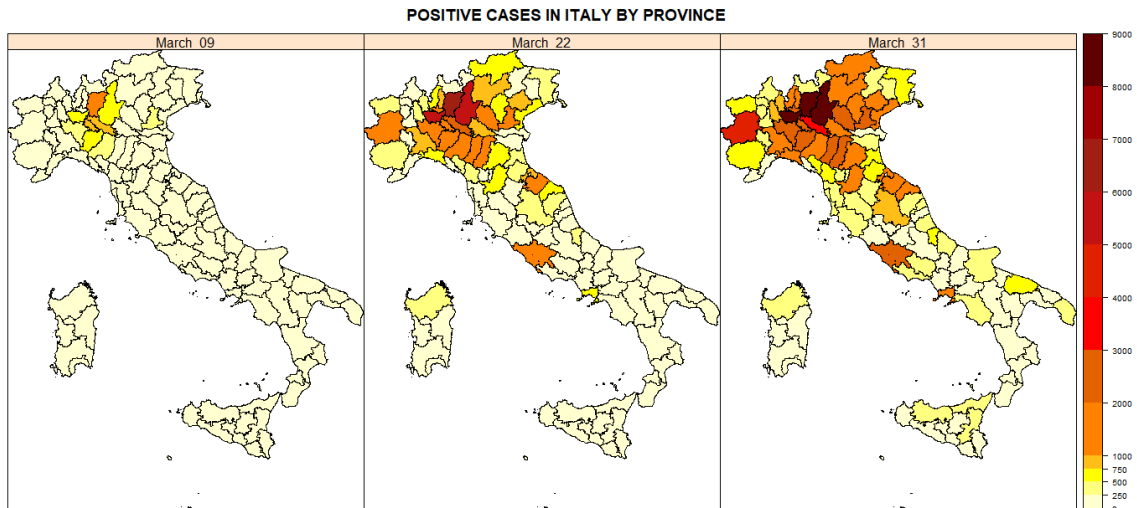
DATA AND METHODOLOGY

Data are collected from one of the official sources: the Civil Protection bulletins and they cover the period from February 24th to March 31st 2020.

We applied a simple descriptive statistics approach to give a numerical and visual inspection of coronavirus pandemic at regional and province level.

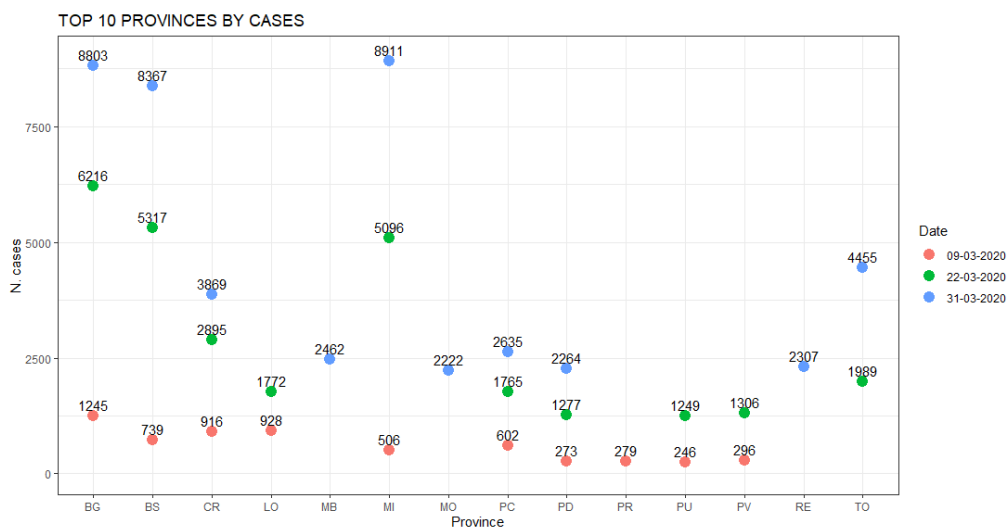
ITALY BY PROVINCE

Map 1



Map 1 shows the spread of COVID-19 along the provinces of Italy. The distribution of positive cases is not homogenous. The provinces in North Italy result to be highly affected since the first days of March, considering that darker colours represent a greater number of infected. Moving from left to right it is possible to understand that the actual situation is not represented by just a linear spreading from the most affected provinces to the nearest. In the Middle-South Italy there are some independent outbreaks in provinces with big cities such as Roma and Napoli. However, at 31st March the provinces of South - Italy and Islands do not have more than 750 cases of COVID-19 because they seem to be still at the beginning of the contagion curve.

Graph 1



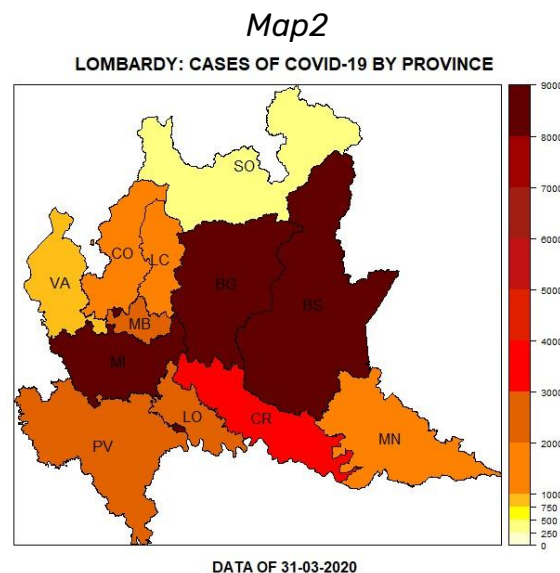
Graph 1 shows the top 10 provinces by number of COVID-19 infected at three different dates. The first is 9th March, the day of the first DCPM¹, that provides

¹ Decreto del Presidente del Consiglio dei Ministri.

restrictive measures to contain the spread of the virus at national level. The province with the highest number of cases is Bergamo. However, in general, the first 10 provinces by number of infections are all below 1250 cases. Then, we consider 22nd March that is the day of the last DCPM. After about two weeks the number of cases had a significant increment in the provinces of Bergamo (BG), Brescia (BS), Milano (MI) and Torino (TO). In last observed day, 31st March, the situation is not homogeneous from the point of view of the absolute number of new contagions and growth of infected. In fact, we can see that Bergamo (BG), Brescia (BS) and Milano (MI) are the most affected. In particular, Bergamo, Brescia, Milano, Monza Brianza (MB), Modena (MO) and Reggio Emilia (RE) appear to have an exponential growth. About Cremona (CR), Piacenza (PC) and Padova (PD), instead, the growth seems to be linear.

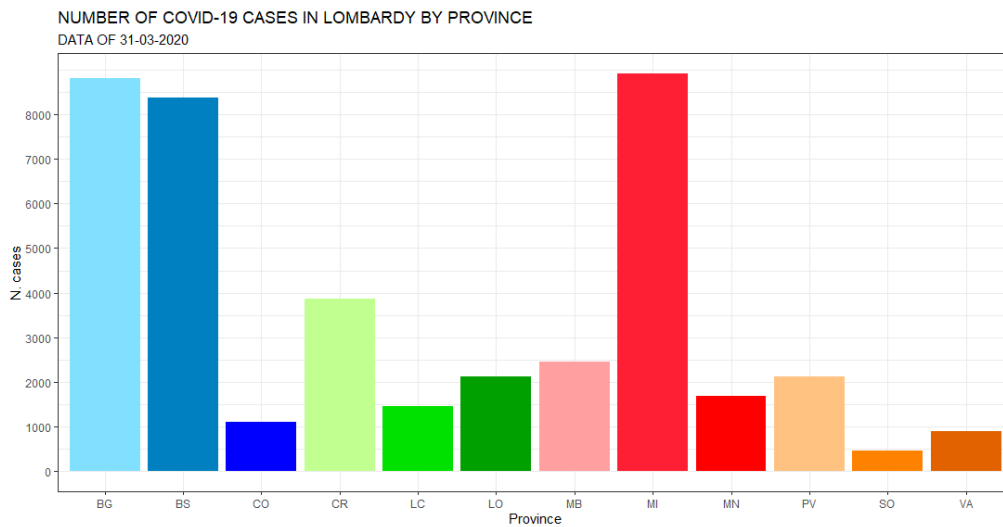
LOMBARDY BY PROVINCE

Lombardy, as we all know, is the Italian region that suffered the most from the pandemic disease. From the 21st February, when the first case of COVID-19 was registered in Codogno, the virus spread rapidly all over the region. The map and the histogram below show the state of the development of the disease in the last day available: 31st March 2020. The darker areas in the map identify the provinces with the most infected.



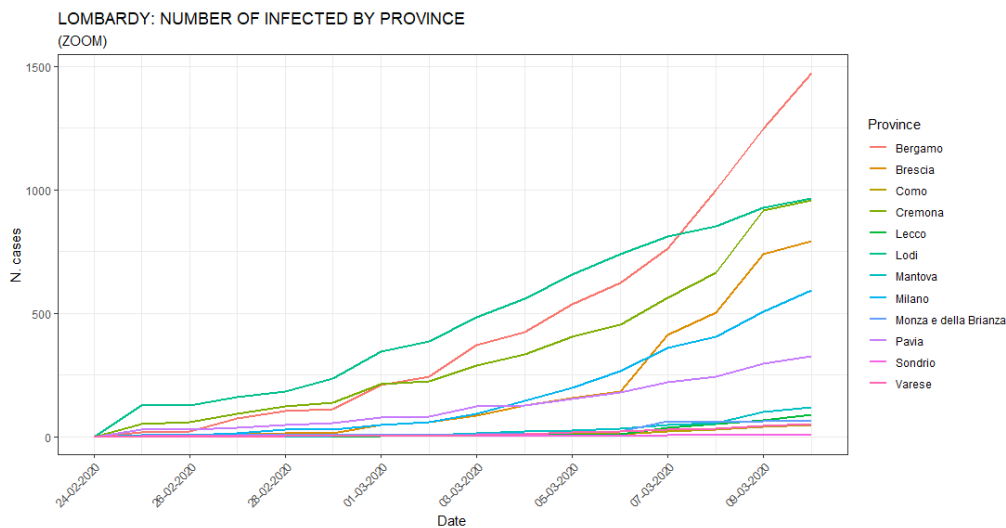
As observed in *map 2* and as the histogram in *graph 2* clearly shows, the provinces with the highest number of cases are Bergamo (BG), Brescia (BS) and Milano (MI). The first province that had been affected was the province of Lodi (LO), where the first red zones were created. The early introduction of the social distances' restrictions might explain the lower number of infected at 31st March 2020.

Graph 2



To have a clear idea regarding the evolution of the situation, we used time series plots for a better inspection. In the two plots shown below, is represented the development since the beginning of the crisis. Focusing the attention on the initial period (*graph 3*), it is possible to notice that up to 7th March, Lodi was the province most affected by the COVID-19. After that day, the situation changed drastically.

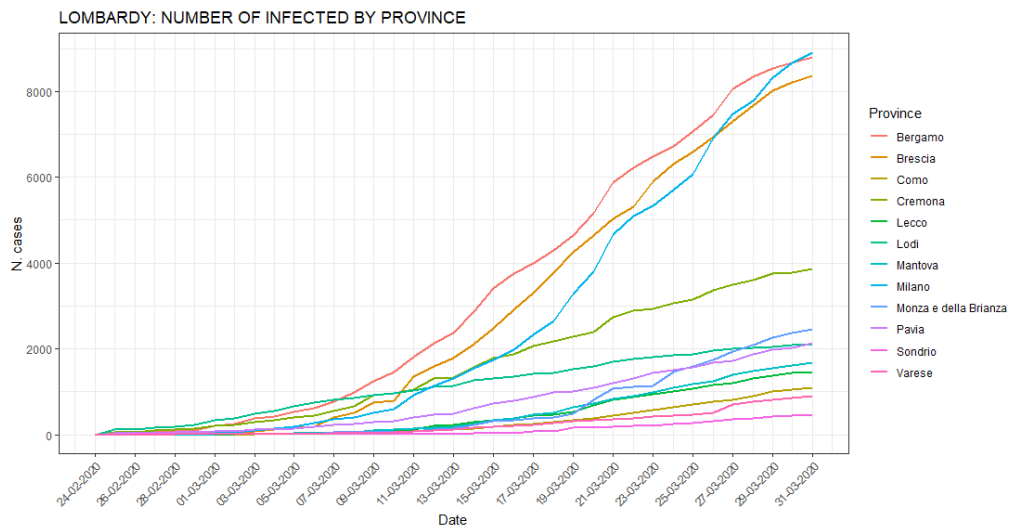
Graph 3



Graph 4 represents the whole period and shows an increasing trend in the number of infected for all the provinces. The clear exceptions are Bergamo and Brescia, that started to behave very differently from the others, with an exponential increase of cases. The period between 7th and 12th March identifies the threshold after which the trend in the two provinces abovementioned begins to grow faster. Meanwhile, Milano recorded fewer cases in the beginning but, after 18th March, as we can observe from the slope of the curve, the number of cases increased with a faster rate, and in the last day (31st March 2020) it exceeded the other two provinces. Another case worth mentioning is Cremona. The province is also

experiencing a large number of infected. Between 8th and 11th March, the number of cases reached the province of Lodi and continued their growth.

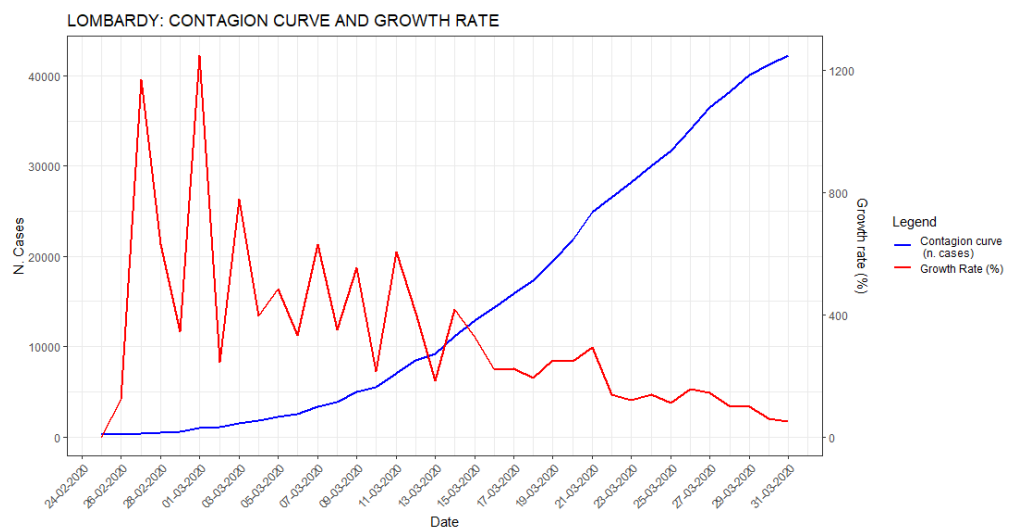
Graph 4



The contagion curve and the daily growth rate for Lombardy are represented together in *Graph 5*. The growth rate is measured as:

$$\frac{x_t - x_{t-1}}{x_{t-1}}$$

Graph 5

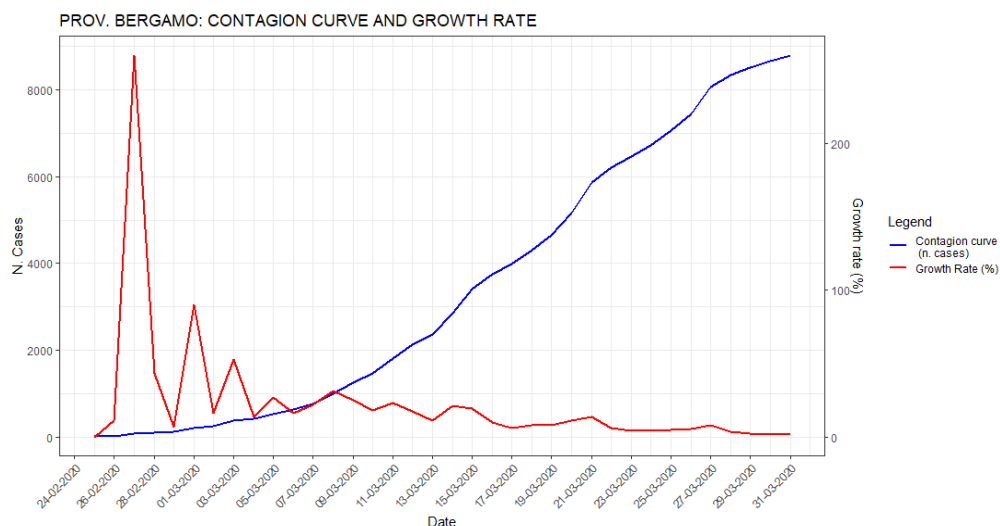


The growth rate has an oscillating pattern, with highest value observed on 1st March. In the first period the variance is higher, while it starts to stabilize after 15th March. The high variability that characterises the initial growth is clearly due to the jumps in the number of infected from one day to the other. The contagion curve summarizes the previous conclusions. In fact, it portrays an upward trend for the whole period.

PROVINCE OF BERGAMO

The province of Bergamo is one of those with the highest number of cases of people positive to COVID-19. The contagion curve in *graph 6* shows that there are some periods (13th-15th March; 20th-21st March; 26th-27th March) where the slope is steeper, indicating a higher quantity of infected people. It seems that the curve reached a peak in those periods, because after that the curve flattened slightly. But then, the number of positive people restarted to increase again. These movements are mirrored in the changes in the growth rate. Of course, comparing the pattern of the daily growth of Bergamo with that one of the whole region, the latter presents more variability. The daily growth rate of Bergamo (measured as before) shows a peak in the first days, as expected, and after that it becomes more stable.

Graph 6



LIMITS

It is well known that these numbers are an underestimate of the real situation of the COVID-19 contagions on the Italian territory. Furthermore, since no other variables are available and the reliability of the forecasting models is currently under discussion, it is not possible to implement estimation or forecast models.

CONCLUSION

The analysis shows that at 31st March 2020, at national level, the province most affected is Milano and the less affected is Isernia (9 cases). South - Italy seems to be at the beginning of the pandemic, for this, it still has a limited number of cases (except a couple of outbreaks) compared to North - Italy.

In Lombardy, the province with more cases of coronavirus is Milano (8911 cases), followed by Bergamo (8803 cases) and Brescia (8367 cases). The less affected province is Sondrio (470 cases). Furthermore, the immediate introduction of the red zone, with all the respective restrictions, in the province of Lodi seems to have scaled down the spread of the virus. This shows that to date, isolation might be the best strategy for fighting this virus.

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[2] *Coronavirus: WHO praises Italy as it declares pandemic*. (2020, 11th March). ANSA. https://www.ansa.it/english/news/2020/03/11/coronavirus-who-praises-italy-as-it-declares-pandemic_15477ab6-7116-4361-8168-08159471d30f.html