

COVID-19: an outbreak in a nursing home in spring 2021

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Abstract. *Introduction:* Nursing home residents were the most vulnerable population to be affected by Coronavirus disease 2019 (COVID-19) in Italy. The Italian vaccination strategy decided to indicate them as the target population in the first phase of the massive vaccination campaign. We carried out an analysis on an outbreak of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) infection which occurred in a nursing home in northern Italy (Cremona) after the administration of the complete vaccination cycle affecting most of the guests of the structure. *Methods:* Data relating to the outbreak were obtained through the Regional Surveillance System for Infectious Diseases of Lombardia Region. *Results:* During the outbreak, among the 61 guests, 56 were vaccinated. Thirty four were found positive for COVID-19: 22 were asymptomatic, 12 were symptomatic and 4 died. The observed difference in the number of deaths between vaccinated and non-vaccinated subjects was significant. During the outbreak 104 healthcare workers (HCWs) were employed in the nursing home, only 66 were vaccinated. Eight HCWs were found COVID-19 positive, 4 of them were vaccinated and of female gender. *Conclusions:* Similarly to data reported in literature for described outbreaks, we observed that the vaccine is able to protect from the symptomatic form and a valid antibody response protect from a symptomatic disease. The low number of HCWs found positive indicates a correct use of individual protective devices.

Key words: COVID 19, Residential Homes, Healthcare Workers, vaccination

Introduction

Nursing home (NH) residents were the most vulnerable population, and the one most disproportionately burdened by high mortality rates among those affected by Coronavirus disease 2019 (COVID-19) in Italy, as well as, in other Countries due to the older age and comorbidities (1-7).

For these reasons the guests of NH were indicated as one of the priority classes to receive the vaccination

against the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) (8).

In Italy, the strategy firstly adopted was to provide the vaccination to the most fragile subjects, and therefore to more easily subjects to death and hospitalization (9).

In particular, mRNA vaccines have shown excellent efficacy in the development of immunogenicity in geriatric cohorts in spite of frailty, age, disability, cognitive impairment or comorbidities (10,11).

Objectives

We carried out an analysis on an outbreak of SARS-CoV-2 infection which occurred in a NH in Cremona (Italy) after the administration of the complete vaccination cycle to most of the guests and Healthcare Workers (HCWs) of the structure.

We analyzed the characteristics of all the guests of the NH, and HCWs who contracted the infection, in relation to their vaccination status and clinical course.

The course and outcomes of the disease between vaccinated and unvaccinated people were evaluated.

Methods

The data relating to the outbreak were obtained through the Regional Surveillance System for Infectious Diseases of the Lombardia Region (12).

Statistical analyses to verify the possible significant associations in the different populations examined were carried out by Student's T Test with a 95% confidence interval and by the Chi Square Test, corrected by Yates, with two-tailed p-values and a 95% Confidence Interval (13).

For this purpose, the software for epidemiological statistics OpenEpi – Open Source Epidemiologic Statistics for Public Health (<http://openepi.com>) was used.

The Ethical Approval was not necessary because all data were anonymous.

Results

The observation period ran from January 1, 2021 to May 9, 2021. Only 5 guests had been infected during the first phase of the epidemic in 2020.

We analysed 61 guests, 50 females (81%) and 11 males (18%), and 104 HCWs (Figure. 1).

Based on contact tracing the index case was an HCW recently hired and not yet vaccinated, who was diagnosed with COVID-19 on March 17, 2021.

Among the females, the negative subjects were 24 (48%) and the positives were 26 (52%), of the positives 7 (26.9%) were symptomatic and 19 (73.1%) were asymptomatic.

Among the males, the negative subjects were 3 (27.3%) and the positives were 8 (72.7%); 5 (65.5%) of the positives were symptomatic and 3 (37.5%) were asymptomatic.

Despite the lower numbers, we note that among the male subjects the percentage of symptomatic was more than double compared to that of females.

The mean age of the guests was 88.8 years (Standard Deviation, SD, 6.6). Minimal differences were observed between the mean age of negative (89.7 – SD 5.9) and positive subjects (88.2 – SD 7.1), even dividing the positives between symptomatic (89.4 – SD 6.0) and asymptomatic (87.5 – SD 7.5) (Table. 1).

The difference was not statistically significant for the comparison between positive and negative ($p=0.384$), and for the comparison between symptomatic and asymptomatic positives ($p=0.454$).

Four positive guests died, whose mean age was 91.7 years (SD 4.6).

After the identification of the index case on March 17, 2021, among the 61 guests there were 34 (55.7%) positive and 27 (44.2%) negative subjects for COVID-19 tests. Out of the 34 cases, 31 were vaccinated and 3 were unvaccinated, with a cumulative incidence of 31/56 (55.3%) among the vaccinated and 3/5 (60%) among the unvaccinated.

Among the COVID-19 positive subjects, 22 of 34 (64.7%) were asymptomatic, while 12 of 34 (35.3%) had a symptomatic course. There were 4 deaths among symptomatic positive hosts.

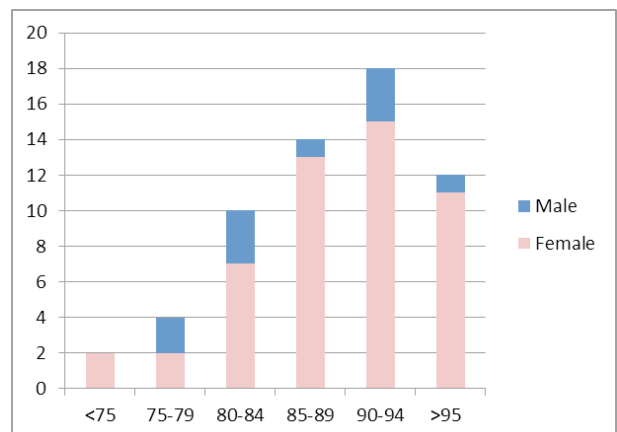


Figure 1. Distribution of guests by age and sex.

Table 1. Features of the guests.

	Total n=61	Negative n=27	Positive n=34	Symptomatic n=12	Asymptomatic n=22
Gender					
Female (%)	50 (82%)	24 (88.9%)	26 (76.5%)	7 (58.3%)	19 (86.4%)
Male (%)	11 (18%)	3 (11.1%)	8 (23.5%)	5 (41.7%)	3 (13.6%)
Age (average, SD#)	88.84 (6.63)	89.67 (5.87)	88.18 (7.1)	89.42 (6.03)	87.5 (7.54)
Not Vaccinated (%)	5 (8.2%)	2 (7.4%)	3 (8.8%) [§]	2 (16.7%) [§]	1 (4.6%)
Days between 2nd dose and diagnosis (average, SD#)	-	-	46.7 (7.77)	43.92 (7.45)	48.29 (7.49)
Days between identification of the index case and positivization (average, SD#)	-	-	12.7 (7.77)	9.92 (7.45)	14.29 (7.49)
Duration of the infection (average, SD#)	-	-	32.17 (11.04)	36.38 (8.69)	30.57 (11.4)
Previous COVID-19 (%)	5 (8.2%)	3 (11.1%)	1 (2.9%)	1 (8.3%)	0

Standard Deviation; § One of which had only taken the 1st dose

The guests who had completed the vaccination course were 56 (91.8%), while the unvaccinated were 5 (8.2%) one of them had only received the first dose.

Guests who completed the vaccination course were given the first dose on January 18 and the second dose (24 days later) on February 11, 2021 with BNT162b2 vaccine (Table. 2).

No differences were observed in the percentages of infected subjects between vaccinated and unvaccinated (Table. 2). A significant difference was detected in the number of deaths between vaccinated and unvaccinated ($p < 0.05$).

Both the two vaccinated hosts who died after the hospitalization had a history of chronic obstructive pulmonary disease (COPD).

The diagnosis was made at a mean distance of 46.7 days (SD 7.77) after the administration of the second dose of vaccine. For the symptomatics the mean was 43.92 days (SD 7.45), while for the asymptomatics was 48.29 days (SD 7.49), resulting in a difference not statistically significant ($p = 0.113$).

Analyzing the number of days between the identification of the index case and the evidence of infection in the guests, we could observe a time interval of 12.7 days (SD 7.77). For the symptomatics the difference was 9.9 days (SD 7.45) while for the asymptomatics was 14.3 (SD 7.49), with no difference statistically significant ($p = 0.113$).

The duration of the infection (the time elapsed between diagnosis and negativization of the oronasopharyngeal swab) was on average 32.2 days (SD 11.04). For the symptomatics the mean time was 36.4 days (SD 8.69) while for the asymptomatics was 30.57 (SD 11.4) days. The difference studied with Student's T test was not statistically significant ($p = 0.135$).

The comorbidities present in the 12 symptomatic subjects and in the 22 asymptomatic subjects were considered.

Among the positives it was observed that 17.7% had a diagnosis of diabetes, 41.2% had cardiovascular disease, 11.8% had severe respiratory disease, 32.4%

Table 2. Distribution between vaccinated and unvaccinated hosts based on their clinical status. The unvaccinated included a guest who had received only the first dose.

	Vaccinated n=56	Not Vaccinated n=5	<i>p</i>
SARS-CoV-2 + %	31 (55.4%)	3 (60%)	0.787
Asymptomatic %	21 (37.5%)	1 (20%)	
Symptomatic %	10 (17.9%)	2 (40%)	0.577
Deceased %	2 (3.6%)	2 (40%)	0.027

had cerebrovascular disease and almost all (94.1%) had hypertension.

The pathologies considered are divided into symptomatic and asymptomatic subjects in Table 3.

Half of symptomatic subjects (50%) presented at least 3 pathologies at the same time and, in general, pathologies were more frequent among symptomatic subjects than asymptomatic ones.

The difference between symptomatic and asymptomatic who presented at least 3 of the pathologies examined was studied with the two-tailed Yates Corrected Chi Square Test (95% C.I.) and was found to be significant ($p=0.007$).

Only 4 of the guests had a previous COVID-19 infection, of these only one was later symptomatic. It was a vaccinated subject, and he recovered completely.

The genome sequencing of the virus was done on 22 positive guests (9 symptomatics and 13 asymptomatics). The Alpha variant (lineage B.1.1.7) of SARS-CoV-2 was identified for all.

A total of 104 HCWs were employees in the NH; 66 (63.5%) received both doses of the vaccine by February 12, 2021, as did most of the guests. There were therefore 38 (36.5%) HCWs who were not vaccinated or had only taken the first dose.

Only 8 HCWs tested positive for SARS-CoV-2 infection, half among the vaccinated 4/66 (6.1%). The difference between infected vaccinated and unvaccinated HCWs was not found to be statistically significant ($p = 0.6593$).

The positive HCWs were all female. Four HCWs presented mild symptoms. None of them had a previous diagnosis of COVID-19.

The average age of the HCWs was 47.1 years (SD 13.25). The comparison between the means of the ages of the symptomatic (46 - SD 12.75) and asymptomatic (48.2 - SD 13.65) was made with Student's T Test showing no significant difference ($p=0.817$).

Table 3. Pathologies present in anamnesis between symptomatic and asymptomatic subjects.

Pathology	Symptomatic n=12	Asymptomatic n=22
Diabetes	4 (33.3%)	2 (9.1%)
Cardiocirculatory Diseases	6 (50%)	8 (36.4%)
Severe Respiratory Diseases	3 (25%)	1 (4.6%)
Hypertension	12 (100%)	20 (90.9%)
Cerebrovascular Diseases	7 (58.3%)	4 (18.2%)

The number of days between the identification of the index case and the positivization of the other HCWs is on average 12.6 days (SD 3.2). The difference between the mean days of symptomatic 11.5 (SD 3.91) and asymptomatic 14 (SD 0) studied with Student's T Test was not significant ($p=0.329$). The index case was excluded from this evaluation.

The duration of the infection, up to the negativization of the oronasopharyngeal swab, was on average 37 days (SD 12.8). The difference between the mean days in symptomatic 39 (SD 6.44) and asymptomatic 35 (SD 16.67) studied with Student's T test was not significant ($p=0.672$).

Table 4 shows the characteristics of individual infection-positive HCWs, including the time interval between administration of the last vaccine dose and infection.

The variant was studied for 5 of the HCWs (4 symptomatic and 1 asymptomatic) and for all the Alpha variant (lineage B.1.1.7) of SARS-CoV-2 was found, as well as for the guests.

Conclusions

The outbreak in the NH occurred two weeks after the detection of the index case, lasted for about five

Table 4: Characteristics of the HCWs.

Vaccinal Status	SYMPTOMATICS				ASYMPTOMATICS			
	Not vaccinated	Not vaccinated	Vaccinated	Vaccinated	Not vaccinated	Vaccinated	Vaccinated	Only 1st dose
Days between the last dose and the infection	-	-	19	53	-	54	54	22
Days between the index case and positivization	15	5	14	12	0	14	14	14
Duration of infection	34	50	35	37	55	9	35	41

weeks, without significant differences between those who presented a symptomatic course rather than asymptomatic.

New infections in vaccinated people cannot be excluded due in part to the particular context that sees a high presence of elderly subjects, in which the effectiveness of the vaccine is lower, perhaps due to the reduced ability to respond to vaccination (14).

A significant proportion of guests who had a symptomatic course of the infection were observed among those who had at least 3 out of the five pathologies examined. This indicates a greater risk of symptomatic course, in case of infection, in guests with multiple pathologies which must be carefully protected against contagion.

From the comparison between vaccinated and unvaccinated, although the latter were only 5/61, no significant differences were observed between the risk of infection, and the presence or absence of symptoms of COVID-19, even if the low number of unvaccinated subjects makes it difficult to evaluate. On the other hand, the difference in terms of mortality between vaccinated subjects and subjects who had not completed the vaccination cycle was significant. There were three hospitalized cases among the vaccinated subjects, two of them died.

As preliminary data, the serological study on vaccinated guests showed a median value of 979 (range 52.5- > 2080) BAU / ml (Binding Antibody Unit / ml) in asymptomatic hosts, and a median value of 44.7 (range 4.8 - 134) BAU / ml in symptomatic positive hosts.

This would seem to indicate that those who have shown a valid antibody response are those who, in case of infection, have had asymptomatic courses or with mild symptoms, while the symptomatic courses have occurred in those with lower antibody response.

A large proportion (82.1%) of vaccinated guests had no symptoms of COVID-19, while 96.4% had not died. These data are in line with what is reported in the literature which reports 80% protection from the symptomatic form and 95% protection from the risk of death following vaccination (15).

In June 2021, there were still more than a third of HCWs who had not completed the vaccination cycle. The cumulative incidence of infection was 6.1% among

vaccinated HCWs and 10.5% among non-vaccinated, a difference that was not statistically significant.

The share of HCWs who tested positive was lower than that of guests (7.7% *versus* 55.7%), this difference was almost certainly linked to the different approaches of the two groups towards the structure (16). While for the guests it was configured as a residence, for the HCWs it was instead a workplace, making it easier for the latter to provide protection against infection through the use of personal protective equipment only for the time spent in the structure.

Some important data seem to emerge from this study. It is confirmed the efficacy of the vaccine in limiting the most severe cases and deaths, particularly in frail and elderly subjects; while the absence of statistically significant differences in the frequency of oronasopharyngeal swab positives, between vaccinated and unvaccinated subjects, could be partly due to the small numbers of unvaccinated subjects among the guests.

The difference in the rate of infection between guests and HCWs could be due to the correct use of protective devices to control viral transmission between HCWs, which reduces the risk even among those who are not vaccinated.

However, there is no data relating to the state of immunization due to infections during the first phase of the pandemic in HCWs (17).

Finally, the circulation of a highly transmissible variant such as the Alpha variant, widely present in the months of March (86.7%) and April (91.6%) 2021 in Italy, or the Delta variant, towards which vaccines show a reduced efficacy in preventing infection with SARS-CoV-2 while maintaining a high capacity to prevent severe symptoms and death, is to be considered an important alarm bell in the event that even more capable variants of evading natural or vaccine-induced defenses may emerge (18).

Study Limitations

The sample of this study is small and it could be considered not representative of the actual course of a SARS-CoV-2 infection outbreak in a NH.

We have no data regarding the reasons why some guests did not receive the COVID-19 vaccination.

The data in our possession do not indicate contraindications to vaccination in these subjects, it is therefore likely that they are new guests or some who have refused vaccination.

Conflicts of interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

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