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Flu and COVID-19 Epidemics in USA

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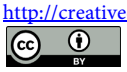

Abstract

We make a study of the influenza and COVID-19 epidemics in the USA (United States of America) for the seasons 2010/11 to 2024/25 for influenza and seasons 2020/21 to 2024/25 for COVID-19. For these, we use the data available from CDC (Centers for Disease Control and Prevention) related to Public Health Laboratory Virologic Age Surveillance and The Burden Estimates presented by CDC yearly.

Keywords

Influenza, COVID-19, Virus Types, Age Groups, Estimates, Laboratory Tests

1. Introduction

Since the season of 2019/2020, COVID19 became a major infectious disease and shares with influenza all aspects of a recurrent epidemic, from seasonal epidemic citizens' behaviour to the interventions from health authorities (see [1]).

Influenza is commonly a seasonal epidemic and it has been present among us for a long time. In general, it occurs in the winter months when the conditions for contagion are greater (see [2] [3]). Influenza viruses have two types which affect humans, A and B. Type A has subtypes according to the antigens HA and NA. Lately, the types A (H1N1), A (H3N2) and B of influenza viruses have co-circulated in all regions of the world (see [4]). The influenza virus is constantly mutating. This change is classified as antigenic drift and shift. The antigenic drift is a small change, but it is possible that the human antibodies do not recognize it and people will become susceptible and get sick again. Otherwise, when antigenic shift occurs a new HA or NA appears then we can have a pandemic. This happened in 2009, where the new virus H1N1 was responsible for the last Influenza pandemic (see [5]-[7]). Although avoiding the contagion is the first care measure, the most relevant prevention procedure is vaccination (see [1] [8]). The vaccination pro-

grams among the countries are updated yearly according to WHO (World Health Organization) guidelines and the recommendation for northern hemisphere is in March and for southern hemisphere is in September (see [9] [10]). The subject of this work (USA) is in the north hemisphere, where the influenza season goes from Week 40 of a year to Week 10 of the following year, which are the Winter months. The vaccination does not avoid the seasonal epidemics, but it can increase the immunity of the more susceptible population, namely youngsters, pregnant women and elders.

The COVID-19 (causative pathogen of Coronavirus Disease 2019 or COVID-19) is a virus belonging to the family of Coronaviridae, able to cause severe respiratory diseases (see [11] [12]). It became a Pandemic which lasted approximately two years starting in the end of 2019 and spreading through the beginning of 2020 where all the world suffered its effects. This was the first time in the modern world influenza was not the main seasonal disease across the world. During those two years, countries restricted mobility by closing frontiers (see [13]). Almost all sectors of society were affected in many aspects, education, commerce, transport, with the purpose of restricting people's contact (see [14]-[16]).

The vaccines developed for COVID-19 had an efficacious effect in decreasing hospitalization (see [17]). However, there is not a consensus about the administration of a dual vaccination, COVID-19 and influenza. Despite some studies showing that influenza vaccination may attenuate the potential of COVID-19 vaccine, the current clinical guideline recommends that COVID-19 vaccination be administered concurrently with a seasonal influenza vaccination (see [18] [19]).

Here we develop a study of the influenza and COVID epidemics in the USA (United States of America) and the study covers the seasons 2010/11 to 2024/25 for influenza and seasons 2020/21 to 2024/25 for COVID-19.

We summarize the rest of this paper: in Section 2, the data analyzed here is explained, in Section 3, we show the statistics of influenza behaviour since 2010/11, in Section 4, the data of COVID-19 since 2020/21 and a study for the two epidemics are presented. In Section 5, we make the conclusion.

2. Data Collection

We use the data provided by the Public Health Laboratory Virologic Age Surveillance of CDC (Centers for Disease Control and Prevention); these data were obtained from CDC network systems:

1) The Respiratory Virus Hospitalization Surveillance Network (RESP-NET) (see [20]).

2) Coronavirus Disease 2019 (COVID-19) Hospitalization Surveillance Network COVID-NET (see [21]).

The influenza strength is estimated according to the virus type and age group. The percentage rates of influenza positive virus specimens reported by Public Health Laboratories in USA are available at the RESP-NET and these rates are used to obtain the Burden Estimates of influenza illnesses. For the age groups, we used the cohorts (0 - 4, 5 - 24, 25 - 64, 65+) so it can keep the focus on the youngers cohort

(age group 0 - 4) and the elder's cohort (age group 65+).

The amount of available data for COVID-19 is much less than that for influenza, whose statistics have been gathering for a long time. Moreover, considering that many of COVID-19 tests are made at home, hence it is not easy to estimate the numbers of positive ones. The data available for COVID-19 are essentially the numbers of hospitalizations, from which the other data are estimated, like the number of positive tests and total burden estimates (see [22]).

3. The Influenza Epidemics

The statistics provided by CDC in USA or any other surveillance systems worldwide do not reflect the actual number of influenza or COVID-19 infected people. The main reason is due to the fact that when people get any ILI (Influenza-Like Illness) symptoms, they do not seek assistance at the first moment, and most of the population with mild symptoms recover without medical assistance.

Our objective here is to study the influenza and COVID-19 strength according to the hospitalization data and positive tests, from where it is possible to estimate the numbers of cases.

We observe in Figure 1 the Burden Estimates of Influenza Illnesses according to age classes. We have here an overall account by age class, but it is not possible to estimate the ages classes with more incidence rate per inhabitant, because the respective populations are not considered.

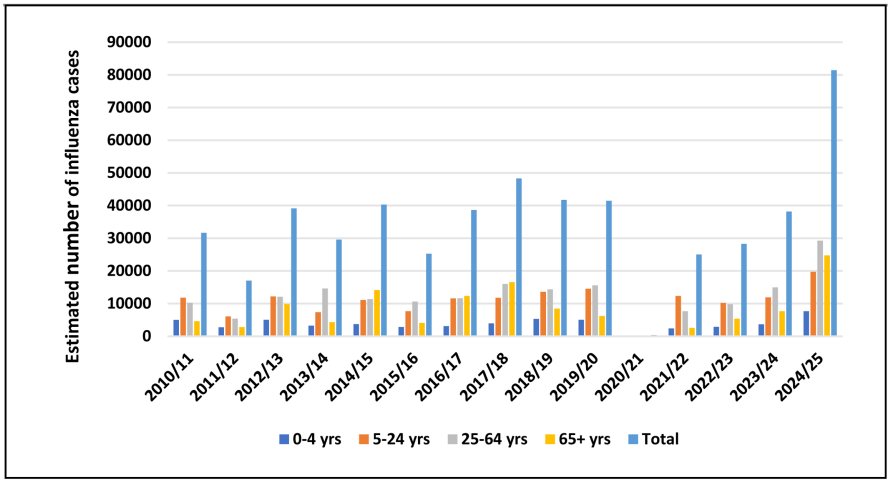

Figure 1. Burden estimates of influenza illnesses 2010/11-2024/25 by age class.

Despite the fact that the analyzed specimens are only a small part of the burden estimate of all infected people with influenza in USA yearly, its percentage distribution by age group and virus type can be applied to the whole population giving a good indicator of the actual total numbers.

We can observe periodic behavior by the total cases over the years. Furthermore, we see that in season 2020/21 the numbers are not relevant, which is due to the lockdown provoked by COVID-19. Also, the peak in present season 2024/25

has been considerably high across all ages (see [23]).

In Figure 2, we have the Distribution of Influenza Positive Specimens from 2010/11 to 2020/25.

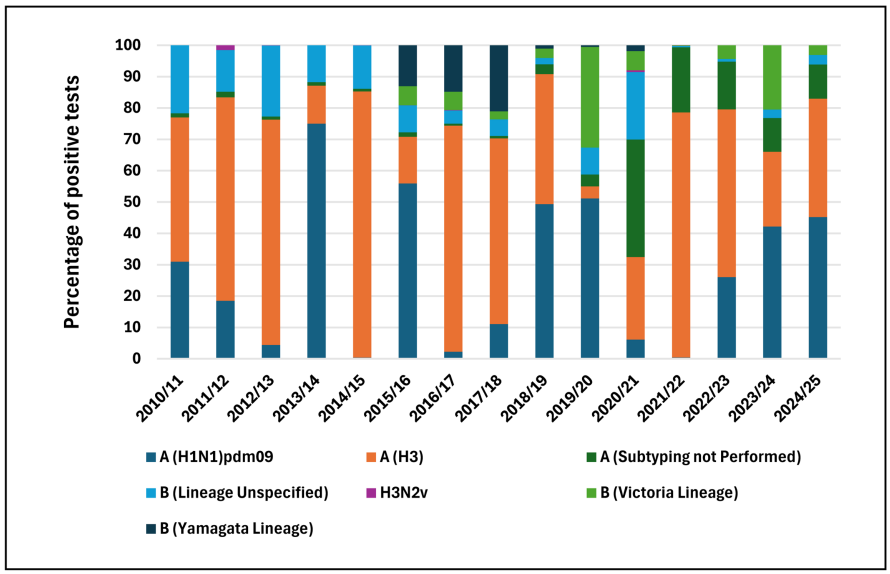

Figure 2. Distribution of influenza positive specimens 2010/11-2024/25.

In Figure 3, the total burden estimates and the respective virus type distribution are presented, these data are obtained by Figure 1 and Figure 2, and we can see that in most of the seasons there is a predominant virus type and that the types A (H3) and A (H1N1) dominate, with B (Lineage Unspecified) and B (Yamagata Lineage) appearing next.

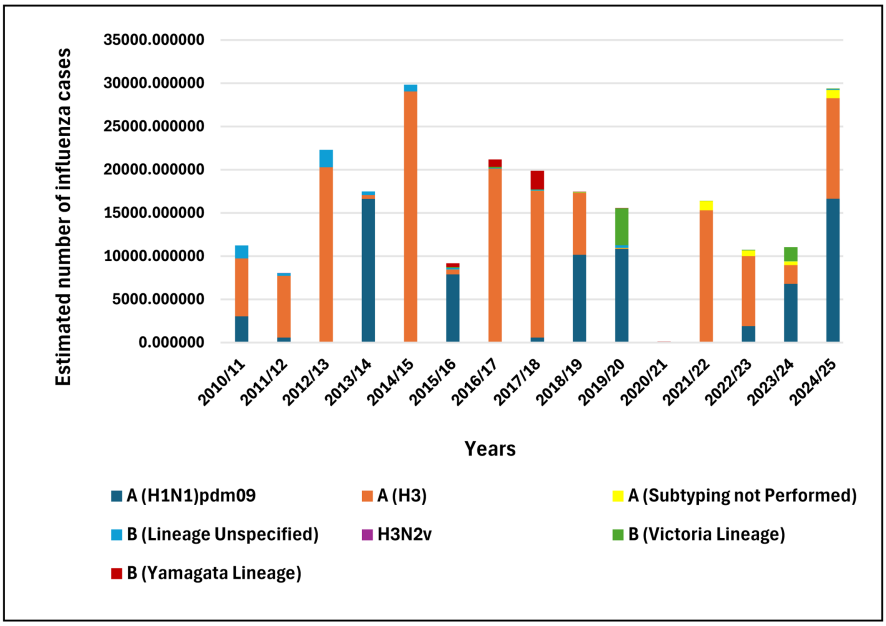

Figure 3. Burden estimates of influenza illnesses by influenza positive specimens 2010/11-2024/25.

In Figure 4, the Burden Estimates by week are considered and in Figure 5, we have the same data for the seasons 2019/20-2024/25, where we can observe, in more details, the peak on the months of December and January, the weeks 50-10 of the year. In the atypical season of 2020/21, we can observe the decrease of incidence, which is due to COVID-19 control measures (see [24]).

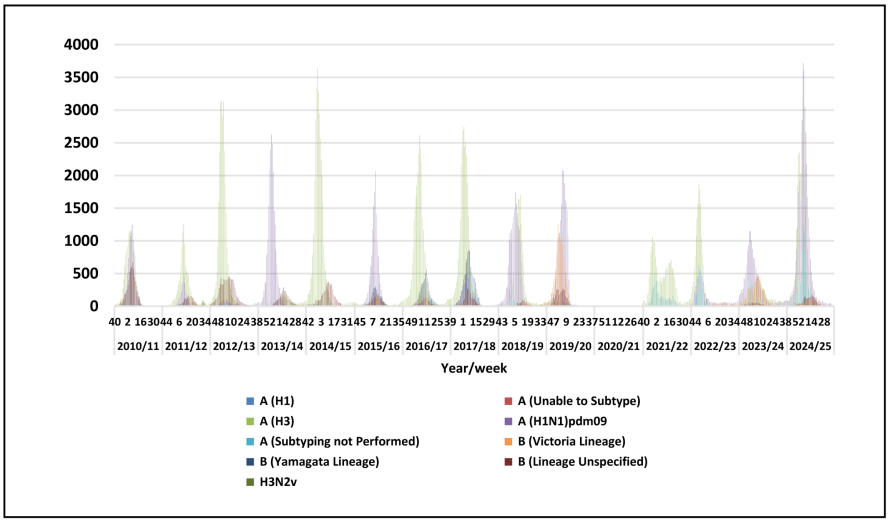

Figure 4. Burden estimates by week 2010/11-2025/25.

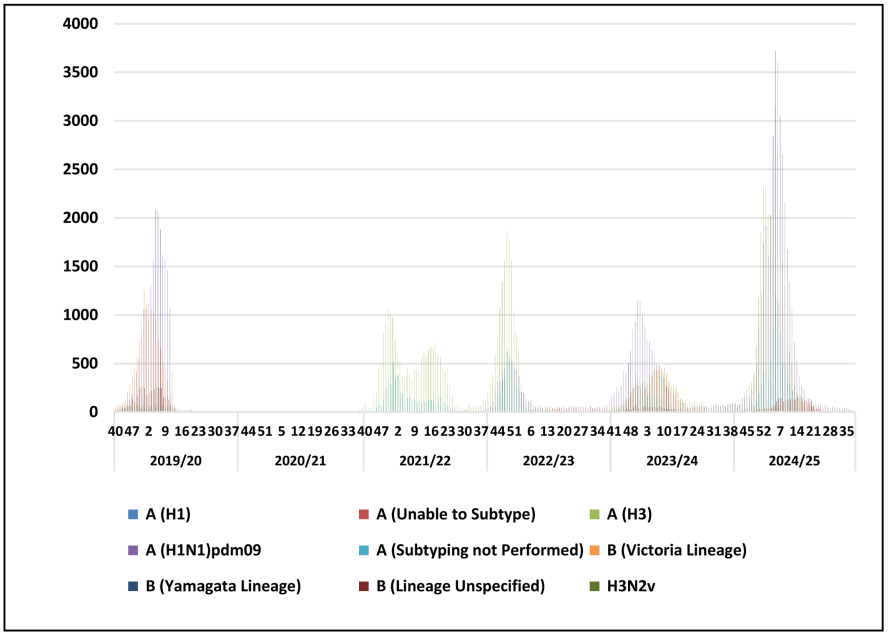

Figure 5. Burden estimates by week 2019/20-2025/25.

In Figure 6, we have the Burden Estimates by month for the seasons 2019/20-2024/25.

In Figure 7, we have the Burden Estimates by the virus types A (H1N1) and A (H3) per 100,000 inhabitants. It can be observed that in general, virus types compete in a way that there is always one which dominates.

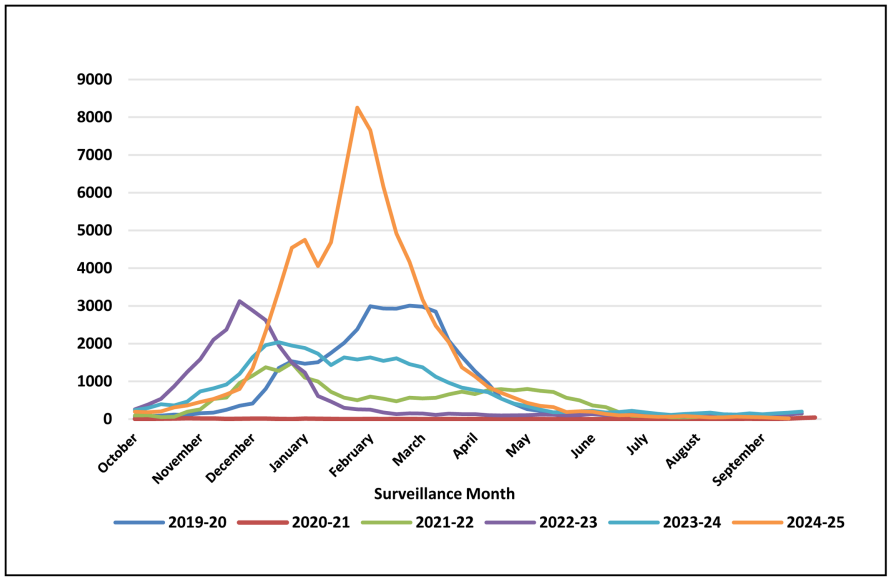

Figure 6. Burden Estimates by month 2019/20-2025/25.

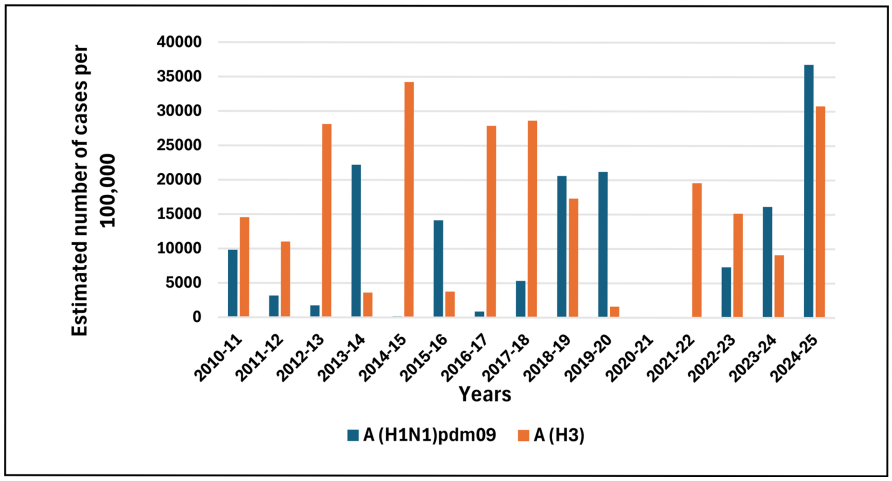

Figure 7. Burden estimates for virus type A (H1N1) and A (H3) per 100,000 inhabitants 2010/11-2018/19.

In Figure 8, we make the same comparison of the Burden Estimates between the virus types A (H1N1) and A (H3) using straight lines. An alternation between the types can be observed. The statistic results point to the fact that the co-circulation of influenza viruses subtypes give cross-immunity to humans and intercede in the competition between the subtypes. The infection of A (H1N1) or A (H3) influenza subtypes gives a partial immunity to the other subtypes of influenza. The mechanism of the viral competition has been investigated under many aspects, such as cross-immunity dynamics [25], mutation and genetic diversion [26], immunity, re-infection and antibody dynamics [27], and mathematical modeling [28].

In Figure 9, we have the Burden Estimates for Virus Type A and B, with subtype and lineage not specified per 100,000 inhabitants. From the comparison between A and B virus types, we can observe that A type has dominance.

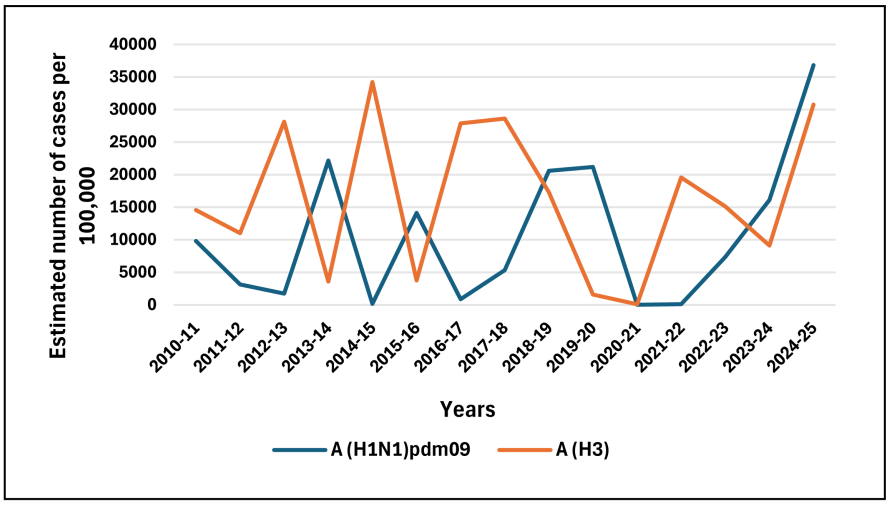

Figure 8. Burden estimates for virus type A (H1N1) and A (H3) per 100,000 inhabitants 2010/11-2018/19 (straight lines).

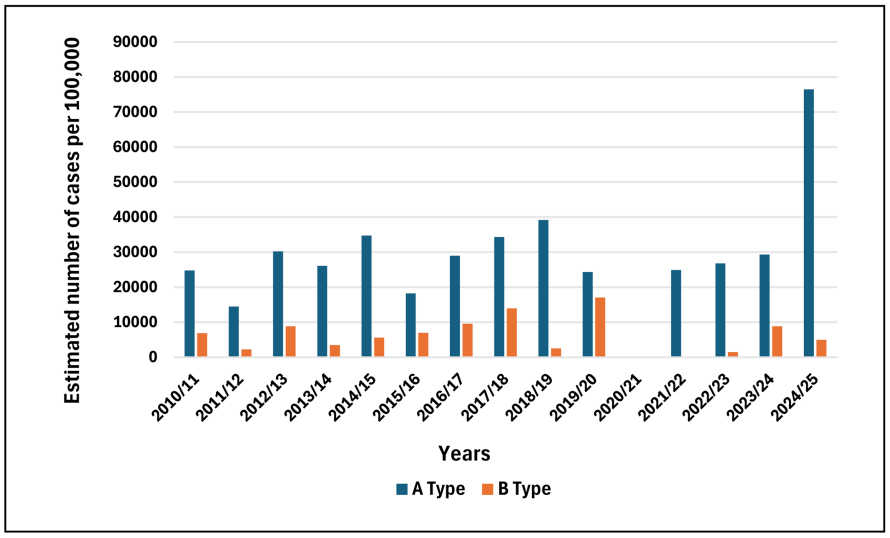

Figure 9. Burden estimates for virus type A and B per 100,000 inhabitants 2010/11-2024/25.

4. Comparing COVID-19 with Influenza

In this section, we present data of COVID-19 since 2019/20 and make a comparison with influenza. COVID-19 were first detected in Wuhan, China in December 2019, the outbreak spread rapidly in the beginning of 2020 all around the world, and in March 2020, WHO declared COVID-19 a pandemic. Countries adopted circulation restrictions, with public health measures implemented to reduce transmission and all society started changing their habit contacts. These were observed in the previous section, where the influenza data for season 2020/2021 was very low due to the lockdown.

The main differences between COVID-19 and influenza are:

1) COVID-19 has a higher transmissibility rate and a longer incubation period, being of 5 - 10 days and 3 - 5 days for influenza.

2) COVID-19 has greater mortality rate, mainly in elders.

3) Seasonable, the influenza is a winter disease and COVID-19 appears in all seasons of the year (see [29], [30]).

In Figure 10, we have the weekly rates of COVID-19 associated with hospitalizations by season (2019/20-2024/25). We can observe in seasons 2019/20 and 2020/21 a huge number, those were the pandemic days. It is interesting to note that this occurred throughout the year, regardless of the season. On the other hand, Influenza cases occurred only in a specific season, the Winter.

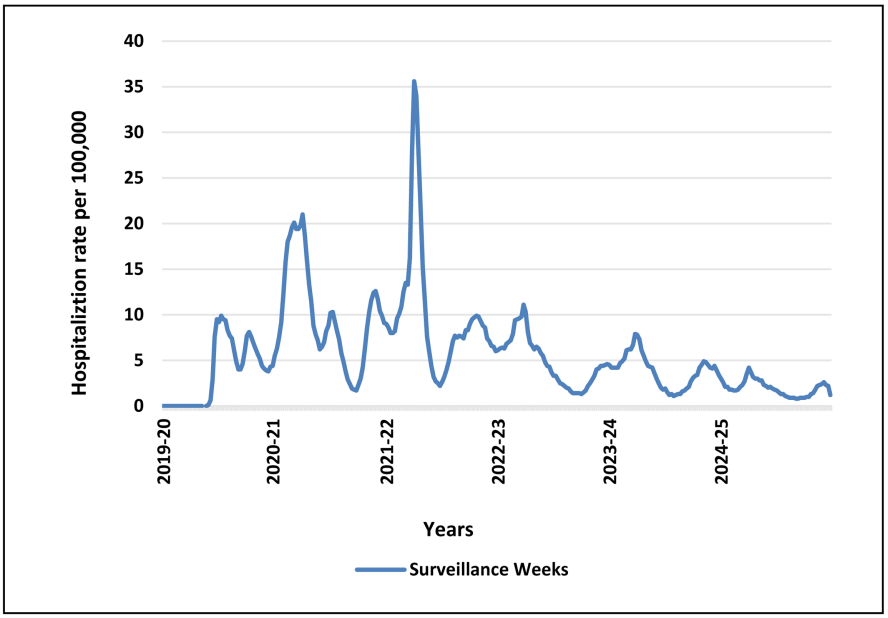

Figure 10. Weekly rates of COVID-19 associated hospitalizations by season (2019/20-2024/25).

We divided Figure 10 into Figure 11 and Figure 12. Then we observe the beginning and the outbreak in Figure 11 and in Figure 12 the last three seasons, where we have descendant trend line of the cases, which is due to public health measures like vaccination, social restrictions and general advice such as masks to avoid contact and reduce transmissions.

In Figure 13 we have the cumulative rates of COVID-19 Associated Hospitalizations by Season (2019/20-2024/25). We observe in blue the season of 2019/20 the beginning of the pandemic COVID-19 in March and that it lasts two years 2020/21 and 2020/21, with a decline in the subsequent seasons.

In Figure 14 we made a comparison between the weekly percentage of positive tests for the viruses that cause COVID-19 and influenza for 2024/25. We can observe that the actual season has been considered strong for influenza and mild for COVID-19, and a fact already observed earlier, that COVID-19 has more than one peak for year, and for what has been observed until now, it has two peaks per year.

Figure 15 has the weekly rates of COVID-19, Flu and combined associated hos-

pitalizations by season (2019/20-2024/25). It can be observed in the COVID-19 pandemic years, the influenza incidence was very low due to the lockdown and subsequent low rate of people contacts.

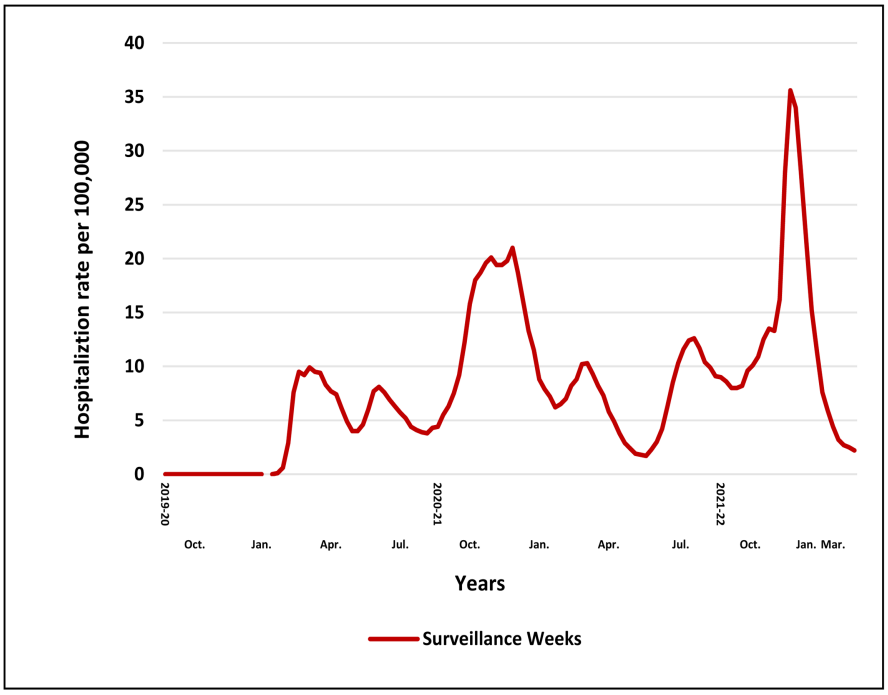

Figure 11. Weekly rates of COVID-19 associated hospitalizations by season (2019/20-2021/22).

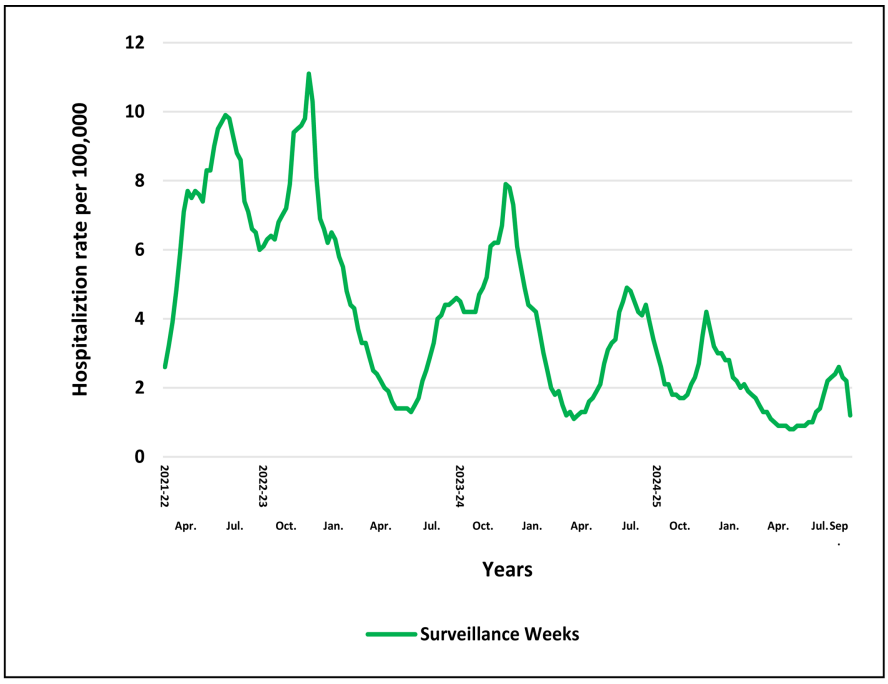

Figure 12. Weekly rates of COVID-19 associated hospitalizations by season (2021/22-2024/25).

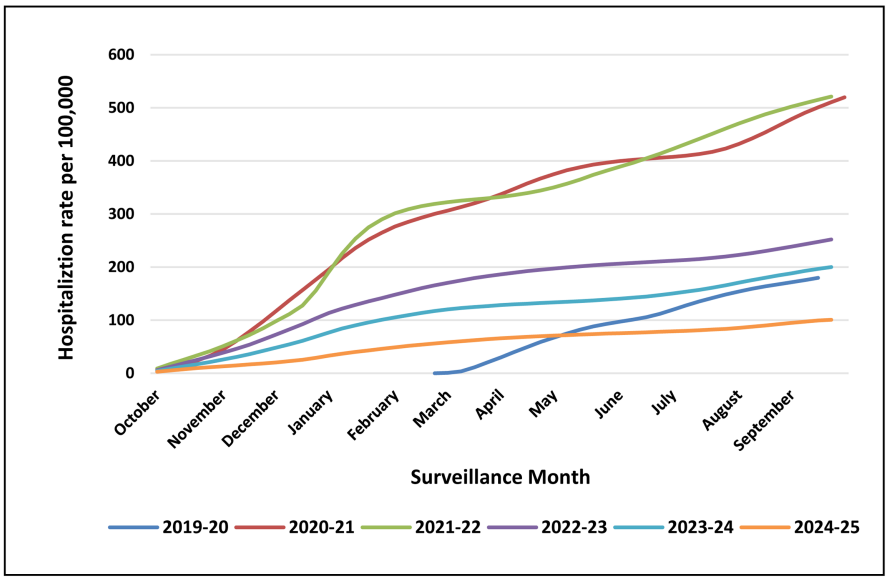

Figure 13. Cumulative rates of COVID-19 associated hospitalizations by season (2019/20-2024/25).

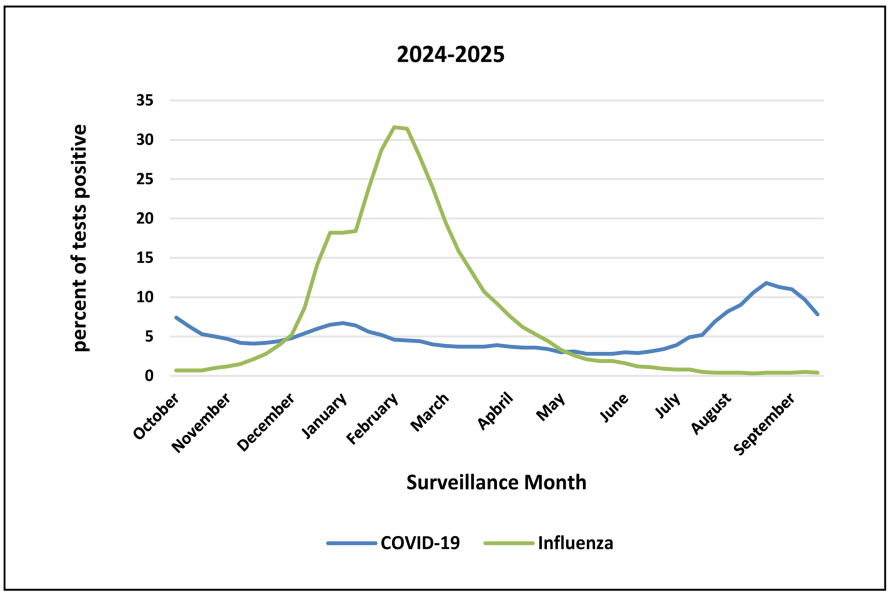

Figure 14. Weekly percentage of positive tests for the viruses that cause COVID-19 and influenza (2024/25).

5. Conclusions

We presented the incidence of influenza and COVID-19 in the USA for the seasons 2010/11-2024/25 and 2019/20-2024/25, respectively. We make a comparison between them presenting the statistics through graphs according to age groups and virus type for influenza and total number of cases, of positive tests and hospitalizations for both epidemics.

It was observed that, contrary to influenza, which is seasonal, COVID-19 appears at any time of the year. Furthermore, data from the last three years show a

decline in COVID-19 incidence. It is still soon to estimate if this will prevail and COVID-19 will become a low-level disease or will continue a major epidemic like influenza.

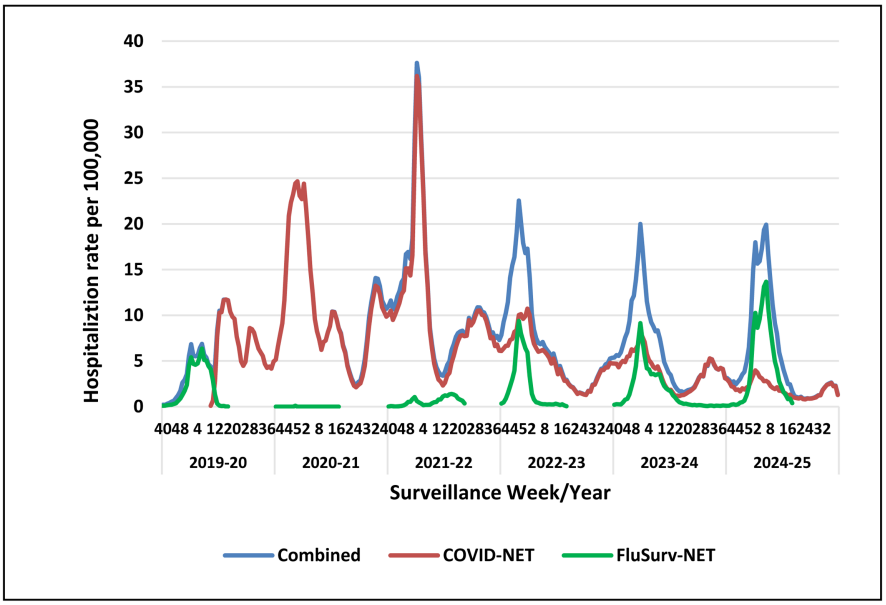

Figure 15. Weekly rates of COVID-19, flu and combined associated hospitalizations by season (2019/20-2024/25).

These trends may be used for future public health strategies on adapting surveillance and coordinating vaccination campaigns for these epidemics.

The analysis made here on estimated surveillance data does not include the unreported cases, which are, generally, of mild illnesses. For influenza, this fact is well known and are estimate by the health organizations like CDC and WHO for their surveillance programs and vaccination campaigns. However, as COVID-19 started a few years ago, the unreported cases cannot be completely measured. We believe that the findings presented here on this issue, according to **Figure 14** and related comments, and also in similar studies, can be used for future public health policies. Furthermore, more studies are needed to understand the dynamic diseases and the necessary measures to coordinate surveillance and vaccination for both epidemics.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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