2024

Fall 2023 COVID-19, Influenza, and Respiratory Syncytial Virus Vaccine Uptake in Kentucky

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Fall 2023 COVID-19, Influenza, and Respiratory Syncytial Virus Vaccine Uptake in Kentucky

THESIS

A thesis submitted in partial fulfillment of the
requirements for the degree of
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By
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ABSTRACT OF THESIS

Fall 2023 COVID-19, Influenza, and Respiratory Syncytial Virus Vaccine Uptake in Kentucky

Background: In the fall of 2023, vaccine recommendations included updated COVID-19 and influenza vaccines, as well as a new vaccine and immunization for respiratory syncytial virus (RSV). Vaccine co-administration, the administration of more than one vaccine in one vaccination session, is safe and effective for COVID-19, influenza, and RSV vaccines and can improve vaccine uptake for all recommended vaccines (Bonanni, et al., 2023; CDC, 2023). The COVID-19 pandemic altered the landscape for locations where people receive vaccinations, and it may be beneficial to public health to have more information on where people are receiving their vaccinations in 2023.

Methods: This cross-sectional study utilized immunization data for Kentucky residents as reported into the Kentucky Immunization Registry (KYIR) from September 1, 2023, to November 30, 2023, for COVID-19, influenza, and RSV vaccinations including the RSV antibody immunization for infants. We studied each of the three vaccines for vaccine uptake and also COVID-19 and influenza co-administration. Analyses included the following indicator variables: age, gender, race, ethnicity, and vaccination location.

Results: Out of 1,273,847 vaccinations analyzed, 298,349 were for COVID-19, 893,811 were for influenza, and 81,687 were for RSV. Out of 859,295 who received either a COVID-19 or influenza vaccine, 138,685 (15.5%) were co-administered. Vaccine uptake for all three vaccines saw peak numbers around early to mid-October. For each of the three vaccines, more females than males were reported receiving them (COVID-19: 55%; influenza: 57%; RSV: 58%) but the odds of co-administration for COVID-19 and influenza vaccines were higher in males (OR (95% CI)*: 1.203 (1.189-1.217)). The majority of all analyzed vaccinations were received by adults aged 60 and older (COVID-19: 67%; influenza: 48%; RSV: 96%), and the odds of co-administration for COVID-19 and influenza were 1.789 times higher for those age 60-74 compared to those aged 18-39.

Conclusion: Influenza vaccine uptake was different from COVID-19 and RSV outcomes in race and age category proportions, and the majority of influenza vaccinations were received in healthcare clinic/hospital settings as opposed to pharmacy settings. Vaccinations were more common in females, but the odds of co-administration for COVID-19 and influenza were higher for males. This data demonstrates a need for further studies on vaccine uptake and co-administration to determine trends and areas for improvement in increasing the co-administration of vaccines.

KEYWORDS: Vaccine Uptake, COVID-19 Vaccine, Influenza Vaccine, RSV Vaccine.

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Analysis of Vaccine Uptake in Kentucky Residents for COVID-19, Influenza, and Respiratory Syncytial Virus (RSV), September 2023 to November 2023

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Introduction

In the United States during the fall of 2023, the Advisory Committee on Vaccination Practices (ACIP) approved and made recommendations for updated COVID-19, influenza, and respiratory syncytial virus (RSV) vaccinations. The Centers for Disease Control and Prevention (CDC) recommended that adults and children aged 6 months and older receive vaccinations for COVID-19 and influenza. Additional recommendations are for high-risk adults 60 and older and pregnant women to receive an RSV vaccination, and high-risk children aged birth to one-year old to receive an RSV antibody immunization (CDC, 2023). Vaccine uptake is not currently known for the updated COVID-19, influenza, and RSV vaccines/immunizations in Kentucky during the fall of 2023 to determine factors related to those with reported vaccinations.

Vaccine co-administration is the process of one individual receiving multiple vaccinations in one visit. Vaccine co-administration can increase the likelihood that a person is up to date on their vaccinations and reduce missed vaccination opportunities (CDC, 2023; Bonanni, et al., 2023). Co-administration of vaccines for COVID-19, influenza, and RSV is generally safe and can increase vaccine uptake of all recommended vaccines (CDC, 2023; Bonanni, et al., 2023). Acceptance of vaccine co-administration was associated with a positive recommendation of co-administration from a healthcare provider (Dolan, et al., 2017). However, adults in the United States are typically hesitant to obtain multiple vaccinations in one visit because of a general lack of knowledge on co-administration (Janssen, et al., 2022; Mercadante & Law, 2021). The implementation of seasonal COVID-19 and influenza vaccines presents an opportunity for the regularizing of vaccine co-administration. Understanding what factors may be related to co-administration of the COVID-19 and influenza vaccines in the fall of 2023 could help guide future communications related to receiving multiple vaccinations in one visit.

The primary locations where the majority of people receive their vaccinations have changed in recent years due to the COVID-19 pandemic. During the pandemic, over 50% of COVID-19 vaccinations in the United States were received in pharmacies, and there was also a rise in the number of influenza vaccinations administered in pharmacies during the pandemic along with a decrease in primary care office vaccinations (Tan, et al., 2022). In the 2011-2012 influenza season, receiving an influenza vaccine in a primary care office was the most common location for adults to be vaccinated (Lu, et al., 2014). It would be valuable for future public health vaccination campaigns to have updated information on where people receive their vaccinations for COVID-19, influenza, and RSV after the COVID-19 pandemic altered the landscape for vaccinations.

To our knowledge, there are currently no other studies that assess vaccine uptake for these vaccines in the state of Kentucky, and studying factors related to barriers to uptake of the newly updated vaccinations can provide important insight and potential interventions for public health. Therefore, this study aims to 1) assess overall

uptake of COVID-19, influenza, and RSV vaccines in Kentucky as reported by the Kentucky Immunization Registry (KYIR); 2) analyze factors that are related to vaccine uptake in the general Kentucky population such as gender, race, ethnicity, age, and vaccination location; 3) analyze vaccine uptake in adults age 60 and older; and 4) analyze factors related to COVID-19 and influenza vaccine co-administration. People who work with vaccinations and vaccine uptake in Kentucky are encouraged to utilize this data to inform future vaccination studies and education campaigns.

Methods

Our cross-sectional study used data obtained from KYIR for all reported COVID-19, influenza, and respiratory syncytial virus RSV vaccinations for Kentucky residents between September 1, 2023 and November 30, 2023. We wanted to focus on the fall for these analyses because that is when the vaccinations were being recommended, and this timeframe includes dates when the updated vaccines were beginning to be administered. We only included observations where the patient's address state was Kentucky to limit the sample to only Kentucky residents. The data used for these analyses was received de-identified with the patient's date of birth, address, parental data, and next of kin data all removed. This project was reviewed by the Kentucky Department of Public Health, and it was determined that approval from the Institutional Review Board (IRB) was not necessary. We analyzed a total of 1,273,847 COVID-19, influenza, and RSV vaccinations reported to KYIR that were administered between September 1, 2023, and November 30, 2023. Of all the reported vaccinations, 298,349 were for COVID-19, 893,811 were for influenza, and 81,687 were for RSV. A subset of these data (859,295 observations) contains COVID-19 and influenza vaccinations with observations removed that were missing age, gender, race, or ethnicity were also used for analysis.

KYIR receives reports of newly administered and historical vaccinations from healthcare centers/clinics, hospitals, pharmacies, the Office of Vital Statistics, and local health departments. Historical vaccinations are those entered by a healthcare professional at a patient visit after the vaccination has occurred. Only federally purchased vaccinations, such as those for Medicare, Medicaid, or Veterans Affairs, are required to be reported in KYIR, though many healthcare centers, health departments, and pharmacies have policies regarding regular reporting of their vaccinations given. The KYIR data that was used for analyses included the following variables: age, gender, race, ethnicity, county of residence, type of vaccine received, vaccination details (historically added or newly administered), date of vaccine administration, and the vaccination clinic name.

Age was converted to a categorical variable for analyses with the categories 0-17, 18-39, 40-59, 60-74, and 75 years and older for compatibility in comparisons with other sets of vaccination data. These age categories were chosen based on the

traditionally used categories for influenza immunization reporting by the CDC. Vaccine administered date was converted from individual dates to the month of vaccination for the creation of the bar charts. Vaccination location was broken down into the following categories: pharmacy, healthcare clinic/hospital, government agency (including health departments and Veterans Affairs clinics), long-term care facilities, correctional facilities, and 'other'. The 'other' category contained locations that did not fall under the other category types and those listed as "Patient Record" that were likely historically entered vaccinations. Categorization of vaccination location was based on keywords in the vaccination clinic name variable. Keywords were chosen on an individual/group basis. Some examples of keywords used for categorizations include: "kroger," "department," "university," "va," "vet," and "healthcare."

Our cross-sectional study utilized immunization data reports from KYIR for residents of the state of Kentucky between the ages of 0 and 109. The main outcome variable studied was vaccine uptake, defined as the number of people vaccinated with a certain dose of the vaccine in a certain time period. The predictor variables used in analyses were age, gender, race, ethnicity, and vaccination location. The data was received and cleaned using data filtering in Microsoft Power BI Desktop version 2.124.2028.0. Spatial analyses and graphs were created with the use of web authoring on Tableau Public from Salesforce. Statistical analyses were developed using R from the R Core Team. Descriptive data analyses in R revealed demographic breakdowns of the populations receiving each vaccine, as well as details on the type of location where vaccinations were received. A combination of analyses in R and calculations in Microsoft Excel provided the background data for spatial analyses in vaccine uptake that were represented with geographic imaging in Tableau Public (Tableau Software, LLC, 2024). Using county population data obtained from the census data for Kentucky from July 1, 2023 and vaccination counts, incidence rates were calculated in Microsoft Excel and used for the spatial analyses in Tableau Public.

Additional analyses were conducted using a subset of data that combined COVID-19 and influenza vaccination data to yield information on co-administration. RSV was not included in the logistic regression analyses because the age ranges for RSV vaccination are inconsistent with the continuous age variable for COVID-19 and influenza, and RSV vaccination counts are much lower. Logistic regression models were created to analyze different covariates potentially relating to odds of vaccination for COVID-19 and influenza. The predictor variables used in the univariate regression models included gender, age range, race, and ethnicity to assess the influence each has on the outcome variable: co-administration of the COVID-19 and influenza vaccines.

Results

298,349 Kentucky residents received COVID-19, 893,811 received influenza, and 81,687 received RSV vaccinations/immunizations during the study period that were reported in KYIR. More vaccinations were reported for females than males for all three vaccines, and the U.S. Census Bureau (2023b) shows that as of July 1, 2023, females made up 50.3% of Kentucky's population. The logistic regression analysis also found that the odds of co-administration for COVID-19 and influenza were actually higher in males than females (OR (95% CI): 1.203 (1.189-1.217)).

This study found that a majority of the Kentucky resident COVID-19, influenza, and RSV vaccinations reported in KYIR for the fall of 2023 were for older adults. The demographic breakdown of the subset of adults aged 60 and older was similar to the total sample demographics and about 73% of that subset were between the ages of 60 and 79. The average age for each of the three vaccines (COVID-19, influenza, and RSV) was 61, 51, and 71, respectively. It was found that these three vaccinations occurred most commonly in the 60-74 age range and the odds of co-administration of the COVID-19 and influenza vaccines for this group were also the highest of any of the age groups (OR (95% CI): 1.789 (1.755-1.824)) when compared to those aged 18-39. In July of 2023, adults aged 65 and older made up only 17.6% of the population of Kentucky (U.S. Census Bureau, 2023b).

The odds of co-administration of COVID-19 and influenza were found to be statistically significant for all covariates. The odds of co-administration were 2.517 times higher for those who reported having multiple races compared with Whites and 1.55 times higher for those who were not Hispanic or Latino compared to those who were reported as Hispanic or Latino. Blacks/African Americans had slightly lower odds of co-administration when compared with Whites (OR (95% CI): 0.958 (0.924-0.993)).

In all Kentucky residents who received at least one of the three vaccinations during the study period that got reported into KYIR, most COVID-19 (79.6%) and RSV (90.0%) vaccinations were received in the pharmacy setting. For influenza vaccinations, the most common vaccination location was healthcare clinics/hospitals (52.6%), followed by pharmacies (40.6%). Between 1% and 2% of all reported COVID-19 and influenza vaccinations were received in a government agency, meaning a health department or VA clinic.

For the spatial analyses, vaccination rates were higher in the central/northern regions of Kentucky for COVID-19 and RSV. It was also found that vaccine uptake for all three vaccinations began to peak in early to mid-October, with a small spike at the end of November for COVID-19 and influenza. COVID-19 vaccine uptake stays relatively high and appeared to drop around Thanksgiving time, and then uptake rose to "normal" levels the following week. Influenza vaccinations rose very steadily from the beginning of the study period, peaked in the middle of October for about two weeks, and then steadily declined.

Table 1. Demographics by vaccine received, September 1, 2023 to November 30, 2023 (Kentucky Immunization Registry)

Demographics	COVID-19 (N=298,349)	Influenza (N=893,811)	Respiratory Syncytial Virus (RSV) (N=81,687)
	N (%)	N (%)	N (%)
Gender			
Male	133,899 (44.88)	382,971 (42.85)	34,440 (42.16)
Female	164,427 (55.11)	510,701 (57.14)	47,243 (57.83)
Missing/Unknown	23 (0.01)	139 (0.02)	4 (0.01)
Race			
American Indian/Alaska Native	67 (0.02)	388 (0.04)	17 (0.02)
Asian/ Native Hawaiian/Other Pacific Islander	1249 (0.42)	8,370 (0.94)	119 (0.13)
Black/African American	7,631 (2.56)	35,771 (4.0)	871 (1.07)
White	93,657 (31.39)	415,801 (46.52)	22,894 (28.03)
Multiple Races	184,608 (61.88)	389,470 (43.57)	55,079 (67.43)
Other	10,171 (3.41)	33,086 (3.7)	2,390 (2.93)
Missing/Unknown	966 (0.32)	10,925 (1.22)	317 (0.39)
Ethnicity			
Hispanic/Latino	6,948 (2.33)	33,487 (3.75)	1,154 (1.41)
Not Hispanic/Latino	281,770 (94.44)	824,874 (92.29)	78,185 (95.71)
Missing/Unknown	9,631 (3.23)	35,450 (3.97)	2,348 (2.87)
Age *mean*	*61*	*51*	*71*
0-17	13,125 (4.4)	146,079 (16.34)	2,174 (2.66)*
18-39	27,963 (9.37)	130,546 (14.61)	544 (0.67)
40-59	56,493 (18.94)	183,931 (20.58)	208 (0.25)
60-74	122,209 (40.96)	270,591 (30.27)	47,002 (57.54)
75+	78,559 (26.33)	162,664 (18.2)	31,759 (38.88)
Vaccination location			
Pharmacy†	237,493 (79.6)	363,060 (40.62)	73,552 (90.04)
Healthcare clinic/hospital‡	53,064 (17.79)	470,435 (52.63)	7,105 (8.7)
Government agency§	4,227 (1.42)	15,670 (1.75)	239 (0.29)
Long-term care facility	120 (0.04)	505 (0.06)	21 (0.03)
Correctional facility	417 (0.14)	2,378 (0.27)	0 (0.0)
Other|	3,028 (1.01)	41,763 (4.67)	770 (0.94)

Notes

* 2,166 (2.65% of total) are aged 0-1.

† Includes drug stores and grocery stores like Walmart, Kroger, etc.

‡ Includes pediatric clinics.

§ Health departments and Veterans Associations.

| Vaccination clinic was not reported or not able to be categorized.

Table 2. Demographics and COVID-19, influenza, and respiratory syncytial virus (RSV) vaccination counts, Kentucky residents aged 60 and older, September 1, 2023 to November 30, 2023 (Kentucky Immunization Registry)

Demographics	Kentuckians aged 60 and older (N=474,708)
	N (%)
Gender	
Male	191,685 (40.38)
Female	242,450 (51.07)
Missing/Unknown	40,573 (8.55)
Race*	
American Indian/Alaska Native	71 (0.01)
Asian/Native Hawaiian/Other	1,049 (0.23)
Pacific Islander	
Black/African American	11,074 (2.33)
White	184,771 (38.92)
Multiple Races	227,220 (47.87)
Other	8,686 (1.83)
Missing/Unknown	1,293 (0.27)
Ethnicity	
Hispanic/Latino	5,457 (1.15)
Not Hispanic/Latino	417,707 (87.99)
Missing/Unknown	51,544 (10.86)
Age	
60-69	180,327 (37.99)
70-79	165,457 (34.85)
80-89	64,116 (13.51)
90 and older	9,948 (2.1)
Vaccinations	
COVID-19	202,536 (42.67)
Influenza	434,164 (91.46)
Respiratory Syncytial Virus (RSV)	79,782 (16.81)
All three vaccines	50,406 (10.62)

Table 3. Logistic regression analyses of COVID-19 and influenza vaccine co-administration, September 1, 2023 to November 30, 2023 (Kentucky Immunization Registry)

Sociodemographic Variables	COVID-19 and Influenza Vaccine Co-administration (N=138,685*)	
	Univariate Odds Ratio (95% Confidence Interval)	p-value
Gender		
Female (*ref*)	--	--
Male	1.203 (1.189-1.217)	<0.001***
Race†		
White (*ref*)	--	--
Black/African American	0.958 (0.924-0.993)	0.0196*
Multiple Races	2.517 (2.486-2.549)	<0.001***
Other	1.063 (1.024-1.102)	0.001**
Ethnicity		
Hispanic or Latino (*ref*)	--	--
Not Hispanic or Latino	1.55 (1.497-1.604)	<0.001***
Age		
18-39 (*ref*)	--	--
0-17	0.424 (0.412-0.436)	<0.001***
40-59	1.417 (1.388-1.447)	<0.001***
60-74	1.789 (1.755-1.824)	<0.001***
75+	1.587 (1.554-1.621)	<0.001***

Notes
Missing/Unknown data were removed for this analysis.
Significance levels: *** 0.001; ** 0.01; * 0.05
* Comparison is out of 859,295 that were reported receiving either a COVID-19 or an influenza vaccination in this time frame.
† Race categories with less than 1% representation were categorized as “Other” for these analyses.

Figure 1. COVID-19, influenza, and respiratory syncytial virus (RSV) vaccine uptake by month, September 1, 2023 to November 30, 2023 (Kentucky Immunization Registry)

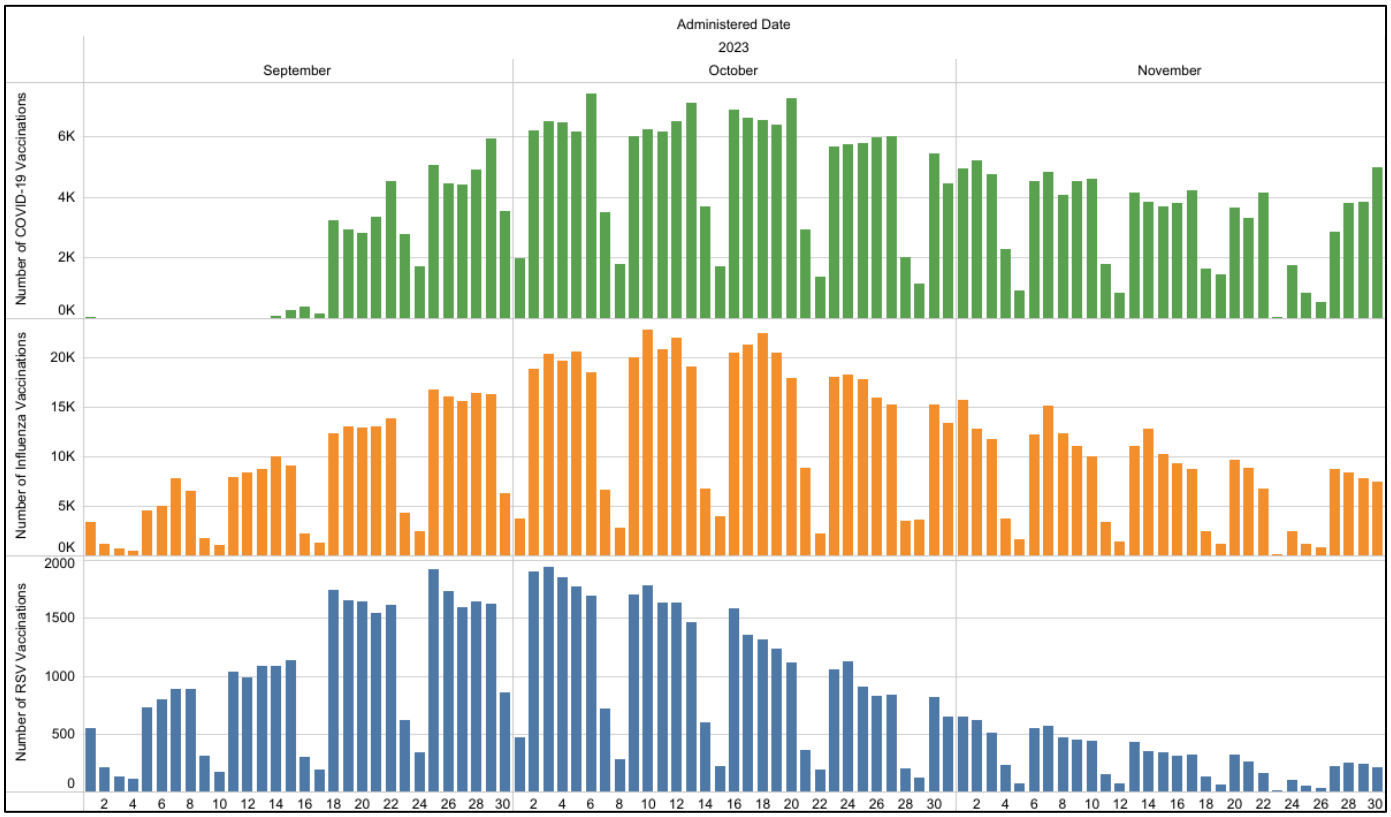


Figure 2a. Rates of COVID-19 vaccine uptake by county in Kentucky, September 1, 2023 to November 30, 2023 (Kentucky Immunization Registry)

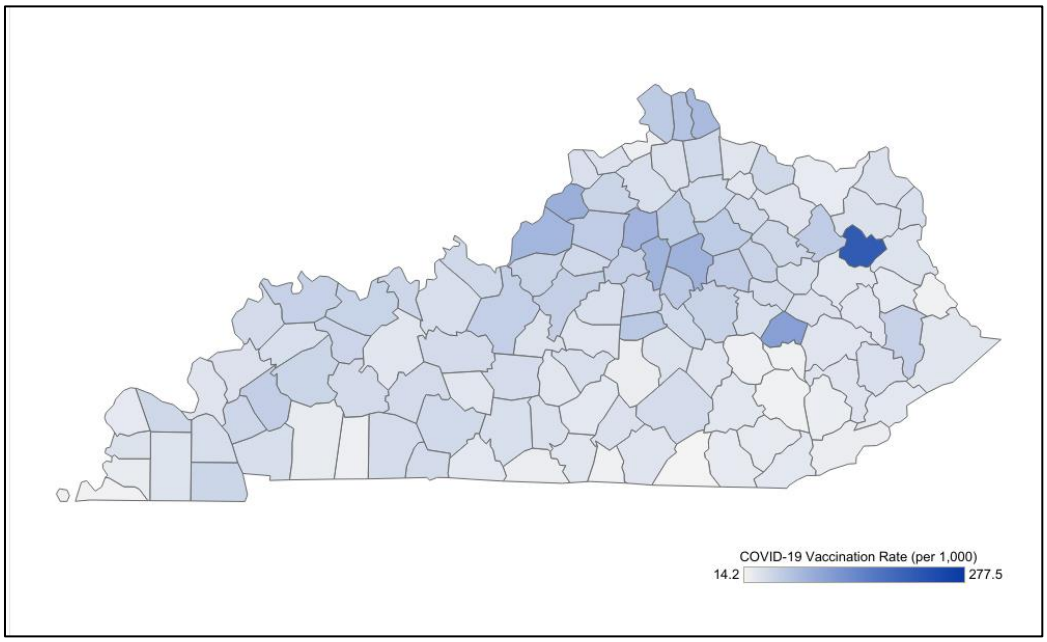


Figure 2b. Rates of influenza vaccine uptake by county in Kentucky, September 1, 2023 to November 30, 2023 (Kentucky Immunization Registry)

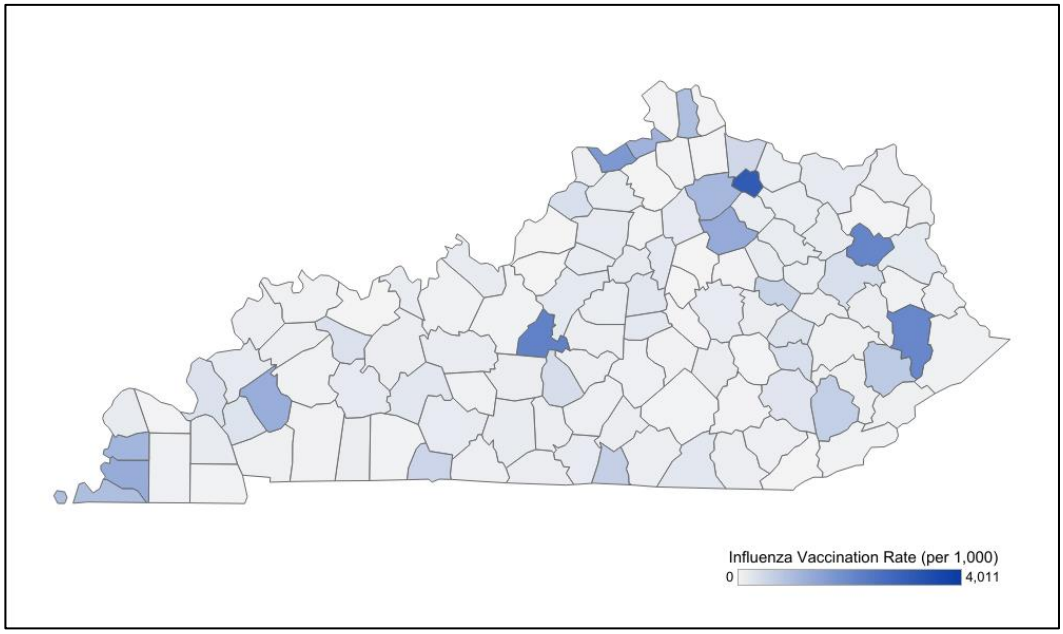
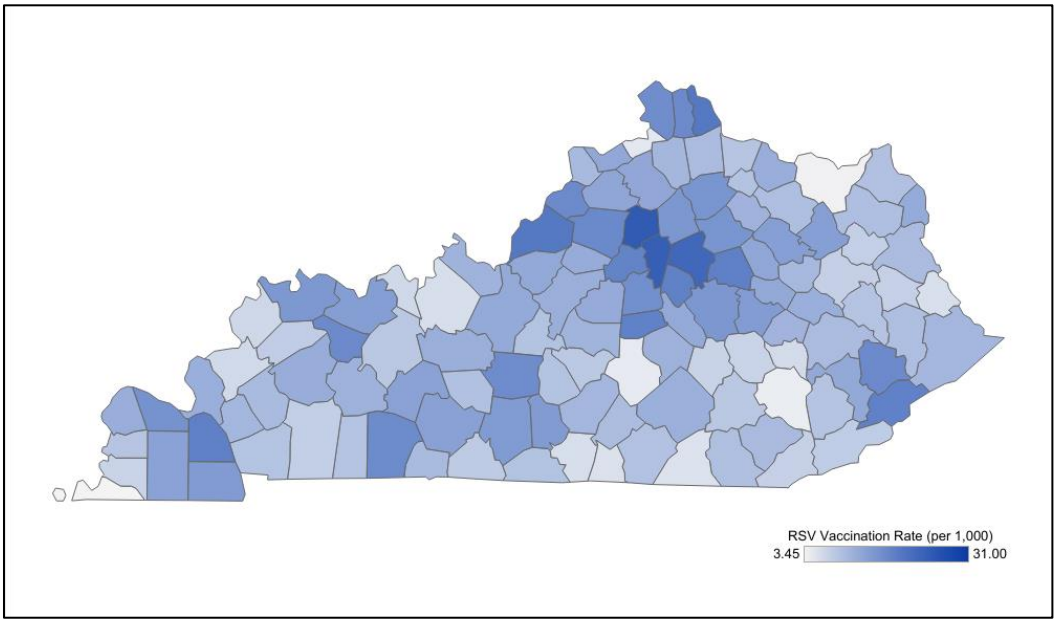


Figure 2c. Rates of Respiratory Syncytial Virus (RSV) vaccine uptake* by county in Kentucky, September 1, 2023 to November 30, 2023 (Kentucky Immunization Registry)



* This map reflects RSV vaccine uptake for whole county populations, while the population recommended to receive RSV vaccination only includes individuals aged 0-1 years-old, 60 and older, and child-bearing aged females.

Discussion

The objective of this cross-sectional study was to analyze COVID-19, influenza, and RSV vaccine uptake for Kentucky residents. To our knowledge, this is the first study of seasonal vaccine uptake to include COVID-19, influenza, and RSV in Kentucky. Vaccination for each of the three vaccines was more common among the age group 60-74, females, and people of multiple races. Influenza had different outcomes than COVID-19 and RSV, in that influenza vaccination was most common in the White race and only slightly higher in the 60-74 age range than other age groups (30.2%) compared with COVID-19 vaccinations (41%) and RSV vaccinations (52%) in that age group. Further studies will be needed to determine if these three vaccinations are more commonly received in older adults in Kentucky, or if there are other factors related to vaccination and co-administration of vaccines like early adoption or more frequent reporting of vaccinations in older adults.

The majority of COVID-19 and RSV vaccinations (COVID-19: 79.6%, RSV: 90.04%) were received in a pharmacy setting, which has been an increasingly popular vaccination location choice in recent years (Tan, et al., 2022). Influenza vaccinations were primarily received in healthcare clinic/hospital settings (52.63%), with only 40.62% received in pharmacies. The higher proportion of influenza vaccinations being received in healthcare clinics/hospitals is consistent with previous findings from before the COVID-19 pandemic that say that influenza vaccinations were most commonly received in primary care offices (Lu, et al., 2014).

Almost all reported RSV vaccinations were among those aged 60 and older (96.42%), with 2.65% among children aged zero to one for the RSV antibody immunization, which is in line with the CDC recommendations for RSV vaccination (Centers for Disease Control and Prevention (CDC), 2024). It is likely that the small proportion of RSV vaccinations that were received outside the ages of 0-1 and 60 and older were pregnant women, as RSV vaccination was recommended for this group as well.

In this study, county-level incident vaccination rates were calculated for each of the vaccines of interest that reflected that there could be geographic disparities in vaccine uptake that should be studied further. Vaccination rates seemed to be higher in the central/northern regions of Kentucky for COVID-19 and RSV but having vaccination data not limited to what is reported in KYIR could have yielded clearer trends. We were unable to obtain population data for only the populations for which RSV vaccination is recommended, and so the incidence rates calculated for Figure 2c are not representative of true vaccine uptake rates for the study period.

Comparison with existing studies is difficult due to the nature of data collection methods and a lack of existing studies conducted with Kentucky residents. One limitation that we found was the inability to decipher long-term care facility vaccinations with pharmacy vaccinations, due to partnerships between long-term care facilities and pharmacy chains to do seasonal vaccinations. This could have created inflated numbers of pharmacy vaccinations and the minimal long-term care facility vaccinations found in the study. Another limitation is the use of a cross-sectional study design, which greatly limited the exploratory analyses to what variables were provided in KYIR. Use of KYIR was also a limitation, because not all vaccinations given in Kentucky are reported in KYIR and historically entered vaccinations provide even less information on the vaccination given.

There were also some difficulties in the study with paring down vaccination location categories involved searching for specific keywords in the Vaccination Clinic Name variable. This was done manually by using the least text required to be able to categorize all of one similar location to the same category. For example, University of Kentucky clinics and hospitals required the keywords “university” and “ukhc”, in addition to the other base keywords used such as “hospital”, “hosp”, “clinic”, and others to be able to successfully categorize all of the different locations reported.

This study highlighted areas of success and areas that need improvement for vaccination levels for COVID-19, influenza, and RSV. Further studies should be done to find more information on factors that influence getting vaccinated versus not getting vaccinated, as well as more in-depth studies on the factors that influence co-administration of vaccinations.

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