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Session: 278. Vaccines: Influenza
Saturday, October 5, 2019: 12:15 PM

Background: Influenza vaccination has been shown to reduce influenza risk in pregnant women and their infants who are not yet age-eligible for vaccine. Ascertainment of vaccination history is important for vaccine safety and effectiveness evaluations. Our goals were to (a) determine coverage, location, and timing of maternal influenza vaccination and (b) compare a subset of self-reported influenza vaccinations with documented vaccine records.

Methods: We enrolled children < 18 years. with acute respiratory illness in 7 pediatric hospitals and emergency departments in the New Vaccine Surveillance Network from December 1, 2016 to October 31, 2018. We interviewed all mothers of enrolled infants < 1 year, and obtained mother's influenza vaccine information while pregnant. As an option, sites obtained maternal influenza vaccine records from reported sources (e.g., registries, provider records, pharmacies).

Results: Among 5,458 mothers, 2,944 (54%) self-reported receiving influenza vaccine during pregnancy (57% in 2016–2017; 51% in 2017–2018), varying from 49% to 74% by site. Among self-reported vaccinees, 17%, 36%, and 47% received vaccine during their first, second, and third trimester, respectively. Most women (76%) were vaccinated at their OB/GYN or midwife office, 7% at their primary care provider, 7% at their workplace, and 5% at a retail pharmacy. Among 1,338 infants < 6 months. during early influenza season (i.e., born from June to August) and thus ineligible for vaccination, only 46% of mothers reported receiving vaccine during pregnancy (42% reported not receiving it, 12% were unsure). Of 2,242 women for whom vaccine verification was attempted, 1,491 (67%) self-reported receiving influenza vaccine during pregnancy; of those, documentation of vaccine receipt was found for 901 (60%).

Conclusion: Influenza vaccination coverage among pregnant women was suboptimal, potentially increasing the risk of influenza in unvaccinated pregnant women. Infants born to unvaccinated women, particularly those born from June to August, may also be at higher risk since they are not age-eligible to receive vaccine before influenza season. The optimal approach to ascertainment of maternal vaccination history with accuracy and completeness merits further investigation.

Disclosures. **All authors:** No reported disclosures.

2739. Comparison of Hemagglutination Antibody Inhibition (HAI) Titers Following Influenza Vaccination by Birth Cohort and Repeated Influenza Vaccination History

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Session: 278. Vaccines: Influenza
Saturday, October 5, 2019: 12:15 PM

Background: The host immune response to influenza vaccination can be affected by prior imprinting to a specific influenza strain based on birth cohort and prior influenza vaccination history. Understanding the underlying immune mechanisms is essential to development of an improved seasonal vaccine and an effective universal influenza vaccine.

Methods: This is a prospective pilot study, with a total of 20 subjects in either the H3N2 cohort (N = 10, born 1968–1977) or the H1N1 cohort (N = 10, born 1948–1957). Each cohort was further stratified by subjects who have received the influenza vaccine < 2 or ≥ 3 of the past 5 years. The FDA-approved quadrivalent 2018–19 influenza vaccine (containing A(H1N1), an A/Michigan/45/2015-like virus; A(H3N2), an A/Singapore/INFIMH-16–0019/2016-like virus; B/Colorado/06/2017-like virus; and B/Phuket/3073/2013-like virus) was administered on Day 1. Demographic information included age, gender, ethnicity, and BMI. HAI titers for each component of the vaccine were obtained at baseline, 29 days post-vaccination, and 180 days post-vaccination. HAI fold-change and HAI geometric mean titers (GMT) were analyzed.

Results: There was no significant difference between H1N1 or H3N2 HAI fold-change in the H3N2 birth cohort (P = 0.7496) or in the H1N1 birth cohort (P = 0.8237), Figure A. Comparing HAI fold-change for the repeatedly vs. minimally vaccinated groups, there was a significant higher fold change in the minimally vaccinated group (H1N1 HAI (P = 0.002) and H3N2 HAI (P < 0.0001), Figure B). GMT was higher at baseline for the repeatedly vaccinated group (H1N1, 70; H3N2, 98; vs. H1N1, 30; H3N2, 21 for the minimally vaccinated group); however, the GMT for the minimally vaccinated group was higher at day 29 (H1N1, 172; H3N2, 184; vs. H1N1, 422; H3N2, 299 for the minimally vaccinated group; Figure C). HAI titers and analysis at day 180 post vaccination are in progress.

Conclusion: There was no evidence of an imprinting effect by birth cohort for HAI titer magnitudes, even when stratified by vaccination history. There was a significantly higher HAI fold change for individuals who had received minimal influenza vaccinations in the past 5 years at 29 days post-vaccination. Individuals who had repeated vaccinations in the last 5 years had higher HAI GMT at baseline.

Disclosures: Nadine Rouphael, MD, Merck: I conduct as Emory PI the PNEUMO MERCK study at Emory, Research Grant; Pfizer: I conduct as co-PI the RSV PFIZER study at Emory, Research Grant; Sanofi-Pasteur: I conducted as Emory PI the CDIFFENSE trial at Emory, Research Grant.

2740. Using Machine Learning Methods to Identify Factors Associated with Pregnant Women Receiving the Influenza Vaccine during 2017–2018

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Session: 278. Vaccines: Influenza
Saturday, October 5, 2019: 12:15 PM

Background. Pregnant women are recommended for influenza vaccination because they are at higher risk of severe illness, and to protect their babies before they are old enough to receive the vaccine. Traditional statistical methods have been used to identify factors associated with vaccination, but programmatic efforts to increase vaccination coverage may be enhanced by machine learning methods that optimize prediction.

Methods. Using data from an Internet panel survey of pregnant women (n = 1,771), we used a random forest classification model to identify the strongest predictors of receiving influenza vaccination using the Gini Mean Decrease Score. The higher the Score, the more important an attribute is in predicting the outcome. Forty-three attributes inputted into the model included demographic, economic, healthcare provider related, health related, and knowledge, attitudes and practices related to influenza and influenza vaccine. The majority (70%) of our data were used to train the model and the rest were used to validate how well it performed by using model performance measures (e.g., accuracy, sensitivity, specificity).

Results. ***Our model had an accuracy of 84% (95% CI:*** 82%, 86%), sensitivity of 89% and specificity of 79%. The most important attribute was the belief that pregnant women should get the flu shot (Gini Score: 457), the second was due date (September–October 2017 and September–October 2018 had low probability of vaccination, Gini Score: 275), and the third was being offered the vaccine by a healthcare provider (Gini Score: 196).

Conclusion. Analyzing data using machine learning techniques may bring new insights for vaccination campaigns. Our results suggest that a provider recommendation is important, but perhaps even without a recommendation, women who form their own beliefs about need for vaccination may also be more likely to get vaccinated. Also, pregnant women and women of childbearing age should be targeted for vaccination during each fall, and for those with due date early in the flu season, providers should stress the importance of maternal vaccination for protection of the infant since the baby will be <6 months old during peak influenza season, when they are most vulnerable but would benefit from maternal antibodies.

FIGURE A

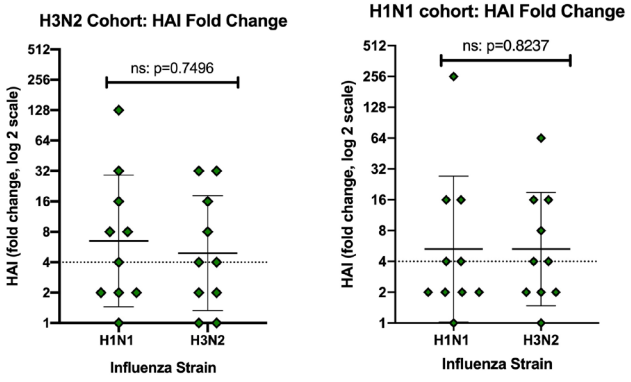


FIGURE B

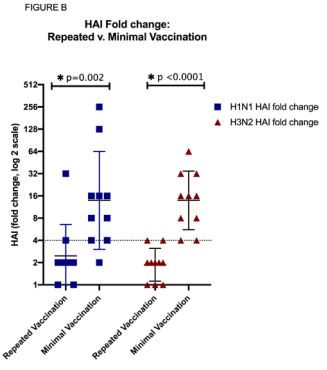
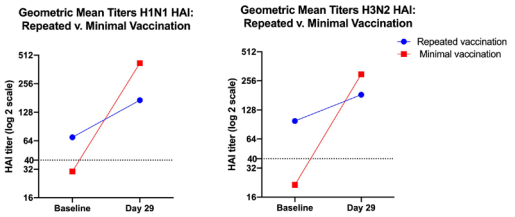


FIGURE C



2741. Seasonal Influenza Vaccine Timing in Children and Adults Hospitalized with Influenza in the United States, FluSurv-NET, 2013–2017

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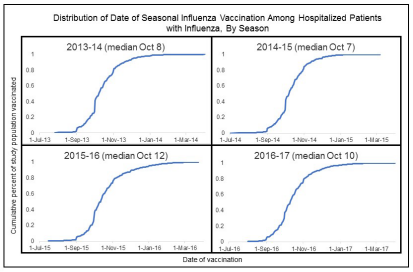
Session: 278. Vaccines: Influenza
Saturday, October 5, 2019: 12:15 PM

Background: Seasonal influenza vaccine may attenuate disease severity among people infected with influenza despite vaccination, but vaccine effectiveness may decrease with increasing time between vaccination and infection. Patient characteristics may play a role in the timing of vaccine receipt.

Methods: We used data from the Influenza Hospitalization Surveillance Network (FluSurv-NET) and included patients ≥ 9 years hospitalized with laboratory-confirmed influenza during October 1–April 30 of influenza seasons 2013–2014 through 2016–2017 who received seasonal influenza vaccine ≥ 14 days prior to admission. Vaccine history was obtained from vaccine registries, medical charts, and patient interviews. We defined "early vaccination" as vaccine receipt before October 15 and "late vaccination" as receipt after (date selected using typical season onset and median vaccination dates). Early and late groups were compared using Chi-square or Fisher exact tests.

Results: Among 21,751 vaccinated patients, 61% received vaccine before October 15, and distribution of vaccination date was similar across seasons (figure). Vaccination occurred earlier with increasing age (45% were vaccinated early among those 9–17 years but 65% in those ≥ 80 years, $P < 0.01$). White non-Hispanic patients were more likely to receive vaccine early compared with black non-Hispanic and Hispanic patients (63% vs. 55% and 54%; $P < 0.01$). Those with metabolic disorders, cardiovascular disease, kidney disease, and cancer were vaccinated earlier whereas those with HIV and liver disease were vaccinated later. Vaccine timing also varied by state ($P < 0.01$) but not by sex.

Conclusion: Among influenza-vaccinated older children and adults hospitalized with influenza, older age, white race, and certain medical conditions were associated with early receipt of influenza vaccination in unadjusted analysis. This may be due to frequent healthcare encounters and targeted public health strategies in high-risk groups. Understanding how timing of vaccine receipt varies among populations can provide insights into variables that must be controlled for in studying possible vaccine effectiveness waning and attenuation of disease among those who are infected despite vaccination.



Disclosures. **All authors:** No reported disclosures.

2742. The Impact of Influenza Vaccination on Antibiotic Use in the United States, 2010–2017

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Session: 278. Vaccines: Influenza
Saturday, October 5, 2019: 12:15 PM

Background: Antibiotic resistance is a cause of morbidity and mortality driven by inappropriate prescribing. In the United States, a third of all outpatient antibiotic prescriptions may be inappropriate. Seasonal influenza rates are significantly associated with antibiotic prescribing rates. The impact of influenza vaccination coverage on antibiotic prescribing is unknown.

Methods: We conducted a retrospective analysis of state-level vaccination coverage and antibiotic prescribing rates from 2010 to 2017. We used fixed effects regression to analyze the relationship between cumulative vaccine coverage rates for a season and the per capita number of prescriptions for systemic antibiotics for the corresponding season (January–March) controlling for temperature, poverty, healthcare infrastructure, population structure, and vaccine effectiveness.

Results: Rates of vaccination coverage ranged from 33% in Nevada to 52% in Rhode Island for the 2016–2017 season, while antibiotic use rates ranged from 25 prescriptions per 1,000 inhabitants in Alaska to 377 prescriptions per 1,000 inhabitants in West Virginia (Figure 1). Vaccination coverage rates were highly correlated with reduced prescribing rates, and controlling for other factors, we found that a one percent increase in the influenza vaccination rate was associated with 1.40 (95% CI: 2.22–0.57, $P < 0.01$) fewer antibiotic prescriptions per 1,000 inhabitants (Table 1). Increases in the vaccination coverage rate in the pediatric population (aged 0–18) had the strongest effect, followed by the elderly (aged 65+).

Conclusion: Vaccination can reduce morbidity and mortality from seasonal influenza. Though coverage rates are far below levels necessary to generate herd immunity, we found that higher coverage rates in a state were associated with lower antibiotic prescribing rates. While the effectiveness of the vaccine varies from year to year and the factors that drive antibiotic prescribing rates are multi-factorial, these results suggest that increased vaccination coverage for influenza would have significant benefit in terms of reducing antibiotic overuse and correspondingly antibiotic resistance.

Table 1. Total antibiotic prescriptions (between January and March) per 1,000 residents, U.S. 2010-2017

	All Ages Coefficient (95% CI)	0-18 years old Coefficient (95% CI)	19-64 years old Coefficient (95% CI)	65+ years old Coefficient (95% CI)
Influenza vaccination coverage (percent)	-1.40 (-2.22- -0.57)***	-1.50 (-2.12- -0.88)***	-0.92 (-1.62- -0.22)**	-1.35 (-1.99- -0.71)***
Kidney dialysis centers per 1 million population	0.34 (-0.79-1.48)	-0.41 (-2.10-1.28)	0.11 (-0.90-1.13)	0.44 (-1.18-2.06)
Physicians' offices per 10,000 population	0.69 (-5.58-6.96)	5.99 (-12.61-24.59)	5.24 (-5.56-16.05)	-14.55 (-30.75-1.65)*
Childcare centers per 10,000 population under five	-0.53 (-1.62-0.56)	0.89 (-1.81-3.59)	-0.78 (-2.23-0.68)	-1.20 (-3.41-1.00)
January-July temperature difference	-0.46 (-0.70- -0.21)***	-0.25 (-0.79-0.30)	-0.47 (-0.66- -0.28)***	-1.53 (-1.95- -1.11)***
Percentage of population with income below poverty line	6.58 (4.38-8.78)***	7.53 (4.01-11.05)***	2.92 (0.68-5.17)**	4.97 (2.00-7.95)***
Vaccine effectiveness rate	0.15 (-0.005-0.31)*	0.44 (0.24-0.65)***	0.13 (-0.01-0.28)*	-0.03 (-0.22-0.16)

Note: CI = confidence interval; * p<0.1; **p<0.05; ***p<0.01

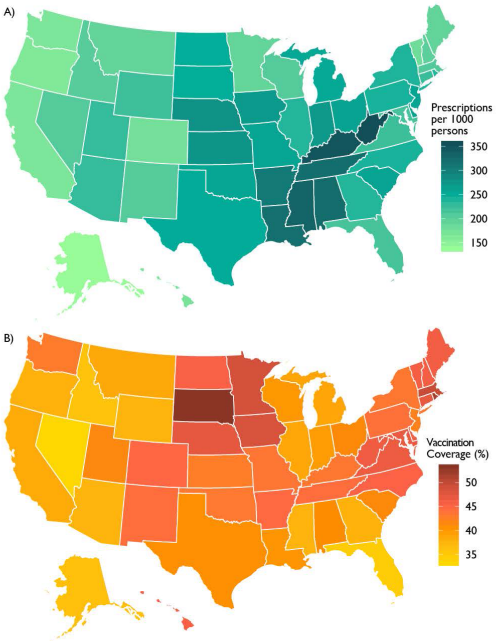

Figure 1: Antibiotic prescriptions and influenza vaccination coverage for each state, United States, 2016-2017
(A) Per capita prescribing rate of antibiotics from January 2017 to March 2017 by state; (B) Influenza vaccination coverage percent for populations ≥ 6 months for 2016-2017 influenza season. Source: CDC FluVaxView, IQVIA MIDAS, 2000-2015, IQVIA Inc. All rights reserved.

Disclosures. **All authors:** No reported disclosures.