DESCRIPTION OF HOSPITALIZED PATIENTS WITH INFLUENZA VACCINE FAILURE

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BACKGROUND

- Despite influenza vaccination, some patients develop illness and require hospitalization.
- Many factors contribute to vaccine failure:
  - Mismatch of the vaccine and circulating strains
  - Timing of influenza season
  - Waning immunity
  - Age
  - Patient comorbidities such as immune function

METHODS

- 2015-2019 Tennessee data from the US Hospitalized Adult Influenza Vaccine Effectiveness Network database.
- Enrolled patients were ≥ 18 years, vaccinated for the current influenza season and admitted with an acute respiratory illness.
- Patient or surrogate interviews and medical chart abstractions were performed.
- Influenza vaccinations were confirmed by vaccine providers.
- Influenza PCR testing was performed in a research lab.
- Statistical analyses were performed with STATA and R using Pearson's chi-squared, Kruskal-Wallis and Wilcoxon rank-sum tests and multivariate logistic regression.

FIGURE 1: DEMOGRAPHICS

N = 1236	Influenza positive (N=235)	Influenza negative (N=1001)	p-value
Median age – years (25th-75th %)	66 (57, 78)	65 (52, 74)	0.02
Gender – no. (%)			0.20
Male	98 (42%)	464 (46%)	
Female	137 (58%)	537 (54%)	
Race – no. (%)			0.43
African-American	53 (23%)	218 (22%)	
Asian	0	7 (1%)	
White	182 (77%)	767 (77%)	
Other	0	4 (0%)	
Pregnant at time of enrollment	0	9 (0.9%)	0.15
Self-reported being vaccinated for current influenza season – no. (%)	144 (61%)	576 (58%)	0.19
Vaccine type – no. (%)			0.21
Standard (trivalent, quadrivalent, recombinant, cell culture)	135 (59%)	625 (63%)	
High-dose and adjuvanted	94 (41%)	360 (37%)	
Median time between vaccine and symptom onset date – days	120 (93, 146)	114 (77, 150)	0.36
Any immunosuppression	147 (63%)	537 (54%)	0.01
Smoking (including vaping) in past 6 mo.	58 (25%)	261 (26%)	0.72
Home O2 use prior to admission	48 (44%)	201 (36%)	0.15
Cancer (Including hematologic)	33 (14%)	150 (15%)	0.65
Heart disease	133 (57%)	564 (56%)	0.94
Lung disease	121 (51%)	595 (59%)	0.07
Kidney disease (including HD)	74 (31%)	285 (28%)	0.59
Diabetes mellitus	86 (37%)	374 (37%)	0.83
Liver disease	19 (8%)	68 (7%)	0.70
Morbid obesity	17 (8%)	113 (13%)	0.04

Figure 1: Demographics of influenza positive versus influenza negative patients in influenza vaccinated, hospitalized patients.

FIGURE 2: LOGISTIC REGRESSION ANALYSES

Variable	All influenza positive		H1N1 positive		H3N2 positive		Self-reported vaccinated patients	
	Odds Ratio	95% CI	Odds Ratio	95% CI	Odds Ratio	95% CI	Odds Ratio	95% CI
Age (40-65)	1.47	1.03-2.10	1.50	0.62-3.60	1.24	0.80-1.91	1.66	1.16-2.39
Female: male	1.21	0.90-1.64	1.61	0.85-3.04	1.13	0.77-1.65	1.11	0.76-1.61
Vaccine type (high dose: standard)	0.87	0.60-1.26	1.98	0.87-4.50	0.87	0.54-1.39	0.71	0.45-1.14
Time between vaccine & symptom onset	1.07	0.76-1.51	0.88	0.43-1.79	0.94	0.61-1.45	1.05	0.76-1.45
# of comorbidities	0.84	0.66-1.07	1.20	0.72-1.99	0.82	0.60-1.11	0.81	0.60-1.10
Immunosuppression	1.56	1.15-2.12	1.04	0.56-1.92	1.86	1.25-2.75	1.40	0.95-2.05
Month of Season (Nov → April)	1.31	0.79-2.19	1.04	0.36-2.97	1.24	0.66-2.32	1.23	0.69-2.18

Figure 2: Logistic regression analyses of vaccinated, hospitalized influenza positive patients; vaccinated, hospitalized patients with influenza A subtypes and self-reported vaccinated, hospitalized influenza positive patients.

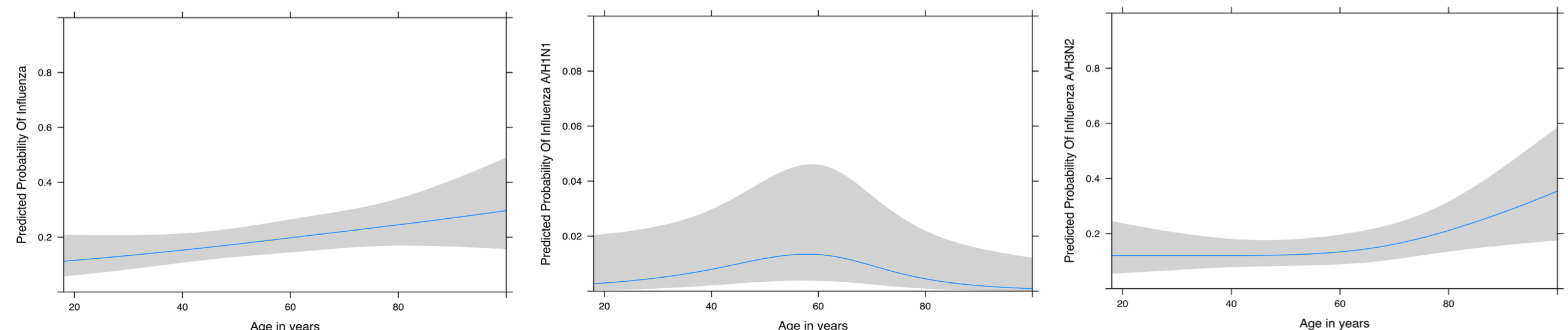## FIGURE 3: PREDICTED PROBABILITY OF HOSPITALIZATION WITH INFLUENZA COMPARED TO AGE

Figure 3: Predicted Probability of Hospitalization with Influenza, Influenza A/H1N1 and Influenza A/H3N2 in Vaccinated Patients Compared to Age. These models were developed based on the risk of female, immunocompromised patients in February of the 2016-2017 influenza season with 2 comorbidities who received a standard dose vaccine requiring hospitalization due to influenza.

RESULTS

- 1236 patients met study criteria, and 235 (19%) tested positive for influenza.
- Morbid obesity was more common in influenza negative patients (13% vs 8%, p = 0.04).
- Immunosuppression was more common in influenza positive patients (63% vs 54%, p = 0.01).
- Other demographics, vaccine history and comorbidities were similar between the two groups.
- Logistic regression analysis demonstrated older patients (OR 1.47, 95% CI 1.03-2.10) and immunosuppressed patients (OR 1.56, 1.15-2.12) were at increased risk for influenza.
- Immunosuppression increased the risk for influenza A/H3N2 (OR 1.86, 95% CI 1.25-2.75).
- A sensitivity analysis was performed on patients who self-reported influenza vaccination for the current season without vaccine verification and demonstrated increased risk of influenza in older adults (OR 1.66, 95% CI 1.16-2.39).

CONCLUSION

- Our study demonstrated an increased risk of influenza vaccine failure in older patients and immunosuppressed patients.
- These groups are also at increased risk for influenza complications.
- To improve protection of these patients against future influenza illnesses, more effective vaccines are needed, and more research on ring vaccination should be pursued.

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