



Demographic and Socioeconomic disparities in preference to get vaccinated by flu shot versus flu spray in the United States National Immunization Survey (NIS) data using Statistical Analysis Software (SAS)

Swapna Ambati, Eliassen Group
Ziphora Sam, Eliassen Group
Presentation No: AS04

PHUSE US Connect Virtual

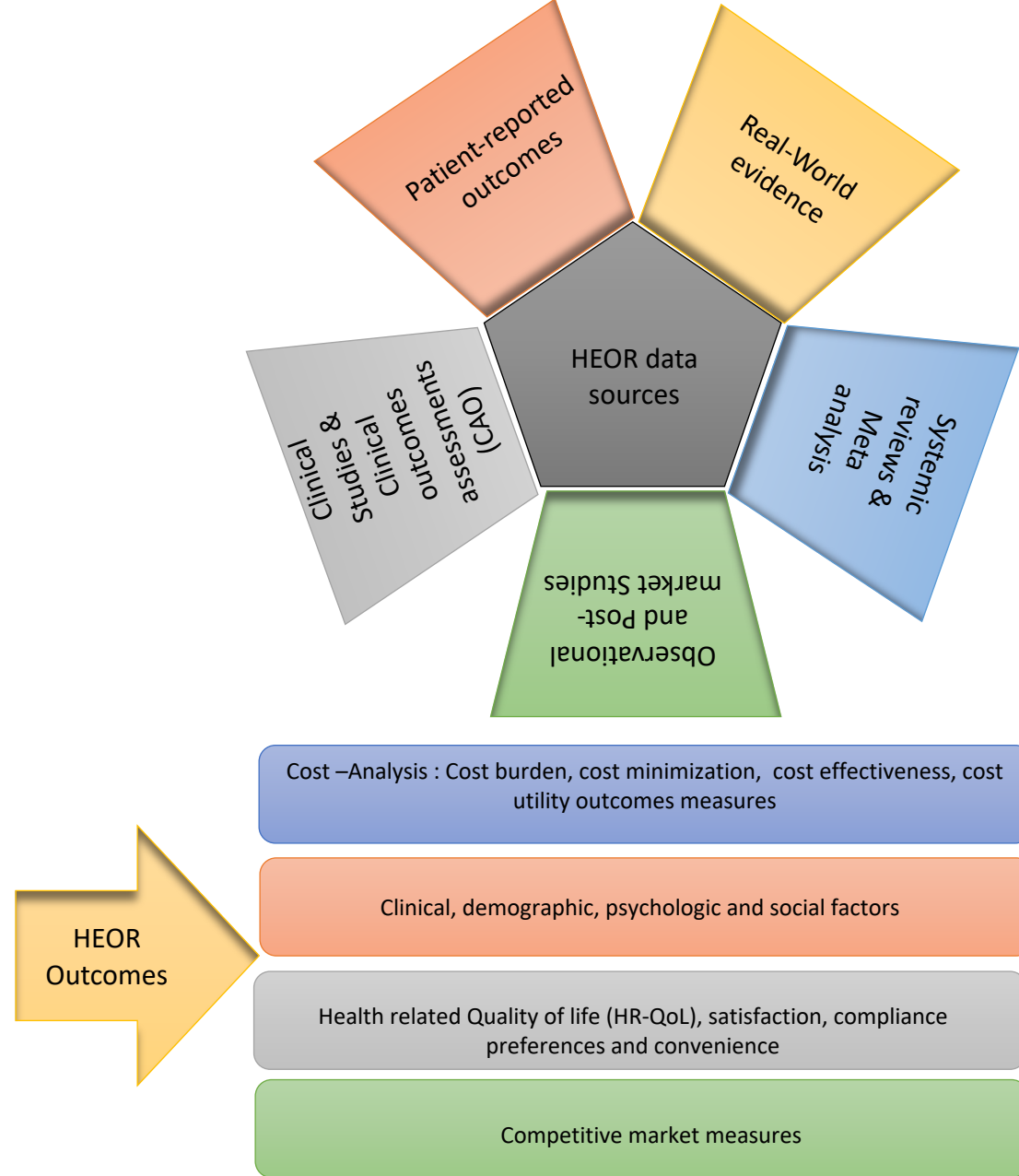
Analytics, Big Data & Statistics team

June 2021

Health Economics and Outcomes Research (HEOR)

Survey data analysis

- HEOR provides important information regarding patient outcomes that help us understand and make healthcare coverage and access decisions.
- A Patient-Reported Outcome (PRO) is "an outcome measure based on a report that comes directly from the patient (e.g., study subject) about the status of the patient's health condition without amendment or interpretation of the patient's response by a clinician or anyone else" according to the National Health Council.
- "Surveys are an important means of collecting health and social science information from a sample of people in a standardized way to better understand a larger population. There are many methods used to conduct surveys, including questionnaires and in-depth interviews via phone, mail, email, and in-person." according to the National Institutes of Health.



National Immunization Survey (NIS)

NIS

Purpose:

- 1) Monitor vaccination coverage.
- 2) Improve Delivery and reduce cost of vaccines.
- 3) Enhance awareness and use of vaccines.
- 4) Improve the Vaccines



Phase I

Random-Digit-Dialing (RDD)

- Eligible Children 19-35 Months
- Eligible Teen 13-17



Phase II

Provider Record Check (PRC) Survey

- Vaccination History





NIS – Variables

- NIS Child

PROVWT_C is the single-frame cell-phone weight excluding territories.

STRATUM is the variance for variable estimation.

SEQNUMHH is the cluster variable.

- NIS Teen

PROVWT_C is the single-frame cell-phone weight excluding territories.

STRATUM is the variance for variable estimation.

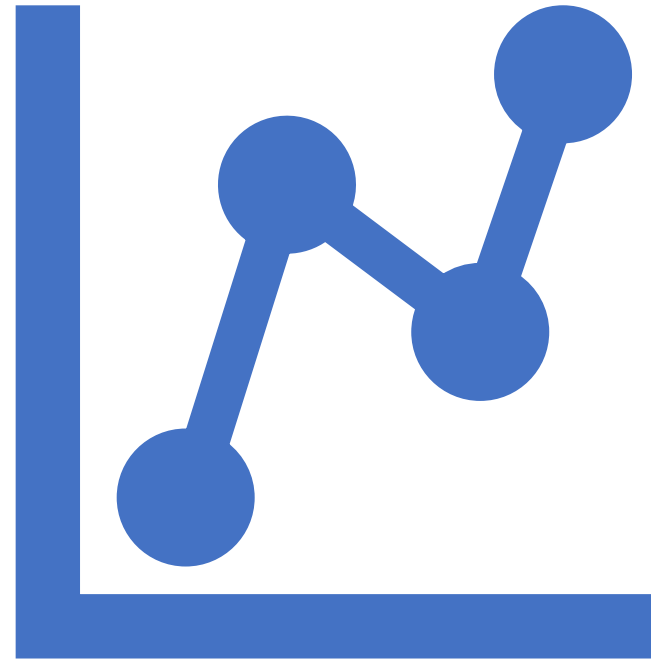
SEQNUMT is the cluster variable.

Statistical Analysis Software (SAS)



SAS is a tool for analyzing statistical data.

- Retrieve
- Report
- Analyze



SAS Software – NIS Survey data analysis

Some SAS Procedures to perform Survey data analysis

- SURVEYMEANS
- SURVEYFREQ
- SURVEYLOGISTIC
- SURVEYREG
- SURVEYPHREG

PROC SURVEYMEANS - Continuous variables

- NIS 2019 Child data Example:

```
PROC SURVEYMEANS DATA = NISDATA SUM;  
STRATUM STRATUM;  
CLUSTER SEQNUMHH;  
WEIGHT PROVWT_C;  
VAR P_NUMFLU;  
RUN;
```

Default:
excludes an observation from analysis if that observation
has a missing value for categorical variable.
So only observations with populated weight variable are
Included in the analysis.

Alternative options:

MISSING

Treats missing values as a valid

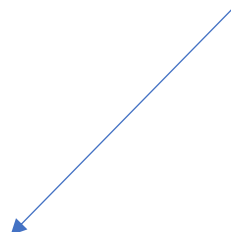
NOMCAR

Computes variance estimates by analyzing the nonmissing values as a domain

The SURVEYMEANS Procedure

Data Summary	
Number of Strata	58
Number of Clusters	15848
Number of Observations	33799
Number of Observations Used	16365
Number of Obs with Nonpositive Weights	17434
Sum of Weights	5638848.81

Weighted Sum



Statistics			
Variable	Label	Sum	Std Error of Sum
P_NUMFLU	NUMBER OF SEASONAL FLU-CONTAINING VACCINATIONS BY 36 MONTHS OF AGE DETERMINED FROM PROVIDER INFO, EXCLUDING ANY VACCINATIONS AFTER THE HH INTERVIEW DATE.	10474952	199043

PROC SURVEYMEANS

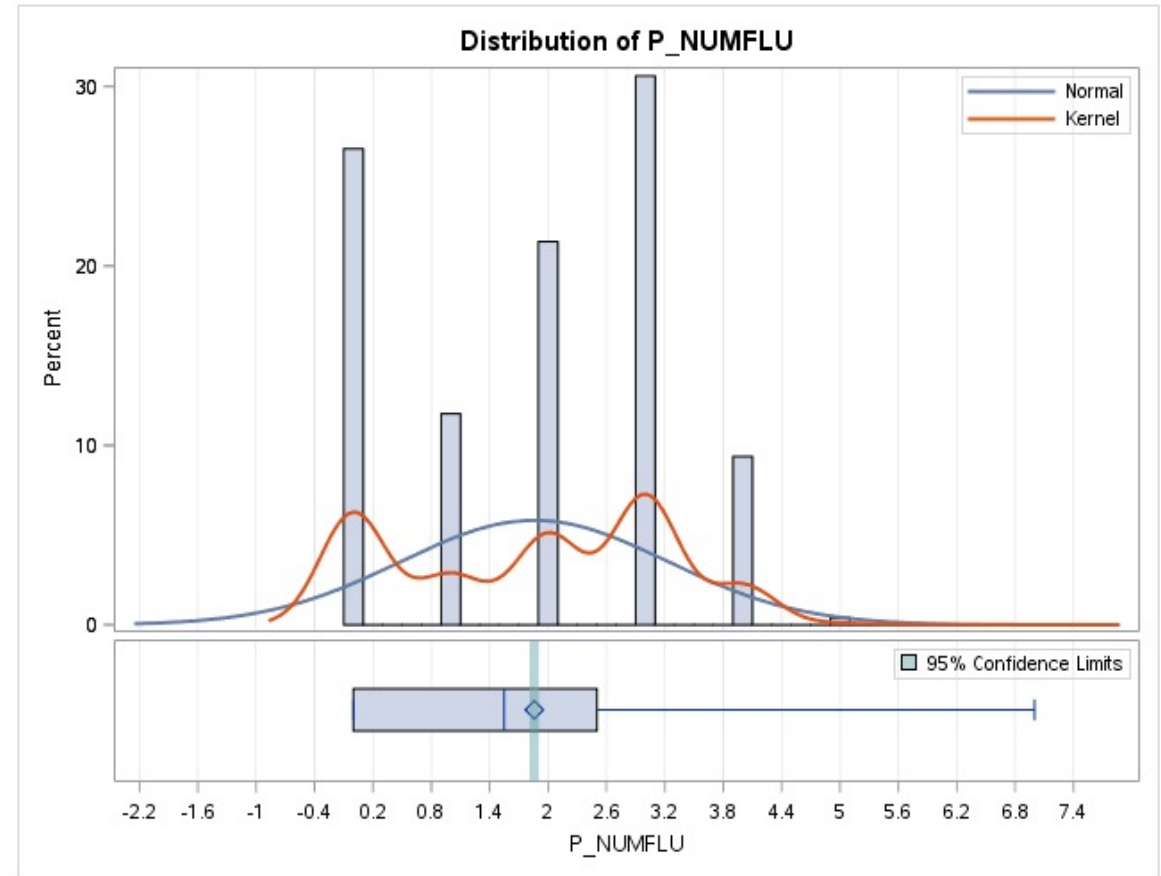
- Continuous variables - Plots

- NIS 2019 Child data Example:

```
PROC SURVEYMEANS DATA = NISDATA SUM PLOTS=ALL;  
STRATUM STRATUM;  
CLUSTER SEQNUMHH;  
WEIGHT PROVWT_C;  
VAR P_NUMFLU;  
RUN;
```

Limitation: Plots are only available for continuous variables. The PLOTS=ALL option is ignored.

The SURVEYMEANS Procedure



PROC SURVEYMEANS – Categorical variables

- NIS Child 2019 Example:

FLU_VACCINATED: Derived 0/1 indicator variable for respondents taking one or more Flu vaccinations.

```
PROC SURVEYMEANS DATA = NISDATA NOBS MEAN SUM CLM ;
```

```
STRATUM STRATUM;
```

```
CLUSTER SEQNUMHH;
```

```
WEIGHT PROVWT_C;
```

```
CLASS FLU_VACCINATED;
```

```
VAR FLU_VACCINATED;
```

```
FORMAT FLU_VACCINATED YESNO.;
```

```
RUN;
```

CONVERT TO PERCENT ESTIMATES
Weighted mean*100

Similarly, Confidence limits
Lower CL * 100
Upper CL * 100

Statistics								
Variable	Level	N	Mean	Std Error of Mean	95% CL for Mean		Sum	Std Error of Sum
FLU_VACCINATED	No	4002	0.265259	0.007710	0.25014582	0.28037260	1495757	48093
	Yes	12363	0.734741	0.007710	0.71962740	0.74985418	4143092	71941

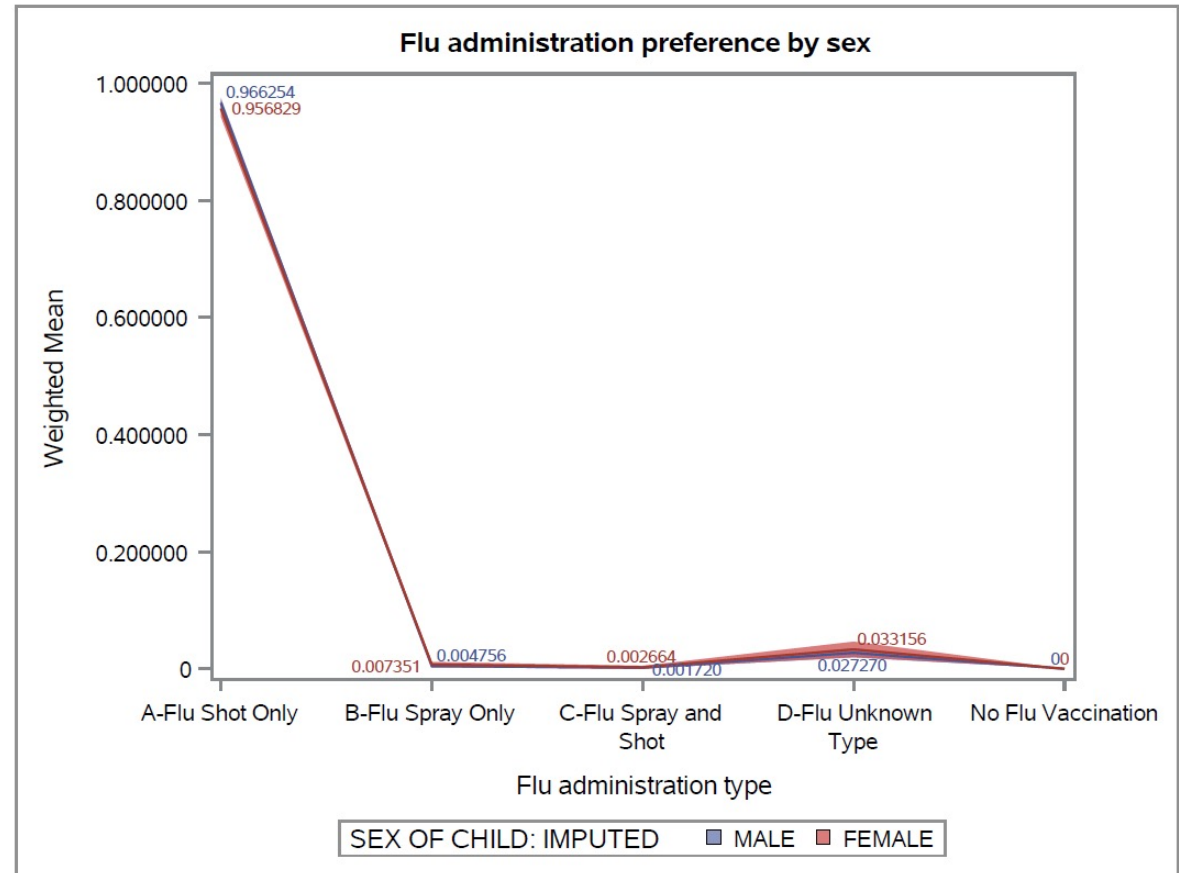
Note: As the NIS Survey data is a sample and not the entire population, It is important to study magnitude of confidence limits so to make sure that estimated differences are not overlapping, and the observed difference is not by chance.

PROC SURVEYMEANS – PROC SGPLOT

Plots for Categorical variables

- NIS CHILD 2019 Example:

```
PROC SGPLOT DATA=MEANSOUTPUT ;  
BAND X=VARLEVEL LOWER=LOWERCLMEAN  
UPPER=UPPERCLMEAN / GROUP=SEX  
TRANSPARENCY=.2 ; XAXIS INTEGER LABEL=" FLU  
ADMINISTRATION TYPE";  
YAXIS LABEL="WEIGHTED MEAN" VALUESFORMAT=DATA;  
TITLE "FLU ADMINISTRATION PREFERENCE BY SEX";  
SERIES Y=MEAN X=VARLEVEL /GROUP=SEX DATALABEL ;  
WHERE FLU_VACCINATED=1;  
RUN ;
```



PROC SURVEYMEANS – Subset analysis

- NIS Child 2019 Example:

```
PROC SURVEYMEANS DATA = NISDATA NOBS SUM MEAN  
STDERR DF CLM FRACTION ;
```

```
ODS OUTPUT DOMAIN=FLUTYPE;
```

```
STRATUM STRATUM;
```

```
CLUSTER SEQNUMHH;
```

```
WEIGHT PROVWT_C;
```

```
CLASS TYPE;
```

```
VAR TYPE;
```

```
DOMAIN FLU_VACCINATED;
```

```
FORMAT FLU_VACCINATED YESNO.;
```

```
RUN;
```

The SURVEYMEANS Procedure

Statistics for FLU_VACCINATED Domains										
FLU_VACCINATED	Variable	Level	N	Sampling Fraction	DF	Mean	Std Error of Mean	95% CL for Mean		Sum
No	TYPE	A-Flu Shot Only	0	0.000	15790	0	0	0.00000000	0.00000000	0
		B-Flu Spray Only	0	0.000	15790	0	0	0.00000000	0.00000000	0
		C-Flu Spray and Shot	0	0.000	15790	0	0	0.00000000	0.00000000	0
		D-Flu Unknown Type	0	0.000	15790	0	0	0.00000000	0.00000000	0
		No Flu Vaccination	4002	0.003	15790	1.000000	0	1.00000000	1.00000000	1495757
Yes	TYPE	A-Flu Shot Only	11985	0.003	15790	0.961717	0.004062	0.95375550	0.96967832	3984482
		B-Flu Spray Only	69	0.000	15790	0.006005	0.001264	0.00352841	0.00848215	24880
		C-Flu Spray and Shot	33	0.000	15790	0.002174	0.000645	0.00090984	0.00343887	9008.550926
		D-Flu Unknown Type	276	0.000	15790	0.030103	0.003826	0.02260349	0.03760342	124721
		No Flu Vaccination	0	0.000	15790	0	0	0.00000000	0.00000000	0

Note: If the data set is subset, meaning that observations not to be included in the subpopulation are deleted from the data set, the standard errors of the estimates cannot be calculated correctly. When the subpopulation option(s) is used, only the cases defined by the subpopulation are used in the calculation of the estimate, but all cases are used in the calculation of the standard errors.

PROC SURVEYFREQ - Categorical variables

Table of FLU_VACCINATED							
FLU_VACCINATED	Frequency	Weighted Frequency	Std Err of Wgt Freq	Percent	Std Err of Percent	95% Confidence Limits for Percent	
No	4002	1495757	48093	26.5259	0.7710	25.0146	28.0373
Yes	12363	4143092	71941	73.4741	0.7710	71.9627	74.9854
Total	16365	5638849	77874	100.0000			

Rao-Scott Chi-Square Test	
Pearson Chi-Square	3607.0580
Design Correction	4.9917
Rao-Scott Chi-Square	722.6153
DF	1
Pr > ChiSq	<.0001
F Value	722.6153
Num DF	1
Den DF	15790
Pr > F	<.0001
Sample Size = 16365	

- NIS Child 2019 Example:

```
PROC SURVEYFREQ DATA=NISDATA ;
```

```
STRATUM STRATUM;
```

```
CLUSTER SEQNUMHH;
```

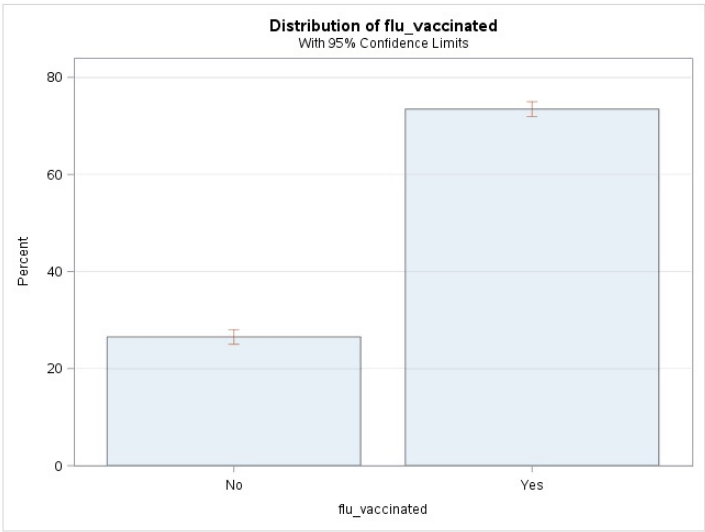
```
WEIGHT PROVWT_C;
```

```
TABLE FLU_VACCINATED /CL CHISQ LRCHISQ  
PLOTS=WTFREQPLOT (SCALE=PERCENT);
```

```
FORMAT FLU_VACCINATED YESNO.;
```

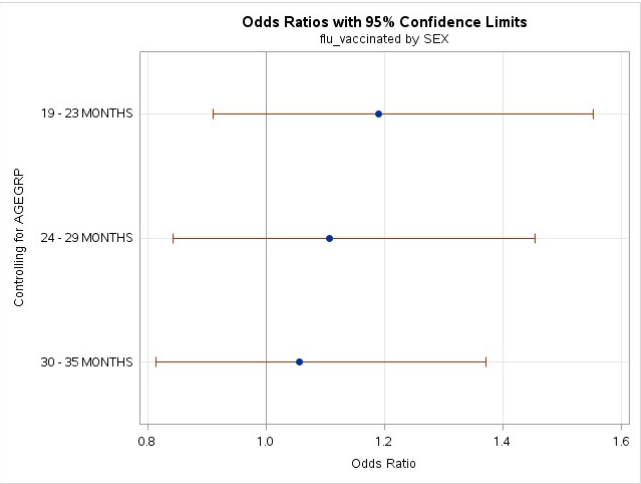
```
RUN;
```

PROC SURVEYFREQ – Plots



NIS Child 2019 Example:

```
PROC SURVEYFREQ DATA=NISDATA;  
STRATUM STRATUM;  
CLUSTER SEQNUMHH;  
WEIGHT PROVWT_C;  
TABLE FLU_VACCINATED /CL CHISQ LRCHISQ  
PLOTS=WTFREQPLOT (SCALE=PERCENT);  
FORMAT FLU_VACCINATED YESNO.;  
RUN;
```



NIS Child 2019 Example:

```
PROC SURVEYFREQ DATA=NISDATA  
ORDER=FORMATTED;  
STRATUM STRATUM;  
CLUSTER SEQNUMHH;  
WEIGHT PROVWT_C;  
TABLES AGEGRP*FLU_VACCINATED*SEX / OR  
PLOTS(ONLY)=ODDSRATIOPLOT RELRISK ;  
FORMAT FLU_VACCINATED YESNO. SEX SEX.;  
RUN ;
```

Odds Ratio and Relative Risks (Row1/Row2)			
Statistic	Estimate	95% Confidence Limits	
Odds Ratio	1.1892	0.9109	1.5526
Column 1 Relative Risk	1.0918	0.9558	1.2471
Column 2 Relative Risk	0.9181	0.8031	1.0495
Sample Size = 16365			

PROC SURVEYFREQ – Subset analysis tables statement

```
PROC SURVEYFREQ DATA=NISDATA ;
STRATUM STRATUM;
CLUSTER SEQNUMHH;
WEIGHT PROVWT_C;
TABLE FLU_VACCINATED*SEX /CL CHISQ LRCHISQ
WCHISQ ;
ODS OUTPUT CROSSTABS=OUT;
ODS OUTPUT TABLESUMMARY=OUT2;
ODS OUTPUT CHISQ=OUT3;
FORMAT FLU_VACCINATED YESNO.;
FORMAT SEX SEX.;
RUN;
```

The SURVEYFREQ Procedure

Data Summary	
Number of Strata	58
Number of Clusters	15848
Number of Observations	33799
Number of Observations Used	16365
Number of Obs with Nonpositive Weights	17434
Sum of Weights	5638848.81

Table of FLU_VACCINATED by SEX								
FLU_VACCINATED	SEX	Frequency	Weighted Frequency	Std Err of Wgt Freq	Percent	Std Err of Percent	95% Confidence Limits for Percent	
No	MALE	2070	735762	32774	13.0481	0.5600	11.9504	14.1458
	FEMALE	1932	759994	36740	13.4778	0.6180	12.2664	14.6893
	Total	4002	1495757	48093	26.5259	0.7710	25.0146	28.0373
Yes	MALE	6519	2148738	56996	38.1060	0.8581	36.4241	39.7879
	FEMALE	5844	1994354	54745	35.3681	0.8427	33.7164	37.0198
	Total	12363	4143092	71941	73.4741	0.7710	71.9627	74.9854
Total	MALE	8589	2884500	63190	51.1541	0.8820	49.4253	52.8828
	FEMALE	7776	2754348	63123	48.8459	0.8820	47.1172	50.5747
	Total	16365	5638849	77874	100.0000			

PROC SURVEYFREQ – Chi square Univariate Significance

Variables	Chi Square	Significance
Child's Age group	Pr > F	0.5474
Child's Race	Pr > F	<.0001
Child's Gender	Pr > F	0.1739
Census Region	Pr > F	<.0001
Mother's Education	Pr > F	<.0001
First Born	Pr > F	<.0001
Income	Pr > F	<.0001
Insurance	Pr > F	<.0001
Hispanic	Pr > F	0.1507
Marital	Pr > F	<.0001
Mother's Age group	Pr > F	<.0001
Provider Facility	Pr > F	0.0213

PROC SURVEYLOGISTIC – Multivariate Significance

```
PROC SURVEYLOGISTIC DATA = NISDATA;
STRATUM STRATUM;
CLUSTER SEQNUMHH;
WEIGHT PROVWT_C;
MODEL FLU_VACCINATED(EVENT='1') = LIST OF VARIABLES / EXPB CLODDS RSQUARE;
ODS OUTPUT LSMEANS=LSM DIFFS=D TYPE3=T3A
PARAMETERESTIMATES = PE DOMAINSUMMARY=DS ;
RUN;
```

The SURVEYLOGISTIC Procedure

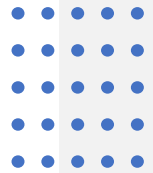
Analysis of Maximum Likelihood Estimates					
Parameter	Estimate	Standard Error	t Value	Pr > t	Exp(Est)
INTERCEPT	2.0027	0.4975	4.03	<.0001	7.409
SEX	-0.1223	0.0827	-1.48	0.1392	0.885
CEN_REG	-0.0957	0.0444	-2.15	0.0312	0.909
EDUC1	0.1132	0.0542	2.09	0.0369	1.120
I_HISP_K	-0.5059	0.1501	-3.37	0.0008	0.603
INCP0V1	-0.1515	0.0535	-2.83	0.0047	0.859
AGEGRP	0.0379	0.0502	0.76	0.4499	1.039
M_AGEGRP2	0.2701	0.0974	2.77	0.0056	1.310
MARITAL2	-0.2002	0.0978	-2.05	0.0407	0.819
RACEETHK	-0.0234	0.0623	-0.37	0.7077	0.977
PROV_FAC	0.0142	0.0384	0.37	0.7106	1.014
INS_STAT2_I	-0.2437	0.0535	-4.56	<.0001	0.784
CBF_01	-0.00095	0.00671	-0.14	0.8877	0.999
FRSTBRN	0.4193	0.0926	4.53	<.0001	1.521
NOTE: The degrees of freedom for the t tests is 15513.					

The SURVEYLOGISTIC Procedure

Odds Ratio Estimates and t Confidence Intervals				
Effect	Unit	Estimate	95% Confidence Limits	
SEX	1.0000	0.885	0.752	1.041
CEN_REG	1.0000	0.909	0.833	0.991
EDUC1	1.0000	1.120	1.007	1.246
I_HISP_K	1.0000	0.603	0.449	0.809
INCP0V1	1.0000	0.859	0.774	0.955
AGEGRP	1.0000	1.039	0.941	1.146
M_AGEGRP2	1.0000	1.310	1.082	1.586
MARITAL2	1.0000	0.819	0.676	0.992
RACEETHK	1.0000	0.977	0.865	1.104
PROV_FAC	1.0000	1.014	0.941	1.094
INS_STAT2_I	1.0000	0.784	0.706	0.870
CBF_01	1.0000	0.999	0.986	1.012
FRSTBRN	1.0000	1.521	1.268	1.823
NOTE: The degrees of freedom in computing the confidence limits is 15513.				

CASE STUDY

Demographic and Socioeconomic disparities in preference to get vaccinated by flu shot versus flu spray in the United States National Immunization Survey (NIS) data using Statistical Analysis Software (SAS)



Purpose

Identify any gaps in the Demographic and the Socio-economic disparities in the children and the teen to get vaccinated for the Flu.

Identify any gaps that could improve the usage of spray as an option for seasonal vaccines such as the Flu and the Covid . Identify if any specific population prefers any specific route of flu vaccine administration.

Introduction

- Influenza (Flu) is one among the most common causes of respiratory illness and absenteeism at work and school for parents and children, respectively.
- Flu is a common virus whose ability to change its genetic makeup could result in pandemic proportion of the disease. During 2009, a novel Influenza virus caused the first Influenza related pandemic in the 21st century.
- The major step in preventing Flu infection and Flu related hospitalizations is taking Flu vaccine every year. Flu vaccine is a seasonal vaccine given once or more every year and Flu vaccine updated as a new version since Flu virus can rapidly change its composition.
- There are at least two ways of administering this vaccine giving people a choice in the method of administration. A Flu vaccine can be administered as a shot or as a spray.
- This will also give us insight on to whether the spray is a good option to develop for any other future seasonal vaccines as a prevention against viruses such as COVID-19 where genetic makeup might be altered quickly, and vaccine must have to be updated and administered every year.

Flu vaccine types based on route of administration

Flu shot and Flu Spray

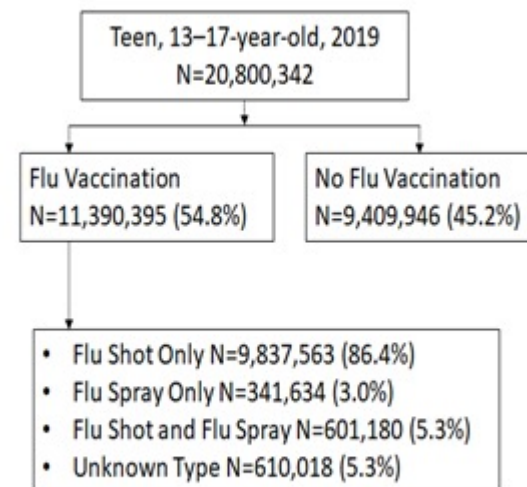
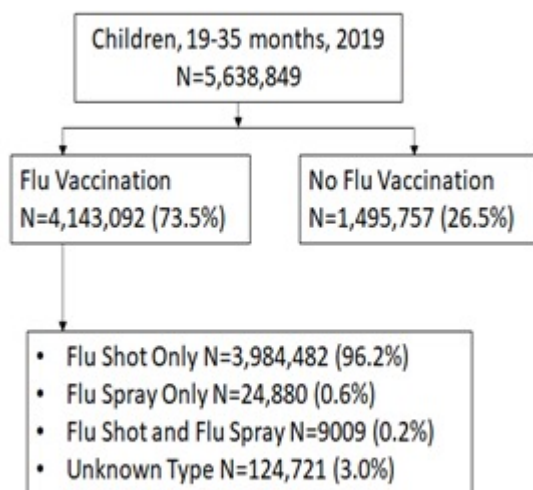
Flu Shot	Flu Spray
Route : Injection (usually into your upper arm) –Inactivated or recombinant vaccine. Given as trivalent, quadrivalent or high dose or adjuvanted . Developed by different methods such as cell based or recombinant etc.	Route: Nasal –Live attenuated influenza vaccine
Side effects: Minor	Side effects: Minor, although can be more severe than flu shot.
Eligible age category: Children (6 months and up) and Adults	Eligible age category: Children (2 or older) and Adults up to 49 years old.
Restrictions: Children under 6 months, people who got Guillain-Barre Syndrome when taking flu vaccine, life threatening allergies.	Restrictions: Children age 2 and under, Adults 50 and older, Pregnant women, People with other medical conditions. Restrictions for usage of flu spray are more than flu shot.
Pros: Available for younger children, safer for a larger age group comparatively.	Pros: Easy to take.
Cons: Shot is not a preferable route of administration.	Cons: More restrictions in use. May be less effective than flu shot. American Academy of Pediatrics (AAP) did not recommend spray for 2016-17 and 2017-18 flu but later it is recommending spray or shot for 2019-2020 season.

Other types: Flu Vaccine by Jet injector



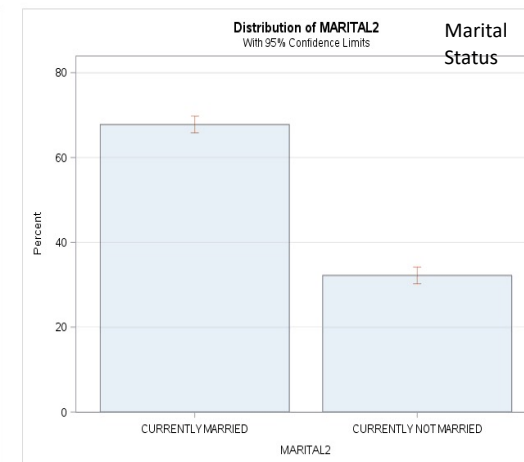
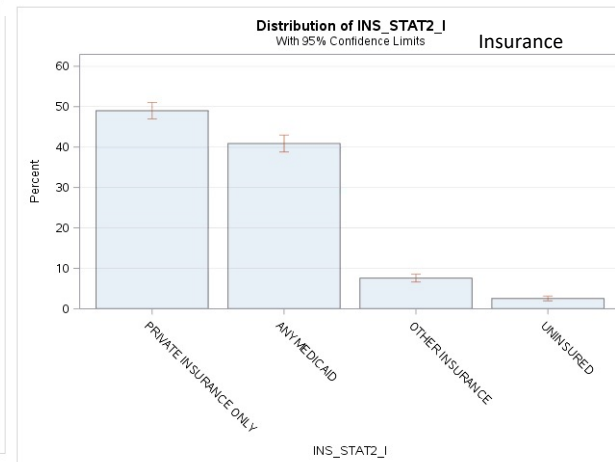
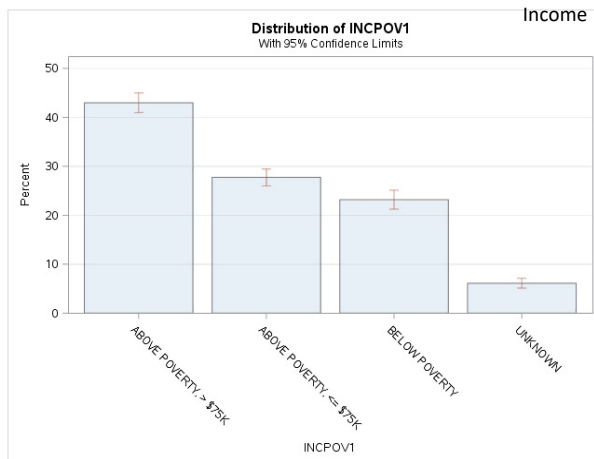
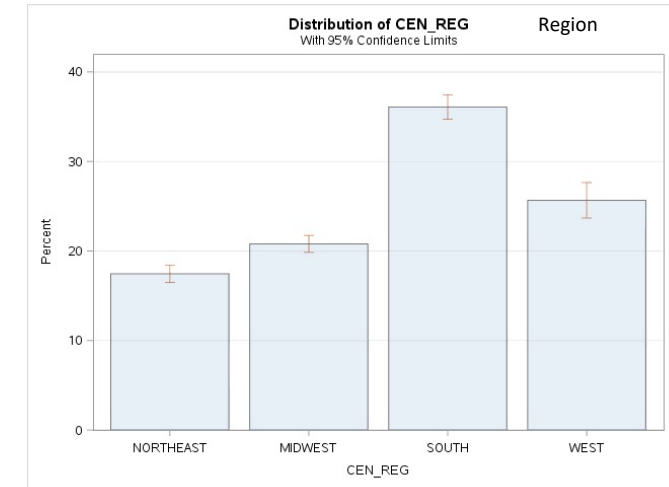
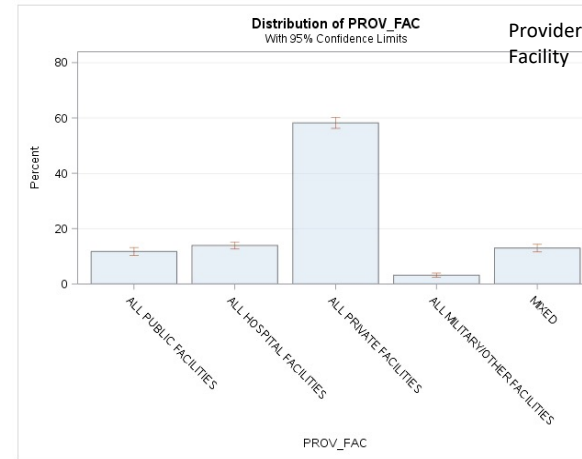
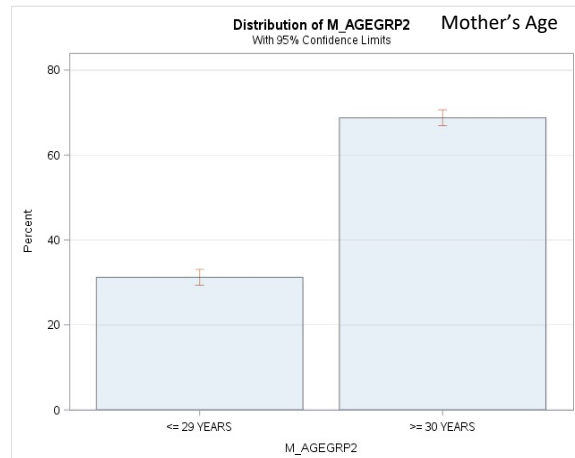
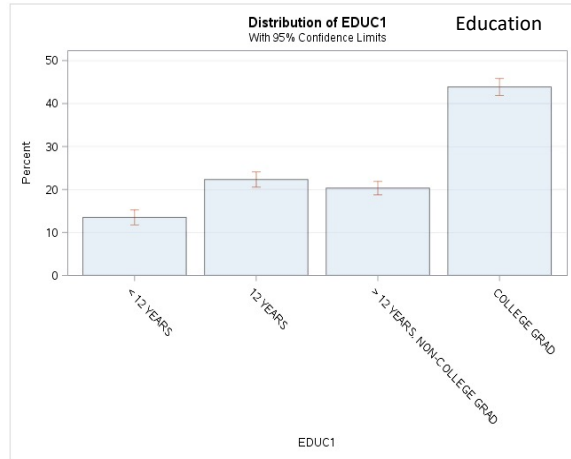
Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

FLU vaccination coverage in the NIS Child 2019 data and the NIS Teen 2019 data & FLU vaccination coverage by administration type



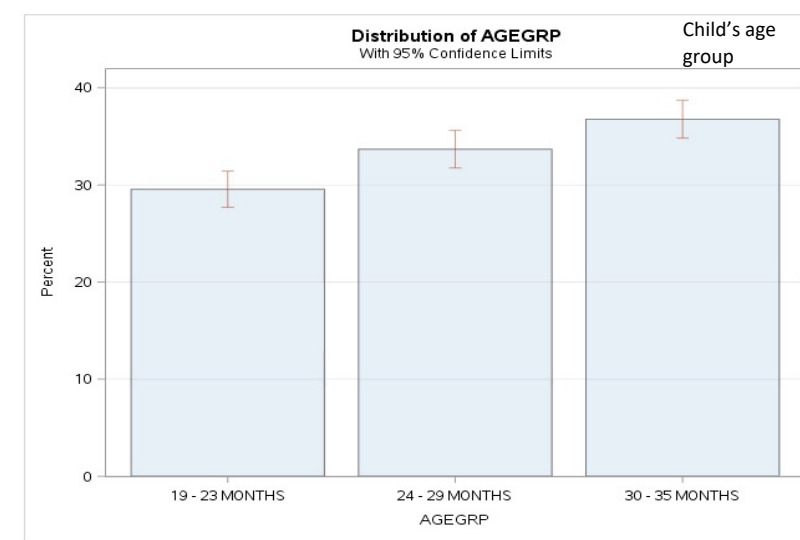
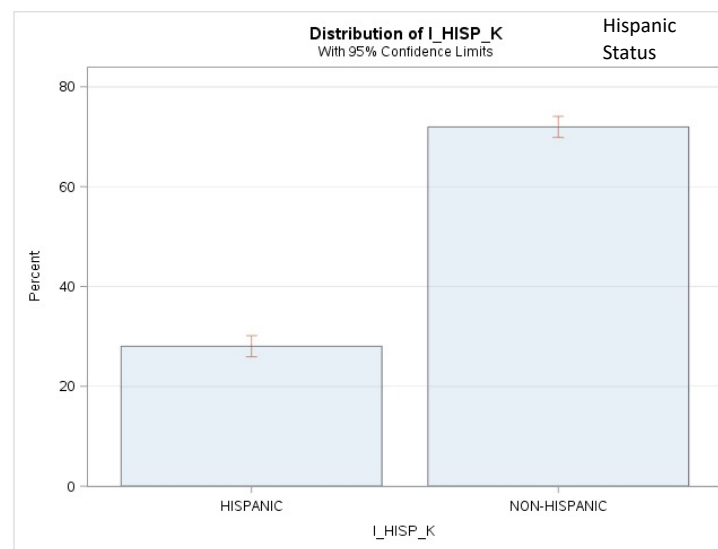
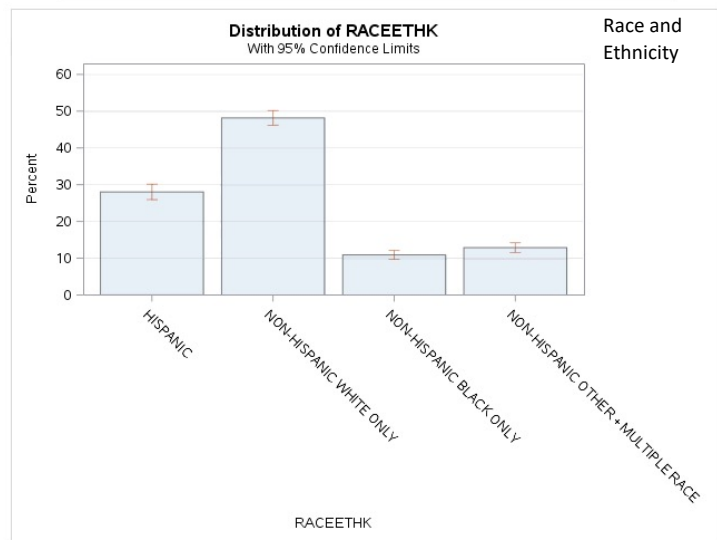
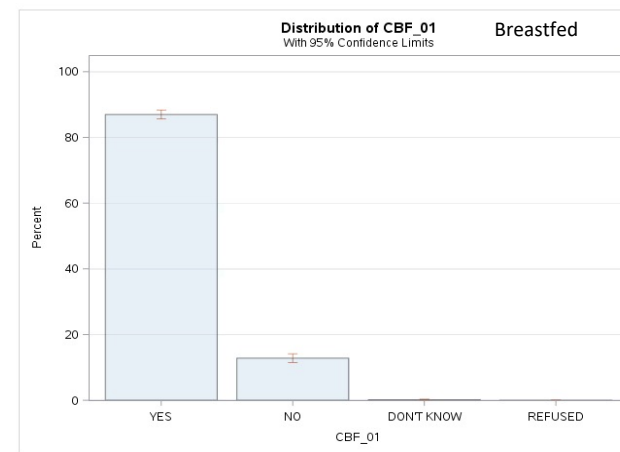
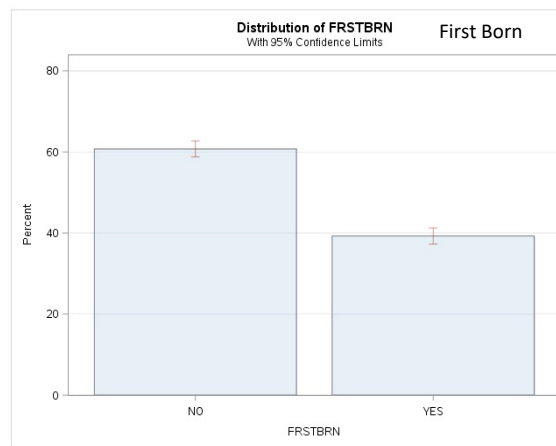
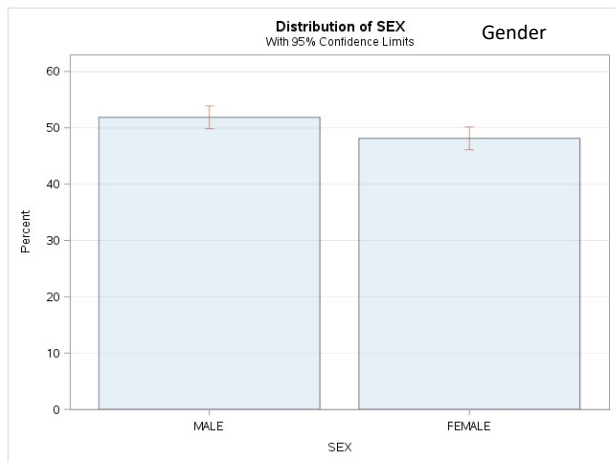
In NIS Child 2019, 73.5% got vaccinated while in NIS Teen 2019, 54.8% got vaccinated. In both Children and Teen, most of them took flu vaccine by shot and very few by spray alone. Although there are more percentage of teens using spray as an option

Demographic & Socio-economic disparities among the flu vaccinated in the NIS Children 2019 data



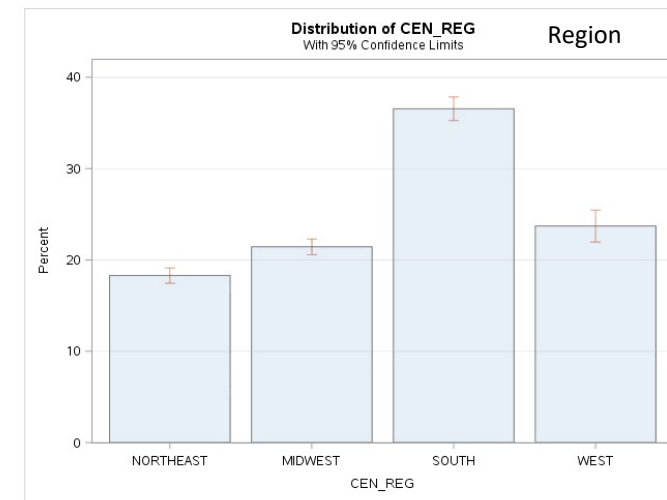
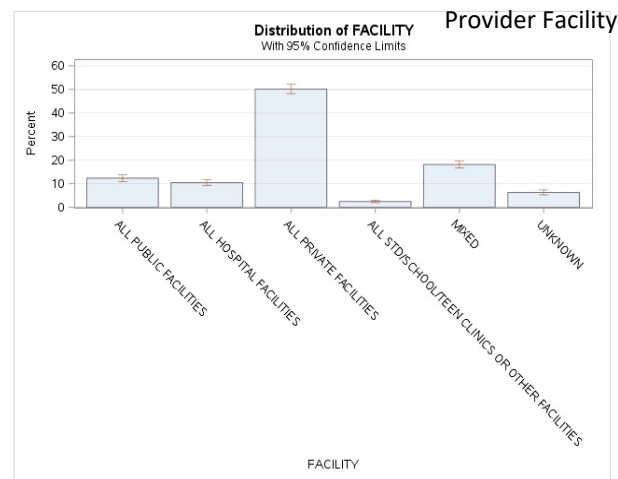
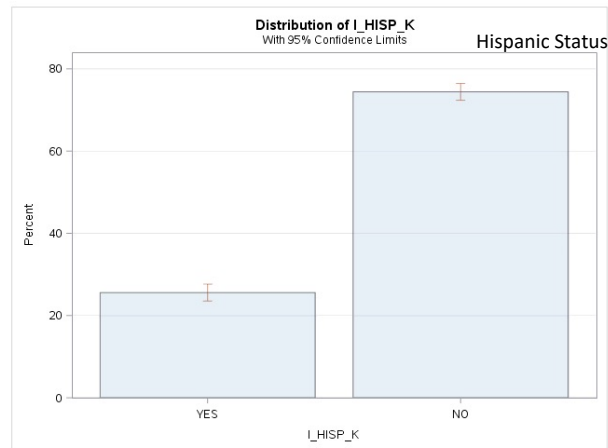
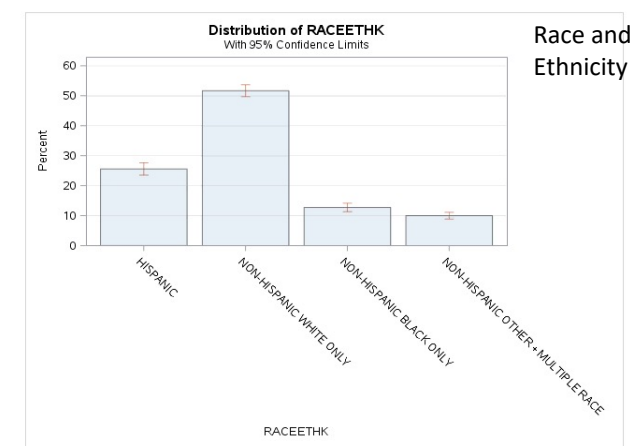
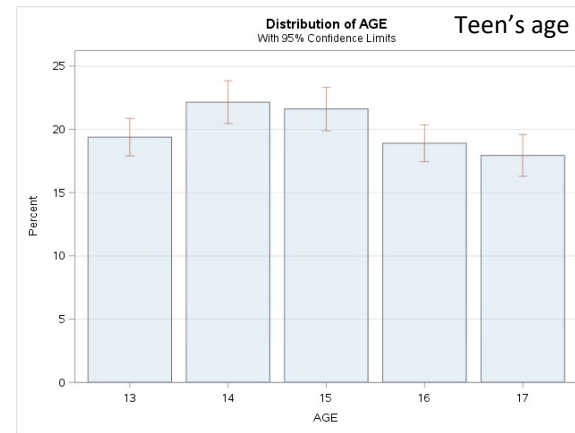
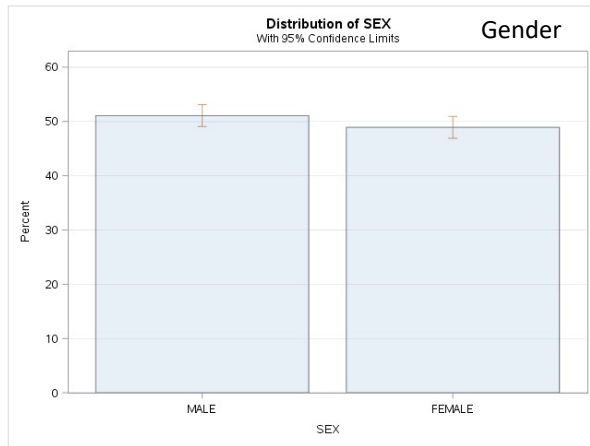
College grads, Older Mothers, Private facilities, South region, Above poverty, Private Insurance and Married – Higher flu vaccination coverage.

Demographic & Socio-economic disparities among the flu vaccinated in the NIS Children 2019 data –Cont'd



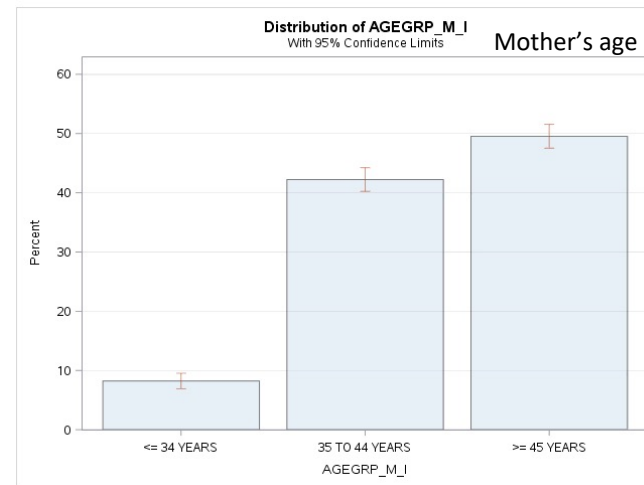
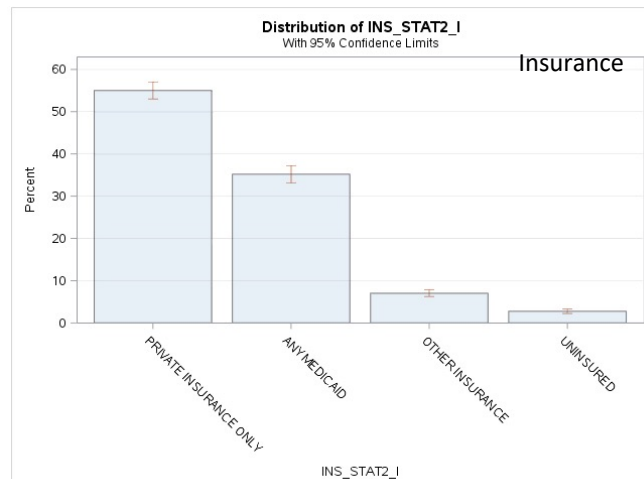
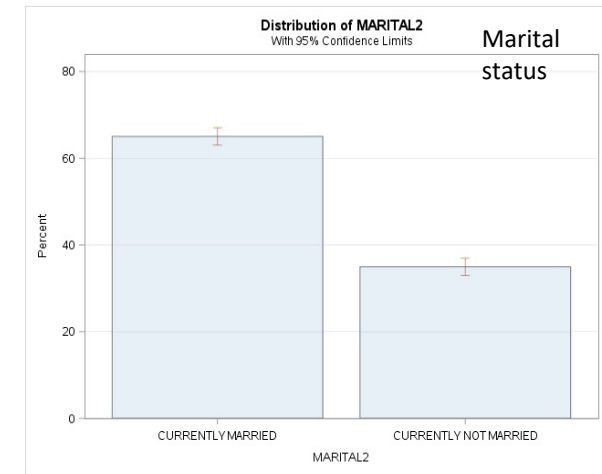
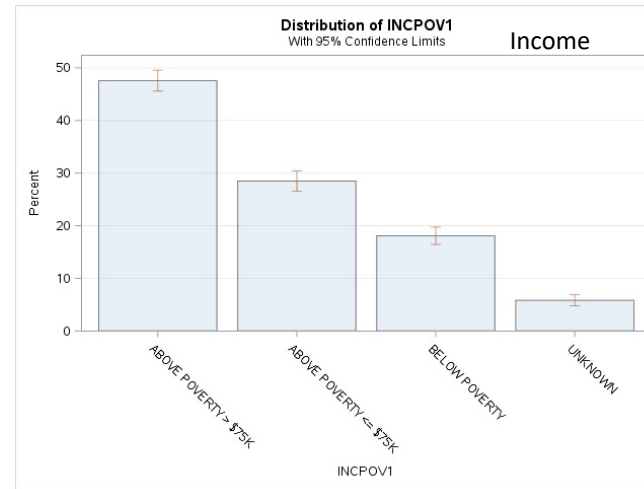
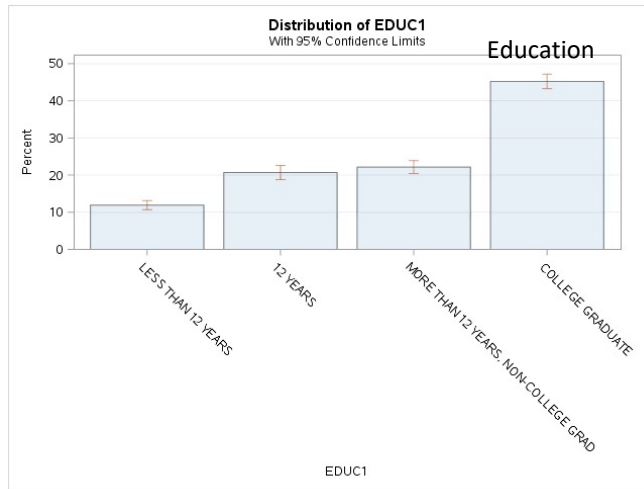
Not first born, Breastfed, Non-Hispanic White, Non-Hispanic – Higher flu vaccination coverage. Male and older children – slightly higher flu vaccination coverage.

Demographic & Socio-economic disparities among the flu vaccinated in the NIS Teen 2019 data



South region, Private facilities, Non-Hispanic White, Non-Hispanic – Higher flu vaccination coverage. Male and older children – slightly higher flu vaccination coverage.

Demographic & Socio-economic disparities among the flu vaccinated in the NIS Teen 2019 data, Cont'd



College grads, Older Mothers, Above poverty, Private Insurance and Married – Higher flu vaccination coverage.

NIS Child 2019

- Flu vaccination coverage by route among different demographic and socio-economic groups

Demographic and Socioeconomic characteristics	Administration Type			
	Flu Shot only	Flu Spray only	Flu Shot and Flu Spray	Unknown
Child's Age				
19-23 months	96 (94.2-97.9)	0.6 (0.1-1)	0.1 (0-0.1)	3.4 (1.5-5.2)
24-29 months	95.2 (93.8-96.7)	0.8 (0.4-1.2)	0.2 (0-0.3)	3.8 (2.4-5.2)
30-35 months	97.2 (96.4-97.9)	0.5 (0.1-0.9)	0.4 (0.1-0.7)	2 (1.4-2.6)
Child's Race				
Hispanic	95.5 (93.4-97.6)	0.6 (0.1-1)	0.3 (0.1-0.5)	3.7 (1.6-5.7)
Non-Hispanic White only	97 (96.1-97.9)	0.6 (0.3-1)	0.2 (0-0.4)	2.1 (1.4-2.9)
Non-Hispanic Black only	94.4 (91.9-96.8)	0.1 (0-0.2)	0 (0-0.1)	5.5 (3.1-8)
Non-Hispanic Other + Multiple Race	96 (94.5-97.6)	1 (0.1-1.8)	0.3 (0-0.6)	2.7 (1.5-4)
Child's Ethnicity				
Hispanic	95.5 (93.4-97.6)	0.6 (0.1-1)	0.3 (0.1-0.5)	3.7 (1.6-5.7)
Non Hispanic	96.4 (95.7-97.2)	0.6 (0.3-0.9)	0.2 (0-0.4)	2.8 (2.1-3.4)
Child's Gender				
Male	96.6 (95.8-97.4)	0.5 (0.2-0.7)	0.2 (0.1-0.3)	2.7 (2-3.5)
Female	95.7 (94.3-97.1)	0.7 (0.3-1.2)	0.3 (0-0.5)	3.3 (2-4.6)
Child First Born				
Yes	95.8 (94.7-96.9)	0.8 (0.4-1.1)	0.2 (0.1-0.3)	3.3 (2.2-4.3)
No	96.7 (95.7-97.8)		0.3 (0-0.6)	2.6 (1.6-3.6)
Mother's Education				
Less than 12 Years	95.6 (91.9-99.2)	0 (00)	0.1 (0-0.2)	4.4 (0.7-8)
12 Years	94.5 (92.7-96.2)	1.2 (0.3-2.1)	0.4 (0-0.9)	3.9 (2.5-5.4)
More than 12 years, not a college graduate	96.3 (94.7-97.8)	0.5 (0.1-0.9)	0.1 (0-0.2)	3.1 (1.6-4.6)
College Graduate	97.2 (96.3-98)	0.5 (0.3-0.8)	0.2 (0.1-0.3)	2.1 (1.3-2.9)
Mother's Age Group				
<= 29 Years	95.6 (94.3-96.9)	0.6 (0.2-1)	0.4 (0-0.8)	3.4 (2.2-4.7)
>= 30 Years	96.4 (95.4-97.4)	0.6 (0.3-0.9)	0.1 (0.1-0.2)	2.8 (1.9-3.8)

Demographic and Socioeconomic characteristics	Administration Type			
	Flu Shot only	Flu Spray only	Flu Shot and Flu Spray	Unknown
Marital Status				
Currently Married	97 (96.3-97.7)	0.6 (0.3-0.9)	0.1 (0.1-0.2)	2.3 (1.6-2.9)
Not Currently Married	94.5 (92.5-96.4)	0.6 (0.2-1)	0.4 (0-0.7)	4.5 (2.7-6.4)
Breastfed				
Yes	96.7 (96-97.3)	0.5 (0.3-0.8)	0.2 (0.1-0.3)	2.6 (2-3.2)
No	92.8 (88.7-97)	1 (0.1-1.9)	0.6 (0-1.4)	5.6 (1.6-9.6)
Poverty				
Above Poverty > \$75k	97.5 (96.5-98.4)	0.5 (0.2-0.8)	0.1 (0-0.2)	1.9 (1-2.8)
Above Poverty <= \$75k	96.1 (94.9-97.2)	1 (0.3-1.7)	0.2 (0.1-0.3)	2.8 (1.8-3.7)
Below Poverty	93.9 (91.4-96.4)	0.4 (0.1-0.7)	0.5 (0-1)	5.2 (2.8-7.6)
Unknown	96 (93.2-98.8)	0.3 (0-0.9)	0 (00)	3.7 (1-6.4)
Census Region				
Northeast	96.3 (94.8-97.9)	0.9 (0.2-1.6)	0.4 (0-1)	2.4 (1.1-3.7)
Midwest	95.4 (94.1-96.7)	0.3 (0-0.6)	0.1 (0-0.3)	4.2 (2.9-5.5)
South	96.8 (96-97.7)	0.6 (0.3-1)	0.2 (0.1-0.4)	2.3 (1.5-3)
West	95.8 (93.4-98.2)	0.6 (0-1.2)	0.1 (0-0.3)	3.5 (1.1-5.8)
Provider Facility				
All Public Facilities	94.7 (92.6-96.7)	0.3 (0-0.7)	0 (0-0.1)	5 (3-7)
All Hospital Facilities	93 (89.3-96.7)	0.3 (0-0.6)	0.5 (0-1.3)	6.2 (2.5-9.9)
All Private Facilities	96.9 (96-97.7)	0.8 (0.4-1.2)	0.2 (0.1-0.3)	2.2 (1.4-2.9)
All Military/ Other Facilities	96.2 (93.7-98.6)	0.4 (0-0.9)	0.6 (0-1.8)	2.9 (0.8-4.9)
Mixed	97.8 (96.6-99.1)	0.3 (0-0.7)	0.2 (0-0.4)	1.6 (0.4-2.8)
Insurance				
Private insurance only	97.3 (96.5-98.1)	0.4 (0.2-0.7)	0.3 (0-0.5)	2 (1.3-2.8)
Any medicaid	95 (93.4-96.6)	0.4 (0.2-0.6)	0.2 (0-0.3)	4.4 (2.9-6)
Other insurance (chip, ihs, military, or other, alone or in comb. with private insurance)	95.9 (93.2-98.6)	2.9 (0.3-5.5)	0.1 (0-0.3)	1.1 (0.4-1.9)
Uninsured	94.4 (89.8-98.9)	0.5 (0-1)	0.4 (0-1.3)	4.7 (0.3-9.2)

In NIS 2019 data, Flu shot was the main method of administration in all groups.

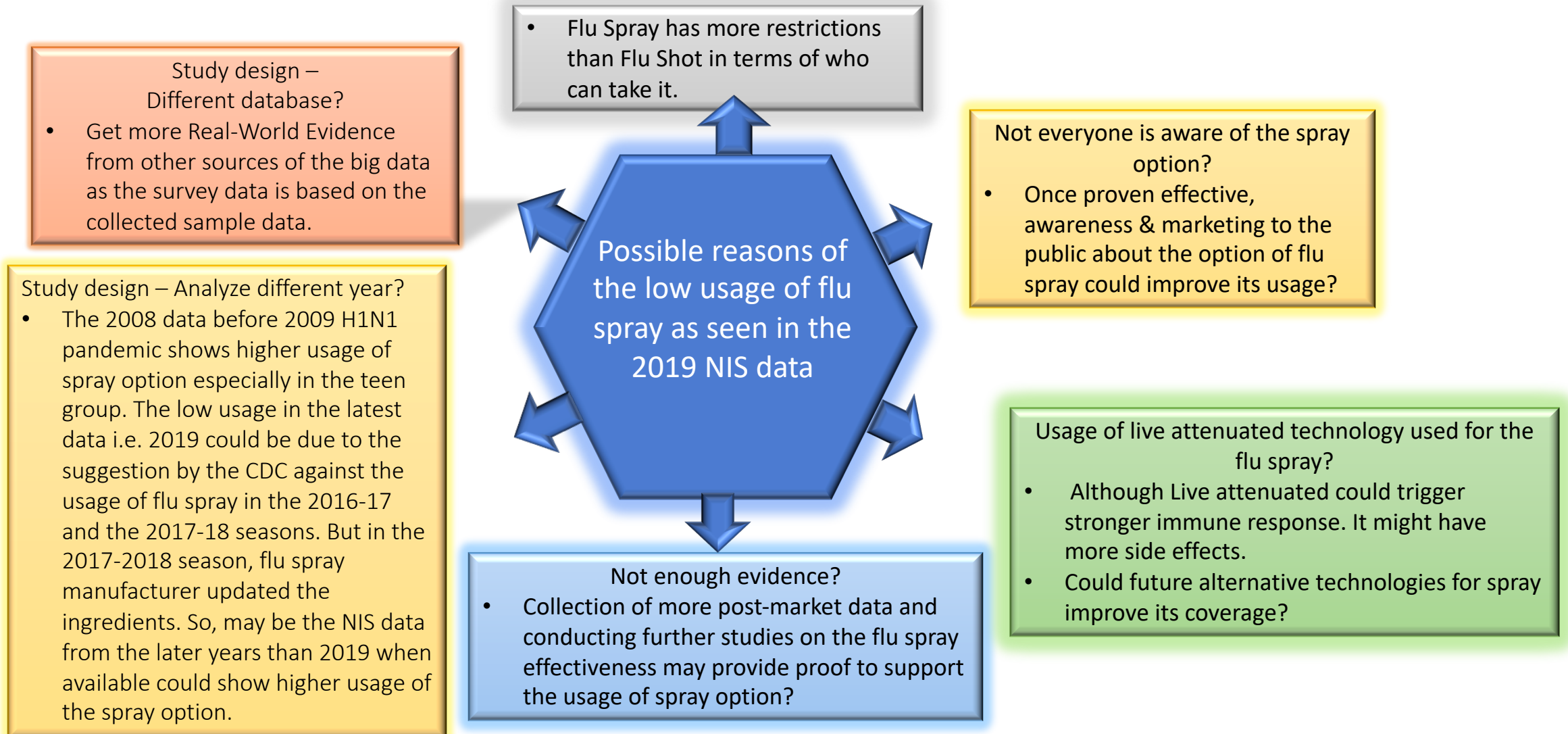
NIS Teen 2019 - Flu vaccination coverage by route among different demographic and socio-economic groups

Demographic and Socioeconomic characteristics	Administration Type			
	Flu Shot only	Flu Spray only	Flu Shot and Flu Spray	Unknown
Teen's Age				
13	84 (80.6-87.4)	2.3 (1.4-3.2)	6 (4.3-7.7)	7.6 (4.6-10.7)
14	87.6 (85.3-90)	3.1 (1.9-4.2)	5.5 (3.9-7)	3.8 (2.5-5.2)
15	87.9 (85.4-90.5)	2.3 (1.2-3.4)	5.5 (3.7-7.3)	4.3 (2.7-5.9)
16	85.2 (82.2-88.1)	4.5 (2.6-6.4)	5.3 (3.9-6.7)	5.1 (3.1-7.1)
17	86.7 (82.7-90.7)	3 (1.7-4.2)	4 (2.7-5.3)	6.3 (2.5-10.2)
Teen's Race				
Hispanic	87 (83.4-90.6)	2.4 (1.4-3.4)	3.8 (2.5-5.1)	6.8 (3.4-10.1)
Non-Hispanic White only	85.9 (84.3-87.4)	3.4 (2.6-4.3)	6.4 (5.4-7.3)	4.3 (3.4-5.3)
Non-Hispanic Black only	84.5 (80.4-88.6)	3.5 (1.7-5.3)	5.6 (2.9-8.3)	6.3 (3.5-9.1)
Non-Hispanic Other + Multiple Race	89.7 (86.4-93)	1.5 (0.7-2.3)	2.9 (1.7-4.2)	5.8 (2.8-8.8)
Teens's Ethnicity				
Hispanic	87 (83.4-90.6)	2.4 (1.4-3.4)	3.8 (2.5-5.1)	6.8 (3.4-10.1)
Non Hispanic	86.2 (84.8-87.5)	3.2 (2.5-3.9)	5.8 (4.9-6.6)	4.9 (4-5.8)
Teens's Gender				
Male	85.5 (83.5-87.6)	3.5 (2.6-4.5)	5.2 (4.2-6.3)	5.7 (4-7.4)
Female	87.2 (85.5-88.9)	2.4 (1.9-3)	5.3 (4.4-6.3)	5 (3.6-6.4)
Mother's Education				
Less than 12 Years	87.6 (84.3-90.9)	2.9 (1-4.7)	4.2 (2.5-5.9)	5.3 (3-7.7)
12 Years	85.5 (82-89)	3.9 (2.3-5.6)	4.5 (3.1-5.9)	6.1 (3.2-8.9)
More than 12 years, not a college graduate	86 (82.5-89.4)	2.4 (1.6-3.3)	5.1 (3.3-6.8)	6.5 (3.4-9.7)
College Graduate	86.6 (85-88.3)	2.9 (2.1-3.7)	6 (5-7.1)	4.5 (3.3-5.6)
Mother's Age Group				
<= 34 YEARS	84.2 (79.4-89)	2.7 (0.9-4.4)	5.3 (2.6-8.1)	7.8 (4.2-11.4)
35 TO 44 YEARS	84.4 (81.9-86.9)	3.8 (2.7-4.8)	5.3 (4.2-6.4)	6.5 (4.4-8.7)
>= 45 YEARS	88.4 (86.9-89.9)	2.4 (1.7-3.1)	5.3 (4.3-6.2)	3.9 (2.9-5)
Marital Status				
Currently Married	85.9 (84.1-87.6)	3.1 (2.4-3.9)	5.6 (4.7-6.4)	5.4 (3.9-6.9)
Not Currently Married	87.3 (85.3-89.3)	2.8 (1.8-3.7)	4.7 (3.5-6)	5.2 (3.9-6.5)

Demographic and Socioeconomic characteristics	Administration Type			
	Flu Shot only	Flu Spray only	Flu Shot and Flu Spray	Unknown
Poverty				
Above Poverty > \$75k	87.2 (85.6-88.8)	2.9 (2.2-3.7)	5.7 (4.7-6.8)	4.1 (3.1-5.2)
Above Poverty <= \$75k	85.4 (82.3-88.4)	3.3 (2.1-4.5)	5.3 (3.9-6.8)	6 (3.4-8.6)
Below Poverty	84.2 (80.5-88)	3.1 (1.7-4.5)	4.4 (3-5.8)	8.3 (5-11.6)
Unknown	91 (86.8-95.2)	1.6 (0-3.6)	4.1 (1.4-6.7)	3.3 (0.7-5.9)
Census Region				
Northeast	88.7 (86.5-90.9)	1.5 (0.8-2.3)	5.3 (3.8-6.7)	4.5 (2.8-6.2)
Midwest	87.5 (85.4-89.6)	2.4 (1.5-3.2)	5 (3.6-6.4)	5.1 (3.7-6.6)
South	84.3 (82.2-86.3)	4.7 (3.4-5.9)	6.4 (5.1-7.6)	4.7 (3.5-5.9)
West	86.8 (82.7-90.8)	2.2 (1.2-3.2)	3.8 (2.4-5.3)	7.2 (3.5-11)
Provider Facility				
All Public Facilities	87.8 (84.3-91.2)	2.5 (1-3.9)	4.6 (2.2-7)	5.1 (3-7.2)
All Hospital Facilities	89.9 (86.8-92.9)	2.1 (0.9-3.3)	3.1 (1.6-4.5)	4.9 (2.5-7.3)
All Private Facilities	86.6 (84.7-88.4)	3.2 (2.4-4)	5.8 (4.8-6.8)	4.5 (3.1-5.9)
All Military/ Other Facilities	88.9 (82.9-95)	2.2 (0-5.2)	1.9 (0-3.7)	7 (1.8-12.1)
Mixed	85 (82.2-87.8)	4.2 (2.4-6)	6.6 (5-8.3)	4.2 (2.6-5.8)
Unknown	79.1 (69.2-89)	1.1 (0-2.1)	3.5 (0.4-6.7)	16.3 (6.4-26.3)
Insurance				
Private insurance only	86.8 (85.2-88.3)	2.8 (2.1-3.5)	5.5 (4.6-6.5)	4.9 (3.8-5.9)
Any medicaid	85.2 (82.2-88.1)	2.8 (1.7-3.8)	5.6 (4.2-7)	6.5 (3.9-9)
Other insurance (chip, ihs, military, or other, alone or in comb. with private insurance)	89.6 (86.9-92.2)	3.6 (2-5.2)	3.2 (1.8-4.7)	3.6 (2-5.2)
Uninsured	85.7 (78.6-92.9)	7.6 (1.1-14)	1.1 (0.2-2)	5.6 (2-9.2)

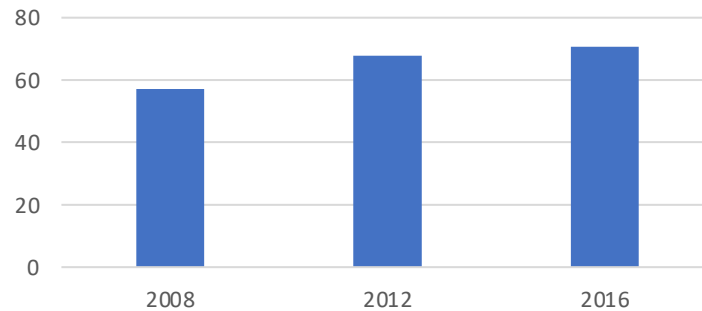
In NIS 2019 data, Flu shot was the main method of administration in all groups.

Possible reasons for the low usage of flu spray observed in the case study

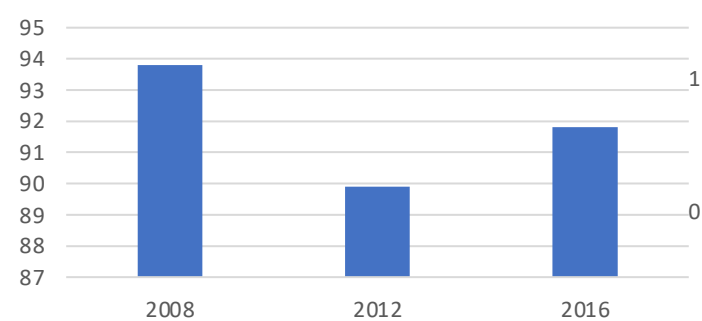


Trends in Flu Vaccines

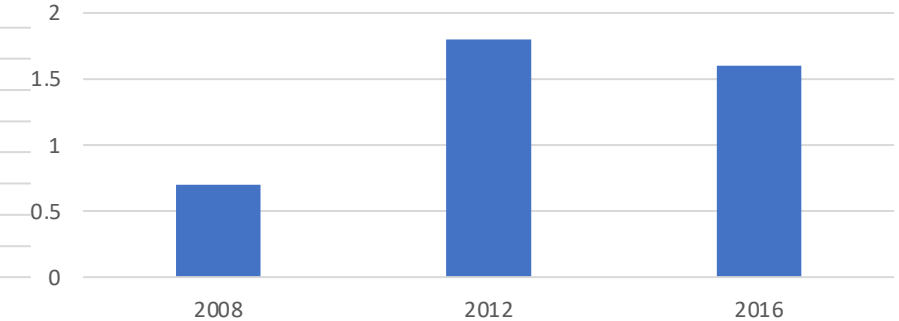
Percent estimates - Flu vaccinated - NIS Child



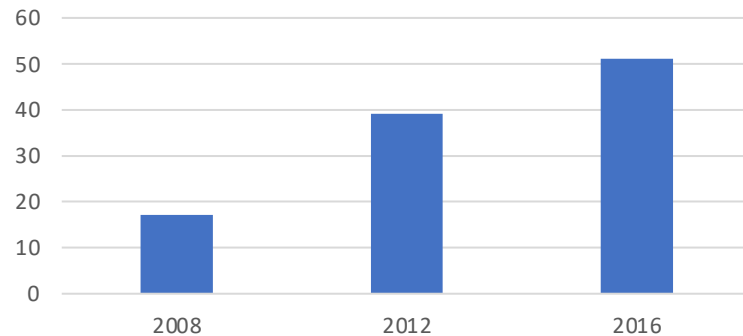
Percent estimates - Flu Shot only among vaccinated - NIS Child



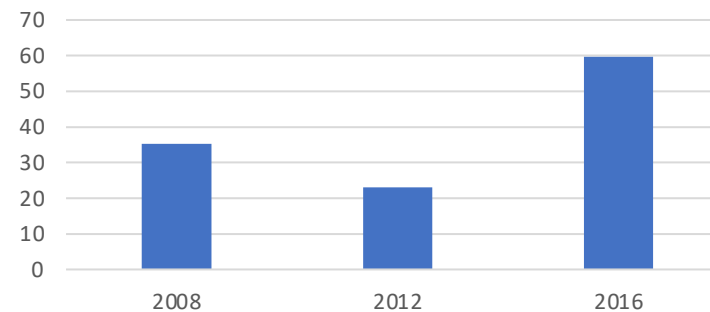
Percent estimates - Flu Spray only among vaccinated -NIS Child



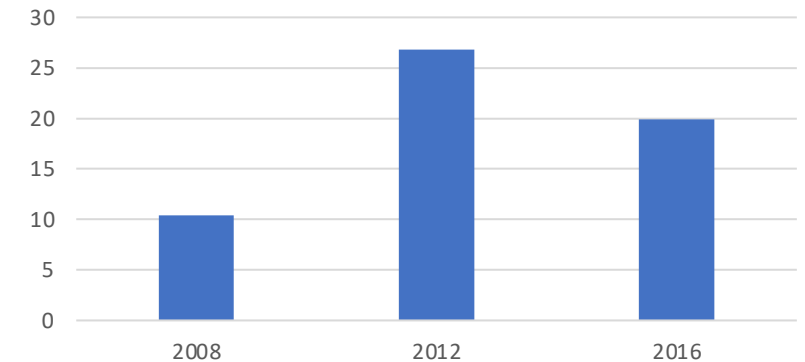
Percent estimates -Flu Vaccinated - NIS Teen



Percent estimates - Flu Shot only among those vaccinated - NIS Teen



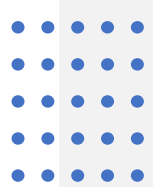
Percent estimates - Flu Spray only among vaccinated - NIS Teen



Total flu vaccinated population increased from 2008 to 2016. Flu shot only is the most preferable option in NIS child and NIS Teen*. NIS Teen tend to use spray more than children. As stated in the previous slide, the flu spray usage was much higher in the prior years than 2019 especially in the NIS Teen group for the year 2012. The CDC's suggestion against flu spray usage during the 2016-2017 and 2017-2018 seasons might have contributed to further decrease in flu spray usage in the 2019 NIS data.

*Exception: In NIS Teen 2012, Flu shot and Flu Spray and Unknown Flu type contributed most of the flu vaccinated.

Note: H1N1 data was available limited in the NIS 2019 database. Other main database to explore for H1N1 is 2009 H1N1 Flu Survey (NHFS).



Future studies: *could any future studies about the use of nanoparticles or mRNA for the nasal spray vaccines instead of live attenuated virus be as effective as well as an easy route for the seasonal vaccines with variants such as the flu and the covid?*

Types of vaccines commonly used:

- Live-attenuated vaccines
- Inactivated vaccines
- Subunit, recombinant, conjugate, and polysaccharide vaccines
- Toxoid vaccines
- mRNA vaccines
- Viral vector vaccines

Recent News about updates in Flu vaccines

- Nanoparticle based Flu shot.

Recent News – Covid as Nasal Spray

- **Nasal Spray COVID Vaccine Shows Promise in Animal Trials**
- <https://www.webmd.com/vaccines/covid-19-vaccine/news/20210119/nasal-spray-vaccine-for-covid-19-in-early-trials>
- **What A Nasal Spray Vaccine Against COVID-19 Might Do Even Better Than A Shot**
- <https://www.npr.org/sections/health-shots/2020/08/28/906797539/what-a-nasal-spray-vaccine-against-covid-19-might-do-even-better-than-a-shot>
- <https://altimmune.com/adcovid/>
- **A future COVID-19 vaccine could be squirted up the nose. The nasal spray could stop transmission, especially in kids.**
- <https://www.businessinsider.com/intranasal-covid-19-vaccine-spray-could-stem-spread-2021-3>

References and Suggested Reading

- SAS guide

<https://support.sas.com/documentation/onlinedoc/stat/142/surveymeans.pdf>

<https://support.sas.com/documentation/onlinedoc/stat/131/surveyfreq.pdf>

<https://support.sas.com/documentation/onlinedoc/stat/141/logistic.pdf>

- National Immunization survey (NIS)

<https://www.cdc.gov/vaccines/imz-managers/nis/index.html>

<https://pubmed.ncbi.nlm.nih.gov/11331127/>

- CDC – Types of Flu Vaccines

<https://www.cdc.gov/flu/prevent/different-flu-vaccines.htm>

<https://www.cdc.gov/vaccines/hcp/vis/vis-statements/flulive.pdf>

<https://www.cdc.gov/vaccines/hcp/vis/vis-statements/flu.pdf>

Questions?

