**Online Appendix 1**

At the time of the interview, respondents could report the child had not yet have received a vaccine for that season, but the child could go on to be vaccinated that season after the date of the interview. This could result in misclassification of seasonal vaccination status. Two separate methodologies have previously been used to account for this issue and estimate influenza vaccine coverage using the National Health Interview Survey.[1](#_ENREF_1),[2](#_ENREF_2) In the main text, we build on the approach of Brim, et. al.[2](#_ENREF_2), which we henceforth in this appendix refer to as “approach 1.” Additionally, we conducted a second analysis that for simplicity of presentation was not included in the main text; this analysis was consistent with the approach of Santibanez, et. al.[1](#_ENREF_1), which we refer to here as “approach 2.” Approach 1 is described in the main text of the manuscript; approach 2 is described below in this online appendix.

*Second analytic approach*

Approach 2 used survival analysis and included all respondent interviews, regardless of interview timing. Interviews from August through July were used to assess vaccinations during each influenza season (August through May). For influenza season 2004-2005, interview dates started in January of 2005 when the first questions about vaccination were added to NHIS. Observations were censored at the time of the NHIS interview if no influenza vaccination was reported. To assess trends over the time period, aggregated estimates by asthma status for each year were entered into a linear regression model, weighting each year’s estimate by the inverse of its variance. Quadratic terms on the linear scale for influenza season were added to the models to see if model fit could be improved, but these were not significant for either children with or without asthma. Time trends in vaccination by asthmas status over the time period were tested for coincidence and, if not coincident, whether they had parallel slopes.[3](#_ENREF_3) For early vaccination, the 2010-2011 season estimate was compared with the estimate for 2012-2013 using Z-tests. For the 2012-2013 season, comparisons of influenza vaccination rates between children with and without asthma were also conducted using Z-tests.

Similar to approach 1, approach 2 examined characteristics associated with earlier timing of influenza vaccination receipt among children with asthma in 2010-2013. Cox proportional hazard regressions were used, both unadjusted and adjusted for all covariates. Schoenfeld residuals were plotted to test the proportional hazards assumption, which was not violated.

**Sample size and missing observations for approaches 1 and 2**

Using approach 1, there were 31,668 sample children 2-17 years of age during April through July of years 2005-2013 (appendix table 1). Of these, 67 (0.2%) were missing information concerning whether the child currently had asthma and 988 (3.1%) were missing information on whether the child had an influenza vaccine during the previous 12 months. Of those that reported having had the influenza vaccine (n=10,494), 1,027 (9.8%) were missing information on the month or year of the vaccination. Among children with asthma (n=3,303), 93 (2.8%) were missing information on whether they had been vaccinated and of the 1,510 reporting vaccination, 123 (8.1%) were missing information on the timing of the vaccination.

For both the logistic regression analyses (approach 1) of the relationship between covariates and receiving any vs. no influenza vaccine and the logistic regression analyses (approach 1) of the relationship between covariates and early vs. late influenza vaccine, there were 10,132 interviews for children 2-17 years of age during April through July from 2011 through 2013. Of these, 26 (0.3%) were missing information on whether the child currently had asthma. Among children with asthma (n= 1,006), 21 (2.1%) were missing information on whether the child had an influenza vaccination during the previous 12 months. Of those that reported having the influenza vaccine (n=330), 22 (6.7%) were missing information on the timing of the vaccination.

Using approach 2, there were 85,087 interviews for children 2-17 years of age across all influenza seasons. Of these, 193 (0.2%) were missing information concerning whether the child currently had asthma and 2,823 (3.3%) were missing information concerning whether the child had an influenza vaccination during the previous 12 months. Of those that reported receiving the influenza vaccination (n=27,261), 2,406 (8.8%) were missing information on the month or year of the vaccination. Among children with asthma (n=8,761), 281 (3.2%) were missing information on whether they had been vaccinated and of those reporting vaccination (n=3,861), 284 (7.4%) were missing information on the timing of the vaccination.

For Cox regression analyses concerning timing of vaccination using approach 2, only interviews during the last three influenza seasons were included: August, 2010 through July, 2013. There were 33,889 interviews for children 2-17 years of age across the last three influenza seasons (2010-2013). Of these, 60 (0.2%) were missing information on whether they had current asthma. Among those identified as having asthma (n=3,543), 152 (4.3%) had missing information about whether they had received an influenza vaccination. Of the 1,819 reporting vaccination, 188 (10.3%) were missing information on the timing of the vaccination. Among children with asthma (n=3543), no data were missing for age, sex, region of country, and urban-rural status; 10.53% were missing data for race/ethnicity, and single imputations for these values were provided by NCHS on the NHIS file and used in all analyses. Another 13 (0.4%) observations were missing data for insurance type or highest level of family education, and these observations were excluded yielding a final analytic sample of 3,530 for the Cox regression analysis (approach 2).

Data for whether the child received an influenza vaccination as well as both the year and month of the vaccination were multiply imputed with a conditional multiple imputation by chained equations,[4](#_ENREF_4),[5](#_ENREF_5) using logistic models for whether the child had the vaccination or not and predictive mean matching for the year and month of those that were vaccinated. Prior to August 2010, whether a child had an influenza vaccine injection and whether the child had an influenza vaccine nasal spray, as well as the timing for each, were imputed as separate variables, consistent with the manner in which the survey was conducted. For all imputation models, age, sex, US census region, and survey design variables of strata and primary sampling unit were used as independent variables. For influenza seasons 2010-2011 through 2012-2013, race/ethnicity was also included. Larger models were considered, but would not converge. Similarly, ordinal models were considered for the month and year of the vaccine, but convergence was not achieved for those models. Five imputed data sets were created and were used in all analyses.

**Appendix to Results**

 Using approach 2, similar to approach 1, approximately 10% of children (SE: 0.1) had asthma across the 2005-2013 influenza seasons (supplemental table 3). Sociodemographic/geographic characteristics by asthma status in the analytical populations used in approach 2 were similar to that of approach 1 (supplemental tables 2 and 3). Using approach 2, the percentage of children with asthma receiving an influenza vaccination increased an average of 3.3% percentage points per year (SE: 0.2; p<0.001 for trend), from 31.6% (SE: 2.3%) in 2004-2005 to 54.6% (SE: 2.5%) in 2012-2013 (Supplemental Figure 1). The percentage of children without asthma receiving an influenza vaccination increased, on average, 4.4 percentage points per year (SE: 2.5; p<0.001 for trend), from 11.4% (SE: 0.5%) in 2004-2005 to 44.1% (SE: 0.9%) in 2012-2013. Similar to approach 1, in 2012-2013, the percentage of children with asthma receiving influenza vaccination was higher than that for children without asthma (p<0.001). Slopes of trends for children with and without asthma were neither coincident nor parallel (p<0.001 and p=0.05, rejecting the null hypothesis of coincidence and parallelism, respectively), indicating, again, a steeper overall linear slope for children without asthma.

Approach 2 also showed that among children 2-17 years, the percentage of children with asthma receiving early influenza vaccination was not statistically different between 2010-2011 (28.2% [SE: 2.0%]) and 2012-2013 (30.4% [SE: 2.0%])(p=0.43). In addition, the percentage of children without asthma receiving early influenza vaccination was also not statistically different between 2010-2011 (22.7% [SE: 0.6%]) and 2012-2013 (24.0% [SE: 0.6%]) (p=0.12). Estimates for the percentage of children with asthma receiving early vaccination in 2012-2013 were higher than for children without asthma (p<0.01).

Finally, using approach 2, we found characteristics associated with vaccination similar to those from approach 1 (supplemental table 4): a decreased likelihood of receiving vaccination among children 12-17 years of age compared to children 2-5 years of age (HR=0.73, p<0.01), uninsured children compared to privately insured children (HR=0.49, p<0.01), children of parents whose highest level of education was some college/associates degree/or a technical school compared to at least college (HR=0.78, p<0.01), and children in the South and West census region of the US compared to the Northeast (HR=0.76 for both, p<0.01 for both). No other variables were found to be significant. Results for adjusted Cox regression models were nearly identical to those found in bivariate analysis.

**Appendix Discussion**:

In general, we found largely similar results using both cumulative incidence and survival analyses approaches. Results for the percentage of children with asthma who were vaccinated were quite similar, and yearly point estimates for children without asthma were similar as well.

One area of discrepancy was whether early vaccination was increasing or not, which yielded inconsistent results between the two approaches. Approach 1 suggested a greater percentage receiving early vaccination during the 2012-2013 season than in the 2010-2011 season, while approach 2 did not. Additional years of data will be needed to better assess trends for early vaccination.

Each approach has advantages. Approach 1, the cumulative incidence approach, has the advantage of ease of calculation and the ability to use the person-level data directly which may allow for more sophisticated analysis such as controlling for other factors. However, due to the use of only 4 months of data per influenza seasons, statistical power may be limited. In addition, because April-July are after the peak influenza vaccination time period, misclassification of vaccination status is possible due to inaccurate recall of events. Approach 2, the survival analysis approach, used interviews from throughout the year and, hence, may have increased statistical power. However, approach 2 may also have some disadvantages compared with approach 1. First, the Kaplan-Meier survival approach and Cox proportional hazard model assume that censored observations have the same underlying distribution as non-censored observations.[6](#_ENREF_6),[7](#_ENREF_7) Here, because many censored observations may never receive the influenza vaccination during that season, [1](#_ENREF_1) this assumption may not be met. Approach 2 is also more technically complicated to conduct using survey data, requiring two types of software.

**1.** Santibanez TA, Lu PJ, O'Halloran A, Meghani A, Grabowsky M, Singleton JA. Trends in childhood influenza vaccination coverage--U.S., 2004-2012. *Public health reports.* Sep-Oct 2014;129(5):417-427.

**2.** Brim S, Rudd R, Funk R, Callahan D. Influenza Vaccination Coverage Among Children with Asthma---United States, 2004-2005 Influenza Season. *Morbidity and Mortality Weekly Report.* 2007;56(9):193-196.

**3.** Kim HJ, Fay MP, Yu B, Barrett MJ, Feuer EJ. Comparability of segmented line regression models. *Biometrics.* Dec 2004;60(4):1005-1014.

**4.** White I.R. RP, Wood A.M. Multiple Imputation using chained equations: Issues and guidance for practice. *Statistics in Medicine.* 2011;30:377-399.

**5.** StataCorp. *Stata Mutiple-imputation reference Manual: Release 13.* College Station, TX: StataCorp LP; 2013.

**6.** Rosner B. *Fundamentals of Biostatistics.* Belmont, CA: Thomson Higher Education; 2006.

**7.** Jackson D, White IR, Seaman S, Evans H, Baisley K, Carpenter J. Relaxing the independent censoring assumption in the Cox proportional hazards model using multiple imputation. *Statistics in medicine.* Nov 30 2014;33(27):4681-4694.