Text4baby Influenza Messaging and Influenza Vaccination Among Pregnant Women

Jessica A. Bushar, MPH,[1] Juliette S. Kendrick, MD,[2] Helen Ding, MD, MSPH,[3] Carla L. Black, PhD, MPH,[4] Stacie M. Greby, DVM, MPH[4]

Introduction: Pregnant women are at risk for severe influenza-related complications; however, only 52% reported receiving an influenza vaccination during the 2013–2014 influenza season. Text4baby, a free national text service, provides influenza vaccination education and reminders to pregnant women. This study examined reported influenza vaccination during pregnancy among Text4baby participants who reported receiving influenza messages and women who reported never participating in Text4baby.

Methods: Opt-in Internet Panel Surveys (April 2013 and 2014) of pregnant women collected demographic and other characteristics; influenza vaccination knowledge, attitudes, and behaviors; and Text4baby participation. Women aged 18–49 years, pregnant anytime from October to January (N=3,321) were included. Text4baby influenza message recallers reported receiving Text4baby influenza messages during their current/most recent pregnancy (n=377). Text4baby non-participants reported never receiving Text4baby messages (n=2,824). Multivariable logistic regression was performed (2014–2016) controlling for demographic and other characteristics, high-risk conditions, and provider recommendation and offer to vaccinate. Adjusted prevalence ratios (APRs) were calculated. Random sampling was assumed for this non-probability sample.

Results: Text4baby recallers were more likely than non-participants to report influenza vaccination regardless of receipt of provider recommendation and/or offer to vaccinate (provider recommendation/offer APR=1.29, 95% CI=1.21, 1.37, provider recommendation/no offer APR=1.52, 95% CI=1.07, 2.17). Among women receiving neither a provider recommendation nor offer to vaccinate, Text4baby recallers were more than three times as likely to report influenza vaccination compared with non-participants (APR=3.39, 95% CI=2.03, 5.67).

Conclusions: Text4baby status was associated with higher influenza vaccination, especially among women whose provider did not recommend or offer the vaccine. Encouraging Text4baby enrollment may help ensure influenza vaccination is given to protect mothers and infants.
Am J Prev Med 2017;53(6):845–853. © 2017 American Journal of Preventive Medicine. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

INTRODUCTION

Pregnant women are at high risk for developing severe influenza-related complications, including secondary pneumonia, acute respiratory insufficiency, premature labor, and death as a result of a shift from cell-mediated immunity to humoral immunity while pregnant.[1] Influenza vaccination is the best way to protect women during pregnancy and the postpartum period, and provides infants, another group at high risk for influenza-related complications, with protective immunity.[2] Maternal influenza immunity protects the infant from infection through the transfer of maternal antibodies via the placenta and breast milk and contributes to a "cocooning" protective environment for the infant.[3]

From the [1]ZERO TO THREE, Washington, District of Columbia; [2]Consultant, Decatur, Georgia; [3]CFD Research Corporation, Huntsville, Alabama; and [4]National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia

Address correspondence to: Jessica A. Bushar, MPH, 1255 23rd Street, NW, Suite 350, Washington DC 20037. E-mail: jbushar@zerotothree.org.

The Centers for Disease Control and Prevention (CDC) recommends all women who are or will be pregnant during an influenza season be vaccinated to protect them and their infants from influenza; however, only 52% received the vaccination during the 2013–2014 influenza season.[2,4] A provider's recommendation with or without an offer to vaccinate increases self-reported vaccination rates among pregnant women.[4] Reminder/recall systems have been shown to improve vaccination coverage[5–7]; texting has been used to deliver reminders and education because of its prevalent use and popularity among minorities and people with lower income and education levels.[8]

Text4baby is a free mobile health (mHealth) service for pregnant women and mothers with infants aged <1 year that sends three weekly texts with health content timed to a woman's due date or her infant's birthday. Text4baby educates women about important health issues, encourages contact with providers, and promotes healthy behaviors. More than 1,400 partners nationwide promote the service and major medical associations share the service as a tool for their members. Women enroll in various ways, including by text, online, via the Text4baby mobile app, and directly via health plans and Medicaid agencies. Text4baby content is developed in accordance with established patient care guidelines and is kept current by the ongoing involvement of a Content Development Council comprising leading national medical health organizations and federal partners.[9]

Text4baby identified maternal influenza vaccination as a critical issue to target and implemented seasonal modules of messages encouraging influenza vaccination. The 2012–2013 module included two components: (1) education tailored to participant-reported reasons for non-vaccination, and (2) an opportunity to schedule a text reminder to get vaccinated. Details on the design, content, and evaluation of the 2012–2013 module are published elsewhere.[10] The 2013–2014 module included information on low-cost influenza vaccination and a separate vaccination reminder. It also included two new components: (1) a coupon offer for a free influenza vaccination for mothers through a partnership with Rite Aid, and (2) additional education about influenza vaccination for infants sent to mothers with infants aged >6 months during influenza season.

The objective of this study is to compare self-reported influenza vaccination coverage during pregnancy among Text4baby participants who reported they received Text4baby influenza messages and women who reported that they never participated in Text4baby.

METHODS

Study Sample

The data sources for this study were two Internet Panel Surveys conducted by CDC targeting pregnant women aged 18–49 years to collect information on influenza vaccination, demographic characteristics, access to care during pregnancy, and knowledge, attitudes, and behaviors regarding influenza vaccination. Since the 2010–2011 influenza season, CDC has conducted this survey in early April for end-of-season influenza vaccination estimates.[11] Survey data from April 2013 and 2014 were used for this study.

Measures

Women aged 18–49 years who were pregnant anytime from August 2012 through early April 2013 and from August 2013 through early April 2014 were recruited from SurveySpot, an opt-in general population internet panel operated by Survey Sampling International. Pregnant women were primarily recruited through a message advertising the survey on the main panel websites, inviting panelists to view the survey eligibility questions and sending an email invitation to a sample of panelists whose profiles indicated that they were women aged 18–49 years living in the U.S. A total of 2,047 eligible women completed the April 2013 survey and 2,042 completed the April 2014 survey, with completion rates of 93% and 96%, respectively. For this study, the sample was restricted to women who were pregnant anytime during the usual peak influenza vaccination period from October 2012 through January 2013 for the April 2013 survey and from October 2013 through January 2014 for the April 2014 survey (1,702 from April 2013, and 1,619 from April 2014; N=3,321). To develop statistical measures for this analysis, random sampling was assumed in this non-probability sample. A non-probability sample was used, given that surveys of rare populations, such as pregnant women, can be time-consuming and costly and few national surveys collect information about receipt of influenza vaccination. For each year, the final sample was weighted through post stratification weighting to represent the age group, race/ethnicity, and geographic distribution of the U.S. population of pregnant women based on data from National Vital Statistics Reports by the National Center for Health Statistics and the Guttmacher Institute, 1990–2008.[a,12,13]

The April 2013 and 2014 surveys included Text4baby questions about receipt of Text4baby messages and about the helpfulness of the influenza messages (Figure 1). The primary outcome of this study was self-reported influenza vaccination coverage, defined as vaccination received before and during pregnancy since July (July 2012 for the April 2013 survey and July 2013 for the April 2014 survey).

---

[a]The total population of pregnant women in the U.S. in each year and the distribution of pregnant women by age and race/ethnicity groups were determined from reported data published in the National Vital Statistics Reports by the National Center for Health Statistics in June 2012, and included combined data on live births from birth certificate information, data on spontaneous abortions from the National Survey of Family Growth, and data on induced abortions from CDC's Abortion Surveillance System. The distribution of U.S. pregnant women aged 18–44 years by Census region in 2008 was determined based on estimates provided for each state in the Guttmacher Institute's state data center, and included pregnancies that ended in live births and spontaneous and induced abortions.
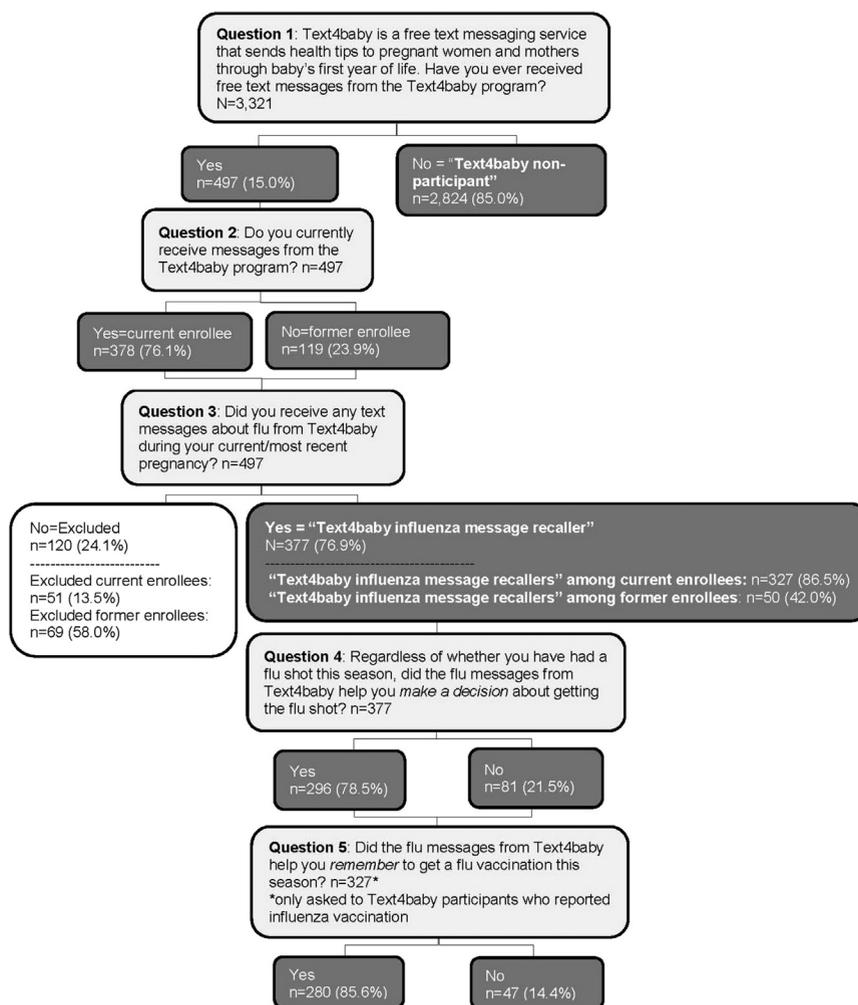
Figure 1. Content and flow of Internet Panel Survey Text4baby questions and participant response.

Survey respondents who reported being pregnant anytime during October through January were grouped as follows: (1) "Text4baby influenza message recallers" were women who reported they received Text4baby influenza messages during their current or most recent pregnancy (those who responded *yes* to Text4baby Questions 1 and 3), and (2) "non-participants" were women who reported they did not receive any Text4baby messages (those who responded *no* to Text4baby Question 1; Figure 1). Current and former Text4baby enrollees who reported they did not receive influenza messaging during their current or most recent pregnancy (those who responded *yes* to Text4baby Question 1, *yes* [current enrollee] or *no* [former enrollee] to Question 2, and *no* to Text4baby Question 3) were excluded, given that their past exposure to influenza messaging sent via the Text4baby platform could not be determined (Figure 1).

Statistical Analysis

Differences in characteristics between Text4baby influenza message recallers and non-participants were tested using chi-square tests. The difference in vaccination coverage by demographic and access to care characteristics, high-risk conditions, Text4baby status, and provider recommendation and offer to vaccinate was assessed in a bivariate logistic regression model. To examine whether Text4baby status was independently associated with influenza vaccination coverage, weighted multivariable logistic regression analyses were performed controlling for demographic and access to care characteristics and high-risk conditions. Variables for inclusion were decided a priori based on factors previously reported to be associated with influenza vaccination. Year of the survey was included in the initial model to control for differences in Text4baby influenza messaging between seasons. Interaction between provider recommendation/offer X Text4baby status on vaccination coverage was tested. All analyses were conducted in 2014–2016 using SAS, version 9.3 survey procedures and SAS callable SUDAAN, version 11.1. Crude and Adjusted Prevalence Ratios (CPRs and APRs) and 95% CIs were estimated using predicted marginal proportions. Respondents gave informed consent to participate at the time of admission to the SurveySpot panel. The surveys were determined to be non-research by CDC and Abt Associates.

RESULTS

Among eligible women who completed the April 2013 or 2014 survey and were pregnant anytime from October

through January (N=3,321), 497 (15.0%) reported they were current (378) or former (119) Text4baby enrollees (Figure 1). Most current enrollees (327 [86.5%]) and slightly less than half of former enrollees (50 [42.0%]) reported they received influenza messages from Text4-baby during their current or most recent pregnancy, for a total of 377 Text4baby influenza message recallers (Figure 1). The 120 Text4baby enrollees who reported they did not receive Text4baby influenza messages during their current or most recent pregnancy were excluded (Figure 1); excluded Text4baby enrollees were more likely to report public insurance than Text4baby recallers (53.3% of excluded enrollees reported public insurance vs 42.6% of Text4baby recallers).

Text4baby recallers (n=377) were more likely than non-participants (n=2,824) to be older (aged 25–49 years [72.2% vs 66.0%, respectively]), non-white (70.5% vs 61.9%), college educated or greater (57.6% vs 49.7%), married (70.2% vs 61.9%), currently working (66.4% vs 48.1%), receiving public insurance (57.4% vs 40.3%), and pregnant for the first time (55.1% vs 44.3%) (Table 1). Text4baby recallers were also more likely to report that they had a high-risk medical condition (54.1% vs 31.8%) and received a provider recommendation and offer to get vaccinated (82.0% vs 56.4%). More than three quarters (77.0%) of Text4baby recallers reported Text4baby influenza messages helped them make a decision about the vaccination (Question 4) and 88.6% reported that the influenza messages helped them remember to get vaccinated (Question 5) (Table 1).

Crude influenza vaccination coverage and the bivariate and multivariable associations between vaccination coverage and participant characteristics are shown in Table 2. Demographic and access to care characteristics and high-risk conditions were included in the multivariable model to control for possible confounding. Provider recommendation and offer and an interaction term between provider recommendation and offer X Text4baby status were included to examine differences by strata. Survey year was not associated with vaccination status and was not included in the model.

Women in the following groups had higher crude influenza vaccination rates: those living in the Northeast (versus South), aged 25–49 years (vs 18–24 years), those who were college educated or greater (versus less than a college education), married (versus not married), living at or above the poverty threshold (versus below poverty), currently working (versus not working), who reported a high-risk condition (versus no high-risk condition), and who reported six or more provider visits (versus zero to five visits). Non-Hispanic black women had lower crude influenza vaccination rates than non-Hispanic white women. Rates of vaccination were lowest for those who

received neither a recommendation nor an offer (13.5%), higher for those who received a recommendation but no offer (39.5%; CPR=2.92, 95% CI=2.33, 3.66), and highest for those who received a provider recommendation and offer (70.5%; CPR=5.21, 95% CI=4.28, 6.35). Influenza vaccination coverage for Text4baby recallers was 81.3% compared with 47.1% for non-participants (CPR=1.73, 95% CI=1.61, 1.85; Table 2).

After adjusting for potential confounders and effect modification, vaccination rates remained higher among the following groups: those who were college educated or greater (college degree APR=1.10, 95% CI=1.02, 1.19; greater than college degree APR=1.15, 95% CI=1.03, 1.28), those living at or above the poverty threshold (APR=1.12, 95% CI=1.01, 1.24), who were Text4baby recallers (APR=1.44, 95% CI=1.30, 1.58), who reported a high-risk condition (APR=1.11, 95% CI=1.04, 1.19), and who reported receiving a provider recommendation with or without an offer to vaccinate (provider recommendation/offer APR=4.04, 95% CI=3.26, 5.00; provider recommendation/no offer APR=2.42, 95% CI=1.90, 3.07). Vaccination rates remained lower for non-Hispanic black women compared with non-Hispanic white women (APR=0.87, 95% CI=0.77, 0.98).

The test for interaction between provider recommendation and/or offer X Text4baby status in the multivariate model was significant (p<0.01). For women who reported that their provider recommended and offered the vaccination (n=1,865), Text4baby recallers were more likely to report influenza vaccination than non-participants (APR=1.29, 95% CI=1.21, 1.37). Similarly, among those who received a provider recommendation but no offer to vaccinate (n=493), Text4baby recallers were more likely to report influenza vaccination (APR=1.52, 95% CI=1.07, 2.17). Finally, among those who received neither a provider recommendation nor offer to vaccinate (n=755), Text4baby recallers were more than three times as likely to report receipt of influenza vaccination (APR=3.39, 95% CI=2.03, 5.67).

DISCUSSION

In this study, Text4baby participants who reported receiving Text4baby influenza messages were more likely than non-participants to report influenza vaccination, and the effect was strongest among those who received neither a provider recommendation nor an offer to vaccinate. This finding supports the potential of Text4-baby to improve influenza vaccination coverage among a group with historically low vaccination coverage, those who receive neither a provider recommendation nor

Table 1. Text4baby Influenza Message Recallers and Non-Participant Characteristics, 2012−2013 and 2013−2014 Internet Panel Surveys, U.S.

Participant characteristics	Message recallers, n (weighted %) (n=377)	Non-participants, n (weighted %) (n=2,824)	p-value
Overall	377 (12.5)	2,824 (87.5)	
Age group, years			
18−24	79 (27.8)	731 (34.0)	
25−49	298 (72.2)	2,093 (66.0)	**0.04***
Race/ethnicity			
White, non-Hispanic	121 (29.5)	1,178 (38.1)	
Black, non-Hispanic	44 (20.3)	279 (18.1)	
Hispanic	157 (39.7)	1,109 (36.4)	
Other, non-Hispanic	55 (10.5)	258 (7.3)	**0.01***
Census regions			
Region 1: Northeast	84 (22.3)	492 (16.9)	
Region 2: Midwest	68 (16.3)	669 (21.0)	
Region 3: South	138 (37.0)	1,041 (36.9)	
Region 4: West	87 (24.3)	622 (25.2)	**0.05***
Education			
Less than college degree	147 (42.4)	1,329 (50.3)	
College degree	167 (40.4)	1,163 (39.1)	
Greater than college degree	63 (17.2)	332 (10.6)	**<0.001****
Parity			
First pregnancy	210 (55.1)	1,191 (44.3)	
Previously pregnant	167 (44.9)	1,633 (55.7)	**<0.001****
Marital status			
Yes	281 (70.2)	1,889 (61.9)	
No	96 (29.8)	935 (38.1)	**0.01***
Poverty status[a]			
Below poverty	81 (24.6)	540 (21.8)	
At or above poverty	295 (75.4)	2,276 (78.2)	0.28
Working status[b]			
No	124 (33.6)	1,437 (51.9)	
Yes	253 (66.4)	1,387 (48.1)	**<0.001****
Insurance coverage			
Any public	199 (57.4)	981 (40.3)	
Private/military only	170 (42.6)	1,708 (59.7)	**<0.001****
High-risk conditions[c]			
Yes	193 (54.1)	918 (31.8)	
No	184 (45.9)	1,906 (68.2)	**<0.001****
Number of provider visits			
0−5 visits	119 (31.4)	931 (34.0)	
6−10 visits	136 (37.6)	1,069 (37.7)	
>10 visits	122 (31.0)	824 (28.3)	0.54
Provider recommendation and/or offer for influenza vaccination[d]			
Recommended and offered	314 (82.0)	1,551 (56.4)	
Recommended with no offer	31 (8.8)	462 (17.0)	
No recommendation or offer	27 (9.2)	728 (26.6)	**<0.001****
Did the flu message you received from "Text4baby" help you make a decision about getting the flu shot this season?	296 (77.0)	N/A	N/A
Did the flu message you received from "Text4baby" help you remember to get a flu shot this season?[e]	280 (88.6)	N/A	N/A

Note: Boldface indicates statistical significance (*p<0.05; **p<0.01).
[a]Below poverty was defined as categorized by the U.S. Census Bureau (www.census.gov/data/tables/time-series/demo/income-poverty/historical-poverty-thresholds.html).
[b]Those who were employed for wages and the self-employed were grouped as working. Those who were out of work, homemakers, students, retired, or unable to work were grouped as not working.
[c]Conditions associated with increased risk for serious medical complication from influenza, including chronic asthma, a lung condition other than asthma, a heart condition, diabetes, a kidney condition, a liver condition, obesity, or a weakened immune system caused by a chronic illness or by medicines taken for a chronic illness.
[d]Excluded women who did not visit a provider since August 2012 (n=27) or women who did not know whether they received a provider recommendation or offer (n=55).
[e]Among women who received Text4baby influenza messages and influenza vaccination (n=318).

offer to vaccinate.[4] Text4baby and Text4baby partners implement national and community-based campaigns to reach and enroll women who may not be connected to the healthcare system. Text4baby can serve as a reminder system that providers can offer to further encourage influenza vaccination in addition to providing a recommendation and offer to be vaccinated. More than three quarters of Text4baby influenza message recallers reported that Text4baby influenza messages helped them make a decision about vaccination and reminded them to be vaccinated. Given these results, it is possible that the positive association between Text4baby status and vaccination may be attributed specifically to Text4baby influenza modules. Findings from this study are consistent with two RCTs that found a positive association between text-based influenza messaging and documented influenza vaccination among children, adolescents, and pregnant women.[6,7] Findings are also consistent with a federally funded evaluation that found Text4baby pregnant participants were significantly more likely to report influenza vaccination compared with participants who had never heard of Text4baby.[14] An evaluation of the 2012–2013 Text4baby influenza module found text reminders and information on low-cost influenza vaccination effective at improving reported influenza vaccination among Text4baby mothers.[10] Finally, findings are consistent with qualitative research that suggests multicomponent approaches, including positively framed, tailored messages that highlight vaccination benefits for pregnant women and their children—all of which were incorporated as part of the Text4baby influenza modules —may lead to increased vaccination.[15,16]

To the authors' knowledge, this study was the first to use a sample of women from across the U.S. to examine the association between reported receipt of specific text messages within a texting intervention and a preventive health recommendation, and more specifically, the first to use a sample of pregnant women from across the U.S. to assess the association between receipt of Text4baby messages and a preventive health recommendation. The approach taken to examine a texting intervention by means of an existing survey allowed for quick assessment and serves as a model for other mHealth interventions in need of timely evaluation given the rapid evolution of technology and survey mechanisms. Future mHealth evaluations should consider controlling for health consciousness when using an external control group and assessing the number and specific content of messages and different incentives, such as the coupon offer for a free influenza vaccination that resulted in a 1.7% redemption rate during the 2013–2014 flu season, which could lead to improved outcomes.[17] The use of nonprobability sampling for public health evaluations should

also be further assessed, particularly for evaluations involving rare populations.

Limitations

This study has limitations. First, all data, including vaccination status, were self-reported and not independently validated. Second, the association between Text4baby status and vaccination may be biased if women who enroll in Text4baby are more likely to be health conscious and therefore more likely to get vaccinated or if they have other demographic characteristics or health seeking behaviors not measured in this study that are associated with increased vaccination. However, findings from the aforementioned Text4baby evaluation show no significant differences in health information seeking, referenced as a key dimension of health consciousness, between Text4baby participants and other prenatal patients who heard of Text4baby but decided not to sign up.[14,18] Third, this study reports an association between Text4baby status and influenza vaccination among a sample of volunteer members of a non-probability Internet panel.[19] Because the sample was not randomly selected, estimates of sampling error are usually not considered valid and not computed.[20] Statistical measures of association were computed as a guide to assess the value of Text4baby on uptake of influenza vaccination. Population-based surveys of a rare population, such as pregnant women, are time-consuming and potentially costly. The Internet Panel Surveys are the only national surveys that collect information about receipt of influenza vaccination and vaccine-related knowledge, attitudes, and behaviors. The estimates of vaccination coverage may be biased if the selection processes for entry into the survey and a woman's decision to participate were related to receipt of vaccination. To reduce bias, data were weighted to be more representative of the U.S. population of pregnant women. Additionally, comparisons to influenza vaccination coverage estimates among pregnant women from population-based surveys such as the Behavioral Risk Factor Surveillance System have shown that, whereas Internet Panel Survey estimates are consistently higher, trends in coverage are similar.[21] Finally, it is possible that the magnitude of association between Text4baby status and vaccination could be overstated among women who received neither a provider recommendation nor an offer for vaccination if Text4baby messages encouraged early vaccination and providers assessed vaccination status before providing a recommendation or offer. The magnitude of the association could also be overstated if Text4baby enrollees who truly received the influenza messages, but did not remember receiving them, were excluded and if this group of enrollees was less likely to be vaccinated than Text4baby influenza message recallers.

Table 2. Influenza Vaccination Coverage, Pregnant Women, by Characteristics, 2012–2013 and 2013–2014 Internet Panel Surveys, U.S.

Participant characteristics	Crude vaccination coverage, n	Crude vaccination coverage, weighted % (95% CI)	Crude prevalence ratio CPR (95% CI)	Adjusted prevalence ratio APR (95% CI)
Age group, years				
18–24	850	47.2 (43.5–50.8)	ref	ref
25–49	2,471	53.5 (51.4–55.6)	**1.13 (1.04–1.24)****	0.97 (0.90–1.06)
Race/ethnicity				
White, non-Hispanic	1,353	53.6 (50.8–56.5)	ref	ref
Black, non-Hispanic	335	44.1 (38.7–49.6)	**0.82 (0.72–0.94)****	**0.87 (0.77–0.98)***
Hispanic	1,311	51.4 (48.5–54.3)	0.96 (0.89–1.04)	**0.93 (0.87–1.00)***
Other	322	57.7 (52.1–63.2)	1.08 (0.96–1.20)	1.05 (0.95–1.16)
Census regions				
Region 1: Northeast	592	56.3 (52.0–60.7)	**1.15 (1.04–1.27)****	1.02 (0.93–1.11)
Region 2: Midwest	762	53.1 (49.2–56.9)	1.09 (0.99–1.19)	1.00 (0.91–1.09)
Region 3: South	1,236	48.9 (45.8–52.0)	ref	ref
Region 4: West	731	50.2 (46.3–54.1)	1.03 (0.93–1.14)	0.97 (0.89–1.06)
Education				
Less than college degree	1,543	44.2 (41.5–47.0)	ref	ref
College degree	1,370	57.3 (54.5–60.2)	**1.30 (1.20–1.40)****	**1.10 (1.02–1.19)***
Greater than college degree	408	62.1 (57.0–67.2)	**1.40 (1.27–1.56)****	**1.15 (1.03–1.28)***
Parity				
First pregnancy	1,453	53.3 (50.5–56.1)	0.93 (0.87–1.00)	0.94 (0.88–1.00)
Previously pregnant	1,868	49.7 (47.2–52.2)	ref	ref
Marital status				
Yes	2,248	55.7 (53.4–57.9)	**1.26 (1.16–1.37)****	1.06 (0.98–1.15)
No	1,073	44.1 (40.8–47.3)	ref	ref
Poverty status[a]				
Below poverty	654	43.0 (38.9–47.1)	ref	ref
At or above poverty	2,658	53.8 (51.8–55.9)	**1.25 (1.13–1.39)****	**1.12 (1.01–1.24)***
Working status[b]				
No	1,624	45.8 (43.2–48.5)	ref	ref
Yes	1,697	56.9 (54.3–59.4)	**1.24 (1.15–1.34)****	1.06 (0.99–1.13)
Insurance during pregnancy				
Any public	1,238	50.5 (47.4–53.5)	ref	ref
Private/military	1,932	54.0 (51.6–56.4)	0.94 (0.87–1.01)	1.05 (0.97–1.13)
High-risk conditions[c]				
Yes	1,151	59.0 (56.0–62.1)	**1.25 (1.16–1.34)****	**1.11 (1.04–1.19)****
No	2,170	47.3 (45.0–49.6)	ref	ref
Number of provider visits				
0–5 visits	1,095	45.1 (41.9–48.3)	ref	ref
6–10 visits	1,250	54.1 (51.0–57.1)	**1.20 (1.09–1.31)****	1.02 (0.94–1.10)
>10 visits	976	55.2 (51.7–58.6)	**1.22 (1.11–1.34)****	0.99 (0.91–1.08)
Text4baby status				
Text4baby influenza message recaller	377	81.3 (76.9–85.7)	**1.73 (1.61–1.85)****	**1.44 (1.30–1.58)****
Text4baby non-participant	2,824	47.1 (45.1–49.1)	ref	ref
Provider recommendation and/or offer for influenza vaccination[d]				
Received recommendation and offer	1,932	70.5 (68.2–72.7)	**5.21 (4.28–6.35)****	**4.04 (3.26–5.00)****
Recommendation but no offer	512	39.5 (34.9–44.1)	**2.92 (2.33–3.66)****	**2.42 (1.90–3.07)****
No recommendation or offer	779	13.5 (10.9–16.2)	ref	ref

Table 2. Influenza Vaccination Coverage, Pregnant Women, by Characteristics, 2012–2013 and 2013–2014 Internet Panel Surveys, U.S. *(continued)*

Participant characteristics	Crude vaccination coverage, *n*	Crude vaccination coverage, weighted % (95% CI)	Crude prevalence ratio CPR (95% CI)	Adjusted prevalence ratio APR (95% CI)
Interaction between provider recommendation and/or offer for influenza vaccination and Text4baby status				
Received recommendation and offer				
Text4baby influenza message recallers	314	88.0 (84.0–91.9)	**1.32 (1.24–1.40)****	**1.29 (1.21–1.37)****
Text4baby non-participants	1,551	66.8 (64.2–69.4)	ref	ref
Received recommendation but no offer				
Text4baby influenza message recallers	31	63.2 (45.2–81.1)	**1.67 (1.23–2.28)***	**1.52 (1.07–2.17)***
Text4baby non-participants	462	37.8 (33.0–42.6)	ref	ref
No recommendation or offer				
Text4baby influenza message recallers	27	41.5 (21.6–61.3)	**3.46 (2.04–5.84)****	**3.39 (2.03–5.67)****
Text4baby non-participants	728	12.0 (9.4–14.6)	ref	ref

Note: Boldface indicates statistical significance (*p < 0.05; **p < 0.01).
[a]Below poverty was defined as categorized by the U.S. Census Bureau (www.census.gov/data/tables/time-series/demo/income-poverty/historical-poverty-thresholds.html).
[b]Those who were employed for wages and the self-employed were grouped as working. Those who were out of work, homemakers, students, retired, or unable to work were grouped as not working.
[c]Conditions associated with increased risk for serious medical complication from influenza, including chronic asthma, a lung condition other than asthma, a heart condition, diabetes, a kidney condition, a liver condition, obesity, or a weakened immune system caused by a chronic illness or by medicines taken for a chronic illness.
[d]Excluded women who did not visit a provider since August 2012 (*n*=27) or women who did not know whether they received a provider recommendation or offer (*n*=55).

CONCLUSIONS

This study suggests Text4baby participants who reported receiving Text4baby influenza messages might be more likely to report influenza vaccination than non-participants, even among women whose provider already recommends and offers the vaccine. Text4baby participants in this study were more likely to report influenza vaccination among the more vulnerable group of women whose providers do not recommend or offer the vaccine. Text4baby is an example of an evidence-based intervention, a reminder system, designed to increase vaccination and enhance care.[5] In recent years, the American College of Obstetricians and Gynecologists has included information on Text4baby in a mailing to providers with resources on influenza for patients and families. Study findings support the need for continued efforts not only to encourage busy providers to recommend and offer vaccination, but also to reinforce a recommendation and offer with other approaches, like Text4baby, that can maximize opportunities to provide preventive care to protect mothers and infants.

ACKNOWLEDGMENTS

REFERENCES

1. Schlaudecker EP, Steinhoff MC. Helping mothers prevent influenza illness in their infants. *Pediatrics.* 2010;126(5):1008–1011. https://doi.org/10.1542/peds.2010-2041.
2. CDC. Prevention and control of seasonal influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices – United States, 2013–2014. *MMWR Morb Mortal Wkly Rep.* 2013;62(RR7):1–43.
3. Nitsch-Osuch A, Woźniak Kosek A, Brydak LB. Vaccination against influenza in pregnant women - safety and effectiveness. *Ginekol Pol.* 2013;84(1):56–61. https://doi.org/10.17772/gp/1541.

4. CDC. Influenza vaccination coverage among pregnant women – United States, 2013–14 influenza season. *MMWR Morb Mortal Wkly Rep*. 2014;63(37):816–821.

5. Guide to Community Preventive Services. Increasing appropriate vaccination. Atlanta, GA: CDC. www.thecommunityguide.org/vaccines/index.html. Updated July 14, 2015. Accessed July 25, 2016.

6. Stockwell MS, Kharbanda EO, Martinez RA, et al. Effect of a text messaging intervention on influenza vaccination in an urban, low-income pediatric and adolescent population: a randomized controlled trial. *JAMA*. 2012;307(16):1702–1708. https://doi.org/10.1001/jama.2012.502.

7. Stockwell MS, Westhoff C, Kharbanda EO, et al. Influenza vaccine text message reminders for urban low-income pregnant women: a randomized controlled trial. *Am J Public Health*. 2014;104(suppl 1):e7–e12. https://doi.org/10.2105/AJPH.2013.301620.

8. Duggan M. Additional Demographic Analysis. Washington, DC: Pew Research Center. www.pewinternet.org/2013/09/19/additional-demographic-analysis/. Published September 19, 2013. Accessed July 25, 2016.

9. Text4baby Message Content and Development. Washington, DC: Text4baby. https://partners.text4baby.org/images/2016/Text4babyContentFactSheetUpdated2016_2.pdf. Accessed April 6, 2017.

10. Jordan E, Bushar J, Kendrick J, Johnson P, Wang J. Encouraging influenza vaccination among Text4baby pregnant women and mothers. *Am J Prev Med*. 2015;49(4):563–572. https://doi.org/10.1016/j.amepre.2015.04.029.

11. Pregnant Women and Flu Vaccination, Internet Panel Survey, United States, November 2016. Atlanta, GA: CDC. www.cdc.gov/flu/fluvaxview/pregnant-women-nov2016.htm. Updated December 9, 2016. Accessed April 6, 2017.

12. Ventura SJ, Curtin SC, Abma JC, Henshaw SK. Estimated pregnancy rates and rates of pregnancy outcomes for the United States, 1990–2008. *Natl Vital Stat Rep*. 2012;60(7):1–21.

13. Total number of pregnancies among women aged 15–44, 2008. Guttmacher Institute Data Center. www.guttmacher.org/datacenter/. Accessed July 25, 2016.

14. Promoting maternal and child health through health text messaging: an evaluation of the Text4baby program—final report. Washington, DC: U.S. DHHS, Health Resources and Services Administration. www.hrsa.gov/archive/healthit/txt4tots/text4babyfinalreport.pdf. Published February 2015. Accessed July 25, 2016.

15. Marsh HA, Malik F, Shapiro E, Omer SB, Frew PM. Message framing strategies to increase influenza immunization uptake among pregnant African American women. *Matern Child Health J*. 2014;18(7):1639–1647. https://doi.org/10.1007/s10995-013-1404-9.

16. Frew PM, Saint-Victor DS, Owens LE, Omer SB. Socioecological and message framing factors influencing maternal influenza immunization among minority women. *Vaccine*. 2014;32(15):1736–1744. https://doi.org/10.1016/j.vaccine.2014.01.030.

17. Bushar J, Garfinkel D, Kendrick J, Anderson C, Johnson P. The evolution of Text4baby influenza vaccine messaging. Washington, DC: ZERO TO THREE. www.zerotothree.org/resources/1509-the-evolution-of-text4baby-influenza-vaccine-messaging. Accessed April 6, 2017.

18. Hong H. Scale development for measuring health consciousness: reconceptualization, Gainesville, FL: Institute for Public Relations. www.instituteforpr.org/wp-content/uploads/ScaleDvlpmentMeasuring.pdf. Published January 10, 2011. Accessed July 25, 2016.

19. Pregnant women and flu vaccination, Internet Panel Survey, United States, November 2014. Atlanta, GA: CDC. www.cdc.gov/flu/pdf/fluvaxview/pregnant-women-nov2014.pdf. Accessed July 25, 2016.

20. Baker R, Blumberg S, Brick JM, et al. Research synthesis AAPOR report on online panels. *Public Opin Q*. 2010;74(4):711–781. https://doi.org/10.1093/poq/nfq048.

21. Lu PJ, Santibanez TA, William WW, et al. Surveillance of influenza vaccination coverage-United States - 2007–2008 through 2011–12 influenza season. *MMWR Morb Mortal Wkly Rep*. 2013;62(SS04):1–29.