OPEN

Vaccination Rates are Associated With Functional Proximity But Not Base Proximity of Vaccination Clinics

John Beshears, PhD, James J. Choi, PhD,† David I. Laibson, PhD,‡ Brigitte C. Madrian, PhD,§ and Gwendolyn I. Reynolds, MTS‖*

Background: Routine annual influenza vaccinations are recommended for persons 6 months of age and older, but less than half of US adults get vaccinated. Many employers offer employees free influenza vaccinations at workplace clinics, but even then take-up is low.

Objective: To determine whether employees are significantly more likely to get vaccinated if they have a higher probability of walking by the clinic for reasons other than vaccination.

Method: We obtained data from an employer with a free workplace influenza vaccination clinic. Using each employee's building entry/exit swipe card data, we test whether functional proximity—the likelihood that the employee walks by the clinic for reasons other than vaccination—predicts whether the employee gets vaccinated at the clinic. We also test whether base proximity—the inverse of walking distance from the employee's desk to the clinic—predicts vaccination probability.

Participants: A total of 1801 employees of a health benefits administrator that held a free workplace influenza vaccination clinic.

Results: A 2 SD increase in functional proximity is associated with a 6.4 percentage point increase in the probability of vaccination (total vaccination rate at company = 40%), even though the average employee's desk is only 166 meters from the clinic. Base proximity does not predict vaccination probability.

Conclusions and Relevance: Minor changes in the environment can have substantial effects on the probability of vaccination. If these results generalize, health systems should emphasize functional proximity over base proximity when locating preventive health services.

Key Words: vaccination, clinics, workplace wellness, proximity, preventive care, influenza

(*Med Care* 2016;54: 578–583)

The annual economic cost of influenza-attributable illness for adults ages 18 and over is estimated to be \$87.1 billion–\$10.4 billion in direct medical costs, \$16.3 billion in lost earnings, and \$60.4 billion in lost statistical lives.[1] Routine annual influenza vaccination is recommended for all persons 6 months of age and older without contraindications,[2] but only 46% of adults over 18 years of age were vaccinated in the 2011–2012 influenza season.[3] Twenty percent of adults ages 18–64 who receive an influenza vaccination receive it at their workplace.[4] However, less than half of employees with access to a free workplace influenza vaccination clinic are vaccinated.[5]

One common approach to increasing the use of preventive health care services is to reduce the physical distance between the individual's base location and the health care facility, so that obtaining health care is less burdensome. But previous literature has reached conflicting conclusions about the relationship between distance from an individual's home to health care facilities and usage of health care services.[6–11] Other research has found that forgetfulness or a failure to plan is partially responsible for the low take-up of vaccinations and other preventive health behaviors.[5,12,13] Therefore, we hypothesized that the likelihood of visiting a free workplace influenza vaccination clinic would be greater among individuals who have a higher probability of walking by the clinic for reasons other than vaccination and thus being reminded of the vaccination opportunity. Furthermore, we hypothesized that this probability would be a more powerful predictor of vaccination than the distance between the employee's desk and the clinic.

Using desk location information and employees' building entry/exit swipe card data from a company that offered a free 2-day worksite influenza vaccination clinic, we separately identify the vaccination effects of base proximity—the inverse

From the *Harvard Business School, Harvard University and National Bureau of Economic Research, Boston, MA; †Yale University and National Bureau of Economic Research, New Haven, CT; ‡Department of Economics; §Harvard Kennedy School, Harvard University and National Bureau of Economic Research; and ‖National Bureau of Economic Research, Cambridge, MA.

The findings and conclusions expressed are solely those of the authors and do not represent the views of the NIH or the NBER.

D.I.L. has served as a member of the Express Scripts Scientific Advisory Board since 2008. In 2010, D.I.L. donated all of these proceeds to charity. Since 2011, Express Scripts has directly donated to charity all compensation that he would have received. The remaining authors declare no conflict of interest.

Reprints: Gwendolyn I. Reynolds, MTS, National Bureau of Economic Research, 1050 Massachusetts Avenue, Cambridge, MA 02138. E-mail: reynolds@nber.org.

Supplemental Digital Content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Website, www.lww-medicalcare.com.

ISSN: 0025-7079/16/5406-0578

of walking distance between one's desk and the clinic—and functional proximity—the likelihood of passing near the clinic during the course of a normal work day (ie, days when the clinic is not open).

METHODS

Study Design

We study the 2011 influenza vaccine uptake of employees at the headquarters of a health benefits administrator in the United States. These employees are generally not health care personnel. All of them have health insurance. Of the company's total workforce (including those not based at the headquarters), 26% are African Americans and 37% are racial minorities.

There are 2 main buildings at the company headquarters. Building One houses 520 employees and is the site of the vaccination clinic; Building Two houses 1281 employees. The 2 buildings are 131 meters apart and connected by an enclosed passageway. The clinic was located near the cafeteria in Building One and adjacent to the passageway connecting the 2 buildings. The clinic was conducted from October 19 to 20, 2011, and it was advertised during the 3 weeks prior. Figure 1 shows a stylized diagram of the 2 buildings and the passageway, as well as the location of the clinic.

The company requires employees to swipe a personalized electronic badge to open the external doors of its buildings, which include the doors to the passageway between the buildings. The company provided us data on the date and time of each swipe in September and October 2011. If an employee swipes her badge and holds the door open for another employee, we do not observe that other employee. The badge swipe data are therefore an incomplete measure of all movements between the buildings. The company also gave us data on employee characteristics and vaccination uptake, scaled architectural plans of the buildings, and employee desk maps.

Predictive Variables and Hypotheses

We use the frequency of an employee's badge swipes for entry into Building One at the end of the passageway from Building Two to create proxies for an employee's "functional proximity" to the clinic. Recall that this door is adjacent to the clinic location, and employees in Building Two who did not walk outdoors had to use this door to reach the clinic. Therefore, we believe that the badge swipe data capture a high fraction of Building Two employees' visits to the clinic location. In contrast, employees in Building One did not have to use this door to access the clinic, as the clinic was in Building One. Badge swipe data consequently capture a smaller fraction of Building One employees' visits to the clinic location. In sum, badge swipes measure functional proximity to the clinic much more accurately for employees in Building Two than for employees in Building One. Hence, we expect attenuation bias from measurement error to affect our estimates of functional proximity's effect on vaccination much more severely for Building One employees than for Building Two employees.

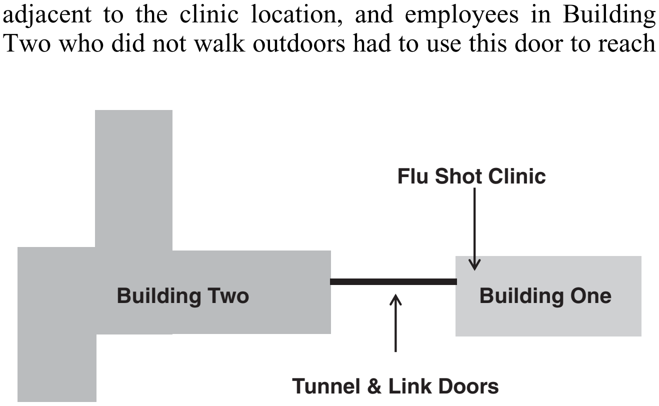

FIGURE 1. Stylized building layout and clinic location.

We would expect a mechanical relationship between the number of badge swipes on clinic days and vaccination, as most Building Two employees who were vaccinated swiped to get to the clinic. Therefore, we construct our functional proximity measures using the number of badge swipes during only the 59 nonclinic days in September and October—that is, excluding October 19–20. We do not use the months before September because the number of badge swipes during the summer is more likely to be affected by vacations, making them less reflective of routines while in the office. We exclude months after October to keep reverse causality from affecting our results; those who get vaccinated might have more badge swipes in subsequent months because they are not home sick with influenza. The last 10 days of October do not create such reverse causality concerns because it takes about 2 weeks after vaccination for immunity to develop.[14]

We create 3 measures: the number of badge swipes on all nonclinic days (including weekends, when the business was not officially open but the building was accessible to employees), the number of badge swipes on nonclinic weekdays from 9 AM to 2:30 PM (the hours that the clinic was open on clinic days), and the number of badge swipes on nonclinic weekdays before 9 AM and after 2:30 PM (the hours that the clinic was closed on clinic days).

We had 3 functional proximity hypotheses:

Hypothesis 1 (H1): For employees based in Building Two (where the clinic was not located), the number of badge swipes for the entry door to Building One on nonclinic days will be positively associated with vaccination.

Hypothesis 2 (H2): For employees based in Building Two, the number of badge swipes for the entry door to Building One on nonclinic days from 9 AM to 2:30 PM (clinic hours) will be more predictive of vaccination than the number of badge swipes for the entry door on nonclinic days before 9 AM and after 2:30 PM (nonclinic hours).

Hypothesis 3 (H3): For employees based in Building One (where the clinic was located), the number of badge swipes for the entry door to Building One on nonclinic days will not be associated with vaccination, regardless of the time of day.We also measure the minimum walking distance from each employee's desk to the clinic using the architectural plans of Buildings One and Two. Vertical distance is excluded from this measure, although horizontal distance to any necessary stairs is included. We test whether "base proximity" (the reciprocal of minimum walking distance in meters) is associated with flu shot uptake.

Hypothesis 4 (H4): For Building Two employees, base proximity will be a weaker predictor of vaccination than the number of badge swipes.

We use the reciprocal of walking distance to reduce the possible impact of outliers whose desk is very far away from the clinic. However, using walking distance as our measure of base proximity yields similar results.

Andersen's[15] Behavioral Model of Health Services Use identifies 3 components that drive health service utilization: the predisposition to use services, factors that enable the use of services, and the need for services. Our study focuses on the location of health services, which is a key enabling factor, along 2 dimensions: functional proximity and base proximity. Predisposing characteristics that incline an individual to get an influenza vaccination that have been documented in the literature include age, sex, race, education, socioeconomic status, insurance status, prior experience with influenza vaccination, beliefs about the efficacy and side effects of vaccination, and predictions of the percentage of coworkers who will be vaccinated.[16,17] Of these, our data allow us to control directly for age and sex, and we know that all employees in our sample have health insurance. We are also able to control for 12 binary variables indicating which of the company's 12 job grades—which are related to job title and description—maps to the individual; 3 binary variables for if the worker is full-time, a regular hire (rather than temporary), or salaried (rather than hourly); and a binary variable for whether the employee has an office instead of a cubicle (indicating higher job status). Job characteristics will be correlated with the employee's education, race, and socioeconomic status. If controlling for job characteristics causes the coefficients on functional proximity and base proximity to attenuate significantly, this would raise concern that the absence of direct education, race, etc. controls is responsible for any significant proximity effects that we find. The absence of other predisposing, enabling, and need characteristics in our data biases our study's estimates of proximity effects only to the extent that these unobserved variables are correlated with functional or base proximity.

We additionally control for binary variables indicating on which building floor level the employee's desk is located to correct for the exclusion of vertical distance from our base proximity measure. Age, sex, and job grade data are occasionally missing for an employee. We correct for this through 3 binary variables indicating whether age, sex, or job grade is missing. The age, sex, or job grade variable values are set to zero when the relevant data are missing.

Statistical Analysis

Our initial descriptive analysis of the main variables consists of computing their means and (where relevant) SDs. We also report *P*-values from tests of whether these variables' means differ between Building One and Building Two.

In our main analysis, we run regressions separately by building to evaluate the impact of employees' proximity to the clinic on their likelihood of receiving an influenza vaccination. For each building's regressions, we standardize our 2 proximity measures to each have zero mean and unit variance within the building. To ease the interpretation of marginal effects from the regression coefficients, we use a linear probability model (ie, an ordinary least squares regression with a binary indicator for receiving a vaccination as the dependent variable), which provides the linear approximation to the conditional expectation function that minimizes the mean squared prediction error. Linear probability models do not rely upon the strong functional and distributional assumptions of logit and probit regressions, and are in this sense more robust.[18] Our results are similar when estimated using logit regressions, as shown in Supplemental Digital Content Tables A1 (Supplemental Digital Content 1, http://links.lww.com/MLR/B130) and A2 (Supplemental Digital Content 2, http://links.lww.com/MLR/B131). All analyses were run using Stata version 13.1 (Stata Corporation, College Station, TX).

RESULTS

Table 1 shows summary statistics for employees in each building. In Building One, 38% of employees received an influenza vaccination, compared with 41% of employees in Building Two. The mean distance to the clinic for employees in Building One is 69.2 meters, compared with 205.1 meters for employees in Building Two. Building One employees swiped their badge 18.22 times on average during the 59 nonclinic days (ie, 0.31 times/d), of which 10.97 swipes occurred between 9 AM and 2:30 PM on nonclinic weekdays and 7.10 swipes occurred before 9 AM or after 2:30 PM on nonclinic weekdays. Building Two employees swiped 4.65 times on average during the nonclinic days, of which 2.84 occurred between 9 AM and 2:30 PM on nonclinic weekdays and 1.79 occurred before 9 AM or after 2:30 PM on nonclinic weekdays.

TABLE 1. Summary Statistics

	Mean (SD)		
	Building One	**Building Two**	**Difference (*P*)**
Vaccination rate (%)	38.08	40.67	0.309
Base distance to clinic	69.16 m (25.08)	205.11 m (22.87)	0.000
Badge use, September–October nonclinic days	18.22 swipes (24.72)	4.65 swipes (9.27)	0.000
Badge use, September–October nonclinic weekdays, clinic time window	10.97 swipes (13.12)	2.84 swipes (5.14)	0.000
Badge use, September–October nonclinic weekdays, not in clinic time window	7.10 swipes (13.94)	1.79 swipes (5.09)	0.000

TABLE 2. Regression of Influenza Vaccination Uptake on Base and Functional Proximity Measures for Employees in Building Two

	Model 1	Model 2	Model 3	Model 4	Model 5
Badge use, September–October nonclinic days, standardized	0.026* (0.014) $P=0.068$			0.032** (0.013) $P=0.011$	
Badge use, September–October nonclinic weekdays, clinic time window, standardized		0.033** (0.016) $P=0.045$			0.033** (0.015) $P=0.031$
Badge use, September–October nonclinic weekdays, not clinic time window, standardized		−0.004 (0.018) $P=0.845$			0.002 (0.015) $P=0.904$
Base proximity (1/base distance), standardized			−0.006 (0.014) $P=0.672$	0.002 (0.014) $P=0.893$	0.002 (0.014) $P=0.894$
Additional controls	No	No	No	Yes	Yes
Observations	1281	1281	1281	1281	1281
F statistic for regression	3.345	2.600	0.179	29.42	78.57
Prob > F	0.068	0.075	0.672	0.000	0.000
R^2	0.003	0.004	0.000	0.040	0.041

This table shows OLS linear probability regression results. The dependent variable is an indicator for being vaccinated. Robust SEs are in parentheses. Additional control variables are building floor level, age, sex, possession of an office, full-time employee status, regular employee status, salaried employee status, job grade, and indicators for whether age, sex, and job grade are missing. Two of the 12 job grades are consolidated into a single dummy variable because there is only 1 Building Two employee in each. Two-tailed statistical significance at the 10%, 5%, and 1% level are indicated by *, **, and ***, respectively.

Table 2 shows coefficients from regressions where the dependent variable is a binary indicator for getting vaccinated. Each column corresponds to a different regression on the same sample (all employees in Building Two), with SEs and P-values below each coefficient point estimate. The only control variable in column 1 is badge use on September to October nonclinic days. Column 2 controls instead for badge use at different times of day during September to October nonclinic days. Column 3 controls only for base proximity. Column 4 controls for both badge use on September to October nonclinic days and base proximity, in addition to which floor the employee's desk is on, demographics, and job characteristics. Column 5 shows the effect of badge use at different times of day and base proximity with the additional controls. Table 3 shows analogous regression results for Building One employees, with the same column scheme. Supplemental Digital Content Tables A3 (Supplemental Digital Content 3, http://links.lww.com/MLR/B132) and A4 (Supplemental Digital Content 4, http://links.lww.com/MLR/B133) contain the full set of regression coefficients using proximity variables that have not been standardized.

Consistent with H1, we find that a 1 SD increase in an employee's badge use during nonclinic days in September and October increases the employee's vaccination likelihood by 2.6 percentage points ($P=0.068$; Table 2, column 1). Supporting H2, when we limit badge swipes to only the hours during nonclinic weekdays when the influenza clinic would be offered on clinic days (9 AM–2:30 PM), the badge swipe effect increases in magnitude and is statistically significant ($P = 0.045$; Table 2, column 2), whereas the effect of nonclinic weekday badge use outside of the clinic time window is much smaller and not statistically significant ($P=0.845$; Table 2, column 2).

In contrast, base proximity in Building Two is unrelated to the vaccination rate ($P=0.672$; Table 2, column 3), as hypothesized in H4. When controlling for both proximity measures simultaneously, as well as the floor the employee's desk is on, demographic controls, and job characteristics, the

TABLE 3. Regression of Influenza Vaccination Uptake on Base and Functional Proximity Measures for Employees in Building One

	Model 1	Model 2	Model 3	Model 4	Model 5
Badge use, September–October nonclinic days, standardized	0.015 (0.022) $P=0.489$			0.005 (0.022) $P=0.812$	
Badge use, September–October nonclinic weekdays, clinic time window, standardized		0.035 (0.028) $P=0.213$			0.037 (0.028) $P=0.193$
Badge use, September–October nonclinic weekdays, not clinic time window, standardized		−0.018 (0.026) $P=0.490$			−0.029 (0.026) $P=0.254$
Base proximity (1/base distance), standardized			−0.022 (0.021) $P=0.308$	−0.007 (0.023) $P=0.751$	−0.005 (0.023) $P=0.811$
Additional controls	No	No	No	Yes	Yes
Observations	520	520	520	520	520
F statistic for regression	0.480	0.788	1.042	17.67	15.75
Prob > F	0.489	0.455	0.308	0.000	0.000
R^2	0.001	0.003	0.002	0.070	0.073

This table shows OLS linear probability regression results. The dependent variable is an indicator for being vaccinated. Robust SEs are in parentheses. Additional control variables are building floor level, age, sex, possession of an office, regular employee status, salaried employee status, job grade, and indicators for whether age and sex are missing. We do not control for missing job grade because all such employees in Building One are also temporary employees, and we do not control for part-time employee status because there is only 1 part-time employee in Building One. Two-tailed statistical significance at the 10%, 5%, and 1% level are indicated by *, **, and ***, respectively.

insignificance of base proximity remains unchanged ($P=0.893$; Table 2, column 4), whereas the badge swipe effect strengthens in magnitude and significance ($P=0.011$; Table 2, column 4). A 1 SD increase in functional proximity, as measured by total nonclinic day badge swipes, implies a 3.2 percentage point increase in the probability of vaccination for employees in Building Two (Table 2, column 4). The fact that our estimate of the functional proximity effect strengthens when we include job characteristic controls suggests that it is not being driven by our inability to control directly for education, race, socioeconomic status, and insurance status. Furthermore, we measure functional proximity with more error than we do base proximity, making more striking the fact that our functional proximity measure significantly predicts vaccination, whereas base proximity does not.

The last column of Table 2 shows that even after controlling for base proximity and the other explanatory variables, the effect of nonclinic weekday badge swipes during the times when the influenza clinic would be offered (9 AM–2:30 PM) remains statistically significant ($P=0.031$; Table 2, column 5), whereas the effect of weekday badge use outside of the clinic time window remains statistically insignificant ($P=0.904$; Table 2, column 5).

As noted earlier, badge swipe data for Building One employees is a poor proxy for functional proximity to the clinic. Accordingly, total badge swipes for employees in Building One do not significantly predict vaccinations ($P=0.489$ without additional controls, $P=0.812$ with additional controls; Table 3, columns 1 and 4). Vaccination is not predicted by swipes during clinic times on nonclinic weekdays ($P=0.213$ without additional controls, $P=0.193$ with additional controls; Table 3, columns 2 and 5) or swipes outside of clinic times on nonclinic weekdays ($P=0.490$ without additional controls, $P=0.254$ with additional controls; Table 3, columns 2 and 5). Therefore, H3 is confirmed. As in Building Two, base proximity in Building One is unrelated to the probability of vaccination ($P=0.308$; Table 3, column 3), and remains so after adding additional control variables ($P=0.751$; Table 3, column 4).

DISCUSSION

Close proximity of health care facilities to individuals' "activity spaces," the set of locations regularly visited during the course of daily living, has been hypothesized to be an enabling resource—in the sense of Andersen[15]—for receiving health services. Cromley and Shannon[19] hypothesize that health care facilities' proximity to activity spaces—that is, functional proximity—is even more important for facilitating health care access than their proximity to individuals' homes. However, empirical evidence on this hypothesis is limited, in large part due to difficulties with identifying and measuring proximity to activity spaces. Nemet and Bailey[20] find that health care utilization is higher among the rural elderly if their primary health care provider is located within their activity space. However, they cannot rule out the possibility that this positive correlation arises due to reverse causality—the individual's activity space encompasses the physician's location because the individual visits the physician frequently. In addition, they measure activity space through respondent self-reports, which are subject to reporting and recall bias. A number of studies have found that offering influenza vaccinations at the workplace, either at fixed locations or using mobile vaccination carts, is effective at increasing vaccination rates.[21–28] But because functional and base proximity to the vaccination facilities were not separately measured, the importance of each factor cannot be separately identified.

Our study uses objective measures of activity space and base proximity, and we can rule out reverse causality because our functional proximity measure excludes days on which the vaccination clinic was operating. We find that functional proximity to the clinic is associated with increased vaccination rates. An employee in Building Two who traveled through the door adjacent to the clinic 2 SDs more often during nonclinic days in September and October was 6.4 percentage points more likely to be vaccinated. In contrast, base proximity to the vaccination clinic (the inverse of the distance from one's desk) is not associated with a higher likelihood of vaccination. When thinking about the enabling factors in Andersen's Behavioral Model of Health Service Use, our results suggest that functional proximity has more impact on increasing health care use than base proximity.

Our study has some limitations. Worker base proximity and functional proximity to the clinic were not randomly assigned, so we cannot completely rule out the possibility that omitted variables that affect vaccination probability (such as race, education, beliefs about vaccination efficacy, etc.) are also correlated with our proximity measures, thus biasing the estimated relationships between proximity and vaccination probability. Future research could measure other predisposing, enabling, and need factors in the studied population so that these characteristics can be directly controlled for when estimating the enabling effect of proximity. In addition, our data come from a single company during a single flu vaccination campaign. Therefore, our results may not generalize to other populations or to other years where there is a different amount of public attention placed on the risks of influenza.

SUMMARY AND CONCLUSIONS

Using objective measures of functional and base proximity to a workplace influenza vaccination clinic, we find that the probability of an employee getting vaccinated increases with functional proximity (the likelihood that the employee walks by the clinic for reasons other than vaccination) but not with base proximity (the inverse of walking distance from the employee's desk to the clinic). A 2 SD increase in functional proximity is associated with a 6.4 percentage point increase in the probability of vaccination, even though the average employee's desk is only 166 meters from the clinic.

Employers currently administer 20% of influenza vaccinations for adults between the ages of 18 and 64.[4] The results of our study suggest that 1 way to assess the structural quality of a workplace preventive care clinic is its functional proximity to employees. Clinics should be placed in a location that workers frequently walk past, which is not necessarily the location that is physically closest to workers' base locations.

ACKNOWLEDGMENTS

The authors thank Express Scripts for conducting the field experiment and providing the data. The authors acknowledge individual and collective financial support from National Institutes of Health grants P30-AG-034532, and P01-AG-005842.

REFERENCES

1. Molinari NA, Ortega-Sanchez IR, Messonnier ML, et al. The annual impact of seasonal influenza in the US: measuring disease burden and costs. *Vaccine*. 2007;25:5086–5096.
2. Centers for Disease Control and Prevention. *Prevention and Control of Seasonal Influenza With Vaccines: Recommendations of the Advisory Committee on Immunization Practices (ACIP)—United States, 2014-15 Influenza Season*. Atlanta, GA: Centers for Disease Control and Prevention; 2014. Available at: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6332a3.htm#Groups_Recommended_Vaccination_Timing_Vaccination. Accessed April 20, 2015.
3. Center for Disease Control and Prevention. *March Flu Vaccination Coverage*. Atlanta, GA: Center for Disease Control and Prevention; 2012. Available at: http://www.cdc.gov/flu/fluvaxview/nfs-survey-march2012.htm. Accessed October 15, 2013.
4. Kennedy ER. *Influenza Vaccination Coverage: How Well Did We Do in 2011-2012?*. Atlanta, GA: National Influenza Vaccine Summit; 2012. Available at: http://www.cdc.gov/flu/pdf/fluvaxview/kennedy_2013_summit_slides2.pdf. Accessed February 9, 2016.
5. Milkman KL, Beshears J, Choi JJ, et al. Using implementation intentions prompts to enhance influenza vaccination rates. *Proc Natl Acad Sci U S A*. 2011;108:10415–10420.
6. Allard SW, Tolman RM, Rosen D. Proximity to service providers and service utilization among welfare recipients: the interaction of place and race. *J Pol Anal Manage*. 2003;22:599–613.
7. Currie J, Reagan P. Distance to hospital and children's use of preventive care: is being closer better, and for whom? *Econ Inq*. 2003;41:378–391.
8. McLafferty S, Grady S. Prenatal care need and access: a GIS analysis. *J Med Sys*. 2004;28:321–333.
9. Arcury TA, Gesler WM, Preisser JS, et al. The effects of geography and spatial behavior on health care utilization among the residents of a rural region. *Health Serv Res*. 2005;40:135–156.
10. Baumgardner DJ, Halsmer SE, Steber DL, et al. Does proximity to clinic affect immunization rates and blood pressure? *Int Psych Med*. 2006; 36:199–209.
11. Buchmueller TC, Jacobson M, Wood C. How far to the hospital? The effect of hospital closures on access to care. *J Health Econ*. 2006; 25:740–761.
12. Milkman KL, Beshears J, Choi JJ, et al. Planning prompts as a means of increasing preventive screening rates. *Prev Med*. 2013;56:92–93.
13. Dai H, Milkman KL, Beshears J, et al. Planning prompts as a means of increasing rates of immunization and preventive screening. *Public Policy Aging Rep*. 2012;22.4:16–19.
14. Centers for Disease Control and Prevention. *Key Facts About Seasonal Flu Vaccine*. Centers for Disease Control and Prevention; 2015. Available at: http://www.cdc.gov/flu/protect/keyfacts.htm. Accessed March 10, 2013.
15. Andersen R. *A Behavioral Model of Families' Use of Health Services Research Series No 25*. Chicago, IL: Center for Health Administration Studies, University of Chicago; 1968.
16. Chapman GB, Coups E. Predictors of influenza vaccine acceptance among health adults. *Prev Med*. 1999;29:249–262.
17. Brien S, Kwong JC, Buckeridge DL. The determinants of 2009 pandemic a/h1n1 influenza vaccination: a systematic review. *Vaccine*. 2012;30:1255–1264.
18. Angrist JD, Pischke JS. *Mostly Harmless Econometrics*. Princeton, NJ: Princeton University Press; 2009.
19. Cromley EK, Shannon GW. Locating ambulatory medical care facilities for the elderly. *Health Serv Res*. 1986;21:499–514.
20. Nemet GF, Bailey AJ. Distance and health care utilization among the rural elderly. *Soc Sci Med*. 2000;50:1197–1208.
21. Pachucki CT, Walsh Pappas SA, Fuller GF, et al. Influenza a among hospital personnel and patients: implications for recognition, prevention, and control. *Arch Intern Med*. 1989;149:77–80.
22. Adal KA, Flower RH, Anglim AM, et al. Prevention of nosocomial influenza. *Infect Control Hosp Epidemiol*. 1996;17:641–648.
23. Sartor C, Tissot-Dupont H, Zandotti C, et al. Use of a mobile cart influenza program for vaccination of hospital employees. *Infect Control Hosp Epidemiol*. 2004;25:918–922.
24. Salgado CD, Giannetta ET, Hayden FG, et al. Preventing nosocomial influenza by improving the vaccine acceptance rate of clinicians. *Infect Control Hosp Epidemiol*. 2004;25:923–928.
25. Song JY, Park CW, Jeong HW, et al. Effect of a hospital campaign for influenza vaccination of healthcare workers. *Infect Control Hosp Epidemiol*. 2006;27:612–617.
26. Kimura AC, Nguyen CN, Higa JI, et al. The effectiveness of vaccine day and educational interventions on influenza vaccine coverage among health care workers at long-term care facilities. *Am J Public Health*. 2007;97:684–690.
27. Lee HY, Fong YT. On-site influenza vaccination arrangements improved influenza vaccination rate of employees of a tertiary hospital in Singapore. *Am J Infect Control*. 2007;35:481–483.
28. Ofstead CL, Sherman BW, Wetzler HP, et al. Effectiveness of worksite interventions to increase influenza vaccination rates among employees and families. *J Occup Environ Med*. 2007;55:156–163.