28. Bolland JM, Wilson JV. Three faces of integrative coordination: a model of interorganizational relations in community-based health and human services. *Health Serv Res.* 1994;29(3):341–366.

29. Schootman M, Yun S. Cancer disparities between African-Americans and Whites in Missouri. *Mo Med.* 2009;106(1):9–13.

30. Missouri Department of Health and Senior Services. Chronic disease profile for St Louis city residents by race. 2008. Available at: http://www.dhss.mo.gov/CommunityDataProfiles. Accessed July 18, 2010.

31. Missouri Department of Health and Senior Services. Chronic disease profile for St Louis County residents by race. 2008. Available at: http://www.dhss.mo.gov/CommunityDataProfiles. Accessed July 18, 2010.

32. Missouri Department of Health and Senior Services. County level study 2007—health and preventive practices for St Louis city adults. 2007. Available at: http://www.dhss.mo.gov/CommunityDataProfiles. Accessed March 11, 2010.

33. Schootman M, Jeff DB, Gillanders WE, Yan Y, Jenkins B, Aft R. Geographic clustering of adequate diagnostic follow-up after abnormal screening results for breast cancer among low-income women in Missouri. *Ann Epidemiol.* 2007;17(9):704–712.

34. Harris JK, Luke DA, Burke RC, Mueller NB. Seeing the forest and the trees: using network analysis to develop an organizational blueprint of state tobacco control systems. *Soc Sci Med.* 2008;67(11):1669–1678.

35. Luke DA, Harris JK, Shelton S, Allen P, Carothers BJ, Mueller NB. Systems analysis of collaboration in 5 national tobacco control networks. *Am J Public Health.* 2010;100(7):1290–1297.

36. Hunter DR, Handcock MS, Butts CT, Goodreau SM, Morris M. ergm: A package to fit, simulate and diagnose exponential-family models for networks. *J Stat Softw.* 2008;24(3):nihpa54860.

37. Valente TW. *Social Networks and Health: Models, Methods, and Applications.* New York, NY: Oxford University Press; 2010.

38. Snijders TAB, Pattison PE, Robins GL, Handcock MS. New specifications for exponential random graph models. *Sociol Methodol.* 2006;36(1):99–153.

39. Goodreau SM. Advances in exponential random graph (p*) models applied to a large social network. *Soc Networks.* 2007;29(2):231–248.

40. Hunter DR, Handcock MS. Inference in curved exponential family models for networks. *J Comput Graph Stat.* 2006;15(3):565–583.

41. Morris M, Handcock MS, Hunter DR. Specification of exponential-family random graph models: terms and computational aspects. *J Stat Softw.* 2008;24(4):1548–7660.

42. DeNooy W, Mrvar A, Batagelj V. *Exploratory Social Network Analysis With Pajek.* Cambridge, UK: Cambridge University Press; 2005.

43. Handcock MS, Hunter DR, Butts CT, Goodreau SM, Morris M. statnet: Software tools for the representation, visualization, analysis and simulation of network data. *J Stat Softw.* 2008;24(1):1548–7660.

44. Blanchard CM, Courneya KS, Stein K. Cancer survivors' adherence to lifestyle behavior recommendations and associations with health-related quality of life: results from the American Cancer Society's SCS-II. *J Clin Oncol.* 2008;26(13):2198–2204.

45. Demark-Wahnefried W, Aziz NM, Rowland JH, Pinto BM. Riding the crest of the teachable moment: promoting long-term health after the diagnosis of cancer. *J Clin Oncol.* 2005;23(24):5814–5830.

46. Burke L, Miller LA, Saad A, Abraham J. Smoking behaviors among cancer survivors: an observational clinical study. *J Oncol Pract.* 2009;5(1):6–9.

47. Bellizzi KM, Rowland JH, Jeffery DD, McNeel T. Health behaviors of cancer survivors: examining opportunities for cancer control intervention. *J Clin Oncol.* 2005;23(34):8884–8893.

48. Siegel K, Mesagno FP, Karus DG, Christ G. Reducing the prevalence of unmet needs for concrete services of patients with cancer - evaluation of a computerized telephone outreach system. *Cancer.* 1992;69(7):1873–1883.

49. Houts PS, Yasko JM, Harvey HA, et al. Unmet needs of persons with cancer in Pennsylvania during the period of terminal care. *Cancer.* 1988;62(3):627–634.

Racial and Ethnic Disparities in Uptake and Location of Vaccination for 2009-H1N1 and Seasonal Influenza

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To learn more about racial and ethnic disparities in influenza vaccination during the 2009-H1N1 pandemic, we examined nationally representative survey data of US adults. We found disparities in 2009-H1N1 vaccine uptake between Blacks and Whites (13.8% vs 20.4%); Whites and Hispanics had similar 2009-H1N1 vaccination rates. Physician offices were the dominant location for 2009-H1N1 and seasonal influenza vaccinations, especially among minorities. Our results highlight the need for a better understanding of how communication methods and vaccine distribution strategies affect vaccine uptake within minority communities. (*Am J Public Health.* 2011;101:1252–1255. doi:10.2105/AJPH.2011.300133)

Epidemiological data collected over the past century suggest that racial and ethnic minorities are at greater risk of contracting seasonal and pandemic influenza—and of experiencing more negative consequences as a result—compared with Whites.[1–3] Despite this heightened risk, minorities in the United States have historically been vaccinated for influenza at rates as much as 15 to 18 percentage points lower than the rates for Whites, reflecting access barriers, negative attitudes toward vaccination, distrust of the medical system, and perceived risk of side effects.[3–7]

To minimize disparities in vaccine uptake during the 2009-H1N1 pandemic, local public health authorities adopted specifically targeted outreach efforts to encourage 2009-H1N1 vaccination among minorities. These outreach efforts included the use of alternative vaccination sites, such as retail clinics and school-located clinics; engagement of faith-based organizations; and communication in multiple languages and through ethnic media.[8–10] Furthermore, the federal government made 2009-H1N1 vaccine available free of charge, to remove cost-related barriers to uptake. However, local public health officials reported disparities in uptake of 2009-H1N1 vaccine.[11] To our knowledge, the only comparable, published national data on this topic measured uptake through the first few weeks of the vaccination campaign.[12] To assess whether targeted outreach to minority populations during the 2009-H1N1 pandemic succeeded in narrowing historical disparities in influenza vaccination, we used national, cross-sectional survey data measuring influenza vaccination of adults to estimate uptake of seasonal and 2009-H1N1 influenza vaccination, vaccination location, and attitudes toward influenza vaccination by race and ethnicity.

METHODS

From March 5 to March 24, 2010, we used an online research panel operated by Knowledge Networks to field a nationally representative survey of US adults aged 18 years and older (n=4040). Knowledge Networks recruits panelists through a probability-based sampling method that includes both online and offline

TABLE 1—Sample Description: Knowledge Networks Panelists, United States, 2010

Characteristics	White (n = 1808)			Black (n = 1141)			Hispanic (n = 588)		
	Unweighted No.	Unweighted %	Weighted %[a]	Unweighted No.	Unweighted %	Weighted %[a]	Unweighted No.	Unweighted %	Weighted %[a]
Age, y									
18–49	434	24	53	273	24	64	190	32	75
50–64	668	37	27	568	50	24	256	44	17
≥65	706	39	20	300	26	12	142	24	8
Gender									
Women	882	49	49	719	63	55	299	51	47
Men	926	51	51	422	37	45	289	49	53
High-risk status[b]									
Recommended for seasonal vaccine	1623	90	78	1031	90	74	516	88	74
Recommended for H1N1 vaccine	582	32	37	487	43	47	225	38	48
Education[c]									
High school graduate	508	28	31	253	22	34	152	26	34
College graduate	594	33	31	360	32	19	161	27	14
Medical insurance									
Uninsured	155	9	13	171	15	26	99	17	34
Currently insured	1642	91	87	964	85	74	483	83	66
Employment[c]									
Currently working	680	38	51	471	41	37	252	43	46
Retired	641	35	19	312	27	19	138	23	14
Household income, $[c]									
<25 000	334	18	18	315	28	44	102	17	24
>75 000	593	33	33	285	25	17	195	33	19

[a]Poststratification weights are computed using data from the Current Population Survey and are adjusted for known sampling probabilities, sample stratification, and nonresponse to panel recruitment and panel attrition.
[b]Adults recommended by the Advisory Committee for Immunization Practices for seasonal influenza vaccine were adults with certain chronic health conditions, adults aged >50 years, pregnant women, health care workers, and adults in contact with high-risk individuals. Adults recommended for 2009-H1N1 vaccine were all adults aged 18–24 years, adults aged 18–64 years with certain chronic health conditions, health care workers, pregnant women, and adults in contact with high-risk individuals.
[c]Columns do not add up to 100% within this category because we did not include all subcategorical responses in the table.

households.[13] To ensure diversity, we oversampled older panelists, Blacks, and Hispanics (Table 1). The completion rate among sampled panelists was 73%. Respondents self-identified their race/ethnicity as White (non-Hispanic), Black (non-Hispanic), Hispanic, other, or multiracial. Respondents who self-identified as other or multiracial (n=503) were excluded from the analysis, for a final sample of 3537. We used questions about age, chronic health conditions, work as a health care professional, and personal contact with high-risk individuals to determine whether a respondent was recommended for seasonal vaccination or 2009-H1N1 influenza vaccination by the Centers for Disease Control and Prevention's Advisory Committee on Immunization Practices.[14]

To determine vaccination status, we asked survey respondents: "Have you received a H1N1/swine [seasonal] flu vaccine this flu season?" We report estimates of 2009-H1N1 and seasonal influenza vaccination, location at which vaccination took place, and attitudes toward influenza vaccination. All data were weighted to produce nationally representative estimates adjusted for known selection probabilities, sample stratification, nonresponse, and Internet use before recruitment into the panel.[15] Pearson's χ^2 test was used to calculate P values. We assessed the robustness of our bivariate results by estimating logistic regression models of influenza vaccination and vaccination location, controlling for household income, insurance status, age, gender, employment status, and recommendation status. We used Stata version 11 (StataCorp LP, College Station, TX) to generate all statistics.

RESULTS

Whites were significantly more likely than were Blacks to receive a 2009-H1N1 vaccination (20.4% vs 13.8%; P=.02) and a seasonal influenza vaccination (42.6% vs 32.2%; P=.004) during the 2009–2010 vaccination season (Table 2). Although Whites were also more likely than were Hispanics to receive a seasonal influenza vaccination (42.6% vs 29.5%; P=.002), we found no significant differences with respect to 2009-H1N1 vaccination between Whites and Hispanics (20.4% vs 18.6%; P=.62). The

TABLE 2—Comparison of Influenza Vaccine Uptake, Location of Vaccination, and Vaccination Attitudes: Knowledge Networks Panelists, United States, 2009–2010

	White, % (95% CI)	Black, % (95% CI)	P[a]	Hispanic, % (95% CI)	P[b]
2009-H1N1 vaccination					
Received 2009-H1N1 vaccine	20.4 (17.7, 23.0)	13.8 (9.3, 18.2)	.02	18.6 (12.3, 24.8)	.62
Received provider recommendation for 2009-H1N1 vaccine	21.5 (18.8, 24.2)	23.9 (18.6, 29.1)	.43	22.2 (15.3, 29.2)	.85
Location of 2009-H1N1 vaccination[c]					
Workplace	18.8 (13.1, 24.5)	11.5 (5.5, 17.5)	.1	6.2 (1.0, 11.9)	.01
Physician's office	23.5 (18.1, 29.0)	39.0 (20.9, 57.0)	.07	42.0 (22.6, 61.4)	.04
Medical clinic/health center	12.1 (7.4, 16.8)	18.7 (8.9, 28.5)	.19	12.3 (0, 26)	.97
Retail setting	12.4 (7.6, 17.2)	2.9 (0.4, 5.3)	.001	7.8 (1.3, 14.2)	.3
Health department flu clinic	22.1 (15.8, 28.4)	7.7 (2.6, 12.7)	.002	19.8 (5.4, 34.2)	.76
Seasonal vaccination					
Received seasonal vaccine	42.6 (39.2, 45.9)	32.2 (26.3, 38.1)	.004	29.5 (22.3, 36.6)	.002
Received provider recommendation for seasonal vaccine	33.0 (28.9, 36.1)	35.2 (29.5, 40.9)	.49	26.2 (19.7, 32.8)	.08
Location of seasonal vaccination[c]					
Workplace	21.4 (16.8, 25.9)	17.0 (9.0, 25.1)	.57	10.5 (4.4, 17.0)	.03
Physician's office	35.1 (30.6, 39.6)	42.1 (31.2, 52.9)	.31	41.8 (28.6, 55.3)	.41
Medical clinic/health center	9.6 (6.7, 12.5)	10.8 (6.5, 15.0)	.65	14.1 (2.7, 25.4)	.39
Retail setting	17.6 (14.1, 21.2)	3.7 (1.4, 21.2)	<.001	13.0 (5.0, 21.0)	.54
Health department flu clinic	5.7 (3.7, 7.6)	8.4 (2.2, 14.6)	.34	12.1 (0, 2.5)	.19
Attitudes regarding vaccination[d]					
Being vaccinated against seasonal flu is safe	60.9 (57.4, 64.4)	52.2 (45.9, 58.6)	.02	54.3 (46.1, 62.5)	.14
Being vaccinated against H1N1/swine flu is safe	44.7 (41.2, 48.1)	40.6 (34.2, 47.0)	.28	39.6 (31.6, 47.5)	.25
Flu vaccines can cause people to get the flu	30.3 (27.0, 33.6)	38.3 (32.1, 44.6)	.02	40.5 (32.5, 48.5)	.02
Vaccines are safe in general	65.6 (62.1, 68.9)	51.6 (45.2, 57.9)	<.001	55.2 (47.0, 63.5)	.02

Note. CI = confidence interval.
[a]Comparing Whites and non-Hispanic Blacks.
[b]Comparing Whites and Hispanics.
[c]Subsample of vaccinated adults.
[d]Statistics correspond to percentage of adults who strongly agree or agree with the listed statements.

statistical significance of the uptake of 2009-H1N1 vaccination between Blacks and Whites persisted when controlling for the aforementioned covariates (odds ratio=0.67; P=.05).

For vaccinated adults of all races, physician offices were the dominant site of 2009-H1N1 and seasonal influenza vaccination. Blacks were less likely than were Whites to be vaccinated in retail clinics for both 2009-H1N1 (2.9% vs 12.4%; P=.001) and seasonal influenza (3.7% vs 17.6%; P<.001). The statistical significance of these differences remained when controlling for covariates in multivariate models (results available from authors upon request). Hispanics were less likely than were Whites to be vaccinated for 2009-H1N1 (6.2% vs 18.8%; P=.01) and seasonal influenza in the workplace (10.5% vs 21.4%; P=.03), although these differences were not statistically significant in multivariate models.

Attitudes toward influenza vaccination differed by race and ethnicity. Both Blacks and Hispanics were less likely than were Whites to agree that vaccines are "safe in general" (P<.001), and Blacks and Hispanics were more likely to agree that influenza vaccines can cause people to get the flu (P=.02).

DISCUSSION

Our analysis showed that historic racial and ethnic disparities in influenza vaccination persisted during the 2009-H1N1 pandemic, although their magnitudes varied across groups and types of vaccination. Most notably, we found that Hispanics and Whites had similar vaccination rates for 2009-H1N1. Because the virus originated in Mexico, this finding may in part be attributable to heightened awareness of 2009-H1N1 within the Hispanic community. This finding, however, is also consistent with previous research suggesting that Hispanics face cost-related barriers to vaccination, which may have been addressed by offering the 2009-H1N1 vaccine free of charge in community settings.[4]

The lower vaccination rates for both seasonal and 2009-H1N1 vaccine among Blacks, on the other hand, may suggest that attitudinal barriers such as historic distrust (often mentioned by unvaccinated Black adults)[4] were

not as easily overcome though targeted outreach and making vaccinations available free of charge. This conjecture is supported by literature showing that Blacks are less likely to have positive attitudes toward vaccination and to get vaccinated, even when vaccination is specifically recommended.[5] Furthermore, our results indicated that physician offices were the dominant vaccination site for seasonal and 2009-H1N1 vaccine among all races, but Whites were more likely to also use complementary vaccination locations, such as health department clinics and retail settings. Previous research has demonstrated that retail clinics serve communities with fewer Black residents and thus may not be effective at alleviating vaccination-related disparities.[16,17] Research has also suggested that offering mass vaccination clinics of the type used in the 2009-H1N1 response, in which several thousand people received vaccine at a school or health department on a given date, may exacerbate disparities because they require individuals to actively seek vaccine.[2]

Although no comparable public data exist on influenza vaccination uptake by race for the 2009–2010 influenza season, our results for seasonal and 2009-H1N1 vaccination uptake for all adults tracks closely (within 1 to 3 percentage points) with results from the Behavioral Risk Factor Surveillance System and the National 2009 H1N1 Flu Survey.[18,19] A validation study conducted using data from 2004 through 2008 suggested that in the past, our approach has yielded estimates of influenza vaccination among racial and ethnic minorities that were moderately higher than were those derived from the National Health Interview Survey.[20] Thus, our results should be interpreted as a conservative measure of disparities in influenza vaccination. As such, the substantial disparities in influenza vaccination rates we reported highlight the need for a better understanding of how various methods of communication and vaccine distribution affect vaccine uptake within minority communities. ■

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This article was accepted February 7, 2011.

Contributors

L. Uscher-Pines contributed to the design of the study, analyzed and interpreted the results, and wrote the article. K.M. Harris procured the funding for the study; J. Maurer and K.M. Harris contributed to the design of the study, assisted with interpretation of the results, and contributed to revisions of the article.

Acknowledgments

This study was supported by the National Institute of Allergy and Infectious Diseases (grant R03AI095084).

Note. The survey data used in this study were collected under contract with GlaxoSmithKline. GlaxoSmithKline had no role in the design, management, analysis, or interpretation of these data, and had no role in the preparation, review, or approval of the article. The opinions expressed here are solely those of the authors and do not represent those of RAND, GlaxoSmithKline, or the National Institute of Allergy and Infectious Diseases.

Human Participant Protection

This study protocol was approved by the institutional review board of RAND.

References

1. Uscher-Pines L, Duggan P, Garoon J, Karron R, Faden R. Social justice and disadvantaged groups. *Hastings Cent Rep.* 2007;37(4):32–39.

2. Hutchins SS, Fiscella K, Levine R, Ompad D, McDonald M. Protection of racial/ethnic minority populations during an influenza pandemic. *Am J Public Health.* 2009;99(suppl 2):S261–S270.

3. Levi J, Vinter S, Segal LM, St Laurent R. *H1N1 Challenges Ahead.* Washington, DC: Trust for America's Health; 2009.

4. Linn ST, Guralnik J, Patel K. Disparities in influenza vaccine coverage in the United States, 2008. *J Am Geriatr Soc.* 2010;58(7):1333–1340.

5. Lindley MC, Wortley P, Winston C, Bardenheier B. The role of attitudes in understanding disparities in adult influenza vaccination. *Am J Prev Med.* 2006;31(4):281–285.

6. Lu P, Bridges C, Euler G, Singleton J. Influenza vaccination of recommended adult populations, US, 1989–2005. *Vaccine.* 2008;26(14):1786–1793.

7. 2009 Adult Vaccination Coverage, NHIS. Centers for Disease Control and Prevention Web site. Available at: http://www.cdc.gov/Vaccines/stats-surv/nhis/2009-nhis.htm. Accessed December 1, 2010.

8. Grande D, Levine E, Bozniak A. Promoting vaccination among ethnic minorities through media and audience outreach. Abstract presented at: National Conference on Health Communication, Marketing, and Media; August 17–19, 2010; Atlanta, GA.

9. Reaching special groups. Promising Practices Web site. Available at: http://www.pandemicpractices.org/practices/list.do?topic-id=25. Accessed April 12, 2011.

10. Stories from the field - search. National Association of County & City Health Officials Web site. Available at: http://www.naccho.org/topics/H1N1/stories_search.cfm?theme=Communications%2520%252D%2520Priority%2520Groups&issue=&state=. Accessed April 15, 2011.

11. Hennessy-Fiske M. Few African Americans vaccinated at L.A. County H1N1 flu clinics. *LA Times.* February 9, 2010. Available at: http://latimesblogs.latimes.com/lanow/2010/02/few-africanamericans-vaccinated-at-la-county-h1n1-flu-clinics.html. Accessed April 18, 2011.

12. Centers for Disease Control and Prevention. Interim results: influenza A (H1N1) 2009 monovalent vaccination coverage—United States, October–December 2009. *MMWR Morb Mortal Wkly Rep.* 2010;59(early release):1–5.

13. KnowledgePanel design summary. Available at: http://www.knowledgenetworks.com/knpanel/docs/KnowledgePanel(R)-Design-Summary-Description.pdf. Published 2010. Accessed April 13, 2011.

14. Fiore AE, Shay DK, Broder K, et al. Prevention and control of seasonal influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices (ACIP), 2009. *MMWR Recomm Rep.* 2009;58(RR-8):1–52.

15. Overview of KnowledgePanel statistical weighting protocol. Available at: http://www.knowledgenetworks.com/ganp/docs/KN-Weighting-Synopsis.pdf. Published November 11, 2009. Accessed November 25, 2009.

16. Lee BY, Mehrotraa A, Burns R, Harris K. Alternative vaccination locations: who uses them and can they increase flu vaccination rates? *Vaccine.* 2009;27(32):4252–4256.

17. Pollack CE, Armstrong K. The geographic accessibility of retail clinics for underserved populations. *Arch Intern Med.* 2009;169(10):945–949.

18. Flu.gov Web site. Final estimates for 2009–10 seasonal influenza and influenza A (H1N1) 2009 monovalent vaccination coverage – US, August, 2009 through May, 2010. Available at: http://www.pandemicflu.gov/professional/hospital/vcoverage0910.html. Published October 20, 2010. Accessed December 15, 2010.

19. Setse RW, Euler GL, Gonzalez-Feliciano AG, et al. Influenza vaccination coverage—United States, 2000–2010. *MMWR Surveill Summ.* 2011;60(01):38–41.

20. Harris KM, Schonlau M, Lurie N. Surveying a nationally representative Internet-based panel to obtain timely estimates of influenza vaccination rates. *Vaccine.* 2009;27(6):815–818.