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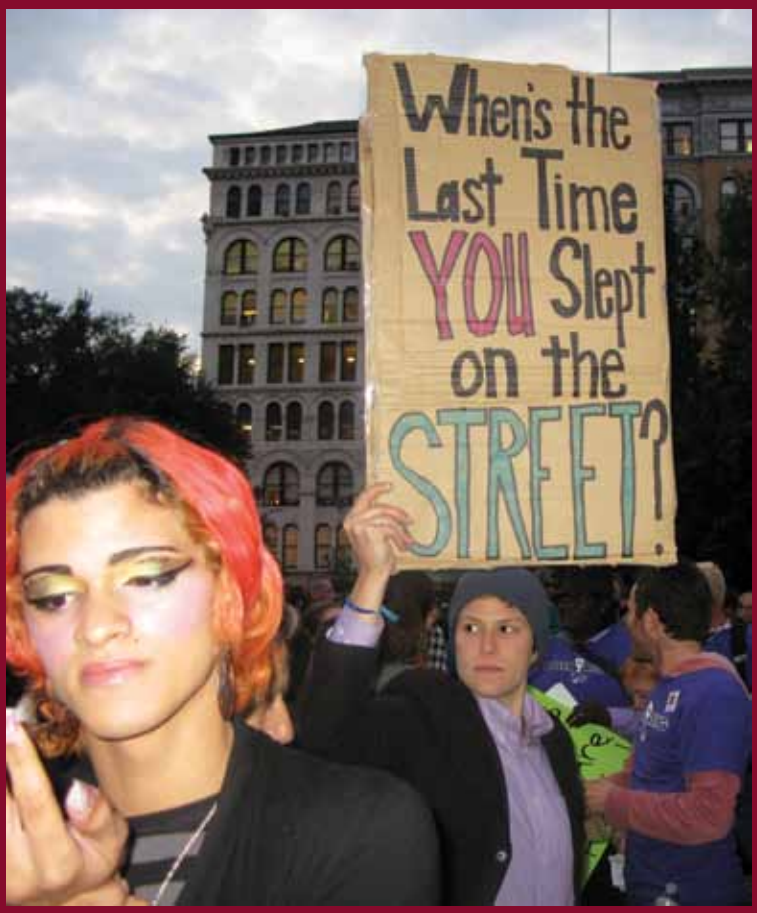

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A Message from the Editor

With this issue of *Public Health Reports* (*PHR*), spring has arrived for those of us living in the Northern Hemisphere. And with the change of seasons comes the excitement to get outdoors and move. To help us think of creative ways to get active, the President's Council on Fitness, Sports, and Nutrition sponsors May as National Physical Fitness and Sports Month. To get fit and stay healthy, adults should aim for at least 2.5 hours of moderate activity a week, including walking fast, dancing, or biking, as well as muscle-strengthening activities at least two days a week. Children should strive for 60 minutes of active play each day.

During May, health-promoting days are plentiful. Officially launched in 1956, National Bike Month and National Bike Safety Month raise awareness about the benefits of cycling and how to ensure safety when traveling by bike. For Bike to School Day on May 8, have your children bike to school to encourage physical activity and education at a young age. For Bike to Work Day on May 17, dust off your two-wheeler and commute to work by bike. Many cities now have designated bike lanes to promote riding rather than driving to work. But don't forget to wear a helmet and make sure your kids wear helmets, too.

May 9 is Occupational Safety and Health Professional Day, which recognizes the efforts and commitment of occupational safety, health, and environmental professionals. It is also part of a broader celebration, North American Occupational Safety and Health Week, which is celebrated the first full week in May. During this week, efforts will be made to better educate the public about the positive benefits of a safe workplace for workers, their families, friends, businesses, and local community.

Today, there is increasing evidence that the work environment and the overall health, safety, and well-being of the workers within it are strongly connected. Sedentary jobs can lead to chronic diseases such as heart disease, obesity, and diabetes. An increase in contingent work can also lead to stress, mental health issues, and psychosocial diseases. As a result, the National Institute for Occupational Safety and Health (NIOSH) has launched a strategy, called Total Worker Health™, which attempts to recognize the synergies between occupational health and personal health to maintain a healthier workforce.

In this issue of *PHR*, the *Executive Perspective* column, by Margaret Kitt and John Howard of NIOSH, takes a look at occupational safety and health in our changing workplace. Today's workforce is older and more diverse than ever before, and more workers suffer from chronic conditions and disabilities. As such, leaders at worksites should consider programs such as Total Worker Health™ that foster safety and health promotion strategies.

Always set for the last Wednesday in May, National Senior Health & Fitness Day® is the nation's largest annual health promotion event for older adults. It's important to build health into every aspect of our day, at every stage of life. On May 29, activities for older adults will take place at more than 1,000 locations throughout the U.S. Local organizations will host a variety of health- and fitness-related activities based on the interests of the older adults in their communities. Event activities include fitness walks, low-impact exercises, health screenings, and health information workshops.

Mary Beth Bigley, DrPH, MSN, ANP

IN MEMORIAM

We are deeply saddened by the sudden loss on March 5 of an important member of the *PHR* family. Jo Ellen Russ, 43, who has been a scientific editor with *PHR* for more than five years, contributed her writing and editing expertise to fine-tune authors' manuscripts prior to publishing. A member of the Editorial Board, who worked with Jo Ellen on a *PHR* special issue, described her as "always so full of cheer, goodwill, and everlasting energy." Her obituary provides this touching summary:

"Her straightforward style, her ability to spin stories, her unwavering loyalty to family and friends, and her chocolate chip cookies (the only authentic replication of her grandmother's recipe) will be as deeply missed as her long hugs and quick smile."

Jo Ellen is survived by her husband, Jeff; her two children, Julianna and Zachary; a large extended family; and numerous friends and colleagues who feel fortunate to have known her. Her extraordinary talent and caring nature will be missed by all.

Executive Perspective

As we celebrate Workers Memorial Day, it is a time to reflect on health in the workplace. Increased research is needed to fully understand the impact of the changing workforce and workplace on worker health. Efforts need to be made to combine health prevention and promotion programs to create a stronger workforce.

Mary Beth Bigley, DrPH, MSN, ANP
Acting Editor, *Public Health Reports*

THE FACE OF OCCUPATIONAL SAFETY AND HEALTH: 2020 AND BEYOND

Margaret Kitt, MD, MPH
John Howard, MD

Every year on April 28, Workers Memorial Day, we honor those who have suffered injury, illness, and death on the job. Great strides have been made in workplace safety and health since Dr. Alice Hamilton and her colleagues began their historic investigation of occupationally related illnesses, as chronicled in her book, *Exploring the Dangerous Trades*.[1] However, as long as the cost of any job is an injury, illness, or death that results in physical, financial, or emotional hardship for a worker or a worker's family, we fall short as a nation.

There is no doubt that workplace hazards such as asbestos, coal-mine dust, and industrial chemicals still exist as in the days of Dr. Hamilton, despite great advancements in controlling exposures and reducing the toll of job-related impairment, disability, and death. However, the National Institute for Occupational Safety and Health (NIOSH) and its partners must not only deal with these legacy hazards, but also recognize new challenges resulting from the evolving nature of work as we move toward 2020 and beyond.

The pace of technological change and the rapid diffusion of information require a vigilant eye to recognize emerging hazards often before their risks are fully understood or characterized. For example, novel materials such as nanoparticles have potential implications for worker health risk that have not been fully defined. There are also likely exposures to toxic materials in relatively new "downstream" processes (e.g., electronic-waste recycling) where the hazards may not be well recognized.

As baby boomers age, the composition of the U.S. workforce is changing. Many workers are remaining in the workplace past traditional retirement age for multiple reasons, such as overall improved health, economic necessity, or changing expectations of work-life balance. More people have multiple careers during the course of their life span. With the baby-boom cohort aging, its share of the labor force, and, ultimately, its exit from the workforce, is projected to keep the growth of the labor force low at an estimated 0.6% per year in the next 50 years.[2] Along with an aging workforce comes an increased prevalence of chronic conditions affecting health, physical ability, or mental dexterity that will require attention to different workplace accommodations.

The U.S. workforce continues to diversify, with minority groups projected to expand their share of the workforce into the future. Since the 1970s and 1980s, women's labor force participation rates have dramatically increased, stabilizing at about 59% in 2005, and women are projected to continue to play a significant role in the workplace for years to come.[2] This greater diversity has many positive aspects, but it also means that the occupational safety and health needs of the 21st century workforce will differ in many significant ways from those of the more homogeneous 20th century workforce.

The workplace itself is also changing. The shift from a manufacturing base to growth in the services sector has affected the distribution of workers not only by industry and occupation, but also by geographical region.[3] With increased technology and automation, work becomes more sedentary, affecting the risk for onset or worsening of a range of chronic diseases associated with lack of physical activity, such as heart disease, obesity, and diabetes. Telecommuting is commonplace, as we live more and more in a virtual world, so personal contact with coworkers may be more limited. More people are working extended hours, which may increase the likelihood of worker injuries associated with fatigue. Longer work days can have serious implications for family well-being, including one's inability to care for ill children or aging parents because of competing work demands. Employers may see (*1*) declines in workers' ability to function due to fatigue, (*2*) the possibility of errors, (*3*) poor productivity,

and (*4*) high turnover rates, resulting in more costs for training new employees. Work-related fatigue has broader implications as well for general public safety, such as the role of fatigue as a risk factor for motor vehicle crashes and medical errors.[4]

There is also increased movement toward contingent work, where a nontraditional worker-employer relationship exists. This trend includes the use of contractors and part-time and temporary employees. According to the Bureau of Labor Statistics, contingent workers are more likely to be young, female, black, or Hispanic, and have lower incomes and fewer benefits.[5,6] Although contingent work may be desirable for some individuals, the associated job insecurity may be a significant source of stress for many other workers and their families. Globalization and international offshoring of jobs also contributes to job insecurity in some sectors. These factors, in addition to demands for increased productivity, may result in widely prevalent mental health and psychosocial diseases associated with stress, anxiety, and depression.[7]

Although absenteeism is problematic for workers and employers, "presenteeism" (i.e., being at work but not functioning up to capacity) is not always readily apparent. Presenteeism can result from numerous health conditions including migraine headaches, asthma, chronic lower-back pain, and depression. The challenge is to identify cost-effective steps that businesses can take to recover productivity losses from presenteeism[8] while improving the quality of work/life for workers.

Increased research is needed to explore the impacts of a changing workforce and workplace, while not abandoning the ongoing task of controlling or eliminating many of the historical but persistent hazards Dr. Hamilton and her colleagues began investigating years ago. NIOSH, along with its extramural partners, has embarked on one strategy to develop a more comprehensive approach to the evolving workplace—Total Worker Health™ (TWH™). Instead of the traditional approach of addressing occupational health and personal health as separate imperatives, TWH™ attempts to recognize the synergies between the two and to truly meld traditional workplace health and safety programs with health promotion programs to build and maintain a healthier workforce.[9] Safer, healthier, and happier workers are essential for achieving increased productivity, lower medical costs, and other benefits to families, communities, the U.S. economy, and society as we look ahead to the next decade.

Margaret Kitt is the Deputy Director for Program and John Howard is the Director at the National Institute for Occupational Safety and Health (NIOSH), in Atlanta, Georgia.

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The findings and conclusions in this article are those of the authors and do not necessarily represent the views of NIOSH.

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Achieving Pharmacy-Based Public Health: A Call for Public Health Engagement

Beth E. Meyerson, MDiv, PhD[a]
Priscilla T. Ryder, MPH, PhD[b]
Carriann Richey-Smith, PharmD[b]

The evolution of pharmacy practice in the last 15 years has created expanded public health access. Community pharmacies now provide a range of public health services with promising improvements in health access and outcomes. The observed practice changes call our attention to systemic issues that remain in need of collective attention. As we strengthen our intersectoral public health system, we must focus on the pharmacy-public health partnership and establish collaborative policy and research agendas to guide this system change for maximum public health impact. Our collective effort to assure the health of communities depends upon our seeing opportunities across systems and sectors, and upon our success in shifting the policy environment to allow health system flexibility.

INTRODUCTION

Community pharmacies are independent, chain, or supermarket pharmacies that directly serve the general public. A systemic change has occurred in community pharmacy practice during the past 20 years. The once segregated druggist with limited public health engagement in times of epidemics or national initiatives[1] has morphed into a medications evaluator, health educator, immunizer, and health-care partner.[2–4] These changes have helped clarify and institutionalize the expression of pharmacy-based public health.

The practice of pharmacy as we know it in modern times dates back to the 18th century. The role of the pharmacist evolved in response to the ever-changing health environment. For example, the apothecary became a temporary vaccine distributor in the 1800s in response to smallpox efforts.[1] Fast-forward to the 20th century, and pharmacists expanded their clinical role to serve within the Indian Health Service and the Bureau of Prisons.[5] The mid-1990s witnessed the emergence of the pharmacist immunizer and vaccine advocate.

Today, community pharmacists provide many services in addition to drug dispensing: medication therapy management;[6–8] immunizations for children

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and adults;[1,9,10] screening for diabetes and cardiovascular disease;[11–13] and health education consultation for a range of health risks and conditions such as diabetes,[14,15] smoking cessation,[16] weight management, hypertension, osteoporosis,[17,18] and substance abuse.[19] These practice changes highlight the fact that pharmacies are important partners for the expansion of public health access. Pharmacists are located in practically every U.S. town and they are available and perceived as trustworthy—even more so than physicians.[20] Further, in some cases, pharmacies are a preferred location for adult immunizations.[21]

The picture of pharmacy-based public health sharpens when framed in terms of the three levels of prevention: primary, secondary, and tertiary. Ferris and Johnson[22] offered this frame for the pharmacy audience in 2010 and it bears repeating. Primary prevention involves intervening to inhibit the initiation of a negative health outcome. Immunization is the classic example of primary prevention. Pharmacy engagement in vaccine efforts dates back to the 1800s and involved primarily the distribution of vaccine materials.[1] Since the late 1990s, immunizations (e.g., for influenza or shingles) have been routinely provided in community pharmacies. This practice change required the development of state policies allowing collaborative practice; i.e., agreements between physicians and pharmacists whereby pharmacists could provide an agreed scope of services.[23] This important structural shift in policy set the environment for additional pharmacy-based public health access.

Secondary prevention involves intervening early in the disease process and before illness manifests. Examples of prevention activities include early intervention for behavior change or disease diagnosis. Pharmacist intervention to identify people at early stages of cardiovascular disease, diabetes, or substance abuse has proven promising in studies evaluating their impact on health behavior, health services use, and health outcome improvement.[17,24,25] Community pharmacies are increasingly providing diagnostic testing.[10,11,17] Pharmacy-based public health stands at the nexus of diagnostic advancement and testing decentralization, away from laboratories and into the hands of individuals. The possibility that pharmacies could become yet another avenue to diagnosis would be a tremendous advancement for early treatment access in the case of human immunodeficiency virus (HIV), as 20% of people living with HIV do not know it[26] and 40% learn their HIV status within a year of an acquired immunodeficiency syndrome diagnosis, well into disease progression.[27]

Tertiary prevention activities seek to slow the progression of disease and reduce complications. Most pharmacy practice has traditionally operated at this level of prevention because it involves medication consultation. The leading edge of this practice involves intensive models of medications evaluation and management in specialized communities, such as people living with HIV,[5] or among populations taking multiple and possibly conflicting medications, such as older people or those with multiple comorbidities. Pharmacist-initiated interventions focusing on increasing medication adherence, reducing dependence, or preventing disease progression have produced positive outcomes from health and economic standpoints.[5,6,8] Activities at the tertiary level highlight the unique position of pharmacists at the point of sale for medications, where issues of medication adherence and affordability meet. Here, too, policy change facilitated this avenue of public health service. The Medicare Prescription Drug Improvement and Modernization Act of 2003,[28] the Patient Protection and Affordable Care Act of 2010 (ACA),[29] and the Health Care and Education Reconciliation Act of 2010[30] clarified pharmacist roles and responsibilities to create a more direct reimbursement mechanism.

CALL FOR STRONGER PUBLIC HEALTH ENGAGEMENT

The emergence of public health pharmacy practice across the U.S. has created an opportunity for systems-level improvements and related policy activity. Public health in the 21st century is about working in and through many and different sectors.[31] While it is easy to acknowledge that many health and non-health-related systems interact to accomplish public health objectives, it is difficult to support public health activities in these disparate environments through policy and practice. Public health funding streams are isolated and cause the institutionalization of disease-focused work. So, too, pharmacy and public health practice cultures have evolved differently, despite a shared history in medicine. Yet, challenges aside, our pharmacy colleagues have engaged in conversation about public health for the past several years. Pharmacy literature shows evidence of discussion about public health pharmacy emergence, benefits, challenges, and the need for policy changes to assure sustainability.[19,32–35] The public health literature, in contrast, has been largely silent. To strengthen community pharmacies as public health partners, we must fully join the conversation about pharmacy-based public health. The following

areas should be the focus of our collective attention: policy, research, and the meaningful integration of pharmacy and public health in practice and education.

Policy

As pharmacies increasingly deliver preventive health services, barriers emerge that are artifacts of a time when such services were the exclusive domain of medical practice. An example of one such barrier is the definition of a health-care provider. Despite the delivery of myriad health services, pharmacists are not defined as health-care providers under state or federal law.[36] Since 2001, there have been several failed efforts to expand the definition to include pharmacists at the federal level.[37] Elements of the ACA[30] and the Health Care and Education Reconciliation Act[31] have created flexibility for pharmacists in the health-care relationship, but they have stopped short of conveying health-care provider status. As such, pharmacists face a systemic inequity: they cannot be directly reimbursed for health-related services and they remain liable without protection.[35] Pharmacy, public health, and medical communities should engage in an open dialogue about health-care provider designations and implications. Policy solutions must be identified and achieved at state and federal policy levels so that pharmacy-based public health is high quality, reimbursed, and sustainable.

Research

Studies should continue to explore the impact of pharmacy-based public health service provision in U.S. contexts. As public health services become increasingly expressed in community pharmacies, it will be important to understand access to and effectiveness of public health services in these settings. The attitudes of pharmacists and pharmacy users regarding the provision and experience of these services should be explored as they relate to system change, particularly as we implement the ACA. As the demand for preventive health services increases, the need for health access options will also increase. Knowing the perceptions about the pharmacy environment as a preventive services gateway will be important for the diffusion of innovation. As pharmacists assume a greater role in health service provision, there is a need for evaluating the role itself. Pharmacist liability, training, documentation, maintenance of health records, and perception of role value should be evaluated as the role of pharmacists continues to shift from drug dispenser to public health provider.

Meaningful integration of pharmacy and public health in practice and education

Opportunities for collaboration exist for intersectoral learning among public health and pharmacy professionals. Local health departments and pharmacies have partnered to provide emergency preparedness, HIV testing, and vaccinations. Partnerships between schools of public health and colleges of pharmacy offer opportunities for students to assist with outreach events focused on medication reviews, take-back programs to prevent improper medication disposal, patient education, and Medicare prescription health plan comparisons. Educational integration can also be expressed by appointments of pharmacy faculty to schools of public health and vice versa. These professional and educational partnerships will help to erase any real or perceived barriers.

Dual-degree programs and integrated curricula offer rich avenues for thoughtful integration over time. The American Association of Colleges of Pharmacy reports an anticipated 18 dual doctor of pharmacy/master of public health degree programs in the U.S.[38] Public health content integration is required in pharmacy curricula and experiential education for pharmacy schools to obtain and maintain accreditation status.[39] Do schools of public health require learning about pharmacy settings as public health arenas? Such experiences would help to dismantle barriers that prevent the further development of intersectoral collaboration to expand health access.

CONCLUSION

The nexus of pharmacy practice change, escalating health-care costs, and diagnostic evolution has revealed a new arena of public health service access that is promising but challenging. The observed practice changes unearth policy and practice challenges for pharmacists, and addressing these challenges requires collective public health engagement and support. We in the public health community must fully embrace the intersectoral nature of public health and work to achieve our public health mission through the dynamic arena of pharmacy practice. Our collective effort to assure the health of communities depends upon seeing opportunities across systems and sectors and upon successfully shifting the policy environment to allow health system flexibility.

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Risk of Substance Abuse and Dependence Among Young Adult Sexual Minority Groups Using a Multidimensional Measure of Sexual Orientation

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ABSTRACT

Objective. We examined associations between two definitions of sexual minority status (SMS) and substance abuse and/or dependence among young adults in a national population.

Methods. A total of 14,152 respondents (7,529 women and 6,623 men) interviewed during wave four of the National Longitudinal Study of Adolescent Health were included in the study (age range: 24–32 years). We used two definitions of SMS based on self-reported attraction, behavior, and identity: 1-indicator SMS (endorsing any dimension) and 3-indicator SMS (endorsing all dimensions). Outcomes included nicotine dependence as well as ≥3 signs of substance dependence, any sign of substance abuse, and lifetime diagnosis of abuse or dependence for alcohol, marijuana, and a composite measure of other drugs. Weighted logistic regression models were fit to estimate the odds of each outcome for each of the sexual minority groups (compared with the heterosexual majority), controlling for sociodemographic covariates.

Results. SMS women were more likely than exclusively heterosexual women to experience substance abuse and dependence, regardless of substance or SMS definition. In adjusted models for women, 3-indicator SMS was most strongly associated with abuse/dependence (adjusted odds ratio [AOR] range: 2.74–5.17) except for ≥3 signs of cannabis dependence, where 1-indicator SMS had the strongest association (AOR=3.35). For men, the 1-indicator SMS group had higher odds of nicotine dependence (AOR=1.35) and the 3-indicator SMS group had higher odds of ≥3 signs of alcohol dependence (AOR=1.64).

Conclusions. Young adult female sexual minority groups, regardless of how defined, are at a higher risk than their heterosexual peers of developing alcohol, drug, or tobacco abuse and dependence.

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Substance abuse and dependence represent significant problems for young adults in the United States. Data from the 2010 National Survey on Drug Use and Health found that 19.8% of emerging adults aged 18–25 years and 7.0% of young adults aged 26 years or older met the criteria for illicit drug or alcohol abuse or dependence in the preceding year.[1]

The risk for substance use may be particularly heightened among sexual minority or lesbian/gay/bisexual individuals. Across all ages, sexual minority status (SMS) has been associated with higher odds for smoking,[2–5] binge drinking and heavy alcohol consumption,[2–4,6–8] and illicit drug use.[5,8–11] The potential pathways between sexual orientation and substance use have primarily been examined within the frameworks of social stress and minority-specific stress in particular. Meyer's Minority Stress Model posits that those in sexual minority groups will experience higher amounts of repeated, lifelong stressors than exclusively heterosexual individuals.[12] The convergence of stressors can negatively bias self-perception, which can decrease coping mechanisms and eventually result in negative mental health outcomes. Pascoe and Richman's Perceived Discrimination and Health Model further suggests that continuously experienced discrimination and subsequent increased risk of perceiving or internalizing prejudice can result in the adoption of negative coping health behaviors, such as substance use or heavy drinking.[13]

Not explicitly stated in these models, however, is the understanding that sexual orientation is not a uniform exposure; rather, it is multidimensional and fluid, reflecting attraction, behavior, and self-applied identity dimensions that are not necessarily consistent for a given individual at one time point, nor stable over time.[14] Further, the pathways between experienced stressors and substance abuse may be moderated by differing patterns of expressed or endorsed orientation dimensions. An examination of SMS identification among adolescents found that participants who defined their identity as heterosexual, yet had experienced same-sex attraction or partnering, were significantly more likely than exclusively heterosexual adolescents to smoke, use hard drugs, and have suicidal thoughts.[5] Similarly, in an examination among adults participating in the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC), odds of lifetime alcohol, stimulant, and hallucinogen use disorder were lower among both males and females reporting a heterosexual identity and same-sex attraction (i.e., heterosexual discordant) than among those reporting a gay/lesbian identity and same-sex attraction (i.e., gay/lesbian concordant). When concordance was defined on the basis of behavior, only heterosexual discordant females had higher odds of lifetime use disorders for alcohol and several classes of drugs than those who reported heterosexual identity and behavior (heterosexual concordant), and no association was observed between heterosexual discordant and gay/lesbian concordant women.[15]

To date, several studies have examined how endorsement of individual dimensions of sexual orientation predicts substance use behaviors. For adolescent respondents (aged 15–24 years) in the National Survey of Family Growth, the odds of substance use were higher among SMS women than among exclusively heterosexual women regardless of dimension considered, with expression of a lesbian or bisexual identity emerging as the strongest predictor of use for all substances except cannabis. For men, however, SMS was predictive only for non-cannabis illicit drug use among men endorsing an SMS identity or attraction.[16] An analysis of 24- to 32-year-old respondents in the National Longitudinal Study of Adolescent Health (Add Health) found higher odds of smoking among sexual minority women for each indicator of orientation, as well as higher odds of binge drinking, both among those reporting a lesbian/bisexual identity and those reporting same-sex attraction. For males, same-sex partnering emerged as the only significant predictor, and only for binge drinking; in contrast to the female literature, the association was negative, with those reporting exclusively male partnering having lower rates of binge drinking.[17] Taken together, these varied findings indicate not only that a more expansive definition of sexual orientation is needed when examining associations between sexuality and substance use, but that it is important to consider biological sex in these investigations.

Further, the association between sexual orientation and substance use may differ based on substance use outcome considered. For example, one examination of NESARC respondents found that lesbian-identifying women and sexual minority men (regardless of orientation dimension) were significantly more likely than their exclusively heterosexual peers to have met Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) criteria in the past year for alcohol dependence, but not heavy drinking.[18] Substance dependence, which may or may not include "physical dependence" (withdrawal symptoms) or "tolerance" (the need to use increased amounts of a drug to achieve the desired effect), is indicated by taking a drug in larger amounts than intended, an inability to cut down on drug use, excessive time spent to obtain the drug, and continued drug use despite health or social problems caused by

the drug. Abuse is indicated by a failure to fulfill major role obligations, legal problems, or continued drug use despite persistent social or interpersonal problems.[19] Given the chronic exposures of both minority stressors and dependence and abuse symptoms, such outcomes may be more relevant to this population, particularly as substance dependence and abuse likely have a more significant impact on health and development than simply substance use.

We examined the association between SMS and substance abuse and dependence, incorporating multiple indicators of sexual orientation, in a contemporary population-based sample of young women and men.

METHODS

Data source and analytic sample

We used data from Add Health, a nationally representative sample of U.S. adolescents in grades 7–12 during the 1994–1995 school year. Four waves of in-home data collection have been completed thus far; the most recent wave took place in 2008, when respondents were aged 24–32 years. Further details on the Add Health sampling procedures and study design are described elsewhere.[20]

Our analytic sample consisted of respondents with valid sampling weights participating in Waves I and IV in-home interviews (original n=14,800). We excluded respondents who were missing data on all indicators of SMS (n=206) or on any outcome variables or covariates (n=442; typically missing substance abuse/dependence variables); the result was a total analysis sample size of 14,152 (7,529 women and 6,623 men).

Measures

We used three indicators of SMS to group respondents, self-reported at Wave IV: attraction (any same-sex attraction vs. none), behavior (same-sex romantic or sexual partners vs. none), and identity (fully or mostly homosexual/bisexual or mostly heterosexual vs. fully heterosexual).

The first group, 1-indicator SMS, consisted of respondents endorsing at least one SMS indicator. The second group, 3-indicator SMS, consisted of respondents endorsing all three indicators. Respondents endorsing none of the three indicators were classified as heterosexual majority.

Primary outcomes included dichotomous measures (1 = yes) of abuse and/or dependence of four substances at Wave IV: nicotine, alcohol, cannabis, and other drugs (a composite of each respondent's most-used other drug and most common misuse of prescription medications). Nicotine dependence was defined as meeting the diagnostic criteria for dependence on either the Fagerström scale[21] or heavy smoking index.[22] For alcohol, cannabis, and other drugs, outcomes included three measures: (*1*) ≥3 symptoms of dependence as listed in the DSM-IV,[23] (*2*) any symptoms of substance abuse as listed in the DSM-IV, and (*3*) lifetime diagnosis of abuse or dependence based on DSM-IV symptoms and assessment of tolerance and withdrawal symptoms. Symptoms measured in Add Health are a subset of the full DSM-IV assessment.

Respondent demographic characteristics included as covariates were self-reported race/ethnicity at Wave I (non-Hispanic white [the reference group], non-Hispanic black, Hispanic/Latino, and non-Hispanic other); age at Wave IV (24–27, 28–29, and ≥30 years [the reference group]); the highest of the respondent's parents' educational attainment as reported at Wave I (<high school, completed high school diploma or general equivalency diploma, some college, and college graduate [the reference group]); and family structure at Wave I (two biological parents [the reference group], other two-parent household, single mom, and other).

Analysis

We used logistic regression models to estimate the odds of each substance abuse or dependence outcome for each sexual minority definition (compared with the majority), resulting in odds ratios (ORs) with 95% confidence intervals (CIs). We used multivariable logistic regression to generate adjusted ORs (AORs) with 95% CIs, adjusting for the aforementioned covariates. All analyses were stratified by biological sex. We performed analyses using Stata® version 12[24] using survey commands to incorporate sampling weights and cluster variables to account for Add Health's complex survey design.

RESULTS

A greater proportion of women than men endorsed 1-indicator SMS and 3-indicator SMS. Descriptive characteristics for each sexual minority group, stratified by biological sex, are shown in Table 1.

Among women, sexual minority groups across both definitions were younger and less likely than majority (i.e., heterosexual) women to have come from a two-biological parent household. The distributions of race/ethnicity and parent education varied between definitions of minority status and were similar to those of the majority. The prevalence of each measure of substance abuse or dependence was higher for minority than for majority women across both SMS definitions.

Among men, distributions of age and race/ethnicity

Table 1. Characteristics of respondents, including prevalence of substance abuse and dependence disorders, by biological sex and sexual minority status definition: Add Health, U.S., 2008

	Females (n=7,529) Weighted percent (unweighted N)			*Males (n=6,623) Weighted percent (unweighted N)*		
Characteristic	*1-indicator SMS[a] 24.7% (n=1,804)*	*3-indicator SMS[a] 7.8% (n=466)*	*Heterosexual 75.3% (n=5,725)*	*1-indicator SMS[a] 9.4% (n=640)*	*3-indicator SMS[a] 3.2% (n=226)*	*Heterosexual 90.6% (n=5,983)*
Self-reported race/ethnicity						
Non-Hispanic white	69.3 (1,009)	68.4 (262)	65.3 (2,982)	63.1 (340)	62.6 (110)	66.6 (3,272)
Hispanic	11.8 (276)	11.5 (64)	11.6 (907)	16.0 (127)	17.8 (51)	11.3 (928)
Non-Hispanic black	11.8 (361)	14.1 (110)	17.5 (1,373)	15.0 (119)	14.3 (46)	15.3 (1,189)
Non-Hispanic other	7.0 (158)	6.0 (30)	5.6 (463)	5.9 (54)	5.2 (19)	6.8 (594)
Wave IV age (in years)						
24–27	42.3 (663)	43.0 (178)	36.4 (1,775)	33.5 (173)	35.9 (63)	35.2 (1,679)
28–29	36.5 (692)	39.9 (193)	33.6 (2,123)	31.3 (247)	32.9 (91)	33.3 (2,248)
≥30	21.2 (449)	17.1 (95)	30.0 (1,827)	35.1 (220)	31.2 (72)	31.5 (2,056)
Parent education in Wave I						
<High school diploma	12.2 (783)	10.4 (48)	12.3 (783)	13.6 (87)	15.0 (31)	11.8 (680)
High school diploma/GED	26.2 (445)	32.2 (132)	28.8 (1,499)	24.7 (153)	25.4 (63)	26.8 (1,482)
Some college	30.9 (542)	30.3 (136)	28.9 (1,619)	27.2 (174)	22.9 (57)	31.1 (1,826)
College graduate	30.6 (595)	27.1 (150)	30.0 (1,824)	34.5 (226)	36.7 (75)	30.3 (1,995)
Family structure in Wave I						
Two biological parents	49.7 (839)	45.8 (200)	56.7 (3,095)	51.8 (325)	49.5 (112)	56.3 (3,314)
Other two parents	19.8 (398)	20.7 (123)	15.4 (945)	17.6 (118)	16.3 (34)	17.2 (1,114)
Single mother	23.4 (435)	24.6 (110)	21.1 (1,271)	22.6 (145)	23.9 (55)	18.3 (1,123)
Other	7.1 (132)	8.9 (33)	6.8 (414)	8.0 (52)	10.3 (25)	8.2 (432)

continued on p. 148

Table 1 (continued). Characteristics of respondents, including prevalence of substance abuse and dependence disorders, by biological sex and sexual minority status definition: Add Health, U.S., 2008

Characteristic	*Females (n=7,529) Weighted percent (unweighted N)*			*Males (n=6,623) Weighted percent (unweighted N)*		
	1-indicator SMS[a] 24.7% (n=1,804)	*3-indicator SMS[a] 7.8% (n=466)*	*Heterosexual 75.3% (n=5,725)*	*1-indicator SMS[a] 9.4% (n=640)*	*3-indicator SMS[a] 3.2% (n=226)*	*Heterosexual 90.6% (n=5,983)*
Wave IV substance use						
Nicotine dependence[b]	21.2 (315)	28.6 (100)	10.6 (501)	22.8 (133)	18.9 (42)	18.9 (998)
Alcohol						
≥3 symptoms of dependence[c]	19.8 (330)	24.4 (100)	8.2 (424)	22.6 (132)	26.4 (54)	18.1 (1,014)
Any symptoms of abuse[d]	32.4 (532)	34.2 (147)	15.7 (798)	28.3 (184)	30.9 (61)	30.1 (1,666)
Lifetime diagnosis of abuse/ dependence[e]	35.6 (598)	38.2 (167)	18.0 (915)	32.7 (206)	33.9 (70)	33.3 (1,868)
Cannabis						
≥3 symptoms of dependence[c]	13.0 (244)	12.5 (71)	3.9 (202)	14.1 (97)	8.8 (28)	11.0 (191)
Any symptoms of abuse[d]	11.9 (214)	14.3 (66)	4.2 (214)	11.6 (93)	8.7 (30)	12.9 (706)
Lifetime diagnosis of abuse/ dependence[e]	18.1 (325)	19.6 (100)	6.0 (309)	17.7 (126)	12.1 (37)	17.4 (984)
Other drugs						
≥3 symptoms of dependence[c]	13.8 (233)	17.7 (72)	3.6 (174)	9.4 (67)	8.1 (22)	7.9 (431)
Any symptoms of abuse[d]	11.1 (195)	15.2 (65)	3.1 (152)	9.6 (63)	9.7 (21)	7.2 (386)
Lifetime diagnosis of abuse/ dependence[e]	15.1 (261)	18.9 (81)	4.0 (199)	11.1 (74)	10.6 (25)	9.5 (515)

[a]1-indicator SMS was defined as endorsing at least one of the following SMS indicators: same-sex attraction, history of same-sex sexual partnering, and/or self-identified homosexual or bisexual identity. 3-indicator SMS was defined as endorsing all three SMS indicators.

[b]Nicotine dependence was defined as meeting the diagnostic criteria for dependence on either the Fagerström scale or heavy smoking index.

[c]Three or more symptoms of dependence as assessed in the Add Health subset of DSM-IV diagnostic criteria

[d]Any symptoms of abuse as assessed in the Add Health subset of DSM-IV diagnostic criteria

[e]Lifetime diagnosis of abuse or dependence as assessed in the Add Health subset of DSM-IV diagnostic criteria for tolerance and withdrawal symptoms

Add Health = National Longitudinal Study of Adolescent Health

SMS = sexual minority status

GED = general equivalency diploma

DSM-IV = Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition

were similar between those in sexual minority groups and the majority across all definitions of SMS. Compared with sexual majority men, higher proportions of sexual minority men had a parent with a college degree, but minority men were also more likely to live with a single mother during adolescence. Prevalence of substance abuse or dependence was relatively similar for minority groups across both definitions and, in some cases, was lower than those of majority men (e.g., most cannabis measures).

Unadjusted and adjusted results for the regression analyses are shown in Table 2, stratified by biological sex and SMS definition. For women, the estimated unadjusted associations between sexual minority membership and the substance abuse or dependence variables were large in magnitude and statistically significant for both definitions. Estimates did not change appreciably after adjusting for covariates. The substance for which adjusted associations were of the largest magnitude was the composite other drugs; AORs for other drug abuse and dependence measures ranged from 4.83 to 5.17 for 3-indicator SMS and 3.54 to 3.90 for 1-indicator SMS. Associations for the 3-indicator SMS group were of a larger magnitude than for the 1-indicator SMS group for all substance abuse/dependence measures with the exception of ≥3 signs of cannabis dependence, where associations were higher among 1-indicator SMS women.

In contrast with the findings for women, the estimated associations for men were small in magnitude, and most of the 95% CIs included the null value. These findings persisted after adjusting for covariates. Exceptions to this pattern were nicotine dependence for the 1-indicator SMS group (AOR=1.35, 95% CI 1.06. 1.72) and ≥3 symptoms of alcohol dependence for the 3-indicator SMS group (AOR=1.64, 95% CI 1.05, 2.57).

DISCUSSION

Using two definitions of SMS reflecting varying levels of endorsing multiple sexual orientation dimensions, we found statistically significant and sizable disparities in multiple indicators of substance abuse and dependence for young adult women. In this population-based sample, young women from sexual minority groups have anywhere from two to almost five times the odds of abuse/dependency compared with peers who do not endorse any sexual minority indicators. Results for males were quite different, with only nicotine or alcohol dependence showing significantly elevated odds for sexual minority groups. Our findings are consistent with findings from both population-based[7,15,17,18] and college-based[25] samples that report greater substance use disparity linked to sexual minority women than men, and our work extends these patterns to abuse and dependence.

It is not clear why sexual minority women appear to be at greater risk of substance abuse/dependency than sexual minority men. One potential explanation is that SMS women (compared with SMS men) may experience heightened emotional and/or psychological distress as a result of encountered minority-specific stressors. According to minority stress and perceived stress theory, this heightened distress may further heighten the adoption of negative coping mechanisms (e.g., substance use), resulting in higher rates of substance abuse/dependence among SMS women compared with men. Findings from two review articles support this hypothesis: a meta-analysis of 28 articles noting higher rates of both depression and substance use and alcohol/drug dependence among sexual minority women compared with men,[26] demonstrating robustness of the association, and a systematic review concluding that women in general have higher rates of comorbid psychiatric disorders, particularly anxiety and depression.[27] Further, such disorders develop before the onset of substance use, indicating that a causal relationship between mood disorders and subsequent substance use is plausible. More developmentally oriented research is needed to understand the processes underlying differential rates of substance abuse and dependence between males and females.

Although we did not test for statistical differences in coefficient size between minority groups, our results suggest that endorsing all three indicators of SMS (identity, attraction, and behavior) confers relatively greater risk of substance abuse/dependence among women. This finding expands on existent congruency literature, which has predominantly compared outcomes on the basis of congruency in one indicator (e.g., identity only) vs. two indicators (e.g., identity plus behavior or attraction)[5,15,28,29] rather than all three. Previously, a higher risk of substance use and mental health disorders observed among those endorsing SMS identity plus same-sex attraction (compared with exclusively endorsing same-sex attraction) provided partial evidence for an additive stress model.[15] Our findings suggest that additional SMS-indicator endorsement may be associated with cumulative risk. In light of minority stress theory,[12] this association further suggests that individuals with multiple sexual orientation minority indicators/characteristics may incur additional sources of stigma and discrimination. Future research should examine whether this apparent additive effect can be replicated before an additive stress model can be endorsed.

Table 2. Unadjusted and adjusted odds ratios for substance abuse/dependence and SMS definition, by respondent biological sex and SMS definition: Add Health, U.S., 2008

	Females				*Males*			
	1-indicator SMS		*3-indicator SMS*		*1-indicator SMS*		*3-indicator SMS*	
Variable	*OR (95% CI)*	*AOR[a] (95% CI)*	*OR (95% CI)*	*AOR[a] (95% CI)*	*OR (95% CI)*	*AOR[a] (95% CI)*	*OR (95% CI)*	*AOR[a] (95% CI)*
Nicotine dependence	2.27[b] (1.84, 2.80)	2.13[b] (1.71, 2.66)	3.38[b] (2.49, 4.59)	3.12[b] (2.28, 4.28)	1.26 (0.99, 1.61)	1.35[b] (1.06, 1.72)	1.00 (0.64, 1.54)	1.06[b] (0.68, 1.64)
Alcohol								
≥3 symptoms of dependence	2.76[b] (2.18, 3.50)	2.57[b] (2.02, 3.27)	3.60[b] (2.54, 5.11)	3.43[b] (2.38, 4.95)	1.32[b] (1.00, 1.76)	1.34[b] (1.00, 1.81)	1.63[b] (1.08, 2.46)	1.64[b] (1.05, 2.57)
Any symptoms of abuse	2.59[b] (2.18, 3.07)	2.49[b] (2.07, 2.98)	2.81[b] (2.10, 3.74)	2.76[b] (2.03, 3.76)	0.92 (0.71, 1.19)	0.92 (0.69, 1.23)	1.03 (0.71, 1.50)	1.04 (0.69, 1.56)
Lifetime diagnosis of abuse/ dependence	2.53[b] (2.14, 2.99)	2.41[b] (2.02, 2.88)	2.83[b] (2.12, 3.77)	2.74[b] (2.01, 3.73)	0.97 (0.76, 1.25)	0.98 (0.74, 1.30)	1.03 (0.71, 1.49)	1.03 (0.69, 1.54)
Cannabis								
≥3 symptoms of dependence	3.66[b] (2.68, 5.01)	3.35[b] (2.43, 4.62)	3.51[b] (2.29, 5.38)	3.18[b] (2.04, 4.95)	1.33 (0.93, 1.89)	1.29 (0.90, 1.86)	0.78 (0.42, 1.46)	0.73 (0.39, 1.36)
Any symptoms of abuse	3.11[b] (2.30, 4.19)	2.90[b] (2.11, 3.98)	3.84[b] (2.50, 5.88)	3.57[b] (2.26, 5.63)	0.89 (0.63, 1.27)	0.87 (0.60, 1.26)	0.64 (0.34, 1.22)	0.61 (0.33, 1.14)
Lifetime diagnosis of abuse/ dependence	3.44[b] (2.66, 4.45)	3.19[b] (2.44, 4.18)	3.79[b] (2.63, 5.46)	3.49[b] (2.36, 5.17)	1.02 (0.74, 1.42)	1.00 (0.71, 1.40)	0.65 (0.38, 1.13)	0.62 (0.36, 1.07)
Other drugs								
≥3 symptoms of dependence	4.30[b] (3.19, 5.80)	3.90[b] (2.86, 5.33)	5.81[b] (3.98, 8.49)	5.17[b] (3.44, 7.76)	1.21 (0.83, 1.76)	1.17 (0.80, 1.73)	1.03 (0.54, 1.95)	0.97 (0.50, 1.89)
Any symptoms of abuse	3.92[b] (2.93, 5.24)	3.54[b] (2.58, 4.85)	5.63[b] (3.77, 8.41)	4.83[b] (3.13, 7.44)	1.37 (0.95, 1.99)	1.35 (0.92, 1.97)	1.39 (0.76, 2.54)	1.34 (0.71, 2.50)
Lifetime diagnosis of abuse/ dependence	4.23[b] (3.20, 5.57)	3.84[b] (2.87, 5.14)	5.54[b] (3.83, 8.01)	4.92[b] (3.30, 7.33)	1.26 (0.99, 1.61)	1.16 (0.83, 1.62)	1.12 (0.64, 1.96)	1.08 (0.60, 1.93)

[a]Adjusted for age, race/ethnicity, adolescent family structure, and parental educational attainment

[b]Statistically significant association

SMS = sexual minority status

Add Health = National Longitudinal Study of Adolescent Health

OR = odds ratio

CI = confidence interval

Strengths

Our study benefited from the nationally representative design of Add Health, which allowed for examining sexual orientation and substance use among a diverse national sample of young adults, rather than a convenience sample of respondents selected on one or more indicators of orientation. Such sampling methodology benefits from a lower risk of selection bias, which may be particularly significant given the population under examination. An additional strength of the present analysis was its use of a comprehensive, multidimensional definition of sexual orientation that included attraction, behavior, and self-identity. Given the highly personalized fluidity of orientation, this flexibility allows for a respondent-driven approach to defining sexual orientation rather than an investigator-driven one, and facilitates the examination of additive stress models.

Our results indicate that individuals, especially women, who endorse even one indicator may be at a higher risk for substance abuse/dependence than exclusively heterosexual individuals. Use of dimension-targeted recruitment (i.e., recruiting on the basis of self-identifying as lesbian/gay) may miss a significant number of at-risk individuals, as their lack of a self-labeled sexual minority identity precludes them from enrollment in potentially helpful prevention/intervention efforts. Clinicians, public health professionals, and paraprofessionals hoping to focus on SMS health should screen patients and participants not just on their identity, but also on their behaviors and attractions—both past and present—to more fully identify those at risk.

Limitations

This study was subject to several limitations. Most notably, sample size restrictions necessitated collapsing bisexual- and exclusively homosexual-identifying respondents into the same categories, whereas evidence suggests that there may be significant differences in substance use outcomes between bisexual and exclusively homosexual individuals.[30] While our decision to collapse sexual minority classifications reflected a need to ensure sufficient cell sizes for analysis, and reflects aggregation employed in other Add Health analyses[11] and the broader sexual orientation literature,[31] future research is needed to better elucidate the possible implications of different combinations of more nuanced indicators (e.g., mostly heterosexual identity with both male and female partners) of sexual orientation for substance use.

Similarly, a significant discrepancy was observed between the number of women (1,804, or 24.7%) and men (640, or 9.4%) endorsing any sexual minority indicator. The fairly small number available for male-specific analyses made it difficult to ascertain if gender-specific differences in associations were due to insufficient sample sizes or true differences in substance use between SMS males and females. However, because our findings replicate previous results indicating that sexual minority women are more at risk than sexual minority men for developing substance use disorders, and because similar proportions of men and women fell into the stricter classification of SMS, there is reason to believe that our findings highlight actual sex differences.

Further, both sexual history and substance use are sensitive topics; therefore, they may be subject to reporting bias. Add Health mitigates this concern through the use of computer-assisted self-interview (CASI) technology for sensitive questions. By increasing respondent privacy, CASI is assumed to improve accuracy based on increased reporting of sensitive behaviors under private conditions.[32]

CONCLUSIONS

Although most people in sexual minority groups do not develop substance abuse or dependence problems, the likelihood of these conditions, particularly for women, is significantly elevated, regardless of how sexual minority is defined. Future research is needed to understand the mechanisms underlying cumulative risk, as reflected in the 3-indicator group, and to determine if particular combinations of indicators vary in their implications for substance abuse as well as other health outcomes. In particular, additional research is needed on the influence of structural, familial, and environmental factors and contexts on the relationship between substance use and sexual orientation. Such knowledge will allow for targeting interventions focusing on the most relevant risk factors for each group.

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All Add Health procedures were approved by the Public Health Institutional Review Board at UNC Chapel Hill; present analyses were deemed exempt.

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Correlates of HIV Risk Behaviors Among Homeless and Unstably Housed Young Adults

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ABSTRACT

Objectives. Homeless young adults are exposed to multiple risk factors for HIV infection. We identified HIV risk behaviors and their correlates among homeless young adults in Portland, Oregon.

Methods. We conducted a community-based, cross-sectional survey of HIV risk behaviors among homeless young adults aged 18–25 years in 2010. Participants completed three study components: (*1*) an interviewer-administered survey of HIV risk behaviors; (*2*) a brief, client-centered HIV risk-based counseling session; and (*3*) rapid HIV testing.

Results. Among 208 participants, 45.8% identified as racial/ethnic minority groups, 63.8% were male, and 35.7% self-identified as nonheterosexual. Six participants, all from sexual minority groups, had positive HIV screening results (two newly identified, four previously known) for a seropositivity rate of 2.9%. Female sex, belonging to a sexual minority group, frequent traveling between cities, depression, and alcohol use to intoxication were significantly associated with unprotected sex in univariate analysis. Female sex and high perceived risk of HIV were significantly associated with unprotected sex in multivariate analysis.

Conclusions. Our findings support the need for enhanced HIV prevention interventions for homeless young adults.

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In the Portland, Oregon, metropolitan area, an estimated 1,500–2,000 homeless young people are living on the street (Personal communication, Caitlin Campbell, Homeless Youth Continuum Coordinator, Multnomah County, Oregon, July 2009). Young adults and adolescents are at particularly high risk of human immunodeficiency virus (HIV) infection. In 2008, the Centers for Disease Control and Prevention (CDC) reported that 13% of all new HIV infections in the U.S. occur among people aged 13–24 years.[1] Statistical modeling estimates that approximately half of HIV infections in the U.S. occur before 25 years of age.[2] The young adult years are accompanied by escalating risk due to sexual contact and initiation of drug use in certain populations.

Homeless young people live at the intersection of multiple risk factors and are especially at risk for HIV infection. Up to 35% of homeless young people identify as gay, lesbian, bisexual, or transgender.[3–6] Homeless populations frequently exchange sex for money, drugs, or a place to stay;[7] have high rates of substance use;[8] and experience substantial unmet needs for multiple types of health care,[9] further increasing their risk for HIV infection. Mental illness, such as depression, has been shown to be associated with infrequent condom usage among homeless adolescents in the U.S. Pacific Northwest.[10] In 1994, Allen et al. reported findings from a 16-city CDC-sponsored seroprevalence study that showed an HIV prevalence of 2.3% among runaway young people aged 15–24 years and 3.4% among homeless adults.[11] More recent studies demonstrate HIV prevalence proportions of 5%–16% among homeless adolescents and young adults.[12,13]

An updated account of HIV prevalence among homeless young adults is essential to inform HIV prevention programs, reduce HIV transmission by educating about behaviors that put people at risk for infection, and connect affected people with resources. Additionally, little is known about current risk-taking behaviors among homeless young adults. The purpose of this study was to identify HIV risk behaviors and their correlates among homeless young adults in the Portland, Oregon, metropolitan area.

METHODS

We conducted a community-based, cross-sectional survey of HIV risk behaviors among homeless young adults aged 18–25 years in Portland in 2010. Our study team included university researchers and staff from two local community-based organizations (CBOs) that had significant experience with homeless young people and HIV prevention. Outside In is a Federally Qualified Health Center and Social Service Agency specializing in work with homeless transition-age young people. Cascade AIDS Project is the oldest and largest acquired immunodeficiency syndrome (AIDS) service organization in Oregon and Southwest Washington. Its mission is to prevent HIV infections, support and empower people affected by and infected with HIV/AIDS, and eliminate HIV/AIDS-related stigma. Cascade AIDS Project provides services through two main program departments: (*1*) prevention and education and (*2*) housing and support services. Services run the gamut from HIV prevention programs for young people and men who have sex with men, to HIV testing, connecting people to HIV care services, providing supportive housing, and staffing the Oregon HIV/STD Hotline.

University researchers provided methodological and analytical expertise, and CBO staff provided expertise regarding recruitment, study venues, and refinement of study instruments and procedures for the target population. Partners collaborated on study design, taking into consideration cultural and other factors to maximize participation by additional community partners, study enrollment, and benefit to study participants. CBOs collaborated to lead study implementation, arrange data collection points, conduct interviews, and administer HIV counseling and testing. University researchers conducted the analyses.

A certificate of confidentiality was obtained from the Health Resources and Services Administration to protect study participants from disclosure of study data pertaining to illicit activities. Prior to study implementation, interviewers, outreach workers, testers, and other study team members were trained in human subjects research, including confidentiality; cultural sensitivity in working with homeless young people; study protocol; and interviewing skills, including interview practice sessions and role-playing.

Eligibility and participant recruitment

We aimed to recruit 200 participants for this pilot study, based on available funding and projected community outreach worker availability from the CBOs. Young adults aged 18–25 years who accessed homeless youth services from January to May 2010 were eligible to participate. Community partners posted informational flyers and recruited participants during regularly scheduled daytime, evening, and weekend homeless youth services at seven local venues. The venues included the only homeless youth shelter in the city, several drop-in sites for homeless young people at local CBOs, a community-run and church-supported weekly hot meal service, and a stationary outreach site

for homeless young people. Participants received a $10 grocery store gift card as compensation.

Study procedures

Participants completed three study components: (*1*) an interviewer-administered survey of HIV risk behaviors; (*2*) a brief, client-centered HIV risk-based counseling session; and (*3*) rapid HIV-1/2 antibody testing.

Interviewer-administered survey. We developed a 44-item interviewer-administered survey to assess HIV risk behaviors and associated characteristics. We assessed the following domains with items adapted from previously validated instruments: (*1*) housing status and mental health (Buprenorphine-HIV Evaluation Support [BHIVES] Collaborative Baseline Client Interview);[14] (*2*) testing history and risk perception (Simple Screening Instruments for Outreach for Alcohol and Other Drug Abuse and Infectious Diseases: Treatment Improvement Protocol Series 11);[15] (*3*) sexual behaviors and injection drug behaviors (Texas Christian University HIV/AIDS Risk Assessment);[16] (*4*) alcohol and drug use (Addiction Severity Index Lite);[17] and (*5*) receipt of HIV test results.[18] We also included items regarding service utilization specific to the metropolitan area to help inform programming efforts for partnering CBOs.

We conducted cognitive interviews with formerly and currently homeless young adults to assess the instrument for content domains and gather feedback regarding wording of new items and response choices specifically related to sexual orientation (pansexual) and sexual behaviors, as well as the concept of the homeless traveler (i.e., a homeless person who moves frequently between cities). We consulted the Steering Committee from the Sexual & Gender Minority Youth Resource Center, a youth-based group that reviewed our interview tool and provided extensive feedback on modifications to make our study more relevant to homeless young adults. Young adults and CBO outreach workers alerted us to the possibility that there was a prevalent misconception among homeless young adults that non-barrier contraception (e.g., birth control pills, Depo-Provera®, and intrauterine devices [IUDs]) were effective means of HIV prevention. Therefore, we included a question using answer choices plus a write-in option, "What do you do to decrease your risk of HIV?" We pilot-tested the instrument with homeless young adults prior to survey initiation. Community outreach workers administered the final 20-minute paper survey to minimize problems related to varying literacy levels among participants.

HIV risk-based counseling. Using the CDC model for client-centered risk-based counseling,[19] community outreach workers provided brief, tailored counseling sessions following survey completion. Counseling sessions included assessing individual HIV risk factors, providing education about the participants' risk factors, assessing readiness and willingness to adopt behaviors to lower participants' risk, and developing action plans to carry out those behavioral changes.

Rapid HIV testing. HIV testing was conducted by outreach staff and trained volunteers using the OraQuick® ADVANCE Rapid HIV-1/2 Antibody Test (OraSure Technologies, Inc., Bethlehem, Pennsylvania). Participants could choose confidential or anonymous testing and were instructed to return to the tester in 20 minutes, if they chose, to receive their results. Participants with positive screening tests were scheduled for confirmatory testing and follow-up at one of the CBO's outpatient clinics. Outreach workers provided de-identified HIV testing results to study investigators.

Data management and statistical analysis

All data were entered from the paper survey and HIV testing result forms into a Microsoft® Excel database by a single investigator. Data quality control was performed by selecting a 10% random sample of participants for manual verification of data elements.

We conducted statistical analyses using Stata® version 11.[20] Descriptive frequencies and measures of central tendency were used for univariate measures. Chi-square and Fisher's exact tests were used to test bivariate associations. We used logistic regression to test multivariable associations between subject characteristics (gender, race/ethnicity, sexual orientation, traveler status, perceived HIV risk, use of non-barrier contraception for HIV prevention, illicit drug use, alcohol use to intoxication, and depression) and the outcome of unprotected sex (vaginal or anal sex without a barrier) in the past 30 days. These variables were chosen for multivariable logistic regression models based on a bivariate significance at the $p<0.1$ level and a priori hypotheses.

RESULTS

Demographics

We recruited 208 participants from January to May 2010. Participant characteristics are shown in Table 1. Of those surveyed, 76.9% (160 participants) reported that they considered themselves homeless. Of the 48 participants reporting they were not homeless, only 4.2% reported that they had permanent housing and 19.7% reported subsidized/public housing or

Table 1. Characteristics of participants in a survey of HIV risk behaviors among homeless young adults aged 18–25 years (*n*=208):[a] January–May 2010, Portland, Oregon

Characteristic	N *(percent)*
Age in years: median (range)	21 (18–25)
Race/ethnicity[b]	
White	111 (54.2)
Native American/Alaska Native	28 (13.7)
African American	19 (9.3)
Hispanic	13 (6.3)
Other	34 (16.6)
Education	
<High school	100 (48.1)
High school graduate	56 (26.9)
Some college	52 (25.0)
Sex at birth[b]	
Male	132 (63.8)
Female	74 (35.8)
Intersex	1 (0.5)
Self-perceived gender[b]	
Male	127 (61.4)
Female	71 (34.3)
Transgender/other	9 (4.4)
Sexual orientation[b]	
Heterosexual	128 (64.3)
Bisexual	47 (23.6)
Gay or lesbian	13 (6.5)
Pansexual	11 (5.5)
Traveler	75 (36.4)
High perceived risk of HIV	12 (5.8)
Non-barrier contraception for HIV prevention[c]	17 (8.2)
Alcohol use to intoxication	121 (60.2)
Illicit drug use, past 30 days	171 (82.2)
Depression	134 (64.4)

[a]Not all respondents answered each survey item. As such, totals may not equal 208.

[b]Percentages may not total 100 due to rounding.

[c]Some participants responded that they used non-barrier contraceptive methods (e.g., birth control pills, Depo-Provera®, or Mirena®) to prevent HIV infection.

HIV = human immunodeficiency virus

transitional/time-limited housing. For those reporting homelessness, the median age at first homelessness was 17 years (data not shown).

A total of 75 (36.4%) participants identified themselves as travelers. This group reported living in a median of two cities (range 1–150) during the past 12 months. Travelers were predominantly white (54.7%) and biologically male (66.7%). Half of those identifying as travelers were from sexual minority groups (i.e., nonheterosexual) and half had completed high school. Participants reported chronic illnesses including hepatitis C (4.8%), depression (64.4%), and posttraumatic stress disorder (35.1%) (data not shown).

Eleven (5.5%) participants identified themselves as pansexual, a sexual orientation they variously defined as a rejection of conventional labels (e.g., "Don't define people by gender. No difference between the two") or as a more inclusive term to explain attraction to more diverse groups of people (e.g., "Doesn't matter what the gender of the person is, what matters is their personality") (Table 1).

HIV testing

Of 207 participants who provided oral fluid specimens for HIV screening, 89.4% elected to receive confidential testing and 82.1% waited onsite to receive their screening results. Of those not wishing to wait for results, 54.1% reported that they did not have time to wait and 29.7% reported that they had been recently tested or already knew their HIV status (data not shown).

Six participants (2.9%) had preliminary positive HIV screening tests, including four who reported knowing their positive status prior to study participation; these four elected not to receive confirmatory testing. For the two participants with newly positive HIV screening results, one had a positive confirmatory test result and the second had confirmatory testing but did not consent to release confirmatory results to study personnel.

Drug use

Alcohol use to intoxication and illicit drug use during the past 30 days were highly prevalent among study participants (Table 2). Although 87.5% of the 24 recent injection drug users reported using needle-exchange programs, 50% reported sharing needles or

Table 2. Alcohol and illicit drug use, past 30 days, in a survey of HIV risk behaviors among homeless young adults aged 18–25 years (*n*=208): January–May 2010, Portland, Oregon

Alcohol and illicit drug use	N *(percent)*
Alcohol use to intoxication	121 (60.2)
Any illicit substance[a]	171 (82.2)
Marijuana	148 (71.2)
Amphetamines	24 (11.7)
Heroin	22 (10.6)
Buprenorphine (nonprescription)	22 (10.6)
Sedatives	20 (9.7)
Cocaine	17 (8.3)
Methadone (nonprescription)	7 (3.4)
Barbiturates	3 (1.5)
Any injection drug use	24 (11.5)
Polysubstance	123 (59.1)

[a]The number of substances may not total 171 because respondents could indicate using more than one substance.

works (i.e., equipment for injecting drugs) in the past 30 days (data not shown). In bivariate analyses, a past diagnosis of hepatitis C was significantly associated with recent needle or works sharing ($p<0.001$).

Sexual risk behaviors

Vaginal or anal sex without barrier protection was common, with 53.4% reporting having unprotected sex (sex without using a condom) at least once during the past 30 days. For those reporting any sex during the past 30 days, the median number of episodes of unprotected sex was four (range 0–140) (data not shown). Rates of unprotected sex, by participant characteristic, are shown in Table 3. Females, travelers, those with a high perceived risk of HIV, those who reported using non-barrier contraception (e.g., birth control pills, IUD, or injectable hormonal contraception) to prevent HIV, as well as those reporting alcohol use to intoxication and a history of depression, all showed significant univariate associations for unprotected sex. However, only females and those who perceived their HIV risk as high showed a significant association with unprotected sex in the multivariable model.

Perceived HIV risk, as assessed by the question "How would you judge your own risk for being infected with HIV?", was associated with reported sexual risk behaviors, as those with higher perceived risk were more likely to engage in unprotected sex in the past 30 days. However, unadjusted analyses showed that a substantial proportion of those who perceived themselves to be at low risk (55.0%) and no risk (45.8%) for HIV infection also engaged in unprotected sex in the past 30 days. In adjusted analyses, those who perceived their HIV risk as high were more likely to report sex without

Table 3. Univariate and multivariable associations between participant characteristics and unprotected sex, past 30 days, in a survey of HIV risk behaviors among homeless young adults aged 18–25 years (*n*=208): January–May 2010, Portland, Oregon

Independent variable	*Unprotected sex, past 30 days* N *(percent)*	*OR (95% CI)*	*AOR[a] (95% CI)*
Race/ethnicity			
White	62 (55.9)	Ref.	
Native American/Alaska Native	13 (46.4)	0.7 (0.2, 2.1)	
African American	9 (47.4)	0.7 (0.3, 1.9)	
Hispanic	6 (46.2)	0.7 (0.2, 2.1)	
Sex at birth[b]			
Male	59 (44.7)	Ref.	
Female	51 (68.9)	2.7 (1.5, 5.0)[c]	3.3 (1.5, 7.2)[c]
Sexual orientation			
Heterosexual	66 (51.6)	Ref.	
Bisexual	26 (55.3)	1.2 (0.6, 2.3)	0.5 (0.2, 1.2)
Gay or lesbian	9 (69.2)	2.1 (0.6, 7.2)	1.6 (0.4, 6.4)
Pansexual	7 (63.6)	1.6 (0.5, 5.9)	0.4 (0.1, 1.9)
Traveler	47 (62.7)	1.8 (1.0, 3.1)[c]	1.7 (0.9, 3.2)
High perceived risk of HIV	11 (91.7)	10.6 (1.3, 83.4)[c]	10.8 (1.3, 92.8)[c]
Non-barrier contraception for HIV prevention	14 (9.1)	4.5 (1.3, 16.2)[c]	3.3 (0.8, 13.6)
Alcohol use to intoxication	71 (58.7)	1.7 (1.0, 3.1)[c]	1.6 (0.8, 2.9)
Illicit drug use	95 (55.6)	1.6 (0.8, 3.4)	NA[d]
Depression	78 (58.2)	1.7 (1.0, 3.1)[c]	1.4 (0.7, 2.8)

[a]Multivariable ORs were adjusted for self-perceived gender, race/ethnicity, sexual orientation, traveler status, perceived HIV risk, alcohol use to intoxication, illicit drug use, and depression.

[b]One participant reporting sex at birth as intersex was not included in these analyses.

[c]Results significant at $p\leq0.5$

[d]The illicit drug use variable was not included in the multivariable logistic regression models because bivariate significance did not meet the $p<0.1$ significance level of the a priori hypotheses.

HIV = human immunodeficiency virus

OR = odds ratio

CI = confidence interval

AOR = adjusted odds ratio

Ref. = reference group

NA = not applicable

barrier protection in the past 30 days (adjusted odds ratio [AOR] = 10.8, 95% confidence interval [CI] 1.3, 92.8) (Table 3).

Only 53.1% of participants reported discussing HIV and other sexually transmitted infections (STIs) with their partners prior to engaging in sex, with 35.4% stating that they do not discuss HIV or STIs at all with sexual partners (data not shown).

When asked about methods to decrease personal HIV risk, 8.2% incorrectly identified non-barrier contraception (e.g., IUD, Depo-Provera®, or birth control pills) as an HIV risk-reduction tool. In unadjusted analyses, those who reported using non-barrier contraception for HIV prevention were more likely than those who did not report this behavior to have had sex without barrier protection in the past 30 days (82.4% v. 50.8%, AOR=4.5, 95% CI 1.3, 16.2). High school graduates were 4.8 times more likely than those who did not graduate from high school to report using non-barrier contraception for HIV (OR=4.8, 95% CI 1.3, 17.7) (data not shown).

DISCUSSION

This study provides additional insight into the HIV risk behaviors among homeless young adults and suggests areas for improving HIV prevention services in CBOs. The HIV prevalence in the study population, based on preliminary rapid HIV testing results, was 2.9%, which is similar to the 1994 multicity CDC-sponsored seroprevalence study among runaway young people,[11] but is low compared with more recent studies of homeless young adults and adolescents.[12,13] The low prevalence may be particular to this sample, which included young adults who were connected with homeless services, such as health and wellness education.

In the current study, 89.4% of participants chose confidential testing. Our rate was higher than a 1986–1992 Seattle study in which 66% of men and 64% of women sought anonymous testing.[21] This difference may reflect established relationships between study participants and CBO partner organizations and health workers in our study. The high proportion of participants receiving HIV testing results in the current study (82.1%) is consistent with a recent study in which 88.8% of homeless people with serious mental illness returned to receive HIV test results; younger patients were even more likely to receive HIV test results in that study.[22] Our proportion of young adults who received test results was slightly lower than that demonstrated by the 1986–1992 Seattle study in which 93.7% returned for standard HIV test results.[21]

Substance use rates in this study were similar to those reported among homeless young people in Denver[23] and Washington, D.C.,[24] but lower compared with homeless young people in Northern California.[5] Although other studies have reported an association between illicit drug use and risky sexual activity,[25] our study did not determine this association, perhaps due to its small sample size. However, we did find a nonsignificant trend toward increased risk of unprotected sex for those who used alcohol to intoxication. This trend suggests the need for HIV prevention interventions for homeless young adults that should include screening for alcohol and drug use with linkage to substance use treatment when indicated.

We found a high rate of sex without barrier protection, particularly among women. Of additional concern was the number of young adults who identified non-barrier contraception (e.g., oral contraceptive pills and Depo-Provera) as an effective means of HIV prevention. This finding highlights an important target in education messaging for homeless young adults, a particularly vulnerable group for HIV infection. Given this misinformation about HIV prevention, it is not surprising that we discovered a substantial discrepancy between actual and perceived HIV risk. Those self-identifying as high risk reported unprotected sex most often. However, approximately half of those reporting no risk, low risk, or unknown risk also engaged in unprotected sex. Enhancing client knowledge of effective HIV prevention strategies and self-risk assessment in CBOs may decrease risky sexual behaviors in homeless young adults.

Young females were more likely than young males to report unprotected sex, which is consistent with a previous study by Clements and colleagues.[26] However, our survey did not elicit information about whether unprotected sex occurred with males, females, or partners with other gender identities. It is possible, therefore, that there were differences in condom use based on the partner's gender. For example, females may be less likely to use barrier protection during sex with females, whereas males may be more likely to use barrier protection during sex with males. Goodenow et al. reported from a statewide survey that adolescent males who have sex only with females or only with males were more likely to use condoms than adolescent males who had both male and female partners.[27]

Rich information about language used to describe sexuality and gender was obtained through pilot testing. This testing indicated the need for a sexual orientation category of pansexuality in addition to traditionally used categories such as heterosexual (straight), homosexual (gay or lesbian), or bisexual. Self-described pansexual young people rejected conventional gender

and sexual orientation labels in favor of this term that they felt more appropriately encompassed an inclusive sexual attraction to people from all genders and sexual orientations. Pansexuality, also known as omnisexuality, has been described by Lenning as the possibility of attraction across the gender identity spectrum.[28]

A trend toward changing views and perceptions of sexuality and orientation seems particularly evident among young adults, as discussed in a recent article by Russell et al., who suggest that contemporary adolescents may be espousing a "post-gay" orientation or sexual experience.[29] The implications of sexual identity on HIV risk can drastically change prevention and safer sex messaging, and young people accessing these services must feel that their unique identities are not just taken into consideration, but acknowledged and respected. Programs need to reassess their approaches to addressing sexuality and the sexual orientation spectrum to create a foundation of trust and safety for young people who may identify in nontraditional ways, so that our institutional systems do not become barriers in and of themselves for young people accessing the services they need in a manner that is respectful to their identities.

Finally, the current study identified a high proportion of young adults who self-identified as "travelers," also known as "nomads"[30] or homeless people who regularly move between cities. We observed a trend toward an increased risk of unprotected sex among participants who self-identified as travelers, a finding that is consistent with other research. For example, a recent study showed that nomadic homeless young people in New York City reported less frequent condom use with their serious partners compared with service-connected young people. Nomadic young people were also more likely to have injected drugs (recent and lifetime) and consumed more alcohol than service-connected homeless young people.[30] It is likely that the conventional venue-based strategies to reach homeless young people for HIV prevention would need modification to target this highly mobile group. One possible future study would be to longitudinally follow this traveling population to capture qualitative data about their experiences with respect to accessing services, issues of stigma, acceptance by their peers, evolution of their identities, and changes to their risk and protective factors over time.

Limitations

The current study should be interpreted in light of several limitations. First, we used a convenience sample of homeless young adults who were already engaged in homeless youth services. These young people are likely better connected with homeless services and may have different risk behaviors than those not engaged in services. Furthermore, social response bias may have occurred because of interviewer-administered surveys. However, computer-assisted self-interviewing was impractical given the venues in which the interviews were administered. Results also may not be generalizable to all homeless young adults. However, survey responses indicate that this group is at high risk for HIV infection, so results may be generalizable to other high-risk homeless young adult populations.

Second, we were unable to confirm HIV results in two participants with preliminary positive rapid HIV test results. Both participants, however, were engaged in services with CBO partners, who facilitated engagement in additional health care outside the context of the current study. Third, our interview items did not assess whether recent unprotected sex occurred with males, females, or transgendered partners; obtaining this information would have provided more information regarding HIV risk. Finally, the small sample size of this pilot study had limited power to detect statistically significant differences in trends between some participant characteristics (e.g., traveler status) and risky sexual behaviors.

CONCLUSIONS

Since study completion, a Cochrane Review highlighting the variability in programming and outcomes for preventing HIV in homeless young people pointed to the uncertainty inherent in designing effective HIV prevention intervention programs.[31] Our findings support the need for enhanced HIV prevention interventions for homeless young adults that particularly target females, those in sexual minority groups, travelers, depressed people, and alcohol users, and include enhanced education specific to reducing behaviors that put young adults at risk, as well as realistic HIV risk prevention tools. This research provides descriptive characteristics and information regarding HIV risk behaviors for a segment of homeless young people in Portland that may be cautiously generalized to other high-risk homeless young adult populations. Results from this study provide valuable updated information to CBOs and researchers as well as policy makers targeting young adult sexual health.

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The Institutional Review Board of the Oregon Health & Science University reviewed and approved the protocol for this study. All participants provided informed written consent for study participation and informed oral consent for human immunodeficiency virus testing, consistent with Oregon State statutes.

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HIV Screening Practices and Hospital Characteristics in the U.S., 2009–2010

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ABSTRACT

Objectives. The Centers for Disease Control and Prevention recommends HIV screening in U.S. health-care settings unless providers document a yield of undiagnosed HIV infections of <1 per 1,000 population. However, implementation of this guidance has not been widespread and little is known of the characteristics of hospitals with screening practices in place. We assessed how screening practices vary with hospital characteristics.

Methods. We used a national hospital survey of HIV testing practices, linked to HIV prevalence for the county, parish, borough, or city where the hospital was located, to assess HIV screening of some or all patients by hospitals. We used multivariate logistic regression analysis to assess the association between screening practices and hospital characteristics that were significantly associated with screening in bivariate analyses.

Results. Of 376 hospitals in areas of prevalence ≥0.1%, only 25 (6.6%) reported screening all patients for HIV and 131 (34.8%) reported screening some or all patients. Among 638 hospitals included, screening some or all patients was significantly ($p<0.05$) more common at teaching hospitals, hospitals with higher numbers of annual admissions, and hospitals with a high proportion of Medicaid admissions. In multivariable analysis, screening some or all patients was independently associated with admitting more than 15% of Medicaid patients and receiving resources or reimbursement for screening tests.

Conclusion. We found that few hospitals surveyed reported screening some or all patients, and failure to screen is common across all types of hospitals in all regions of the country. Expanded reimbursement for screening may increase compliance with the recommendations.

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Of the 1.2 million people in the United States who are infected with human immunodeficiency virus (HIV), it is estimated that 20% are unaware of their infection.[1] Early diagnosis of HIV infection allows infected people to obtain treatment that can prolong the quality and duration of their lives and can lead to reductions in high-risk behaviors and HIV transmission.[2–8] More generally, HIV infection satisfies the usual criteria for routine screening for infectious disease: it is a serious health disorder that can be diagnosed before symptoms appear; it can be detected by a reliable, noninvasive test; there are great potential health benefits to early detection; and the benefits of detection are large relative to the cost of screening.[9] For these reasons, and to reduce the number of undiagnosed people living with HIV, in 2006 the Centers for Disease Control and Prevention (CDC) recommended HIV screening in all health-care settings for all individuals aged 13–64 years, regardless of risk, seen at facilities with an HIV prevalence of undiagnosed infections ≥0.1% among a sample of patients, and annual screening for patients known to be at risk for HIV infection.[10]

Previous research has shown that the teaching status and size of hospitals, as well as the region and type of metropolitan area in which they are located, are associated with the availability of HIV testing in hospitals.[11] However, there are few published data about hospital characteristics that are associated with the adoption of CDC's revised testing recommendations, and existing studies do not consider the impact of external factors, such as state regulations or third-party reimbursement policies, that might influence whether hospitals adopt the testing guidelines. Also unknown is how the screening practices of hospitals that serve larger proportions of low-income and minority patients compare with the practices of other hospitals.

To address these open questions, we assessed the association between characteristics of hospitals and adoption of CDC's revised recommendations for HIV testing in health-care settings using data from a national hospital survey of HIV testing practices in 2009. The results of that national survey, comparing responses in 2009 with those from 2004, have been previously reported.[12] However, that report did not consider factors that might influence screening practices, such as county HIV prevalence, information on state HIV testing regulations, and information on the percentage of admissions of low-income and minority patients at participating hospitals.

METHODS

Sample

In 2009–2010, a national survey of HIV testing was sent to a random sample of 1,500 nonfederal general medical and surgical hospitals within the U.S. selected from the 4,554 hospitals in the 2006 American Hospital Association (AHA) Annual Survey database.[12] Infection-control practitioners from 754 (50.2%) hospitals responded. We obtained data on HIV prevalence by county, parish, borough, or city ("area") from CDC's national HIV surveillance system,[13] and each hospital was linked to the rate corresponding to the area in which it is located based on its address in the AHA Survey database. HIV prevalence rates are not reported for areas with fewer than five cases or with populations of <100 people. In addition, rates are not available for all states or areas; we excluded hospitals that could not be linked to available HIV prevalence data (n=116).

Variables

The primary outcome for this study was whether a hospital reported screening some or all patients for HIV. The current CDC recommendations for HIV testing in health-care settings only apply to providers serving patient populations with prevalence of undiagnosed infection ≥0.1%.[3] As we did not have rates of undiagnosed HIV infection at the provider level, we categorized each hospital according to the HIV prevalence in the area in which the hospital was located. Although the national HIV prevalence rate is estimated to be approximately 0.5%,[14] our random sample of hospitals was not stratified on population, leading to overrepresentation of small rural hospitals when compared with the number of patients in rural areas. As such, we had few hospitals in areas with HIV prevalence >0.5%; instead, we used strata of <0.1%, 0.1%–0.3%, and >0.3%.

Hospital characteristics included the following variables from the 2009 AHA Survey: metropolitan status (urban—defined as division, metropolitan, or micropolitan—or rural), teaching status (member of Council of Teaching Hospitals, having a residency program, or neither), ownership (public, private nonprofit, or private for profit), geographic U.S. Census region (Northeast: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; Midwest: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin; South: Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Texas, Virginia, Washington, D.C., and West Virginia; and West: Alaska,

Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming), total admissions per year (classified as ≤3,500, 3,501–10,000, and >10,000) after examining the distribution of hospitals, to create roughly equal-sized groups), and percentage of admissions that were Medicaid patients (classified as ≤15% vs. >15%, the approximate median).

We considered four additional independent variables. One variable was whether hospitals reported that they had an opt-out policy for HIV testing (i.e., hospitals performed testing unless patients specifically declined to be tested). A second variable was whether laws of states in which hospitals are located required separate written consent for HIV testing. We classified hospitals according to whether their state laws did not require separate consent prior to 2009, were modified to no longer require separate consent during 2009, or required separate consent as of the end of 2009.[15] A third variable we considered was whether hospitals reported receiving any type of third-party reimbursement for HIV screening. We classified a hospital as receiving reimbursement for screening if it reported that it "received funding, resources, or in-kind support from external organizations (e.g., local or state health departments, federal departments, and private foundations) to support HIV testing" or that it "received reimbursement from third-party payers (e.g., Medicaid, Medicare, or private insurance plans) for HIV tests that are performed *for screening purposes*" (emphasis in the survey). The fourth variable was the percentage of African American patients served by hospitals. Because data on the racial/ethnic distribution of people admitted to participating hospitals were not available, we used the percentage of African Americans among the Medicare admissions to the hospital, based on the 2007 Medicare Provider Analysis and Review file, as a proxy for the percentage of African Americans admitted to the hospitals. After examining the distribution of the primary outcome over deciles of this variable, we categorized the percentage of African Americans among Medicare admissions as either ≤40% or >40%.

Statistical analysis

We summarized hospital characteristics and their HIV screening practices and used Chi-square tests to compare characteristics of surveyed hospitals with and without prevalence data. For the primary outcome, we summarized the results by prevalence category; we also examined screening practices according to whether the hospital reported having an opt-out policy. To examine the bivariate association between independent variables and the primary outcome, we fit a series of logistic regression models. Then, to determine which hospital factors were independently associated with hospitals adopting HIV screening practices, we fit a multivariate logistic regression model that included all independent variables associated with screening some or all patients at $p<0.05$ on bivariate analysis. To determine if any of the independent effects were attenuated by the proportion of patients treated who were African American, we fit this final model with and without the percentage of African Americans among Medicare admissions as an independent variable. Because area HIV prevalence likely does not reflect the true rate of undiagnosed HIV at a given hospital, we replicated all analyses using only those hospitals in counties of prevalence ≥0.25% as a sensitivity analysis. Finally, because Medicaid is a potential source of reimbursement, we assessed whether there was an interaction effect between the Medicaid and reimbursement variables.

Hospitals missing data on screening practices ($n=38$) were omitted from analyses of screening practices. We used multiple imputation with 30 imputations to account for missing values for percentage African American ($n=5$ missing values) and third-party reimbursement ($n=79$ missing values).[16,17] We calculated Wald tests for multiple category variables.[18] We performed all analyses using Stata® version 12,[19] with $p<0.05$ considered statistically significant.

RESULTS

Of the 754 hospitals surveyed, area HIV prevalence data were available for 638 (84.6%) hospitals. The characteristics of surveyed hospitals are shown in Table 1. Hospitals lacking prevalence data and excluded from this analysis were less often teaching and for-profit hospitals and more often in the Midwest, with fewer admissions, and in rural areas than hospitals with prevalence data (all $p<0.001$). Hospitals included in the analysis were predominantly nonteaching (80.9%), private not for profit (66.5%), and urban (82.8%); the median area HIV prevalence per 1,000 population for the 638 hospitals was 0.13% (interquartile range 0.07, 0.29).

HIV screening practices

The HIV screening practices of participating hospitals are shown in Table 2. Among the 638 included hospitals, 35 (5.8%) reported screening all patients and 157 (26.2%) reported screening some patients. Of 376 hospitals in areas with HIV prevalence ≥0.1%, only 25 (6.6%) reported screening all patients for HIV and only 11 of 153 (7.5%) hospitals in areas with HIV prevalence >0.3% reported screening all patients; the corresponding numbers for screening some or all

Table 1. Characteristics of hospitals (*n*=754) included in a 2009–2010 survey of HIV testing practices in the U.S.

Characteristic	*Included in analysis (prevalence data present)* N *(percent)*	*Not included in analysis (no prevalence data)* N *(percent)*	P-*value*[a]
Total	638 (100.0)	116 (100.0)	
Teaching hospital			<0.001
No	516 (80.9)	112 (96.6)	
Yes	122 (19.1)	4 (3.4)	
Ownership			<0.001
Private not for profit	424 (66.5)	63 (54.3)	
Private for profit	74 (11.6)	48 (41.4)	
Public	140 (21.9)	5 (4.3)	
Annual admissions			<0.001
≤3,500	250 (39.2)	106 (91.4)	
3,501–10,000	181 (28.4)	6 (5.2)	
>10,000	207 (32.4)	4 (3.4)	
Region[b]			<0.001
Northeast	112 (17.6)	7 (6.0)	
Midwest	198 (31.0)	71 (61.2)	
South	245 (38.4)	17 (14.7)	
West	83 (13.0)	21 (18.1)	
Area			<0.001
Rural	110 (17.2)	89 (76.7)	
Urban	528 (82.8)	27 (23.3)	
State HIV testing regulations compatible with CDC revised recommendations[c]			0.922
Not	84 (13.2)	16 (13.8)	
Changed in 2009 to be compatible	97 (15.2)	19 (16.4)	
Yes	457 (71.6)	81 (69.8)	
Percentage of Medicaid admissions			<0.001
≤15%	460 (72.1)	75 (64.7)	
>15%	178 (27.9)	41 (35.3)	
Medicare percent African American[d]			0.370
≤40%	597 (93.6)	110 (94.8)	
>40%	35 (5.5)	4 (3.4)	
HIV prevalence per 1,000 population			<0.001
Mean percent (SD)	0.23 (0.30)		
Median percent (interquartile range)	0.13 (0.07, 0.29)		

[a]*P*-value based on Chi-square test of independence

[b]Northeast includes Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. Midwest includes Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. South includes Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Texas, Virginia, Washington, D.C., and West Virginia. West includes Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

[c]Compatible regulations are those that allow hospitals to perform HIV testing after obtaining general consent for medical care and not specific consent for HIV testing.

[d]Percentages are based on hospitals with nonmissing data on race.

HIV = human immunodeficiency virus

CDC = Centers for Disease Control and Prevention

SD = standard deviation

patients were 131 out of 376 (34.8%) for hospitals in areas with HIV prevalence ≥0.1% and 60 out of 153 (39.2%) for hospitals in areas with HIV prevalence >0.3%. Of the 131 hospitals in areas with prevalence ≥0.1% that reported screening some or all patients for HIV, 52 (39.7%) reported having opt-out screening; of the 60 hospitals in areas with prevalence >0.3% that reported screening some or all patients for HIV, 22 (36.7%) reported having opt-out screening (data not shown). Ninety-six (25.5%) hospitals located in areas with HIV prevalence ≥0.1% reported performing opt-out HIV screening, whereas 37 (24.2%) hospitals

Table 2. HIV screening practices in hospitals (*n*=638) participating in a 2009–2010 survey of HIV testing practices in the U.S., by area[a] HIV prevalence

		Area[a] HIV prevalence			
HIV testing practice	*All* N *(percent)*	*<0.1%* N *(percent)*	*0.1%–0.3%* N *(percent)*	*>0.3%* N *(percent)*	P-*value*[b]
Total	638 (100.0)	262 (100.0)	223 (100.0)	153 (100.0)	
HIV screening performed[c]					0.061
No	397 (66.2)	175 (73.2)	139 (65.0)	83 (56.5)	
Yes	35 (5.8)	10 (4.2)	14 (6.5)	11 (7.5)	
Yes, some	157 (26.2)	51 (21.3)	57 (26.6)	49 (33.3)	
Don't know	11 (1.8)	3 (1.3)	4 (1.9)	4 (2.7)	
Opt-out screening performed					0.839
No	478 (74.9)	198 (75.6)	164 (73.5)	116 (75.8)	
Yes	160 (25.1)	64 (24.4)	59 (26.5)	37 (24.2)	
Screening performed in ED[c]					<0.001
No	508 (88.8)	214 (93.0)	184 (90.2)	110 (79.7)	
Yes	64 (11.2)	16 (7.0)	20 (9.8)	28 (20.3)	
Screening performed in inpatient units[c]					0.024
No	514 (89.9)	214 (93.0)	185 (90.7)	115 (83.3)	
Yes	57 (10.0)	16 (7.0)	19 (9.3)	22 (15.9)	
Don't know	1 (0.2)	0 (0.0)	0 (0.0)	1 (0.7)	
Screening performed in LD[c]					0.007
No	403 (70.3)	178 (76.7)	141 (69.1)	84 (61.3)	
Yes	170 (29.7)	54 (23.3)	63 (30.9)	53 (38.7)	
Screening performed in primary care clinic(s)[c]					0.176
No	469 (87.8)	199 (90.0)	165 (89.2)	105 (82.0)	
Yes	59 (11.0)	20 (9.0)	19 (10.3)	20 (15.6)	
Don't know	6 (1.1)	2 (0.9)	1 (0.5)	3 (2.3)	
Screening performed in urgent care[c]					0.051
No	467 (91.0)	200 (93.9)	164 (91.6)	103 (85.1)	
Yes	43 (8.4)	12 (5.6)	15 (8.4)	16 (13.2)	
Don't know	3 (0.6)	1 (0.5)	0 (0.0)	2 (1.7)	
Screening performed in substance abuse clinic(s)[c]					0.017
No	425 (89.3)	183 (92.9)	152 (89.4)	90 (82.6)	
Yes	47 (9.9)	13 (6.6)	18 (10.6)	16 (14.7)	
Don't know	4 (0.8)	1 (0.5)	0 (0.0)	3 (2.8)	

[a]"Area" refers to a county, borough, parish, or (Virginia only) city.

[b]*P*-value is for Chi-square test of independence of prevalence rate category (0.1%–0.3% and >0.3%) and hospital characteristic (all hospitals with prevalence >0.1%).

[c]Does not total 638 because of missing or not applicable responses

HIV = human immunodeficiency virus

ED = emergency department

LD = labor and delivery

located in areas with prevalence >0.3% reported performing opt-out HIV screening. Among the 96 hospitals in areas with HIV prevalence ≥0.1% that reported opt-out screening, 52 (54.2%) screened some or all patients. For emergency departments, inpatient units, labor and delivery, and substance abuse clinics, screening was significantly more likely in higher prevalence areas ($p<0.05$ for all).

Bivariate and multivariate analyses

Bivariate associations of hospital characteristics with screening practices are shown in Table 3. Screening some or all patients was more common in teaching hospitals than in nonteaching hospitals, in hospitals with >10,000 annual admissions (vs. those with ≤10,000 admissions), in urban (vs. rural) hospitals, in hospitals with >40% African Americans among Medicare admissions (vs. ≤40% African American Medicare admissions), and in hospitals that reported receiving reimbursement for HIV screening (vs. no reimbursement).

Table 3. Bivariate analysis of characteristics associated with screening some or all patients in hospitals (*n*=638) participating in a 2009–2010 survey of HIV testing practices in the U.S.

	Screen some or all vs. screen none		
Characteristic	*OR (95% CI)*	P-*value*	*Wald* p-*value*
Teaching hospital			<0.001
No	Ref.		
Yes	2.37 (1.58, 3.56)	<0.001	
Ownership			0.070
Private not for profit	Ref.		
Private for profit	1.01 (0.59, 1.70)	0.984	
Public	0.60 (0.38, 0.93)	0.023	
Annual admissions			<0.001
≤3,500	Ref.		
3,501–10,000	1.84 (1.18, 2.86)	0.007	
>10,000	2.97 (1.96, 4.51)	<0.001	
Region[a]			0.244
Northeast	Ref.		
Midwest	1.07 (0.65, 1.77)	0.790	
South	0.81 (0.50, 1.33)	0.406	
West	1.37 (0.75, 2.49)	0.306	
Area			0.003
Rural	Ref.		
Urban	2.17 (1.30, 3.65)	0.003	
Percentage Medicaid admissions			<0.001
≤15%	Ref.		
>15%	1.92 (1.34, 2.73)	<0.001	
Medicare percentage African American			0.003
≤40%	Ref.		
>40%	2.86 (1.43, 5.68)	0.003	
State HIV testing regulations compatible with CDC revised recommendations[b]			0.088
No	Ref.		
Changed to be compatible in 2009	1.12 (0.57, 2.24)	0.738	
Yes	1.65 (0.96, 2.86)	0.071	
Receives reimbursement			<0.001
No	Ref.		
Yes	2.62 (1.78, 3.86)	<0.001	
Area[c] HIV prevalence (per 0.1% increase)	1.10 (1.04, 1.16)	0.001	

[a]Northeast includes Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. Midwest includes Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. South includes Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Texas, Virginia, Washington, D.C., and West Virginia. West includes Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

[b]Compatible regulations are those that allow hospitals to perform HIV testing after obtaining general consent for medical care and not specific consent for HIV testing.

[c]"Area" refers to a county, borough, parish, or (Virginia only) city.

HIV = human immunodeficiency virus

OR = odds ratio

CI = confidence interval

Ref. = reference group

The likelihood that a hospital screened some or all patients also increased with increasing HIV prevalence, with the probability increasing about 1% for each 0.1% increase in area HIV prevalence.

In multivariate analysis, only the percentage of Medicaid admissions and receipt of third-party reimbursement for HIV screening were independently associated with screening some or all patients in models that did and did not include as a covariate the percentage of African American patients among the Medicare admissions (Table 4). When we included a term for the interaction of percentage Medicaid and

reimbursement status in our models, we found no interaction effect ($p>0.7$ for both models); as such, the term was not included in the final models. Sensitivity analyses restricted to the 191 hospitals in areas with prevalence ≥0.25% gave similar results: in bivariate analysis, screening some or all patients was more common in teaching hospitals than in nonteaching hospitals, in hospitals with high annual admissions vs. those with annual admissions of ≤10,000, in hospitals with >40% African American Medicare admissions (vs. those with ≤40% African American Medicare admissions), and in hospitals receiving reimbursement (vs. no reimbursement), while in the multivariable model including these factors, only reimbursement was significantly associated with the outcome.

DISCUSSION

In this first study of factors associated with hospital adoption of CDC's revised recommendations for HIV testing in health-care settings in the U.S., we found that among 638 hospitals with HIV prevalence data, only 32.0% screened some or all patients, and that of 376 hospitals located in areas with area HIV prevalence ≥0.1%, approximately the same percentage reported screening some or all of their patients. In general, among these hospitals, the failure to screen was common across all categories of hospitals, while about one-quarter of hospitals reported having an opt-out policy regardless of area HIV prevalence.

These results add to those of the previous report of this survey by Voetsch et al., who used the full sample of survey respondents and found that 27.3% screened for HIV in at least one department. The authors also found that screening was more likely to occur in larger

Table 4. Multivariate analysis of characteristics associated with screening some or all patients in hospitals (*n*=638) participating in a 2009–2010 survey of HIV testing practices in the U.S.

	Model 1[a] *Screen some or all*			*Model 2*[b] *Screen some or all*		
	OR (95% CI)	*P-value*	*Wald p-value*	*OR (95% CI)*	*P-value*	*Wald p-value*
Teaching hospital			0.357			0.393
No	Ref.			Ref.		
Yes	1.27 (0.76, 2.13)	0.357		1.25 (0.75, 2.10)	0.000	
Annual admissions			0.117			0.093
≤3,500	Ref.			Ref.		
3,501–10,000	1.42 (0.86, 2.36)	0.175		1.44 (0.87, 2.40)	0.156	
>10,000	1.81 (1.03, 3.17)	0.039		1.86 (1.06, 3.27)	0.030	
Area			0.417			0.333
Rural	Ref.			Ref.		
Urban	1.29 (0.70, 2.38)	0.417		1.36 (0.73, 2.51)	0.333	
Percentage Medicaid admissions			<0.001			0.001
≤15%	Ref.			Ref.		
>15%	2.02 (1.37, 2.98)	0.000		1.96 (1.33, 2.90)	0.001	
Medicare percentage African American						0.054
≤40%				Ref.		
>40%				2.23 (0.99, 5.02)	0.054	
Receives reimbursement			<0.001			<0.001
No	Ref.			Ref.		
Yes	2.59 (1.70, 3.97)	0.000		2.57 (1.68, 3.95)	0.000	
Area[c] HIV prevalence (per 0.1% increase)	1.03 (0.97, 1.09)	0.372		1.00 (0.94, 1.07)	0.885	

[a]Includes the variables shown with significant bivariate association except for Medicare percentage African American

[b]Includes Medicare percentage African American

[c]"Area" refers to a county, borough, parish, or (Virginia only) city.

HIV = human immunodeficiency virus

OR = odds ratio

CI = confidence interval

Ref. = reference group

hospitals, urban hospitals, and teaching hospitals, with the lowest screening rates at public hospitals.[12] We examined a smaller set of hospitals—those with available HIV prevalence data, with a focus on the subset of those in areas of ≥0.1% HIV prevalence—and used a different outcome, "screening some or all patients," but found similar bivariate results. However, results of our multivariable analysis indicated that these associations disappear after adjusting for percentage of Medicaid patients and the availability of outside resources or reimbursement to support screening.

In the current study, several characteristics of hospitals were associated with screening some or all patients in the bivariate analysis: teaching hospitals, those in urban areas, those with higher annual admissions, those reporting being reimbursed for screening, and those with higher percentages of Medicaid and African American Medicare patients. However, of these factors, only receipt of resources or reimbursement for HIV screening and having Medicaid patients account for ≥15% of admissions were independently associated with an increased likelihood of screening some or all patients.

The association between third-party resources or reimbursement for screening tests and report of screening some or all patients indicates that cost may be an important barrier to testing. This finding is consistent with prior studies that have surveyed providers concerning the barriers to HIV screening.[20,21] It is not surprising that hospitals are more likely to screen patients if they are reimbursed for some or all of the costs associated with HIV testing, but it is notable that this factor was more important than all other factors except the percentage of Medicaid patients admitted. While hospitals were not asked to identify the source of reimbursement, it is known that Medicaid programs offer different levels of reimbursement in different states, with some state Medicaid programs reimbursing for screening.[22] Other possible sources of reimbursement mentioned in the survey question are Medicare, private insurers, local municipalities, and state and local health departments.[23] In 2010, Medicare adopted a policy of payment for screening of high-risk patients; while this policy will largely apply to disabled patients and patients older than 65 years of age, it may influence hospital practices for other patients.[24] While the observational cross-sectional nature of the study design does not let us draw causal inferences, this finding indicates that policy makers who wish to increase HIV screening should consider lack of reimbursement as an important barrier.

Another notable finding, likely related to reimbursement for screening, is that hospitals with Medicaid admissions accounting for >15% of all admissions were more likely to screen patients for HIV. This finding may reflect Medicaid reimbursement policies, although the absence of an interaction effect between percentage of Medicaid admissions and reimbursement suggests that this effect is distinct from the effect of reimbursement. Similarly, while the correlation between percentage of Medicaid admissions and area HIV prevalence in our sample was positive (Spearman's correlation coefficient $r=0.29$, $p<0.05$), our models were adjusted for prevalence rate, indicating that the effect of having a high proportion of Medicaid patients is independent of prevalence.

Limitations

This study was subject to several limitations. First, this study was observational; therefore, any associations cannot be inferred to be causal. However, it does provide the first cross-sectional look at the association between the HIV screening practices of hospitals, the prevalence of HIV, the available reimbursement for HIV screening, and the low-income and minority status of patients seen by the hospital. Another limitation was that only about half of the hospitals responded to the survey, and there may be a correlation between the hospitals' characteristics and practices and their response to this survey. However, Voetsch et al. reported that respondents differed from nonrespondents only with respect to region (with the Northeast overrepresented) and ownership (with public hospitals underresponding), suggesting minimal response bias with respect to the outcome.[12] Similarly, the outcome was self-reported and of unknown accuracy; however, the surveys were completed in each hospital by the infection-control director, who might be more likely to overstate than understate screening practices, and overstatement would only bias our main finding toward the null.

There were several important limitations related to our use of HIV prevalence data. The greatest such limitation was that we did not have hospital-specific prevalence data—only area prevalence data—although CDC's revised recommendations for HIV testing in health-care settings apply to people with undiagnosed HIV infection who present for health care. There are no prevalence data for areas in which the population was fewer than 100 people; the number of HIV cases was fewer than five; and for all of Hawaii, Idaho, North Dakota, South Dakota, and Vermont. However, as there are few counties with populations of <100 people that also have hospitals, the first two of these restrictions likely had little effect on our results. The lack of data for five states was more problematic, but still allowed us to make estimates based on the majority of states. More importantly, there may be little relationship between area prevalence and the proportion of undiagnosed

cases seen at a hospital. Whereas in rural areas the county or parish rate may be well-correlated with undiagnosed prevalence, in urban areas there may be large differences in the prevalence of undiagnosed infection among people served by different hospitals in the same area.[25] This difference would have biased our results toward the null, and may explain why we found no relationship between prevalence and screening practices in multivariable analysis. Finally, it is important to note that contemporary with the CDC guidelines, the U.S. Preventive Services Task Force (USPSTF) issued HIV screening recommendations for all people at high risk for HIV infection (Grade A recommendation), but made no recommendation for or against routinely screening for HIV adolescents and adults who are not at increased risk (Grade C recommendation).[26] Many hospitals and/or payers may have elected to implement as their standard of practice only those recommendations with a grade of A or B from the USPSTF.

CONCLUSION

This study presents the first assessment of findings from a national survey of HIV testing practices that takes reported HIV prevalence rates into consideration. Few hospitals reported following CDC's recommendations for HIV screening in 2009, and failure to screen is common across all types of hospitals in all regions of the country. As a first step, hospitals should be encouraged to establish the HIV prevalence rate among their patient population to clarify if the guidelines apply. Lack of reimbursement may be an important barrier to screening, but other strategies also need to be identified to increase compliance with screening guidelines.

The findings and conclusions in this article are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention (CDC). The study protocol and survey instrument were approved by CDC's Institutional Review Board as research that does not involve identifiable human subjects.

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Cardiovascular Disease Among Black Americans: Comparisons Between the U.S. Virgin Islands and the 50 U.S. States

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ABSTRACT

Objectives. Consistent findings show that black Americans have high rates of cardiovascular disease (CVD) and related behavioral risk factors. Despite this body of work, studies on black Americans are generally limited to the 50 U.S. states. We examined variation in CVD and related risk factors among black Americans by comparing those residing within the U.S. Virgin Islands (USVI) with those residing in the 50 U.S. states and Washington, D.C. (US 50/DC) and residing in different regions of the US 50/DC (Northeast, Midwest, South, and West).

Methods. Using data from the 2007 and 2009 Behavioral Risk Factor Surveillance System, we compared CVD and CVD risk factor prevalence in non-Hispanic black people (≥20 years of age) in the USVI and US 50/DC, examining the relative contributions of health behaviors, health insurance, and socioeconomic status (SES).

Results. Accounting for age, sex, education, health insurance, and health behaviors, US 50/DC black Americans were significantly more likely than USVI black people to report ever having a stroke and coronary heart disease, and to be hypertensive, diabetic, or obese. While there was heterogeneity by region, similar patterns emerged when comparing the USVI with different regions of the US 50/DC.

Conclusion. USVI black people have lower CVD and risk factor prevalence than US 50/DC black people. These lower rates are not explained by differences in health behaviors or SES. Understanding health in this population may provide important information on the etiology of racial/ethnic variation in health in the U.S. and elsewhere, and highlight relevant public health policies to reduce racial/ethnic group disparities.

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Consistent findings show that black Americans have the highest rates of cardiovascular disease (CVD) compared with any other racial/ethnic group in the United States, seriously diminishing life expectancy and physical, social, and economic well-being throughout the life course.[1,2] Despite this large and rapidly growing body of work, studies on black Americans are largely limited to the 50 U.S. states and District of Columbia (hereafter called US 50/DC). Importantly, black Americans also reside in U.S. territories, and including these populations in health studies may provide a more thorough and nuanced picture of the factors associated with health and well-being among black Americans.

Previous research has shown that examining the association between race/ethnicity and health in sites outside of the US 50/DC allows us to better understand how race and context intersect to explain health.[3–5] Prior research indicates that CVD risk factor prevalence among individuals of African origin varies across regions of the U.S. and throughout the world.[3–15] For example, in a well-known international collaborative study on CVD of populations in the African diaspora (collected from 1991 to 1995), large variations in the prevalence of diabetes, body mass index (BMI), and hypertension were found.[6,11] Geographic variation in hypertension and stroke among black people in the US 50/DC has also been examined.[9,16] However, this work has not been extended to study black Americans in U.S. territories. We sought to fill an important gap in the literature by providing a comparative study of black Americans in the US 50/DC and the U.S. Virgin Islands (USVI).

Although the health of individuals of African origin in the US 50/DC is often compared with individuals of African origin born and/or living outside of U.S. boundaries, such as Nigeria and Jamaica, little is known about the health of black Americans residing in the USVI. This comparison group might help to refine our understanding of racial disparities in CVD within the U.S. context.

The USVI is a U.S. territory located in the Caribbean, and residents are predominantly black (76.2%).[17–20] Similar to the US 50/DC, many USVI black people are the descendants of slaves. However, unlike the rest of the U.S., slaves in the USVI were freed in 1848 following a slave revolt (while under the rule of Denmark), 17 years prior to emancipation in the U.S. The USVI was sold to the U.S. by Denmark in 1917.[21] The USVI comprises three main islands—St. Croix, St. Thomas, and St. John—with approximately 106,405 residents according to 2010 U.S. Census data.[22] Despite being U.S. citizens, the USVI population and its health have been largely overlooked in research, as well as in national policy and public health initiatives. In this study, we sought to answer two questions: (*1*) How does the CVD prevalence of black Americans in the US 50/DC compare with that of black Americans in the USVI?; and (*2*) If there are differences in CVD prevalence, what are the behavioral and sociodemographic mechanisms underlying these differences? Specifically, we examined the explanatory role of health behaviors, health insurance, and socioeconomic status (SES).

Our findings may provide some insight into the health of an understudied population that, while sharing a racial designation and national identity with black Americans in the US 50/DC, has significant cultural and historical differences. Furthermore, comparing U.S. populations that share racial characteristics but not necessarily sociocultural ones may illuminate the role of social context and place in physical health statuses and their determinants.

METHODS

The Behavioral Risk Factor Surveillance System (BRFSS) is an annual state-based, population-representative telephone health survey system of adults living in the US 50/DC, Puerto Rico, Guam, and the USVI. BRFSS data from 2007 and 2009 were combined to ensure that a sufficient number of USVI participants were included in these analyses. The Council of American Survey and Research Organizations' median response rate was 50.6% (53.3% in the USVI and ranging from 26.9%–65.4% in the U.S.) in 2007 and 52.5% (57.8% in the USVI and ranging from 37.9%–66.9% in the U.S.) in 2009.[23,24] Further BRFSS details are reported elsewhere.[25]

Of the 62,964 US 50/DC and 3,005 USVI 2007 and 2009 self-identified non-Hispanic black BRFSS participants ≥20 years of age, 4,109 (7.0%) US 50/DC and 179 (6.0%) USVI participants were excluded for missing data on one or more health outcomes or other covariates. Another 4,661 (7.4%) US 50/DC and 243 (8.1%) USVI participants were excluded for missing data on education, insurance status, or health behaviors. These exclusions left 54,194 US 50/DC and 2,583 USVI participants for these analyses. We used 2007 and 2009 data (as opposed to 2009–2010 or 2008–2009 data) because hypertensive status, one of our CVD outcomes, was only asked every other year in the BRFSS. Because our questions focused on the health of non-Hispanic black Americans, we did not include other U.S. territories (i.e., Puerto Rico and Guam) due to small sample sizes.

We examined US 50/DC vs. USVI differences in three CVD outcomes (hypertension, stroke, and

coronary heart disease [CHD]) and two CVD-related outcomes (obesity [BMI ≥30 kilograms per square meter, calculated from self-reported height and weight] and diabetes). All outcomes were self-reported. We adjusted for seven covariates: age (continuous), education (categorized as <high school, high school diploma or general equivalency diploma [GED], and >high school), current smoking, recommended physical activity (dichotomized as ≥20 minutes of vigorous activity at least three times a week or ≥30 minutes of moderate activity at least five times a week), heavy alcohol use (men: >2 drinks a day, women: >1 drink a day), recommended fruit and vegetable consumption (≥5 servings a day), and any kind of health insurance coverage.

We first evaluated the age-adjusted prevalence of all variables and tested for US 50/DC vs. USVI statistical differences using logistic regression. We then examined US 50/DC vs. USVI differences in the five health outcomes, sequentially adjusting for the seven covariates. Based on previous research showing heterogeneity in CVD outcomes among black people within the US 50/DC,[9,16,26] we also assessed differences in these outcomes between black people living in different regions of the US 50/DC (Northeast, Midwest, South, and West) and in the USVI. Regions are based on the U.S. Census definitions.[27] We conducted all analyses using SAS® version 9.2.[28]

RESULTS

USVI black people reported significantly lower levels of all CVD and CVD-related outcomes than US 50/DC black people (Table 1). For example, CHD and stroke prevalence were 1.7% and 1.6%, respectively, for USVI black people, but 3.7% and 4.0%, respectively, for US 50/DC black people. In addition, hypertension prevalence was 29.3% for USVI black people but 41.1% among US 50/DC black people. Differences were smaller but remained significant for diabetes and obesity. USVI black people were more likely than US 50/DC black people to lack a high school diploma/GED and to be without health insurance. USVI black people were more likely than US 50/DC black people to consume recommended levels of fruit and vegetables, and they were less likely to be current smokers. There were no differences in physical activity or heavy alcohol use between USVI and US 50/DC black people.

Findings were similar when we compared US 50/DC black people across different regions with USVI black people (Table 2). There were significant overall differences by U.S. area of residence for all CVD and CVD-related outcomes as well as insurance status and education. One notable difference for health behaviors was that while there was no significant difference in physical activity between USVI and US 50/DC black people, we found that black people living in the West were substantially more likely to report meeting recommended levels of physical activity than black people living in the other areas of the U.S. (17.9% in the West vs. 10.8%–12.4% in the other regions and the USVI).

After adjusting for age, sex, and education, US 50/DC black people were 2.37 (95% confidence interval [CI] 1.63, 3.43) times as likely to have CHD compared with USVI black people (Table 3). These lower odds for USVI black people were somewhat attenuated after adjusting for health behaviors, obesity, hypertension, and diabetes (odds ratio [OR] = 1.66; 95% CI 1.14, 2.43), but the difference remained significant. As with CHD, US 50/DC black people were significantly more likely to have had a stroke compared with USVI black people (age-, sex-, and education-adjusted OR=2.81; 95% CI 1.93, 4.08), and this difference was only partially

Table 1. Age-adjusted prevalence of CVD and risk factors for non-Hispanic black adults ≥20 years of age among U.S. and USVI residents: Behavioral Risk Factor Surveillance System, U.S., 2007 and 2009

CVD and risk factors	*U.S. (n=54,194) Percent*	*USVI (n=2,583) Percent*
CVD outcomes[a]		
Coronary heart disease	3.7	1.7[b]
Stroke	4.0	1.6[b]
Hypertension	41.1	29.3[b]
CVD-related outcomes[a]		
Diabetes	14.9	10.4[b]
Obesity	38.6	32.1[b]
CVD risk factors		
<High school education	12.5	18.4[b]
No health insurance	19.9	25.6[b]
Health behaviors		
Heavy alcohol use	3.2	3.0
Recommended fruit and vegetable intake	23.1	30.3[b]
Recommended physical activity	11.6	11.2
Current smoker	20.5	4.1[b]

[a]Prevalence of all outcomes, with the exception of obesity (calculated from self-reported height and weight), were based on self-reported history of diagnosis from a doctor. Characteristics were weighted using weights provided by the Behavioral Risk Factor Surveillance System.

[b]$p<0.05$ for the U.S. vs. USVI difference based on a logistic regression model additionally adjusted for age

CVD = cardiovascular disease

USVI = U.S. Virgin Islands

Table 2. Age-adjusted prevalence of CVD and risk factors for non-Hispanic black adults ≥20 years of age among U.S. and USVI residents, by U.S. area of residence: Behavioral Risk Factor Surveillance System, U.S., 2007 and 2009

	U.S. (n=54,194)				*USVI (n=2,583)*
CVD and risk factors	*Northeast Percent*	*Midwest Percent*	*South Percent*	*West Percent*	*Percent*
CVD outcomes[a]					
Coronary heart disease	3.7	4.4	3.5	3.5	1.7[b]
Stroke	3.9	4.3	4.0	3.3	1.6[b]
Hypertension	38.0	41.5	42.3	37.4	29.2[b]
CVD-related outcomes[a]					
Diabetes	14.9	14.2	15.5	12.0	10.4[b]
Obesity	34.9	39.2	39.5	36.8	32.2[b]
CVD risk factors					
<High school education	11.1	11.8	13.7	7.0	18.3[b]
No health insurance	15.1	19.1	22.1	16.1	25.7[b]
Health behaviors					
Heavy alcohol use	2.9	3.5	3.0	5.4	3.0
Recommended fruit and vegetable intake	26.1	21.5	22.1	25.8	30.3[b]
Recommended physical activity	10.8	12.4	11.0	17.9	11.3[b]
Current smoker	20.7	24.6	19.2	22.8	4.1[b]

[a]Prevalence of all outcomes, with the exception of obesity (calculated from self-reported height and weight), were based on self-reported history of diagnosis from a doctor. Characteristics were weighted using weights provided by the Behavioral Risk Factor Surveillance System.

[b]$p<0.05$ for test of overall association between U.S. area of residence (Northeast, Midwest, South, West, and USVI) and each of the covariates, based on a logistic regression model additionally adjusted for age

CVD = cardiovascular disease

USVI = U.S. Virgin Islands

explained by adjusting for covariates (fully adjusted OR=2.13; 95% CI 1.45, 3.12). While the magnitude of the associations was weaker, USVI black people were also significantly less likely to be hypertensive, diabetic, or obese compared with US 50/DC black people after adjusting for age, sex, and education. These differences were not explained after adjusting for insurance status or health behaviors. In supplemental analysis (data not shown), we also included interactions between US 50/DC and education to determine whether socioeconomic patterning of health outcomes was different for US 50/DC compared with USVI black people, but none of these interactions were significant ($p>0.05$).

While there is heterogeneity by region, US 50/DC black people in all regions were more likely to have adverse CVD and CVD-related outcomes compared with USVI black people (Table 4). In fully adjusted models, ORs for CHD comparing US 50/DC and USVI black people ranged from 1.98 (95% CI 1.14, 3.47) for black people in the West to 2.53 (95% CI 1.69, 3.77) for black people in the Midwest. Black people living in all regions of the US 50/DC were more than twice as likely to have had a stroke compared with USVI black people. Black people living in the US 50/DC were between 1.50 (West: 95% CI 1.19, 1.88) and 1.88 (South: 95% CI 1.66, 2.13) times as likely to be hypertensive and between 1.19 (Northeast: 95% CI 1.03, 1.39) and 1.45 (South: 95% CI 1.29, 1.64) times as likely to be obese. Black people living in the South, the Northeast, and the Midwest were significantly more likely to be diabetic than USVI black people. However, differences between black people living in the West and USVI black people were not significant (OR=1.29; 95% CI 0.95, 1.74).

DISCUSSION

The results of this study revealed that USVI black people have better cardiovascular health profiles and healthier lifestyles than their US 50/DC counterparts, despite having lower education and health insurance coverage. While there was some heterogeneity by region, similar patterns emerged when comparing the USVI with different regions of the US 50/DC. In fact, CVD differences were largely unchanged after accounting for health behaviors or SES, suggesting that there may be contextual factors, both social and physical, that influence these differences in health behaviors and CVD outcomes among black people living in the US 50/DC and the USVI.

The results support the notion that the black race is a fluid construct. This notion is a critical consideration given that being categorized as black is generally treated as a static risk factor for disease and given its persistent relation to poor health,[29,30] even after considering SES, health-care coverage, and health behaviors. This trend in the literature presents significant challenges to the implementation of policies and interventions that could improve health within the diverse black American population.[11,31] A growing body of research provides evidence of the contextual nature of racial-group categorization, revealing that the health of individuals of African origin, particularly CVD risk factor prevalence, varies across regions of the U.S. and throughout the world.[3–14] These within-group differences among black people in different national and cultural contexts highlight the importance of sociostructural determinants of health that can most effectively be addressed at local and national policy levels to reduce racial/ethnic health disparities in the U.S. and elsewhere and to improve the health of black Americans specifically.

Given the increasingly well-documented health consequences of racial discrimination and other forms of social marginalization, such as segregation, one plausible explanation for the present findings is that the unique sociodemographic context of the USVI (i.e., majority black at 76.2%) compared with the US 50/DC (only 12.6% black people[32]) reduces the incidence of racialized experiences of chronic stress and stigma, which may, in turn, differentially influence health behaviors and outcomes.[33–36] The majority of the USVI population is black, possibly making racial residential segregation—and its consequent social, economic, and political marginalization—less prevalent and experiences with racial discrimination less likely. Thus, these stressors associated with poor physical and mental health may be less prevalent and salient in the USVI than in the US 50/DC.[35,36]

It is also possible that the unique sociohistorical differences in the understanding of race and racial identity differ for USVI black people. As discussed previously, slavery in the USVI was abolished in 1848 while under Danish rule, 17 years prior to the abolition of slavery in the continental U.S.[21] Therefore, USVI black people may have a longer legacy of leadership positions and some level of economic freedom than US 50/DC black people. In addition, because the Danish slave trade was abolished in the early 19th century (1803), slave health and health care became a central concern for plantation owners and colonial administrators in the Danish West Indies, who were trying to reduce the high mortality rates of slaves who could not be replaced with additional slaves from Africa.[37] Due to these economic reasons, there may have been a more established infrastructure serving the basic health needs of this population of black people that was not available in the continental U.S. until considerably later.

Research comparing Caribbean-born black people currently residing in the U.S. with native-born black

Table 3. Odds ratios of CVD and CVD-related outcomes for U.S. vs. USVI (reference group) non-Hispanic black adults: Behavioral Risk Factor Surveillance System, U.S., 2007 and 2009

Outcome	*Model 1*[a] *OR (95% CI)*	*Model 2*[b] *OR (95% CI)*	*Model 3*[c] *OR (95% CI)*	*Model 4 OR (95% CI)*
Coronary heart disease	2.37 (1.63, 3.43)	2.33 (1.60, 3.38)	2.11 (1.45, 3.07)	1.66 (1.14, 2.43)[d]
Stroke	2.81 (1.93, 4.08)	2.78 (1.91, 4.03)	2.47 (1.66, 3.68)	2.13 (1.45, 3.12)[d]
Hypertension	1.96 (1.74, 2.21)	1.95 (1.73, 2.20)	1.90 (1.68, 2.14)	1.79 (1.58, 2.02)[e]
Diabetes	1.63 (1.39, 1.91)	1.61 (1.37, 1.89)	1.73 (1.45, 2.07)	1.61 (1.35, 1.93)[e]
Obesity	1.32 (1.19, 1.47)	1.32 (1.18, 1.47)	1.41 (1.26, 1.58)	1.40 (1.25, 1.57)[f]

[a]Adjusted for age, sex, and education

[b]Adjusted for age, sex, education, and health insurance status

[c]Adjusted for age, sex, education, health insurance status, current smoking, and heavy alcohol use

[d]Adjusted for age, sex, education, health insurance status, current smoking, heavy alcohol use, physical activity, fruit/vegetable intake, obesity, hypertension status, and diabetes status

[e]Adjusted for age, sex, education, health insurance status, current smoking, heavy alcohol use, physical activity, fruit/vegetable intake, and obesity

[f]Adjusted for age, sex, education, health insurance status, current smoking, heavy alcohol use, physical activity, and fruit/vegetable intake

CVD = cardiovascular disease

USVI = U.S. Virgin Islands

OR = odds ratio

CI = confidence interval

people also finds a health advantage among black Caribbean Americans residing in the U.S. mainland.[26,38–41] Although issues of selection (e.g., healthier individuals may be more likely to migrate than less healthy individuals) might explain some of these differences, there are additional explanations that can be applied to our study. One important example is that Caribbean black people who immigrate to the U.S. may have fewer experiences with racialized stress and discrimination, which have been linked to poor health.[36,42,43] As discussed previously, Caribbean islands such as the USVI have a profoundly different racial context than that of the U.S. mainland. Black people are unlikely to be the minority in any social setting. These majority black settings afford Caribbean black people the opportunities and the ability to gain cultural

Table 4. Odds ratios of CVD and CVD-related outcomes for U.S. vs. USVI non-Hispanic black adults by U.S. region of residence: Behavioral Risk Factor Surveillance System, U.S., 2007 and 2009

Region of residence	*Model 1*[a] *OR (95% CI)*	*Model 2*[b] *OR (95% CI)*	*Model 3*[c] *OR (95% CI)*	*Model 4 OR (95% CI)*
Coronary heart disease				
South	2.21 (1.52, 3.22)	2.60 (2.05, 3.31)	2.19 (1.50, 3.19)	2.01 (1.38, 2.93)
Northeast	2.42 (1.58, 3.71)	2.38 (1.87, 3.04)	2.36 (1.54, 3.61)	2.14 (1.40, 3.27)
Midwest	2.88 (1.94, 4.28)	2.40 (1.89, 3.05)	2.83 (1.90, 4.21)	2.53 (1.69, 3.77)
West	2.25 (1.29, 3.92)	1.96 (1.54, 2.50)	2.20 (1.27, 3.84)	1.98 (1.14, 3.47)
USVI	1.00	1.00	1.00	1.00[d]
Stroke				
South	2.76 (1.90, 4.01)	2.73 (1.88, 3.97)	2.46 (1.65, 3.66)	2.08 (1.42, 3.05)
Northeast	2.82 (1.79, 4.43)	2.76 (1.76, 4.34)	2.43 (1.50, 3.95)	2.14 (1.34, 3.41)
Midwest	3.11 (2.10, 4.61)	3.07 (2.07, 4.55)	2.67 (1.75, 4.07)	2.33 (1.56, 3.49)
West	2.50 (1.48, 4.20)	2.45 (1.46, 4.13)	2.17 (1.25, 3.79)	2.03 (1.19, 3.44)
USVI	1.00	1.00	1.00	1.00[d]
Hypertension				
South	2.07 (1.83, 2.34)	2.06 (1.82, 2.33)	2.01 (1.77, 2.27)	1.88 (1.66, 2.13)
Northeast	1.69 (1.44, 1.99)	1.68 (1.42, 1.97)	1.62 (1.38, 1.91)	1.57 (1.33, 1.85)
Midwest	2.02 (1.74, 2.33)	2.01 (1.74, 2.32)	1.93 (1.67, 2.23)	1.81 (1.56, 2.10)
West	1.66 (1.32, 2.09)	1.65 (1.31, 2.08)	1.59 (1.27, 2.00)	1.50 (1.19, 1.88)
USVI	1.00	1.00	1.00	1.00[e]
Diabetes				
South	1.70 (1.44, 2.00)	1.68 (1.43, 1.98)	1.80 (1.50, 2.16)	1.67 (1.38, 2.00)
Northeast	1.64 (1.34, 2.00)	1.60 (1.31, 1.95)	1.73 (1.40, 2.16)	1.66 (1.33, 2.07)
Midwest	1.55 (1.29, 1.86)	1.52 (1.27, 1.83)	1.64 (1.34, 2.00)	1.53 (1.24, 1.87)
West	1.26 (0.96, 1.67)	1.24 (0.94, 1.63)	1.38 (1.03, 1.86)	1.29 (0.95, 1.74)
USVI	1.00	1.00	1.00	1.00[e]
Obesity				
South	1.38 (1.23, 1.54)	1.38 (1.23, 1.54)	1.47 (1.31, 1.65)	1.45 (1.29, 1.64)
Northeast	1.12 (0.97, 1.30)	1.12 (0.97, 1.29)	1.20 (1.03, 1.40)	1.19 (1.03, 1.39)
Midwest	1.35 (1.19, 1.54)	1.35 (1.19, 1.53)	1.45 (1.26, 1.66)	1.44 (1.25, 1.65)
West	1.28 (1.03, 1.59)	1.27 (1.02, 1.58)	1.35 (1.08, 1.69)	1.36 (1.09, 1.71)
USVI	1.00	1.00	1.00	1.00[f]

[a]Adjusted for age, sex, and education

[b]Adjusted for age, sex, education, and health insurance status

[c]Adjusted for age, sex, education, health insurance status, current smoking, and heavy alcohol use

[d]Adjusted for age, sex, education, health insurance status, current smoking, heavy alcohol use, physical activity, fruit/vegetable intake, obesity, hypertension status, and diabetes status

[e]Adjusted for age, sex, education, health insurance status, current smoking, heavy alcohol use, physical activity, fruit/vegetable intake, and obesity

[f]Adjusted for age, sex, education, health insurance status, current smoking, heavy alcohol use, physical activity, and fruit/vegetable intake

CVD = cardiovascular disease

USVI = U.S. Virgin Islands

OR = odds ratio

CI = confidence interval

and social capital that is less available to native-born US 50/DC black people and is protective of health.[40,43]

In addition to the sociodemographic and sociohistorical contexts, the cultural and tropical climates in the USVI may facilitate health-promoting activities and avenues for social interaction and support, including outdoor activities with family, neighbors, and friends, as well as availability and affordability of locally grown fruit and vegetables for consumption (dry goods and other grocery store items, however, tend to be more expensive in the USVI than in the US 50/DC).[44–46] Data limitations prohibit exploration of these potential explanations for the health advantages evidenced among USVI black people at the present time, making this an important area for future research. Disentangling these patterns will require additional data collection efforts that include obtaining detailed social, demographic, and health (including biological) information for this population.

Our work supports a growing literature on the importance of place and context for the health of black people and people of African origin in the U.S. and throughout the world.[3–14] These studies highlight the fluid nature of the relationship between race and health, as well as differences in social, economic, and environmental contexts across geographical space, complicating questions regarding the nature of policies that can improve the health of Americans of African origin. Beyond the basic and necessary provision of insurance coverage and health-care access, we must consider the role of public policies that are not often directly linked to health in popular discourse. Examples of these policies include urban planning and zoning laws, which have direct implications for access to healthy foods, opportunities for physical activity, and facilitation of community social cohesion.[47–51] Additional research attention and funding directed at examining variability in health, both within and between ethnic groups, will help to pinpoint relevant policies and public health strategies for reducing disparities and improving health among black people and people in other racial/ethnic minority groups.

Limitations

This study had several limitations. The telephone sampling may have underrepresented those without regular access to telephones and those who exclusively use cellular telephones. In addition, the BRFSS has a low response rate. The BRFSS data were weighted to adjust for both selection and nonresponse,[52] but lower response rates may have increased the potential for bias. However, national estimates from state-aggregated BRFSS data have been shown to be comparable with estimates from the National Health Interview Survey and other surveys with higher response rates.[53] Another limitation was that the data were self-reported and, thus, subject to recall and misclassification bias. However, our results for U.S. outcomes are comparable with reports using available clinical examination measures.[54] Some of our estimates differ from the only USVI study conducted with measured health outcomes, possibly due to differences in the study population and design (e.g., data from that study came exclusively from the island of St. Croix and were collected between 1995 and 1999).[18,19]

The BRFSS does not include data on nativity, citizenship, and acculturation, which are important contextual factors for CVD and other related health outcomes[55–60] that might have impacted our results. For example, black people in the US 50/DC may include foreign-born black people whose health profile might be better than native-born black people, which could likely underestimate the differences in CVD outcomes between U.S. black people and USVI black people found in this study. Future research in this area should attempt to account for these important factors. Lastly, we could not account for potential differences in lower CVD risk factor screening rates in the USVI, which might contribute to the lower prevalence observed in the present study. It should be noted that our findings do not diminish considerable health and health-care needs for the USVI population, as levels of underinsurance are higher for USVI black people than for US 50/DC black people.

CONCLUSION

We provide one of the first comparisons of health behaviors, sociodemographic factors, and CVD and related outcomes between US 50/DC and USVI non-Hispanic black people. We highlight the value of examining geographic and cultural variation in the health and well-being of the U.S. black population. Treating race as a fluid construct that is largely dependent upon context can help to illuminate how we think about race as it relates to health. Further, understanding health in the USVI black population may provide important information on the etiology of racial/ethnic variation in health and health disparities in the U.S. and the Caribbean.

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Estimates of Smoking Before and During Pregnancy, and Smoking Cessation During Pregnancy: Comparing Two Population-Based Data Sources

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ABSTRACT

Objectives. We compared three measures of maternal smoking status—prepregnancy, during pregnancy, and smoking cessation during pregnancy—between the Pregnancy Risk Assessment Monitoring System (PRAMS) questionnaire and the 2003 revised birth certificate (BC).

Methods. We analyzed data from 10,485 women with live births in eight states from the 2008 PRAMS survey, a confidential, anonymous survey administered in the postpartum period that is linked to select BC variables. We calculated self-reported prepregnancy and prenatal smoking (last trimester only) prevalence based on the BC, the PRAMS survey, and the two data sources combined, and the percentage of smoking cessation during pregnancy based on the BC and PRAMS survey. We used two-sided t-tests to compare BC and PRAMS estimates.

Results. Prepregnancy smoking prevalence estimates were 17.3% from the BC, 24.4% from PRAMS, and 25.4% on one or both data sources. Prenatal smoking prevalence estimates were 11.3% from the BC, 14.0% from PRAMS, and 15.2% on one or both data sources. The percentages of prepregnancy smokers who indicated that they quit smoking by the last trimester were 35.1% from the BC and 42.6% from PRAMS. The PRAMS estimates of prepregnancy and prenatal smoking, and smoking cessation during pregnancy were statistically higher than the corresponding BC estimates (t-tests, $p<0.05$).

Conclusions. PRAMS captured more women who smoked before and during the last trimester than the revised BC. States implementing PRAMS and the revised BC should consider information from both sources when developing population-based estimates of smoking before pregnancy and during the last trimester of pregnancy.

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Prenatal smoking remains one of the most common preventable causes of infant morbidity and mortality. Smoking may cause reduced fertility and delayed conception among women and is associated with an increased risk of cleft lip and palate.[1,2] Smoking during pregnancy causes placental abruption, placenta previa, preterm delivery, low birthweight, Sudden Infant Death Syndrome (SIDS), and preterm-related death.[2] In the United States, an estimated 5%–8% of preterm deliveries, 13%–19% of full-term low birthweight deliveries, 23%–34% of SIDS deaths, and 5%–7% of preterm-related deaths could be averted if prenatal smoking was eliminated.[3]

Healthy People 2020 goals include reducing the smoking prevalence before and during pregnancy and increasing smoking cessation during pregnancy.[4] Most states can measure progress in achieving these goals by using two population-based data sources, the Pregnancy Risk Assessment Monitoring System (PRAMS) and the revised 2003 birth certificate (BC). PRAMS surveys women with live births and collects information on smoking in the three months before pregnancy, during the last three months of pregnancy, and approximately four months after delivery. PRAMS data are linked to each infant's BC. As of 2011, 40 states and New York City were implementing PRAMS, representing 75% of U.S. live births.[5] Unlike the 1989 version of the BC, which ascertains whether a woman smoked during pregnancy without specifying in which trimester, the 2003 revised BC collects data on smoking status during the three months before pregnancy and during the first, second, and third trimesters. As of 2011, 38 states had implemented the revised BC, representing 86% of U.S. live births (Personal communication, Joyce Martin, National Center for Health Statistics, October 2011).

Two previous studies compared the BC and PRAMS in ascertaining self-reported smoking during pregnancy only and found that using PRAMS resulted in higher estimates of prenatal smoking than using the BC.[6,7] In the Allen et al. study,[6] only two of the 24 states had implemented the revised BC in 2004. To our knowledge, no studies have compared BC and PRAMS estimates of smoking in the three months before pregnancy and the percentage of women who quit smoking during pregnancy. Thus, our study is an update and expansion of findings from previous work.

The purpose of this study was to compare estimates of prepregnancy and prenatal smoking using PRAMS, the BC, and both sources combined, and to compare the percentage of smokers who quit by the last trimester of pregnancy estimated using PRAMS with the percentage estimated using the BC. A secondary goal was to assess whether smokers identified by only one data source had similar or different demographic characteristics than smokers identified by both data sources.

METHODS

PRAMS is an ongoing, population-based surveillance system of maternal behaviors and experiences before, during, and after pregnancy. All health departments participating in PRAMS use a standardized data collection methodology developed by the Centers for Disease Control and Prevention (CDC).[5] In each state, a monthly stratified sample of 100–300 new mothers is selected systematically from recent BCs. PRAMS staff mail a self-administered questionnaire to selected women two to three months after the delivery of a live infant, and nonresponders are contacted by telephone. Survey data are linked to selected BC variables. Smoking data from the BC are only for those respondents who completed the PRAMS survey, and the data were available from the states as part of the sampling process for PRAMS. The data are weighted for sample design, nonresponse, and noncoverage to represent all live births delivered in each state. Among 38 states that participated in PRAMS in 2008, our analysis was restricted to eight states that implemented the 2003 revised BC and achieved a ≥65% response rate: Colorado, Delaware, New York (excluding New York City), Ohio, Oregon, Tennessee, Washington State, and Wyoming. Response rates ranged from 65% in Oregon to 80% in Delaware.

Variables

In the 2003 revised BC, smoking status is determined from the question about the average number of cigarettes or packs of cigarettes smoked per day for the three months before pregnancy and during each trimester of pregnancy. Prepregnancy smokers and prenatal smokers were defined as smoking >0 cigarettes or packs of cigarettes per day for the three months before pregnancy and during the third trimester of pregnancy, respectively. The BC does not contain a mechanism for indicating smoking amounts of <1 cigarette per day. The CDC National Center for Health Statistics published estimates of smoking during any trimester of pregnancy using the revised BC for 24 states (Florida, Georgia, and Michigan were excluded, as they did not report smoking in a compatible format).[8] For our study, we report only smoking during the last trimester, as this is the measure collected by PRAMS and can be used to calculate estimates of smoking cessation during pregnancy.

In PRAMS, women were first asked if they smoked at least 100 cigarettes in the past two years; if they

responded yes, they were asked how many cigarettes they smoked per day on average during the three months before pregnancy and during the last three months of pregnancy (the only measure collected during pregnancy). Categorical responses included 0, <1, 1–5, 6–10, 11–20, 21–40, or ≥41 cigarettes. Prepregnancy smokers and prenatal smokers were defined as smoking >0 cigarettes per day during the three months before pregnancy and during the last three months of pregnancy, respectively.

For both data sources, we calculated the proportion of women who quit smoking (i.e., smoking cessation) by the last trimester of pregnancy by dividing the number of women who reported both prepregnancy smoking and not smoking any cigarettes during the last trimester by the number reporting prepregnancy smoking.

We calculated combined prevalence estimates of prepregnancy and prenatal smoking using smoking status indicated from the BC, PRAMS, or both sources. Smoking cessation was dependent on indication of prepregnancy smoking status; thus, we did not calculate a combined estimate for smoking cessation. Women were considered nonsmokers before and during pregnancy when neither source indicated prepregnancy or prenatal smoking.

To assess potential bias by reporting source of smoking, the source indicating a woman was a smoker (BC, PRAMS, or both) was explored by maternal characteristics (age, education, race/ethnicity, marital status, trimester of entry into prenatal care [PNC], parity, insurance coverage during PNC, and participation in the Special Supplemental Nutrition Program for Women, Infants, and Children [WIC]) and infant birthweight.

Statistical analysis

We used kappa (k) statistics to compare the agreement between the BC and the PRAMS questionnaire in ascertaining prepregnancy and prenatal smoking, and we assessed cut-points for agreement at <0.21 (poor), 0.21–0.40 (fair), 0.41–0.60 (moderate), 0.61–0.80 (good), and 0.81–1.00 (very good). Using each data source separately, we calculated prevalence and 95% confidence intervals (CIs) of prepregnancy smoking, prenatal smoking, and smoking cessation for the total (all states combined) and for each state. We calculated combined prevalence estimates of prepregnancy and prenatal smoking using data from both sources. We conducted two-way t-tests to evaluate differences in the prevalence estimates between data sources. Relative proportion differences were calculated by subtracting the BC estimate from the PRAMS estimate and then dividing by the BC estimate. We calculated adjusted prevalence ratios (APRs) and 95% CIs using logistic regression, as described by Bieler et al.,[9] to examine whether maternal characteristics associated with smoking status differed by data source. We used Chi-square tests to examine differences in characteristics and the average number of cigarettes smoked per day among women with smoking indicated on one data source only (BC only or PRAMS only) compared with women who indicated smoking on both sources. All analyses were conducted using SAS® version 9.2 and SUDAAN® version 10.0 to account for the complex survey design of PRAMS.[10,11] The data were weighted to represent women who delivered live births in each state.

A total of 10,797 records were available for analysis. Women were excluded if data were missing in either data source for prepregnancy smoking status (PRAMS: n=195, 1.8%; and BC: n=97, 0.6%) or prenatal smoking status (PRAMS: n=192, 1.8%; and BC: n=98, 0.6%). The final analytic sample included 10,485 women (97.1%). At the time of PRAMS questionnaire completion, the average infant's age was 3.8 months.

RESULTS

Prepregnancy smoking

There was "good" agreement between the two data sources for prepregnancy smoking status (k=0.68) (Table 1). Of the 10,485 women in the sample, 2,577 women (25.4%, 95% CI 24.1, 26.8) had prepregnancy smoking indicated on one or both data sources (i.e., BC and/or PRAMS). Of the 2,577 prepregnancy smokers, 1,524 (64%) had smoking indicated on both data sources, 117 (4%) had smoking indicated on the BC only, and 936 (32%) had smoking indicated on PRAMS only (data not shown).

Prepregnancy smoking prevalence was 17.3% from the BC and 24.4% from PRAMS (Table 2). The total PRAMS estimate was 41% higher than the BC estimate, based on the relative proportion difference. Overall and by state, the PRAMS prepregnancy smoking estimates were statistically higher than the BC estimates (t-tests, p<0.05). The state-specific combined estimates of prepregnancy smoking ranged from 18.2% in Colorado to 32.6% in Ohio.

The PRAMS estimates of prepregnancy smoking were statistically higher than the BC estimates for all sociodemographic subgroups (Table 3). The two data sources identified the same subgroups of women with the highest prepregnancy smoking prevalence: those who were aged <20 years and 20–24 years, of non-Hispanic white race/ethnicity, unmarried, Medicaid-enrolled, WIC participants, educated 12 years, and with either late or no PNC. In the adjusted analysis,

Table 1. Prepregnancy and prenatal smoking by U.S. women as reported on the revised 2003 birth certificate and PRAMS questionnaire, 2008[a]

	PRAMS			
Smoking status	*Smoker* N *(percent)*[b]	*Nonsmoker* N *(percent)*[b]	*Total* N *(percent)*[b]	*Kappa (95% CI)*
Prepregnancy smoking[c]				
Birth certificate				0.68 (0.67, 0.70)
Smoker	1,524 (16.3)	117 (1.0)	1,641 (17.3)	
Nonsmoker	936 (8.1)	7,908 (74.6)	8,844 (82.7)	
Total[d]	2,460 (24.4)	8,025 (75.6)	10,485 (100.0)	
Prenatal smoking[e]				
Birth certificate				0.75 (0.73, 0.77)
Smoker	964 (10.1)	109 (1.2)	1,073 (11.3)	
Nonsmoker	444 (3.9)	8,968 (84.8)	9,412 (88.7)	
Total[f]	1,408 (14.0)	9.077 (86.0)	10,485 (100.0)	

[a]Data include eight states that have implemented PRAMS and the 2003 revised birth certificate (Colorado, Delaware, New York State [excludes New York City], Ohio, Oregon, Tennessee, Washington, and Wyoming).

[b]The percentages were weighted to adjust for survey design, noncoverage, and nonresponse. Unweighted numbers are provided.

[c]Prepregnancy smoking is defined as any smoking during the three months before pregnancy.

[d]The total sample included 10,485 women, of which 2,577 women reported prepregnancy smoking on one or both data sources (i.e., birth certificate and/or PRAMS).

[e]Prenatal smoking is defined as any smoking during the last trimester of pregnancy.

[f]The total sample included 10,485 women, of which 1,517 women reported prenatal smoking on one or both data sources (i.e., birth certificate and/or PRAMS).

PRAMS = Pregnancy Risk Assessment Monitoring System

CI = confidence interval

although there were some changes of high-risk groups from the bivariate analysis, prepregnancy smoking was independently associated with similar characteristics in both data sources: 25–29 years of age, having ≤12 years of education, being of non-Hispanic white race/ethnicity, being unmarried, being enrolled in Medicaid or uninsured, and participating in WIC.

Women who were non-Hispanic black or Hispanic and women who smoked ≤5 cigarettes per day prepregnancy were more often identified as prepregnancy smokers in only one data source compared with women who were white or smoked >5 cigarettes per day who were more likely to be identified as prepregnancy smokers in both data sources (data not shown). In PRAMS, a higher proportion of women reported smoking ≤5 cigarettes per day prepregnancy compared with the BC. Additionally, women who had >12 years of education, were married, were privately insured, and were not enrolled in WIC were more likely to report being prepregnancy smokers on PRAMS only (data not shown).

Prenatal smoking

There was "good" agreement between the two data sources for prenatal smoking status (k=0.75) (Table 1). Of 10,485 women, 1,517 women (15.2%, 95% CI 14.1, 16.4) had prenatal smoking indicated on one or both data sources. Of the 1,517 prenatal smokers, 964 (66.5%) had smoking indicated on both data sources, 109 (7.8%) had smoking indicated on the BC only, and 444 (24.7%) had smoking indicated on PRAMS only (data not shown).

The total prenatal smoking prevalence was 11.3% from the BC and 14.0% from PRAMS (Table 2). Overall and by state, the PRAMS estimate was statistically higher than the BC estimate. Based on the relative proportion difference, the overall PRAMS estimate of prenatal smoking prevalence was 24% higher than the BC estimate. The combined state-specific estimates ranged from 8.9% in Colorado to 21.5% in Tennessee.

The PRAMS estimates of prenatal smoking were statistically higher than the BC estimates for all sociodemographic subgroups except for non-Hispanic black race/ethnicity (Table 4). The two data sources identified the same subgroups of women with the highest prenatal smoking prevalence: those who were aged 20–24 years, of non-Hispanic white race/ethnicity, unmarried, Medicaid-enrolled, participating in WIC, with 12 years of education, and with late or no PNC. Similar to prepregnancy smoking, there were some changes of high-risk groups from the bivariate to

Table 2. Smoking status by state and data source among U.S. women who have delivered a live birth: revised 2003 birth certificate and PRAMS, 2008[a]

State	Data source	Prepregnancy smoking[b] Percent (95% CI)[c]	Prenatal smoking[b] Percent (95% CI)[c]	Smoking cessation[b,d] Percent (95% CI)[c]
Total[e,f,g]	Birth certificate	17.3 (16.1, 18.6)	11.3 (10.3, 12.4)	35.1 (31.5, 39.0)
	PRAMS	24.4 (23.1, 25.8)	14.0 (12.9, 15.2)	42.6 (39.4, 45.9)
	Combined estimate	25.4 (24.1, 26.8)	15.2 (14.1, 16.4)	NC
Colorado[e,f]	Birth certificate	9.4 (7.8, 11.3)	5.7 (4.5, 7.2)	39.6 (30.3, 49.7)
	PRAMS	17.0 (14.8, 19.3)	8.2 (6.6, 10.0)	51.9 (44.6, 59.1)
	Combined estimate	18.2 (16.0, 20.7)	8.9 (7.4, 10.8)	NC
Delaware[e,f]	Birth certificate	15.1 (13.2, 17.2)	10.0 (8.5, 11.9)	34.0 (27.5, 41.2)
	PRAMS	24.3 (21.9, 26.8)	13.0 (11.2, 15.1)	46.3 (40.6, 52.1)
	Combined estimate	25.3 (23.0, 27.9)	13.5 (11.7, 15.6)	NC
New York[e,f]	Birth certificate	14.4 (12.0, 17.3)	9.7 (7.7, 12.2)	32.9 (24.3, 42.8)
	PRAMS	21.2 (18.4, 24.4)	11.9 (9.7, 14.6)	43.9 (36.2, 52.0)
	Combined estimate	22.0 (19.1, 25.3)	13.3 (11.0, 16.1)	NC
Ohio[e,f,g]	Birth certificate	25.5 (22.6, 28.8)	15.7 (13.2, 18.5)	38.7 (32.2, 45.7)
	PRAMS	31.4 (28.3, 34.8)	18.3 (15.7, 21.3)	41.8 (35.6, 48.2)
	Combined estimate	32.6 (29.4, 36.0)	19.4 (16.8, 22.5)	NC
Oregon[e,f]	Birth certificate	8.5 (6.3, 11.3)	6.1 (4.2, 8.7)	28.4 (17.0, 43.4)
	PRAMS	19.9 (16.7, 23.5)	11.2 (8.7, 14.3)	43.9 (34.4, 53.8)
	Combined estimate	20.3 (17.1, 24.0)	11.3 (8.8, 14.4)	NC
Tennessee[e,f]	Birth certificate	23.9 (20.2, 28.2)	16.2 (13.0, 19.9)	33.5 (25.1, 43.1)
	PRAMS	30.6 (26.5, 35.1)	19.7 (16.3, 23.7)	35.6 (27.9, 44.2)
	Combined estimate	31.5 (27.4, 36.1)	21.5 (17.9, 25.6)	NC
Washington[e,f]	Birth certificate	12.8 (10.6, 15.4)	9.2 (7.3, 11.5)	28.3 (20.2, 38.2)
	PRAMS	19.7 (17.1, 22.6)	10.8 (8.8, 13.2)	45.5 (37.6, 53.5)
	Combined estimate	20.9 (18.2, 23.9)	12.2 (10.1, 14.7)	NC
Wyoming[e,f]	Birth certificate	23.3 (20.1, 26.9)	12.8 (10.4, 15.7)	45.6 (37.4, 54.1)
	PRAMS	28.9 (25.5, 32.6)	16.4 (13.7, 19.6)	43.3 (36.1, 50.9)
	Combined estimate	30.3 (26.8, 34.0)	17.3 (14.5, 20.5)	NC

[a]Data include eight states that have implemented PRAMS and the 2003 revised birth certificate (Colorado, Delaware, New York State [excludes New York City], Ohio, Oregon, Tennessee, Washington, and Wyoming).

[b]Prepregnancy smoking is defined as any smoking during the three months before pregnancy. Prenatal smoking is defined as any smoking during the last trimester of pregnancy. Smoking cessation is defined as the proportion of women who reported both prepregnancy smoking and not smoking any cigarettes during the last trimester divided by the number reporting prepregnancy smoking.

[c]Weighted percentages and 95% CIs

[d]The estimate of smoking cessation was determined from women who reported prepregnancy smoking: for birth certificate (n=1,641) and PRAMS (n=2,460).

[e]The difference in prepregnancy smoking between birth certificates and the PRAMS questionnaire, as assessed by a t-test, $p<0.05$

[f]The difference in prenatal smoking between birth certificates and the PRAMS questionnaire, as assessed by a t-test, $p<0.05$

[g]The difference in smoking cessation between birth certificates and the PRAMS questionnaire, as assessed by a t-test, $p<0.05$

PRAMS = Pregnancy Risk Assessment Monitoring System

CI = confidence interval

NC = not calculated

the adjusted analysis; however, prenatal smoking was independently associated with similar characteristics in both data sources (except for parity and entry into PNC): aged 25–29 years, having ≤12 years of education, being of non-Hispanic white race/ethnicity, being unmarried, being enrolled in Medicaid or uninsured, and participating in WIC.

Women who smoked ≤5 cigarettes per day during pregnancy were more likely to be identified as prenatal smokers in only one data source compared with women who smoked >5 cigarettes per day, who were more likely to be identified as prenatal smokers in both data sources (data not shown). Additionally, women who were <20 years of age, privately insured, and not enrolled in WIC were more likely to be indicated as prenatal smokers on PRAMS only (data not shown).

Smoking cessation by last trimester of pregnancy

Among prepregnancy smokers identified using the BC only (n=1,641), 35.1% of women (95% CI 31.5, 39.0) quit smoking by the last trimester (Table 2). State-specific estimates ranged from 28.3% in Washington State to 45.6% in Wyoming. Among those who quit smoking and remained that way until the end of pregnancy, 58% quit before the first trimester, 31% quit before the second trimester, and 11% quit before the third trimester (data not shown).

Among prepregnancy smokers identified using PRAMS only (n=2,460), 42.6% (95% CI 39.4, 45.9) quit smoking by the last trimester (Table 2). State-specific estimates ranged from 35.6% in Tennessee to 51.9% in Colorado. The overall PRAMS estimate of smoking cessation was statistically higher than the BC estimate;

Table 3. Prevalence and APR of prepregnancy smoking in U.S. women by sociodemographic characteristics and data source, 2008[a]

	Birth certificate		*PRAMS*		*Combined*	
Characteristic	*Prevalence (percent)*	*APR (95% CI)[b]*	*Prevalence (percent)*	*APR (95% CI)[b]*	*Prevalence (percent)*	*APR (95% CI)[b]*
Age (in years)						
<20[c]	23.8	0.78 (0.57, 1.07)	34.2	0.86 (0.67, 1.11)	36.7	0.90 (0.71, 1.14)
20–24[c]	25.5	1.06 (0.86, 1.31)	35.6	1.13 (0.96, 1.33)	36.7	1.12 (0.96, 1.32)
25–29[c]	18.2	1.26 (1.05, 1.51)	24.9	1.21 (1.05, 1.39)	26.0	1.22 (1.06, 1.39)
>29[c]	10.1	Ref.	14.9	Ref.	15.4	Ref.
Education (in years)						
<12[c]	22.9	1.60 (1.26, 2.03)	29.5	1.39 (1.14, 1.70)	31.2	1.41 (1.16, 1.71)
12[c]	29.3	1.73 (1.43, 2.09)	40.7	1.69 (1.46, 1.97)	41.9	1.67 (1.44, 1.93)
>12[c]	10.7	Ref.	16.1	Ref.	16.8	Ref.
Race/ethnicity						
Non-Hispanic white[c]	20.3	1.66 (1.22, 2.25)	28.3	1.44 (1.15, 1.81)	29.2	1.40 (1.14, 1.73)
Non-Hispanic black	16.9	0.72 (0.49, 1.06)	22.0	0.61 (0.46, 0.83)	24.0	0.63 (0.48, 0.84)
Hispanic[c]	5.9	0.27 (0.17, 0.43)	10.4	0.33 (0.23, 0.46)	11.3	0.33 (0.24, 0.46)
Other[c]	11.1	Ref.	18.2	Ref.	19.3	Ref.
Marital status						
Not married[c]	30.4	2.10 (1.73, 2.55)	40.7	2.01 (1.74, 2.33)	42.3	1.99 (1.72, 2.29)
Married[c]	10.1	Ref.	15.5	Ref.	16.2	Ref.
PNC						
First trimester[c]	15.5	Ref.	22.2	Ref.	23.3	Ref.
Second trimester[c]	23.1	1.15 (0.95, 1.38)	31.3	1.11 (0.96, 1.29)	32.4	1.08 (0.94, 1.25)
Third trimester/no PNC[c]	24.8	1.22 (0.92, 1.62)	35.2	1.23 (0.98, 1.54)	36.1	1.20 (0.96, 1.50)
Insurance during PNC						
Medicaid[c]	28.5	1.53 (1.22, 1.90)	37.8	1.41 (1.19, 1.67)	39.6	1.43 (1.22, 1.68)
Uninsured[c]	22.6	1.55 (1.21, 1.98)	29.6	1.35 (1.12, 1.64)	30.2	1.32 (1.10, 1.60)
Other[c]	9.7	Ref.	15.4	Ref.	16.0	Ref.
WIC						
Participant[c]	28.6	1.61 (1.32, 1.96)	36.6	1.40 (1.20, 1.64)	38.1	1.40 (1.20, 1.62)
Not a participant[c]	10.3	Ref.	16.6	Ref.	17.2	Ref.
Parity						
0[c]	17.3	0.96 (0.82, 1.12)	25.7	1.00 (0.89, 1.14)	26.7	0.99 (0.88, 1.12)
≥1[c]	17.5	Ref.	23.7	Ref.	24.7	Ref.

[a]Data include eight states that have implemented PRAMS and the 2003 revised birth certificate (Colorado, Delaware, New York State [excludes New York City], Ohio, Oregon, Tennessee, Washington, and Wyoming).

[b]Adjusted for age, education, race/ethnicity, marital status, PNC, insurance, WIC, and parity

[c]Statistically significant difference in prepregnancy smoking estimates between the 2003 revised birth certificate and the PRAMS questionnaire by subgroup, as assessed by t-tests, $p<0.05$

APR = adjusted prevalence ratio

PRAMS = Pregnancy Risk Assessment Monitoring System

CI = confidence interval

Ref. = reference group

PNC = prenatal care

WIC = Special Supplemental Nutrition Program for Women, Infants, and Children

Table 4. Prevalence and APR of prenatal smoking in U.S. women by sociodemographic characteristics and data source, 2008[a]

	Birth certificate		*PRAMS*		*Combined*	
Characteristic	*Prevalence (percent)*	*APR (95% CI)[b]*	*Prevalence (percent)*	*APR (95% CI)[b]*	*Prevalence (percent)*	*APR (95% CI)[b]*
Age (in years)						
<20[c]	13.7	0.55 (0.36, 0.83)	20.3	0.81 (0.57, 1.16)	22.6	0.86 (0.62, 1.20)
20–24[c]	16.7	0.91 (0.70, 1.19)	20.4	1.10 (0.86, 1.40)	22.5	1.13 (0.89, 1.42)
25–29[c]	13.2	1.36 (1.08, 1.71)	15.5	1.39 (1.13, 1.72)	16.7	1.42 (1.16, 1.74)
>29[c]	6.0	Ref.	7.5	Ref.	7.8	Ref.
Education (in years)						
<12[c]	18.5	2.24 (1.65, 3.02)	22.8	2.01 (1.52, 2.66)	24.4	1.96 (1.51, 2.54)
12[c]	20.2	2.05 (1.59, 2.66)	23.7	1.89 (1.51, 2.38)	26.0	1.85 (1.49, 2.30)
>12[c]	5.4	Ref.	7.3	Ref.	7.9	Ref.
Race/ethnicity						
Non-Hispanic white[c]	13.5	1.63 (1.11, 2.37)	16.5	1.50 (1.06, 2.12)	17.7	1.46 (1.07, 1.99)
Non-Hispanic black	10.9	0.63 (0.39, 1.01)	12.5	0.56 (0.36, 0.86)	15.1	0.60 (0.40, 0.90)
Hispanic[c]	2.8	0.14 (0.08, 0.26)	4.6	0.21 (0.12, 0.35)	4.9	0.19 (0.12, 0.32)
Other[c]	8.0	Ref.	10.9	Ref.	11.9	Ref.
Marital status						
Not married[c]	21.2	2.08 (1.62, 2.67)	25.5	2.12 (1.71, 2.64)	28.0	2.13 (1.73, 2.62)
Married[c]	5.9	Ref.	7.7	Ref.	8.2	Ref.
PNC						
First trimester[c]	9.6	Ref.	12.1	Ref.	13.2	Ref.
Second trimester[c]	17.5	1.32 (1.06, 1.65)	20.5	1.27 (1.04, 1.55)	22.0	1.22 (1.01, 1.47)
Third trimester/no PNC[c]	19.0	1.35 (0.97, 1.88)	25.9	1.52 (1.13, 2.05)	26.6	1.39 (1.04, 1.85)
Insurance during PNC						
Medicaid[c]	20.8	1.95 (1.43, 2.66)	23.9	1.47 (1.14, 1.89)	26.5	1.57 (1.24, 1.99)
Uninsured[c]	16.9	2.06 (1.46, 2.90)	19.5	1.58 (1.18, 2.12)	21.3	1.65 (1.25, 2.17)
Other[c]	4.5	Ref.	6.9	Ref.	7.1	Ref.
WIC						
Participant[c]	21.0	2.02 (1.54, 2.64)	24.3	1.78 (1.41, 2.25)	26.6	1.76 (1.42, 2.19)
Not a participant[c]	5.0	Ref.	7.4	Ref.	7.8	Ref.
Parity						
0[c]	9.8	0.91 (0.74, 1.12)	12.5	0.80 (0.66, 0.96)	13.6	0.79 (0.66, 0.94)
≥1[c]	12.4	Ref.	15.2	Ref.	16.5	Ref.
Infant birthweight (in grams)						
<1,500	16.6	1.48 (1.08, 2.02)	18.9	1.35 (1.01, 1.82)	21.5	1.39 (1.07, 1.81)
1,500–2,500[c]	19.7	1.50 (1.27, 1.77)	22.9	1.47 (1.27, 1.69)	24.6	1.42 (1.24, 1.63)
>2,500[c]	10.7	Ref.	13.4	Ref.	14.5	Ref.

[a]Data include eight states that have implemented PRAMS and the 2003 revised birth certificate (Colorado, Delaware, New York State [excludes New York City], Ohio, Oregon, Tennessee, Washington, and Wyoming). Prenatal smoking is defined as any smoking during the last trimester of pregnancy.

[b]Adjusted for age, education, race/ethnicity, marital status, PNC, insurance, WIC, parity, and infant birthweight

[c]The difference in prenatal smoking between birth certificates and the PRAMS questionnaire, as assessed by a t-test, $p<0.05$

APR = adjusted prevalence ratio

PRAMS = Pregnancy Risk Assessment Monitoring System

CI = confidence interval

Ref. = reference group

PNC = prenatal care

WIC = Special Supplemental Nutrition Program for Women, Infants, and Children

however, this difference was statistically significant in only one state (Ohio). Based on relative proportion difference, the total PRAMS estimate of quitting was 21% higher than the BC estimate.

With the exception of age, the two data sources identified similar groups of women with the highest proportion of smoking cessation (those with >12 years of education, of Hispanic race/ethnicity, married, privately insured, not participating in WIC, and nulliparous) (Table 5). For these demographic groups, the PRAMS estimate of smoking cessation was higher than the BC estimate, although not all reached statistical significance. On the BC, smokers who were <20 years of age had the highest proportion of smoking cessation (43%) compared with other age groups; on PRAMS, smokers >29 years of age had the highest proportion of smoking cessation (50%). For both data sources, quitters were more likely to report smoking ≤5 cigarettes per day prepregnancy compared with women who did not quit (data not shown).

When comparing data sources, the independent associations between maternal characteristics and smoking cessation during pregnancy were generally in the same direction, although the strength of the association varied by data source, with few exceptions (Table 5). On both sources, compared with reference categories, having >12 years of education, not participating in WIC, and having an infant who weighed >2,500 grams were associated with smoking cessation. On the BC, being Hispanic, initiating PNC in the first trimester, and being privately insured were associated with smoking cessation. On PRAMS, being nulliparous was associated with smoking cessation.

DISCUSSION

When combining information on smoking status from both data sources, we estimated that one in four women smoked in the three months before pregnancy and 15.2% of women smoked during the last trimester of pregnancy in the eight study states. Compared with the BC, PRAMS captured more prepregnancy and prenatal smokers during the last trimester only; subgroups of women who were privately insured, were non-WIC participants, and smoked ≤5 cigarettes per day were more likely to report smoking on the PRAMS questionnaire than on the BC. Despite these differences in reporting, the two data sources identified similar predictors of prepregnancy and prenatal smoking among women who delivered live infants.

Among women who smoked prepregnancy, we found that 35% and 46% quit smoking by the last trimester based on BC and PRAMS, respectively. The discrepancy was largely due to the substantial number of women indicated as prepregnancy smokers on PRAMS but not on the BC; the majority (69%) of these women reported not smoking during the last trimester of pregnancy. The characteristics of these women were consistent with those most likely to quit smoking during pregnancy: higher education, Hispanic, privately insured, not a WIC participant, and smoking fewer cigarettes per day prepregnancy.

Limitations

This study was subject to several limitations. A national study validating self-reports with serum cotinine found that 23% of pregnant smokers and 10% of nonpregnant smokers did not disclose their smoking.[12] PRAMS is a confidential survey completed by the mother, on average, four months after delivery. In contrast, the BC is completed during the delivery hospitalization, and information on smoking status is obtained from the mother using a worksheet.[13] Thus, nondisclosure and recall bias may affect the reporting of smoking status for both sources. The higher prevalence of smoking reported on PRAMS suggests that nondisclosure is of less concern for PRAMS than for the BC. Furthermore, the PRAMS and BC questions that ascertain smoking status are different, which could affect estimates. In particular, non-daily smokers (i.e., those who smoke <1 cigarette per day) would likely not be identified using the BC. Also, the 100 cigarettes filter question could result in PRAMS not detecting women who recently initiated smoking or who do not smoke frequently. It was also not possible to compare differences in the level of smoking between data sources, as only a categorical response for the number of cigarettes smoked per day is captured on PRAMS.

PRAMS asks about smoking during the last three months of pregnancy; thus, the timing of smoking cessation (before or during pregnancy) cannot be determined using PRAMS alone. However, an advantage of the revised BC is being able to calculate smoking cessation and relapsing within pregnancy using first- and second-trimester smoking status.[8] These study findings also may not be generalizable to women who have delivered a live birth outside of the eight study states or to women whose pregnancy ended in a stillbirth. As mentioned previously, we examined only last trimester smoking; therefore, published estimates of smoking at any time during pregnancy using the revised BC among the states included in this study (range: 8.6% in Colorado to 20.2% in Wyoming) were higher than our study BC estimates of last trimester smoking.[8]

PRAMS identified more smokers before pregnancy and during the last trimester of pregnancy than the

Table 5. Percentage and APR of U.S. women who quit smoking by last trimester of pregnancy among women who smoked prepregnancy, by sociodemographic characteristics and data source, 2008[a]

	Birth certificate		*PRAMS*	
	Quit Percent[b]	*APR (95% CI)*[c]	*Quit Percent*[d]	*APR (95% CI)*[c]
Age (in years)				
<20[e]	42.6	1.81 (1.28, 2.56)	40.7	1.21 (0.90, 1.61)
20–24	34.7	1.26 (0.93, 1.70)	42.6	1.06 (0.85, 1.32)
25–29	28.5	0.79 (0.57, 1.08)	37.9	0.82 (0.65, 1.02)
>29[e]	40.8	Ref.	49.9	Ref.
Education (in years)				
<12[e]	19.5	0.47 (0.31, 0.72)	22.9	0.55 (0.41, 0.75)
12	31.6	0.66 (0.52, 0.84)	41.7	0.82 (0.69, 0.99)
>12[e]	49.6	Ref.	54.6	Ref.
Race/ethnicity				
Non-Hispanic white[e]	34.2	1.09 (0.66, 1.80)	41.6	0.93 (0.66, 1.32)
Non-Hispanic black	37.0	1.54 (0.90, 2.64)	42.9	1.22 (0.82, 1.81)
Hispanic	53.2	2.05 (1.16, 3.60)	56.7	1.44 (0.97, 2.13)
Other	28.4	Ref.	40.4	Ref.
Marital status				
Not married	30.6	0.91 (0.71, 1.18)	37.2	0.88 (0.73, 1.05)
Married[e]	42.3	Ref.	50.1	Ref.
PNC				
First trimester[e]	37.9	Ref.	45.7	Ref.
Second trimester	24.7	0.70 (0.49, 0.99)	34.6	0.84 (0.66, 1.07)
Third trimester/no PNC	23.4	0.72 (0.46, 1.12)	26.8	0.66 (0.41, 1.07)
Insurance during PNC				
Medicaid	27.1	0.69 (0.52, 0.93)	36.7	0.92 (0.76, 1.12)
Uninsured	26.4	0.67 (0.45, 0.99)	34.0	0.78 (0.58, 1.05)
Other[e]	54.0	Ref.	55.4	Ref.
WIC				
Participant[e]	26.9	0.64 (0.50, 0.82)	33.7	0.72 (0.60, 0.86)
Not a participant	51.3	Ref.	55.2	Ref.
Parity				
0[e]	43.6	1.08 (0.86, 1.35)	51.4	1.28 (1.08, 1.53)
≥1[e]	29.3	Ref.	35.9	Ref.
Infant birthweight (in grams)				
<1,500	32.5	0.97 (0.69, 1.35)	40.1	0.89 (0.66, 1.21)
1,500–2,500[e]	24.1	0.76 (0.60, 0.96)	29.6	0.78 (0.65, 0.93)
>2,500[e]	36.2	Ref.	43.8	Ref.

[a]Data include eight states that have implemented PRAMS and the 2003 revised birth certificate (Colorado, Delaware, New York State [excludes New York City], Ohio, Oregon, Tennessee, Washington, and Wyoming).

[b]The estimate of smoking cessation was determined among women who reported prepregnancy smoking on the birth certificate (n=1,641).

[c]Adjusted for age, education, race/ethnicity, marital status, PNC, insurance, WIC, parity, and infant birthweight

[d]The estimate of smoking cessation was determined among women who reported prepregnancy smoking on PRAMS (n=2,460).

[e]Statistically significant difference in smoking cessation estimates between birth certificates and the PRAMS questionnaire, as assessed by t-tests, $p<0.05$

APR = adjusted prevalence ratio

PRAMS = Pregnancy Risk Assessment Monitoring System

CI = confidence interval

Ref. = reference group

PNC = prenatal care

WIC = Special Supplemental Nutrition Program for Women, Infants, and Children

BC. When reporting estimates of smoking based solely on the BC, the likelihood of underreporting the "true" smoking prevalence should be acknowledged. For states implementing PRAMS and the 1989 BC, using the PRAMS survey only will be sufficient in ascertaining smoking status before and during pregnancy.

CONCLUSIONS

PRAMS, a confidential, anonymous survey administered during the postpartum period, captured more women who smoked before pregnancy and who smoked during the last trimester of pregnancy than the 2003 revised BC. States implementing PRAMS and the revised BC should consider information from both sources when developing population-based estimates of smoking before pregnancy and during the last trimester of pregnancy.

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Preschool Vision Screening in Primary Care Pediatric Practice

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ABSTRACT

Objectives. We determined the efficacy of pediatric-based preschool vision screening, as knowledge of vision screening effectiveness in primary care pediatrics is incomplete.

Methods. Pediatricians and staff at nine primary care pediatric practices were trained in vision screening, and practices screened children aged 3–5 years from May 2007 through July 2008. Children failing or considered untestable were referred for pediatric ophthalmology examinations. We determined rates of testability, failure, referral, and ophthalmologic examination completion, as well as positive predictive values (PPVs) of screening failure and untestability. We also surveyed practices to assess the ease and accuracy of preschool vision screening.

Results. Of 2,933 children screened, 93 (3.2%) failed the vision screening and 349 (11.9%) were untestable. Untestability was highest (27.1%) among 3-year-olds. The PPV for failing any aspect of the vision screening was 66.7%; for children aged 3, 4, and 5 years, the PPVs for failing were 30.0%, 77.8%, and 87.5%, respectively. However, only 38.7% of children who failed the vision screening received ophthalmologic examinations, despite multiple follow-up attempts. Pediatricians rated the ease and accuracy of screening 3-year-old children lower than for screening older children.

Conclusions. Visual acuity-based screening had good PPV for vision loss for 4- and 5-year-old children but was less successful for 3-year-olds. Rates of referral and ophthalmologic examination completion were low, especially among children from low-income families.

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Amblyopia, the primary target condition of preschool vision screening, is caused by deficient visual stimulation of an eye during the years of visual development. Untreated amblyopia leads to permanent vision loss.[1] The estimated prevalence of amblyopia in the United States is 1%–4%.[2–4] For detection of amblyopia or its risk factors, the U.S. Preventive Services Task Force recommends vision screening of all children at least once between the ages of 3 and 5 years.[5] Vision screening is recommended as a component of the well-child examination by the American Academy of Pediatrics (AAP), the American Academy of Ophthalmology, and the American Association for Pediatric Ophthalmology and Strabismus (AAPOS).[6–8] The AAP states that visual acuity screening should begin at 3 years of age as part of routine pediatric care. In addition, children aged 3–5 years should undergo assessment of the external eye appearance, ocular alignment and motility, pupils, and ocular media clarity.[7]

In the U.S., however, many children fail to receive timely screening examinations.[9,10] Only 21%–36% of children younger than 6 years of age have undergone vision screening or comprehensive examinations.[9,11] In a recent survey, 35% of pediatricians reported routinely screening 3-year-old children using eye charts, and 73% reported screening 4-year-old children.[12] Barriers to primary care vision screening may include deficiencies in reimbursement, incomplete primary care education in screening, and limitations of the testing techniques themselves.[12,13] Problems have been reported with primary care screening related to screening penetrance, testability, and referral.[13,14] Evidence for the real-world effectiveness of preschool vision screening in the primary care setting is lacking.[15] Therefore, the Children's Eye Foundation (CEF), the charitable foundation of AAPOS, established its See by Three program with the goal of significantly reducing amblyopia in young children. The CEF requested proposals for two projects to assess the effectiveness of preschool vision screening in primary care pediatric practice.

METHODS

The CEF selected Nemours Children's Clinic in Jacksonville, Florida, in collaboration with Vision Is Priceless Council (a vision-screening charity also based in Jacksonville), to conduct one of the projects. The second project was based at the University of West Virginia. We describe the Jacksonville project. The screening was performed from May 2007 through July 2008.

Patients

The target population was children aged 3–5 years receiving well-child examinations. Two private pediatric practices (PPs) agreed to participate, with 14 pediatricians practicing in three locations. Six Duval County Health Department (HD) primary care pediatric clinics, with an additional 14 pediatricians in six locations, also participated. The inclusion of PPs and HD clinics created a study population that was representative of the socioeconomic strata of the county's preschool population. Compared with the PP population, HD children were more frequently insured by Medicaid, of a lower socioeconomic status, and African American. For individual patients, however, sex, age, race/ethnicity, and primary language were not recorded. Practices agreed to screen all children arriving for annual well-child visits.

Screening tests

Of greatest interest was the effectiveness of visual acuity screening. Selected physical examination tests performed by pediatricians were also included in the study. The screening procedures were based on AAP guidelines, but with some intentional differences, which are noted hereafter. The study used the Early Treatment of Diabetic Retinopathy Study (ETDRS)-style LEA Symbols eye chart (Model 255001, Good-Lite Co., Elgin, Illinois) with illuminated cabinet, chart mask, penlights, and near-fixation target toys. Monocular linear visual acuity was measured at 10 feet. An adhesive eye patch was used to occlude the opposite eye (ATL, Menomonee Falls, Wisconsin). For children refusing the patch, we used Children's Fun Occluder Frames (Good-Lite Co.).

The critical line for vision screening referral was 20/40. To pass the visual acuity screening, children were required to identify four of the five symbols on the critical line with each eye. This criterion differed because five figures were present on the chart's critical line rather than six figures, as described in the AAP guidelines.[17] Children who were uncooperative or did not comprehend the test were categorized as untestable. Pediatricians also performed the red reflex test and the corneal light reflex test. Optionally, the Bruckner test was allowed as a substitute for the red reflex and corneal light reflex tests. Additionally, a cover test for near fixation was to be performed for each child. The AAP guidelines specify distance cover testing, but near cover testing was more adaptable to the various primary care settings. Random dot E stereo, another AAP-recommended test, was not included because of reported poor results in the preschool age group and the additional anticipated testing time.[16,17]

To assure consistent implementation of the study, several steps were taken. First, a research study coordinator (SC) and a nurse experienced in vision screening trained the physicians and staff at all sites. The clinic staff received face-to-face training on study design, methodology for visual acuity screening, pass/fail/untestable criteria, data documentation, and management of children categorized as failures or untestable. Second, the SC supplied the clinics with equipment and supervised its installation. And third, the pediatricians received training in vision screening techniques using verbal training and an educational compact disc (Pediatric Vision Screening®, Nemours).

Eligible children were initially enrolled in the study for nine months. To reach study enrollment goals, screening at the three PP sites was extended for an additional five months. Because of higher enrollment rates at the PP sites, extension of screening in those sites was considered the most efficient method to reach study enrollment goals.

Screening failures and untestability

All screening failures and untestable children were referred for comprehensive ophthalmologic examinations. Although AAP guidelines recommend rescreening untestable children before referral, we were interested in the significance of a single instance of untestability. We did not assess the effectiveness of a rescreening strategy for untestable children.

De-identified data were collected on children passing the screening examination. Parents of children who failed or were untestable signed a Health Insurance Portability and Accountability Act (also known as HIPAA) release of information form before contact information was sent to the SC. The children who failed or were untestable were referred for comprehensive ophthalmologic examination. Pediatricians were requested to direct all referrals to the study center's pediatric ophthalmology practice for examination by one of four pediatric ophthalmologists. The SC called each parent to facilitate ophthalmology appointment scheduling. In cases of failure to show up for examination, at least three calls were made to the parents to reschedule the appointment. In addition, the primary care pediatrics office was notified. At the ophthalmology visit, informed consent was obtained and the patient was enrolled into the study.

For children referred to but not completing an ophthalmologic examination, attempts were made by the SC to determine the reason for not receiving the examination by contacting the families. All participating pediatric ophthalmologists were educated on the study design and instructed in the examination protocol. The ophthalmologists were aware that each study participant had either failed a screening examination or was considered untestable, but no additional screening details were revealed. The ophthalmologic examination elements recorded were initial visual acuity, cover test, Bruckner test, pupils, external eye examination, slit lamp examination, cycloplegic refraction using cyclopentolate 1% ophthalmic solution, best-corrected visual acuity, and funduscopic examination. Distance linear visual acuity was measured with LEA Symbols using the SmartSystem® II PC-Plus Visual Acuity System (M&S Technologies, Inc., Park Ridge, Illinois). Results of the ophthalmology examination were recorded on standardized data forms (Scantron, Eagan, Minnesota).

Vision screening process assessment by participating practices

At the conclusion of the study, representatives of each primary care site were surveyed to obtain their assessment of different aspects of the vision screening process for each of the ages screened.

Statistical analysis

Screening results were compared with the results of the ophthalmologic examination.[18] All categorical variables were summarized using frequencies and percentages. We compared the quality of two or more proportions (percentages) using Chi-square statistics with appropriate degrees of freedom. We compared the frequency and rates for pass, fail, and untestable by age groups and practice types using Chi-square analysis. We calculated positive predictive values (PPVs) with 95% confidence intervals (CIs) to compare pediatric vision screening results with ophthalmology examination results. Analyses were two-tailed, with 0.05 considered significant. We used SPSS® Statistics version 17.0.[19]

RESULTS

Well-child examinations and screening

Across the participating sites, there were 5,896 well-child visits by children 3, 4, or 5 years of age, and 2,970 (50.4%) visits included documented vision screening. Of the 2,970 children screened, 880 (29.6%) were 3-year-olds, 1,175 (39.6%) were 4-year-olds, and 912 (30.7%) were 5-year-olds. Ages were not recorded for three screened children. The proportion screened (screening/total visits) did not differ significantly among the age groups. The higher number of 4-year-olds screened was due to a higher number of well-child visits for that age group. There were no known cases of the same child being screened more than once, but

de-identification of screening passes disallowed for the assessment of all records.

Visual acuity and other screening

Of the 2,970 children screened, 37 (1.2%) were noted at screening to be developmentally delayed, autistic, or both. Twenty-nine of the 37 (78.4%) children with developmental delays or autism were screened at HD sites. Developmentally delayed or autistic children were excluded from further analysis. After exclusions, PP screening accounted for 62% of 861 3-year-olds, 70% of 1,160 4-year-olds, and 77% of 909 5-year-olds screened. Overall, 72 of 2,933 (2.5%) children failed visual acuity screening and 345 (11.8%) were untestable (Table 1).

Twenty-five of 2,933 (0.8%) children failed vision screening components of the pediatrician's physical examination. Of the 25 failures on physical examination, four children also failed visual acuity screening, 15 passed visual acuity screening, and six were untestable by visual acuity (data not shown).

Overall screening

The overall screening failure rate consisted of children failing either the visual acuity screening or a physical examination test. Ninety-three of 2,933 (3.2%) children failed at least one screening component, and 349 (11.9%) were untestable (Table 1). Failure rates among the age groups did not differ significantly (p=0.852). The untestability rate was higher among 3-year-olds (27.1%, 233/861) than among 4-year-olds (8.2%, 95/1,160) and 5-year-olds (2.2%, 20/909; p<0.001). The failure rates of the two practice types differed, with a failure rate of 2.4% among PP sites (50/2,049) and 4.9% among HD sites (43/884) (p<0.001). Similarly, the untestability rates of the two practice types differed, with an untestability rate of 4.3% at PP sites (89/2,049) and 29.4% at HD sites (260/884) (p<0.001). Among the six HD sites, the untestability rates ranged from 13.5%–42.1%.

Referrals for ophthalmologic examinations

Referral of children varied among practice sites and ages (Table 2). Of those who failed screening, 76 of 93 patients (81.7%) were referred for ophthalmologic examinations. Among screening failures, fewer 3-year-olds were referred (65.5%, 19/29) than 4-year-olds (91.4%, 32/35) and 5-year-olds (86.2%, 25/29) (p=0.021).

Of 321 total referrals, 285 (88.8%) records indicated the practice to which the child was referred, and the study center's ophthalmology practice was indicated in 263 (92.3%) of these referrals. Efforts were unsuccessful in determining whether any of the children referred elsewhere received ophthalmologic examinations (data not shown).

Ophthalmologic examination completion

Of children referred to the study center, 97 of 263 (36.9%) received examinations (Table 3). Of children referred but failing to appear for ophthalmologic examinations, the majority of the families did not respond to phone calls and letters. Of the 15 parents who were successfully contacted, seven considered an examination unnecessary, four indicated insurance problems, one indicated transportation problems, and three reported plans to be examined elsewhere (data not shown).

Dropout from screening to receiving an ophthalmologic examination

Combining failure-to-refer and failure-to-appear reasons for not receiving an ophthalmologic examination, 36 (38.7%) of the 93 children who failed vision screening received examinations at the study center

Table 1. Primary care pediatric vision screening results and frequencies for children aged 3–5 years at private practice and health department sites: Jacksonville, Florida, May 2007–July 2008

Variable	*Visual acuity screening results (n=2,933)* N *(percent)*			*Overall screening results (n=2,933)* N *(percent)*			*Total* N
	Fail	*Untestable*	*Pass*	*Fail*	*Untestable*	*Pass*	
Overall	72 (2.5)	345 (11.8)	2,516 (85.8)	93 (3.2)	349 (11.9)	2,491 (84.9)	2,933
Age (in years)							
3	24 (2.8)	227 (26.4)	610 (70.8)	29 (3.4)	233 (27.1)	599 (69.6)	861
4	27 (2.3)	96 (8.3)	1,037 (89.4)	35 (3.0)	95 (8.2)	1,030 (88.8)	1,160
5	21 (2.3)	21 (2.3)	867 (95.4)	29 (3.2)	20 (2.2)	860 (94.6)	909
Practice type							
Private practice	44 (2.1)	87 (4.2)	1,918 (93.6)	50 (2.4)	89 (4.3)	1,910 (93.2)	2,049
Health department	28 (3.2)	258 (29.2)	598 (67.6)	43 (4.9)	260 (29.4)	581 (65.7)	884

Table 2. Primary care pediatric vision screening referral rates and frequencies for children aged 3–5 years at private practice and health department sites: Jacksonville, Florida, May 2007–July 2008

Variable	*Screening failures referred*[a] N *(percent)*	*Screening untestables referred*[a] N *(percent)*
Overall	76/93 (81.7)	196/349 (56.2)
Age (in years)		
3	19/29 (65.5)	138/233 (59.2)
4	32/35 (91.4)	47/95 (49.5)
5	25/29 (86.2)	11/20 (55.0)
Practice type		
Private practice	43/50 (86.0)	40/89 (44.9)
Health department	33/43 (76.7)	156/260 (60.0)

[a]The denominator represents the corresponding number of screening failures or untestables.

(Figure). Of screening failures, 34.9% of 3-year-olds, 51.0% of 4-year-olds, and 27.0% of 5-year-olds appeared for ophthalmologic examinations. More screening failures from PPs (54.0%) underwent ophthalmologic examinations than from HD sites (20.9%) (p=0.002) (data not shown).

Ophthalmologic examination results and screening reliability

A screening failure was a true positive result if, on ophthalmologic examination, the child failed one of the AAPOS amblyogenic factors or if distance visual acuity measured 20/50 or worse for either eye.[18] The overall PPV of screening failures compared with ophthalmologic examinations was 66.7% (95% CI 48.9, 80.9) (Table 4). By age groups, the PPV was 30.0% for 3-year-old failures, 77.8% for 4-year-olds, and 87.5% for 5-year-olds. The PPV of visual acuity screening failure was 64.5% (95% CI 45.4, 80.2). The overall PPV of untestability for an ophthalmologic abnormality was 28.1% (95% CI 17.4, 41.8). For children who failed screening for reasons other than visual acuity, seven received ophthalmologic examinations. Six of the seven (85.7%, 95% CI 42.0, 99.0) were found to have an abnormality. Four of the seven had passed visual acuity screening and, of those, three of four had an abnormality (data not shown).

For 50 of 58 children (86.2%) who were untestable by screening, visual acuity was obtainable at the ophthalmologic examination. Forty-two of the 58 children had normal visual acuity, eight failed, and eight were again untestable (data not shown).

Vision screening process assessment by practice

Questionnaire responses for the primary care sites are listed in Table 5. The ease and accuracy of preschool screening as well as the likelihood of continuing to screen was rated higher for 4- and 5-year-old children than for 3-year-olds. Of barriers to screening, the time required to test was rated as the most significant barrier.

DISCUSSION

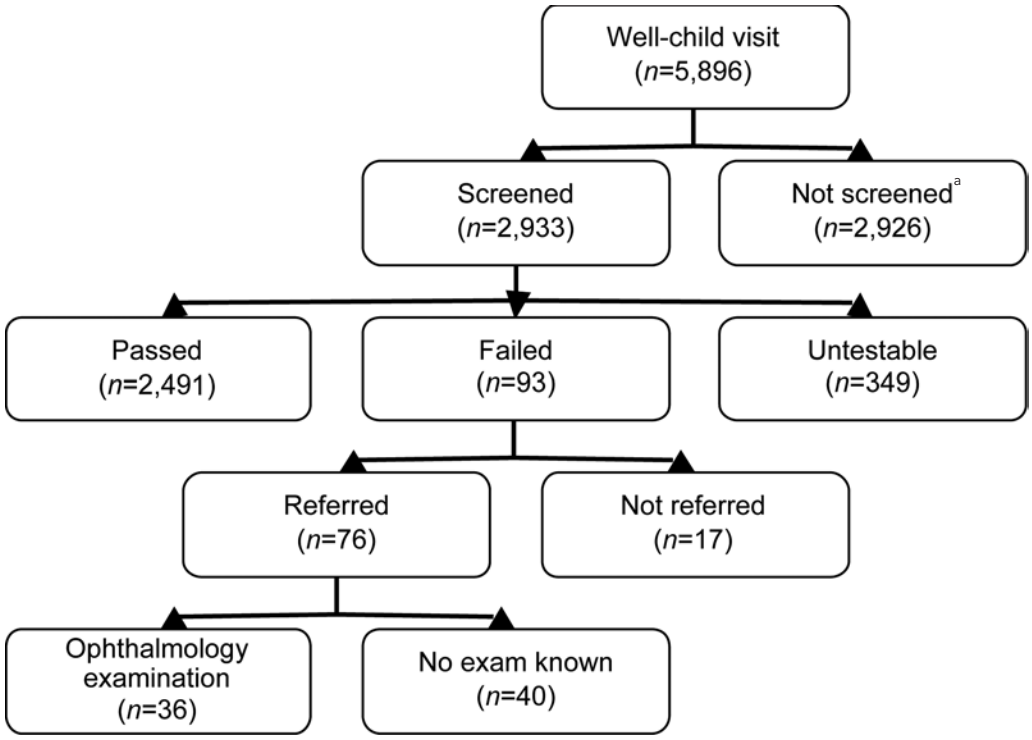
This study indicates that pediatric vision screening may be effective, particularly after the age of 48 months. For children aged 4 and 5 years, untestability was only

Table 3. Primary care pediatric vision screening rates of ophthalmologic examination completion for children aged 3–5 years referred to the study center at private practice and health department sites: Jacksonville, Florida, May 2007–July 2008

Variable	*Pass*[a] N *(percent)*	*Fail*[a] N *(percent)*	*Untestable*[a] N *(percent)*	*Total*[a] N *(percent)*
Overall	4/35 (11.4)	36/64 (56.3)	57/164 (34.8)	97/263 (36.9)
Age (in years)				
3	1/7 (14.3)	10/16 (62.5)	39/115 (33.9)	50/138 (36.2)
4	3/11 (27.3)	18/29 (62.1)	13/40 (32.5)	34/80 (42.5)
5	0 (0.0)	8/19 (42.1)	5/9 (55.6)	13/28 (46.4)
Practice type				
Private practice	3/20 (15.0)	27/40 (67.5)	12/36 (33.3)	42/96 (43.8)
Health department	1/15 (6.7)	9/24 (37.5)	45/128 (35.2)	55/167 (32.9)

[a]The denominator represents the corresponding number of referrals to the study center.

Figure. Flow of children aged 3–5 years arriving for well-child visits at primary care pediatric practice study sites, from well-child visit to completion of an ophthalmology examination: Jacksonville, Florida, May 2007–July 2008



[a]An additional 37 children were screened, for a total of 2,970. However, they were excluded from further analysis because of development delay or autism.

5% and the PPV of screening failure was nearly 80%. These results compare favorably with results from other primary care screening studies.[13,14,20,21] Screening results for 3-year-olds and overall rates of ophthalmology examination completion, however, were poor. Visual acuity screening results among 3-year-olds specifically indicates problems with the use of eye charts for young preschoolers in the primary care setting. The low referral and ophthalmology examination completion rates, however, indicate additional problems related to the acceptance of preschool vision screening by pediatricians, office staff, and parents.

The 77.8% and 87.5% PPV of screening failure among 4- and 5-year-olds, respectively, is consistent with previous studies and supports the potential effectiveness of visual acuity screening in more mature preschoolers. The PPV of the combined screening battery was higher than for visual acuity alone, supporting the added value of screening techniques performed by the pediatrician rather than relying on visual acuity screening alone. The 30.0% PPV for screening failure among 3-year-olds is of great concern. The CI for this PPV was particularly wide because relatively few 3-year-olds completed an ophthalmologic examination, but this result in combination with the high untestability rate, the low referral rate, and the results of the questionnaire indicate significant dysfunction in primary care visual acuity screening of 3-year-old children. For those younger than 4 years of age, objective techniques such as photoscreening are emerging as preferred alternatives to visual acuity testing.[22,23]

This study found a high percentage of 3-year-old children to be untestable. Among individual sites, untestability rates varied greatly and were as high as 42.1%, suggesting variability in successful training or acceptance of screening. Although there are limited comparative data, other studies show similarly high untestability rates among 3-year-olds in the primary care setting.[13,14] Interestingly, our study found that for 86.0% of the children referred because of untestability, visual acuity was measurable in the ophthalmology office. It is therefore unlikely that higher untestability rates at the HD sites occurred because of differences between the HD and PP pediatric populations. Other studies have also found much higher testability rates when visual acuity screening is performed by pediatric eye care providers.[24,25] Reasons for lower testability rates in PP offices may include lack of screening experience,

staff turnover, time constraints, and distractions in the office setting.[12,26–28]

The 24.6% PPV of untestability for the presence of an amblyogenic factor is significantly higher than the prevalence of amblyopia in the general preschool population and also higher than the 16.0% of low-income preschoolers with refractive errors found in a recent study.[29] Abnormal ocular conditions may be twice as prevalent among untestable preschoolers compared with those who pass a screening test.[30] The high rates of untestability and of treatable conditions in the untestable group combined to threaten screening sensitivity. Prompt rescreening or referral should be considered for children who are considered untestable. Rescreening may reduce the rate of referral, but would necessitate additional visits to the pediatrician. This study did not attempt to determine whether rescreening or immediate referral is the better option.

Limitations

This study was subject to several limitations. For one, the study sites failed to screen all eligible children. Documentation of screening events was dependent on completion of data forms, however, and it is likely that some screening was performed but not recorded, resulting in an underestimation of screening rates. Secondly, many children who failed screening were not referred for ophthalmologic examinations. The particularly low rate of referral among 3-year-olds is consistent with previous studies that report lower acceptance among pediatricians of eye chart screening in 3-year-olds.[12,26,27] It is also consistent with the lack of confidence in 3-year-old screening indicated by this study's survey responses.

Thirdly, of screening failures referred, many children did not appear for ophthalmologic examinations. Kemper et al. found that minority and low-income families were less likely to follow up, consistent with the lower rate we found among children referred by the HD sites.[31]

Fourth, the study results related to screening rates, untestability, underreferral, and failure to show for ophthalmologic examinations were suboptimal, perhaps due to incomplete acceptance of screening among staff at certain primary care sites and among some parents. Confirmatory examination and treatment are necessary following a screening failure. For children screened in day care centers, many parents do not follow through to obtain comprehensive eye examinations.[32] Unfortunately, this study demonstrated a similar problem with confirmatory examination completion when screening was performed in the pediatrics office. Lack of follow-up underscores the need for the health-care system to reduce barriers to referral to ophthalmology for preschool children. Additionally, primary care practices must actively track children who have failed vision screening to assure adequate follow-up. In this study, no additional educational materials other than those

Table 4. Primary care pediatric vision screening PPVs of screening failure and untestability for children aged 3–5 years at private practice and health department sites: Jacksonville, Florida, May 2007–July 2008

Variable	*Overall failure vs. any ophthalmic abnormality* N *PPV (95% CI)*	*Overall failure vs. amblyopia factor* N *PPV (95% CI)*	*Visual acuity failure vs. any ophthalmic abnormality* N *PPV (95% CI)*	*Untestable vs. any ophthalmic abnormality* N *PPV (95% CI)*	*Untestable vs. amblyopia factor* N *PPV (95% CI)*
Overall	24/36 66.7 (48.9, 80.9)	21/36 58.3 (40.9, 74.0)	20/31 64.5 (45.4, 80.2)	16/57 28.1 (17.4, 41.8)	14/57 24.6 (14.5, 38.0)
Age (in years)					
3	3/10 30.0 (8.1, 64.6)	2/10 20.0 (3.5, 55.8)	2/9 22.2 (3.9, 59.8)	8/39 20.5 (9.9, 36.9)	7/39 17.9 (8.1, 34.1)
4	14/18 77.8 (51.9, 92.6)	12/18 66.7 (41.2, 85.6)	12/15 80.0 (51.4, 94.7)	6/13 46.2 (20.4, 73.9)	6/13 46.2 (20.4, 73.9)
5	7/8 87.5 (46.7, 99.3)	7/8 87.5 (46.7, 99.3)	6/7 85.7 (42.0, 99.2)	2/5 40.0 (7.3, 83.0)	1/5 20.0 (1.0, 70.0)
Practice type					
Private practice	19/27 70.4 (49.7, 85.5)	17/27 63.0 (42.5, 79.9)	17/25 68.0 (46.4, 84.2)	4/11 36.4 (12.4, 68.4)	4/11 36.4 (12.4, 68.4)
Health department	5/9 55.6 (22.7, 84.7)	4/9 44.4 (15.3, 77.3)	3/6 50.0 (18.7, 81.2)	12/46 26.1 (14.8, 41.4)	10/46 21.7 (11.4, 36.8)

PPV = positive predictive value

CI = confidence interval

Table 5. Post-study assessment of the vision screening process for children aged 3–5 years by primary care practices participating in a vision screening study: Jacksonville, Florida, May 2007–July 2008

	Survey responses		
Assessment of vision screening process	*Private practice mean*[a]	*Health department mean*[a]	*Overall mean*[a]
Ease of screening			
3-year-olds	2.6	1.6	2.0
4-year-olds	4.1	3.0	3.4
5-year-olds	5.0	4.2	4.7
Accuracy of screening			
3-year-olds	2.9	1.8	2.2
4-year-olds	4.3	3.5	3.8
5-year-olds	4.7	4.2	4.2
Effectiveness of tests			
Bruckner	4.3	3.0	3.8
Cover	4.2	3.0	3.6
Red reflex	4.7	5.0	4.8
Corneal light reflex	4.7	4.7	4.7
Impression of parents' reactions	4.6	3.2	3.6
Overall impression	4.5	3.2	3.5
How likely to continue to screen			
3-year-olds	2.8	2.8	2.8
4-year-olds	5.0	4.7	4.8
5-year-olds	5.0	5.0	5.0
Significance of barriers to screening			
Time	3.4	3.8	3.7
Reimbursement	2.6	3.2	3.0
Cost to test	2.3	1.8	2.0
Impression of reliability	1.8	3.0	2.6
Impression of necessity	1.8	2.3	2.2
Training and knowledge	2.5	2.7	2.6
Staff turnover	2.4	2.7	2.6

[a]All responses were on a five-point Likert scale, where 5 = very easy, accurate, effective, important, or likely; and 1 = not at all easy, accurate, effective, important, or likely.

routinely provided by the practices were supplied to parents of children who had failed screening. Perhaps increased education of parents on the meaning of a failed vision screening may increase the proportion seeking appropriate follow-up.

CONCLUSIONS

This study supports the use of visual acuity screening among 4- and 5-year-old children in PPs. For children aged 4 years and older, a visual acuity screening failure indicates a high probability of having a vision disorder and necessitates referral for a comprehensive ophthalmologic examination. This study also generally supports the use of certain additional screening tests for children aged 3–5 years. The study calls into question the effectiveness of eye chart visual acuity screening of 3-year-olds. Visual acuity screening of 3-year-olds, compared with 4- and 5-year-olds, resulted in higher untestability rates, lower referral rates of screening failures, and lower PPVs. The AAP vision screening policy may require modification, recommending that visual acuity screening be initiated at 4 years of age. Substitution of photoscreening for visual acuity screening may be a better option for children younger than 4 years of age. Low primary care screening rates and inadequate rates of referral and completion of an ophthalmologic examination indicate that a different screening device will not in itself result in optimal detection and treatment of vision loss. Rather, improvements are needed in the entire process of preschool vision screening in the primary care setting, from screening to definitive diagnosis and, ultimately, to successful treatment.

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Partners in Immunization: 2010 Survey Examining Differences Among H1N1 Vaccine Providers in Washington State

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ABSTRACT

Objectives. Emergency response involving mass vaccination requires the involvement of traditional vaccine providers as well as other health-care providers, including pharmacists, obstetricians, and health-care providers at correctional facilities. We explored differences in provider experiences administering pandemic vaccine during a public health emergency.

Methods. We conducted a cross-sectional survey of H1N1 vaccine providers in Washington State, examining topics regarding pandemic vaccine administration, participation in preparedness activities, and communication with public health agencies. We also examined differences among provider types in responses received (n=619, 80.9% response rate).

Results. Compared with other types of vaccine providers (e.g., family practitioners, obstetricians, and specialists), pharmacists reported higher patient volumes as well as higher patient-to-practitioner ratios, indicating a broad capacity for community reach. Pharmacists and correctional health-care providers reported lower staff coverage with seasonal and H1N1 vaccines. Compared with other vaccine providers, pharmacists were also more likely to report relying on public health information from federal sources. They were less likely to report relying on local health departments (LHDs) for pandemic-related information, but indicated a desire to be included in LHD communications and plans. While all provider types indicated a high willingness to respond to a public health emergency, pharmacists were less likely to have participated in training, actual emergency response, or surge capacity initiatives. No obstetricians reported participating in surge capacity initiatives.

Conclusions. Results from this survey suggest that efforts to increase communication and interaction between public health agencies and pharmacy, obstetric, and correctional health-care vaccine providers may improve future preparedness and emergency response capability and reach.

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Responding to a public health emergency involving vaccines requires preparation, training, collaboration, and clear communication between public health and frontline health-care providers. As experienced during the 2009–2010 H1N1 influenza vaccination campaign, large-scale public health emergencies involving vaccines or other countermeasures often require the involvement of a diverse set of health-care providers. In addition to providers who routinely administer vaccines (e.g., pediatricians and family practitioners), nontraditional vaccine providers (e.g., obstetricians and correctional health-care providers) can play a vital role in emergency response. Pharmacists are now permitted to administer vaccines in all states. As such, they serve an increasingly important role as community vaccinators during events requiring mass vaccination and were identified during the H1N1 influenza response as a target group for receiving pandemic vaccine.[1–3]

Studies conducted to date on practices of health-care providers during public health emergencies have been limited and mainly conducted in homogeneous groups of traditional providers. However, other providers are often called upon during an emergency response.[4] Pharmacists in particular have been identified as potential first responders, as they often report a willingness to respond in emergency situations.[5,6] Because of their ubiquitous presence in communities (93% of Americans live within five miles of a community retail pharmacy), pharmacists are uniquely situated to provide swift, broad-reaching care.[7] Pharmacists also have increased capacity through extended hours of operation as well as established and streamlined access to prophylactics, and they have established themselves as vaccine providers.[6,8,9]

In addition to pharmacy providers, other unique providers can play important roles during vaccine-related emergencies. Obstetricians can influence maternal immunization, which is particularly important in the context of influenza immunization for both seasonal and pandemic influenza seasons.[10–12] Correctional facility providers often must contend with dangers posed by crowding, inmates' high mixing ratio with the public, and patients with higher susceptibility to infectious diseases.[13] We explored differences in provider experiences administering vaccine during a public health emergency.

METHODS

From September to December 2010, we collected data from a stratified random sample of 800 of 2,523 providers in Washington State who administered H1N1 influenza vaccine to patients and/or staff during the 2009 H1N1 influenza pandemic. We determined our sample size based on an expectation of a 50% response rate, seeking survey estimates accurate within ±5% for all measures. We stratified our sample by the following provider types: traditional family practitioners, nontraditional practitioners, pharmacy providers (including both community and chain pharmacies), women's health providers, government providers, pediatricians, hospital-based providers, and health-care providers at correctional facilities. Descriptions of provider types can be found in Table 1. Based on our desired sample size and research interests, we sampled 100.0% of women's health and correctional facility providers and randomly sampled 27.5% from each strata (provider type) of the remaining providers. The original list of providers who ordered H1N1 influenza vaccine during the 2009 H1N1 influenza pandemic was obtained from the Washington State Department of Health.

Materials

The survey instrument covered the following themes: practice demographics, communication with public health agencies and the public, 2009–2010 H1N1 vaccine administration, staff participation in public health preparedness activities, and use of immunization information systems (IISs). The IIS section pertained specifically to the Washington State Child Profile Immunization Registry.

On September 15, 2010, a fax was sent to all sampled providers informing them about the upcoming survey and outlining the survey goals. Two weeks later, the survey was sent to study participants as a survey kit. Each kit was addressed to the person identified by the Washington State Department of Health as the primary contact for ordering H1N1 vaccine at the practice. Included in the survey kit were a hard copy of the survey instrument, cover letter, frequently asked questions (FAQ) page addressing informed consent topics, postage-paid addressed return envelope, pen, and $25 gift card to Target®. The cover letter described the contents of the survey kit and the survey objectives, provided contact information for the investigators, and indicated ways that respondents could complete the survey (e.g., mail, fax, or online). The FAQ page addressed gift card use, funding source, and ways to complete the survey. It served as a proxy for informed consent by addressing general concerns about confidentiality, the voluntary nature of the survey, and the risks and benefits of the survey. The online survey tool and paper data entry of faxed and mailed surveys was administered using Feedback Server version 2008.[14] A maximum of three phone calls and two fax reminders to nonresponders was conducted by phone and fax in the nine weeks following the survey mailing.

Table 1. Provider types in a survey of vaccine provider preparedness: Washington State, 2010

Provider type	*Description*	*Number sampled (total)*[a]	*Number responded (percent) (n=619)*[b]	*Response rate*[b] *(overall: 80.9%)*
Traditional family	Family practices	221 (795)	147 (23.9)	76.6
Nontraditional	Alternative medicine practices, community vaccinators, rehabilitation practices, occupational health practices, skilled nursing facilities, and specialists	145 (526)	126 (20.5)	84.6
Pharmacy	National or regional chain stores	153 (555)	105 (17.1)	71.4
Women's health	Obstetricians, gynecologists, and women's health/family planning clinics	109 (109)	87 (14.1)	81.3
Government	Department of social and health services facilities, Federally Qualified Health Centers, rural health clinics, community mental health clinics, Indian Health Services facilities, local health jurisdictions, military, Veterans Affairs, and job corps	67 (238)	53 (8.5)	88.3
Pediatric	Colleges, pediatric practices, juvenile group homes, schools, and teen health	39 (141)	45 (7.3)	93.8
Hospital	Emergency medical services (e.g., fire and ambulance responders, hospitals, state hospitals, and urgent care)	35 (125)	28 (4.6)	90.3
Correctional facility	Federal and state prisons, juvenile rehabilitation facilities, and jails	34 (34)	25 (4.1)	80.6

[a]Sample does not exclude those ultimately eliminated from denominator post-hoc.

[b]Stratified numbers exclude three practices that did not indicate provider type and providers eliminated from the denominator post-hoc.

Quantitative analysis

Frequencies stratified by provider type were unweighted and, thus, yielded slightly different percentages from aggregated analyses, which were all weighted. We used pre- and post-stratification weights for the aggregated analysis to limit bias in estimates. We determined pre-stratification weights using probability of selection and determined post-stratification weights using response rates for each provider-type stratum. Descriptive and bivariate analyses are presented as weighted frequencies. We performed bivariate crosstabs between provider strata of interest compared with the other provider types aggregated. Statistical significance was tested using the Rao-Scott design-adjusted Chi-square test for weighted frequencies. We performed statistical analyses using SAS® version 9.2,[15] and results were considered statistically significant at an alpha level of 0.05. These methods were previously described and nonresponse bias was examined in detail elsewhere.[16]

Qualitative analysis

Some survey questions allowed respondents to write in their own answer either to further describe their selection of "other" or in response to a qualitative question. Qualitative answers were compared against answer choices, then categorized and grouped into themes. To analyze open-ended qualitative questions, two researchers collaboratively developed a codebook and each independently categorized and grouped 100% of the data. For all qualitative variables, researcher agreement was ≥70%.

RESULTS

Of the original sample of 800 providers, 765 questionnaires were successfully delivered. A total of 619/765 (80.9%) surveys were completed (Table 1). We excluded three respondents who did not indicate provider type, for a final sample of 616/765 (80.5%).

Stratified results from the survey include demographic variables (Table 2), administration of vaccine to health-care personnel (Table 3), communication with public health agencies (Table 4), guidance from public health agencies (Table 5), and surge capacity (Table 6) and preparedness training.

Demographics

On average, pharmacists reported seeing a greater total number of all patients (including pharmacy clinic patients and those filling prescriptions), older children

Table 2. Demographic variables of vaccine providers in a survey of vaccine provider preparedness: Washington State, 2010

Variable	*Total* N *(percent) or mean (SD)*	*Family medicine Percent or mean*	*Nontraditional Percent or mean*	*Pharmacy Percent or mean*	*Women's health Percent or mean*	*Government Percent or mean*	*Pediatrics Percent or mean*	*Hospital Percent or mean*	*Corrections Percent or mean*
Number of physicians in practice or pharmacy branch									
0	147 (27)	3	16	91	10	8	18	22	4
1–3	249 (39)	50	46	6	41	57	51	19	72
4–6	100 (14)	21	12	0	31	21	22	11	12
7–9	48 (7)	11	8	0	15	4	4	7	12
≥10	70 (13)	16	18	3	2	11	4	41	0
Number of pharmacists in practice or pharmacy branch									
0	411 (63)	84	82	2	95	64	93	46	44
1–2	110 (20)	8	14	49	2	27	5	11	32
3–4	59 (11)	3	3	39	1	2	0	11	20
≥5	33 (6)	4	0	11	1	8	2	32	4
Number of patients seen per day by patient category: mean (SD)									
Children <5 years of age	8.1 (32.5)	7.8	0.9	11.2	0.5	7.2	28.2	3.4	0.0
Children 5–18 years of age	11.4 (34.6)	11.3	2.6	18.2	6.1	10.1	20.5	8.2	6.4
Adults >18 years of age	67.1 (195.4)	52.5	74.5	107.7	34.2	49.1	12.7	97.3	38.8
Pregnant women	4.6 (20.2)	3.8	1.1	4.6	26.3	4.4	0.3	2.5	0.9

SD = standard deviation

Table 3. Administration of vaccine to health-care personnel in a survey of vaccine provider preparedness: Washington State, 2010

Variable	*Total* N *(percent)*	*Family medicine Percent or mean*	*Nontraditional Percent or mean*	*Pharmacy Percent or mean*	*Women's health Percent or mean*	*Government Percent or mean*	*Pediatrics Percent or mean*	*Hospital Percent or mean*	*Corrections Percent or mean*
Administration of seasonal and H1N1 influenza vaccine to staff									
Both offered	552 (92)	95	88	94	87	92	93	89	64
Only seasonal	9 (1)	0	2	2	1	2	2	0	4
Only H1N1	36 (5)	4	8	2	11	2	4	8	16
Neither offered	11 (1)	1	2	2	1	2	0	0	16
Don't know	2 (0)	0	0	0	0	2	0	4	0
Were staff required to receive seasonal and/or H1N1 influenza vaccine?									
Both required	111 (18)	27	12	6	15	31	32	19	12
Only seasonal	11 (2)	3	2	1	1	0	7	0	0
Only H1N1	24 (4)	4	2	1	11	4	3	0	4
Neither required	464 (76)	66	84	92	73	65	57	82	84
Percentage coverage of staff with vaccine during 2009 influenza season: mean (SD)									
Seasonal	80.4 (47.3)	87.0	77.3	72.8	79.3	88.1	86.4	72.6	70.1
H1N1	76.6 (54.0)	85.7	73.5	62.4	84.1	85.9	82.8	76.3	64.0

SD = standard deviation

Table 4. Communication with public health agencies in a survey of vaccine provider preparedness: Washington State, 2010

Variable	*Total* N *(percent)*	*Family medicine Percent*	*Nontraditional Percent*	*Pharmacy Percent*	*Women's health Percent*	*Government Percent*	*Pediatrics Percent*	*Hospital Percent*	*Corrections Percent*
Preferred source of information about public health emergencies									
Federal	239 (40)	38	36	51	30	47	42	29	28
News	46 (8)	6	11	12	9	2	0	4	0
Professional societies	49 (7)	5	6	11	17	4	7	4	4
State health department	286 (45)	43	53	39	56	55	36	46	32
Local health department	410 (66)	73	66	49	64	66	82	75	88
Other	43 (7)	3	9	13	7	8	0	4	4
Top methods used to disseminate information received from public health officials to practice or pharmacy staff									
Face-to-face conversations	443 (70)	75	70	61	82	83	80	43	67
E-mail	351 (56)	52	58	50	55	72	42	89	79
Hardcopy fax/flyers	269 (44)	50	34	43	39	55	56	43	38
Posting in common areas	245 (40)	40	49	30	36	40	38	54	38

Table 5. Usefulness of guidance from public health agencies in a survey of vaccine provider preparedness: Washington State, 2010

Variable	*Total* N *(percent)*	*Family medicine Percent*	*Nontraditional Percent*	*Pharmacy Percent*	*Women's health Percent*	*Government Percent*	*Pediatrics Percent*	*Hospital Percent*	*Corrections Percent*
Usefulness of guidance from state health department									
Very useful	209 (34)	34	38	20	42	46	42	26	24
Useful	228 (38)	37	40	35	37	39	24	56	48
Somewhat useful	96 (16)	15	14	25	12	8	22	11	16
Not useful	18 (3)	1	3	10	2	0	0	4	4
Irrelevant	12 (2)	1	1	6	1	2	2	0	0
Cannot recall	43 (7)	12	5	4	6	6	9	4	8
Usefulness of guidance from local health department									
Very useful	327 (54)	55	56	38	58	59	66	59	68
Useful	184 (31)	32	33	28	31	30	25	26	32
Somewhat useful	62 (11)	8	9	22	7	7	9	15	0
Not useful	4 (1)	0	0	4	0	0	0	0	0
Irrelevant	5 (1)	1	0	2	1	2	0	0	0
Cannot recall	18 (3)	4	3	6	2	2	0	0	0
Ease of adhering to priority group guidelines									
Easy	379 (62)	56	70	59	72	50	67	75	57
Moderate	210 (35)	42	26	38	28	48	31	18	39
Hard	15 (3)	1	4	3	0	2	2	7	4
Barriers to storing and administering H1N1 influenza vaccine									
Storage space for vaccine	105 (16)	18	9	16	26	25	18	15	21
Storage space for supplies	28 (5)	5	3	4	4	14	4	0	8
Staff capacity	56 (10)	7	3	17	5	21	18	12	0
Other	36 (6)	5	10	6	2	12	2	4	0
None	419 (68)	72	82	65	68	46	71	73	79

Table 6. Surge capacity effectiveness of vaccine providers in a survey of vaccine provider preparedness: Washington State, 2010

Variable	*Total* N *(percent)*	*Family medicine Percent*	*Nontraditional Percent*	*Pharmacy Percent*	*Women's health Percent*	*Government Percent*	*Pediatrics Percent*	*Hospital Percent*	*Corrections Percent*
Willing to work with local and state health departments in a future vaccine-related public health emergency									
Strongly agree	334 (56)	56	48	55	54	66	69	54	63
Agree	217 (36)	39	38	35	39	26	31	39	29
Neutral	43 (7)	5	12	9	6	8	0	0	8
Disagree	3 (0)	0	0	1	1	0	0	4	0
Strongly disagree	4 (1)	0	3	0	0	0	0	4	0
Willing to work with public health in the future to distribute nonvaccine countermeasures in the event of an emergency									
Strongly agree	260 (44)	41	40	47	48	42	52	44	46
Agree	210 (36)	39	34	32	34	38	33	37	38
Neutral	111 (18)	19	19	20	18	19	12	11	17
Disagree	7 (1)	1	2	1	0	2	2	0	0
Strongly disagree	8 (2)	0	5	0	0	0	0	7	0
Participation of staff in training sessions or preparedness drills in response to large-scale public health disaster, in past five years									
Yes	268 (44)	40	45	19	33	74	47	89	83
No	198 (32)	32	36	62	30	8	20	4	8
Not sure	146 (24)	27	19	19	37	19	33	7	8
Participation of staff in actual response to large-scale public health disaster									
Yes	80 (13)	10	14	6	12	29	9	29	21
No	319 (53)	48	57	79	43	31	50	36	50
Not sure	209 (34)	42	29	15	45	40	41	36	29
Participation of medical staff in medical surge capacity initiatives (e.g., Medical Reserve Corps)									
Yes	46 (8)	5	6	2	0	29	11	22	17
No	349 (57)	52	57	85	59	33	52	37	54
Not sure	213 (35)	43	38	14	41	39	36	41	29

(aged 5–18 years), and adult patients than other vaccine providers. Pharmacists saw a mean total of 136.7 patients per day (95% confidence interval [CI] 113.1, 160.2), while the daily mean among other providers was 71.4 patients per day (95% CI 61.3, 81.4) (data not shown). Using an indexed value comparing reported number of patients seen per day with the number of physicians and pharmacist practitioners within each practice, pharmacists saw significantly more patients per practitioner per day on average (44.5, 95% CI 37.8, 51.2) (Figure 1) than other vaccine providers (12.6, 95% CI 10.9, 14.2).

Staff vaccine coverage

Pharmacy providers were less likely (7%) to require staff to receive an influenza vaccination (either H1N1 or seasonal influenza vaccine or both) than other providers (29%) ($p<0.001$) (Figure 2a). Pharmacy providers also reported a lower mean staff coverage with seasonal and H1N1 influenza vaccines (73%, 95% CI 68, 78) than other providers (83%, 95% CI 81, 85) (data not shown). Mean coverage among staff with H1N1 influenza vaccine was 62% (95% CI 56, 68) among pharmacy providers vs. 81% (95% CI 78, 83) among other providers (Figure 2b).

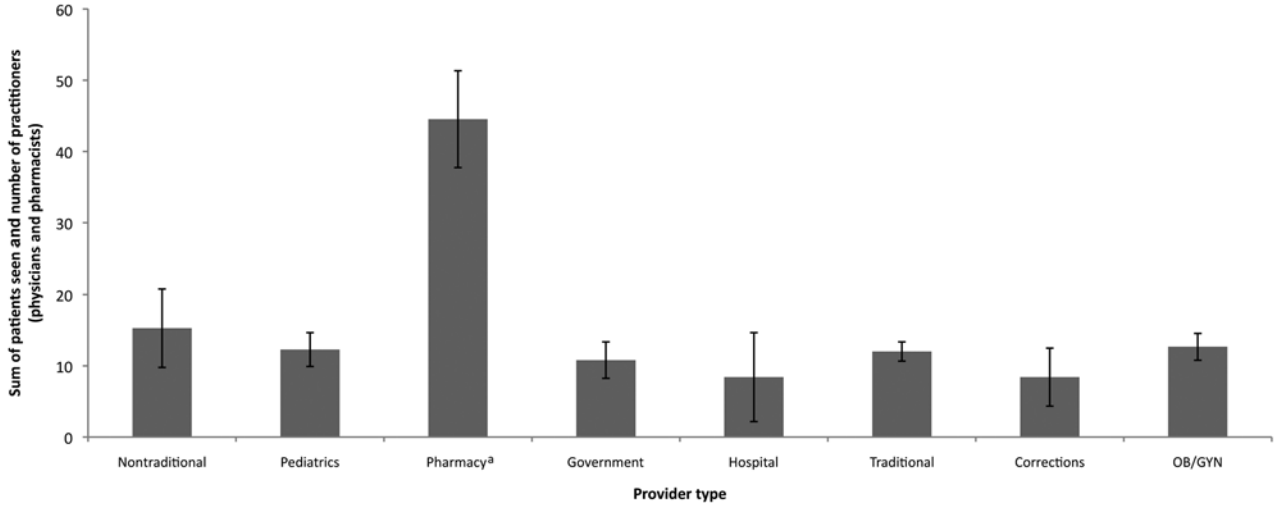
Pediatric (44%) and government (37%) providers were more likely to require staff to receive an influenza vaccination (either H1N1 or seasonal influenza vaccine or both) than other health-care providers (23%) ($p=0.02$) (Figure 2a). Government providers also reported higher coverage among staff with seasonal and H1N1 influenza vaccines (88%, 95% CI 84, 92) than other health-care providers (80%, 95% CI 78, 82) (data not shown). Mean coverage among staff with H1N1 influenza vaccine was 86% (95% CI 81, 91) among government providers vs. 76% (95% CI 73, 78) among other providers (Figure 2b).

Providers based at correctional facilities reported significantly lower coverage among staff with seasonal and H1N1 influenza vaccines (69%, 95% CI 60, 79) than other providers (81%, 95% CI 79, 83) (data not shown). Mean coverage among staff with H1N1 influenza vaccine was 62% (95% CI 50, 74) among corrections providers vs. 77% (95% CI 74, 79) among other providers (Figure 2b).

Preferred sources of information

There were significant differences in preferred sources of information about public health emergencies between pharmacy providers and other vaccine providers. Compared with other providers, pharmacists were more likely to rely upon information from federal sources (51% vs. 38%, $p=0.01$), more likely to rely upon news media sources (12% vs. 7%, $p=0.04$), less likely to rely on local health departments (LHDs) (49% vs. 71%, $p<0.001$), and more likely to rely on other sources, specifically corporate headquarters, internal thought leaders, and professional organizations, as

Figure 1. Mean number and 95% confidence intervals[a] of patients seen daily per practitioner, by provider type, in a weighted analysis of a survey of vaccine provider preparedness: Washington State, 2010[b]



[a]The lines that extend from each bar shows the 95% confidence intervals.

[b]Pharmacy providers were compared with other provider types and had a statistically significant higher mean than each of the other provider types when compared individually.

OB/GYN = obstetrician/gynecologist

Figure 2a. Vaccine requirements among providers in a survey of vaccine provider preparedness: Washington State, 2010

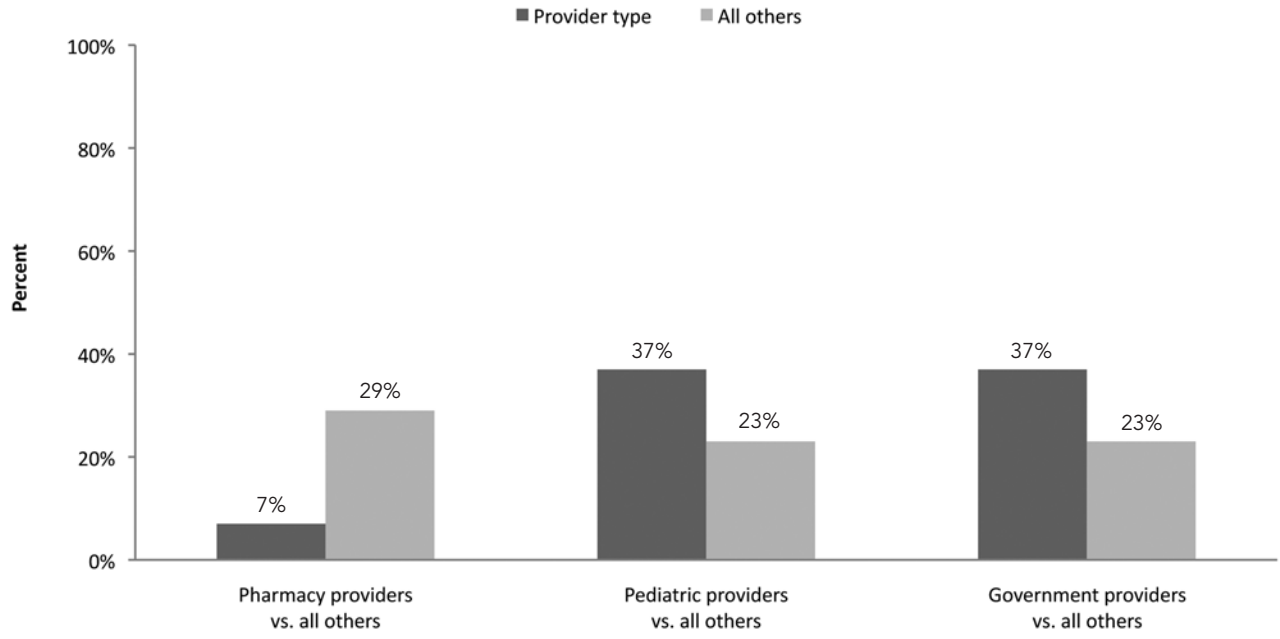
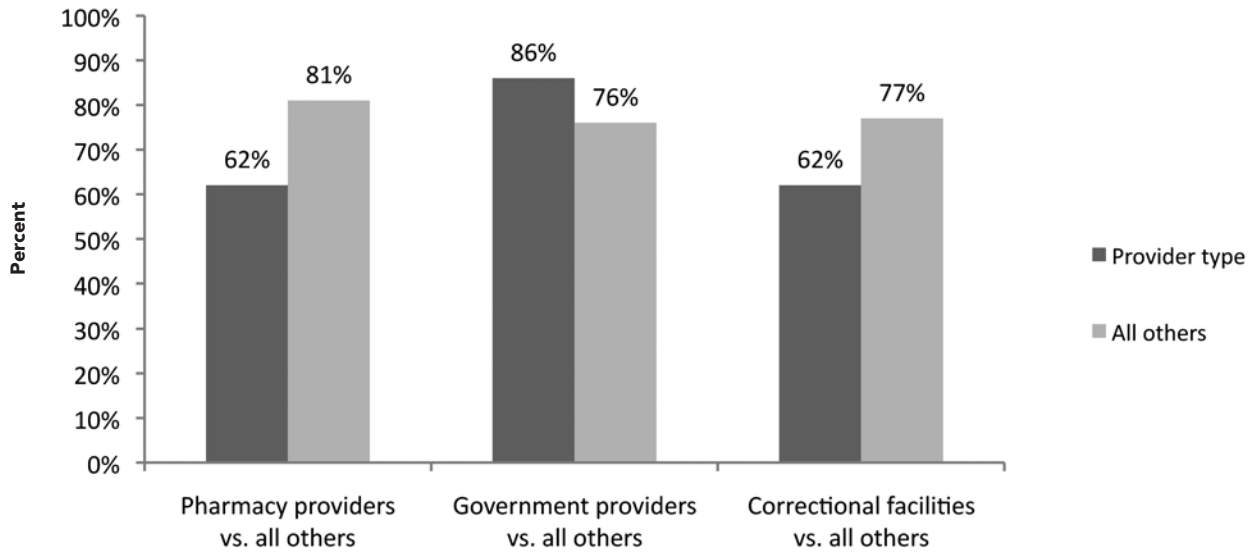
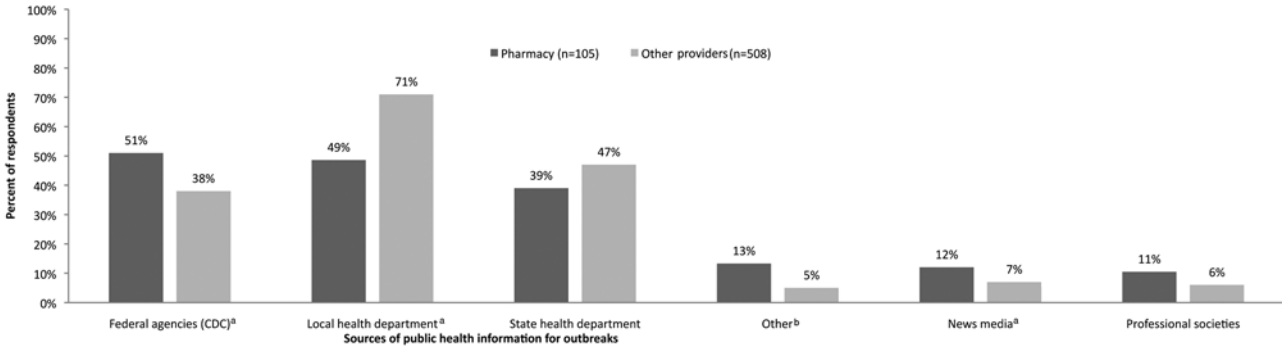


Figure 2b. Staff H1N1 influenza vaccine coverage in a survey of vaccine provider preparedness: Washington State, 2010



indicated in a qualitative analysis of those open-ended responses (13% vs. 5%, p=0.004) (Figure 3a). Those who indicated relying on other sources were given the opportunity to comment on their answer choice. From a qualitative analysis of these comments, 15 cited corporate headquarters, 11 cited internal thought leaders, six cited professional organizations, and three cited public health. Top sources for receipt of emergency-related information among all respondents were LHDs (65.6%), state health departments (45.3%), and federal government agencies (e.g., Centers for Disease Control and Prevention [CDC], 40.2%) (data not shown).

Figure 3a. Preferred sources of public health information in a weighted analysis of a survey on vaccine provider preparedness: Washington State, 2010



[a]Statistically significant at $p<0.05$

[b]"Other" sources from qualitative analysis included these themes: "corporate headquarters," "internal thought leaders," and "professional organizations."

CDC = Centers for Disease Control and Prevention

Usefulness of public health guidance

A majority of respondents rated the guidance received from their state health department and LHDs as useful or very useful. Among all respondents, 72% (437/606) rated guidance received from their state health department as useful or very useful, and 85% (511/600) rated guidance received from their LHD as useful or very useful (Table 5). When compared with other providers, pharmacists were less likely to rate the guidance from their LHD as useful or very useful (71% vs. 91%, $p<0.001$); they were also less likely than other providers to report guidance received from their state health department as useful or very useful (57% vs. 82%, $p<0.001$) (Figure 3b).

Surge capacity and preparedness training

Respondents overwhelmingly reported a willingness to work with local and state health departments in future vaccine-related public health emergencies (56% strongly agreed and 36% agreed) as well as a willingness to work with public health in the future to distribute nonvaccine countermeasures in the event of an emergency (44% strongly agreed and 36% agreed). Among all respondents, 44% reported staff participation in preparedness training, 13% reported staff responding to an actual large-scale public health disaster, and 8% reported staff participation in medical surge capacity initiatives during the past five years (Table 6).

Providers varied in terms of participation in preparedness training, response to public health emergencies, and surge capacity initiatives (e.g., Medical Reserve Corps). Among all respondents, 43.3% reported staff participation in training sessions or preparedness drills for large-scale public health disasters within the past five years. Thirteen percent of respondents reported staff participation in actual response(s) to large-scale public health disasters, and 7.9% reported medical staff participation in medical surge capacity initiatives.

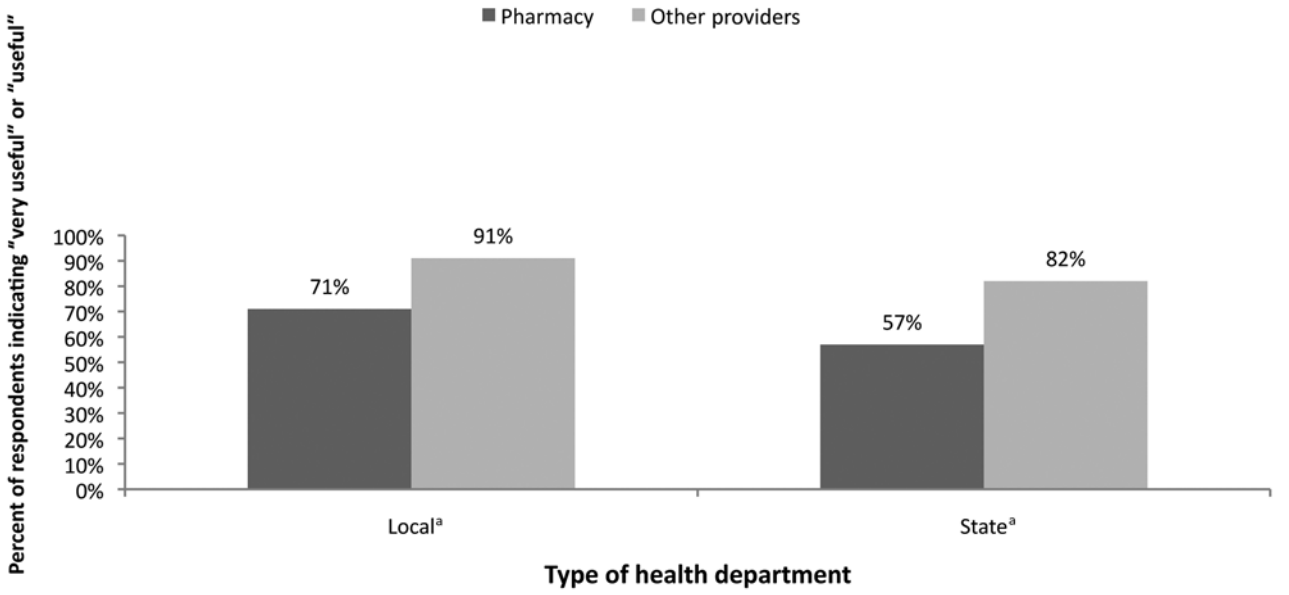
Pharmacists were less likely than other providers to participate in all three types of preparedness activities: 19% of pharmacists vs. 50% of all other vaccine providers participated in preparedness training ($p<0.001$), 6% of pharmacists vs. 14% of other vaccine providers participated in actual response(s) to public health disasters ($p=0.017$), and 2% of pharmacists vs. 9% of other vaccine providers had medical staff who participated in surge capacity initiatives ($p=0.014$) (Figure 4). No obstetricians reported participating in surge capacity initiatives.

DISCUSSION

Washington State vaccine providers vary in terms of public health preparedness, especially among pharmacy providers, obstetricians, correctional facilities, and government providers. Our survey provides evidence that pharmacy providers may be able to have a broad impact during a widespread emergency response, especially if they engage in capacity building beforehand.

Pharmacy providers have higher patient volume, lower proportion of respondents with vaccination mandates, lower reliance on LHDs, and less preparedness training and experience compared with other

Figure 3b. Perceived usefulness of guidance from health departments in a weighted analysis of a survey on vaccine provider preparedness: Washington State, 2010



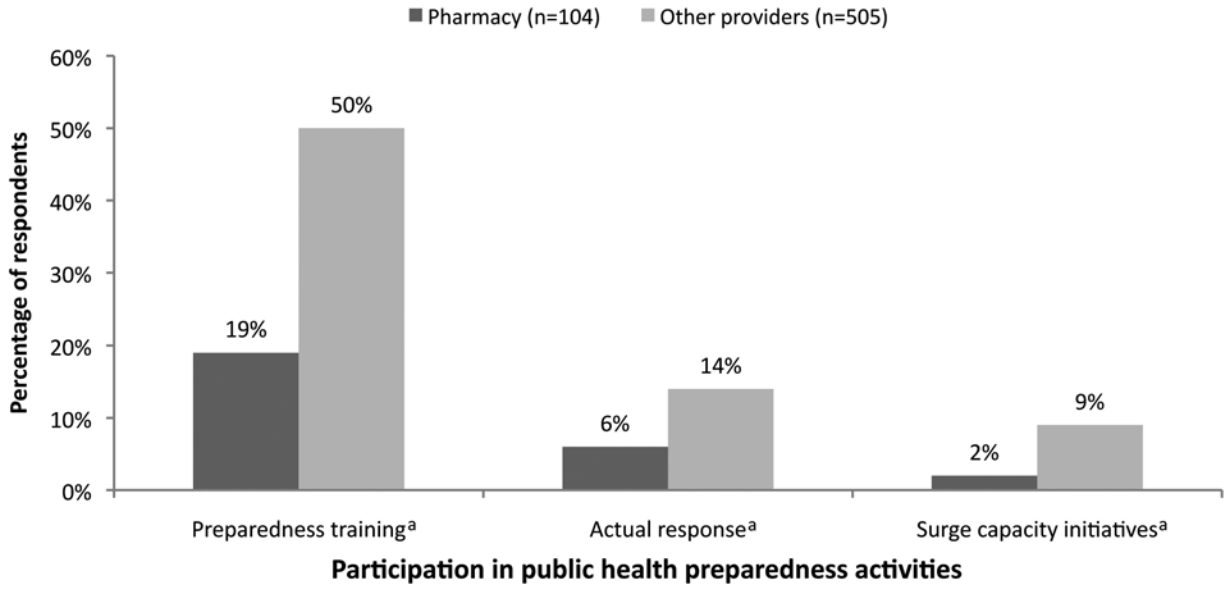
[a]Statistically significant at $p<0.0001$

provider types. Pharmacy providers differ from other types of providers in terms of staff influenza vaccination, communication with local public health, and preparedness training. While pharmacy providers were not the only provider type to report lower proportions of staff receiving influenza vaccine in our survey, it may be a concern—given the large number of people they serve—that pharmacy providers were both less likely to require staff vaccination and less likely to report receiving seasonal or pandemic influenza vaccination themselves. Correctional facilities also reported lower staff receipt of influenza vaccine in contrast with higher participation in surge capacity initiatives. This gap may be important to address given the vulnerabilities specific to the correctional setting, especially in crowded facilities.[13]

By contrast, pediatric and government providers were more likely to require staff to have these influenza vaccines, and government providers reported higher coverage of receiving them. During the H1N1 response, the Advisory Committee on Immunization Practices prioritized health-care providers in their recommendations for who should receive the vaccine due to their potential to further spread the virus and the impact absenteeism among this population would have on surge capacity.[17] Many respondents made comments suggesting that even when not required for staff, vaccination was highly recommended or strongly encouraged by their employer. In qualitative analysis, providers reported that staff members were sometimes given alternatives to vaccine such as signing a letter or waiver, or wearing a mask and gloves at all times. Although we believe overall self-report of staff vaccination may be overestimated (mean = 80%, median = 90%, mode = 100%), coverage estimates were high, suggesting that these alternatives may be important factors in improving health-care provider vaccination rates in the absence of mandates.

Compared with other providers, pharmacy providers relied more on federal sources for public health information and less on LHDs than other providers. Also, they have a lower perceived usefulness of guidance from state health departments and LHDs. These factors suggest that outreach between pharmacy providers and health departments may be warranted. In the increasingly parsimonious circumstances of local government, traditional providers with long established relationships may be the most adept at garnering information exchange and collaboration. Pharmacy providers' lower perceptions of usefulness of information from state health departments and LHDs may reflect their reliance on other sources for information, such as chain headquarters, which rely on federal sources, and professional organizations such as the American Pharmacists Association and the National Association of Chain Drug Stores.

Figure 4. Training, emergency response, and surge capacity participation for pharmacy providers vs. other providers in a weighted analysis of a survey on vaccine provider preparedness: Washington State, 2010



[a]Statistically significant at $p<0.05$

Although pharmacists can now administer immunizations in all 50 states, laws governing which vaccines may be administered and to whom vary by state.[1,18] Given pharmacists' ubiquitous presence in communities, improving pharmacy participation in emergency preparedness training may significantly bolster overall emergency response. A multifaceted approach for pharmacy outreach should account for differences in state and local laws and ensure that consistent messages are coordinated through professional organizations and public health partner organizations, such as the Association of State and Territorial Health Officials, the National Association of County and City Health Officials, and CDC.

It is encouraging that attitudes about willingness to respond to future emergencies were comparatively positive and homogenous among all providers, with 92% indicating that they were willing to respond to future disasters. Preparedness training experience indicators were low overall, particularly among pharmacists (19%) and obstetricians (33%). These provider types are prime targets for preparedness training exercises because pharmacists are trusted and have broad reach in their communities.[5] Similarly, obstetricians have a specific reach among pregnant women, an important vulnerable population to consider during a pandemic.[11]

Because government providers can constitute a vital on-the-ground delivery system for emergency vaccine, it was unexpected that government providers were more likely to report having staff capacity barriers to providing mass vaccine. Partnering with pharmacy providers during seasonal influenza vaccination campaigns may be a strategy for health departments to build collaborative relationships for future responses and consequently resolve some of these barriers.

Limitations and strengths

This study was subject to several limitations. As with any survey of this kind, self-report may be a source of recall bias. Our high response rate both overall and among provider types was a predominant strength that limits other sources of bias. Van Otterloo et al. found few significant differences among early and late responders to this survey, which may serve as a proxy for nonresponders.[16] The index we created post-hoc to compare patient volume by provider type may not reflect how many patients each provider sees on a daily basis, but rather an average for a given period of time. Any bias resulting from this calculated variable would likely be nondifferential across provider types.

CONCLUSIONS

The Pharmacists' Guide to Pandemic Preparedness, developed in 2007, advocates for pharmacists to serve as first responders, participate in community planning

and training opportunities, plan for emergency supplies of vaccines and other countermeasures, and plan for unique administrative changes during a pandemic.[19] Our study results suggest that building connections for partnership and communication among public health agencies, professional organizations, and pharmacy providers may have a positive and important impact on preparedness for public health emergencies and leveraging the extensive community reach of pharmacy providers during a response effort. Additionally, our results suggest that increasing preparedness knowledge and participation in training exercises and surge capacity initiatives among pharmacists, obstetricians, and correctional health-care providers may be vital steps toward emergency preparedness improvement.

The authors thank the health-care providers who responded to this survey for their valuable contributions; Mitch Rothholz for his guidance in clarifying pharmacy communication structures; the statistician, Paul Weiss, for assistance with the sampling strategy; and graduate research assistants Joshua Van Otterloo, Andrea Fletcher, Meghan Griffin, Katharina van Santen, and Koo Whang-Chung for their assistance with data collection and data cleaning related to the survey.

The Emory University Institutional Review Board (IRB) approved the study as exempt (#0004491). The Washington State IRB approved the study as non-human subject research (#E-072110-H). The authors obtained informed consent using a frequently asked questions document, delivered with the survey by courier, which addressed the purpose, risks and benefits, confidentiality, incentives, and voluntary nature of the survey.

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Using GIS and Secondary Data to Target Diabetes-Related Public Health Efforts

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ABSTRACT

Objectives. To efficiently help communities prevent and manage diabetes, health departments need to be able to target populations with high risk but low resources. To aid in this process, we mapped county-level diabetes-related rates and resources/use using publicly available secondary data to identify Michigan counties with high diabetes prevalence and low or no medical and/or community resources.

Methods. We collected county-level diabetes-related rates and resources from Web-based sources and mapped them using geographic information systems (GIS) software. Data included age-adjusted county diabetes rates, diabetes-related medical resource and resource use (i.e., the number of endocrinologists and percentage of Medicare patients with diabetes who received hemoglobin A1c testing in the past year), community resources (i.e., the number of certified diabetes self-management education and diabetes support groups), as well as population estimates and demographics (e.g., rural residence, education, poverty, and race/ethnicity). We created GIS maps highlighting areas that had higher-than-median rates of disease and lower-than-median resources. We also conducted linear, logistic, and Poisson regression analyses to confirm GIS findings.

Results. There were clear regional trends in resource distribution across Michigan. The 15 counties in the Upper Peninsula were lacking in medical resources but higher in community resources compared with the 68 counties in the Lower Peninsula. There was little apparent association between need (diabetes prevalence) and diabetes-related resources/use. Specific counties with high diabetes prevalence and low resources were easily identified using GIS mapping.

Conclusion. Using public data and mapping tools identified diabetes health-service shortage areas for targeted public health programming.

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Diabetes is endemic in the United States and its prevalence is increasing. From 2004 to 2010, the age-adjusted rate of diabetes among adults rose from 7.3% to 8.4%, and annual incidence rates continue to rise.[1,2] Type 2 diabetes accounts for approximately 95% of diabetes cases,[3] and this increased prevalence has been attributed primarily to lifestyle changes and the increasing rates of obesity in the U.S.[4–6]

Diabetes is a chronic condition that involves a considerable amount of medical care as well as careful disease self-management.[7] In addition to regularly scheduled primary care visits and endocrinology visits for complicated cases,[8] those with diabetes must adhere to appropriate self-management practices, including glucose monitoring; foot self-examinations; and regimens for nutrition, exercise, and prescribed medications.[9,10] These lifestyle changes can be confusing, especially regarding nutrition, and adherence is difficult.[11,12] However, public health strategies, such as individual and group health education within clinic and community settings, have proven effective in facilitating these changes.[13–16] As a result, diabetes self-management education (DSME) programs are recommended by the American Diabetes Association (ADA) for all people diagnosed with diabetes.[17,18] Diabetes support groups have also emerged as a popular community resource for diabetes management.[19]

Unfortunately, demand for these services is rising at a time that public health budgets are shrinking.[20,21] In the face of limited public health funds, developing strategies to accurately target services is crucial. Historically, public health data have played a key role, frequently through large-scale surveillance efforts and longitudinal survey studies.[22,23] However, the expense of collecting these data places them outside the reach of most state and local public health efforts. The increased availability of electronically, publicly accessible health-related information[24,25] can allow state and local systems to more efficiently target diabetes programming.[26] This study describes one such method that was conducted using county-level Michigan data coupled with geographic information systems (GIS), a powerful tool for identifying and communicating problem areas. The purpose of this study was to demonstrate the utility of secondary data analysis and GIS in determining if diabetes rates were associated with diabetes-related resources and resource use, as well as to identify diabetes-related high need/low resource counties within Michigan.

METHODS

Design

We conducted a secondary data analysis using GIS and electronically available published county-level Michigan data. We collected data through two methods: exporting existing datasets and abstracting information published on various websites. Three types of data were collected for each of the 83 counties: diabetes-related health information, population demographics, and diabetes resources and their use. The study region, the state of Michigan, reflects the national trend of increased diabetes, with age-adjusted prevalence growing from 7.7% in 2004 to 9.2% in 2010.[27]

County attribute dataset compilation

Diabetes-related health data. Due to the positive association between obesity and diabetes,[5,6] county-level age-adjusted diabetes (2005–2009) and obesity (2009) rates were exported from the Centers for Disease Control and Prevention (CDC) website.[28] CDC prevalence estimates were derived from survey responses collected in the Behavioral Risk Factor Surveillance System[29] and combined with annual population estimates from the U.S. Census Bureau's Population Estimates Program.[30] Diabetes rates were based on the percentage of adult survey respondents who replied "yes" when asked, "Has a doctor ever told you that you have diabetes?" Age-adjusted rates were used to account for the different age distributions within each county. To illustrate the increase in counties meeting the 2009 highest quartile cutoff for diabetes prevalence in Michigan during 2005–2009 (i.e., a rate of 9.5 per 100,000 population), counties were categorized into four groups based on 2009 diabetes prevalence quartiles. Obesity rates were based on the self-reported height and weight of these same respondents; the body mass index (BMI) category was subsequently calculated from these data. The percentage of county adults with an obese BMI were categorized into low obesity counties (i.e., an obesity rate at or below the state median) and high obesity counties (i.e., obesity rates above the state median).

Population size and demographics. Because of the positive association between diabetes and lower socioeconomic status,[31] rural geography,[32] and minority race/ethnicity,[33] we also collected information regarding demographics. The 2009 county population and demographic estimates (race/ethnicity, living in a rural setting, and education) were exported from the County Health Rankings website[34] and based upon the Dartmouth Atlas of Health Care,[35] which drew the population, rural residence, and race/ethnicity figures from 2009 U.S. Census Bureau data. For the education-level

variable, the County Health Rankings used data from 2006–2010 to determine high school graduation rates (i.e., the percentage of county adults aged 25 years or older with a high school degree or general equivalency diploma). The remaining demographic variable, poverty rate, was defined by the percentage of households with incomes lower than the federally defined poverty rate in 2009 and was manually abstracted from the U.S. Census Bureau website.[36]

Diabetes resource availability and use. Data on medical resource use (hemoglobin A1c [A1c] testing) and availability (endocrinologists) and community-based resources (DSME programs and support groups) were collected and summarized for each county. A1c testing, exported from the County Health Rankings website[34] and based upon the Dartmouth Atlas of Health Care,[35] was measured as the percentage of Medicare patients with diabetes who received at least one A1c test in the previous year, and reflected rates from 2009. The number of endocrinologists practicing in each county in 2010 was abstracted from the Ucompare Healthcare website[37] and expressed as a rate by dividing this number by 100,000. If an endocrinologist practiced in more than one county, that person was counted in both counties.

The number of DSMEs within each county was manually abstracted from the ADA website,[38] and the number of diabetes support groups was abstracted from the Michigan Diabetes Outreach Network website in 2010.[39] Similar to the endocrinologist variable, both community resource variables were depicted as rate per 100,000 residents.

For mapping purposes, a county was considered low in a resource when the rate was either at or below the statewide median rate for that resource. Conversely, a county was defined as high in a resource when the county resource rate was above the state median rate.

Developing study maps. Study maps were created using ArcGIS® version 10.2.[40] A shapefile for the state of Michigan containing county boundaries was imported from the Michigan Center for Geographic Information website.[41] The state map layer was then joined to the county attribute dataset using the five-digit Federal Information Processing Standard county code.

Spatial and statistical analyses. The maps were examined visually to identify low resource/high diabetes counties. Following visual analysis, we used multivariate regression analyses to determine if age-adjusted diabetes rates were predictive of A1c testing after controlling for percentage rural, percentage of population of minority race, percentage of population living below the federal poverty level (FPL), and percentage of the population that are high school graduates. The same four covariates were controlled for in modeling whether age-adjusted diabetes rates predicted endocrinologists, DSMEs, and support groups. Due to zero-inflated data, endocrinologists, DSMEs, and support groups were modeled using a two-part regression.[42] First, we modeled the chances of observing zero using binary logistic regression, where each resource was defined as "yes" (having at least one resource in the county) or "no." This modeling was followed by a Poisson regression in which the logarithms of the mean of the nonzero responses were modeled. Regression coefficients were estimated using the Expectation-Maximization algorithm.[43] We considered the same sets of county-level covariates for both; however, the choice of covariates in the final Poisson models was impacted by the requirement for the zero-inflated Poisson regression that the design matrix of the covariates for the nonzero part be of full rank. This requirement led to different sets of covariates for DSMEs and support groups vs. endocrinologists (Table) to satisfy this criterion.

The alpha level was set at 5% while performing two-sided hypotheses. Statistical analyses were conducted using R software[44] along with the Political Science Computational Laboratory package contributed by Simon Jackman (Stanford University), Alex Tahk, Achim Zeileis, Christina Maimone, and Jim Fearon.[45]

RESULTS

Diabetes prevalence

The series of maps displayed in Figure 1, created for the years 2005–2009 and categorized using 2009 quartiles, demonstrates the increasing prevalence of diabetes across the state overall. However, this increasing trend appears to have slowed in the Upper Peninsula compared with the Lower Peninsula, where the percentage of counties in the highest quartile (as defined by 2009 state numbers, ≥9.5%) decreased from 27% in 2008 (four counties) to 13% in 2009 (two counties). In the Lower Peninsula, during the same time period, 9% of counties (n=6) were in the highest state quartile in 2008 compared with 25% of counties (n=17) in 2009.

Medical resources/resource use

Testing levels for A1c ranged from 67% to 95%, with a median of 86%. Twenty-nine percent of Michigan's 83 counties had one or more endocrinology practices, with a median rate of 0 per 100,000 residents (rates ranged from 0.0 to 10.9). When these medical resources and resource use factors were examined against diabetes rates, there appeared to be no relationship between the rates and the availability of these factors. There were

Table. Association between age-adjusted diabetes rates and resource availability and use in Michigan counties (*n*=83), 2009–2010

	Medical		*Community*	
	A1c[a,b] *Beta SE (p-value)*	*Endocrinologist*[a,b] *Beta SE (p-value)*	*DSME*[a,c] *Beta SE (p-value)*	*Support group*[a,c] *Beta SE (p-value)*
Variable	*Linear regression*	*Logistic regression*	*Logistic regression*	*Logistic regression*
County-level age-adjusted diabetes rate	−0.793 0.66 (0.231)	1.508 0.84 (0.072)	10.630 5,218.57 (0.998)	17.974 20.49 (0.380)
		Poisson regression	*Poisson regression*	*Poisson regression*
County-level age-adjusted diabetes rate	NA	−0.213 0.19 (0.271)	−0.220 0.17 (0.197)	0.013 0.15 (0.933)

[a]A1c = percentage of Medicare patients receiving an A1c test in the previous year, 2009. For endocrinologist, DSME, and support group outcome variables, each was modeled as having the resource in the county, yes or no, for binary logistic regression and then nonzero counts were modeled using Poisson regression.

[b]Model controlled for percentage rural, percentage nonwhite minority, percentage below poverty level, and percentage of high school graduates.

[c]Model controlled for percentage rural, percentage nonwhite minority, and percentage below poverty level.

A1c = hemoglobin A1c

DSME = diabetes self-management education

SE = standard error

NA = not applicable

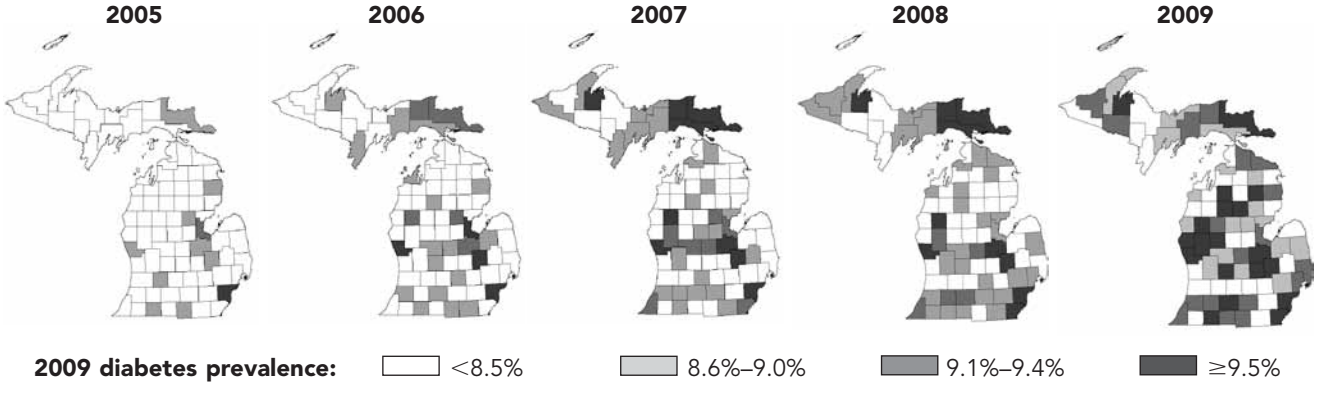
clusters of higher A1c testing rates in the Western and Northeastern part of the Lower Peninsula as well as the mid-portion of the Upper Peninsula. There was a lack of endocrinologists in all but Southeast Michigan and in a couple of counties in Northern Michigan.

Twenty-nine of Michigan's 83 counties were low in both medical resources and use. In the Upper Peninsula, the two counties with the highest diabetes rates in 2009 had lower-than-median medical resources/use in 2009. In the Lower Peninsula, less than one-third (four of 14) of low medical resource/use counties were also high in diabetes (Figure 2).

Community resources

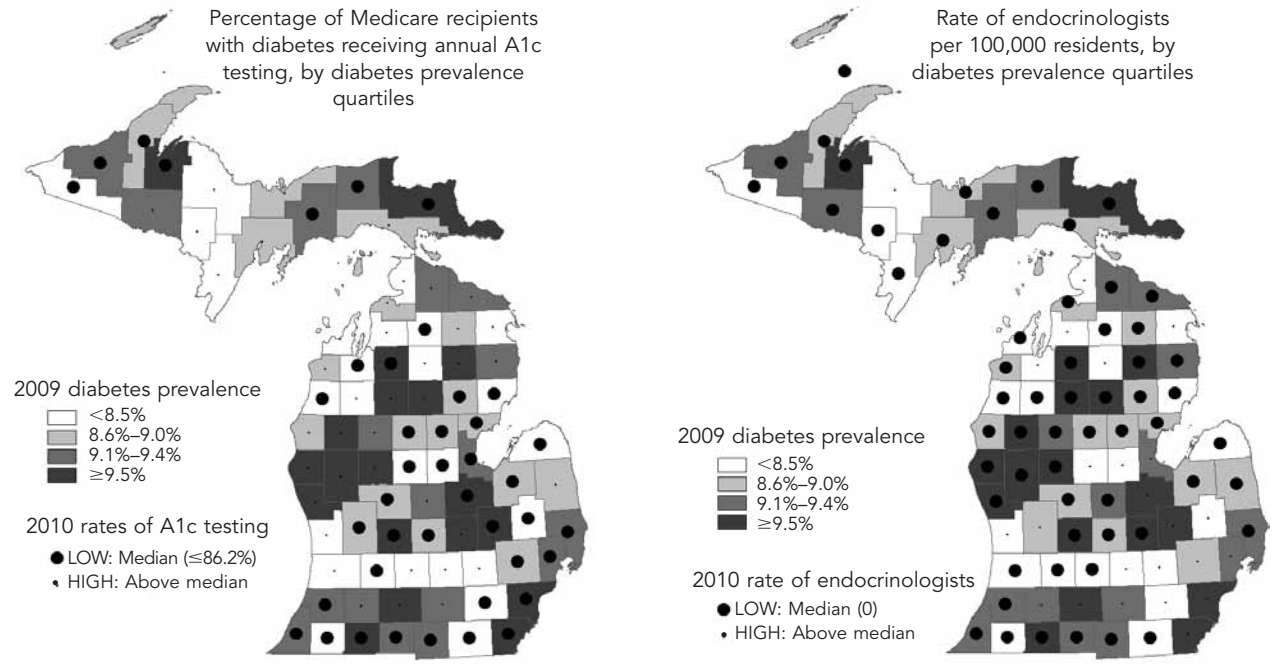
Similar numbers of counties had DSMEs and support groups: 68.7% had one or more DSMEs and 69.9% had one or more support groups in operation. The median rates of these resources were 1.0 per 100,000 population for DSMEs and 1.4 per 100,000 population for support groups. The rate of DSMEs ranged from

Figure 1. Five-year trend of age-adjusted diabetes prevalence for Michigan counties using 2009 quartile categorization[a]



[a]Data were categorized in quartiles by 2009 prevalence rates (percentage of adult population).

Figure 2. Maps of Michigan age-adjusted diabetes prevalence and medical resource availability and utilization (2009–2010)



Alc = hemoglobin Alc

0.0 to 14.9 per 100,000 population, and the rate of support groups ranged from 0.0 to 29.7 per 100,000 population. When examining diabetes rates overlaid by diabetes-related community resources, there again appeared to be no association between rates and resources. Higher rates of both DSMEs and diabetes support groups were clustered in the Upper Peninsula regardless of diabetes rates (Figure 3).

Low resources/use and high diabetes rates

Taken together, three counties in Michigan were identified as higher than the median on diabetes rates and lower than the median on all four measures of resources and their use: Berrien, Ionia, and Van Buren counties. All three counties are located in the southern part of the Lower Peninsula; Berrien and Van Buren counties are in the southwest corner of the state and Ionia is in the central, southern part of the state.

Target population illustration

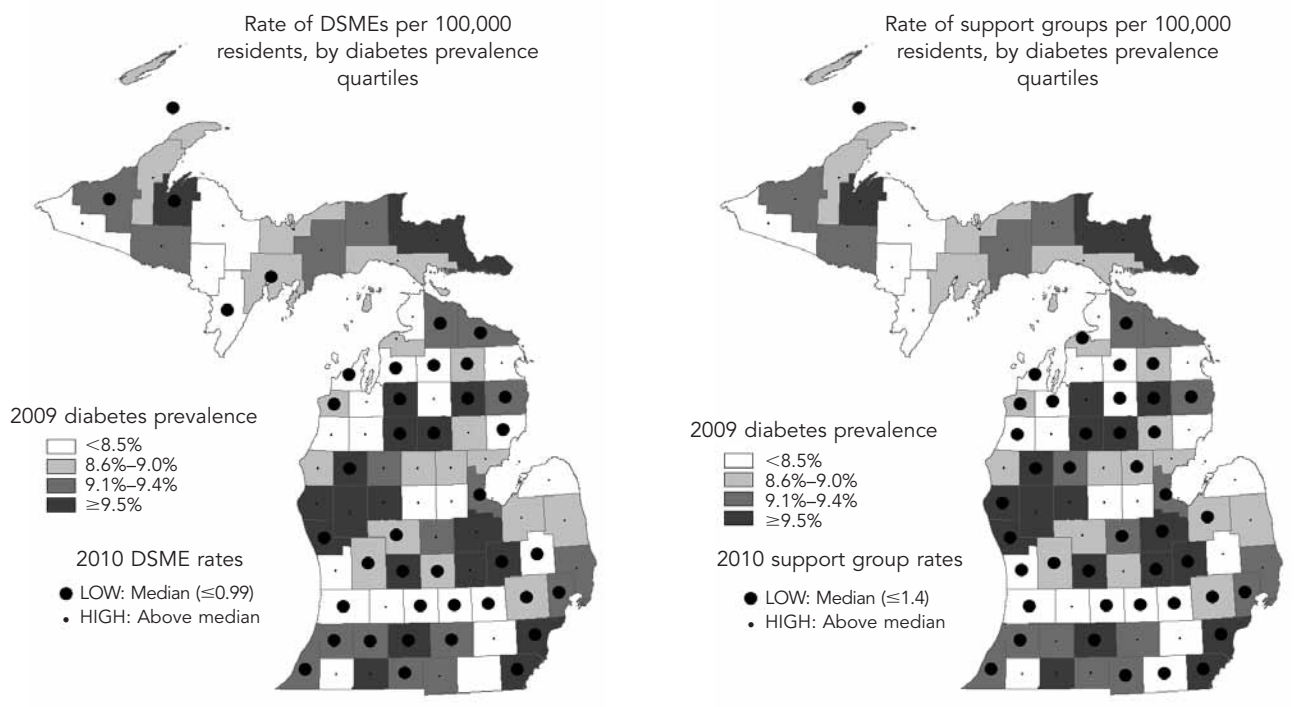
Two example maps were created to illustrate the potential of such maps to highlight pockets of high need or regions with a particular target population for diabetes-related interventions. The first map in Figure 4 highlights counties with higher than state median diabetes and poverty rates as well as a higher-than-median percentage of minority populations (nonwhite) for interventions targeting low-income minority populations with diabetes, with clusters noted in West Michigan, in the Bay county region, in Chippewa county in the Upper Peninsula, and in Wayne County (Detroit). The second map shows 16 high diabetes/high obesity/low high school graduation rate counties; the counties are similar to the first map, with notable differences in the Upper Peninsula and the most southern portion of the Lower Peninsula, where the target areas shifted east.

Regression analysis

Similar to the GIS findings, the multivariate regression results indicated that diabetes rates were not associated with any of the county resource/use measures after controlling for other factors (Table). A multivariate linear regression model of those with diabetes in Medicare receiving at least one A1c test in the previous year found no association with age-adjusted county diabetes rates (beta=−0.793, p=0.231).

For each of the zero-inflated outcome variables (endocrinologist, DSMEs, and support group), two sets of regression (logistic and Poisson) results are shown for the age-adjusted diabetes rates. Age-adjusted diabetes rates were not statistically significantly related

Figure 3. Maps of Michigan age-adjusted diabetes prevalence (2009) and community resources (2010)



DSME = diabetes self-management education

to any of the resources in either the logistic or Poisson models ($p>0.05$).

DISCUSSION

This study illustrates the utility of accessing publicly available secondary data combined with GIS maps to examine resource gaps and target interventions. Policy-relevant findings were obtained quickly, on a relatively low budget, with no threats to human subjects, and with exemption from the Western Michigan University Institutional Review Board. By geographically examining the entire state at the county level, this study demonstrated the wide variation in medical and community resources across the state, a variation that had little apparent link to the severity of a county's diabetes problems, but did show regional and temporal trends. Geographically, the Upper Peninsula was found to be lower in medical-related resources/use and higher in community-based resources, particularly support groups, compared with the rest of the state. Three counties in southern Michigan (Berrien, Ionia, and Van Buren counties) were also identified as being high in diabetes rates and lower than the median on all resources/use. The overall lack of a disease rate-resource relationship was confirmed with regression modeling; however, the regional trends were identified through the visual analysis of the maps, an interpretation that can be completed without any statistical expertise.

The study findings highlight several health-service shortage areas across medical and community resources. The median percentage of Michigan Medicare recipients receiving at least one A1c test in the previous year, a primary medical management tool, was 86% in 2009, far below the ADA-recommended 100% testing twice a year.[9] While increased work is needed in this area across the state, it is especially needed in the cluster of lower testing counties seen in the east and south of the Lower Peninsula and east and west ends of the Upper Peninsula. Also related to medical resources, there was one endocrinology practice for every 3,774 patients with diabetes in Michigan; this shortage is typical across the U.S.[46] However, the finding that the availability of endocrinologists per diabetes patient was unevenly spread throughout the state is important to note. Those in the northern part of the state will likely have to travel much farther, and may have to wait much longer, to access this resource.

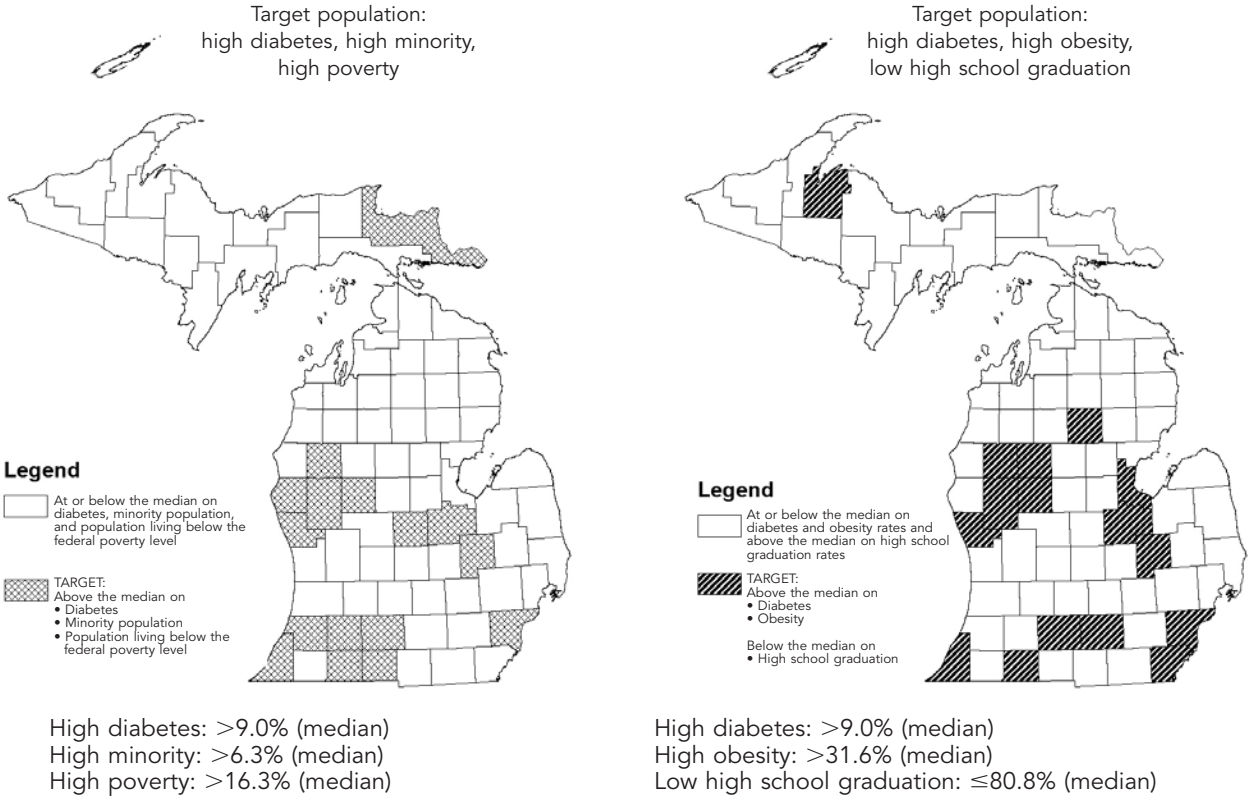
A key component of diabetes self-management is

health education. Diabetes education is recommended for all diabetes patients upon diagnosis and as needed thereafter.[8,9] However, less than 70% of counties had at least one ADA-certified DSME program per 100,000 population with diabetes. Also, the rate of DSMEs was actually lower in a number of high prevalence areas, such as Detroit. Although there is less evidence regarding the effectiveness of support groups, they are a tool that can be used to help those with diabetes self-manage their disease.[47] The pattern of support groups was somewhat similar to the pattern for DSMEs; the rate was highest in the Upper Peninsula. This finding is different from the medical-related resources/use that were generally more plentiful in the Lower Peninsula compared with the Upper Peninsula.

While this study was one of the first to combine geographic and secondary data to examine an entire state for the county-level distribution of resources relative to the diabetes problem, GIS and public health data have multiple applications in health policy. For example, they can be used to model the spread of infectious diseases to identify vectors, pinpoint spatial clustering of health events, and investigate health disparities.[48] In a diabetes-related example, one study used national data at the ZIP Code level to determine the impact of disease management programs on geographic regions with high diabetes rates and high densities of minority populations. It found that individuals from high minority areas benefited most from the programs, with a greater increase in A1c testing rates.[49] Mapping study figures clearly communicates the results to a range of audiences, from community groups to policy makers and administrators, showing statistical relationships through a medium that is commonly understood. When linked with publicly available health information, which is becoming more and more plentiful,[50] this method has tremendous potential to inform health administration and community advocacy.[48,51]

The types of spatial and health data used in this study are widely available, an important factor in policy-relevant research.[52] Spatial shapefiles and community-level demographic data, such as that used in the current study, are obtainable online through U.S. Census TIGER/Line® Shapefiles and associated aggregated U.S. Census data. Summary public health data are available through federal and state surveillance

Figure 4. Identifying target populations for diabetes intervention in Michigan counties[a]



[a]"High" denotes greater than the state median. All data are from 2009, except percentage of county residents who were high school graduates, which was calculated using County Health Rankings data from 2006–2010. Diabetes rates are age-adjusted.

systems, disease registries, and posted health survey data such as the County Health Rankings, which were used in this study. Health utilization data are available in geographic units, such as ZIP Codes, through hospital discharge data, and in a multitude of proprietary databases maintained by health systems and insurance companies.[53] Health-care resource and provider information, as with all of the resource data for this study, can be obtained through Internet searches for specific locations and through directories of professional organizations, such as the ADA, the American Hospital Association, and the American Medical Association.

The potential of GIS and health data can be further extended when supplemented with primary data, such as that collected through surveys and interviews. Typically, as is the case with diabetes, these data can be implemented in smaller geographic units. For instance, a study was conducted that used GIS data collected from interviews regarding places that individuals most frequently visited to aid in targeting a culturally sensitive diabetes prevention program in one rural, southern community.[54] This mixed-methods GIS approach has been used in other diabetes-related public health assessments to examine the effectiveness of programming,[47] the health outcomes of a community,[55,56] the relationship of socio-environmental factors to disease outcomes,[57] and the association of social network and health knowledge.[58] Another survey study in Genesee County, Michigan, identified an important problem-resource gap: those living in ZIP Codes with the highest risk for diabetes were the least likely to receive diabetes screening.[59] This finding is consistent with the lack of association between resources and rates in the current study.

Limitations

Although all counties were included in the analysis, several methodological limitations should be noted. This was a cross-sectional, ecological study that used publicly available data with only one year of data for each of the resources and A1c testing. It cannot be determined if these medical factors and community resources have affected diabetes rates or even if those with diabetes are accessing these resources in their county of residence. Additionally, we were not able to determine if higher resources have led to a decline in diabetes rates. Finally, the dates for the resources and rates were collected from several different sources and included both 2009 and 2010. However, these data can be used to target counties for further examination and to identify geographic areas of potentially high risk/low resources.

CONCLUSION

Using publicly available secondary data with GIS analysis, several regional diabetes-related resource shortages were identified, as was a statewide disconnect between county-level diabetes rates and diabetes resources and use, including A1c testing, endocrinologists, DSME programs, and diabetes support groups. This approach provided policy-relevant information that is useful for public health planning and evaluation.

The Western Michigan University Human Subjects Institutional Review Board (IRB) reviewed the study and deemed it exempt from IRB oversight.

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Correlation Between Aerial Insecticide Spraying to Interrupt West Nile Virus Transmission and Emergency Department Visits in Sacramento County, California

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ABSTRACT

Objectives. Insecticides reduce vector-borne pathogen transmission but also pose health risks. In August 2005, Sacramento County, California, underwent emergency aerial ultralow-volume (ULV) application of pyrethrin insecticide to reduce the population of West Nile virus (WNV)-infected mosquitoes and thereby interrupt enzootic and tangential transmission. We assessed the association between aerially applied pyrethrin insecticide and patterns of emergency department (ED) visit diagnoses.

Methods. We used geographic information systems software to determine ZIP Code-level exposure to pyrethrin. We used logistic regression models to examine the relationship between exposure status and three-digit International Classification of Diseases, Ninth Edition, Clinical Modification (ICD-9-CM) codes (785 in total) for all ED visits (n=253,648) within Sacramento County in 2005 and for specific diagnostic clusters (e.g., respiratory, gastrointestinal, skin, eye, and neurologic). All models were adjusted for age, gender, race/ethnicity (individual level), median income, ozone, and temperature (ZIP Code level).

Results. Exposure to aerially applied insecticide was not associated with clusters of respiratory, gastrointestinal, skin, eye, and neurologic complaints in adjusted models but was inversely associated with ICD-9-CM code 799 ("other ill-defined morbidity and mortality"), with adjusted odds ratios (AORs) ranging from 0.31 to 0.36 for 0–3 lag days (95% confidence interval 0.17, 0.68). Spraying was also directly associated with ICD-9-CM code 553 ("other abdominal hernia"), with AORs ranging from 2.34 to 2.96 for 2–3 lag days.

Conclusions. The observed significant ICD-9-CM code associations likely represented chance findings. Aerial ULV pyrethrin applications were not associated with ED visits for specific diagnoses or clusters of diagnoses.

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Insecticides play an important role in public health protection as part of a sustainable integrated mosquito management system. Integrated mosquito management programs begin with surveillance of mosquito activity and mosquito-borne disease activity and include strategies such as reducing breeding sites, conducting community outreach and public education programs, and employing chemical control of juvenile (larvae) and adult mosquitoes.[1,2] Adulticiding programs (i.e., killing adult mosquitoes) have become the method of choice when mosquito populations are extreme or when outbreaks of serious diseases, such as West Nile virus (WNV), occur.[1] Using public health insecticides safely has long been important to control programs on the international (e.g., World Health Organization), national (e.g., Centers for Disease Control and Prevention and Environmental Protection Agency), and local (e.g., departments of public health and mosquito abatement agencies) public health agency levels. With the 1999 arrival of WNV in the United States and increased efforts to control vector mosquitoes, insecticide safety questions were expressed by the public[3,4] that incited debates about the risk-to-benefit ratio for aerial insecticide applications vs. preventing WNV infection and disease.[5]

The benefits derived from aerial pyrethrin insecticide applications for WNV include a quick and widespread reduction in the mosquito population,[6] leading to an interruption of transmission by infected mosquitoes within the enzootic avian-mosquito cycle and a decrease in the number of new human cases of WNV, a potentially fatal illness.[7] Pyrethrin insecticides, however, are known to pose risks to human health ranging from skin and eye irritation to respiratory and gastrointestinal (GI) disturbances, as well as more vague systemic complaints such as lethargy, fatigue, and dizziness.[8,9] Studies performed in New York City at the start of the WNV epidemic found no evidence of asthma exacerbation after insecticide spraying,[10,11] but the studies did not examine other potential health effects. In addition, these studies were relatively small, focused on ground-level rather than aerial spraying, and analyzed pyrethroid spraying, a synthetic insecticide related to pyrethrin that is more stable in sunlight.[12]

In August 2005, Sacramento County, California, had the greatest number of human cases of WNV in the U.S.[13,14] In response, the Sacramento-Yolo Mosquito and Vector Control District (SYMVCD) applied an ultralow-volume (ULV) formulation of pyrethrin insecticide (Evergreen EC 60-6: 6% pyrethrin insecticide, 60% piperonylbutoxide; MGK, Minneapolis, Minnesota) at 0.003 kilogram/hectare (0.0025 pound/acre) over 218 square kilometers (km^2) in north Sacramento on August 8, 9, and 10, 2005, and 243.5 km^2 in south Sacramento on August 11, 20, 21, and 22, 2005, as previously described.[5] These emergency measures were taken to quickly reduce the infected mosquito population for the duration of the viremia period in infected birds and, thereby, interrupt both enzootic and tangential transmission. This aerial application of insecticides over a large urban area led to objections by residents, activist groups, and politicians[15] in California because of the concern for potential health problems resulting from the insecticide exposure.

In this study, we addressed the question of acute or short-term "risk" (reflected in increased emergency department [ED] visits) to human health when pyrethrin insecticides are sprayed aerially for WNV mosquito control. We examined whether specific diagnostic codes (e.g., respiratory, GI, skin, eye, and neurologic) were more likely in sprayed areas on spray days and lag days (i.e., the number of days between insecticide exposure and visiting an ED) than in those same areas on non-spray days and in non-spray areas on both spray and non-spray days. Because the known and possible effects of pyrethrin insecticides are diverse, we also evaluated other potential acute adverse effects as evidenced by any association between ED visits for 785 diagnostic categories and spray exposure.

METHODS

Patient data

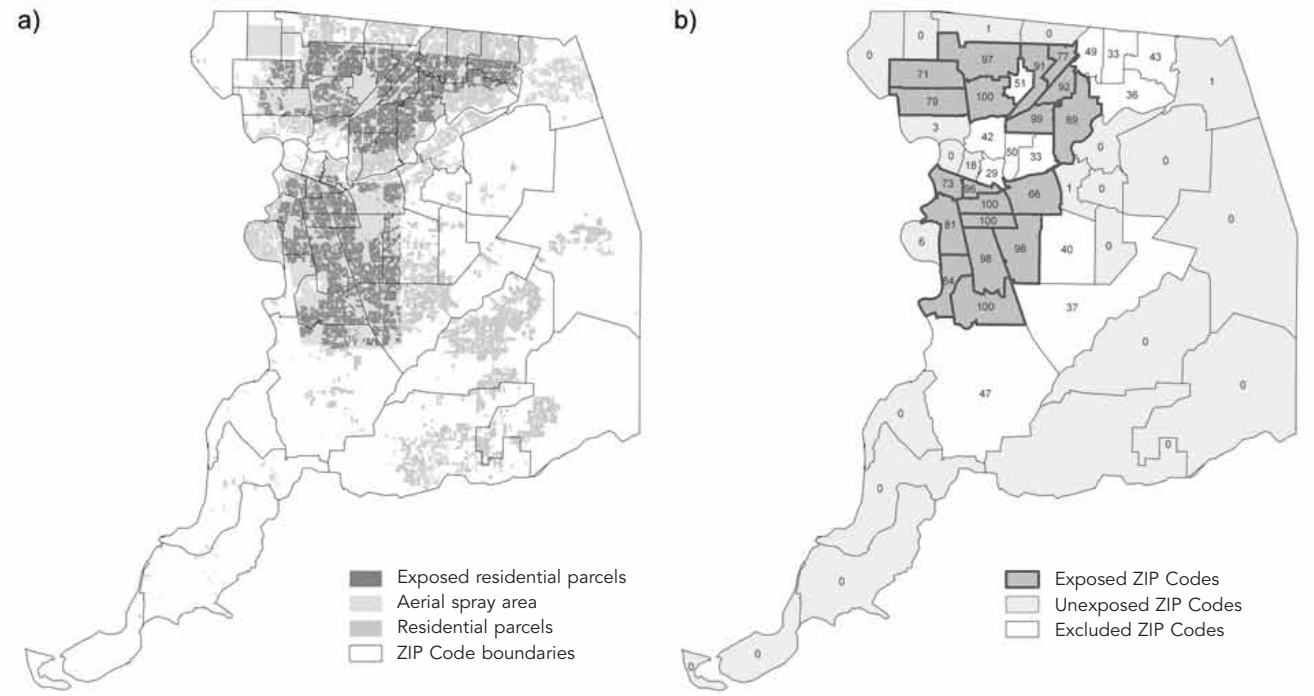
We obtained 2005 ED visit data for Sacramento County from the Office of Statewide Health Planning and Development (OSHPD). Since January 2005, the California Health and Safety Code §128736[16] has required emergency care data records to be reported to OSHPD, resulting in virtually complete data for nongovernmental (i.e., excluding Veterans Hospitals) ED visits. This restricted-use database contains each patient's ZIP Code of residence as the smallest available spatial variable.

Insecticide exposure estimation

We used ArcGIS® version 9.3.1[17] geographic information systems (GIS) software to determine aerial pyrethrin insecticide exposure status for all Sacramento County citizens by their residential ZIP Code. The SYMVCD provided georeferenced data documenting the times and locations of the aerial spray swaths over Sacramento County.

We assumed that most county residents were in their homes during the spray periods because (*1*) there was significant publicity about the mosquito-adulticiding program requesting that residents stay indoors and (*2*)

Figure. Sacramento County, California, aerial pyrethrin insecticide exposure during the August 2005 West Nile virus outbreak[a]



[a]Map "a" shows the aerial spray area (light gray) overlaid on Sacramento County ZIP Codes. Medium gray areas show the residential parcels in the county and dark gray areas indicate those residential parcels within the aerial spray zone. Map "b" indicates the final determination of the dichotomous exposure variable by Sacramento County ZIP Code. The numbers inside the ZIP Codes are the percentage of residential areas within the ZIP Code that were exposed to aerially sprayed pyrethrin insecticide.

the flights were scheduled from 8 p.m. to 12 a.m., a period when the mosquito vectors species (*Culex [Cx.] pipiens* and *Cx. tarsalis*) are most active[18,19] and when most people are indoors at home.

We employed dasymetric modeling to calculate pyrethrin insecticide exposure. Dasymetric modeling is a spatial technique used to separate aggregated data to account for the lack of homogeneity in the spatial distribution of those data.[20] Because population density varies within ZIP Codes, dasymetric mapping allowed us to adjust for the uneven distribution of exposed populations within ZIP Codes by overlaying ZIP Codes with residential parcel data (Sacramento County GIS Data Library[21]) to account for only the populated areas. Redistributing the population in this way improved the estimation of exposure to aerially sprayed insecticides by deriving a percentage of a ZIP Code's residential areas that were exposed (Figure, map "a"). We created a dichotomous exposure variable based on both natural breaks in the data and expert opinions of the authors (Figure, map "b"), whereby if 64%–100% of the population in a ZIP Code was included in a sprayed area, that ZIP Code would be considered "exposed," and if 0%–18% of the population in a ZIP Code was included in a sprayed area, that ZIP Code would be considered "unexposed." Our analyses excluded ZIP Codes with an intermediate proportion of residences exposed (19%–63%) to maximize the distinction between exposed and unexposed areas. Of the 52 Sacramento County ZIP Codes that existed in 2005, 12 ZIP Codes (23%) were excluded (comprising 78,574 or 23.7% of ED visits).

In addition to the exposure variable, we also created several lag-day variables. We theorized that some people who may have experienced a health effect related to the spraying event may have delayed seeking immediate emergency care, waiting a few days to be seen. It is also possible that the insecticide exposure had a cumulative and/or delayed effect. Finally, although the pyrethrin insecticides are unstable in sunlight and evaporate quickly,[22] some evidence notes that there is a longer-lasting residue from the product in certain environments, such as wetlands.[23,24] To account for these issues, we developed models for zero (day of exposure), one, two, and three lag days for each date of application.

Other environmental exposure variables

Because some diagnoses may be related to ambient temperature,[25–27] we created a variable for daily 24-hour average temperature by ZIP Code in Sacramento County. In addition, to control for potential confounding by ozone (most notably in summer months), we created ZIP Code-level estimates for ozone (daily one-hour maximum). For these environmental variables, daily data were obtained from the California Air Resources Board. Then, within the GIS, we performed interpolation of daily values during the study area. We used the simple Kriging method, using the 12 nearest monitors for temperature interpolation, because this method has been shown to produce superior results compared with other interpolation techniques for daily temperature estimation.[28] To avoid error in interpolation around the edges of Sacramento County, we included the entire state of California in the interpolation. We used an inverse distance-squared weighting method to interpolate the statewide ozone. Inverse distance-squared weighting calculates diminishing contributions of observations (from the nearest 12 monitors) depending on their distance from the point to be interpolated. We then applied zonal analysis to the interpolated values as a method of aggregation at the ZIP Code level. The interpolation process was repeated for each day during the study period (January 1–December 31, 2005).

Other independent variables

We derived age, gender, and race/ethnicity (black, white, Asian, Hispanic, or other, where Hispanic ethnicity took categorical precedence over any race) from the OSHPD data. We obtained median household income per ZIP Code from 2008 U.S. Census estimates provided by GeoLytics, Inc.[29] and matched them to each patient's record based on the patient's ZIP Code of residence.

Statistical analysis

We examined the adjusted relationships between potential insecticide exposure and short-term risk of ED visits for specific diagnoses and for all causes of ED visits based on three-digit International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes.[30] Within the ED dataset, an encounter may have up to 24 coded diagnosis fields (ICD-9-CM codes). Analyses showed that 91% of all unique diagnoses were included in the first three diagnostic fields. Therefore, we included, as separate observations, each of an individual's first three diagnoses in the regression. The primary analyses employed logistic regression models using the generalized estimating equations approach to account for the nesting of patient diagnoses within a patient and of patients within ZIP Codes. All analyses were adjusted for age, gender, race/ethnicity, median income, and non-insecticide environmental exposures (temperature and ozone).

Specific diagnosis cluster analyses. Based on previously documented human health risks associated with the related pyrethroid insecticides,[31,32] we examined whether ED visits due to specific clusters of respiratory, GI, skin, eye, and neurologic diagnoses were associated with insecticide application. Using the first three diagnoses existing in the ED database, two clinicians (Geraghty and Franks) independently reviewed and assigned each diagnosis to one of the aforementioned groups where appropriate. Disagreements were resolved through discussion and literature search. We also created a reference ICD-9-CM category to represent a group of diagnoses that were unlikely to be related to insecticide exposure (i.e., codes 800–848 encompassing orthopedic fractures and dislocations). Logistic regression analyses employed each specific diagnostic cluster (i.e., respiratory, GI, skin, eye, or neurologic vs. reference category) as the dependent variable and insecticide exposure status (yes or no at zero, one, two, or three lag days) as the key independent variable.

All diagnosis cluster analyses. In exploratory analyses, because much less is known about the risks of pyrethrin insecticide exposure, we sought to identify previously unreported effects of aerial applications of pyrethrins. We evaluated other potential short-term adverse effects as evidenced by any association between ED visits for 785 diagnostic categories and spray exposure. The dependent variable in each regression was considered to be whether or not the ED visit occurred in a patient from an exposed ZIP Code on an application date (or lagged [one, two, or three] exposure days). The key independent variable was the three-digit ICD-9-CM code, using the aforementioned reference category (fractures and dislocations). To reduce the risk of identifying spurious associations, the dataset was randomly split into two equal halves and the analysis was repeated for each set. An ICD-9-CM category was considered significantly associated with exposure status at $p<0.05$ in both datasets, with the effect direction consistent in both analyses.

Sensitivity analyses. In sensitivity analyses, we restricted the analytic datasets, both for specific diagnosis clusters and for all diagnosis clusters, to the summer months including July 5–September 30, 2005.

We conducted all logistic regression analyses using Stata®/MP version 11.2.[33] Statistical tests were two-sided and $p<0.05$ was considered statistically significant.

RESULTS

Sacramento County had 52 ZIP Codes in 2005. In our exposure analysis, we focused on ZIP Codes with residential areas that were either considered fully exposed (n=19) or fully unexposed (n=21) to aerial ULV insecticide applications on the spray days. These analyses assumed downwind drift was minimal due to aerial onboard spray modeling equipment and selection of spray days with wind conditions generally <10 miles per hour.

During 2005, 332,222 unique Sacramento County ED visits were documented, and 253,648 (76.3%) ED visits were in fully exposed or fully unexposed areas. There were 78,574 (23.7%) ED visits among individuals living in partially exposed areas that were not included in the analysis. Among the ED visits that composed our analytic sample, there were 471,312 diagnoses altogether, 428,258 (91%) of which were within the first three diagnosis fields; of these observations, 408,233 (95.3%) had no missing variables and formed our analytic dataset. Characteristics by ZIP Code exposure status for those visiting the ED and the ZIP Code population are shown in Table 1. Those living in exposed ZIP Codes, and those visiting the ED from exposed ZIP Codes, were more likely than their counterparts from unexposed ZIP Codes to be nonwhite and have lower incomes (p<0.001, data not shown).

The frequency of the top 20 most common diagnostic codes in spray areas on spray and/or lag days was similar to the top 20 diagnostic codes in spray areas on non-spray and lag days and in non-spray areas on all days (Table 2).

Specific diagnosis clusters

In unadjusted models, we found that there was a significant (p<0.021) association between the GI diagnostic cluster and insecticide exposure plus three lag days (odds ratio [OR] = 1.14, 95% confidence interval [CI] 1.02, 1.28). In fully adjusted models, this effect became nonsignificant. There were no statistically significant associations between diagnostic clusters for respiratory, skin, eye, or neurologic causes and exposure to aerial insecticide spraying in either adjusted or unadjusted models (Table 3).

Results for all diagnoses

Significant associations from the four pairs (i.e., the test and validation datasets) of logistic regressions for 0–3 lag days are shown in Table 4. Pyrethrin applications were associated with a lower adjusted risk of ICD-9-CM code 799 ("other ill-defined morbidity and mortality;" adjusted odds ratios [AORs] ranged from 0.31 to 0.36 for 0–3 lag days in all regressions, p<0.001) and a higher adjusted risk of ICD-9-CM code 553 ("other abdominal hernia;" AORs ranged from 2.34 to 2.96 for two and three lag days in four regressions, p<0.05).

Results for analysis of summer months only

Analyses for both specific diagnosis clusters and for all diagnoses restricted to the summer months revealed no statistically significant associations between pyrethrin exposure and ED visit diagnoses (data not shown).

DISCUSSION

Aerial ULV applications of pyrethrin insecticide for WNV intervention were not associated with any of the known types of diagnoses for which exposure to these insecticides has been implicated. When we analyzed all possible ED diagnoses, insecticide exposure was associated with two three-digit ICD-9-CM codes, with a lower risk of ICD-9-CM code 799 ("other ill-defined morbidity and mortality") and an elevated risk of code 553 ("other abdominal hernia"). Given that neither outcome is biologically plausible, these outcomes are likely chance observations. In a regression analysis with 785 diagnostic codes, with the dataset split into two, chance would likely produce two diagnostic codes that are significantly associated with spraying in both datasets (785 diagnoses × 0.05 × 0.05 = 1.96).

"Other abdominal hernia" is not an acute illness causally related to aerial insecticide exposure. The 799 code, however, includes a number of subcategories that are reasonably associated with insecticide exposure, such as asphyxia and hypoxemia, hypoxemia, respiratory arrest, and nervousness. Of the 10,122 observations in this category (799 code), only 179 observations (1.7%) were related to these subcategories. The majority of observations with the 799 code were categorized as "other unknown and unspecified cause: undiagnosed disease, not specified as to site or system involved." Furthermore, the effect direction was toward a protective rather than harmful effect of spraying. It is possible that susceptible individuals in exposed ZIP Codes may have responded to health education messages (i.e., to remain indoors), thereby protecting themselves from insecticide and other environmental exposures.

Insecticide exposure was determined using a dasymetric modeling technique to improve the precision of ZIP Code-level exposure assignment, which allowed determination of the proportion of the population within a ZIP Code exposed (high and low proportions as well as intermediate proportion and, thus, potentially allowing study of a dose-response effect). Given that our logistic models revealed little evidence of an effect

Table 1. Sociodemographic characteristics of the total and ED user population of Sacramento County, California, by ZIP Code exposure status in a study of pyrethrin spraying against West Nile virus-carrying mosquitoes, 2005

	Exposed ZIP Codes (n=19)		*Unexposed ZIP Codes (n=21)*	
Category	*Total population* N *(percent)*[a]	*Visited ED* N *(percent)*[b]	*Total population* N *(percent)*[a]	*Visited ED* N *(percent)*[b]
Total	707,409 (100.0)	147,632 (100.0)	363,006 (100.0)	62,097 (100.0)
Gender				
Male	345,783 (48.9)	64,280 (43.5)	182,791 (50.4)	28,746 (46.3)
Female	361,626 (51.1)	83,324 (56.4)	180,215 (49.7)	33,335 (53.7)
Unknown	0 (0.0)	28 (0.0)	0 (0.0)	16 (0.0)
Race/ethnicity				
White	433,957 (61.1)	58,683 (39.8)	262,023 (72.2)	33,226 (53.5)
Black	102,032 (14.4)	28,150 (19.1)	32,586 (9.0)	6,598 (10.6)
Hispanic	161,519 (22.8)	24,828 (16.8)	68,113 (18.8)	8,157 (13.1)
Asian	122,861 (17.4)	9,583 (6.5)	48,734 (13.4)	3,005 (4.8)
Other	48,555 (6.9)	26,388 (17.9)	19,664 (5.4)	11,111 (17.9)
Age (in years)				
<5	46,456 (6.6)	16,615 (11.3)	22,284 (6.1)	5,956 (9.6)
5–14	112,383 (15.9)	13,542 (9.2)	51,754 (14.3)	5,078 (8.2)
15–24	112,650 (15.9)	23,545 (16.0)	49,923 (13.8)	9,473 (15.3)
25–34	97,935 (13.8)	22,788 (15.4)	47,990 (13.2)	9,493 (15.3)
35–44	98,278 (13.9)	22,392 (15.2)	55,874 (15.4)	9,449 (15.2)
45–54	92,767 (13.1)	19,342 (13.1)	55,280 (15.2)	8,739 (14.1)
55–64	66,748 (9.4)	11,133 (7.5)	39,324 (10.8)	5,195 (8.4)
65–74	39,951 (5.7)	7,453 (5.1)	21,797 (6.0)	3,639 (5.9)
≥75	40,241 (5.7)	10,822 (7.3)	18,744 (5.2)	5,075 (8.2)
Median income (SD)	$40,914 ($12,727)	$40,168 ($10,775)	$56,403 ($23,910)	$50,786 ($17,091)

[a]Represents the percentage of the total population within exposed vs. unexposed ZIP Codes. Population data culled from GeoLytics, Inc. (East Brunswick, New Jersey). Not all percentages total 100% due to rounding.

[b]Represents the percentage of unique patients visiting an ED during the study period. Not all percentages total 100% due to rounding.

ED = emergency department

SD = standard deviation

Table 2. The top 20 ICD-9-CM codes in the 2005 Sacramento County, California, OSHPD ED dataset by exposure status during spraying of pyrethrin insecticide against West Nile virus-carrying mosquitoes

	Exposed ZIP Codes on spray and lag days			*Exposed ZIP Codes on non-spray or lag[a] days and unexposed ZIP Codes on all days*		
Rank	*ICD-9-CM code*	*Description*	N *(percent)*	*ICD-9-CM code*	*Description*	N *(percent)*
1	780	General symptoms	418 (5.62)	780	General symptoms	23,388 (5.35)
2	789	Other abdomen/pelvis symptoms	350 (4.70)	786	Respiratory system/other chest symptoms	20,225 (4.62)
3	786	Respiratory system/other chest symptoms	325 (4.37)	789	Other abdomen/pelvis symptoms	18,104 (4.14)
4	305	Nondependent drug abuse	260 (3.49)	305	Nondependent drug abuse	13,812 (3.16)
5	401	Essential hypertension	100 (2.51)	401	Essential hypertension	13,041 (2.98)
6	787	Digestive system symptoms	204 (2.74)	787	Digestive system symptoms	11,039 (2.52)
7	847	Sprain/strain of back	193 (2.59)	799	Ill-defined morbidity and mortality	10,063 (2.30)
8	599	Other urinary tract disorder	182 (2.44)	493	Asthma	9,939 (2.27)
9	784	Symptoms involving head/neck	162 (2.18)	847	Sprain/strain of back	9,619 (2.20)
10	250	Diabetes mellitus	161 (2.16)	784	Symptoms involving head/neck	8,900 (2.03)
11	724	Other back disorders	160 (2.15)	724	Other back disorders	8,741 (2.00)
12	276	Fluid/electrolyte disorders	149 (2.00)	250	Diabetes mellitus	8,713 (1.99)
13	682	Other cellulitis and abscess	138 (1.85)	599	Other urinary tract disorder	8,596 (1.97)
14	873	Other open wound of head	62 (1.56)	873	Other open wound of the head	8,238 (1.88)
15	493	Asthma	119 (1.60)	465	Acute upper respiratory infections	8,126 (1.86)
16	959	Other injury	109 (1.46)	276	Fluid/electrolyte disorders	6,985 (1.60)
17	300	Neurotic disorders	98 (1.32)	682	Other cellulitis and abscess	6,670 (1.52)
18	924	Contusion leg and other site	90 (1.21)	959	Other injury	5,766 (1.32)
19	079	Viral infection of unspecified site	88 (1.18)	382	Otitis media	5,667 (1.30)
20	923	Contusion of upper limb	78 (1.05)	300	Neurotic disorders	5,267 (1.20)

[a]Lag days refers to the number of days between insecticide exposure and visiting an ED.

ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification

OSHPD = Office of Statewide Health Planning and Development

ED = emergency department

Table 3. Logistic regression results for specific diagnostic clusters (respiratory, gastrointestinal, skin, eye, and neurologic) in the 2005 Sacramento County, California, OSHPD ED dataset on pyrethrin insecticide exposure days and up to three lag days[a]

Diagnostic cluster[b]	*0-day lag OR (95% CI)*	*One-day lag OR (95% CI)*	*Two-day lag OR (95% CI)*	*Three-day lag OR (95% CI)*
Unadjusted model				
Respiratory	0.93 (0.80, 1.09)	0.99 (0.86, 1.14)	1.03 (0.91, 1.16)	1.06 (0.95, 1.19)
Gastrointestinal	0.97 (0.83, 1.13)	1.05 (0.92, 1.21)	1.09 (0.96, 1.23)	1.14 (1.02, 1.28)
Skin	1.23 (0.92, 1.65)	1.23 (0.94, 1.62)	1.16 (0.90, 1.49)	1.21 (0.96, 1.52)
Eye	1.18 (0.67, 2.08)	1.23 (0.74, 2.05)	1.21 (0.75, 1.93)	1.28 (0.84, 1.96)
Neurologic	0.98 (0.82, 1.16)	1.01 (0.86, 1.18)	1.08 (0.94, 1.24)	1.08 (0.95, 1.23)
Adjusted model				
Respiratory	0.92 (0.77, 1.09)	0.98 (0.83, 1.16)	1.01 (0.87, 1.16)	1.02 (0.90, 1.16)
Gastrointestinal	0.91 (0.78, 1.07)	0.99 (0.84, 1.17)	1.03 (0.91, 1.16)	1.08 (0.96, 1.21)
Skin	1.06 (0.68, 1.64)	1.07 (0.69, 1.65)	1.04 (0.73, 1.47)	1.14 (0.83, 1.56)
Eye	0.97 (0.51, 1.84)	1.05 (0.60, 1.86)	1.06 (0.63, 1.79)	1.14 (0.72, 1.79)
Neurologic	0.99 (0.83, 1.18)	1.02 (0.87, 1.19)	1.07 (0.94, 1.21)	1.07 (0.96, 1.19)

[a]Lag days refers to the number of days between insecticide exposure and visiting an ED.

[b]Diagnostic clusters were treated as dependent variables in this analysis.

OSHPD = Office of Statewide Health Planning and Development

ED = emergency department

OR = odds ratio

CI = confidence interval

Table 4. Logistic regression results for all diagnoses in the 2005 Sacramento County, California, OSHPD ED dataset on pyrethrin insecticide exposure days and up to three lag days[a]

	Test dataset		*Validation dataset*	
ICD-9-CM code (description)[b]	*AOR (95% CI)*	*P-value[c]*	*AOR (95% CI)*	*P-value[c]*
Spray day				
799 (other ill-defined morbidity/ mortality)	0.33 (0.17, 0.68)	0.002	0.35 (0.21, 0.61)	<0.001
One lag day				
799 (other ill-defined morbidity/ mortality)	0.36 (0.19, 0.66)	0.001	0.35 (0.21, 0.59)	<0.001
Two lag days				
553 (other abdominal hernia)	2.90 (1.39, 6.08)	0.005	2.83 (1.21, 6.62)	0.017
799 (other ill-defined morbidity/ mortality)	0.34 (0.19, 0.61)	<0.001	0.31 (0.19, 0.50)	<0.001
Three lag days				
553 (other abdominal hernia)	2.96 (1.61, 5.47)	0.001	2.34 (1.06, 5.17)	0.036
799 (other ill-defined morbidity/ mortality)	0.33 (0.19, 0.55)	<0.001	0.32 (0.20, 0.05)	<0.001

[a]Lag days refers to the number of days between insecticide exposure and visiting an ED.

[b]Diagnostic codes were treated as independent variables in this analysis.

[c]Only diagnoses showing statistical significance in both the test dataset and the validation dataset are shown.

OSHPD = Office of Statewide Health Planning and Development

ED = emergency department

ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification

AOR = adjusted odds ratio

CI = confidence interval

on fully exposed vs. unexposed populations in a ZIP Code, further analysis was not considered necessary.

Limitations

This study was subject to several limitations. For one, debate exists in the literature regarding the optimal methods for temperature and pollutant interpolation.[34] Some research suggests, for example, that Kriging (i.e., an interpolation method based on the semivariogram) may be more optimal than inverse distance-weighting schemes for ozone modeling.[35] Because no effect of aerial insecticide spraying was found in our adjusted models, we considered it improbable that an effect of aerial insecticide spraying would emerge if we had used an alternate interpolation method.

Our study suggests that the short duration of pyrethrin insecticides (pyrethrin + piperonyl butoxide) exposure during emergency intervention in response to WNV, as was done in Sacramento in 2005, did not incur additional negative health consequences as measured by ED visits. However, in other areas, mosquito populations are subject to aerial spraying at regular intervals throughout the year. The potential health impact of repeated exposures to these insecticides requires further investigation. Our study also did not address the potential latent effects of insecticide exposure.

CONCLUSIONS

The large database of ED records allowed for a detailed and sensitive evaluation of potential negative health effects associated with wide-scale aerial insecticide spraying. The emergency application of aerial pyrethrin insecticides to control WNV transmission in Sacramento County was not associated with increased ED visits reflecting specific or general short-term health effects.

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Law and the Public's Health

This edition of *Law and the Public's Health* considers one of the most complex and important issues in health law and public health system transformation: how the law affects the use, release, and sharing of health information. In her article, Professor Jane Thorpe examines the role of information in transforming health care, how information shapes the essential relationship between health system reform and public health, and how the law is shaping this interaction.

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HEALTH SYSTEM TRANSFORMATION AND THE ROLE OF HEALTH INFORMATION LAW

Jane Hyatt Thorpe, JD

Increasingly, transforming the American health-care delivery system into one that is more patient-centered, value-based, and coordinated is understood to be an essential step in improving both patient and population health. For this type of system transformation to occur, health information is crucial. This installment of *Law and the Public's Health* examines the legal dimension of health information and considers its implications for public health policy and practice.

BACKGROUND

Experts and stakeholders have long agreed that the current health-care system is unsustainable. By 2020, health-care spending will comprise almost 20% of the gross domestic product.[1] Furthermore, an enormous and growing body of evidence suggests that, as measured by key quality indicators such as potentially avoidable hospital readmissions and patient mortality, health care is not experiencing the types of improvements that would justify this steep cost growth.[2–5]

The Patient Protection and Affordable Care Act (ACA) was a seminal event in the progress toward transforming the American health-care delivery system.[6] Many of the programs and initiatives authorized by the provisions of the ACA hold the potential to reduce the rate of cost growth, improve health-care quality, and strengthen the bonds between health care and public health as a central element of system transformation. These programs include financial and nonfinancial incentives for provider performance measurement reporting, public reporting, performance that generates desired outcomes (e.g., value-based purchasing), and new payment and care delivery models that foster greater levels of care coordination between and among providers and across settings of care.

Critical to the success of these programs and the ultimate goal of a transformed health-care system is the real-time electronic exchange of patient health information. Experts agree that greater access to patient health information is integral to improving the quality, efficiency, and safety of health-care delivery.[3,7] However, little progress has been made toward determining how patient health information, both administrative and clinical, may be electronically shared in real time between and among providers; across settings of care; and with consumers, patients, payers, and other third parties (e.g., a data aggregator or personal health record vendor). Furthermore, there is a significant amount of uncertainty about current federal and state legal requirements that protect the privacy and security of patient health information. The financial incentives for the meaningful use of electronic health records (EHRs), authorized under the 2009 Health Information Technology for Economic and Clinical Health (HITECH) Act (part of the American Reinvestment and Recovery Act),[8] have driven measurable progress recently. But, arguably, the lack of widespread electronic health information exchange (HIE) is the greatest remaining barrier to achieving truly coordinated, patient-centered health care.

ELEMENTS OF DELIVERY SYSTEM TRANSFORMATION

Provider quality measurement and reporting

The Centers for Medicare & Medicaid Services has implemented numerous provider quality measurement and public reporting programs (e.g., the Hospital

Inpatient Quality Reporting Program[9] and the Hospital Compare website[10]). Most of these programs were extended under the ACA and new programs were authorized (e.g., home health and hospice).[11] Initially, these programs used only quality measures calculated from administrative data that could easily be extracted from claims. As clinical information has become more readily accessible from electronic sources such as EHRs, the number of available measures has grown significantly. Many private payers have developed similar programs to compare their network providers and make this information available to their enrollees.

Despite this significant progress, these measurement programs typically only assess the performance of single providers (e.g., a hospital or physician practice) in a single setting of care. They do not capture information about the quality of care a patient experiences across an episode of care that may include a physician office visit, inpatient hospital procedure, and post-acute care (e.g., physical therapy). Measures are being developed that will be able to capture the quality performance of a medical team (e.g., a physician, hospital, and rehabilitation facility) across providers and settings of care. However, the implementation of these measures is hampered by the lack of electronic exchange of patient information. Furthermore, provider performance on existing quality measures is hampered by the providers' lack of real-time access to related patient health information.

Value-based purchasing

Public and private payers also are moving beyond measuring and reporting provider quality performance to linking reimbursement to actual performance. For example, reimbursement rates for hospitals participating in the Medicare program are adjusted according to their performance on a specific set of quality measures.[12] However, similar to the quality measurement and reporting programs, these value-based purchasing programs are designed to financially incentivize higher-quality care delivered by a single hospital or single physician practice. This single-provider approach is in large part the result of the way the health-care reimbursement system was built—siloed payment structures organized by provider type. Yet, this is exactly the barrier that health-care delivery transformation is intended to break down. Only when different provider types (e.g., a medical team) responsible for the care of a single patient are held jointly accountable for the care of a patient through value-based purchasing arrangements will the system experience real change. But this change requires the electronic exchange of patient health information.

Testing and implementing new payment and care delivery models

Building on existing programs, the ACA authorized financial incentives for a number of new payment and care delivery models designed to overcome the current siloed approach to health-care delivery and reimbursement. These new models include accountable care organizations (ACOs),[13] medical homes,[14] health homes,[15] readmissions penalties,[16] and bundled payment demonstrations.[17] All of these reforms share a common goal of aligning care delivery across providers and settings of care to achieve a more patient-centered and coordinated approach to health-care delivery. However, one of the early lessons from these programs and demonstrations is that truly achieving patient-centered care and improving the quality and coordination of care is not possible without access to patient clinical and administrative information at the point of care. For example, even though the ACA specifically authorized ACOs to receive Medicare claims data,[13] challenges exist to build systems that can transfer real-time patient data and to design data-sharing arrangements that meet federal and state law requirements.

ENCOURAGING HIE

EHR incentive program

In addition to the financial incentives available for quality measurement and reporting and new models of care delivery that may support HIE activities, HITECH authorized significant financial incentives for eligible physicians and hospitals that can demonstrate that they are "meaningful users" of EHRs. Demonstrating meaningful use requires meeting specific performance requirements based on a set of core and optional quality measures. In addition to incentives for meaningful use, physicians and hospitals participating in the Medicaid program may elect to receive advance funds to support the acquisition and implementation of EHR systems.[8]

The EHR meaningful use incentive program has been successful in increasing the numbers of physicians and hospitals using EHRs. But there is still a fundamental lack of electronic HIE occurring across settings of care and providers. While this lack of cross-setting HIE may be improved in future stages of the EHR meaningful use incentive program, which includes measures of actual care coordination facilitated by HIE, it is still nascent. Furthermore, a significant portion of the provider community, especially post-acute care and long-term care providers, is not eligible for incentive payments in the EHR meaningful use incentive program. As such, implementation rates among these

providers remain low, even though these providers are often better positioned to avoid complications and readmissions with real-time clinical information. For example, 12% of short-term acute care hospitals have a basic EHR system compared with 6% of long-term acute care hospitals, 4% of rehabilitation hospitals, and 2% of psychiatric hospitals.[18] Close to one-third of all Medicare patients discharged from short-term acute care hospitals are discharged to post-acute care settings, such as rehabilitation hospitals, but there is little capacity in the system today to support electronic HIE across these settings.

BARRIERS TO HIE

Uncertainty about legal requirements

The privacy and security of patient health information is governed by a series of federal and state laws that are not always consistent and certainly not uniform. These legal frameworks include the Health Insurance Portability and Accountability Act (HIPAA),[19,20] the Privacy Act of 1974,[21] the Common Rule,[22] the Federal Information Security and Management Act,[23] federal regulations protecting patient information involving substance abuse and mental health issues,[24] and myriad state laws that protect the privacy and security of patient health information. Furthermore, amendments to HIPAA authorized by HITECH expand the range of entities that are subject to HIPAA and increase penalties for HIPAA violations.[8] Experts agree that these privacy and security standards are imperfect. Furthermore, there is a high degree of uncertainty regarding the requirements, coupled with a high degree of sensitivity about the privacy and security of patient health information in general.[7] This legal complexity has challenged the development and implementation of arrangements between entities to facilitate the exchange of patient health information in a way that complies with applicable laws and regulations.

Lack of financial incentives across systems

There are increasing opportunities for providers to secure financial incentives for improving the quality of care they provide through the use of EHRs. But these programs are largely provider-specific (e.g., inpatient hospitals, physician practice groups, and nursing homes). Arguably, provider performance in these programs will be enhanced through sharing patient information electronically with other providers who are involved in the patient's care (e.g., a hospital providing an electronic discharge summary to a nursing home at the time of discharge is likely to reduce the chance that the patient will be readmitted to the hospital, thus avoiding readmission penalties for the hospital). However, what is really needed are programs and measures that incentivize information sharing and coordination of care across settings and that link financial incentives to the collective provider team (e.g., bundled payments that must be allocated across different provider types for the care of a single patient across settings of care). It is anticipated that Stage 3 of the EHR meaningful use incentive program will promote this type of cross-setting exchange of patient health information; however, Stage 3 will begin no earlier than 2016.[25]

Lack of uniform governance structures for data exchange

Since 2001, several efforts to define a common or uniform governance structure for electronic HIE have been launched. For example, in 2001, the National Committee on Vital and Health Statistics released recommendations for a nationwide HIE that identified a three-dimensional structure (i.e., personal health, health-care provider, and population health).[26] From 2005 to 2008, the U.S. Department of Health and Human Services (HHS) Office of the National Coordinator of Health Information Technology (ONC) worked to develop and implement a draft model data use and reciprocal support agreement as a framework to guide the obligations of all participants (or trusted entities) in the National Health Information Network.[27] In 2007, the Agency for Healthcare Research and Quality released a request for information (RFI) to gather information on stakeholder perspectives regarding the need for and potential role of data stewardship entities that would manage data in a safe and secure manner.[28]

In May 2012, the ONC issued an RFI on a broad range of topics, including whether there should be a voluntary program to validate entities that facilitate HIE, the scope and requirements for such entities, and a process to assess readiness of these entities.[27] It is unclear at this point whether or when the ONC may release additional guidance on this issue, and there has been little progress toward the widespread adoption of earlier governance efforts.

LOOKING AHEAD: COMMON GOVERNANCE RULES AND CONSENT FORMS

Need for uniform governance rules

As providers, health plans, states, community collaborative organizations, and other stakeholders develop and implement models of care delivery, with increased attention to coordinating patient care supported by access to real-time patient health information across

providers and settings of care, a uniform set of governance rules is needed to assist them in developing appropriate arrangements to facilitate the exchange of patient information in accordance with applicable federal and state laws. While the laws and regulations are complex and vary by state, certain core elements should be incorporated into arrangements involving the exchange of patient health information:

(*1*) Clear understanding and written descriptions of roles and responsibilities for all participants. All participants should be considered trusted sources and stewards of information.

(*2*) Clear understanding and written descriptions of how the patient health information will be transmitted and used, to whom the data will be returned or released, and in what format (e.g., identifiable or de-identified data, quality performance results). These activities must be allowable under applicable federal and state laws.

(*3*) Creation of a data use agreement signed by all parties and applicable to all non-de-identified data that stipulates the penalties and remedies for any misuse of the data (e.g., unauthorized disclosure, loss, or misuse).

(*4*) The ability of patients to authorize the use, release, or disclosure of personal health information.

Common consent forms

One common element of most privacy and security laws is the right of patients to access their data and consent to or authorize their providers and others to share their health information for specified purposes. For example, under HIPAA, there are only two required instances in which a covered entity must release protected health information: (*1*) to the HHS Secretary to determine compliance with HIPAA and (*2*) to the patient. In developing new models of care delivery facilitated by greater exchange of patient health information across providers and settings of care, a common consent form may prove a useful tool. Such a form could be used to obtain authorization to share a patient's health information across a team of providers that may or may not be directly involved in treating the patient at a given point in time. The following elements would be important to include:

(*1*) A description indicating to whom the patient health information may be released,

(*2*) A description of the purpose or purposes for which the patient health information may be released,

(*3*) A statement that the patient may revoke the authorization at any time,

(*4*) A statement that the authorization will be reviewed and renewed periodically, and

(*5*) The patient's signature.

IMPLICATIONS FOR PUBLIC HEALTH POLICY AND PRACTICE

As the transformation of the U.S. health-care delivery system continues, the sensitive legal and policy issues surrounding the exchange of patient health information will become increasingly acute. Ideally, uniform governance rules and common consent forms could achieve the delicate balance between the importance of greater access to patient health information to support system transformation while preserving appropriate levels of privacy and security. These resources hold the potential to not only support providers and other stakeholders who are working toward new coordinated models of care, but also ease concern related to the use and disclosure of health data. More fundamentally, this transformation may also require revisiting the underlying laws and regulations that govern health information privacy and security to determine whether more systemic changes are needed.

If, as a matter of public health policy and practice, stakeholders and policy makers are not able to address these critical and sensitive issues, the exchange of patient health information will continue to be limited and, ultimately, progress toward a truly transformed health system will be limited as well. Furthermore, beyond the transformation of the health-care delivery system, weather-related and other public health emergencies continue to highlight the critical importance of electronic access to patient health information. In such cases, paper documents and files are lost, leaving consumers and their providers with no record of care, medical history, or even current prescription information. To ensure the public health, safety, and sustainability of the U.S. health-care system, a balanced approach is needed that enables patient health information to freely flow between and among providers, consumers, payers, and other third parties as necessary through a trusted system with appropriate privacy and security protections.

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NCHS Dataline

The National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention reports that the number of American homes with only wireless telephones continues to grow. More than one-third of American homes had only wireless telephones during January–June 2012. A new NCHS report presents data on the consumption of alcoholic beverages, finding that the U.S. adult population consumes an average of almost 100 calories per day from alcoholic beverages. Another new report on diet drink consumption finds that consumption of diet drinks differs by race/ethnicity and income level.

WIRELESS PHONE USE AT HIGHEST LEVEL EVER

"Wireless Substitution: Early Release of Estimates from the National Health Interview Survey, January–June 2012"[1] presents the most up-to-date estimates available from the federal government concerning the use of cellular telephones in American households. Preliminary results from the January–June 2012 National Health Interview Survey (NHIS) indicate that the number of American homes with only wireless telephones continues to grow. More than one-third of American homes (35.8%) had only wireless telephones (i.e., cellular or mobile telephones) during the first half of 2012—an increase of 1.8 percentage points since the second half of 2011, the smallest increase in the past decade. During January–June 2003—the first time period for which data on wireless phone use were collected—an estimated 20.2% of households were wireless only. The percentage of wireless-only households has increased steadily since then.

The report also presents data on households with both landlines and wireless telephones, landlines without wireless telephones, and households without any telephone service. The percentage of adults and children living without any telephone service has remained relatively unchanged at 2.1% during the past three years. Nearly 4.5 million adults (1.9%) and 1.6 million children (2.2%) lived in these households. Data for January–June 2012 show that 34.0% of all adults (about 80 million adults) lived in households with only wireless telephones; 40.6% of all children (approximately 30 million children) lived in households with only wireless telephones.

The survey documents notable demographic differences in the use of wireless telephones. For the period January–June 2012, there were four demographic groups in which the majority lived in households with only wireless telephones: adults aged 25–34 years, adults living only with unrelated adult roommates, adults renting their home, and adults living in poverty.

The highest rate of wireless-only use during the time period was among adults aged 25–29 years, where six in 10 lived in households with only wireless telephones. This rate was higher than the wireless-only rates for adults aged 18–24 years (49.5%) or 30–34 years (55.1%). The percentage of adults living in households with only wireless telephones decreased as age increased beyond 35 years: 39.1% for those aged 35–44 years, 25.8% for those aged 45–64 years, and 10.5% for those aged 65 years and older.

More than three-quarters of adults living only with unrelated adult roommates (75.9%) were in households with only wireless telephones. This rate was higher than the rate for adults living alone (43.0%) and for adults living only with spouses or other adult family members (27.0%). More than half of all adults renting their homes (58.2%) had only wireless telephones, a rate that was more than twice as high as adults who owned their homes (23.2%). Adults living in poverty (51.8%) were more likely than adults living near poverty (42.3%) and higher-income adults (30.7%) to be living in households with only wireless telephones.

Differences on wireless-only use were reported by gender, geographic region, and race/ethnicity. Men (35.2%) were more likely than women (32.9%) to be living in households with only wireless telephones. Adults living in the Midwest (37.5%), South (37.2%), and West (34.0%) were more likely than adults living in the Northeast (23.1%) to be living in households with only wireless telephones. Hispanic adults (46.5%) were more likely than non-Hispanic white (NHW) adults (30.4%) or non-Hispanic black (NHB) adults (37.7%) to be living in households with only wireless telephones.

The NHIS is a large-scale household interview survey with a sample of the nation's civilian, noninstitutionalized population. The in-person health interviews collect data on a wide range of health topics including, for the past 10 years, the use of wireless telephones. This report is published as part of the NHIS Early Release Program. Twice each year, NCHS publishes selected estimates of telephone coverage. The Early Release Program also reports quarterly on 15 selected key indicators of health, among them health status, smoking, alcohol use, exercise, serious psychological

distress, vaccination coverage, access to health care, usual source of medical care, and insurance coverage. Many health surveys and social science research are conducted using random-digit-dial telephone surveys. Until relatively recently, most of these surveys did not include wireless telephones; now, most do. Having data on telephone coverage and health characteristics from the NHIS allows both earlier and current data to be analyzed and compared to increase the quality and understanding of the findings.

ALCOHOL CONSUMPTION AMONG U.S. ADULTS

The National Health and Nutrition Examination Survey (NHANES) has released a report, "Calories Consumed from Alcoholic Beverages by U.S. Adults, 2007–2010,"[2] which shows significant differences in alcoholic consumption patterns by age, gender, and income, but similar consumption patterns by race/ethnicity. In 2007–2010, the U.S. adult population aged 20 years and older consumed an average of almost 100 calories per day from alcoholic beverages (i.e., beer, wine, and liquor). On a given day, one-third of men and 18% of women consumed calories from alcoholic beverages. Although 67% of men and 82% of women did not consume any alcoholic beverages on a given day, almost 20% of men and 6% of women consumed more than 300 calories from alcoholic beverages daily, which is equivalent to ≥2 12-ounce (oz) beers, more than 2.5 glasses of wine (12.5 oz), or more than 4.5 oz of spirits.

The report found that men consumed more calories from alcoholic beverages than women; on average, men consumed 150 calories of alcohol per day while women consumed slightly more than 50 calories of alcohol per day. Men and women in older age groups consumed fewer calories from alcoholic beverages. Young men aged 20–39 years consumed nearly 175 calories on average from alcoholic beverages, while older men aged 60 years and older consumed 96 calories from alcoholic beverages per day. Similarly, women aged 20–39 and 40–59 years consumed an average of about 60 alcoholic calories per day, while older women consumed about one-half of that amount (33 calories per day). On a given day, consumers of alcoholic beverages obtained approximately 16% of their total caloric intake from alcoholic beverages.

No significant differences were observed in the average number of calories per day from alcoholic beverages consumed by NHW, NHB, and Hispanic people. The average number of calories consumed from alcoholic beverages was greatest among those in the highest income category. On average, 117 calories of alcoholic beverages were consumed per day by those living at ≥350% of the federal poverty level (FPL), higher than the average of just more than 90 calories from alcoholic beverages per day consumed among those living at <130% of the FPL. Women living at ≥350% of the FPL consumed an average of 75 calories from alcoholic beverages on a given day, while those living at <130% of the FPL consumed slightly more than 40 calories of alcoholic beverages per day. Among men, no differences by income were found in average daily calories consumed from alcoholic beverages.

A larger percentage of men than women consumed beer; however, a larger percentage of women than men consumed wine on a given day. Almost 20% of men and 5% of women consumed beer, while 4% of men and 7% of women consumed wine on a given day. In both men and women, the average number of calories obtained each day from beer consumption decreased with age.

NHANES obtains data from standardized physical examinations in mobile examination centers, personal interviews in the home and mobile examination centers, and laboratory tests of a national sample of the civilian, noninstitutionalized population. Data for this report were collected via an in-person, 24-hour dietary recall interview; dietary recalls cover intake during the day (24 hours) prior to the standardized physical examination.

DIET DRINK CONSUMPTION

NHANES also collected data on diet drink consumption during 2009–2010. The report, "Consumption of Diet Drinks in the United States, 2009–2010,"[3] describes the consumption of diet beverages among the U.S. population aged 2 years and older during 2009–2010 by sex, age, race/ethnicity, and income, and details trends in diet drink consumption from 1999–2000 through 2009–2010. About 20% of the U.S. population aged 2 years and older consumed diet drinks on a given day during 2009–2010. The percentage consuming diet drinks was similar for females and males at all ages except among 12- to 19-year-olds, where a higher percentage of females than males consumed diet drinks. Diet drink consumption differed by race/ethnicity. Although 15.3% of NHW children and adolescents consumed diet drinks, only 6.8% of NHB and 7.5% of Hispanic children and adolescents consumed any diet drink on a given day during 2009–2010. Similarly, 27.9% of NHW adults consumed any diet drink on a given day compared with 10.1% of NHB and 14.1% of Hispanic adults.

The percentage of higher-income people who consumed diet drinks on a given day was higher than that of lower-income people. A total of 18.3% of children and adolescents living in households with incomes at ≥350% of the FPL consumed diet drinks compared with 11.5% of those living between 130% and 350% of the FPL and 8.0% of those living at <130% of the FPL. A similar pattern was observed for adults. Although 32.6% of adults living at ≥350% of the FPL consumed diet drinks, only 20.1% of those living between 130% and 350% of the FPL and 12.2% of those living at <130% of the FPL consumed diet drinks.

From 1999–2000 through 2009–2010, the percentage of people who consumed diet beverages increased. An increase was observed in the percentage of females and males who consumed diet drinks on a given day during the 12 years studied. From 1999–2000 through 2009–2010, the percentage of people who consumed diet drinks increased from 17.8% to 21.2% for females, and from 13.9% to 19.0% for males. About 80% of people consumed no diet beverages. On a given day, about 3% consumed some but no more than 8 fluid oz of diet drinks, and 11% consumed ≥16 fluid oz of diet drinks. Diet drinks include calorie-free and low-calorie versions of sodas, fruit drinks, energy drinks, sports drinks, and carbonated water. Diet drinks do not include 100% fruit juice or unsweetened teas or coffees.

NCHS Dataline was prepared by Sandra S. Smith, MPH, Communications Consultant at the National Center for Health Statistics.

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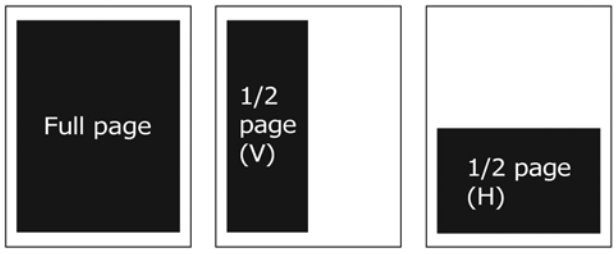

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