

Factors Affecting Implementation of the U.S. Smallpox Vaccination Program, 2003

STEPHEN J. WILSON, MD, MPH^a

On December 13, 2002, President George W. Bush announced his administration's plan to vaccinate select military and civilian personnel against smallpox as part of the overall war on terrorism. The first phase of the civilian program called for approximately 500,000 health care workers to be vaccinated on a voluntary basis.¹ On January 24, 2003, Department of Health and Human Services Secretary Tommy G. Thompson signed a declaration allowing states to begin the smallpox vaccination program. However, by mid spring 2003, vaccination efforts by state and local health departments had largely ground to a halt.² On August 1, 2003, roughly six months after smallpox vaccine became available to the states, the official tally from the Centers for Disease Control and Prevention (CDC) stood at just over 38,000 health care workers vaccinated.³ This number represented less than 10% of the original phase one goal.

As the hospital epidemiologist at a large, university-affiliated, public teaching hospital, I had been intimately involved in discussions regarding the pros and cons of prevent smallpox vaccination, not only at our hospital, but also in the surrounding community. During this time I read as much as I could about smallpox in particular and bioterrorism in general, as I am sure most of us in the public health arena did. I also developed the habit of checking the CDC website frequently for information including the number of health care workers who had been vaccinated in each state. What struck me about these reports was not necessarily the smaller-than-expected number of volunteers nationally, but rather the wide variation in smallpox vaccination rates per population from state to state. For example, as of August 1, 2003, the CDC reported 4,241 health care workers vaccinated in Texas but only 17 in Nevada.³ The differences remained striking even when adjusted for population, ranging from less than 1 health care worker vaccinated per 100,000 persons in Arizona to more than 97 per 100,000 in South Dakota.

There were many reasons why individual health care workers did or did not volunteer to be vaccinated against smallpox as part of the 2003 federal vaccination program. These included concerns about possible side effects from the vaccine in addition to uncertainties about who would pay the health care costs or disability that might result from those effects. There was also some apprehension about potential nosocomial spread of vaccinia virus from health care workers to patients. Individual decisions aside, however, it was striking how different the vaccination rates were at the state level.

Several factors could help explain the wide-ranging vaccination rates. First, the amount of federal bioterrorism funding allocated to the states could be a significant predictor of the financial resources available to devote to the vaccination program. Second, the number of medical schools in each state could be an indicator of other

^aDepartment of Medicine, Division of Infectious Diseases, Indiana University School of Medicine, Indianapolis, IN

Address correspondence to: Stephen J. Wilson, MD, MPH, Indiana Univ. Medical Center, Wishard Memorial Hospital, 1001 W. 10th St., OPW 430, Indianapolis, IN 46202; tel. 317-630-2675; fax 317-630-7522; e-mail <wilson@iupui.edu>.

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resources and infrastructure available for the vaccination program. And third, possible political factors—such as the level of support for the Bush Administration—could also help shed some light on the disparities among vaccination program success rates in the different states. In an attempt to test these hypotheses, I decided to collect and analyze some readily available public data.

From the smallpox vaccination report posted and updated weekly on the CDC website, I obtained data on the total number of persons vaccinated against smallpox in each state from January 24, 2003, through August 1, 2003.³ I obtained data on the amount of federal bioterrorism funding allocated to each state for fiscal year 2002 (ending June 30, 2003) from the Department of Health and Human Services website.⁴ I obtained data on the number of medical schools in each state from the Association of American Medical Colleges website.⁵ I obtained data on the number of votes for George W. Bush along with the total number of presidential votes cast in each state in the 2000 election from the Federal Election Commission website.⁶ Finally, I obtained data on the population of each state in the year 2000 from the Census Bureau website.⁷ I used these data to carry out simple linear regression analyses with the smallpox vaccination rate per 100,000 population as the response variable and federal bioterrorism funding per capita, number of medical schools per 10,000,000 population, and percentage of votes for the Bush-Cheney ticket, all on the state level, as the predictor variables, respectively. In addition, I analyzed these data using a multiple linear regression model with all three of the predictor variables included. The findings were interesting to say the least, and I hope they will generate a healthy discourse.

The smallpox vaccination rate per 100,000 population in each state ranged from 0.8 to 97.6 with a median (interquartile range) of 14.6 (7.8 to 22.1). Federal bioterrorism funding per capita in each state ranged from \$2.87 to \$13.25 with a median (interquartile range) of \$3.92 (\$3.46 to \$5.68). The number of medical schools per 10,000,000 population in each state ranged from 0 to 16.4 with a median (interquartile range) of 4.7 (2.5 to 6.3). The percentage of votes for the Bush-Cheney ticket in each state ranged from 31.9% to 67.8% with a median (interquartile range) of 50.6% (44.6% to 56.8%). The Figure shows the scatter plots of the simple linear regression analyses. The Table shows the results of the multiple linear regression analysis. Each of the factors was a significant, independent predictor of the smallpox vaccination rate by state, and together they explained 58% of the variability from state to state.

It is no surprise that the amount of federal bioterrorism funding allocated to each state was a significant, independent predictor of the smallpox vaccination rate. All public health endeavors, including the smallpox vaccination program, cost money.⁸ Certain states did much better than others in garnering federal bioterrorism funding, ranging from less than \$3.00 per capita in some states to more than \$13.00 per capita in others.

The number of medical schools in each state, adjusted for population, was also a significant predictor of the smallpox vaccination rate. It is important not to fall prey to the so-called ecologic fallacy when interpreting this result. However, it is likely that states with a higher density of medical

Figure. Scatter plots with regression lines of the smallpox vaccination rate per 100,000 population and (A) federal bioterrorism funding per capita ($r^2=0.254$, $p=0.0002$), (B) number of medical schools per 10,000,000 population ($r^2=0.215$, $p=0.0007$), and (C) percentage of votes for George W. Bush ($r^2=0.220$, $p=0.0006$), by state

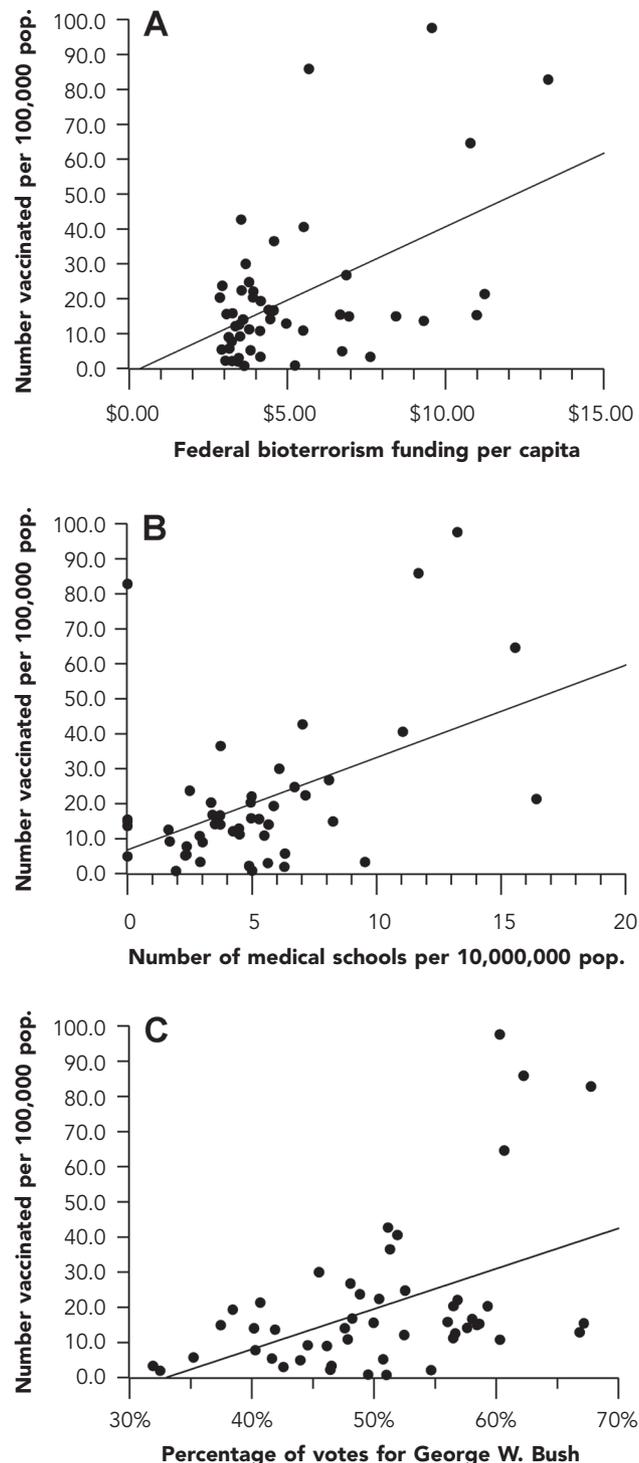


Table. Multiple linear regression model of the smallpox vaccination rate per 100,000 population based on federal bioterrorism funding per capita, number of medical schools per 10,000,000 population, and percentage of votes for George W. Bush, by state ($r^2=0.575$, $p<0.0001$)

Variable	Coefficient (β)	Standard error	95% confidence interval	p value
Intercept	-62.20	12.77	—	—
Funding	2.43	0.86	0.70 to 4.15	0.0069
Medical schools	2.60	0.57	<1.45 to 3.76	<0.0001
Votes for Bush	1.13	0.25	<0.63 to 1.62	<0.0001

schools benefit from the wealth of infrastructure intrinsic to an academic medical center campus. Such infrastructure—whether it be expert knowledge of bioterrorism,⁹ more adaptable person power, existing relationships with public health departments, or simply physical space that is centrally located—provides flexible capacity that can be redirected in times of crisis.

Finally, the percentage of voters who cast a ballot for George W. Bush in each state was also a significant, independent predictor of the smallpox vaccination rate. This result is also not surprising but may be more nuanced in its explanation compared to the issue of funding or number of medical schools. I did not have data on whether individuals who voted for Bush were more likely to volunteer for smallpox vaccination. However, on the state level it seems reasonable to attribute this finding to the general level of trust that people had for the President in states that voted for him. That is, it seems logical to hypothesize that states with larger percentages of persons who voted for George W. Bush were more likely to follow his lead when he rolled out the voluntary smallpox vaccination program, especially given uncertainties about the risk of a smallpox attack and the rare, but finite, risk of adverse side effects from the vaccine itself.¹⁰

In conclusion, as we move forward in our efforts to prepare for a potential bioterrorist attack, it is essential that we take a critical look at our progress to date. To paraphrase George Santayana, the Spanish-American poet and philosopher, those who fail to learn from history are destined to repeat it. The 2003 federal smallpox vaccination program is history at this point, with less than 10% of the original goal of health care workers vaccinated. My findings demonstrate that on the state level, higher federal bioterrorism funding per population, higher number of medical schools per population, and higher percentage of voters for the Bush-Cheney ticket were each significant, independent predictors of the smallpox vaccination rate. Together, these three factors accounted for nearly 60% of the variability in the vaccination rates by state. It behooves those of us in the medical and public health professions to learn as much as we can from

this experience so that we might improve our ability to plan for—and indeed prevent—a future bioterrorist attack, whether it be smallpox, anthrax, or other biological agent.

We need to take a hard look at how federal monies for bioterrorism are allocated and where. We need to make sure that our medical centers and health departments have adequate resources. These decisions, to every extent possible, should be based on objective risk assessments rather than politics. Finally, I believe that all Americans are willing to take risks, even substantial risks, if they believe there is a serious threat to our national security. In this regard, it is imperative that we trust our political leaders, who in turn must be able to trust those who provide them with intelligence and counsel.

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