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What Dermatologists Do Not Know about Smallpox Vaccination: Results from a Worldwide Electronic Survey

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The risk of a bioterrorist attack with smallpox has increased owing to breakthroughs in the de novo synthesis of long-chain DNA molecules. Although the leading roles of dermatologists in diagnosing recent outbreaks of cutaneous anthrax and monkeypox demonstrate the importance of dermatologist preparedness for bioterrorism, dermatologist knowledge regarding smallpox vaccination has not been extensively examined. We conducted a cross-sectional worldwide electronic survey of all members of the American Academy of Dermatology with available e-mail addresses. The response rate was 23% (1,303/5,723): 34% of respondents were women, 52% were age 50 or older, 85% practiced in the US, and 90% reported English as their primary language. Less than 37% indicated the Centers for Disease Control and Prevention estimated rate of death owing to smallpox vaccination (1 in 1,000,000), and many failed to identify vaccination contraindications: previous myocardial infarction (83%), angina (83%), congestive heart failure (78%), steroid eye drop use (65%), and the non-emergency vaccination of those younger than age 18 (95%). Widespread dermatologist smallpox vaccination knowledge deficits pinpoint opportunities for educational efforts.

INTRODUCTION

US smallpox vaccination policy has generated heated debate (Beane, 2004; Kaiser, 2005). Although US physicians and patients are increasingly unwilling to volunteer for smallpox vaccination (Blendon et al., 2003; Everett et al., 2003, 2004; Kuhles and Ackman, 2003; Benin et al., 2004; Centers for Disease Control and Prevention, 2005a), advances in long molecule DNA synthesis that facilitate in vitro synthesis of viral genomes have recently heightened concerns about smallpox bioterrorism attacks (Tian et al., 2004). This study assessed dermatologist knowledge regarding smallpox vaccination.

RESULTS

The response rate for the electronic survey (Online Appendix A) was 23% (1,303/5,723). Thirty-four percent of respondents were women, 52% were age 50 or older, 85% practiced in the USA, and 90% reported English as their primary language. Respondents reflected American Academy of Dermatology (AAD) fellow sex and age distributions, and over-represented fellows in the USA (Online Appendix B).

Questions regarding smallpox vaccination adverse events and contraindications were imbedded among 29 questions addressing the practices and attitudes of dermatologists regarding smallpox vaccination and responder demographics. Owing to skip patterns determined by the answers provided, all responders completing the full survey viewed at least 21 of the 29 questions. Response rates per question for these 21 questions ranged from 99% for the first question regarding types of media exposure through which smallpox educational information had been obtained to 90% for the fill-in question requesting country of practice. Except for one nurse, all respondents were physicians. Most respondents (71%) saw patients in a town of 100,000 or more people, and 46% practiced in a group setting.

Few respondents (17%) reported recent vaccination for smallpox in the preceding 5 years (16.8% US vs 27.3% outside the US) (relative risk for smallpox vaccination among US respondents = 0.6; 95% confidence interval = 0.3, 1.3). Eighty-three percent of those who had been given
a choice regarding whether or not to be vaccinated stated that vaccine safety had influenced their decision (Table 1). Most reported receiving recent information on smallpox from journal articles (91%), medical mailings (85%), Internet information (72%), medical lectures (71%), or newspaper articles (70%).

Dermatologists were frequently not in agreement (15% overestimated, 22% underestimated, 26% unsure) with the CDC estimate of death owing to smallpox vaccination (1 in 1,000,000) (Table 2). Most identified immunosuppression (97%), eczema (93%), breastfeeding (58%), and a household member with a history of eczema (57%) as contraindications to smallpox vaccination, but few identified myocardial infarction (17%), angina (17%), congestive heart failure (22%), use of steroid eye drops (35%), and non-emergency vaccination of those under age 18 (5%).

**Table 1. Smallpox vaccination status**

|                                       | Yes  | No   | Not sure |
|---------------------------------------|------|------|----------|
| Has smallpox vaccination been available in your country in the past 5 years? | 618 (52) | 415 (35) | 165 (14) |
| Has smallpox vaccination been available to you in the past 5 years? | 526 (44) | 479 (40) | 205 (17) |
| Were you able to freely choose whether or not to receive smallpox vaccination? | 448 (87) | 51 (10) | 15 (3) |

**What factors influenced your smallpox vaccination decision?**

- Level of risk of a smallpox outbreak
- Vaccination safety
- Recommendations by healthcare organizations
- Recommendations by healthcare providers
- Vaccination convenience
- Patriotism
- Planned travel to other countries
- Recommendations by employer
- Incentives for vaccination
- Have you recently been vaccinated (within 5 years) for smallpox?
  - Year
    - 2004
    - 2003
    - 2002
    - 2001
    - 2000

| Has you recently been vaccinated (within 5 years) for smallpox? | Yes  | No   | Not sure |
|------------------------------------------------------------|------|------|----------|
| 2004                                                        | 2 (2)|      |          |
| 2003                                                        | 64 (74)|     |          |
| 2002                                                        | 20 (23)|    |          |
| 2001                                                        | 1 (1)|     |          |
| 2000                                                        | 0 (0)|     |          |

The answers of those who responded before the third e-mail invitation on October 8, 2004 (n=877) were compared with the answers of those responding after October 8, 2004 (n=426). No significant differences between the two groups were found with regard to sex, age, vaccination status, or agreement that a smallpox attack was likely in the next 12 months.

**DISCUSSION**

In 2001, the CDC recommended smallpox vaccination for medical or laboratory personnel exposed to non-highly attenuated orthopoxviruses (Rotz LD et al., 2001). In
December 2002, President George W. Bush announced that those “deployed or who may deploy to certain high threat areas be vaccinated” (CDC, 2005b). In 2003, the CDC recommended vaccination “for persons designated by public health authorities to conduct investigation and follow-up of initial smallpox cases that might necessitate direct patient contact.” Each state and territory has been advised to establish and maintain at least one smallpox response team consisting of members who have previously been vaccinated (Wharton et al., 2003). Cardiac complications from smallpox vaccination precipitated a CDC press release recommending deferral for heart patients volunteering for smallpox vaccination in March 2003 (Casey et al., 2005). Our survey occurred in late 2004. As of December 5, 2005, over 920,000 Department of Defense operational forces and healthcare workers have been vaccinated (CDC, 2005c; Office of the Assistant Secretary of Defense, 2005).

Dermatologists would likely be among the first consultants summoned to perform skin biopsies and help distinguish smallpox from chickenpox, monkeypox, or, and other diagnoses. Although dermatologists in this survey indicated willingness to be vaccinated if a smallpox outbreak occurred, the current low rate of recent vaccination parallels that of other healthcare workers (Kuhles and Ackman, 2003; Benin et al., 2004; CDC, 2005a).

Smallpox vaccination confers immunity to smallpox for 3–5 years with waning immunity thereafter (CDC, 2005d; Hatakeyama et al., 2005). The CDC identifies the risk of serious side effects from vaccination, including the spread of the live virus used in the vaccinia inoculation to other sites of the body or to other people, to occur in 1 in 1,000 persons (CDC, 2005e). The CDC also reports that 14 to 52 in 1,000,000 vaccinees will experience life-threatening reactions including eczema vaccinatum, progressive vaccinia, and postvaccinal encephalitis, and one to two in 1,000,000 vaccinees may die as a result. The CDC’s contraindications to smallpox vaccination for persons unexposed to smallpox currently include having eczema or other skin conditions, immunosuppression, pregnancy or plans to become pregnant within 1 month of vaccination, an allergy to the vaccine or its components, age younger than 1 year in an emergency setting or younger than 18 years in a non-emergency setting, breastfeeding, use of steroid eye drops, history of a heart condition diagnosed by a physician, or three or more of the following cardiac risk factors diagnosed by a physician: high blood pressure; high blood cholesterol; diabetes; first-degree relative with a heart condition before age 50; and currently smoking cigarettes (CDC, 2005e).

Most responders’ answers did not reflect CDC guidelines for smallpox vaccination of persons with heart disease or under the age of 18 years, a finding consistent with nearly half of healthcare workers not feeling well informed about the risks and benefits of smallpox vaccination (Yih et al., 2003). Physician advice has also deviated from widely publicized public health guidelines for other infectious agents (Chan et al., 1997; Deng et al., 2006), highlighting the need for new approaches for physicians learning of public health messages (Armstrong and Parsa-Parsi, 2005).

This study has strengths and weaknesses:

(a) The response rate was 23% reflecting increasing limitations in obtaining high response rates to electronic surveys (Sheehan, 2001). We were, however, encouraged to achieve a response rate similar to those of many other published electronic surveys (Sheehan, 2001; Hester et al., 2004) despite the decreased tendency of physicians to respond to surveys compared with other sample populations (Asch et al., 1997).

(b) The potential for response bias from e-mail surveys is greater than for mailed or telephone surveys (Braithwaite et al., 2003). Voluntary response to an electronic survey likely selected for responses from physicians more interested in and knowledgeable about smallpox. The results therefore likely overestimate vaccination rates and underestimate knowledge deficits regarding smallpox vaccination.

(c) Survey invitations were emailed directly by AAD administration in the hope of improving response rate as well as to ensure anonymity of respondents. However, as no e-mail addresses or other identifying variables for AAD members were provided to the authors, examination of non-responder bias was not possible. Late responders have been suggested to display biases that might be accentuated in non-responders (Armstrong and Overton, 1977). Comparison of early and late responders to this survey showed no significant differences.

(d) The questionnaire was not available in languages other than English, deterring response from non-native English speakers and creating a possible language barrier for the 10% of respondents whose primary language was not English.

(e) This study did not assess dermatologists’ smallpox diagnostic skill, an important parameter for successful response to a bioterrorist attack.

Smallpox vaccination remains a topic of high importance and publicity. This study highlights the need to more effectively inform dermatologists about facts that may influence decisions regarding smallpox vaccination and provides descriptive information for improving public health smallpox communications with dermatologists and other potential first responders worldwide (Institute of Medicine, 2005). Future studies might investigate dermatologists’ smallpox diagnostic skill, how they view the importance of knowledge of smallpox, and how better knowledge might impact management of a bioterrorist attack.

**MATERIALS AND METHODS**

AAD fellows with active e-mail addresses (5,723 of 8,293) were emailed an introductory letter containing a link to the electronic-based questionnaire on August 9, 2004. Up to three further elicitations were emailed to non-responders on September 17, October 8, and December 9, 2004. The AAD mediated the emailing of members to protect member e-mail address confidentiality and prevent the authors from identifying responding and non-responding AAD members individually.
The survey (Online Appendix A) consisted of 29 questions addressing: (1) knowledge of efficacy, risks, and contraindications to smallpox vaccination, (2) perceived threat of a smallpox bioterrorism attack, (3) attitudes about vaccination, (4) personal vaccination history, and (5) demographic data. Information regarding contraindications to smallpox vaccination was obtained from the CDC (CDC, 2005e).

The questionnaire was designed and data collected using Survey Monkey, an Internet-based electronic survey resource (www.surveymonkey.com). Invitees were informed that all responses would remain anonymous and only be analyzed in aggregate. Data analysis, including relative risks with 95% confidence intervals, was performed using SAS Version 9 (Cary, NC). This study received Colorado Multiple Institutional Review Board approval (no. 03-677).

CONFLICT OF INTEREST
The authors state no conflict of interest.

ACKNOWLEDGMENTS
This study was presented at the International Dermatopoepidemiology Association (IDEA) Americas Chapter meeting in St Louis, MO on May 5, 2005. We thank the members of the AAD who made this survey possible, especially 2004 President Boni Elewski, MD, Jon Hanfin, MD, and Jeffrey J. Melfert, MD, respectively, member and chair of the AAD Bioterrorism Task Force Committee, and AAD staff liaison Connie Tegeler. We thank Barbara Paez for providing AAD Fellowship demographics. We thank Kara Wallington, MRCP, for thoughtful discussion during the preliminary stages of the work. All authors helped design the project, draft, and pilot the survey, and comment upon the analysis of results and subsequent manuscript. Additionally, R.P.D. provided support for the study, wrote the first draft of the manuscript, and served as the principle investigator and corresponding author. L.F.H. conducted the analyses. This study was supported by National Institutes of Health (Bethesda, MD) Grants CA92550 (R.P.D.), 5 D14HP00153 (L.M.S.), and T32 AR07411 (K.R.J. and E.J.H.).

SUPPLEMENTARY MATERIAL
Online Appendix A. The survey.

Online Appendix B. Table reporting respondent and AAD fellow demographics.

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