

SHORT REPORT

Laboratory worker knowledge, attitudes and practices towards smallpox vaccine

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Background	Recent cases of laboratory-acquired vaccinia virus (VV) infection highlight the need for laboratory safety.
Aims	To determine laboratory worker adherence to the Advisory Committee for Immunization Practices smallpox vaccination recommendations, assess potential barriers to vaccination and determine the influence of training on laboratory worker attitudes.
Methods	Ninety-two laboratory workers in Pennsylvania were contacted and asked to complete an online survey about VV usage; 45 responded.
Results	Eighty-seven per cent had received a smallpox vaccination in their lifetime; 73% received vaccination in the past 10 years. More workers had been given training regarding the potential risks, versus the potential benefits of vaccination, and most perceived that adverse outcomes were more likely to occur following vaccination versus accidental infection.
Conclusions	The results of this study suggest that the main barrier to vaccination may be fear associated with possible vaccine adverse effects and a willingness to risk accidental infection rather than be vaccinated. More information and training about the potential benefits of vaccination, as well as the potential adverse outcomes associated with accidental infection, is therefore warranted.
Key words	Knowledge attitudes and practices; smallpox vaccine; vaccinia virus; WR-vaccinia.

Introduction

As the fields of molecular biology and vaccine development have expanded, the use of vaccinia virus (VV) as a molecular tool has become increasingly common [1]. However, despite its utility, VV is a potentially hazardous pathogen and laboratory workers should have the necessary tools and information to protect themselves against accidental infection.

In recognition of this, the Advisory Committee on Immunization Practices (ACIP) has recommended vaccination with smallpox vaccine (ACAM2000, Acambis) for the prevention of VV infection among laboratory workers [2] in the USA. In addition, biosafety guidelines recommend the use of personal protective equipment (PPE) [3].

Recent cases of laboratory-acquired VV infection highlight the need for a greater understanding of the knowledge, attitudes and practices of laboratory workers handling VV [4]. The purpose of this study was therefore to determine adherence to ACIP recommendations, assess potential barriers to vaccination and determine the influence of training on laboratory worker attitudes.

Methods

This investigation was conducted as part of a public health response following an accidental VV infection in a Pennsylvania laboratory worker. (This activity was deemed non-research in accordance with agency interpretation of the US Code of Federal Regulations, Title 45, Part 46, which sets forth regulations for the protection of human subjects.)

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Laboratories in Pennsylvania in which VV was handled were identified by the Centers for Disease Control and Prevention and the Pennsylvania Department of Health. In March of 2005, letters were sent to the occupational health and safety directors of each identified institution ($n = 16$), requesting the email addresses of employees who, in the past 5 years, had worked in laboratories that utilize VV. Five of 16 institutions contacted during the investigation declined to participate, citing that VV was not currently being utilized in their laboratories. Ninety-two eligible workers were identified, contacted and asked to complete an online survey to evaluate their knowledge, attitudes and practices regarding smallpox vaccination. Investigators were blinded to names and email addresses of prospective subjects to protect anonymity. Contact information was stored separately from responses. No information was retained for those who declined to participate. The survey contained 42 structured questions with a series of response options provided. Data were managed and summarized using SPSS.

Results

Forty-five (49%) workers responded to the survey (Table 1). Eighty-seven per cent of respondents had received a smallpox vaccination in their lifetime; 73% received vaccination in the past 10 years. Sixty per cent

Table 1. Characteristics of all respondents, vaccinated respondents and non-vaccinated respondents

Characteristics	All, n (%)	Vaccinated, n (%)	Non-vaccinated, n (%)
Respondents	45 ^a (100)	39 (87)	5 (11)
Institution	44 ^a	38	5
University	25 (57)	20 (53)	5 (100)
Industry	17 ^a (39)	16 (42)	0
Private	2 (5)	2 (5)	0
Occupation	44 ^a	38	5
Laboratory director	12 (27)	12 (32)	0
Graduate student	9 (21)	6 (16)	3 (60)
Laboratory technician	7 (16)	6 (16)	1 (20)
Staff scientist	6 (14)	6 (16)	0
Postdoctoral researcher	4 (9)	4 (11)	0
Instructor/non-tenure	3 (7)	2 (5)	1 (20)
Other	3 ^a (7)	2 (5)	0
Age	44 ^a	38	5
>37 years	18 (41)	16 (42)	2 (40)
33–37 years	8 ^a (18)	5 (13)	2 (40)
<33 years	18 (41)	17 (45)	1 (20)

^aIncludes one with unknown vaccination status.

of respondents worked with non-highly attenuated strains of VV. Of these, seven had not received vaccination in the past 10 years. The non-vaccinated respondents ($n = 5$) were all affiliated with universities. No information was recorded for eligible laboratory workers who declined participation.

Although 89% of respondents reported being aware of contraindications to smallpox vaccine, 21% of those who had been vaccinated had contraindications, including skin conditions and immune compromise (Table 2).

Nearly, all who responded (96%) had received training on the risks of working with live VV and the risks of smallpox vaccine. Respondents who had not been vaccinated in the past 10 years received less training than those who had been vaccinated in the past 10 years.

Respondents perceived that specific adverse outcomes were more likely to occur following vaccination versus accidental infection, namely, 'swelling of glands' (91 versus 51%), 'feeling bad enough to miss work' (53 versus 29%) and 'accidental infection of a contact' (26 versus 13%). Respondents were more concerned about vaccine side-effects than accidental infection, although 31% of respondents knew someone who was infected by VV due to a laboratory accident.

Among those who were ever vaccinated, 59% reported their primary reason for receiving vaccination as 'required by institution'. Seventy-six per cent reported that 'concern for personal safety' was the strongest influence on their adherence to safe laboratory practices. Ninety-five per cent of respondents thought that people who work with VV should be required to follow safety guidelines and wear PPE. When asked why workers do not wear PPE, 55% respondents reported 'don't think it's

Table 2. Awareness of contraindications and presence of contraindications among all respondents, vaccinated respondents and non-vaccinated respondents

Characteristics	All, n (%)	Vaccinated, n (%)	Non-vaccinated, n (%)
Respondents	45 ^a	39	5
Aware of contraindications	40 (89)	37 (95)	3 (60)
Have contraindications	11 (24)	8 (21)	3 (60)
Work with non-highly attenuated strains	9 (82)	6 (75)	3 (100)
Immunodeficiency	7 (64)	6 (75)	1 (33)
Skin condition	9 (82)	7 (88)	2 (67)
Pregnant/breastfeeding	5 (46)	5 (63)	0
Cardiac disease	3 (27)	3 (38)	0
Contact with infant	5 (46)	5 (63)	0
Close contact having contraindications	5 (46)	5 (63)	0

^aIncludes one with unknown vaccination status.

necessary', 48% reported 'limits visibility or dexterity', 36% reported 'lack of availability' and 14% reported 'implies lack of laboratory skill'.

Forty-eight per cent of respondents agreed that laboratory workers who handle VV should be required to receive smallpox vaccination. Most (81%) agreed that people who have contraindications for smallpox vaccination should be discouraged from working with live VV.

Discussion

Although most laboratory workers in this study received vaccination, more than a quarter of those who handled non-highly attenuated strains had not been vaccinated in the past 10 years.

Despite the fact that a majority of respondents reported an awareness of contraindications to vaccine, and agreed that workers with contraindications should be discouraged from working with VV, >20% of vaccinated workers themselves had contraindications. Moreover, most of the workers with contraindications manipulated non-highly attenuated strains (Table 2).

Over 90% of respondents received training on the risks of working with VV and how to protect oneself from accidental infection. Despite the amount of training received, however, respondents remained unclear about the biosafety levels associated with VV work and outcomes of accidental infection. All the most senior workers (identified as laboratory directors, staff scientists or post-doctoral workers) received vaccination, highlighting the special considerations posed for student and temporary workers who may perceive that they will derive less benefit from vaccination due to the transient nature of their VV research activities.

A comparison of accidental VV infection among vaccinated versus non-vaccinated cases revealed that those who had never been vaccinated had more serious outcomes, including hospitalization [4–10]. Such examples may help to better inform laboratory workers about the benefits of vaccination.

This study is limited by a weak response rate and by the clustering of participants according to institution. Additionally, not all participants responded to all questions. Despite these limitations, the findings can help to guide future safety recommendations for laboratory workers who handle VV.

In order to formulate effective policy, it is critical to obtain insight into the prevailing beliefs and practices of the population to which such policy is targeted. The results of this study reveal a lack of adherence to current recommendations of the ACIP, a need for greater training of laboratory workers who handle VV and that institutional policies are important in ensuring the safety of laboratory workers through vaccination.

Key points

- The results of this study reveal a lack of adherence to current smallpox vaccination recommendations and suggest a need for greater training of laboratory workers who handle vaccinia virus.
- Among laboratory workers who manipulate vaccinia virus, the main barrier to receiving smallpox vaccination may be fear associated with possible vaccine adverse effects and a willingness to risk accidental infection rather than be vaccinated.
- The results of this study suggest that institutional policies can play a major role in ensuring the safety of laboratory workers through vaccination.

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Conflicts of interest

None declared.

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