MAJOR ARTICLE

# A 2009 Varicella Outbreak in a Connecticut Residential Facility for Adults with Intellectual Disability

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**We investigated a varicella outbreak in a residential facility for adults with intellectual disabilities. A case of varicella was defined as a generalized maculopapular rash that developed in a facility resident or employee. Immunoglobulin M testing was conducted on serologic samples, and polymerase chain reaction testing was performed on environmental and skin lesion samples. Eleven cases were identified among 70 residents and 2 among ~145 staff. An unrecognized case of herpes zoster was the likely source. Case patients first entered any residential facility at a younger age than non-case residents (9.5 vs 15.0 years; $P < .01$). Varicella zoster virus DNA was detected 2 months after the outbreak in environmental samples obtained from case patients' residences. This outbreak exemplifies the potential for at-risk pockets of varicella-susceptible adults, especially among those who have lived in residential facilities from a young age. Evidence of immunity should be verified for all adults and healthcare staff in similar residential settings.**

Varicella disease in adults is uncommon in the United States because most adults have naturally acquired immunity. National seroprevalence data from 1988 to 1994 showed that ⩾95% of adults ⩾20 years old were immune to varicella-zoster virus (VZV) [1]. In addition, adults comprised only 2%–4% of varicella cases in outbreaks reported from a varicella surveillance site during 1995–2005 [2].

In December 2008, the Connecticut Department of Public Health was notified of a varicella outbreak in a residential facility for adults with intellectual disabilities (facility A) operated by the Connecticut Department of Developmental Services. The Connecticut Department of Public Health subsequently undertook an investigation to describe the outbreak and identify challenges in case management and outbreak control in this setting.

## METHODS

***Case investigation.*** Facility A employed ~145 staff and housed 70 residents with various levels of intellectual and physical disabilities in apartments in 3 buildings. Each apartment had 3 bedrooms with 2 beds in each bedroom. Staff included nursing, direct care, physical and occupational therapists, psychologists, cleaning staff, and clerical staff. A varicella case was defined as a generalized maculopapular rash (with or without vesicles and without another apparent cause) occurring

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between 1 November 2008 and 1 February 2009 in a resident or employee in facility A. Cases were identified by facility medical staff and/or chart review.

Information on all residents was abstracted from medical charts and facility admission histories using a standardized form and from interviews with facility caregivers. Staff case patients were interviewed by using a standardized case investigation form.

***Laboratory testing.*** Serum samples were tested for VZV-specific immunoglobulin M (IgM) and immunoglobulin G (IgG) by using an in-house Centers for Disease Control and Prevention assay as described elsewhere [3] and an enzyme immunoassay at a commercial laboratory. VZV DNA isolation from skin lesions by polymerase chain reaction (PCR) and genotyping were performed as described elsewhere [4]. To identify VZV in the environment, sterile polyester swabs moistened with phosphate buffered saline were used to collect samples from various surfaces ($2 \times 2$ $cm^2$ sample area) in residents' rooms and common areas. Samples were collected from residential building 2, where no cases were identified, as control samples. Environmental samples were collected during the outbreak investigation and ~2 months after rash onset in the last case. VZV detection and genotyping of the environmental samples by PCR was done as reported elsewhere [4]. Laboratory staff was blinded as to whether specimens were case or control samples.

***Definitions and statistical analysis.*** The attack rate was calculated as the proportion of cases among the residents of facility A. Residents' degrees of intellectual and physical disabilities were categorized by an intelligence quotient score (moderate, 35–55; severe, 20–40; or profound, <20) [5] and by functional ability (requiring full physical assistance, some physical assistance, or verbal and/or visual and/or psychosocial prompts).

We used a Student *t* test for continuous variables and Pearson $\chi^2$ or Fisher exact test for categorical variables to analyze data. A significant association was defined as one with a 2-sided *P* value of <.05. Approval from an institutional review board was not required because this investigation was conducted as part of a public health response.

## RESULTS

***Case investigation.*** From 4 December 2008 through 7 January 2009, 11 of the 70 residents of facility A had varicella rash onset, for an overall attack rate (AR) of 15.7%. Varicella diagnoses were laboratory confirmed for 3 case patients (2 who were positive for varicella IgM and 1 with VZV DNA detected in a skin lesion). Case patients ranged in age from 32 to 49 years (median, 39 years). All case patients resided in buildings 1 and 3 (8 cases in building 1 and 3 cases in building 3; AR in buildings 1 and 3 were 33% and 13%, respectively) and attended 1 of 2 off-site day programs using 1 of 2 transportation vehicles. In addition to day programs, residents interacted with each other at occasional facility-wide social events. Five case patients had ⩾50 lesions, and 1 had >500 lesions. The median duration of rash was 9 days, and fever was present in 90% of case patients. Complications did not develop in any case patients, but 1 patient died 10 days after rash onset of causes unrelated to varicella. Two case patients had a documented history of varicella disease.

Varicella was identified among 2 facility A staff (a nurse and a caregiver, aged 28 and 33 years, respectively). Both developed a rash with >250 lesions on 22 December 2008. Neither staff member reported a history of varicella vaccination or disease; one was born outside the United States. One additional case was identified in a severely disabled nonfacility participant of one of the day programs attended by 7 of the 11 infected residents. This case patient had no history of varicella vaccination or disease and developed a rash with 250–500 lesions on 18 December 2008.

During the medical records review conducted in January, we identified a possible case of herpes zoster in the 41-year old roommate of the first varicella case patient. The roommate developed a localized vesicular rash on his right arm on 17 November 2008 (18 days before the start of the varicella outbreak) that lasted 8 days. He had a documented history of varicella disease in 1985 and a positive VZV IgG test result from a blood sample obtained on 10 December 2008. His lesions were thought to be fungal in origin at the time of rash. Because his lesions were not diagnosed as herpes zoster at the time of presentation, his rash was not kept covered.

***Analysis.*** There were no statistically significant differences among case patients and non-case residents by age, sex, or race and/or ethnicity (Table 1). The mean age when they were first admitted to a residential facility was younger for case patients than non-case residents (9.5 vs 15.0 years; $P < .01$). A larger proportion of case patients than non-case residents required full or some physical assistance, and proportionally more of them attended day program A. Non-case residents were more likely to attend other day programs. Only 1 case patient was on an immunosuppressive medical regimen (methotrexate and tumor necrosis factor $\alpha$ inhibitor) for treatment of rheumatoid arthritis; there were no statistically significant differences between cases and non–case residents in the prevalence of medical conditions associated with immunosuppression.

***Outbreak control measures.*** Case patients were kept in their bedrooms or on their residential floor until their lesions scabbed over, although bedroom doors remained open at all times to allow staff to monitor residents. Non-case residents living in apartments with case patients were not allowed to leave their apartments for 14 days following rash onset in the last case. Due to the limited number of rooms, facility A did

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**Table 1. Demographic and Clinical Characteristics of Facility A Residents by Varicella Case Status**

| Characteristic | Case patients ($n$ = 11) | Non-case residents ($n$ = 59) | $P$ value |
|---|---|---|---|
| Age, years (SD) | 42 (6) | 45 (10) | .31 |
| Male sex | 8 (73) | 38 (64) | .74 |
| Race or ethnicity | | | .71 |
| Black | 0 (0) | 5 (8) | |
| White | 10 (91) | 45 (76) | |
| Hispanic | 0 (0) | 5 (8) | |
| Unknown | 1 (9) | 4 (7) | |
| Years living in residential facilities, mean (SD) | 32 (7) | 29 (13) | .36 |
| Years at facility A, mean (SD) | 25 (7) | 21 (9) | .18 |
| Age when began living in a residential facility, mean, years (SD) | 10 (4) | 15 (11) | <.01 |
| Intellectual disability level | | | .48 |
| Moderate | 0 (0) | 2 (3) | |
| Severe | 1 (9) | 17 (29) | |
| Profound | 10 (91) | 40 (68) | |
| Functional assessment | | | .22 |
| Full physical assistance | 6 (55) | 13 (22) | |
| Some physical assistance | 4 (36) | 29 (49) | |
| Other[a] | 1 (9) | 14 (24) | |
| Data missing | 0 (0) | 3 (5) | |
| Day program participation[b] | | | <.01 |
| Day program A | 7 (64) | 12 (21) | |
| Day program B | 4 (36) | 6 (10) | |
| Other day program | 0 (0) | 40 (69) | |
| No. of skin lesions | | | … |
| <50 | 6 (55) | | |
| 50–249 | 1 (9) | | |
| 250–500 | 3 (27) | | |
| >500 | 1 (9) | | |

**NOTE.** Data are no. (%) unless otherwise indicated. SD, standard deviation.

[a] Other assistance includes verbal, visual, and/or psychosocial prompts.

[b] Data on day program and transportation missing for 1 non-case resident.

not isolate cases from their non–case roommates. There were 2 rooms where both roommates became cases, although in both instances, rash onset dates were within 3 days of each other, indicating that transmission did not occur between roommates. Facility A recommended that all staff (healthcare and non-healthcare) check their varicella immunity status with their private healthcare provider and undergo vaccination if susceptible; however, evidence of immunity was not required to continue working.

Facility A vaccinated 55 (93%) of 59 residents who had not developed a varicella-like rash from 30 December 2008 through 6 January 2009 because information on history of varicella disease was incomplete on medical records and could not be accurately obtained from guardians. In addition, it was challenging to obtain a serology specimen from all residents to assess susceptibility. A second dose of varicella vaccine was given ⩾28 days later to 50 of these residents. On 17 January 2009, a maculopapular vesicular rash with <50 lesions developed on the face, trunk, and legs of a resident who was vaccinated on 30 December 2008. Vaccine strain VZV DNA was detected from skin lesion samples from this resident. The 4 residents who were not vaccinated because of guardian refusal or documented history of varicella had IgG testing done, and all were VZV IgG positive.

***Environmental testing.*** Of the 71 environmental samples collected in January 2009 (Table 2), we detected wild-type (WT) VZV DNA from 9 (82%) of the 11 case patients' beds and belongings, from the bedroom floor and wheelchair of the possible herpes zoster case patient, and from the common areas of building 1. No VZV DNA was detected in samples collected from building 2, where there were no cases. An additional 25 environmental specimens were collected in March 2009: VZV DNA remained detectable in samples from the bedrooms of 6 (75%) of 8 varicella case patients and from the common area of building 1. In addition, Oka- (vaccine) strain VZV was detected in environmental samples collected in January and



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**Table 2. Varicella-Zoster Virus Polymerase Chain Reaction (PCR) Results for Environmental Samples Collected during and after a Varicella Outbreak in a Residential Facility in Connecticut**

| Source of specimen | Samples collected January 2009 | | | | Samples collected March 2009 | | | |
|---|---|---|---|---|---|---|---|---|
| | No. tested | PCR results | | | No. tested | PCR results | | |
| | | Positive | Negative | Indeterminate[a] | | Positive | Negative | Indeterminate[a] |
| Varicella case patients' room and/or belongings | 26 | 17 (65) | 5 (19) | 4 (15) | 16 | 10 (63) | 3 (19) | 3 (19) |
| Possible herpes zoster case patient's room and/or belongings | 6 | 3 (50) | 1 (17) | 2 (33) | 0 | … | … | … |
| Vaccine-associated rash case patient's room and/or belongings[b] | 2 | 1 (50) | 0 (0) | 1 (50) | 2 | 1 (50) | 0 (0) | 1 (50) |
| Non-case resident's room and/or belongings | 4 | 0 (0) | 4 (100) | 0 (0) | 0 | … | … | … |
| Building 1 common area | 17 | 4 (24) | 10 (59) | 3 (18) | 4 | 2 (50) | 1 (25) | 1 (25) |
| Building 2 common area | 8 | 0 (0) | 5 (63) | 3 (38) | 0 | … | … | … |
| Building 3 common area | 4 | 0 (0) | 3 (75) | 1 (25) | 3 | 0 (0) | 3 (100) | 0 (0) |
| Transport vehicle | 4 | 3 (75) | 1 (25) | 0 (0) | 0 | … | … | … |
| Total | 71 | 28 (39) | 29 (41) | 14 (20) | 25 | 13 (52) | 7 (28) | 5 (20) |

**NOTE.** Data are no. (%) of participants, unless otherwise indicated.

[a] Results for samples classified as indeterminate due to insufficient DNA or because they were actin negative. Actin PCR was run concurrently with all varicella-zoster virus PCR assays as a control to indicate whether the specimen included cellular material and, therefore, whether the specimen was adequately collected.

[b] Positive PCR results were genotyped as varicella-zoster virus vaccine strain.

March 2009 from the bedroom of the resident with vaccine-associated rash.

## DISCUSSION

This varicella outbreak in a facility for adults with intellectual and physical disabilities highlights several important aspects of varicella prevention and control. Residents affected by this outbreak had been living in residential settings for most of their lives. This presumably resulted in greater social isolation and fewer opportunities for exposure to varicella in childhood. Although current guidelines from the Advisory Committee on Immunization Practices state that birth before 1980 is evidence of varicella immunity for the general population [1], this may not be predictive of immunity for individuals who have lived in residential facilities since childhood. As a result of the outbreak, the Connecticut Department of Developmental Services amended its varicella guidelines for similar institutional settings to no longer accept birth before 1980 as evidence of varicella immunity for residents. Because of challenges in obtaining complete medical and vaccination histories and collecting serum specimens, it can be difficult to determine varicella immunity among residents of adult residential facilities. Thus, for residents for whom it is difficult to document a history of varicella disease or vaccination and challenging to obtain a serology specimen to assess immunity, the most efficient approach may be to screen all current and potential residents for evidence of immunity to varicella [1] and to vaccinate susceptible individuals, even those born before 1980, prior to admission to the facility.

Varicella outbreaks have been described in other residential facilities for adults, including long-term care facilities, hospitals, and prisons [6–10], but few have been described in residential settings for people with intellectual and physical disabilities. Other than young age at admission to a residential facility, we did not find any individual level risk factors for varicella among residents in this outbreak. Because most adults have naturally acquired immunity to varicella [1], varicella disease in adult settings typically does not spread extensively. Although the overall attack rate in this outbreak was high (16%) compared with that for other reported outbreaks among adults (0.2%–3.6%) [4, 6–8, 10], disease presentation was not particularly severe. Adults, however, often have more severe disease with increased rates of mortality when they develop varicella [11]. A varicella outbreak among adults with learning disabilities, the majority of whom have lived most of their lives in a residential facility in the Netherlands, resulted in a varicella-related death [6].

Varicella is highly infectious; secondary attack rates in susceptible household contacts might reach 90% [1]. Recommended control measures [12–13], such as airborne respiratory isolation measures or isolation of case patients to their own room, can be extremely difficult and expensive for residential facilities to implement [9,14]. Case patients in this outbreak could not be effectively isolated alone in their rooms because they required 24-h supervision for their personal safety. Due to their level of disability, residents did not have the capacity to follow basic infection control practices.

In this outbreak, it is likely that a single unrecognized herpes zoster case resulted in 3 generations of disease transmission in the facility and community. Herpes zoster typically occurs in older populations, although zoster can occur in younger per-



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sons with an estimated annual rate of 1–2/1000 persons for 20–40-year-olds [15]. To prevent VZV transmission from herpes zoster cases, contact precautions should be followed [1]. In this outbreak, proper infection control measures were not implemented because the herpes zoster case was retrospectively identified after the rash had resolved. It is important for staff in residential facilities to consider herpes zoster as a diagnosis for unilateral rashes and implement control measures as appropriate to prevent VZV transmission from these cases. This recommendation is also important for school settings and other residential facilities, such as long-term care facilities, prisons, hospitals, army barracks, and shelters, in which there is a higher risk of exposure if VZV is introduced in this type of setting due to the constant close contact of students or residents.

Healthcare providers in residential facilities should be screened for immunity to varicella and other vaccine-preventable diseases prior to employment [1, 12]. Birth before 1980 should not be considered evidence of immunity to varicella for US-born healthcare staff, since it is important that they have confirmed immunity to varicella [1]. For healthcare staff who are not born in the United States, it is also important that they are screened for immunity to varicella regardless of when they were born because the epidemiology of varicella may differ in other countries [1]. Ensuring immunity among healthcare providers ensures protection for both them and the residents they care for, who may not have immunity to these diseases. For other staff in residential facilities, a requirement for evidence of immunity to varicella and other vaccine-preventable diseases can be considered depending on their level of contact with residents and the prevalence of contraindications preventing vaccination of susceptible residents.

Laboratory testing of clinical and environmental samples are important tools for investigation and control of outbreaks. Varicella and herpes zoster can easily be mistaken for other rash illnesses. Pain, a characteristic commonly associated with herpes zoster, may be less prevalent in younger adults [16] or difficult to ascertain in persons who are nonverbal. PCR of skin lesion specimens is the preferred method for laboratory confirmation of varicella cases while skin lesions are still present. Serology testing requires invasive blood collection procedures and is less sensitive for establishing a diagnosis. Laboratory testing also plays a critical role in identifying vaccine-associated adverse events. Through genotyping, we were able to identify a resident with a vaccine-associated rash during this outbreak.

As demonstrated in this and a previous outbreak investigation [4], environmental sampling is useful for confirming a varicella case or outbreak, particularly in situations in which lesions are no longer present or clinical specimens would be difficult to collect and environmental specimen collection and testing are feasible. We were able to detect VZV DNA in environmental samples from case patients' bedrooms and belongings and found that it could still be detected in the environment several months after rash onset. Other outbreak investigations have also found that VZV may possibly be spread through airborne transmission [17, 18], and VZV has been detected from throat and air filter samples of herpes zoster and varicella case patients in a hospital setting [19, 20]. Collection of airborne particles using aerosol samplers, which has been used for detection of influenza and respiratory syncytial virus [21], may be a potential method for providing additional information on airborne transmission of VZV. Detection of VZV DNA in the environment should be interpreted with care, because it could result from viral shedding that occurred remotely and because detection of VZV DNA in the environment may not necessarily indicate the presence of viable infectious virus. Because clinical specimens are still the optimal method for confirmation of a varicella case and limitations in interpreting results, we do not recommend environment specimens as the routine source for laboratory testing.

This outbreak demonstrated that adults who have lived in residential settings for most of their lives are potentially susceptible to varicella disease. It is important for residential facilities to screen all current and potential residents and staff for varicella immunity prior to admission or employment and to vaccinate those who are susceptible to help prevent disease in this setting. Susceptible residents or staff who are not screened prior to admission or employment should be vaccinated within 5 days of exposure to VZV, although vaccination is recommended even after this period because vaccination will provide protection for future exposures [1]. Staff in these facilities should remain alert for herpes zoster, as well as varicella, and implement appropriate infection control measures in a timely fashion to prevent VZV transmission to susceptible residents and staff. Laboratory testing plays an important role in determining susceptibility to varicella in adults; it can be used to confirm diagnoses in an outbreak so that adequate control measures can be implemented, and it can be used to identify vaccine adverse events.

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