Varicella in Child Care Centers: Recommendations for the Investigation and Control of Varicella Outbreaks

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Introduction:

Varicella, or chickenpox, is caused by varicella-zoster virus (VZV) which may be easily transmitted from person-to-person with secondary attack rates that approach 90% in susceptible persons (1-3). In the United States, 4 million cases of varicella occur each year and account for approximately 6,000 hospitalizations and 120 deaths in both children and adults (4-6). With the licensure of a live, attenuated VZV vaccine in the U.S. in 1995, physicians and public health officials now have an opportunity to prevent many cases of varicella, especially in young children (7).

Young children represent one of the most important age groups at risk for varicella in the United States. Because VZV is highly transmissible from infected to susceptible persons, children may be exposed in the household, in pre-school or child care centers (CCC) or in school after their entry into kindergarten (2,8). Previous studies suggest that the highest incidence rates for varicella infection occur among preschool age children (9-11). Child care centers have received increased attention because many children attending these centers may be susceptible to varicella. In addition, large numbers of susceptible children in closed indoor environments may create the opportunity for rapid spread of VZV leading to varicella outbreaks in these centers.

Varicella immunization is presented as one option for varicella outbreak control in the context of recommended steps which can be undertaken during a varicella outbreak investigation. Because investigators may not be able to provide varicella immunization in all outbreaks due to economic constraints or vaccine storage limitations and the vaccine may not be available through all health care providers, investigators should remain flexible in their approach to outbreak control. We are also aware that not all state or local health departments and health care providers may have access to varicella vaccine. For this reason, alternative approaches to control of varicella outbreaks would employ control measures that have been used in the past such as excluding ill clients from attendance until their lesions have healed. Varicella vaccination of clients may be offered to parents/caregivers as an option which they could discuss with and obtain through their child’s usual health care provider. In other situations where varicella vaccine is available to state or local health departments, use of purchased vaccine would be at the discretion of health departments in the context of other vaccine and funding priorities.

Rationale for outbreak investigations in child care centers:

There is limited experience with investigations of varicella outbreaks in child care centers. One recent investigation of a varicella outbreak in a Georgia CCC focused on the effectiveness of vaccination to prevent disease in susceptible children (Izurieta H et al, unpublished data). This investigation found an attack rate of 88% among children in CCCs who were not vaccinated with varicella vaccine. Previous studies have shown a protective efficacy greater than 90% when children were vaccinated within 3 days of exposure (12,13). Additional studies of varicella outbreak in different CCC will help determine the usefulness of vaccination in terminating varicella outbreaks in child care settings.

As varicella vaccine comes into more widespread use, many public health agencies will begin collecting information on varicella vaccine coverage rates among young children. Cases of varicella in children attending CCC may serve as sentinel events which suggest the need to investigate the possibility of vaccine failure related to improper handling and storage. This may be especially important for the attenuated vaccine licensed in March, 1995 (VARIVAX®, produced by Merck, Sharpe and Dome) which requires storage and transport at -15 C or colder.
During varicella outbreaks in CCCs, varicella cases may occur among both unvaccinated and vaccinated children. Due to the thermolability of the varicella vaccine and its stringent storage requirements, there is concern that field efficacy of varicella vaccine may be lower than the efficacy found in clinical trials where vaccine is tested under controlled conditions. Current estimates of varicella vaccine efficacy have ranged from 70% to 95% in vaccine trials. As vaccine coverage rates increase over time, we might also expect that a higher proportion of cases will occur in vaccinated children. Such “breakthrough” cases (i.e. primary varicella cases in previously vaccinated children) will be important to characterize since these cases may indicate failures in vaccine delivery, handling or storage. Ultimately, if not corrected, such problems will lead to lower than expected field efficacy of varicella vaccine.

Methods of Varicella outbreak Investigation

Case definition, outbreak identification and confirmation of outbreak:

For each outbreak investigation, a case definition must be established by investigators and will likely consist of the following: “Any client who has the acute onset of a diffuse (generalized) papulovesicular rash without other apparent cause and who was ill during the period from (date) to (date) at child care center A”. The dates included in this definition should include the time period starting three weeks (one incubation period) before the first case of varicella was reported in the outbreak under investigation. To determine the presence of an outbreak, investigators may briefly question staff to determine the usual number of cases during the same period of time in the previous year(s). This baseline number of cases represents the background rate of varicella for the group under study. If the number of new varicella cases reported exceeds the background rate, the group of new cases should be considered an outbreak. In many CCC, however, either due to frequent staff turnover or the lack of record keeping of symptoms or illness history for absent clients, information on background rates of disease will not be available. In these situations, an absolute number of five varicella cases among clients reported during a three week period would constitute an outbreak. All cases should be clinically confirmed by an experienced clinician by direct examination of the client’s skin lesions. Other rash illnesses should be ruled out including measles, rubella, scarlet fever and roseola infantum.

Client interview and questionnaire distribution:

After confirmation of the outbreak, a cover letter to explain the purpose of the investigation may be distributed with the questionnaire to parents/caregivers of all clients in the CCC (Appendices 1 and 2). These questionnaires may be administered either in person or may be self-administered. The latter approach may be most time-efficient since many parents/caregivers may be accessible only during narrowly defined periods of time each day. Questionnaires may be distributed at the time of pick-up or drop off of the clients with instructions for the questionnaires to be completed and returned to the CCC as soon as possible.

In outbreak situations, obtaining the most accurate immunization history possible will be a priority so that susceptible clients who have not received varicella vaccine may be identified as early as possible. A history of immunization with varicella vaccine should be specifically requested. In some facilities, CCC staff maintain immunization records which are updated as the child receives additional immunizations. These records may be requested and if the history remains unclear or records are not maintained at the CCC, a history should be obtained from the parents/caregivers. This history may also be verified by checking with the health care provider’s immunization history.
Data collected using the questionnaire will include an illness history and should include the date that rash was first noted in the affected client. Other clinical information which should be recorded includes the patient’s temperature, the duration of symptoms and the severity of rash. Because the number of lesions may be difficult to count, many parents/caregivers may be able to better quantify the severity of the rash when the number of lesions are grouped into ranges, e.g. less than 50 (able to be counted in 30 seconds), 50-500, and > 500 (confluence of lesions in may skin areas).

Information should be obtained regarding previous history of varicella and sequelae of varicella including hospitalization (i.e. length of stay recorded in days) or complications of varicella (e.g. encephalitis, pneumonia). Parents/caregivers can provide useful information on the child’s previous medical history including chronic disease problems such as cystic fibrosis, asthma, diabetes or a seizure disorder.

Data collection instruments:
A sample questionnaire has been developed to assist health departments in data collection during the varicella outbreak (Appendix 2). The questionnaire has been formatted to collect information outlined above and has space available for interviewer or parent/caregiver comments obtained during the administration of the questionnaire. Data from questionnaires may be entered into EpiInfo or similar epidemiologic analysis software depending on the preference of local investigators.

Determining clients eligible for varicella immunization:
All clients or staff without a history of previous natural varicella and those without a history of varicella vaccination are eligible for varicella vaccine. Contraindications to varicella immunization are noted below. Parents/caregivers should be provided printed fact sheets on varicella and will be informed of the risk and benefits associated with varicella vaccination. In some cases, investigators may be able to arrange a special time and site within the CCC facility to vaccinate clients which is convenient to both parents/caregivers and staff of the CCC. If investigators elect to recommend that parents/caregivers obtain varicella immunization in the office of the regular health care provider, parents/caregivers should be encouraged to schedule the varicella immunization as soon as possible.

For clients aged 12 months through 12 years of age, one 0.5 mL dose of VARIVAX may be administered subcutaneously. Clients or staff 13 years of age should receive two 0.5 mL doses of VARIVAX, administered subcutaneously 4 to 8 weeks apart. More detailed recommendations are contained in the statement of the Advisory Committee on Immunization Practices (ACIP) (7).

Criteria for excluding clients from varicella immunization:
Any client with a previous history of natural varicella illness or a history of previous varicella immunization should not receive varicella vaccine. Varicella vaccine is a live virus vaccine which is contraindicated when persons have allergy to selected vaccine components, pre-existing severe illness or have an history of altered immunity. A description of the vaccine contraindications may be found in the manufacturer’s package insert and may be found in the statement of the Advisory Committee on Immunization Practices (ACIP) (7). Information on client characteristics or medical history which contraindicate varicella immunization may be obtained from CCC medical records, the history reported by the parents/caregivers or health care provider medical records in cases where the parents/caregivers history or CCC records may not provide complete information. Any susceptible clients with any contraindications to vaccination with VARIVAX® should not be vaccinated but may still be followed in the outbreak.
investigation. If medical history indicates that a client may be immunocompromised, investigators should review with CCC staff and the parent/caregiver the role of excluding a susceptible client from attendance at the facility until the varicella outbreak has concluded.

**Client Follow-up and surveillance for additional varicella cases:**

Following the interview of parents/caregivers and vaccination of clients, investigators should be available for daily follow-up with CCC staff, health department collaborators and parents/caregivers of clients. In addition, investigators should encourage all parents/caregivers to report any unusual, unexpected or adverse events or reactions which occur in the client following vaccination. Cases of suspected reactions to vaccination should be investigated and reviewed with a physician to decide if further medical intervention is necessary.

An active effort should be made to identify additional varicella cases during a six-week period following identification of the index case. CCC staff and parents/caregivers should be asked to report any suspected cases of varicella and each case should be followed-up by investigators to confirm the illness as varicella.

**Environmental epidemiologic data collection:**

Information should be collected during an outbreak which will describe general environmental characteristics of the child care facility (Appendices 4 and 5). Such information would include the total number of clients enrolled, number of clients in each classroom, floor plan of the CCC, nature of daily activities for each class (e.g. recreational activities), number of hours that rooms may be shared by more than one class and the total number of rooms used by child care center clients. Descriptive characteristics should also include the number of staff and teachers employed at the facility and within each classroom.

**Descriptive data analysis:**

As cases of varicella are identified, an epidemic curve illustrating the number of cases by date of occurrence should be constructed and updated as new cases are identified. The initial analysis will consist of a descriptive analysis including a calculation of varicella attack rates by classroom, age, sex, vaccination status and other risk factors of interest. This analysis should include a systematic description of varicella cases as they occur by person (e.g. age, sex), place (e.g. room which client occupies while in attendance) and time (e.g. date of illness). Because some children will have received the varicella vaccine before the outbreak, the investigator should calculate the percentage of clients who have been vaccinated, i.e. a coverage rate for the client population. This coverage rate may also be determined for distinct age groups within the client population.

**Analysis of vaccine effectiveness:**

As soon as available, data may be analyzed to determine the effectiveness of the vaccine among clients of the CCC (both vaccine administered to clients before the outbreak began and vaccine administered during the outbreak, if applicable). In the calculation of vaccine effectiveness, ill and well clients may be classified based on their history of varicella immunization (14,15). Vaccine efficacy (VE) can be calculated with the following equation: VE (%) = [(Attack Rate unvaccinated - Attack Rate vaccinated)/Attack Rate unvaccinated] x 100. This may abbreviated as [(ARU - ARV)/ARU] x 100. The following table illustrates how data may be organized:

<table>
<thead>
<tr>
<th>Clinical status</th>
<th>Vaccinated</th>
<th>Unvaccinated</th>
<th>Unknown</th>
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Outbreak control can also be assessed by calculating the decline in proportion of varicella cases over time after clients have been vaccinated. Results from vaccination efforts in CCCs affected by varicella outbreaks may also be compared to varicella rates in CCCs where no vaccine was offered during an outbreak.

Investigating low field vaccine effectiveness:
Following the initial outbreak investigation, the finding of field efficacy of varicella vaccine below 75 percent should prompt an investigation to determine the underlying cause or causes of low field vaccine effectiveness. Investigators should consider pursuing information to rule out improper vaccine handling or storage as a cause of lower than expected vaccine effectiveness. Health care provider surveys will provide basic demographic characteristics of the providers’ clinical practice, policies and recommendations with respect to varicella vaccination that were in effect during the outbreak period. Interview of health care providers or their office staff will allow outbreak investigators to confirm dates of vaccine administration, determine side-effects that may have occurred after administration and will permit collection of information on the vaccine storage conditions (e.g. type of freezer, freezer temperatures) (Appendix 3).

Parents/caregivers can provide the source of the child’s vaccination and the office where vaccine was administered. Investigators may search for clues which explain possible vaccine failures or cases of varicella in those previously immunized with varicella vaccine. Vaccine failure may occur due to several reasons including improper manufacturer production, improper storage temperature, use of expired vaccine and improper vaccine reconstitution, delivery or administration.

Following the survey of health care provider facilities, investigators may identify conditions which represent suboptimal storage conditions or insufficient monitoring of vaccine storage conditions which cannot demonstrate maintenance of proper vaccine storage and handling conditions. The implications of such findings may be critical from a public health perspective and may have legal ramifications for individual providers and their patients. For example, inadequate recording of freezer temperature or a temperature log which shows insufficiently cold temperature to ensure vaccine potency, may call into question the effectiveness of vaccines delivered to patients which were stored under these suboptimal conditions. In these situations, each finding should be dealt with on an individual basis with the goal to employ interventions which do the least harm to patients, minimize interruptions to the health care provider’s facility and prevent reoccurrences of conditions or procedures which could permit vaccine failure in the future.

References
Appendix 1: Example Cover Letter for Parents-Caregivers

Date

Your name
Your address
City, State   Zip code
Telephone number

Dear parent-caregiver:

We have learned that some children attending the _______________________ (name of child care center) have developed chickenpox. Although chickenpox is usually not a serious illness, it is a common disease and often causes parents to miss work when they stay home to care for their children. In some children, chickenpox may cause more serious illness and may require hospitalization.

A vaccine which can prevent chickenpox has been made and the vaccine is safe for children who are older than 12 months of age. This vaccine is recommended for children who have never had chickenpox or have never had the chickenpox vaccine before. We would like to recommend that you contact your child’s regular pediatrician or family physician as soon as possible to see if the chickenpox vaccine is available for your child.

At the health department, we are trying to learn more about why children develop chickenpox and how we can best prevent this disease. In the attached questionnaire, we ask a few questions about your child and whether or not they have had chickenpox or the chickenpox vaccine. If your child has had chickenpox in the past three months, we have asked you a few questions regarding your child’s illness.

All information that you provide is strictly confidential and cannot be shared with other persons within the health department who are not involved with this study, with other physicians, parents or insurance carriers. In addition, your name and the name of your child will not be recorded in our database and it will not appear on the questionnaire.

We thank you for your help in completing the attached questionnaire and please do not hesitate to contact us at any time if you should have any questions.

_______________________ (Study Coordinator)   Telephone number:
Appendix 2: Varicella in Child Care Centers Questionnaire for Parent/Caregiver

Questionnaire Number: ________ (health department use only)

Date: _____/_____/____

1. Age of child: ______ (circle one: years     months)
2. Race (circle one): 1. white    2. black   3. Asian/pacific islander   4. Other

3a. Has your child ever received the chickenpox vaccine?    Yes No DK
3b. If yes, please write date _______________

4a. Has your child had chickenpox?       Yes   No   DK
4b. If yes, please write date: ____________ (Month and Year, if possible)
4c. Please write the name of your child’s usual clinic and doctor (if applicable):
   Clinic or office name: _____________________________________
   Doctor: _____________________  Telephone: (____)__________________

If child has never had chickenpox, please stop here.
If child had chickenpox in the last three months, please answer the following questions:

5. Please write date that you first noticed your child’s rash: ____/____/____(MM/DD/YY)
6. How many days did rash last (until all scabs crusted)? _____ (days)
7. At the most severe stage of the illness, how many lesions were present? (Please select one of the following):
   a. All pock marks could be counted them in 30 seconds or less (< 50 pock marks).
   b. An average number of pock marks were found (50-500).
   c. Many pock marks present and in some areas, you could not see normal skin between areas where pock marks were found (>500 pock marks).

8a. Did child have fever at least once during illness?
   Yes  No  Don’t know
8b. If known, please write the highest temperature that you measured:___  ( F, C)
8c. Did fever spike occur more than one time?   Yes   No   DK
9a. Did your child visit a physician because of chickenpox or a complication of chickenpox?
   Yes  No  DK
9b. If Yes, please write date of office visit: ____/____/____

10. Did your child have any skin infection during his episode of chickenpox?  Yes No   DK
11a. Was your child hospitalized because of chickenpox or one of its complications?
    Yes  No  DK
11b. If your child was hospitalized, how long was the hospital stay: ____ (days)

12a. Did your child have other complications of chickenpox that did not require hospitalization?
    Yes  No  DK
12b. If Yes, please name the complication, if possible:________________________
14a. Did child receive any medication during the chickenpox illness:
   Yes  No  DK
14b. If Yes, please mark any of the following medications that apply:

   Antibiotics on skin lesions?   Y    N    DK
   Oral or injectable antibiotics?   Y    N    DK
   Zovirax (Acyclovir)?   Y    N    DK
   Benadryl?   Y    N    DK
   Medication(s) for fever?
      Tylenol:   Y    N    DK
      Advil:   Y    N    DK
      Ibuprofen   Y    N    DK

15. Did your child receive any other medications for chickenpox? (Please specify name)
   ______________________________

16a. Does this child have any chronic health problems that began before he/she developed
chickenpox?  Y    N    DK
16b. If Yes, please check any of the following conditions that apply:

      Bronchitis:____   Asthma: _____   Cystic fibrosis: ____
      Other lung problems: ___________________________________
      Diabetes:____    Chronic ear infections: ______
      Allergies:____    Epilepsy or seizures: ______
      Heart disease: _____
      Other (please specify): ______

17a. Is child taking any regular medications for any condition under the care of a physician?
   Yes  No  DK
17b. If Yes, please name these regular medications:

   __________________________________________
   __________________________________________
   __________________________________________

General comments from parent-caregiver:

   __________________________________________
   __________________________________________
Appendix 3: Health Care Provider Survey

1. Provider ID# P-______________  2. City: ________  3. County: _______

4. Practice volume: ____________ (Please record average number of patients seen each day)

5. Proportion of children ages 12 months to 12 years in your practice?______%

6. Do you offer childhood immunizations in your clinic?    Yes    No

7a. Do you offer varicella vaccine to patients in your office?     Yes     No

7b. If Yes, to whom do you recommend use of the vaccine? (Circle all that apply)
   1. All children under the age of 13 years
   2. Children aged 12 to 18 months of age
   3. Person greater than or equal to age 13 years
   4. Health care workers
   5. Family of immunocompromised persons
   6. Child care employees
   7. Residents or staff of institutional settings.
   8. College students
   9. Non pregnant women of childbearing age

7c. If No, please mark reasons why vaccine is not offered (mark all that apply):
   1. Unable to meet freezer temperature requirements: ______
   2. Vaccine not necessary for patients: ______
   3. Cannot afford to purchase vaccine for patients: ______
   4. Patients cannot afford to purchase vaccine: ______
   5. Other reasons:_____________________________________

8. Where do you store varicella vaccine in your office?
   1. Refrigerator  2. Freezer  3. Other: _______

9a. Do you have a thermometer which records accurate temperature in your vaccine storage unit (e.g. freezer)? Yes No DK

9b. If Yes, what is the current temperature of cold storage area (e.g. freezer) where you store varicella vaccine? ______ (F, C)

10a. Have you been required to discard varicella vaccine due to any storage or handling problems?: Yes No DK

10b. If yes, please state problems: __________________________________________

11a. Have you returned any doses of varicella vaccine to manufacturer due to any storage or handling problems? Yes No DK

11b. If yes, please state problems: __________________________________________
12. Approximately how many doses of vaccine do you administer each week (average #): 

____________

13. On average, how many cases of varicella do you see each month in your practice? ________

14. Has the number of varicella cases that you have seen in your office in the past one month been:

1. about normal
2. slightly above normal
3. greatly above normal
4. below normal
Appendix 4: Environmental Survey of Child Care Facility

1. Total number of child care attendees: _____

2. Total number of full-time staff: _____

3. Total number of part-time staff: _____

4. Total number of class rooms used everyday: _____

5. Number of classrooms used for part of day only: _____

6. List classrooms (record name of room which indicates activity) used for group activities
   a. _________________________  b. _________________________
   c. _________________________  d. _________________________
   e. _________________________  f. _________________________
   g. _________________________  h. _________________________

7. Please list class levels in child care center and age ranges of children in each level:
   a. Level ___. Age range_____ # of children ____ Classroom number: __
   b. Level ___. Age range_____ # of children ____ Classroom number: __
   c. Level ___. Age range_____ # of children ____ Classroom number: __
   d. Level ___. Age range_____ # of children ____ Classroom number: __
   e. Level ___. Age range_____ # of children ____ Classroom number: __
   f. Level ___. Age range_____ # of children ____ Classroom number: __

   Comments:
   _______________________________________________________________________
   _______________________________________________________________________
   _______________________________________________________________________
Graphical representation of child care center floor plan and room dimensions (record linear dimensions of rooms when available):

Child care facility name:_________________________ Date recorded _____/_____/______
Appendix 6: Line listing of Clients in Child Care Center Affected by Varicella Outbreak (For follow-up of clients only; names will not be recorded in database)

<table>
<thead>
<tr>
<th>Client Number</th>
<th>Client’s Name (Last,First)</th>
<th>Parent-Caregiver Name</th>
<th>Telephone</th>
<th>Age of child</th>
<th>Class</th>
<th>Staff in charge of class</th>
<th>Ill/Well</th>
<th>Start date of illness</th>
<th>Last day of illness</th>
<th>Varicella vaccine (Yes,No)</th>
<th>Date of Varicella Vaccine</th>
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