Review of an Outbreak of *E. coli* O157 Infections in South Carolina Childcare Facility, May – June, 2015

Centers for Disease Control and Prevention

National Center for Emerging and Zoonotic Infectious Diseases

Division of Foodborne, Waterborne, and Environmental Diseases

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Purpose of this report

The Centers for Disease Control and Prevention (CDC) prepared this report in response to the South Carolina Department of Health and Environmental Control's (DHEC's) request for technical assistance after an outbreak of *E. coli* O157 infections in a child care facility. CDC reviewed DHEC investigation documentation focused on methods and procedures related to the recent *E. coli* outbreak in a child care center in Greenwood, South Carolina, including public health laboratory, environmental health and epidemiologic investigations and interventions. The purpose of the report is to provide comments and help inform any opportunities for improvement that may be identified.

Review Process

Over four weeks, a group of subject matter experts from the Division of Foodborne, Waterborne, and Environmental Diseases, CDC, reviewed documentation and selected discussions provided by DHEC for an outbreak of *E. coli* O157 infections in a childcare facility that occurred May – June, 2015. Based on this information, initial detection management and response and management of the outbreak were identified as the areas for comment on what went well and what could be improved. Resources and suggestions were also given for areas of outbreak response in a childcare setting that lack standardized procedures and guidelines.

Background on Surveillance in South Carolina

We first reviewed surveillance data at CDC to provide an overview of South Carolina surveillance for enteric bacteria (such as *E. coli* O157) and participation in national surveillance systems managed by the CDC. CDC-coordinated programs provide technical support and guidance to state and local health departments through a variety of mechanisms. As part of

program coordination, CDC program staff often collect and review state-level data submitted to national surveillance systems or through program-specific activity reports.

1. PulseNet Metrics

PulseNet, the national molecular subtyping network (http://www.cdc.gov/pulsenet/index.html), has collected centralized, standardized pulsed-field gel electrophoresis (PFGE) data from participating public health laboratories since 1996. PulseNet collects molecular subtyping, or DNA "fingerprinting", data from 87 participating laboratories across the United States. PulseNet surveillance data can be evaluated to determine the volume and timeliness of PFGE testing from participating laboratories.

The South Carolina PulseNet lab has been an active laboratory partner in PulseNet. DHEC lab staff have proficiency certifications in *Salmonella*, *E. coli* O157 and *Shigella*; they were also certified in *Listeria*, non-O157 *E. coli* and *Shigella flexneri* until their long-time microbiologist left for FDA earlier this year. We understand they are currently looking to fill an additional position in the PulseNet lab. They share data on the PulseNet SharePoint site and frequently communicate with CDC. The past 2 years they have submitted about 2500 patterns to the PulseNet national databases (about 2.5% of the total number of patterns submitted in the country) and have maintained a fast 4-day turn-around time for testing *E. coli* O157 and *Listeria* isolates. We find the number of submissions and turn-around times to be impressive given DHEC's limited lab staffing.

2. FoodCORE Shiga toxin-producing *E. coli* (STEC) Metrics

The FoodCORE (Foodborne Diseases Centers for Outbreak Response Enhancement) program (http://www.cdc.gov/foodcore/index.html) builds structural capacity in state and local health departments to conduct faster, more complete and standardized foodborne disease surveillance and outbreak response. The 10 FoodCORE Centers submit performance metrics data biannually to CDC program staff. These performance metrics allow for process evaluation, including the completeness and timeliness of laboratory testing, epidemiologic investigation, and outbreak response and reporting activities.

South Carolina has been a participant in FoodCORE since 2010 and has increased both the volume and speed of their surveillance measurably since then. During 2010, South Carolina had 15 isolates and isolate-yielding specimens for Shiga toxin-producing *E. coli* (STEC) submitted to or recovered at the DHEC Bureau of Laboratories (BOL). It took a median of 5 days from isolate receipt at BOL to serotype result and a median of 4 days from isolate receipt or recovery at BOL to PFGE upload to PulseNet. Eleven laboratory confirmed cases were reported to the epidemiology staff; interviews were attempted for all of those cases within a median of 1 day from report to interview attempt. DHEC has improved timeliness

while handling an increased volume of testing, case reporting, and cluster investigation since then.

From January-June 2015, the South Carolina FoodCORE program identified 51 isolate and isolate-yielding specimens for STEC from among over 400 clinical STEC specimens and samples. The median days from isolate receipt/recovery at BOL to serotype result was 3 days. The turn-around time for PFGE, from receipt/recovery at BOL to uploading results was also a median of 3 days. Twenty-four laboratory confirmed cases were reported to the epidemiology staff; interviews were attempted for all of those cases with a median of 0 days from report to interview attempt. Public health officials collected at least some exposure history for all of the reported STEC cases. This indicates a high level of speed and completeness is being achieved routinely. The South Carolina FoodCORE program is an active participant in all FoodCORE activities and these most recent performance metrics indicate that they are continuing to maintain a very high level of performance.

3. NORS Outbreak Reporting

The National Outbreak Reporting System (NORS) is a web-based platform designed to support reporting to CDC by local, state, and territorial health departments in the United States of all waterborne disease outbreaks and enteric disease outbreaks transmitted by food, contact with environmental sources, infected persons or animals, or unknown modes of transmission. Most outbreaks in the United States are investigated by state, local, and territorial health departments. Outbreak information is then voluntarily reported to NORS by the public health agency that conducted the investigation. South Carolina consistently reports outbreaks of all types to NORS. During 2010-2014, South Carolina reported 420 single state outbreaks of all etiologies and modes of transmission to CDC. South Carolina also had one or more cases in 37 multistate foodborne or animal contact outbreaks during this same time period. One single state foodborne outbreak was caused by *E. coli* O157 and South Carolina had cases in one multistate foodborne outbreak of *E. coli* O157 infections. In 2014, South Carolina reported 15 single state foodborne disease outbreaks to CDC (3.14 outbreaks per 1,000,000 persons). South Carolina's reports consistently met or exceeded standards for outbreak reporting to CDC in terms of complete demographic and epidemiologic information. This indicates that DHEC reports foodborne outbreaks at about the national average rate, which indicates that DHEC finds and investigates an expected number of outbreaks each year.

Initial Detection of Cases: Management and Response

1. First Reported Case

What went well?

- DHEC investigated the first reported case by interview within 24 hours of notification, collecting key details that allowed this case to be rapidly linked to the subsequent Hemolytic Uremic Syndrome (HUS) case.
- It was decided that the adult case, then asymptomatic for at least a week, did not pose a risk of further transmission to others. There is no evidence that this case did pose such a risk.

What could be improved?

- **Speed of diagnosis and notification.** The amount of time from when the hospital collected and submitted a specimen from the first reported case to the laboratory to when the results were reported to DHEC was 13 days. This timeline is not unusual, but is longer than desired, and largely reflects the time it took to culture the specimen. Additional review of the routine culture process might identify ways to shorten the time elapsed (10 days between submission of specimen and final result at BOL, and 3 days, including a weekend, before notification).
    - Specimen testing. With clinical labs, explore the possibility of testing for STEC at the same time as tests for other bacterial enteric pathogens or sending the specimen to BOL for STEC without first testing for other pathogens. For more information, see the CDC Recommendations for Diagnosis of Shiga Toxin-Producing *Escherichia coli* Infections by Clinical Laboratories.
    - Specimen routing and processing. Review timeliness of specimen processing and transport more comprehensively, from the time specimens are submitted to clinical labs until the epi team is notified, to help identify steps that could become more efficient.

What are the areas that lack standardized procedures or guidelines?

- The first reported case could have been used as an opportunity to detect other cases earlier in the outbreak. There is no evidence of transmission from the first reported case; however, this case occurred in a person associated with a high-risk setting in which others were experiencing clinically compatible illnesses.
- **Threshold for contacting the childcare facility/school directly**. DHEC investigators reacted quickly to the information they received from BOL and interviewed the first reported case the next day. Currently, DHEC guidance

suggests launching a facility investigation if a single confirmed STEC case and other clinically compatible illnesses are associated with the same facility, which seems prudent. However, there are challenges in ascertaining whether additional illnesses are occurring at a facility, if such information is collected only from the first reported case. Cases/parents of cases may have limited knowledge of other illnesses in their childcare facilities or schools. It could be useful for the health department to follow up directly with the facility for a more complete assessment early in the investigation, perhaps using attendance records or information from the facility director, school nurse, or other staff.

    - The STEC investigation flowchart and section 4.C. in the current (dated June 17, 2015) DHEC STEC surveillance and response guidelines reflects this issue well and suggests that an outbreak investigation should be conducted if any contacts of the case are ill and there are shared exposures (e.g., childcare facility). This may have been the case in this situation.

- **Communication with facility and parents.** When a serious infectious illness has occurred in association with a childcare facility, early notification of others in the facility could help improve case-finding and intensified hygiene promotion, which might in turn prevent illnesses. It is common, for example, for childcare facilities to post notices for parents when a single case of streptococcal pharyngitis has been identified in the classroom. The effort of DHEC to contact the facility is reported, however the extent to which the facility notified parents/family members of illness in the facility is unknown.
- **Initiation of wider investigation at the center/school.** The initial interview with the first reported case yielded information about other recent diarrhea cases at the facility around the time of this case's illness onset. By itself, a report of diarrheal illnesses among toddlers at a childcare may not represent an unusual situation. It is worth considering whether in the setting of a known STEC infection is a staff member, direct contact between health department and the childcare facility/school following the interview might have led to a wider investigation at that time. This means handling the culture–confirmed illness in the staff person as a marker of possible transmission at the workplace, like the proverbial "canary in a coal mine." Of note, it appears that some STEC transmission had already occurred at the time the first reported case was identified, so a wider investigation at that time would not have prevented the earlier illnesses.
    - The current DHEC STEC surveillance and response guidelines (dated June 17, 2015), section 4.C. reflects this issue well, and recommends considering testing asymptomatic childcare attendees who are household contacts of confirmed cases.

- **Exclusion from work while symptomatic.** We do not know what the first reported case's symptom status was while working. If no STEC diagnosis had been made then the diarrheal illness would have fallen under guidance for general diarrheal illness. Current DHEC STEC surveillance and response guidelines (dated June 17, 2015) reflects this issue well, and suggest that staff with diarrhea are not to work.
- **Decision to allow asymptomatic adult case to return to work.** There is likely to be a range of professional judgements about how to manage a single adult case of unknown source. In this event, DHEC documentation indicates that the daycare allowed the first reported case to return to work without convalescent cultures. We believe that the case at that point posed little or no risk to others at the place of work. However, some guidelines (applied most vigorously in the setting of an established outbreak) suggest the need for negative culture in this setting. For example, current DHEC STEC surveillance and response guidelines (dated June 17,2015), the American Academy of Pediatrics Caring for our Children (Chapter 7, page 312), and the American Public Health Association Control of Communicable Diseases Manual, state that childcare staff with STEC infection are to be excluded from the childcare facility until two convalescent stool cultures are negative. This is for staff at childcare facilities and kindergartens. It is unclear to us how such a policy would impact STEC transmission from asymptomatic adults.
    - DHEC documentation reviewed did not state when the first reported case returned to work, or whether she was aware that she had an STEC infection at that time. Increasing timeliness of diagnosis and notification would be useful in this regard.
    - We suggest that given the high risk of transmission in childcare settings and the potential severity of illness, it would be prudent to exclude both children and staff with known STEC infections from childcare facilities/kindergartens until convalescent stool specimens are free of STEC, as stated in current DHEC STEC surveillance and response guidelines (dated June 17, 2015).
- **Testing family members of the first reported case**. It is not clear whether the child of the first reported case was symptomatic, but we understand that they attended the childcare facility. There is substantial room for judgement about how much effort should be put into testing family members of an adult who have not been symptomatic. Inquiring about the status of each family member as part of the initial interview might have revealed that the child was at the childcare facility related to where the case worked in the school.
    - The current DHEC STEC surveillance and response guidelines (dated June 17, 2015), section 4.C. reflects this issue, and also recommends considering

testing asymptomatic childcare attendees who are household contacts of confirmed cases; it is unclear whether testing the child of the first reported case was considered before the larger outbreak was recognized.

2. Second Case

What went well?

- The common institutional connection between the first reported case and the second case was made rapidly on the same day that the second case was reported.
- The health department contacted the childcare facility on the same day that the second case was reported, beginning the onsite investigation and instituting initial control measures on the next working day.

What could be improved?

- Notification from hospital of Hemolytic Uremic Syndrome (HUS) case. It is not apparent to us when DHEC learned of the HUS case from the hospital through formal disease reporting. Other channels of communication appear to have provided this critical signal.

What are the areas that lack standardized procedures or guidelines?

- The medical care and advice that the second case received before developing HUS is not known to us. If they had bloody diarrhea, one hopes that they were excluded from the childcare facility, came to medical attention, and were cultured for STEC. There is a possibility a sample from this patient could have been in the system even before HUS was diagnosed.

3. Other Comments

- **DHEC Hypothesis-generating questionnaire.** The questionnaire is comprehensive and detailed, particularly with regard to food and water exposures, which reflects DHEC's participation in FoodCORE. It might be configured to easily capture other illnesses in family members, and whether there is anyone else in the family associated with a childcare facility or school. This would be useful in assessing cases of infection with *Shigella*, STEC or *Giardia*. In addition, questions 17 and 18 would yield richer information if they asked about the nature of the work/association with a childcare facility or school, size of the facility, ages of children in the facility, foodhandling practices, etc. If an association with childcare facility or school is identified, it may be useful to then ask explicitly whether the person knows of other persons with gastrointestinal illness there.

Management of the Outbreak

1. Case finding, survey, and exclusion

What went well?

The DHEC response was immediate and comprehensive as soon as the link between the first two reported cases was identified.

- DHEC school and childcare exclusion policy was rapidly implemented.
- DHEC communicated rapidly with the community, parents of children in the child care, staff at the childcare facility, and with other childcare facilities in the area.
- DHEC promptly sought expertise from other states and CDC.
- Identification of a possible origin in a day trip to a petting farm led to prompt environmental assessment, and a web survey of the families for diarrheal illness the two months past.
- DHEC did not close the childcare facility immediately. This is good as the delay meant there was time to warn both parents and other childcare facilities of the danger of spreading the outbreak by transferring children to other facilities. Closure of childcare facilities can be risky, as children may be sent to other childcare facilities, thus exposing more children.
- DHEC activated the Care Line as a resource for information and education about STEC prevention.

What could be improved?

- **Contacting all families rapidly.** The challenge is how to immediately contact all families at once, with information that they need. Emergency contact phone numbers, text messaging, emails, and social media were all used, but this seems to have been difficult. Consideration may be given to discussing with the agency that licenses childcare facilities about how to require such contact protocols, and perhaps about demonstrating their efficacy in a drill.

What are the areas that lack standardized procedures or guidelines?

- **Managing a community "town hall" meeting.** Such meetings can be critical to reassure the community that the investigation is ongoing, and that appropriate control measures are being implemented, and that their questions will be answered. It may be helpful to consult with the South Carolina emergency response organization about how best to stage such a meeting, and which figures of authority might best help lend their support.

2. Screening

What went well?

- A very large number of children and staff were tested using a sensitive laboratory test, and shown not to harbor *E. coli* O157:H7 before they were allowed to return to childcare facility or school.
- Nearly all the required tests were done by the DHEC BOL staff, as it appears that few clinical laboratories in South Carolina test for STEC.
- All symptomatic cases were tested using immunomagnetic separation (IMS). This is the most sensitive assay available.
- Some cases had their second stool screening done after screening with Biofire Film Array, which gave an answer quickly. This assay was backed by culture, which confirmed Film Array findings.

What could be improved?

- **Setting expectations for how exclusion would be managed, and how laboratory results would be released.** It appears this was a substantial challenge, and the strong desire of the parents to learn the results for their children overwhelmed laboratory and epidemiological staff. It may be helpful to set expectations from the beginning, to collect a contact number for each person as the specimen is collected to designate one single point of contact for lab results, and to provide a time of day when new information will be provided.

What are the areas that lack standardized procedures or guidelines?

- If resources permit, testing all specimens from all individuals using the IMS methods (asymptomatic as well as symptomatic) may offer additional sensitivity for screening everyone for return.

3. Public Health Control and Prevention

What went well?

- Most importantly, the outbreak was rapidly controlled, as the epidemic curve shows that transmission at the childcare facility ceased by June 1, no more than one day after second case recognition (allowing for a 24 hour incubation period). The combination of exclusion, handwashing education and cleaning appears to have been effective.
- Only one additional case was reported with onset after June 1, with likely exposure in a home setting. This number could have been much greater, and attests to the general effectiveness of the effort to educate the families and faculty about precautions at home.

- No cases were detected in other childcare facilities or schools after the first facility/school was closed, indicating this closure did not lead to detectable spread in the community.
- The inspecting authority and DHEC performed a thorough inspection of the center, made numerous recommendations. DHEC followed up to make sure the facility complied, which necessitated more efforts by the cleaning company.

What could be improved?

- **Managing public communications.** It appears that responding to the considerable media interest was a challenge. Designating a regular time schedule for updates of case counts and other news can help manage the intense desire of the press for news. That time (for example 3 pm) can be daily, or every other day, and all press questions dealt with at that time by the designated DHEC spokesperson.

What are the areas that lack standardized procedures or guidelines?

- **Scheduled handwashing.** As a general preventive measure, some facilities conduct regular scheduled handwashing at intervals, starting with arrival at the childcare facility, and periodically throughout the day. This may be useful in the setting of an acute outbreak, and it may also be useful as a standing policy. Some publications describing this policy approach are provided at the end of this document.
- **General policies.** Some general resources are provided below. We understand that the current DHEC STEC surveillance and response guidelines (dated June 17, 2015) reflect the experience with this outbreak. The challenges encountered by the DHEC team in managing this outbreak response are not unique. To the extent that DHEC is able, it will be helpful to share these guidelines and participate in a dialogue with other states. Further work in this general area would be useful to public health practitioners in many states.

4. Other Comments

- Consider engaging other state agencies in a tabletop exercise to work out communications and information flow outside of an immediate live outbreak response setting. This could be facilitated with assistance from an outside group (e.g. Integrated Food Safety Centers of Excellence (COEs), FDA Rapid Response Teams).

Options for Support and Technical Assistance

1. During Outbreaks

- **Technical consultation by phone.** CDC program experts are ready to consult with state public health staff in many areas at any time. A call to the CDC Emergency Operation Center (770-488-7100) will be quickly connected to the appropriate program. Just be sure to identify yourself as a public health official. This includes questions regarding diagnosis, treatment, epidemiological investigation, control and prevention.
- **Epi-AIDS.** CDC stands ready to support rapid investigations of public health emergencies by sending a CDC field epidemiology team to assist state or local health department staff. This is done at the request of the state epidemiologist, who can request an Epi-AID 24/7. This is at no cost to the state. CDC deploys about 80 Epi-AIDS a year across the country, for a wide variety of emergency public health investigations.
- **Laboratory support.** CDC laboratories can answer questions regarding method or findings, and can provide or arrange surge capacity when a large number of tests need to be done quickly.

2. General resources

Surveillance Capacity Building. CDC has several state-based programs that are intended to build capacity for surveillance, outbreak detection and response, and control of enteric infections. South Carolina has been a vigorous partner in the first three, and the resources of the fourth are available to DHEC on request.

- ELC: The Epidemiology and Laboratory Capacity Building Cooperative Agreement. This general Cooperative Agreement has specific sections in it for requesting support for building capacities for surveillance and response capacities for foodborne and enteric infections. It allows each state to apply for additional support to implement proven methods that make surveillance faster and more effective.
- Pulse Net
- FoodCORE Model Practices
- Integrated Food Safety Centers of Excellence (COEs)

Childcare policy documents

- Caring for Our Children, National Health and Safety Performance Standards, Guidelines for Early Care and C Education Programs
    - Daily Health Check – page 89
    - Hand Hygiene – page 110

- American Academy of Pediatrics Redbook
- National Resource Center for Health and Safety in Childcare and Early Education
- Literature on scheduled handwashing
    - Correa J.C., Pinto D., Salas L.A., Camacho J.C., Rondón M., Quintero J. A cluster-randomized controlled trial of handrubs for prevention of infectious diseases among children in Colombia. *Rev Panam Salud Publica* 2012;31(6):476–84.
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3. Statement of Limitations

The review and suggestions in this report are based solely on documentation and interviews made available to the CDC by the South Carolina Department of Health and Environmental Control. The observations, opinions, and suggestions contained in this report are those of the subject matter experts who reviewed the documentation and do not necessarily represent an official position or policy of the Centers for Disease Control and Prevention.