

SHIGA TOXIN-PRODUCING *ESCHERICHIA COLI* (STEC) AND HEMOLYTIC-UREMIC SYNDROME (HUS)

I. DESCRIPTION AND EPIDEMIOLOGY

A. Overview

Escherichia coli are gram-negative bacteria that are commonly found in animal and human intestinal flora. *E. coli* are categorized into serotypes by antigens in their cell wall (somatic O antigen) and in their flagellae (H antigen). Most *E. coli* serotypes are not pathogenic to humans. Of the *E. coli* that cause disease, Shiga toxin-producing *E. coli* (STEC), also known as enterohemorrhagic *E. coli*, or verotoxin-producing *E. coli*, is the most important human pathogen. STECs produce Shiga toxin 1 and/or Shiga toxin 2, potent toxins responsible for many of the pathogenic effects of STEC infection. The most widely recognized serogroup among STEC is O157; however, numerous other STEC serogroups, often lumped together as non-O157 STEC, have been recognized. STECs are associated with gastrointestinal disease characterized by abdominal cramps, diarrhea, and hemorrhagic colitis, and at times complicated by hemolytic-uremic syndrome (HUS).

B. STEC and HUS in California

The California Department of Public Health (CDPH) Infectious Diseases Branch (IDB) monitors cases and epidemiologic trends of STEC infections and post-diarrheal HUS in California and assists in the investigation of outbreaks and clusters. All STEC and HUS reports are reviewed and verified by an IDB STEC Subject Matter Expert (SME). Between 300 and 500 laboratory-confirmed cases of STEC infections are reported per year in California. The proportion of non-O157 STEC infections have steadily increased since non-O157 STEC reporting became mandatory in 2006, and currently accounts for approximately half of all STEC infections that are reported in California. For HUS, less than 50 cases are reported per year; most are associated with STEC O157 infections. The majority of STEC infections appear to be sporadic rather than outbreak-related. For outbreak-related cases, California STEC outbreaks in recent years have been associated with contaminated foods including undercooked ground beef, commercially packaged cookie dough, Gouda cheese, raw milk, and pre-packaged salads.

C. Symptoms

After ingestion, STEC colonize the intestine then release Shiga toxins which act locally or systemically to cause disease. Symptoms typically begin with abdominal cramps and non-bloody diarrhea, which frequently progresses to bloody diarrhea. Nausea and vomiting may also be reported, but fever is generally low-grade or absent. Infection may also be mild or asymptomatic. The usual duration of uncomplicated gastroenteritis due to STEC infection is generally 4 to 10 days.

The most severe clinical manifestation of STEC infection is HUS, which is defined as a combination of hemolytic anemia, renal failure, and often a low platelet count. HUS complicates 2-15% of STEC O157 infections; children under 5 years of age are at highest risk. Thrombotic thrombocytopenic purpura (TTP) is similar to HUS but mainly affects older adults and includes fever and neurologic symptoms. When preceded by diarrhea, TTP is often triggered by infection with STEC. HUS is more likely to be associated with STEC O157 than with STEC non-O157 infections.

D. Transmission

STEC is most often transmitted through the ingestion of undercooked food derived from infected animals or food contaminated by feces of an infected animal or person. Asymptomatically colonized cattle are the main reservoir for STEC. However, STEC has also been isolated from other animals, including deer, sheep, pigs, and goats. Survival of STEC in the environment for months has been documented.

Raw and improperly cooked or handled foods of animal origin such as beef and dairy products are the most common source of STEC infection, but transmission may also occur through the consumption of contaminated produce and ready-to-eat foods such as pre-packaged lettuce, nuts, and cookie dough. Waterborne transmission by ingesting contaminated water, for example through drinking untreated well water or by swimming in a lake or under-chlorinated pool, may occur. Transmission through direct contact with farm animals such as in petting zoos or at fairs is also not uncommon. Person-to-person fecal-oral transmission may occur, especially when diarrhea is present and hands are not washed adequately.

The infectious dose of STEC O157 is low; less than 100 organisms can cause infection. The risk of transmission exists for the duration of fecal excretion of organisms, and can last from days to weeks. A temporary carrier state can continue for weeks, especially in children, but prolonged asymptomatic carriage is unusual.

E. Incubation Period

The incubation period is generally 3 to 4 days, but ranges from 1 to 10 days.

F. Clinical Management

Clinical management decisions should be made by the patient's primary care physician or infectious disease specialist. Because some studies have found an association between the use of antimicrobials and the development of HUS, most experts, including the U.S. Centers for Disease Control and Prevention (CDC), do not recommend the use of antibiotics for treatment.

II. COUNCIL OF STATE AND TERRITORIAL EPIDEMIOLOGISTS (CSTE) SURVEILLANCE CASE DEFINITIONS

A. Shiga Toxin-Producing *Escherichia coli* (2014)

The CSTE case definition for STEC can be found on the CDC's website at:

[2014 CSTE case definition for STEC](#)

CSTE Position Statement(s)

09-ID-30: <http://c.ymcdn.com/sites/www.cste.org/resource/resmgr/PS/13-ID-01.pdf>

Clinical Description

Shiga toxin-producing *Escherichia coli* (STEC) is an infection of variable severity characterized by diarrhea (often bloody) and abdominal cramps. Illness may be complicated by hemolytic uremic syndrome (HUS) or thrombotic thrombocytopenic purpura (TTP); asymptomatic infections also may occur and the organism may cause extraintestinal infections.

Laboratory Criteria for Diagnosis

Isolation of shiga toxin-producing *Escherichia coli* from a clinical specimen. *Escherichia coli* O157:H7 isolates may be assumed to be Shiga toxin-producing. For all other *E. coli* isolates,

Shiga toxin production or the presence of Shiga toxin genes must be determined to be considered STEC.

Case Classification

Suspected: A case of postdiarrheal HUS or TTP (see HUS case definition), or identification of Shiga toxin in a specimen from a clinically compatible case without the isolation of the Shiga toxin-producing *E. coli*.

Probable: A case with isolation of *E. coli* O157 from a clinical specimen, without confirmation of H antigen or shiga toxin production, OR A clinically compatible case that is epidemiologically linked to a confirmed or probable case, OR Identification of an elevated antibody titer to a known shiga toxin-producing *E. coli* serotype from a clinically compatible case.

Confirmed: A case that meets the laboratory criteria for diagnosis. When available, O and H antigen serotype characterization should be reported

B. Hemolytic Uremic Syndrome, Post-Diarrheal (2010)

The CSTE case definition for HUS, Post-Diarrheal may be found at:

[2010 CSTE case definition for HUS](#)

CSTE Position Statement(s)

09-ID-37 <http://c.ymcdn.com/sites/www.cste.org/resource/resmgr/PS/09-ID-37.pdf>

Clinical Description

Hemolytic uremic syndrome (HUS) is characterized by the acute onset of microangiopathic hemolytic anemia, renal injury, and low platelet count. Thrombotic thrombocytopenic purpura (TTP) also is characterized by these features but can include central nervous system (CNS) involvement and fever and may have a more gradual onset. Most cases of HUS (but few cases of TTP) occur after an acute gastrointestinal illness (usually diarrheal).

Laboratory Criteria for Diagnosis

The following are both present at some time during the illness:

- Anemia (acute onset) with microangiopathic changes (i.e., schistocytes, burr cells, or helmet cells) on peripheral blood smear, AND
- Renal injury (acute onset) evidenced by either hematuria, proteinuria, or elevated creatinine level (i.e., greater than or equal to 1.0 mg/dL in a child aged less than 13 years or greater than or equal to 1.5 mg/dL in a person aged greater than or equal to 13 years, or greater than or equal to 50% increase over baseline)

Note: A low platelet count can usually, but not always, be detected early in the illness, but it may then become normal or even high. If a platelet count obtained within 7 days after onset of the acute gastrointestinal illness is not less than 150,000/mm³, other diagnoses should be considered.

Case Classification

Probable: An acute illness diagnosed as HUS or TTP that meets the laboratory criteria in a patient who does not have a clear history of acute or bloody diarrhea in preceding 3 weeks, OR

An acute illness diagnosed as HUS or TTP, that a) has onset within 3 weeks after onset of an acute or bloody diarrhea and b) meets the laboratory criteria except that microangiopathic changes are not confirmed

Confirmed: An acute illness diagnosed as HUS or TTP that both meets the laboratory criteria and began within 3 weeks after onset of an episode of acute or bloody diarrhea

Comment(s)

Some investigators consider HUS and TTP to be part of a continuum of disease. Therefore, criteria for diagnosing TTP on the basis of CNS involvement and fever are not provided because cases diagnosed clinically as post-diarrheal TTP also should meet the criteria for HUS. These cases are reported as post-diarrheal HUS. Most diarrhea-associated HUS is caused by Shiga toxin-producing *Escherichia coli*, most commonly *E. coli* O157. If a patient meets the case definition for both shiga toxin-producing *E. coli* (STEC) and HUS, the case should be reported for each of the conditions.

III. CASE SURVEILLANCE, INVESTIGATION, AND REPORTING

A. Purpose of Surveillance, Investigation, and Reporting

- To identify STEC outbreaks, recognize food vehicles, and interrupt potential sources of ongoing transmission
- To detect new and emerging STEC serotypes, and monitor epidemiologic trends
- To better understand the epidemiology of STEC infections and post-diarrheal HUS in California, and to develop targeted interventions to decrease rates of illness
- To educate people about how to reduce their risk of STEC infection

B. Local Health Jurisdiction (LHJ) General Case Investigation Recommendations

- Begin case investigation as soon as Shiga toxin-positive stool, STEC O157, STEC non-O157, or HUS is reported from a clinical laboratory or health care provider. Clinical laboratories and health care providers are required to report STEC infections immediately by telephone upon identification. The sooner a patient is interviewed, the better the recall of food and other exposures. While most STEC infections are sporadic, approximately 20 percent of cases in California that have undergone strain typing have been part of a recognized cluster. Most clusters are identified through pulsed-field gel electrophoresis (PFGE), a molecular subtyping technique. Unfortunately, because of inherent delays in the current system, an isolate is often identified as part of a cluster several weeks after the presumed exposure has occurred. In order to improve the likelihood of determining the vehicle of an outbreak, it is helpful to try to get as much information as possible in the initial interview, and to document any activities which may help prompt recall later (such as a party or other significant event, or daily food diary in the week prior to illness onset).
- Case-patients should be interviewed using the CDPH STEC Case Report Form (see below). Please ask about exposures during the 7 days prior to illness onset. Inform patient about the possibility of follow up calls for additional information, especially if the patient is later identified to be part of a cluster or outbreak.

- If the patient appears to be part of a point-source outbreak, follow your protocol for foodborne outbreak investigations. This should include notifying CDPH about the outbreak (see below).
- If you require assistance with your case or outbreak investigation, call the CDPH IDB Disease Investigations Section (DIS) at 510-620-3434.
- Ensure that the STEC isolate is saved and forwarded to the local public health laboratory or to the CDPH Microbial Diseases Laboratory (MDL) for serotyping and molecular subtyping (see MDL resources, below). This includes Shiga-toxin positive broths, if testing by the clinical or local public health laboratory (PHL) does not identify a pathogen or further testing was not performed.

C. LHJ Reporting

LHJ Reporting Overview

STEC O157 infections and post-diarrheal HUS have been reportable conditions in California since 1996. In 2006-7, infections due to non-O157 STEC and Shiga-toxin positive stool (without culture confirmation) were added to the California list of reportable diseases. The following seven related conditions must be reported to CDPH:

- *E. coli* O157 infection with HUS
- *E. coli* O157 infection without HUS
- Hemolytic Uremic Syndrome, post-diarrheal
- STEC non-O157 infection with HUS
- STEC non-O157 infection without HUS
- Shiga toxin positive feces with HUS
- Shiga toxin positive feces without HUS

Both STEC infections and HUS are nationally notifiable conditions and are reported by CDPH to CDC's National Notifiable Diseases Surveillance System (NNDSS) on a weekly basis. Confirmed, probable and suspect cases of STEC O157 infections (with and without HUS) and STEC non-O157 infections (with and without HUS) are reported to CDC as "Shiga toxin-producing *Escherichia coli*". Confirmed, probable and suspect cases of HUS (STEC O157 with HUS, STEC non-O157 with HUS, HUS post-diarrheal, and Shiga toxin positive feces with HUS) are reported to CDC as "Hemolytic Uremic Syndrome, post-diarrheal". Thus, the reporting for STEC infections and HUS are not mutually exclusive; for example, a patient with STEC O157 infection complicated by HUS will be counted as both a case of STEC infection as well as a case of HUS for reporting purposes. Only confirmed and probable (not suspect) cases of "Shiga toxin-producing *Escherichia coli*" infections and "Hemolytic Uremic Syndrome post-diarrheal" are included in the CDC Morbidity and Mortality Weekly Report's national "Summary of Notifiable Diseases." Because cases of STEC infections and HUS are uploaded to NNDSS on a weekly basis, accurate classification is crucial.

The seven conditions related to STEC infections are not included as part of California's final case count for the Yearly Summary Report until each Case Report Form is reviewed and confirmed by the CDPH IDB STEC SME. It is therefore important that all of the fields needed to

appropriately classify and confirm a case are entered by the LHJ investigator to facilitate this process.

Note that although CDC combines STEC O157 and STEC non-O157 infections into a single category, due to the differences in demographics and possibly exposures among persons infected with STEC O157 compared to STEC non-O157, CDPH tracks and analyzes these conditions separately.

When discordant results occur, i.e., results from a clinical laboratory and PHL or MDL conflict (for example, a Shiga toxin positive EIA result by a clinical lab but negative by Vero cell assay or PCR by the PHL or MDL), the results of the PHL or MDL will be considered final. Furthermore, if there is a conflict between the results of testing by the PHL and MDL, the MDL results will be considered conclusive for final reporting considerations. However, the case investigation **should not wait** for confirmation of clinical laboratory results by a PHL or MDL.

As of January 1, 2014 (see Section V, Applicable State Statutes), California Code of Regulations (Title 17, section 2505[1]) added Shiga-toxin positive broths as well as STEC O157 and non-O157 isolates to the list of specimens and isolates that must be saved and submitted by the clinical laboratory to a PHL. Therefore, the PHL confirmation questions in CalREDIE or the CDPH Case Report Form must be filled out.

Instructions for CalREDIE-participating jurisdictions

- Begin the case investigation and enter the patient information into CalREDIE upon notification of the case by a clinical laboratory or health care provider. All seven STEC-related conditions are options in CALREDIE; please select the correct “Disease Being Reported”. The body of the case report form (i.e., the Clinical, Laboratory, Epidemiologic, and Case Investigation pages) is the same for all seven conditions.
- Because of the requirement to report immediately, the first report to public health may be for a person with Shiga toxin-positive feces, and may be entered into CALREDIE as such. However, please remember to update the Disease Being Reported when *E. coli* O157 or STEC non-O157 culture results become available.
- In the Clinical Info page, indicate whether or not the patient had HUS. If the patient was not hospitalized, it is assumed by the STEC SME that the patient did not have HUS. Nonetheless, it is preferred that the LHJ clearly indicate yes/no to the HUS question. This is especially important if the patient was hospitalized.
- In the Laboratory Info page, please enter isolate and serotype information as completely as possible. At the very minimum, please indicate:
 - *Laboratory Results Summary – Shiga Toxin Tests*: Indicate whether or not the isolate was Shiga toxin positive, including Shiga toxin type (Shiga toxin 1 and/or Shiga toxin 2), if possible.
 - *Laboratory Results Summary – Confirmation and PFGE*: Enter in the results from the LHJ PHL or MDL as “Shiga toxin positive”, “STEC non-O157” (please specify serogroup), “STEC O157”, or “Not forwarded to PHL”. If the PHL or MDL result is “STEC Not O157, O26, O103, O111, O121, and O145”, please indicate this under “serotyping confirmation”. Alternatively, it can be shortened to “STEC O-undetermined”.
- Please remember that the laboratory information is crucial to properly categorize status. The case record cannot be closed by CDPH unless this information is included. If the

Laboratory Information page is incomplete, it will be returned to the LHJ. Uploading laboratory results to the electronic filing cabinet, especially PHL/MDL results, is encouraged, as this assists the STEC SME to properly categorize the Resolution Status. Clearance specimen results do not need to be entered into CALREDIE; only the details of the first positive result and PHL/MDL confirmation need to be entered. Please do not enter “closed by LHD” in the process status until the final results from the PHL or MDL have been entered.

- The CALREDIE report will NOT be reviewed by IDB STEC SME and “Closed by State” unless the process status is “Closed by LHD”, regardless of the resolution status. The “Closed by LHD” process status is the trigger for IDB to review the incident report.

Instructions for CalREDIE NON-participating jurisdictions

- For jurisdictions not currently participating in CalREDIE, CMR and case report data must still be provided, including the information requested in the forms provided on the CDPH website:

<http://www.cdph.ca.gov/pubsforms/forms/CtrlIdForms/cdph110a.pdf>

<http://www.cdph.ca.gov/pubsforms/forms/CtrlIdForms/cdph8640.pdf>

The use of the STEC Case Report Form allows for the standardized collection of potential exposures for rapid comparison when clusters and outbreaks are identified. CDPH IDB encourages electronic submission of Case Report Form data.

- In the Clinical Information section of the Case Report Form, please indicate whether or not the patient had HUS. If the patient was not hospitalized, it is assumed by the STEC SME that the patient did not have HUS. Nonetheless, it is preferred that the LHJ clearly indicate yes/no to the HUS question.
- In the Laboratory Information Section, please enter isolate and serotype information as completely as possible. At the very minimum, please indicate:
 - *Laboratory Results Summary – Shiga Toxin Tests*: Indicate whether or not the isolate was Shiga toxin positive including Shiga toxin type (Shiga toxin 1 and/or Shiga toxin 2), if possible.
 - *Laboratory Results Summary – Confirmation and PFGE*: Enter in results from the PHL or MDL as “Shiga toxin positive”, “STEC non-O157”, “STEC O157”, or “Not forwarded to PHL”. If the PHL or MDL result is STEC Not O157, O26, O45, O103, O111, O121, and O145 please indicate this under “serotyping confirmation”. Alternatively, it can be shortened to “STEC O-undetermined”.
- This is very important in order to properly categorize status. The case record cannot be closed by CDPH and included in the final case count unless this information is included. If the form is incomplete, it will be returned to the LHJ.

Reporting Outbreaks and Clusters

Suspected STEC outbreaks, including point-source outbreaks and PFGE clusters within your jurisdiction, should be reported immediately to CDPH.

- *CalREDIE-participating jurisdictions*: Create a new outbreak in CalREDIE. From the dropdown list for “Disease”, select the appropriate disease category such as “GI, Foodborne”, “GI, Waterborne”, “GI, Other/Unknown”, etc.
- *Non-participating jurisdictions*: Complete the Preliminary Report of Communicable Disease Outbreak form (CDPH 9060, <http://www.cdph.ca.gov/pubsforms/forms/CtrldForms/cdph9060.pdf>) and fax to Infectious Diseases Branch at 510-620-3425 or email to CDOUTBREAK@cdph.ca.gov. For foodborne outbreaks, complete and submit the Foodborne Disease Outbreak Report form (CDPH 8567, <http://www.cdph.ca.gov/pubsforms/forms/CtrldForms/cdph8567.pdf>).

D. Laboratory Considerations/ MDL Resources

Laboratory Testing Overview

Most STEC O157 can be identified accurately in the clinical laboratory because of its ability to grow in selective media. However, most clinical laboratories do not use selective media for the isolation of STEC non-O157, and therefore STEC non-O157 identification is usually done at the PHL or MDL.

Clinical laboratories are able to screen for the presence of Shiga toxin. However, the detection of Shiga toxin alone is inadequate; culture of the pathogen is needed for serotyping and molecular characterization, which are both essential for public health action. As of January 2014, clinical laboratories are required by the California Code of Regulations to submit STEC isolates and Shiga toxin-positive specimens or enrichment broths to a PHL as soon as possible for confirmation, isolation, and additional characterization. The local PHL will do additional testing depending on capacity, which includes Shiga toxin testing, identification of serogroup (STEC O157 and STEC non-O157), and strain typing.

In 2009, CDC formalized Recommendations for Diagnosis of Shiga Toxin-Producing *Escherichia coli* Infections by Clinical Laboratories which strongly recommended the simultaneous culture of stool for STEC and EIA testing for Shiga toxin:

<http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5812a1.htm>

However, many clinical laboratories do not culture stool for STEC; most lack the capacity to isolate non-O157 STEC. In addition, clinical laboratories are increasingly relying on culture-independent diagnostic techniques (CIDT) to screen for the presence of pathogens. Clinical laboratories should be encouraged to automatically proceed to culture for any positive screen. If this is not possible, positive broths and / or stool specimens must be submitted to a PHL for further processing. Good communication between clinical laboratories and PHL is essential for the timely completion of isolation and genotyping activities.

CDPH MDL Resources

- *Shiga-toxin testing*: MDL receives Shiga toxin-positive broths, STEC isolates that are not serogrouped, and STEC O157 and non-O157 isolates. MDL will confirm the presence of Shiga toxin by PCR or Vero cell assay, including verifying the Shiga toxin type (1 or 2). PCR assays are used to detect Stx1 and Stx2 genes by many PHLs, including the CDPH MDL, for the diagnosis and confirmation of STEC infection. These tests are not currently available commercially, and PHL often use these assays for confirmatory testing. The Vero cell assay is a tissue culture technique that tests for cytopathic effect of Shiga toxin. Confirmation that the cytopathic effect is caused by Shiga toxin is

performed by neutralization using anti-Stx1 and anti-Stx2 antibodies. This is a sensitive technique that is rarely used in clinical laboratories, but will be used at times by MDL.

If either PCR or Vero cell assay fails to detect Shiga toxin, it will be reported out negative, and further identification will not be attempted; for the purpose of reporting, these should NOT be reported as a case.

- **Serogrouping:** If the specimen is Shiga toxin positive, MDL will attempt to isolate an STEC by culture and taking multiple colony picks. If STEC is isolated, MDL will attempt to serogroup by identifying the O antigen. If STEC is not isolated, it will be reported out as Shiga toxin-positive only.

In the United States, six non-O157 serogroups (O26, O45, O103, O111, O121, and O145) account for the majority of reported non-O157 STEC infections. MDL has the capacity to test for the presence all six of these serogroups as well as O157. Enteric identification of isolates that do not fall into these serogroups will be reported to the LHJ as “*Escherichia coli* not O26, O103, O111, O121, O145, O157”. This designation is also referred to as STEC O-undetermined.

Prior to 2013, isolates that were identified as STEC O-undetermined would be sent to CDC for further attempts at serogrouping/ serotyping. However, *E. coli* O-undetermined are no longer routinely forwarded to CDC for serogroup testing. Also as of 2013, MDL has discontinued the testing for flagella H antigen (which determines serotype). The testing for H antigen was considered to be redundant, as screening for Shiga toxin production occurs for all presumptive STEC isolates received by MDL. All O157:H7 isolates are presumed to be Shiga toxin positive, but STEC O157:NM (nonmotile) is also reportable. By CSTE surveillance case definition criteria, all STEC O157, regardless of H7 status, is reportable, and considered to be a confirmed case- the presence of Shiga toxin defines the organism as a STEC.

- **PFGE:** PFGE is done by MDL on all STEC isolates as soon as they are identified. For STEC, PFGE is done by two restriction enzymes, XbaI and BlnI, to enhance specificity. If the XbaI and BlnI PFGE pattern combination is indistinguishable from that of other STEC isolates in California, or are matches to known active clusters, MDL will notify an IDB epidemiologist, and the IDB epidemiologist will notify the LHJ communicable disease control staff.
- **Multiple-Locus Variable Number Tandem Repeat Analysis (MLVA):** In addition to PFGE, MLVA is now done on all STEC O157 (but not STEC non-O157) isolates. MLVA is another molecular subtyping technique that allows comparison among O157 isolates. MLVA looks at specific genomic sequences within the entire bacterial genome. STEC O157 isolates received by MDL are batched and undergo MLVA testing once a week. Results are confirmed by CDC. Most clusters of STEC infections are identified by PFGE; however, MLVA can be a useful adjunct to STEC O157 cluster investigations.

MDL provides testing results to the PHL that submitted the specimen, not necessarily the case-patient’s jurisdiction of residence. It is the responsibility of the local PHL to notify the communicable disease control staff of the testing results. Of note, certain clinical laboratories, including Kaiser Permanente, Northern California Region, sends specimens directly to MDL. MDL will provide results to the Northern California Kaiser regional laboratory or to any other clinical laboratory that submitted the specimen. These laboratories will in turn notify the LHJ of residence of the case-patient.

IV. CASE MANAGEMENT AND PUBLIC HEALTH CONTROL MEASURES

A. Management of Cases

All case-patients with STEC infection should be educated regarding disease transmission and appropriate infection control measures. In addition, patients should be instructed to monitor for signs and symptoms of HUS in the weeks following the onset of diarrhea.

Title 17 (2612) exclusion criteria for foodhandlers, childcare or eldercare workers, and health care workers do not apply for STEC infections. However, specific language for STEC infections is covered by the California Health and Safety Code Section 113949.1 which specifies particular actions for employees of food facilities. Details may be found in the Applicable State Statutes (Section V).

The California Association of Communicable Disease Controllers (CACDC) has proposed the following recommendations for the management of contacts to confirmed STEC case-patients, which are not bound by state statute (and therefore left to the discretion of the local Health Officer).

- For persons in sensitive occupations: Restrict/exclude until 2 negative stool specimens, taken at least 24 hours apart and at least 48 hours after cessation of antibiotics, are negative.
- For children 5 years and younger in a group setting (e.g., day care): Restrict/ exclude until 2 consecutive stool specimens, taken at least 48 hours after antibiotics are stopped and at least 24 hours apart are negative.

For additional information, see <http://www.lluo.php.org/enteric/content/shiga-toxin.html> and <http://www.cdph.ca.gov/programs/cid/Documents/EntericDiseaseMatrix.pdf>

Of note, STEC can be shed in stool for several weeks after the resolution of symptoms. In particular, young children shed for a greater duration, although chronic carriage is unusual. Nonetheless, the infectious dose, especially for STEC O157, tends to be quite low, and therefore, asymptomatic shedders are capable of infecting others.

B. Management of Contacts

There are no specific applicable codes guiding the management of contacts.

CACDC has proposed the following recommendations for the management of symptomatic contacts to confirmed STEC case-patients, which are not bound by state statute (and therefore left to the discretion of the local Health Officer). See CACDC Enteric Disease Exclusion Summary Chart for details. No restriction is recommended for asymptomatic contacts.

- For a symptomatic contact in a sensitive occupation: For persons in sensitive occupations who are a symptomatic contact to a confirmed or probable case: Restrict/exclude and collect 1 stool specimen for testing at a public health laboratory.
- For symptomatic contact who is a child 5 years and younger in a group setting: Restrict/exclude and collect 1 stool specimen for testing at a public health laboratory.

C. Infection Control Measures

Environmental inspection is indicated if a commercial food service facility, child care center, or public drinking water supply is suspected as the source of infection.

Hospitalized patients should be cared for using standard precautions. Contact precautions should be used for diapered or incontinent persons for the duration of the illness to control institutional outbreaks.

The case-patient should be educated regarding effective hand washing, particularly after using the toilet, changing diapers, and before preparing or eating food. The importance of proper hygiene must be stressed, as excretion of the organism may persist for several weeks.

V. APPLICABLE STATE STATUTES AND REGULATIONS

A. California Code of Regulations, Title 17, Public Health, Sections 2500, 2502:

<http://ccr.oal.ca.gov/linkedslice/default.asp?SP=CCR-1000&Action=Welcome>

2500: Health care providers are required to report Shiga toxin detected in feces, Hemolytic Uremic Syndrome, and Shiga toxin-producing *Escherichia coli* to the local health officer where the patient resides immediately by telephone.

2502: The Local Health Officer is required to report Shiga toxin detected in feces, Hemolytic Uremic Syndrome, and Shiga toxin-producing *Escherichia coli* to the state Department of Public Health at least on a weekly basis.

2502 (I): Assembly Bill 186, chaptered on October 7, 2011 amended the CA Health and Safety Code Section 120130 (b), required that the California Department of Public Health (CDPH) “establish a list of communicable diseases and conditions for which clinical laboratories shall submit a culture or a specimen to the local public health laboratory.”

This list has been added to California Code of Regulations, Title 17, Section 2502 (I) as of January 1, 2014:

A culture of a specimen as listed in this subsection shall be submitted as soon as soon as available to the public health laboratory designated in Section 1065 for the local health jurisdiction where the health care provider is located.... The cultures or specimens pursuant to this requirement are..... Shiga toxin-positive fecal broths; Shiga toxin-producing *Escherichia coli* (STEC) O157 and non-O157 isolates.....

B. California Health and Safety Code §113949.1:

http://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml

It is the intent of the Legislature to reduce the likelihood of foodborne disease transmission by preventing any food employee who is suffering from symptoms associated with an acute gastrointestinal illness, or known to be infected with a communicable disease that is transmissible through food, from engaging in the handling of food until the food employee is determined to be free of that illness or disease, or incapable of transmitting the illness or disease through food as specified in this article.

Section 113949.1(a) When a local health officer is notified of an illness that can be transmitted by food in a food facility or by an employee of a food facility, the local health officer shall inform the local enforcement agency. The local health officer or the local enforcement agency, or both, shall notify the person in charge of the food facility and shall investigate conditions and may, after the investigation, take appropriate action, and for reasonable cause, require any or all of the following measures to be taken.....

Section 113949.1(b) For purposes of this section, “illness” means a condition caused by any of the following infectious agents... Enterohemorrhagic or shiga toxin producing *Escherichia coli*.

Section 113949.2. The owner who has a food safety certificate issued pursuant to Section 113947.1 or the food employee who has this food safety certificate shall instruct all food employees regarding the relationship between personal hygiene and food safety, including the association of hand contact, personal habits and behaviors, and food employee health to foodborne illness. The owner or food safety certified employee shall require food employees to report the following to the person in charge: (a) If a food employee is diagnosed with an illness due to one of the following... Enterohemorrhagic or shiga toxin producing *Escherichia coli*.

VI. ADDITIONAL RESOURCES

A. Food Safety

Detailed food handling recommendations and details about USDA product testing and other information may be found on the USDA website:

http://www.fsis.usda.gov/wps/portal/fsis/topics/food-safety-education/get-answers/food-safety-fact-sheets/foodborne-illness-and-disease/escherichia-coli-o157h7/ct_index

B. General Information/ Patient Education

- CDPH: <http://www.cdph.ca.gov/HealthInfo/discond/Pages/Salmonellosis.aspx>
- CDC: <http://www.cdc.gov/ecoli/>
- CDC videos on food safety: <http://www.cdc.gov/ncezid/dfwed/medscape/foodsafety.html>

C. References

- Heymann, DL Ed. *Control of Communicable Diseases Manual, 19th Edition*. Washington, DC, American Public Health Association, 2008
- CIFOR (Council to Improve Foodborne Outbreak Response) Guidelines: <http://www.cifor.us/toolkit.cfm>
- Pennington, H. *Escherichia coli* O157. *Lancet* 2010; 376:1428-1435
- Red Book Online. Section 3: Summaries of Infectious Diseases; *Escherichia coli* Diarrhea: http://aapredbook.aappublications.org/content/1/SEC131/SEC180.body?related-urls=yes&legid=redbook;1/1/S03_42

VII. UPDATES

Original version finalized and completed on January 12, 2015

VIII. Summary of Action Steps: Stx-Positive stool, STEC, and HUS

Action	Specific Steps
<input type="checkbox"/> Begin case investigation as soon as Stx + stool, STEC, or HUS is reported from a lab or healthcare provider.	<ul style="list-style-type: none"> • Review information in the CDPH IDB Guidance and other resources as needed. • Obtain and review clinical documentation, medical records, and lab reports as applicable. • Contact patient for interview.
<input type="checkbox"/> Confirm case definition.	<ul style="list-style-type: none"> • To count as a case, only lab confirmation that Stx has been detected, or STEC has been isolated, from a human specimen is needed. The specimen site can be sterile (e.g., blood) or unsterile (e.g., stool). Clinically compatible illness is not necessary for a case to be counted.
<input type="checkbox"/> Attempt to identify source of exposure.	<ul style="list-style-type: none"> • Use the STEC case report form in CalREDIE or posted to the CDPH website to guide your interview. • Include as many details that may later trigger memory, such as parties or special events, and inform patient that they may be contacted again. • If patient appears to be part of an outbreak, follow your protocol for foodborne outbreak investigations; this should include notifying CDPH about the outbreak. Suspected STEC outbreaks, including point-source outbreaks and PFGE clusters within your jurisdiction, should be reported within 24 hours to CDPH.
<input type="checkbox"/> Implement control measures.	<ul style="list-style-type: none"> • Determine if the patient is in a sensitive occupation (e.g., foodhandler or healthcare worker); administer appropriate infection control recommendations. See CACDC Enteric Disease Matrix: http://www.lhuophp.org/enteric/content/salmonellosis.html
<input type="checkbox"/> Confirm status of STEC isolate or Stx + broth.	<ul style="list-style-type: none"> • Stx-positive broths and STEC isolates must be saved and forwarded to a PHL for confirmation as per regulations. • Ensure that the appropriate specimen has been sent to a local PHL or MDL for serogrouping and molecular subtyping.
<input type="checkbox"/> Report to CDPH Confirmed and probable STEC cases must be reported. <input type="checkbox"/> Ensure proper documentation.	<ul style="list-style-type: none"> • Obtain the final result testing result from a PHL and document in the laboratory section; include details, including serogroup details (e.g., O157, O111, O26, or O-undetermined). Stx status (positive or negative) must be included. Include Stx type (1 and/or 2), if available. • The disease classification “Shiga-toxin positive stool” should be reserved only for cases where a PHL was unable to isolate STEC but confirmed the presence of Shiga toxin. • Verify whether or not the patient had HUS. • Select the appropriate “disease being reported” based on this information. • Complete above steps prior to closing the case by LHD or submitting to CDPH. • CalREDIE NPJs must also complete the Confidential Morbidity Report form (CDPH 110a).

If you require assistance with your investigation, call IDB Disease Investigations Section at 510-620-3434.