Epidemiologic Summary of Typhoid Fever in California, 2009 - 2012

Key Findings

Typhoid fever is a potentially life-threatening infectious disease caused by *Salmonella* Typhi bacteria. These bacteria are found only in humans and are passed to others when someone eats or drinks something that is contaminated with *S.* Typhi bacteria. These bacteria can spread from someone infected with *S*. Typhi who does not wash their hands properly after using the toilet. Symptoms include a prolonged high fever, weakness, and stomach pain. Without treatment, typhoid fever can be severe and cause death. Typhoid fever is not common in the United States. Most cases of typhoid fever in the United States and California are reported in people who were infected while traveling internationally in areas with poor water or sanitation systems where the disease is common, including in Asia, Africa, and Latin America.

Typhoid Fever in California from 2009 through 2012

Total Cases: A total of 330 typhoid fever cases were reported from 2009 through 2012. Of these cases, one reported to have died with typhoid fever.

Rate: The average annual rate of new typhoid fever cases during 2009-2012 was less than 1 case per 100,000 people in California.

- **By County**: There were 8 counties in California that reported at least 1 case of typhoid fever each year during 2009-2012, each with an average rate of less than 1 case or about 1 case per 100,000 people.
- **By Sex:** The average rates for males and females were similar, but rates were less than 1 case per 100,000 people for both groups.
- **By Age Group**: The average rates were highest in children aged 1 to 4 years and 5 to 14 years, and adults aged 25 to 34 years, but rates in all groups were less than 1 case per 100,000 people.
- **By Race/Ethnicity**: For cases where race and ethnicity information was available, the highest percentage of cases was in people who reported non-Hispanic Asian/Pacific Islander race/ethnicity (about 76%).

To help prevent typhoid fever, people planning to travel in areas where typhoid fever is common should talk to their doctor about getting a typhoid fever vaccine. Whether or not you've been vaccinated, it's important to avoid risky food and drinks while traveling, including foods from street vendors and flavored ices. While traveling, drink only bottled water or boil water for one minute before drinking and eat only foods that have been thoroughly cooked.

For more information about typhoid fever in California, please visit the CDPH Typhoid fever webpage. For details about key infectious diseases in California, please visit the CDPH Surveillance and Statistics Section webpage.

Background

Typhoid fever is caused by *Salmonella* Typhi, an uncommon but important bacterial pathogen, with more than 350 reported cases of culture-confirmed typhoid fever per year in the United States, mostly among travelers.[1] While uncommon in the U.S. and other industrialized regions such as Canada, Western Europe, Australia, and Japan, typhoid fever is highly endemic in low and middle-income countries with limited access to safe drinking water, and where sanitation infrastructure and hygiene practice is poor, including in South Asia and parts of East and Southeast Asia, Africa, the Caribbean, and Central and South America. Most cases (estimated 85%) in the U.S. are in travelers returning from endemic areas (such as India, Pakistan, and Bangladesh). *S.* Typhi infection is restricted to humans (does not occur in animals), and consumption of food or water contaminated by the feces or urine of persons with typhoid fever are the leading sources of exposure.[2]

Typhoid fever is an acute systemic illness with an incubation period usually between 9 and 20 days but can vary from 3 to over 60 days depending on size of the inoculum and host factors.[3] Illness onset is often insidious and non-specific, characterized by fever, malaise, chills, myalgia, headache, and abdominal pain.[4] Most cases in the U.S. are associated with hospitalization. Without therapy, typhoid fever can be a life-threatening disease, with historical death rates before antibiotics ranging between 12% and 30%. Among untreated patients with acute illness, 10% shed bacteria for three months after initial onset of symptoms. Even when treated, up to 2.0-5.0% can become chronic typhoid carriers and bacteria can persist in the biliary tract even after symptoms have resolved.[5, 6] A chronic carrier state may follow acute illness, even mild or subclinical infections.

Two typhoid vaccines are currently available in the U.S.; one is an injectable vaccine and the other is an oral vaccine. Both vaccines confer about 50-80% protection in children and adults. Notably, vaccine-induced immunity provides little protection against large challenge doses and protection decreases over time, requiring a booster.[7]

This report describes the epidemiology of typhoid fever cases in California from 2009 through 2012. Due to multiple factors that can contribute to underreporting, data in this report are likely underestimates of actual disease incidence. For a complete discussion of the definitions, methods, and limitations associated with this report, please refer to the *Technical Notes*. The epidemiologic description of typhoid fever for earlier surveillance periods can be found in the *Epidemiologic Summary of Typhoid Fever in California, 2001-2008*.[8]

California Reporting Requirements and Surveillance Case Definition

California Code of Regulations (CCR), Title 17, Section 2500 requires health care providers to report suspected cases of typhoid fever and carriers of *S.* Typhi to their local health department within one working day of identification or immediately by telephone if an outbreak is suspected.[9] Per CCR, Title 17, Section 2505, clinical and reference laboratories are also required to report laboratory testing results suggestive of *S.* Typhi to either the California Reportable Diseases Information Exchange (CalREDIE) (via electronic laboratory reporting) or the local health department; notification should occur within one working day after the health care provider has been notified of the laboratory testing result.[10]

California regulations require cases of typhoid fever and carriers of *S.* Typhi to be reported to the California Department of Public Health (CDPH). CDPH officially counted typhoid fever cases that satisfied the U.S. Centers for Disease Control and Prevention (CDC)/Council of State and Territorial Epidemiologists (CSTE) surveillance case definition. During the surveillance period, a confirmed case of typhoid fever was defined as a case with a compatible clinical syndrome in which *S.* Typhi was cultured from a clinical specimen. A probable case was defined as one with clinically compatible illness and an established epidemiologic link to a laboratory-confirmed case during an outbreak.[11] CDPH defined a convalescent typhoid carrier as a person who shed typhoid bacilli for three or more months after onset of typhoid fever. A chronic typhoid carrier was defined as: (a) a person who continued to excrete typhoid bacilli for more than 12 months after onset of typhoid fever or (b) (i) a person who gave no history of typhoid fever or who had the disease more than one year previously, and (ii) whose feces or urine were found to contain typhoid bacilli on two separate examinations at least 48 hours apart, confirmed by the CDPH Microbial Diseases Laboratory. CDPH defined other typhoid carriers as persons who had typhoid bacilli isolated from surgically removed tissues, organs, or draining lesions and continued to excrete typhoid bacilli for more than 12 months.

Epidemiology of Typhoid Fever in California, 2009-2012

CDPH received reports of 330 total cases of typhoid fever with estimated symptom onset dates from 2009 through 2012. This corresponds to an average annual incidence rate of 0.2 cases per 100,000 population [Figure 1]. Death was reported among one case-patient at the time of case report.

Statewide from 2009 through 2012, eight counties reported at least one case for each year of the surveillance period: Alameda, Contra Costa, Los Angeles, Orange, Sacramento, San Diego, San Mateo, and Santa Clara counties. Cases from these 8 counties made up 80.0% of the total typhoid fever cases reported. Among these 8 counties, the highest average annual rate was in Santa Clara County (1.0 per 100,000; 74 cases) [Figure 2]. By region (see *Technical Notes*), the average annual incidence rate for the surveillance period was higher in Northern California (0.3 per 100,000; 210 cases) than Southern California (0.1 per 100,000; 120 cases). The Bay Area region reported the highest average annual incidence rate in California (0.5 per 100,000; 153 cases).

From 2009 through 2012, incidence rates were similar in males (0.2 per 100,000; 162 total cases) and females (0.2 per 100,000; 165 cases); 49.1% of case-patients were male and 50.0% were female. Sex was not reported for three case-patients.

By age group, the average annual incidence rate during the surveillance period was highest in children aged 5 to 14 years (0.3 per 100,000 population in this age group; 69 cases), followed by children aged 1 to 4 years (0.3 per 100,000; 27 cases), and adults aged 25 to 34 years (0.3 per 100,000; 69 cases) [Figure 3].

Incidence rates by race/ethnicity were not calculated due to missing race/ethnicity data for 28.8% of cases. For typhoid fever cases with complete race/ethnicity information, the highest percentage of cases was among those who reported non-Hispanic Asian/Pacific Islander race/ethnicity (75.8%), which is disproportionally higher than the percentage of the non-Hispanic Asian/Pacific racial/ethnic population in California during the same time period (75.8% vs. 13.4%, respectively) [Figure 4].

Two outbreaks of typhoid fever were detected during the surveillance period. In 2010, twelve cases from multiple states, including seven from California, were epidemiologically associated with consumption of frozen fruit pulp from a manufacturer in Guatemala. In 2010, a cluster of three California cases in different households involved a patient who had returned from the Philippines and was identified as the likely index case.

From 2009 through 2012, 16 persons were reported as chronic typhoid carriers. Chronic carriers were more likely than acute typhoid fever cases to be older (median age 41.5 years vs. 28 years) and of Hispanic race/ethnicity (43.8% vs. 18.1%).

Figure 1. Typhoid Fever Cases and Incidence Rates by Year of Estimated Illness Onset, California, 2009-2012

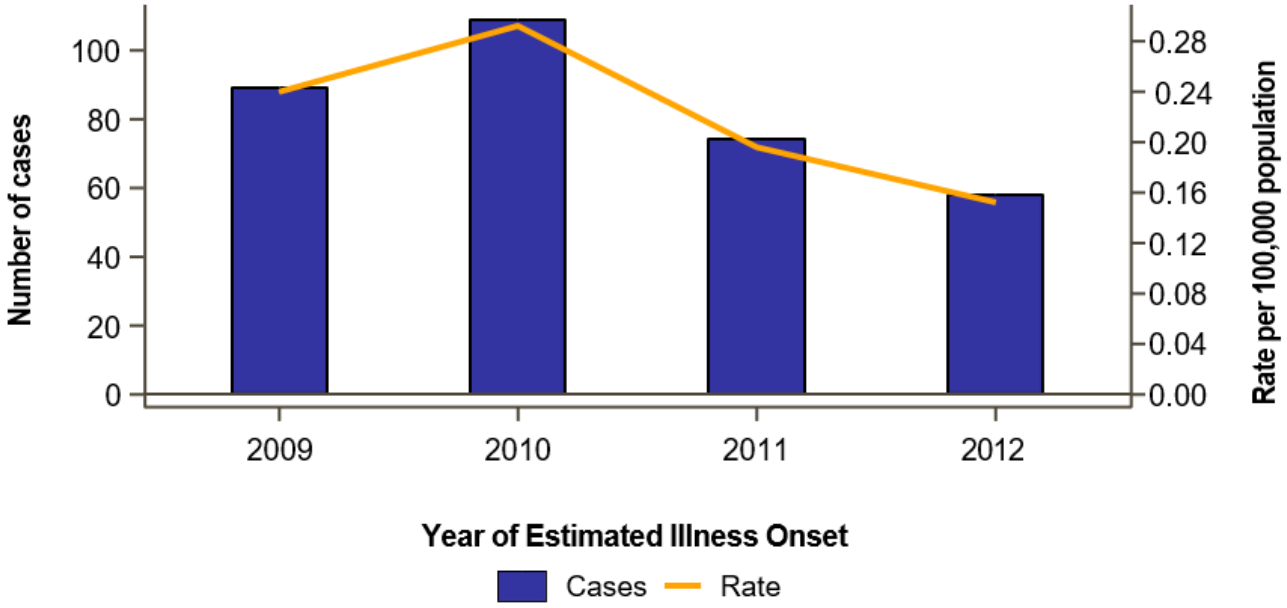


Figure 2. Typhoid Fever Average Annual Incidence by County, California, 2009-2012

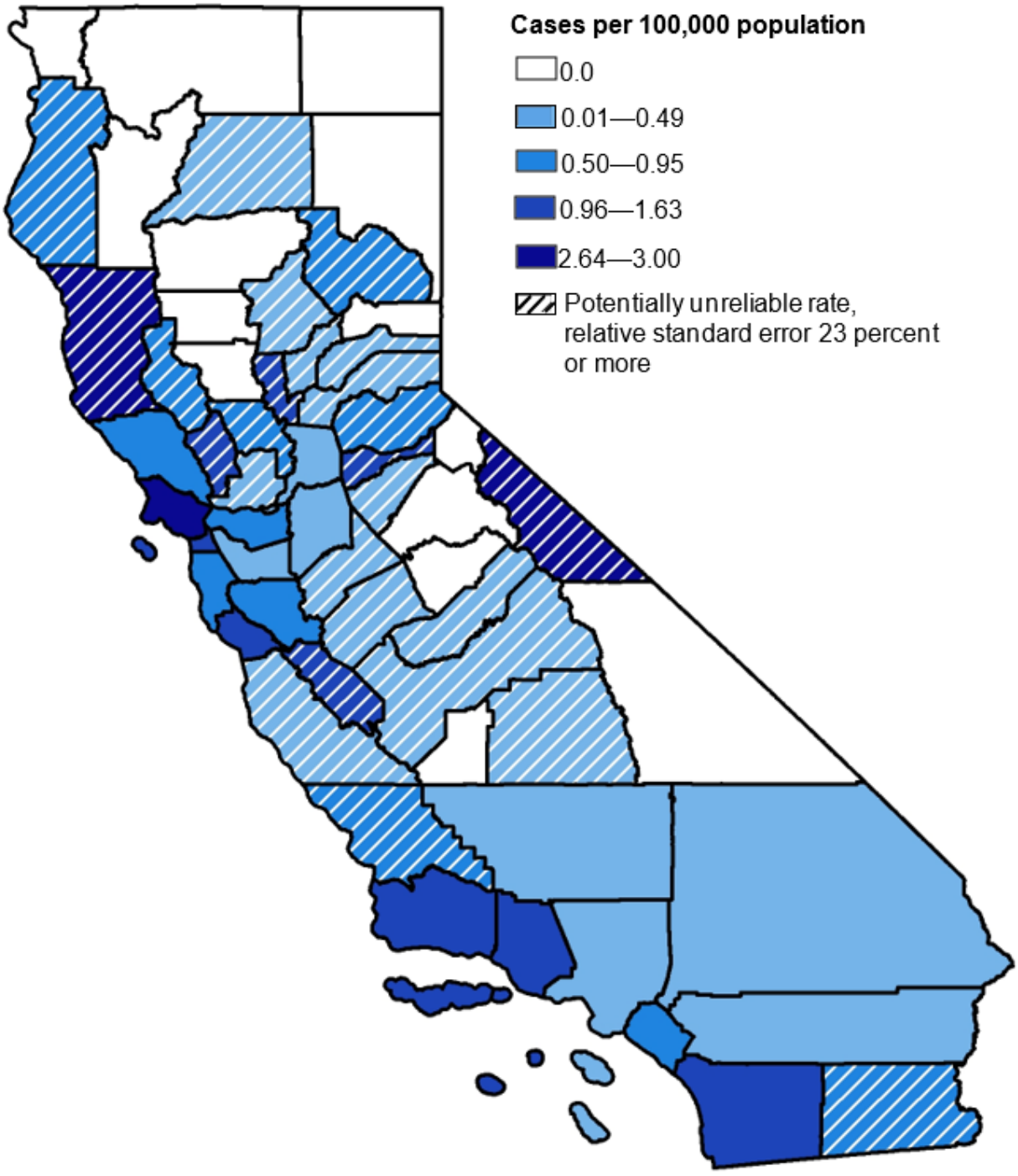
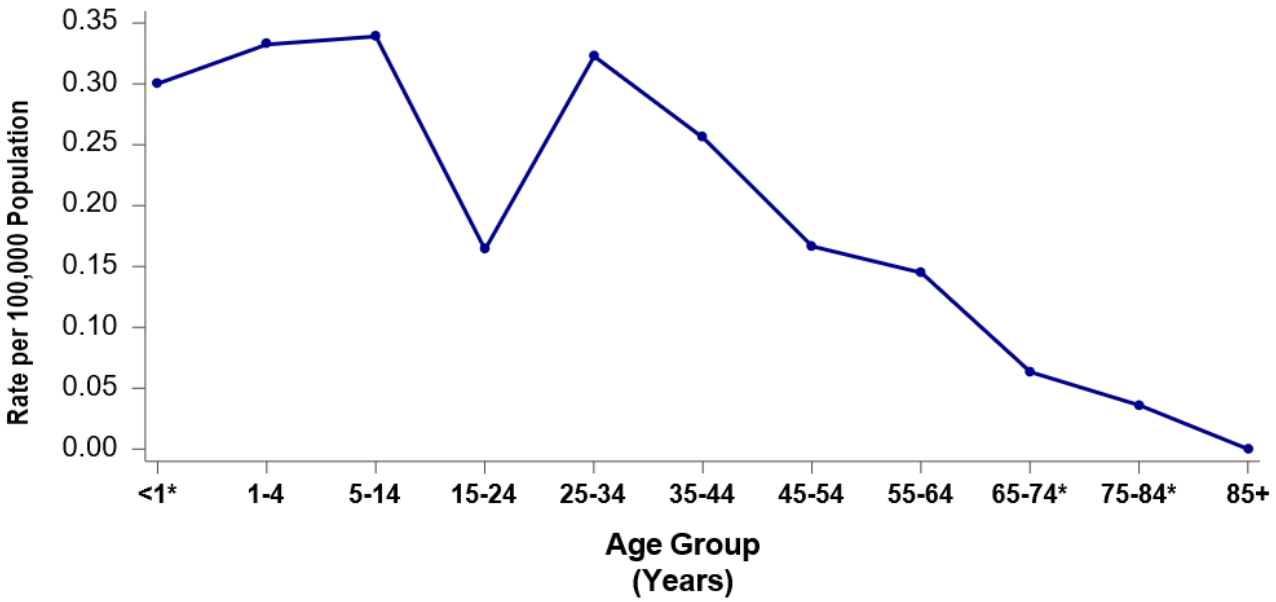
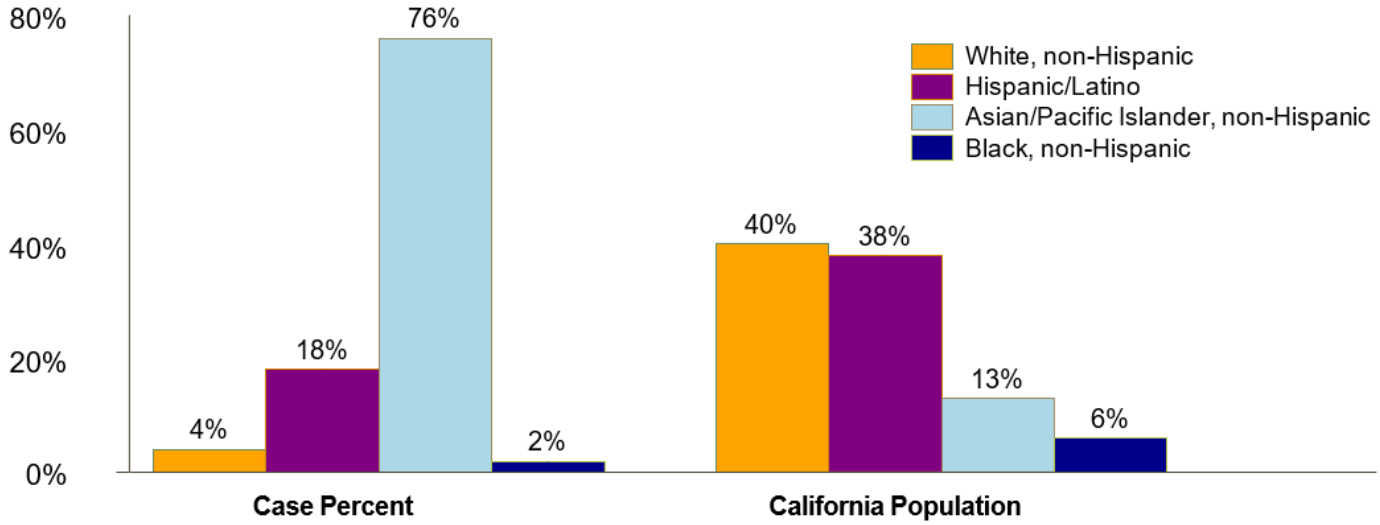


Figure 3. Typhoid Fever Average Annual Incidence Rates by Age Group, California, 2009-2012



*Potentially unreliable rate: relative standard error 23 percent or more.

Figure 4. Typhoid Fever Cases and Population by Race/Ethnicity, California, 2009-2012



28.8% (n=95) of reported incidents of Typhoid Fever did not identify race/ethnicity and 2.4% (n=8) of incidents identified as 'Other' race/ethnicity and are not included in the Case Percent calculation. Information presented with a large percentage of missing data should be interpreted with caution.

Comments

Vaccination against typhoid is recommended for international travelers to destinations where the risk of contracting typhoid fever is high.[12] Persons traveling to areas where water and/or sanitation infrastructure is inadequate (including South Asia) should be vaccinated against typhoid fever before travel, and should avoid risky food and drinks while traveling, including foods from street vendors and flavored ices. While traveling, persons should drink only bottled, canned, or properly treated/filtered drinks, and eat only foods that have been thoroughly cooked. While a typhoid vaccine confers some degree of protection, ensuring the safety of food and water is still the most important protective measure as typhoid immunization provides no protection against infection with *S.* Paratyphi and other potentially food- and water-borne enteric pathogens.

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Technical Notes

Background

CDPH maintains a mandatory, passive reporting system for a list[9] of communicable disease cases and outbreaks. Health care providers and laboratories are mandated to report all cases, including suspected cases, of these communicable diseases to their local health department (LHD). LHDs are also mandated to report these cases to CDPH.

These *Technical Notes* describe the definitions, methods, and limitations used to summarize the epidemiology of typhoid fever reported to CDPH.

The distribution of information on the health of the community is a core function and essential service of public health. The data in the *Epidemiologic Summaries* provide important health information on the magnitude and burden of communicable diseases in California. Bearing in mind their limitations, these data can identify high risk groups that may benefit from public health prevention activities and aid in tracking the effectiveness of control and prevention measures.

Materials and methods

Case data sources and inclusion criteria

The *Epidemiologic Summary of Typhoid Fever in California, 2009-2012* describes typhoid fever cases that had an estimated illness onset during January 1, 2009 through December 31, 2012. Case data were extracted from California Confidential Morbidity Reports that were submitted to CDPH by May 1, 2020 and entered into the CalREDIE system or reported electronically by CalREDIE non-participating LHDs. Cases included met the surveillance case definition (see below).

Data were quality checked, and duplicate records were removed based on a data-matching

algorithm.

Data on foodborne and waterborne outbreaks with estimated onset dates from 2009 through 2012 were extracted from outbreak report forms submitted to CDPH by May 1, 2020. These reports were the source for the number of outbreak-associated cases per disease, when presented.

Population data source

State of California, Department of Finance population projections and estimations data were used.[13, 14, 15, 16]

Definitions

A case was defined as one with laboratory and/or clinical evidence of infection or disease that satisfied the most recent communicable disease surveillance case definition published by CDC or CSTE.[17, 18] To determine if the surveillance case definition was met, LHDs reviewed detailed clinical and laboratory information provided on disease-specific case history forms. The surveillance case definition for typhoid fever is described in the *California Reporting Requirements and Surveillance Case Definition* section.

The estimated date of illness onset for each case was defined as the date closest to the time when symptoms first appeared. For cases for which an illness onset date was not explicitly reported, estimated date of illness onset was selected as the earliest of: date of diagnosis, date the case was reported to or received by CDPH, date of laboratory specimen collection, or date of patient death. In the case of insidious disease onset, estimated onset was often based on the diagnosis date.

Mutually exclusive race/ethnicity categories were defined as follows: Hispanic/Latino (of any, including unknown, race), and non-Hispanic White, Black, Asian/Pacific Islander, American Indian/Alaska Native, Multiple Race, and Other.

Cases were classified geographically according to the case-patient's county of residence. Cases reported from the City of Berkeley were included in Alameda County, and cases from the cities of Long Beach and Pasadena were included in Los Angeles County. Regions of California were defined by aggregating counties with similar geography, demography, and economic conditions as described by the Public Policy Institute of California.[19] Regions included the Far North (Butte, Colusa, Del Norte, Glenn, Humboldt, Lake, Lassen, Mendocino, Modoc, Nevada, Plumas, Shasta, Sierra, Siskiyou, Sutter, Tehama, Trinity, and Yuba counties); Sacramento Metro (El Dorado, Placer, Sacramento, and Yolo counties); Sierra (Alpine, Amador, Calaveras, Inyo, Mariposa, Mono, and Tuolumne counties); Bay Area (Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma counties); San Joaquin Valley (Fresno, Kern, Kings, Madera, Merced, San Joaquin, Stanislaus, and Tulare counties); Central Coast (Monterey, San Benito, San Luis Obispo, Santa Barbara, and Santa Cruz counties); Inland Empire (Riverside and San Bernardino counties); South Coast (Los Angeles, Orange, and Ventura counties); and San Diego (Imperial and San Diego counties). Southern California was defined as the counties comprising the Inland Empire, South Coast, and San Diego regions, while all other counties comprised Northern California.

Data analyses

Case totals and incidence rates per 100,000 population (unless otherwise indicated) were reported and stratified by estimated year of illness onset, county and county-aggregated region, sex, and age group.

The formulas used to calculate the incidence rate and relative standard error were:

- Incidence rate (IR) = Number of cases/population x 100,000
- Standard error (SE) = IR/√number of cases
- Relative standard error = SE/IR x 100

An incidence rate was considered unstable if the relative standard error was 23 percent or more (a threshold recommended by the National Center for Health Statistics[20]).
To reduce the level of random error when the case number or population was small, the time and geographic range for incidence rates was expanded, and multiple-year average annual incidence rates and region-specific (rather than county-specific) rates were calculated, as needed. Relative standard errors were calculated for all incidence rates.

Because a substantial portion of typhoid fever case-patients from 2009 through 2012 did not identify their race/ethnicity (28.8%) or identified as non-Hispanic Other race/ethnicity (2.4%), incidence rates by race/ethnicity were not calculated. However, since race/ethnicity can be an important marker for complex social, economic, and political factors that influence health, the racial/ethnic distribution of cases and the statewide population were presented side-by-side when the data were sufficient. Cases of non-Hispanic Other race/ethnicity were not included in the analysis of race/ethnicity due to lack of population data for this group.

Analyses were conducted using SAS software version 9.4, and maps were created using ArcGIS software version 10.7.1.

Limitations

Data quality

For typhoid fever, CDPH relied on LHDs to determine whether the surveillance case definition was met. It is possible that some cases included in this report did not meet surveillance case definitions and counting criteria.

Deaths

The number of case-patients who died of their illness was calculated based on date of death and other death-related information reported on the Confidential Morbidity Report or case history. However, deaths might have occurred after the case report was completed (and thus were not included in the calculated numbers). The numbers of deaths and case-fatality ratios reported should be interpreted with caution.

Completeness and timeliness of reporting

The numbers of cases reported in this *Epidemiologic Summary* are likely to underestimate the true magnitude of disease. Factors that may contribute to under-reporting include delays in notification, limited collection or appropriate testing of specimens, obstacles or impediments to ill persons seeking health care, limited resources and competing priorities in LHDs, and lack of

reporting by clinicians and laboratories. Factors that may contribute to enhanced reporting include disease severity, the availability of new or less expensive diagnostic tests, changes in the case definition by CDC or CDPH, recent media attention or public interest, and active surveillance activities.

Because outbreak-related case reports were not always identified as such on the Confidential Morbidity Report, it was not possible to ascertain the proportion of outbreak-related cases that were also reported as individual cases. Additionally, case definitions used to classify probable outbreak-related cases may not meet the specific surveillance criteria required for individual case reporting. Thus, some outbreak-related cases may not be included in the total number of cases reported.

Small numbers and rate variability

All rates, even those based on full population counts, are subject to random error. Random error may be substantial when the number of cases is small (e.g., less than 20) and can make it impossible to distinguish random fluctuations from true changes in the underlying risk of disease. Rates and proportions based on small numbers should be interpreted with caution.

Count and Rate comparisons

Incidence rate comparisons between geographic areas and over time should be made with caution. The limitations previously listed (especially the completeness of reporting and random variability of rates) should be considered when interpreting and comparing incidence rates.

Data presented may differ from previously published data due to delays inherent to case reporting, laboratory reporting, and epidemiologic investigation.

Updated by Kirsten Knutson, Alyssa Nguyen, and Yanyi Djamba – Infectious Diseases Branch

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