Typhoid and Paratyphoid Fevers
NSW Control Guidelines for Public Health Units

Revision history			
Version	**Date**	**Revised by**	**Changes**
1.0	01/04/2014	-	-
2.0	5/12/2016	Communicable Disease Branch	Update for consistency with the Typhoid and paratyphoid Fevers Series of National Guidelines (SoNG) v1.0 (endorsed 1 March 2017, released 15 March 2017), localised for NSW as indicated by [hard brackets].
2.1	1/04/2019	Communicable Disease Branch	Update literature on the incubation period for Paratyphoid

1. Summary

Public health priority

High

Case management

Public health investigations involve two separate scenarios:

- travellers recently returning from endemic countries; and
- cases with no recent international travel history.

Generally, cases are travellers recently returned from endemic areas. If there is no history of international travel, the likely source of infection should be identified as soon as possible. If the case is a food handler, a child in pre-school, kindergarten or childcare (below the age of primary school entry), or directly cares for patients, children, the debilitated or elderly, refer to Section 9. Case management for details of exclusion and screening arrangements.

Contact management

Management of contacts depends on the likely source of the case's infection and whether the contact is at higher risk for transmitting the infection. Refer to Section 11. Contact management for details of exclusion and screening arrangements for the different types of contacts.

Note

These guidelines cover both typhoid fever, caused by *Salmonella enterica*, serovar Typhi (*S.* Typhi) and paratyphoid fever caused by *Salmonella enterica*, serovars Paratyphi A, B, and C. These guidelines, however, do not cover *S*. Paratyphi B biovar Java as this causes gastroenteritis rather than paratyphoid fever and as such is grouped with other salmonella) (1, 2).

2. The disease

Infectious agent

The nomenclature and classification of the *Salmonella* genus have changed over the years. The current classification of the causative bacterium of typhoid is *Salmonella enterica* subspecies *enterica* serovar Typhi (commonly referred to as *S.* Typhi) (3). A number of strains are recognised and phage typing and pulse field gel electrophoresis (PFGE) are currently used to characterise *S*. Typhi isolates for epidemiological purposes and in outbreak settings. Paratyphoid is caused by *S. enterica*, subspecies *enterica* serovars Paratyphi A, B, and C with the exception of *S*. Paratyphi B biovar Java (also called biovar L(+) tartrate(+)/biovar dT+) which does not cause a typhoid-like enteric illness (4). Globally, *S*. Paratyphi A is the most frequently described of the three serovars (1, 5). Little is known about serovars Paratyphi B and Paratyphi C (1).

Reservoir

S. Typhi – Humans are the only reservoir.

S. Paratyphi A – Humans are the only reservoir.

S. Paratyphi B and C - Humans are the principal reservoir (6). Domestic animals may also carry these serovars. Paratyphi B infections have occasionally been associated with cattle (7).

Both *S.* Typhi and *S.* Paratyphi can survive in the environment (Section 10. Environmental evaluation).

Mode of transmission

Transmission is via the faecal-oral route. Overwhelmingly, transmission is indirect by the ingestion of water and food contaminated with faeces and/or urine. Transmission by direct person-to-person contact can occur but is rare (8). Chronic carriers transmit typhoid by contaminating food as a consequence of unsatisfactory hygiene practices (12). Little is known about chronic paratyphoid carriage.

Food was identified as the source of paratyphoid A infection following an outbreak among travellers returning from Nepal (5, 8, 9). To explain the higher incidence of paratyphoid in returned travellers, authors of a Swedish study of enteric fever (typhoid fever or paratyphoid fever) surmised that travellers are more likely to be exposed to food from street vendors infected by *S*. Paratyphi than to persons carrying *S*. Typhi (10). Imported foods have also been associated with outbreaks of typhoid (11).

Incubation period

Typhoid - Ranges from three days to more than 60 days (depending on infective dose and host factors), but is typically eight to 14 days.

Paratyphoid - The incubation period for *S.* Paratyphi is thought to be shorter than for typhoid, usually one-10 days (6). However surveillance data suggests that the incubation period for paratyphoid can be just as long as for typhoid (50).The inoculum size and the type of vehicle in which the organisms are ingested, greatly influence both the incubation period and the attack rate (12). The infective dose for paratyphoid is higher than for typhoid (13).

Infectious period

Typhoid - The infectious period lasts as long as the bacteria are present in excreta, usually from the first week of illness and throughout convalescence. Left untreated, about 10% of typhoid fever patients will discharge *S.* Typhi for three months after the onset of symptoms (6) and 3-5% become chronic carriers (6, 14, 15). Chronic carriage may occur with or without the case ever having an acute illness. This chronic carrier state, defined as shedding the organism for more than one year, may last for many years and is more common in females, the elderly and in patients with gallstones (16, 17). Some cases have been shown to be infectious in an asymptomatic period prior to developing acute illness. Concurrent schistosomiasis and kidney stones are associated with chronic urinary carriage (6, 15).

Paratyphoid - There is less published literature on the excretion of *S*. Paratyphi but it appears that excretion is similar to most other salmonellae: most people will excrete it for 5-6 weeks whilst a small minority may continue excreting for months or even years. Prolonged biliary excretion applies in some cases, as in typhoid (7).

Clinical presentation and outcome

Typhoid – The clinical picture of typhoid can vary from asymptomatic to mild illness with low-grade fever to severe systemic disease. Age, strain virulence, infectious dose, delay before treatment, host factors (e.g. HLA type, AIDS or other immunosuppression), medication which diminishes gastric acid secretion or other causes of gastric achlorhydria, and previous vaccination, all influence the severity of disease expression (12, 18).

Presenting symptoms are typically insidious in onset and include: fever, marked headache, and malaise (6, 19). Other symptoms and signs that present in some patients include: anorexia,

abdominal pain, splenomegaly, constipation, diarrhoea, relative bradycardia, non-productive cough and rose spots (clusters of pink macules on the trunk) (20).

Without antibiotic therapy, the illness may last for 3-4 weeks. After beginning antibiotics, symptoms typically abate within four days to a week. However, relapses with milder symptoms occur 2-3 weeks after the initial fever resolves in 5 to 20% of patients, depending on the antimicrobial agent used (6). The case-fatality rate is estimated to be less than 1% with prompt antibiotic treatment (21).

Incomplete immunity follows recovery from clinical disease, inapparent infection and active immunisation (6), however, infection-derived immunity has been shown to be significantly less protective, than that induced by effective vaccination (22).

Chronic carriers form a crucial reservoir for the further spread of the disease through bacterial shedding in faeces and urine. Chronic *S*. Typhi infections can persist for decades, and although infected individuals are contagious, they are typically asymptomatic, making the identification of carriers difficult (16, 23). Approximately 25% of carriers experience no clinical manifestations during the acute phase of the disease (17). Approximately 90% of chronically-infected carriers have gallstones (16).

Depending on the clinical setting and the quality of available medical care, up to 10% of typhoid patients may develop atypical signs and serious complications (12), typically in the third week of disease. These include: intestinal perforation, hepatitis, renal failure, osteomyelitis, myocarditis, psychosis, cholecystitis, meningitis, encephalomyelitis, cranial or peripheral neuritis, Guillain-Barré syndrome, haemorrhages (causing rapid death in some patients), isolated arthralgias, severe jaundice, disseminated intravascular coagulation, thrombocytopaenia, gallbladder and hepatobiliary carcinoma, and haemolytic uraemic syndrome and pneumonia (14, 24), (12, 20, 25).

Paratyphoid - Paratyphoid is clinically similar to typhoid but tends to have a more benign course(26). Relapses may occur in anywhere between 3 to 9% of cases (6, 15). The case fatality rate is estimated at approximately 0.5% (26).

Complications typically arise in the third week (15) and have been reported in 10% to 15% of cases in the United States. Meningitis, endocarditis, hepatic abscess, osteomyelitis and psoas abscess, gallbladder cancer and pancytopenia have been associated with infection (1).

Persons at increased risk of disease

Susceptibility is general, but cases in endemic areas occur mainly in pre-school children and those aged from 5-19 years. Infection risk is also increased in individuals who travel to endemic areas and those with gastric achlorhydria (6).

Travellers who return to their countries of origin, where enteric fever is endemic, to visit friends and relatives, are an identified risk group for contracting typhoid and paratyphoid (27, 28). A six-month review of typhoid and paratyphoid cases in New South Wales, showed that 85% were travellers returning from overseas after visiting friends and relatives. None of these travellers were vaccinated prior to travel (28). Similarly, in the United States of America (USA) and United Kingdom (UK), travellers returning from visiting friends and relatives accounted for the majority of enteric fever cases (29, 30).

Disease occurrence and public health significance

Enteric fever remains an important public-health problem, particularly in endemic regions (including Asia, the Middle East, Africa, Latin America and the Pacific Islands). In these regions, morbidity and mortality are increasing with the emergence and worldwide spread of *S*. Typhi and *S.* Paratyphi strains that are resistant to most previously-useful antibiotics (31). The real impact is difficult to estimate because the clinical picture is often confused with that of other febrile infections.

Additionally, incidence of the disease is underestimated because there are no bacteriology laboratories in most areas of developing countries (12).

In 2010, typhoid fever incidence rates ranged from <0.1 cases per 100,000 population in Central and Eastern Europe and Central Asia, to 724.6 cases per 100,000 population in Sub-Saharan Africa. In the same year, paratyphoid incidence rates ranged from 0.8 cases per 100,000 population in North Africa/Middle East to 77.4 cases per 100,000 population in Sub-Saharan Africa and South Asia (26). In 2010, enteric fever was responsible for an estimated 190,000 deaths and more than 12.2 million disability-adjusted life years (32, 33).

Locally-acquired cases of typhoid and paratyphoid in Australia are uncommon, with the vast majority of cases sporadic, and associated with international travel to endemic countries (34, 35). Outbreaks or clusters of cases in Australia are rare. In 2014, 92% of notified cases were known to have been acquired overseas (35).

There were 116 cases of typhoid fever notified in Australia in 2015 (0.5 cases per 100,000 population). The five- year mean from 2011 to 2015 was 129 cases, compared to the five- year mean for the previous five years of 96.8 cases. Typhoid fever was most frequently notified amongst younger adults (57 cases in those aged 20 to 34 years) in 2015 (35, 36).

There were 55 cases of paratyphoid fever notified in Australia in 2015 (0.2 cases per 100,000 population). Paratyphoid fever was most frequently notified amongst younger adults (29 cases in those aged 20 to 34 years).

S. Typhi is believed to be the dominant cause of enteric fever in most endemic countries, but the proportion of infections attributed to S. Paratyphi A has been increasing in Asia, especially India and China (37, 38). A greater number of cases of enteric fever in travellers returning to the UK and Sweden were reported to be caused by *S*. Paratyphi, compared to *S*. Typhi (10, 20, 27). However, this trend has not been reported in Australia (28).

3. Routine prevention activities

- Educate the general public about safe food preparation and personal hygiene measures to prevent the spread of infections. Emphasise hand washing as a routine practice after visiting the toilet and before preparing, serving or eating food.
- Ensure suitable hand-washing facilities are available for food handlers and people caring for patients and children.
- Vaccination (see below) does not offer full protection from typhoid and is not available for paratyphoid.
- Travellers to endemic regions where food hygiene may be suboptimal and drinking water may not be adequately treated, should further be advised to avoid the following: raw (or undercooked) shellfish, salads, cold meats, untreated water and ice (in drinks) and food sold by street vendors.

Vaccination

A vaccine is only available for typhoid fever. Typhoid vaccination is not routinely recommended in non-endemic countries such as Australia. Vaccination is recommended for:

- children aged ≥2 years* and adults travelling to endemic regions, where food hygiene may be suboptimal and drinking water may not be adequately treated; or travelling to endemic regions to visit friends and relatives;
- military personnel;
- laboratory personnel routinely working with *S*. Typhi.

*Oral live attenuated vaccine is not recommended for use in children aged <6 years.

Travellers visiting friends and relatives in countries where typhoid is endemic should be encouraged to be vaccinated prior to travel and doctors providing travel advice to such travellers should be reminded to promote vaccination for this group. A list of endemic countries is available from the International Association for Medical Assistance to Travellers web site (https://www.iamat.org/risks/typhoid-fever).

For further information on vaccination, see the current edition of *The Australian Immunisation Handbook:*
*(*http://www.immunise.health.gov.au/internet/immunise/publishing.nsf/Content/Handbook10-home~handbook10part4~handbook10-4-21).

4. Surveillance objectives

To reduce the transmission of enteric fever within Australia by allowing:

- prompt identification of the source of infection of diagnosed cases;
- assurance of adequate exclusion and treatment of cases;
- investigation and management of contacts; and
- identification and mitigation of local sources.

To monitor the epidemiology of the disease in order to better inform prevention strategies.

To evaluate the effectiveness of public-health programs and other interventions to reduce infection.

5. Data management

Laboratory definitive evidence of a new case of typhoid or paratyphoid infection should be notified to the local public health unit (PHU) [and entered onto the NSW Notifiable Conditions Information Management System (NCIMS)] within one working day. Notifications are made by doctors and laboratories to [NSW PHUs] under the provisions of the [NSW Public health Act 2010].

Enter faecal clearance results, where applicable, onto [NCIMS].

For data recording purposes, a case should be counted as a second episode of disease only when a distinctly-different strain of *S.* Typhi/Paratyphi has been reported in patients who have previously resolved typhoid/paratyphoid*.* This is to differentiate a new case with a relapse of primary infection in a resolved case who has become reinfected. A new infection can occur following recovery from typhoid/paratyphoid as acquired immunity following clearance of a primary infection with antibiotic treatment is insufficient to prevent reinfection (39).

6. Communications

Pathology laboratories notify the [local PHU] on microbiological confirmation of a case of *S*. Typhi or *S*. Paratyphi, by telephone, facsimile, or electronic means. A PHU staff member investigates the case and records case details in [NCIMS]. On completion of the investigation of a confirmed case, the PHU should prepare a report for CDB. The report should include: the patient's age, sex, date of onset, laboratory status, travel status, possible sources of infection, other people thought to be at risk, and follow-up action taken [CDonCall template].

If the case is a resident of another Australian state or territory, the CDB will refer the case for investigation to the appropriate CDB in that jurisdiction. Similarly, if a contact of a case (Section 11. Contact management) is a resident of another Australian state or territory, the CDB will coordinate contact follow-up with the CDB in that jurisdiction.

Cases of locally-acquired enteric fever infection should be investigated locally and reported to OzFoodNet to assist with detection of a widely-distributed outbreak within Australia.

[Enteric oncall]should be advised immediately if an outbreak (two or more locally-acquired cases not resulting from transmission within a household), is suspected. [Enteric oncall will notify CDB manager, who will inform] CDNA. CDNA and OzFoodNet will coordinate investigations if a multi-jurisdictional outbreak of typhoid or paratyphoid fever is detected. CDB may need to inform a range of other agencies in the event of a potential outbreak of typhoid or paratyphoid, including the: [NSW] Food Authority [NSWFA]; local government health authority; Coroner (if a death occurs as part of an outbreak); and Commonwealth Department of Health through HealthOps.

7. Case definition

Typhoid

Reporting

Only **confirmed cases** should be notified.

Confirmed case

A confirmed case requires **Laboratory definitive evidence** only.

Laboratory definitive evidence

Isolation or detection of *Salmonella* Typhi.

Paratyphoid

Reporting

Only **confirmed cases** should be notified.

Confirmed case

A confirmed case requires **Laboratory definitive evidence** only.

Laboratory definitive evidence

Isolation or detection of *Salmonella* Paratyphi A or *S.* Paratyphi B (excluding *S.* Paratyphi B biovar Java) or *S.* Paratyphi C.

Case definitions can be found on the Department of Health's website (http://www.health.gov.au/casedefinitions).

8. Laboratory testing

Definitive diagnosis of typhoid or paratyphoid fever is by culture of the organism from blood, faeces, bone marrow or urine. The causal organisms can be isolated from blood early in the disease and from urine and faeces after the first week (7). The sensitivity of blood culture ranges from 45 to 70% for *S.* Typhi (40). A large volume of blood and early collection of samples from patients improves sensitivity (21). Culture of bone marrow aspirate is more sensitive than blood culture and is of value in patients who have commenced treatment (6), who have a long history of illness and for whom there has been a negative blood culture with the recommended volume of blood, where the diagnosis is still being considered. Sampling of marrow is not often performed because it requires skill and specialised equipment, and it is an invasive procedure (41).

Faecal culture is not usually positive during the early phase of the disease. The sensitivity of faecal culture increases with the duration of the illness. However, bacterial shedding in faeces is irregular

and the sensitivity of faecal culture depends on the amount of faeces cultured and number of samples tested. Antigen excretion in urine is intermittent and the sensitivity of urine culture is less than 1% (21).

Antibiotic resistance among *S*. Typhi and *S*. Paratyphi isolates is increasing in many endemic countries (7), and multidrug-resistant strains have been isolated, as well as isolates with poor susceptibility to fluoroquinolones. *In vitro* susceptibility should be determined for all cultured strains, to guide antimicrobial treatment.

Differentiation of *S*. Paratyphi B from *S*. Paratyphi B biovar Java requires special laboratory testing. This testing is important because *S.* Paratyphi B biovar Java causes a typical *Salmonella* gastroenteritis instead of enteric fever (42) and may not require the same public-health follow-up.

Serology is of little use for public-health management and is not recommended routinely (7). Serological testing may occasionally be useful in cases in whose cultures are negative (because of delays in diagnosis or treatment). *Salmonella* O-agglutination (Widal) titres of >200 in unvaccinated individuals, are associated with infection with *S*. Typhi; however this test has low sensitivity and is no longer widely performed. Newer serologic assays for *S.* Typhi infection are occasionally used in outbreak situations and are more sensitive and specific than the Widal test, but are not an adequate substitute for blood, stool, urine or bone marrow culture (21). Note that serology results in the absence of positive culture do not meet the case definition of a laboratory-confirmed case.

Food and water samples may also be sent for culture in the event of a suspected outbreak.

Refer to Public Health Laboratory Network (PHLN) laboratory case definitions website for more detailed information on tests.

9. Case management

Response times

Begin the follow-up investigation within one working day of notification of a confirmed case.

Response procedure

Public health follow up includes:

- identifying the likely country of acquisition and potential sources of exposure;
- liaising with the laboratory to ensure all isolates are retrieved, stored and fully characterised to determine potential relatedness and antibiotic sensitivity;
- preventing further spread of infection by:
    - ensuring appropriate public-health action is carried out in the event of high risk case/s or contact/s (see below for definition of ‘high risk’);
    - ensuring that each case is aware of appropriate hygiene precautions to prevent spread of infection.

Refer to Appendix 1: Case Investigation Check List for a Case Investigation Check List.

Case investigation

The response to a notification will normally be carried out in collaboration with the case’s doctor. Regardless of who does the follow-up, for confirmed cases, PHU staff should ensure that action has been taken to:

- find out if the case or relevant care-giver has been told the diagnosis and seek the doctor’s permission to contact the case or relevant care-giver (where possible) before beginning the interview;

- confirm results of relevant pathology tests;
- confirm the onset date and symptoms of the illness;
- determine the travel history and identify potential sources of infection;
- ensure appropriate investigations are undertaken to determine the source for cases who have not travelled overseas;
- ensure all relevant contacts who may have been exposed to the same source as the case, or to the infectious case, are alerted that they may develop symptoms;
- review case and contact management, ensuring relevant exclusions have been made;
- ensure infection control and other professionals are notified where appropriate.

[The Typhoid and Paratyphoid investigation form (add hyperlink) is available to assist in the case interview] Appendix 2.

Exposure Investigation

Each case should be assessed to decide if their illness is travel-related. As a general rule, cases who develop symptoms within 28 days after their return to Australia from an endemic country can be considered 'travel-related' (7). This 28-day timeframe should be used as a guide but should not be seen as prescriptive. Cases outside or at the upper limit of the 28-day period require an assessment of other possible sources and local professional judgement of likely source, based on the individual details of each case. If the case is non-travel–related and not explainable by household transmission, and food or water within Australia is suspected as the source of infection, the initial risk assessment should be conducted [involving the PHU, CBD, the NSWFA and any other relevant parties].

Information regarding history of exposures during the period 60 days before onset of illness (10 days for Paratyphoid) should be sought, including:

- household-type contacts who have had an illness consistent with enteric fever;
- restaurants and takeaway venues where the case has eaten or worked;
- travel by a household-type or other close contact to countries with endemic enteric fever;
- social gatherings where the case has eaten;
- attendance or employment at child-care services or in other care-giving industries (e.g. health-care workers, carers to elderly) by the case or household contacts;
- hospitalisation.

Case treatment

Treatment is the responsibility of the treating doctor. Refer to current *Therapeutic Guidelines: Antibiotics* (http://www.tg.org.au/). An infectious diseases physician should be consulted about treatment for chronic carriers.

Education

All cases should be informed about the nature of the infection and mode of transmission (refer to fact sheet for typhoid and paratyphoid at Appendix 3: [NSW Health Communicable Diseases] fact sheet for typhoid and paratyphoid fevers (enteric fever)). If the case is in an occupation with a higher risk of transmitting disease (see "Isolation and restriction" below), a letter can be provided for their workplace confirming exclusion from work or requesting reassignment of duties (see example letter at Appendix 4: Sample letters). A letter of clearance to return to work can also be provided where appropriate (see example letter at Appendix 4: Sample letters).

Isolation and restriction

Appendix 5: Public Health Management of cases of enteric fever flow diagram

Hospital care is often considered to be desirable during acute illness and enteric precautions should be taken while the case is ill (6). Mild cases with a good understanding of hygiene and who are compliant with taking medication, may be able to be treated at home (43).

Though there is limited evidence, the risk of transmission appears low where hygiene practices are good. However, the following groups are considered at higher risk of transmitting the disease because of occupational or personal characteristics:

- food handlers;
- health-care workers involved in direct patient care;
- carers of children below primary school age;
- carers of the elderly;
- children in pre-school, kindergarten or child care (i.e. below primary school age);
- those unable to maintain personal hygiene and their carers.

All cases should be excluded from work, school, child care and swimming pools until 48 hours after resolution of symptoms. All cases should be advised not to aid in feeding or preparing food for others until at least 48 hours after resolution of their symptoms.

Food handlers, carers of patients, carers of children, carers of the elderly, and carers of others who are not able to maintain their own personal hygiene, should further be excluded from working with food or caring for people until two consecutive stool specimens - collected at least 48 hours apart and the first specimen collected not sooner than 48 hours post cessation of antibiotics - are culture negative. This includes cases who are chronic carriers. They may return to work to undertake duties other than handling food or caring for people once they have been free of symptoms for 48 hours and are continent and are able to take adequate hygiene measures.

Children in pre-school, kindergarten or child care (i.e. below primary school age) and any case who is unable to maintain their own hygiene, should be isolated (i.e. stay at home) until two consecutive culture negative stool specimens collected at least 48 hours apart and the first not sooner than 48 hours post cessation of antibiotics are obtained. Children of primary-school age or above, can return to school once they are symptom free for 48 hours, provided they are continent and are able to take adequate hygiene measures.

For establishing clearance, urine samples must be collected (not sooner than 48 hours post cessation of antibiotics and until two consecutive negative samples at least 48 hours apart) in addition to stool samples if the case is considered at higher risk of transmitting the disease (see above) **and** originally had any of the following:

- a positive urine culture;
- concurrent schistosomiasis;
- a history of kidney stones.

Active case finding

If there is no history of any international travel, local sources of infection should be investigated.

In this situation, household-type contacts should be asked to provide stool samples even if asymptomatic and not in a group at higher risk of transmitting disease (11. Contact management). If these are negative, investigation should expand to question (and possibly request stool samples from) other contacts in an attempt to identify the source of infection for the case. Other people in contact with the case in the month prior to the onset of illness, their travel history, a history of previous typhoid-like illness and the likelihood of transmitting disease to the case based on the nature of contact, should be taken into account.

Food histories are generally only collected if the case is suspected to have acquired their illness locally and if there is no history of international travel for them and all of their household type and other contacts.

10. Environmental evaluation

Although *S*. Typhi and *S.* Paratyphi A are strictly adapted to humans, both serovars can remain viable in the environment, surviving in water and underlying sediment for days to weeks (44, 45).

Cases in non-endemic countries suspected to be locally acquired usually result from a chronic carrier who has contaminated food, as person-to-person transmission is unlikely. If the case is a food handler and has worked while infectious, the PHU should work with the relevant local government authority or jurisdictional food authority to conduct an environmental evaluation/risk assessment (see 12. Special Situations).

Where a food source is suspected on epidemiological grounds, contact [Enteric oncall] and the [NSWFA] to arrange an environmental evaluation.

11. Contact management

The aim of identifying contacts is to:

- alert them to the possibility that they could develop disease;
- detect asymptomatic carriers who are at higher risk of transmitting the infection to others, including those who work in a high risk setting;
- aid in identifying a source where the case has not acquired their infection overseas.

Definition of contacts

Contacts may be co-travellers or have had household-type contact with the case.

Co-traveller: someone who travelled with the case who shared accommodation and/or ate at least one meal with the case during the case's incubation period and is likely to have been exposed to the same source of infection as the case (rather than someone who merely travelled on the same bus/plane as the case). They may not necessarily live with the case.

Household-type: someone who, while the case was infectious:

- lives/stayed in the same household as the case (including a chronic carrier); and/or
- has shared a bathroom; and/or
- ate food prepared by the case.

Prophylaxis

Vaccination

Vaccination is recommended for household contacts of chronic typhoid carriers but not recommended for other contacts.

Antibiotics

Not recommended

Education

PHU staff should manage distribution of information in the form of a letter and/or fact sheet (see Appendices 3 and 4) or direct contacts to a jurisdictional website with this information. This can be done directly or through the treating doctor or other intermediary such as a child-care director.

All identifiable contacts should:

- receive information about the disease, mode of transmission and the importance of hygiene, in particular hand washing before eating and preparing food, and after going to the toilet;
- be advised to exclude themselves (see Isolation and restriction below) and present to their medical practitioner should symptoms develop within the month following contact with an infectious case or their own return from a typhoid/paratyphoid endemic area;
- be requested to make contact with the PHU should they become unwell.

Isolation and restriction

Appendix 6: Public Health Management of contacts of enteric fever flow diagram.

- Co-traveller and household-type contacts who belong to one of the groups considered at higher risk of transmitting infection because of occupational or personal characteristics, should be excluded from work, school, and child care until proof of 2 negative stool samples at least 24 hours apart. If feasible, they may undertake other duties (not high risk) while awaiting specimen results.
- Household-type contacts who *don't* belong to a group considered at higher risk for transmitting infection to others, but *where the case has **not** travelled to an endemic area*, should also provide 2 stool samples 24 hours apart. These contacts do not require exclusion.
- Other contacts do not need to be screened or excluded unless they become symptomatic.

12. Special situations

Case is a food handler and worked while infectious

If the case is a food handler and has worked while infectious, the PHU should work with the [NSWFA] and the [Enteric oncall] to conduct an environmental evaluation/risk assessment as part of a site visit to the food premises. Under the NSW Public health Act 2010, public health directors have legislative powers to issue public health orders to direct non-compliant individuals who have typhoid fever.

Other food handlers at the facility may be at risk of enteric fever if they ate food handled by the case or shared toilets or washing facilities with the case. If other staff are at risk, they should be counselled about the potential for infection and be advised that should they develop symptoms, they should exclude themselves from work and notify the PHU. If they develop symptoms, they should have stool/blood culture specimens collected and remain away from work until results are returned negative and they have been well for 48 hours. If they develop enteric fever, they will need to be managed as a case. Self-monitoring for symptoms in food handlers at risk of infection should continue for an incubation period (pragmatically 14 days) after exposure to the case.

The environmental evaluation/risk assessment should include reports from the food handler and his/her supervisor and co-workers about their duties, hygiene practices (glove use, hand hygiene), type of food preparation/handling undertaken by the case, evidence of hygiene training, and previous assessments of the sanitation practices in the facility.

Follow-up of patrons should be considered if:

- the food handler, while infectious, directly handled food that was not subsequently cooked prior to serving;

AND

- the food handler had diarrhoea or poor hygiene practices.

Public health actions in this situation should be guided by the risk assessment, but may include:

- taking no action with respect to patrons of the food premises;
- contacting patrons if booking lists are available;
- placing signs within the food premises;
- distributing information via media releases.

Going public

The following guidelines are designed to assist in deciding whether potentially-exposed patrons should be alerted via the news media. In applying these criteria and judging the risk of spread of infection, the PHU, together with food safety officers should:

- make every possible effort to obtain accurate information;
- exercise sound judgment about the accuracy of information received, especially the consistency of hygiene information received from different sources;
- consider the history of the facility's food inspections' records while under its current management;
- determine whether the manager has had food-safety training and applies it through employee training, supervision and hazard-control systems at the facility.

Good practices include that:

- management supervises and inspects food protection and food-handling practices of all shifts on a routine basis;
- training addresses personal hygiene and supervision of all food handlers' handwashing practices;
- management has established a routine means of evaluating employee performance such as through observing that all food handlers wash their hands on entering a food preparation area and after visiting a restroom;
- hand-washing facilities are checked frequently each day for adequate supplies and operation, and that records are kept;
- high-risk food-handling tasks are designed so that direct handling of food and cross-contamination are minimised;
- an effective management policy is in place for encouraging employees not to work with symptoms that could indicate a communicable disease (e.g. diarrhoea or vomiting), thereby encouraging employees to report illnesses to management.

High-risk food is defined as food that is handled and not subsequently cooked before consumption (e.g. salad ingredients, sandwiches, sushi, cake filling or icing, and sliced fruit).

General principles for decision-making

Generally, infectious food-handler situations fall into one of three categories.

1. Food handler has not handled any high-risk food

Notification of potentially-exposed patrons is rarely necessary.

2. Food handler handles high-risk foods, but facility manager has received food service safety training and uses a hazard control system

If the food handler has handled high-risk foods, but the facility manager can document receipt of approved training and implementation of an approved hazard-control system, public notification is usually not indicated, if all of the following conditions are met:

- no transmission within the facility to co-workers or to patrons has been documented;
- the record of inspections of the facility under present management indicates that both personal hygiene of food handlers and the facilities for food handlers to wash hands, have met inspection standards;
- inspection of the facility after identification of the case reveals that hand-washing facilities for employees are adequate;
- information obtained from the infected food handler, supervisor, and other reliable sources, indicates that the infected food handler followed good hand-washing practices;
- during their infectious period, the infected employee never had diarrhoea and/or did not handle high-risk foods on days when experiencing diarrhoea.

3. The food handler handles high-risk food, and the manager has not received training and/or does not have an approved hazard-control system

In this situation, notification of potentially-exposed patrons through the news media should be considered, especially if one or more of the following criteria are met:

- transmission within the facility to co-workers or patrons has already been documented;
- inspection of the facility after identification of the case reveals that hand-washing facilities for employees in the food preparation area or the employees' toilet facilities are inadequate (e.g. no soap, no disposable paper towels, no running water);
- one or more food handlers are not conforming to good hygiene practices (e.g. food handlers are not washing their hands on commencement of work or after using the toilet);
- the record of inspections of the facility under the present management indicates that food handlers' personal hygiene or facilities for food handlers to wash their hands, have been a problem two or more times during the previous two years;
- the infected employee, while potentially infectious, handled high-risk foods on days when experiencing diarrhoea;
- information obtained from the infected food handler, supervisor, or other reliable source, indicates that the infected food handler did not follow good hand-washing practices or failed to appropriately use gloves or utensils, (e.g. did not change gloves when food preparation was interrupted for a non-food preparation task).

Consult with CDB and departmental media units before going public. An expert panel may need to be convened to advise in difficult cases.

Case is a health-care worker, or carer of children or the elderly, and worked while infectious

Other staff and clientele at the facility may be at risk of enteric fever, depending on the activities of the case whilst infectious. Thus the PHU should undertake a risk assessment considering:

- activities/duties of the case whilst he/she was infectious;
- whether the case shared toilets or washing facilities with other staff/clientele;
- the case's hygiene practices.

If staff or clientele ate food handled by the case or shared toilets or washing facilities with the case, they may be at risk and should be counselled about the potential for infection. If at risk, clientele may be given a letter and factsheet (see Appendices 3 and 4).

The staff at risk should be advised to exclude themselves from work and notify the PHU should they develop symptoms. If they develop symptoms, they should have stool/blood culture specimens collected, and remain away from work until results are returned negative and they have been well for 48 hours. If they develop enteric fever, they will need to be managed as a case. Monitoring of symptoms should continue for an incubation period (pragmatically 14 days) after exposure to the case.

Outbreaks or clusters

An outbreak is defined as two or more geographically, temporally or epidemiologically-linked cases (that are not the result of intra-household transmission).

PHUs should immediately inform the Communicable Diseases Branch [via enteric oncall] if a typhoid or paratyphoid outbreak is suspected. Investigation of clusters or outbreaks of enteric infection that cross [State] jurisdictional borders, should include OzFoodNet and local food authorities. It is important that investigators recognise that an infection acquired in Australia may relate to a case being investigated by another PHU or state or territory, and if so, will require a coordinated response by OzFoodNet with oversight from the Communicable Diseases Network Australia.

Investigation of clusters of typhoid and paratyphoid cases usually involves an intensive search for other related cases and identification of the infection source including food, water, or a chronic carrier. Identifying sources of infection relies on microbiological testing of suspected carriers of infection, epidemiological studies, and trace back of possible food sources. Where an internationally-distributed food source is identified causing an outbreak, the Australian Department of Health may need to inform other countries through the International Health Regulations (2005) and other international food-regulatory networks.

Typhoid fever outbreaks caused by asymptomatic carriers are usually small, prolonged, and therefore difficult to detect by routine surveillance. In the USA between 1999 and 2010, 16 of 28 outbreaks were linked to a confirmed or suspected carrier; two were linked to contaminated food, and five occurred in household contacts with an unknown source (46).

Typhoid and paratyphoid clusters and outbreaks in Australia are uncommon. The last major typhoid outbreak occurred in Victoria in 1977 with 37 cases, associated with a food handler who was a chronic carrier (47). More recently: a multi-jurisdictional outbreak of 12 cases of typhoid was investigated in 1999 relating to people travelling on a cruise ship and visiting the Kokoda Track (48); four locally-acquired cases residing in the same geographic area of Melbourne were identified in 2009 but no source was identified; and a family-associated cluster occurred in Sydney in 2013 (49).

Chronic carriers

Definition

An asymptomatic person who sheds *S.* Typhi or *S.* Paratyphi for more than 12 months.

Treatment

The patient should be referred to an infectious disease physician.

Investigation

Manage chronic carriers the same as others with a positive specimen (Section 9. Case management).

Contacts of chronic carriers

All household and household-type contacts of chronic carriers should be:

- given hygiene advice, information about symptoms and advised to exclude themselves and seek investigation should symptoms occur;
- recommended vaccination against typhoid.

Household contacts of chronic carriers who are considered at higher risk for transmitting infection to others should also:

- be screened at the time of notification of the case as per Isolation and restriction;
- have reinforced the need for scrupulous hygiene both within the household and at work until the case is non-infectious.

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14. Appendices

Appendix 1: Case Investigation Check List

Appendix 2: Typhoid and Paratyphoid Investigation form

Appendix 3: Sample fact sheet for typhoid and paratyphoid fevers (enteric fever)

Appendix 4: Sample letters

Appendix 5: Public Health Management of cases of enteric fever flow diagram

Appendix 6: Public Health Management of contacts of enteric fever flow diagram

Appendix 1: Case Investigation Check List

Contact the patient's doctor to:

- Obtain patient's history, particularly about overseas travel;
- Confirm results of relevant laboratory tests;
- Confirm what treatment the patient has been given and its duration;
- Seek the doctor's permission to contact the case or relevant care-giver (where possible).

Contact the case to:

- Confirm onset date and symptoms of the illness;
- Complete Appendix 2: Typhoid and Paratyphoid Investigation form;
- Provide a Appendix 3: [NSW] fact sheet for typhoid and paratyphoid fevers (enteric fever);
- Investigate the likely source of infection;
- Recommend exclusions and restrictions as appropriate;
- Recommend and arrange faeces/urine clearance specimens as appropriate;
- Identify contacts and obtain contact details;
- Review vaccination status.

Contact the case's contacts to:

- Enquire as to symptoms and recommend and arrange testing as appropriate;
- Recommend and arrange screening faeces specimens as appropriate;
- Recommend exclusions and restrictions as appropriate;
- Provide with [NSW] *Typhoid and Paratyphoid Disease Factsheet.*

Other issues:

- [Attach] *Case Investigation Form* [to NCIMS record];
- For a death, report details to[CBD via Enteric oncall];
- Enter case data onto [NCIMS];
- Ensure case isolates are forwarded to the appropriate Public Health Microbiology Laboratory for further typing;
- Assess the possibility of a common source outbreak if there is a cluster of cases;
- Maintain surveillance for further cases;
- Further investigate the source of infection if case has not travelled overseas;
- Ensure appropriate investigations are undertaken to determine the source of infection for cases who haven't travelled overseas – consider household contacts, food and water as potential sources;
- If a food source is suspected/identified, inform [Enteric oncall and NSWFA];
- Ensure all relevant contacts who may have been exposed to the same source as the case are alerted that they may develop symptoms;
- Ensure relevant clearance, screening and exclusions have been made.

Appendix 2: Typhoid and Paratyphoid Investigation form

Typhoid and Paratyphoid investigation form can be accessed via the Typhoid and Paratyphoid Fevers SoNG webpage (www.health.gov.au/internet/main/publishing.nsf/Content/cdna-song-typhoid-paratyphoid.htm).

Appendix 3: NSW Health Fact sheet for typhoid and paratyphoid fevers (enteric fever)

What is typhoid and paratyphoid fever?

Typhoid fever is a disease caused by the bacteria *Salmonella* Typhi. Paratyphoid fever is a disease caused by the bacteria *Salmonella* Paratyphi. These diseases cause a similar illness. Paratyphoid infections tend to be less severe and less common than typhoid. These diseases are rare in Australia and are often grouped together and called 'enteric fever'

In Australia, most typhoid and paratyphoid infections are acquired overseas by individuals eating contaminated food or water in developing countries while visiting friends and relatives or travelling. These infections are different to infection with *Salmonella* which usually causes gastroenteritis.

What are the symptoms?

People with enteric fever may experience mild or severe symptoms. The symptoms may include:

- prolonged fever;
- sweating;
- severe headache;
- feeling generally unwell;
- abdominal pains;
- diarrhoea or constipation;
- lack of appetite and weight loss.

The onset of symptoms is usually slow, gradually worsening over about three or four days. Untreated, the illness can be fatal. Most people recover fully over several weeks with appropriate treatment; symptoms usually clearing within a week. A few people, despite having no symptoms of illness, continue to have bacteria in their faeces and/or urine for more than a year (chronic carriers), and can infect others.

The time from contact with the typhoid bacteria to the start of symptoms (incubation period) is usually 8-14 days but can be as early as 3 days or as late as 60 days after infection. The incubation period for paratyphoid is shorter than for typhoid, usually 1-10 days.

How is it spread?

The bacteria that cause typhoid and paratyphoid fever are found in the faeces of infected individuals and sometimes in their urine. Some people (known as carriers) continue to carry the bacteria even after symptoms have resolved. Transmission usually occurs when faecally-contaminated food and water are ingested. Therefore, typhoid fever is more common in less developed countries with poor sanitation, poor hand hygiene and food handling standards, and untreated drinking water. Raw fruits and vegetables and shellfish are the types of foods most often associated with illness. Flies may transfer the bacteria to food.

Who is at risk?

Typhoid fever is widespread in most parts of the world except for the developed regions. In Australia, enteric fever almost always occur in people who travel to areas where enteric fever is common. Immigrants who return to developing countries (in particular India, Pakistan and Bangladesh) to visit friends and relatives are at greatest risk of acquiring the disease.
People who have travelled or live with an infected person will be screened for typhoid fever by

their local public health unit. Household contacts, or people who have travelled with a person infected with typhoid, will be screened for typhoid by their local public health unit. Contacts should be aware of the symptoms of typhoid and should see their general practitioner if they develop symptoms.

How is it prevented?

People travelling to countries where typhoid and paratyphoid fever are common should:

- wash hands thoroughly with soap and water after going to the toilet and before eating
- avoid uncooked foods, including fruit and vegetables unless you are able to be peel them yourself
- drink bottled or boiled water (even when brushing teeth);
- not drink untreated water, including ice and drinks mixed with water
- avoid eating from street stalls
- ensure hot food is thoroughly cooked and eaten whilst hot.

Typhoid vaccination is recommended for all travellers two years of age and older going to endemic regions where food hygiene may be suboptimal and drinking water may not be adequately treated. Unfortunately, there is no vaccination available for paratyphoid.

People infected with typhoid or paratyphoid fever, or who share a house with someone infected with typhoid, MUST NOT work if their work involves food handling or caring for children, patients or the elderly, and should not prepare food for others until stool samples have shown that they are not infectious. A number of stool tests will be required to assess when you are no longer infected. Your local public health unit will advise you when are able to return to work.

How is it diagnosed?

To diagnose typhoid or paratyphoid, your general practitioner or local hospital will send a blood or stool (faeces) sample to a laboratory for testing.

How is it treated?

Enteric fever is treated with antibiotics. Antibiotic treatment is required to treat carriers also. If symptoms are severe, hospitalisation may be needed.

What is the public health response?

- Doctors, hospitals and laboratories must notify cases of typhoid or paratyphoid fever to the local public health unit.
- Public health unit staff will interview the doctor or patient (or carers) to find out how the infection occurred.
- The NSW Food Authority, in collaboration with NSW Health, is responsible for the environmental investigation of food handlers with typhoid or paratyphoid fever.
- Your local public health unit can provided further advice regarding exclusions from work and school. People excluded from work will need to have a number of stool tests done before they are allowed to return to work.

For further information please call your local Public Health Unit on 1300 066 055 or visit the New South Wales Health website www.health.nsw.gov.au

Appendix 4: Sample letters

A. Contacts

<Date>

Dear < >

The <Public Health Unit/CDB/Chief Health Officer> has been advised that you have been in close contact with a person with <typhoid/paratyphoid> infection. There is a fact sheet with this letter which has more information about the illness and advice on how you can protect yourself.

<Typhoid/paratyphoid> infection usually causes a high fever for several days, with headaches, general pains, stomach upset or diarrhoea. If you develop these symptoms in the next month, please get medical attention immediately and show this letter to your doctor.

A good way to prevent illnesses such as <typhoid/paratyphoid> is to wash your hands carefully before preparing and eating food or drinks and after using the toilet. People who are ill or who take care of others who are ill (such as helping with toileting or changing nappies) should be very careful with hand hygiene. Young children may need an adult to help them wash their hands.

If you have any questions, please contact the < Public Health Unit/CDB/Chief Health Officer>.

Sincerely,

B. Letter to employer: Exclusion of an employee who is a confirmed case

<Date>

Dear <Employer Name>

RE: EXCLUSION OF EMPLOYEE – <Name>

As authorised by the <Public Health Act>, and in order to protect the public's health, your employee , <name>, has been advised to stay away from work involving <list of duties to be specified by the Public Health Unit>, because <he/she> has a communicable disease that can be spread to others through preparation of food and drink and direct contact with other people. <Name> has been given both verbal and written information about the criteria that must be met before returning to work. When the necessary criteria are met, the public/environmental health officer will provide you and <name> with a letter from this office, advising him/her that it is safe to return to work.

In the meantime, if he/she is well enough to work, it may be possible for him/her to carry out some duties that will not create a risk to public health. You must have medical health officer approval for this. See contact details below. Please note that <name> may only be cleared to return to work by a medical officer from the Public Health Unit. A letter from your employee's physician to you or your employee will not clear your employee to return to work. If you have any questions, please contact the Public Health Unit <number>.

Sincerely,

cc. Case at last known address.

C. Letter of clearance to return to work

<Date>

Dear <Employer Name>

RE: RETURN TO WORK OF EMPLOYEE – <Name>

Your employee, <name>, has now met the required public health criteria for clearance in relation to a communicable disease that can be spread to others through preparation of food and drink. They are now safe to return to work.

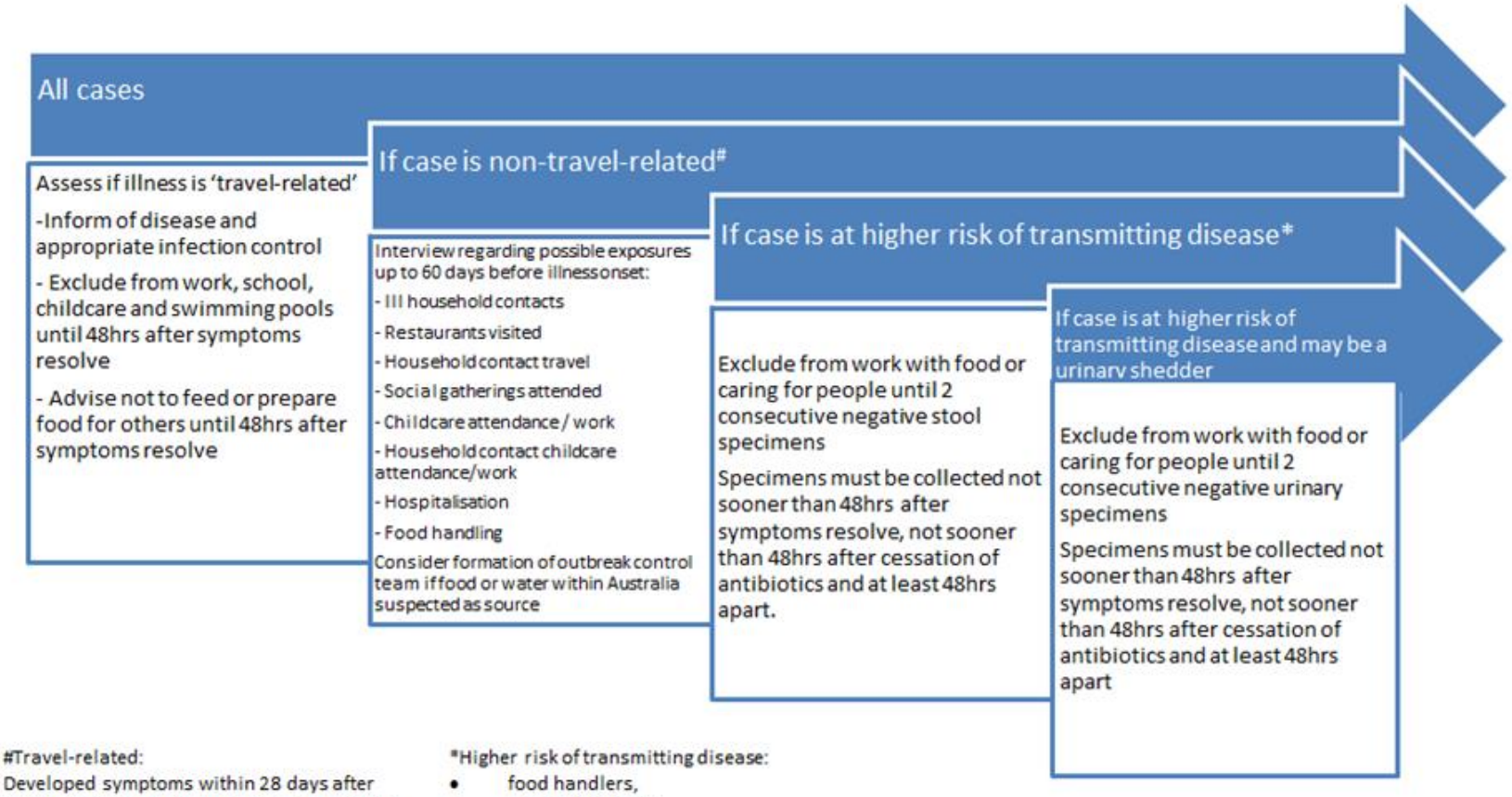
If you have any questions, please contact the Public Health Unit <number>.

Sincerely,

<Medical Officer>

<Public Health Unit>

Appendix 5: Public Health Management of cases of enteric fever flow diagram



#Travel-related:
Developed symptoms within 28 days after return to Australia from an endemic country (cases outside 28 day window require further assessment of source but may still be travel related).

*Higher risk of transmitting disease:

- food handlers,
- carers of patients,
- carers of children,
- carers of the elderly,
- children in pre-school, kindergarten or child care (ie below primary school age)
- those unable to maintain personal hygiene and their carers.

Appendix 6: Public Health Management of contacts of enteric fever flow diagram