



衛生防護中心
Centre for Health Protection

Scientific Committee on Emerging and Zoonotic Diseases

Streptococcus suis infection in Hong Kong

Purpose

This paper presents the local epidemiology of *Streptococcus suis* infection in human.

Background

2. *Streptococcus suis* is an important bacterial pathogen of pigs, and is endemic in most pig-rearing countries.¹ Infection in pigs is usually asymptomatic but it can also cause a range of diseases including arthritis, meningitis, pneumonia, septicaemia, endocarditis, polyserositis, abortions and abscesses.² It has also been found in wild boars, horses, dogs and cats.³⁻⁶

3. *S. suis* is a known zoonotic agent. People in close contact with pigs or raw pig products are potentially at risk. Individuals who are immunosuppressed or asplenic are at increased risk. Transmission to humans is most likely to occur through wounds on the skin, including minor abrasions.⁷ The incubation period has been reported to range from few hours to ten days, mostly within three days.^{8,9}

4. Human infection was first described in the 1960s.^{7,10} Meningitis, hearing loss, septicaemia, arthritis, pneumonia, endocarditis, endophthalmitis, toxic shock syndrome and death caused by *S. suis* have been reported.⁸⁻²⁰ Most reports in the literature were case series or reports of sporadic cases, but three outbreaks in the Mainland China have been reported, including two outbreaks in Jiangsu Province in



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1998 and 1999, and the outbreak in Sichuan Province this year.^{8,9,21,22} To date, the outbreak in Sichuan is the largest known outbreak of *S. suis* infection in human: 204 cases including 38 deaths were recorded between mid-June and early August 2005.²³

5. To date, at least 35 serotypes have been described.²⁴⁻²⁷ Serotypes 2, 9 and 1 are the most prevalent serotypes recovered from diseased pigs.²⁸ Four serotypes have been implicated in human infections: serotype 2 is the predominant serotype, and serotypes 1, 4 and 14 have been isolated in Croatia, the Netherlands and the United Kingdom respectively.^{1,16,29,30}

Local epidemiology

6. *S. suis* infection is an occupational disease specified in the Employees' Compensation Ordinance (Cap. 282). Six cases have been confirmed during 1995 – 2004 (Table 1).

Table 1. Number of S. suis infection cases confirmed as an occupational disease under the Employees' Compensation Ordinance in 1995 – 2004

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
No.	2	1	0	0	1	0	1	0	0	1

7. In view of the Sichuan outbreak identified in late July, Hong Kong has listed *Streptococcus suis* infection as a statutory notifiable infectious disease since 2 August 2005 to better understand the local epidemiology. Moreover, in collaboration with the Hospital Authority, the Centre for Health Protection has conducted a review of all laboratory confirmed cases of *S. suis* infection among patients admitted into public hospitals during the period from 1 January 2003 to 31 July 2005.

8. The retrospective study identified 21 cases, including one fatal case, during the 31-month period. [CHP, unpublished data] *S. suis* isolates from 15 cases were available for serotyping; they were identified to be serotype 2, and sensitive to penicillin but resistant to tetracycline. Main clinical presentations were meningitis (48%), septicaemia (38%) and endocarditis (14%). Hearing loss was a common complication among meningitic cases: unilateral or bilateral hearing loss was reported in six out of 10 cases. Among the 21 cases, the male to female ratio was 18:3. The age range of male patients and female patients were 26 – 89 and 67 – 83 respectively; and their median age was 53.5 and 81 respectively. Only 24% of cases had occupational exposure to pigs or raw pork. Two-thirds of cases reported no wound or skin lesion, and 52% reported no exposure to pigs or raw pork. The distribution of cases by month of onset is shown in Figures 1(a) and 1(b).

Figure 1(a). *S. suis* cases in 2003 – 2004, breakdown by month of onset

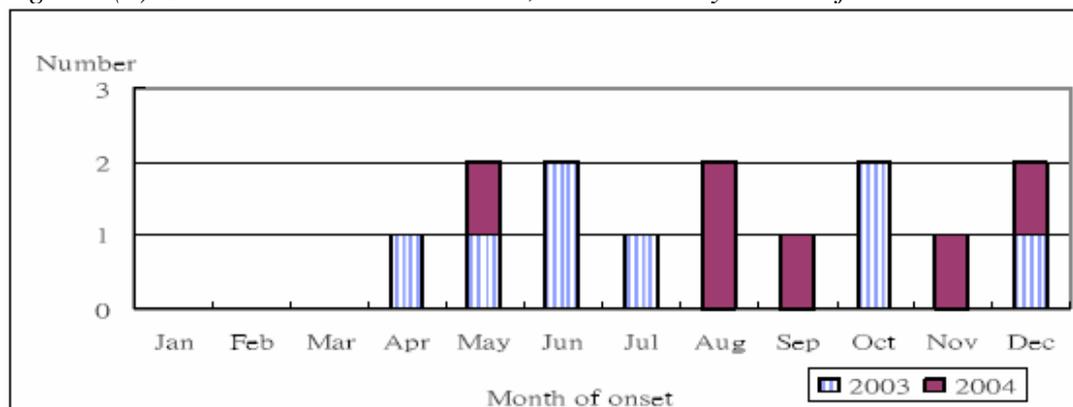
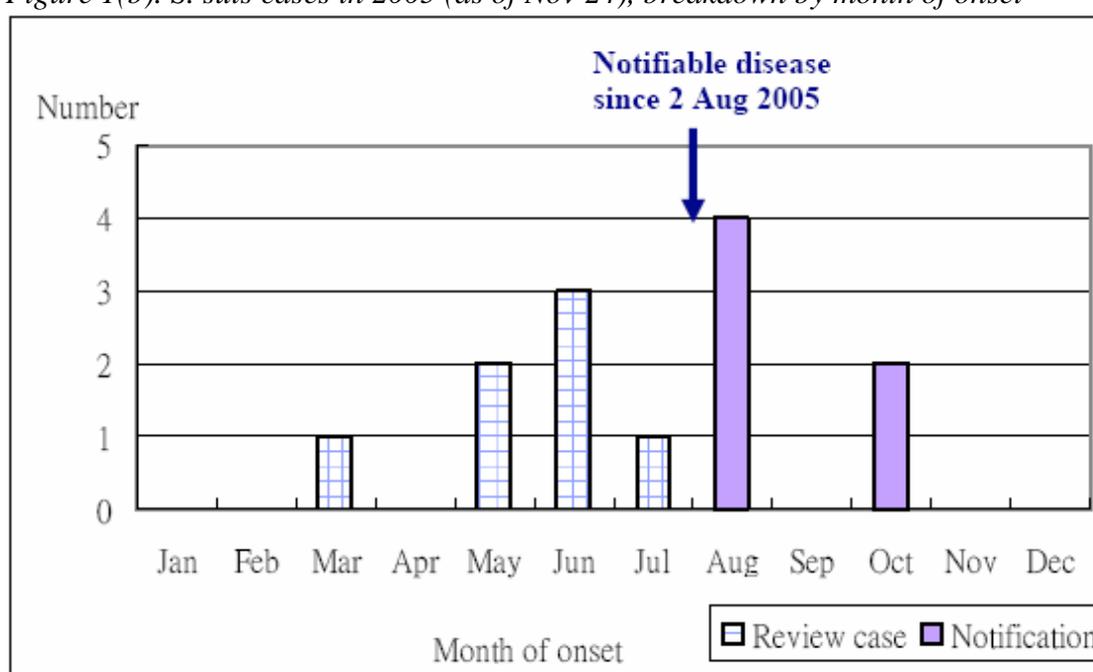


Figure 1(b). *S. suis* cases in 2005 (as of Nov 24), breakdown by month of onset



9. Since 2 August 2005, a total of six cases have been notified to CHP. [Figure 1(b)] All six isolates were serotype 2, and sensitive to penicillin but resistant to tetracycline. The sex ratio among the notified cases was 1:1. Two cases that developed toxic shock like syndrome died at one to 13 days after onset of illness. Three cases had recovered from septicaemia and were discharged from hospital at 11 to 14 days after onset of illness. The remaining case had a left paraspinal abscess and remained hospitalized. The latter case was afebrile and his chief complaints were several months of weight loss and low back pain with recent increase in severity. He used to be a butcher but has retired since early 2005. Two other cases had occupational exposure to raw pork. Although all six cases reported exposure to raw pork, two-thirds reported no wound or skin lesion.

Discussion

10. Based on the current local data, penicillins are the drugs of choice for treating disease caused by *S. suis*. The duration of treatment varies depending on the clinical response. Relapse cases have been reported in Hong Kong and Thailand, and required prolonged treatment.^{13,14} The treatment guidelines from Hospital Authority are shown in its Fact Sheet on *Streptococcus suis* infection. (Annex 1)

11. Deafness is a characteristic and serious complication of *S. suis* meningitis, and is likely to remain permanent. Unilateral or, more commonly, bilateral hearing loss has been documented in $\geq 50\%$ of cases in local and overseas case series.^{13,16} The time of onset of hearing loss varied from one to 14 days.^{13,14} Walsh B. et al, authors of a British case series on *S. suis* serotype 2 meningitis during 1975 – 1990, commented that administration of penicillin at an early stage did not appear to affect subsequent hearing loss.¹⁵ Kay R. et al, authors of a local case series on *S. suis* infection among inpatients of two hospitals during 1984 – 1993, suggested that corticosteroids be considered as an adjunctive treatment for *S. suis* meningitis since clinical trials had demonstrated that dexamethasone improved the auditory outcome of bacterial meningitis, at least in the variety commonly found in children.^{13,31}

12. Surveys have found 0% - 73% carriage of *S. suis* serotype 2 in the tonsils of apparently healthy pigs in various countries.³²⁻³⁶ *S. suis* serotype 2 has also been isolated from the reproductive and alimentary tracts of carrier pigs.^{32,37} One survey also found *S. suis* serotype 2 in the blood of 3% of apparently normal pigs slaughtered at a meat processing plant. The presence of this organism in edible tissue poses a risk to consumers and meat-workers.³²

13. In the Netherlands, the estimated annual risk of developing *S. suis* meningitis among abattoir workers and pig breeders was 3.0 per 100 000, that of butchers was 1.2 per 100 000. Reportedly, the risk among the abattoir workers and pig breeders was about 1500 times higher than the general population.¹⁶ In Germany, the nasopharyngeal carriage rate of *S. suis* in the high risk group, e.g. butchers, abattoir workers and meat processing employees, was 5.3% while none of those without contact with pigs or pork had a positive finding.³⁸ A New Zealand study revealed 9% of dairy farmers, 10% of meat inspectors and 21% of pig farmers were seropositive to *S. suis* serotype 2, indicating the presence of some human subclinical infections.³⁹

14. European case series identified occupational exposure in a high proportion of *S. suis* meningitis cases (over 80%).^{15,16} Previous local case series also identified occupational exposure in over 60% of cases.¹¹⁻¹³ However, less than 30% among the 21 local cases in the retrospective review had occupational exposure to pigs or raw pork; this finding was similar to that from a Thai case series.¹⁴ Apart from a lower proportion of cases with occupational

exposures, a history of wound or skin lesion in the preceding two weeks was not very common among local cases. Of the cases notified since 2 August 2005, two-thirds (4/6) reported no wound or skin lesion in the preceding two weeks.

15. The three reported outbreaks in the Mainland were associated with occurrences of dead or sick pigs; and in two of them, it has been documented that the swine outbreak preceded the human outbreak^{8,9,23} The great majority of cases had contact with dead or sick pigs. Control measures in these outbreaks included surveillance, health education, prohibition of slaughter or sale of dead or sick pigs, administration of prophylactic antibiotics to exposed pigs in the herd, and pig vaccination.²³ Prophylactic antibiotic use among human has not been reported in these outbreaks.

16. In Hong Kong, cases of *S. suis* infection have been detected in most years since the 1980s.^{11-13,40} The number of cases reported in 2005 was higher than that identified in public hospitals in 2003 or 2004. There also seem to be differences in the characteristics of the notified cases compared with the cases in the retrospective study. At this point, it is difficult to tell whether these changes are real or apparent, since the disease has been made statutory notifiable in Hong Kong amidst the heightened awareness generated by the Sichuan outbreak, and notification data have been collected for just over three months.

Prevention

17. Vaccines are available for pigs but their efficacy is not firmly established.⁷ There is no human vaccine.¹ Prevention of the disease in humans depends upon the control in pig populations.⁷

18. Pork is one of the main meat sources in Hong Kong. Although sick pigs found in slaughterhouse are condemned and will not enter the market, there is no reliable means for identifying a pig infected with *S. suis* in slaughterhouse. Therefore, any pig should be considered as a potential carrier and systematic preventive measures are required in the slaughterhouse and pig-related industry. Awareness should also be extended to everyone who prepares and cooks pork. Use of gloves appropriate to the handling process and proper cover for existing wounds are recommended. Immediate cleansing/disinfection of any cuts during the handling process should also be emphasized. Recommendations on good hygiene practice are available at the websites of the Food and Environmental Hygiene Department and the World Health Organization.^{41,42} (Annexes 2 and 3)

19. Proper cooking (temperatures at or above 70°C in all parts of the product) kills *S. suis*.⁴² Pork and other parts of pigs should be properly cooked before consumption.

Advice sought

20. Members are invited to provide comments and advice on the prevention and control of *S. suis* infection in Hong Kong.

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1. Title

Fact sheet on *Streptococcus suis* infection

2. Infectious Agent

Streptococcus suis is a common infection in pigs causing meningitis, septicaemia, pneumonia, and arthritis. Asymptomatic carriage at porcine palatine tonsils is common (80% in certain countries) and it spread among pigs by nose to nose contact or by aerosol over short distances. Occasionally it affects humans, causing meningitis, and it became a recognized zoonosis since 1968 when first reported in Denmark. *Streptococcus suis* serotype 2 is associated with the vast majority of human diseases.

3. Epidemiology

Over 100 cases of *S. suis* infection have been described previously, with a geographic distribution heavily biased towards Northern Europe and Southeast Asia, including Hong Kong, Thailand and Taiwan. Most cases are related to close contact with pigs or pork handling. The disease should be recognized as an occupational hazard to butchers, abattoir and meat-processing plant workers, cooks and pig farmers. No human to human transmission had been documented.

4. Pathogenesis

Pathogenic isolates of *S. suis* type 2 are capsulated and show resistance to phagocytosis. Meningitis occurs after a period of bacteremia when the organism invades the cerebrospinal fluid within monocytes. The commonest complication of sensorineural deafness is related to suppurative labyrinthitis. Brainstem auditory evoked potentials demonstrated loss of cochlear function. Other identified virulence factors included muramidase-released protein and suilysin. *S. suis* also stimulates the in-situ production of IL-6 and IL-8 in human brain microvascular endothelial cells, leading to specific adhesion and increased blood-brain barrier permeability.

5. Clinical features

S. suis type 2 meningitis predominantly affected males in Europe (up to 97%), while the male-to-female ratio in Hong Kong was reported to be 1.7:1. The mean age was 47-55 years (range 17-87 years). Most cases had relevant history of exposure. However, significant skin injury (inflicted 4-16 days prior to presentation) as portal of entry was only evident in 14-20% of cases. Majority (85%) of the cases had classical signs of meningitis with fever, neck

stiffness and photophobia ± unresponsiveness and confusion. Arthralgia is also common and can be a prodromal symptom 1-2 days prior to the onset of meningism. A striking feature of *S. suis* type 2 meningitis is a much higher reported incidence of high-tone deafness (up to 54-80% of cases) as compared to other causes of bacterial meningitis. It is usually evident within 24 hours of presentation (1-12 days; bilateral > unilateral). Vertigo and ataxia, which represents vestibular involvement, occurs in 30-50% of cases. Concurrent septic arthritis (mono- or poly-articular) occurs in 20-53% (including hip, elbow, wrist, sacroiliac, spine and thumb joints), which is another distinguishing feature of this disease. Cellulitis occurs in 21% of cases. Occasionally, patients present solely with arthritis and cellulitis in lower limbs, which are not associated with deafness. Bacteraemia, endocarditis, pneumonia, endophthalmitis, purpura fulminans and septic shock had also been reported. Case fatality rate was reported as high as 13%. Among the survivors, neurological sequelae including moderate to severe degree high-tone sensorineural deafness (50-67%) and vertigo/ataxia (30%) are common, and may become permanent

6. Diagnosis

Blood cultures are essential for all suspected cases, and so is CSF examination whenever indicated. Almost all cases of *S. suis* infections have positive blood cultures, and 71% also had positive CSF cultures. CSF is typically purulent with predominant neutrophil, and increased protein and depressed glucose levels. Gram stain may show large gram positive cocci in pairs or short chains. CSF and blood cultures show alpha- or beta-hemolytic colonies which are sensitive to penicillin on disc testing. There should be no reaction with standard streptococcal antisera (Lancefield Groups A, B, C, F or G). The diagnosis of *S. suis* type 2 is suggested biochemically by the API-20 STREP Identification Strip, and verified by group R, S and T antiserum. Occasionally, *S. bovis* can cause diagnostic confusion.

7. Treatment

S. suis is usually sensitive to penicillin (MIC ≤ 0.06mg/l), ampicillin, cephalothin, cotrimoxazole and vancomycin. Resistance to tetracycline, erythromycin, clindamycin and gentamicin had been reported. Intravenous benzyl-penicillin is the treatment of choice (12-24 megaunits/day) in *S. suis* meningitis. Prompt resolution of fever is expected in <48 hours following treatment. For cases of endocarditis or septicemia, a combination of penicillin and gentamicin can be used. A fulminant or relapse course of disease was reported among patients with splenectomy. Early administration of penicillin does not appear to reduce neurological sequelae, and corticosteroid use is controversial.

8. The Hong Kong Situation

The first case of *S. suis* meningitis in Hong Kong was reported in 1981. From 1981-1984, a total of 36 cases were identified, and was regarded as the most common form of bacterial meningitis at that time. According to a previous study in 1984-1993, the crude yearly incidence in Hong Kong was estimated to be 0.17 per 100,000 populations. About 70% of cases occurred during summer seasons (June-September). Apart from occupational exposure, cases involving housewives who handled pork from fresh meat markets had been identified.

9. Notification

- a. It is a **notifiable** occupational disease under the Occupational Safety and Health Ordinance and should be reported to the Labour Department. From 1994 to 2004, Labour Department reported 7 cases of occupation related infection. From May 2004 to April 2005, CHP received 5 reports of sporadic cases of Streptococcus suis infection (Diseases Watch, vol2, No9, weeks 17-18 (April 17-30, 2005)):
http://www.chp.gov.hk/files/pdf/grp-cdw_v2_09_en_20050504.pdf
- b. *Streptococcus suis* infection is gazetted as one of the notifiable diseases since 2nd August, 2005 which should be reported to CHP (see Annex 1 to HA Operations Circular No. 17/2005).

10. Prevention and Infection Control

The public should be advised to observe personal and environment hygiene and avoid contact with pigs that are sick. For persons with frequent contact with pigs or raw pork, they should use protective glove, wash hands after handling pigs and raw pork, cover any wounds and avoid injury while processing meat. Patients admitted to the hospital should be nursed with Standard Precautions. There is no vaccine available against *S. suis* meningitis.

11. References

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Safe Food & Public Health



Safety Tips on Handling Pork

The Ministry of Health in Mainland has recently reported an illness affecting farmers who have slaughtered pig or sheep in the Sichuan Province. The illness is initially found to be related to *Streptococcus suis* which is a common pathogen in pigs. Human infection by the bacterium has been reported occasionally worldwide as well as locally. The infection is often related to occupational exposure through wounds while handling infected pig carcasses.

The issue has been a concern of the local community as pork is one of the main meat source in Hong Kong. As pigs diagnosed of infection in slaughterhouse would be condemned and would not enter the food chain, the chance of contracting the bacteria is extremely small. Besides, the bacteria can be killed at a temperature of 75°C or above and for the consumers, the mainstay of control lies with thorough cooking.

As a general precautionary measure, people handling raw pork are advised to observe good personal, food and environmental hygiene at all times. The following safety tips are useful:

Purchase

- Do not buy obscure pork from unlicensed fresh provision shops and hawkers.
- Avoid touching raw pork directly when buying pork in the market.

Handling

- Cuts or wounds on hands should be properly covered by waterproof dressings or plastic gloves before handling raw pork.
- When handling raw pork (including fresh, chilled, frozen or thawed pork), avoid touching the face and other body parts. Thereafter, immediately wash hands thoroughly with soap or liquid cleanser.
- Surfaces, utensils and equipment that have been in contact with raw pork should be thoroughly cleansed.
- Use separate knives and chopping boards for raw foods (like uncooked pork) and ready-to-eat foods.
- Uncooked pork should be kept in well covered containers. It should be stored in the lower compartment of the refrigerator at a temperature of 4°C or below. Ready-to-eat food and cooked food should be kept in the upper compartment to prevent cross-contamination.
- Frozen pork should be stored at a temperature at or below -18°C.
- Frozen pork should be thawed in refrigerator at a temperature between 0°C and 4°C or inside a microwave oven. Thawed meat should be processed and cooked as soon as possible to reduce the chance of contamination.

- Wash the pork before cutting or mincing.

Consumption

- Pork should be cooked thoroughly before consumption, the central part of the pork should be maintained at 75°C or above for at least 15 seconds.
- If there are pinkish fluid running from the cooked pork or the middle part of the pork is still red in colour, the pork should be cooked again until fully done.
- When taking hotpot, use separate sets of chopsticks and utensils to handle raw and cooked food. Also, do not place too much food on the table to prevent cross contamination.

Food safety and *Streptococcus suis*

Streptococcus suis is a bacterium commonly present in pigs in many parts of the world. In most cases it does not cause disease in pigs. People in direct contact with pigs or raw pig-products are at risk of infection but the small number of reported clinical cases in humans would suggest that the risk is very low.

Human infection is usually through direct contact with infected pigs or raw pig-products and is thought to occur through cuts or abrasions on the skin when handling infected pig material. Proper cooking (temperatures at or above 70° C in all parts of the product) kills this bacterium. Well cooked pork meat is safe but handling infected raw pig products, including those which are refrigerated or frozen, can be hazardous if good hygienic practices are not observed (see below).

The recent outbreak of *Streptococcus suis* in areas of Sichuan in China has raised concern about the risk associated with infected pork meat. In these areas, slaughtering and butchering of sick or dead pigs has been strictly prohibited. However, contact with infected pigs and raw pork from the affected areas could pose a risk of infection to farmers, slaughterers, butchers as well as to those processing or preparing the meat for consumption. The export of pork meat from the affected areas in Sichuan to Hong Kong was suspended on the 28 July 2005.

A group of international experts on *Streptococcus suis* convened by WHO reiterated that human infection is most likely to occur through cuts or abrasions on the skin. Although consumption of raw or undercooked pork may lead to disease, eating properly cooked pork is unlikely to represent an increased risk, even if the outbreak strain of *Streptococcus suis* involved is more dangerous.

Recommended good hygiene practices to avoid contracting *Streptococcus suis*:

During slaughtering:

- Do not slaughter sick animals
- Dead animals must not be used for food or feed and should be safely disposed to avoid contamination
- Wear protective clothing and ensure that all wounds are covered
- Keep the slaughtering area clean and separate from the food processing area
- Remove protective clothing and wash exposed body areas after slaughtering

During food preparation:

- Do not handle raw pig-products if you have wounds on your hands unless you cover all wounds by waterproof dressings or plastic gloves
- Keep the preparation area clean and wash your hands after handling
- Separate raw meat from cooked or ready-to-eat foods to avoid contamination
 - Do not use the same chopping board or the same knife
 - Do not handle both raw and cooked meat without washing your hands in between
 - Do not place cooked meat back on the same surface it was on before cooking
- Cook thoroughly (temperatures at or above 70° C in all parts of the product)

For further information

- ∴ [WHO Regional Office for the Western Pacific](#)
- ∴ [Outbreak associated with *Streptococcus suis* in pigs in China: Update](#)

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