Incidence and mortality of post-operative sepsis in New South Wales, Australia, 2002–2009

Lixin Ou, Jack Chen, Tony Burrell, Arthas Flabouris, Kenneth Hillman, Rinaldo Bellomo, Michael Parr

ABSTRACT

Objective: To describe the incidence and mortality of post-operative sepsis in New South Wales, Australia.

Design, setting and participants: A retrospective study of adult elective surgical admissions (n = 229 918) in 82 public acute care hospitals in NSW, 2002–2009.

Main outcome measures: Changes in the incidence rate of post-operative sepsis and sepsis-related mortality.

Results: Although the mortality rate among patients with sepsis decreased from 26.9% in 2002 to 20.2% in 2009 (P = 0.006 for adjusted trend), the incidence rate of sepsis increased from 12.7 to 15.8 per 1000 admissions (adjusted rate ratio [RR], 1.23; 95% CI, 1.06–1.42). Thus, the incidence rate of sepsis-related deaths remained unchanged (3.4 v 3.2 per 1000 admissions; adjusted RR, 0.90; 95% CI, 0.67–1.22), as did deaths from sepsis as a proportion of all elective surgical deaths (P = 0.96 for adjusted trend). The incidence rate of infections without a specified organism identified increased; was twice the rate of gram-positive infections (8.5 v 4.1 per 1000 admissions, P < 0.001); and was three times the rate of gram-negative infections (8.5 v 2.7 per 1000 admissions, P < 0.001). Also, compared with patients with gram-positive infections, patients with an unspecified infection were more likely to die (adjusted RR, 1.33; 95% CI, 1.13–1.57), but patients with gram-negative infections and mixed infections had a similar likelihood of death from their infection.

Conclusion: Over 8 years, the mortality from post-operative sepsis decreased, but its incidence rate increased, resulting in a lack of improvement in the incidence rate of sepsis-related deaths. The increasing incidence of post-operative sepsis and the poor record of identification of causative organisms remain a significant public health challenge.

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Sepsis is a common post-operative complication, which may account for one-third of all cases of sepsis.[1] Patients who develop sepsis during or after surgery can progress to multiple organ dysfunction, and have a significantly greater mortality rate during their hospital stay.[2-4] The cost of treating such patients was estimated as three times higher than treating surgical patients without post-operative sepsis.[5] Sepsis complicated by organ failure is also responsible for 10%–12% of admissions to intensive care units.[6,7] Finally, sepsis-related morbidity appears to have an adverse impact on long-term outcomes after hospital discharge.[8]

The American Agency for Healthcare Research and Quality (AHRQ) has developed a set of patient safety indicators (PSIs), including for post-operative sepsis (PSI 13), with the aim of detecting preventable hospital complications and adverse events after surgery.[9] These indicators are evidence-based measures of patient safety designed for use in administrative databases.[10] Over the past decade, this definition of post-operative sepsis has been widely used in the United States to measure aspects of patient safety and quality and to monitor the impact of quality improvement initiatives.[4,10-13] Based on the AHRQ methodology, the Organisation for Economic Cooperation and Development (OECD) Quality Indicator Project also included post-operative sepsis in its patient safety indicators.[14]

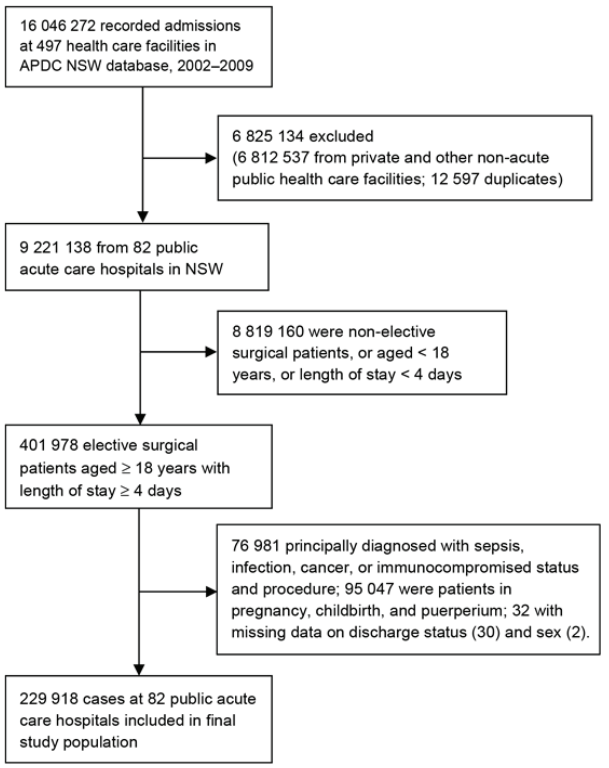
Despite such large data management initiatives, there are currently no large studies on measuring and reporting the epidemiology of post-operative sepsis in Australia. This is unfortunate because the issue is of major public health interest and because, given the unique aspects of the American health care system, there is uncertainty about the applicability of the US findings in Australia. Our aim was therefore to study the epidemiology of post-operative sepsis and sepsis-related mortality among adult elective surgical patients admitted in all public acute care hospitals between 2002 and 2009 in New South Wales, Australia, using AHRQ methodology.

Methods

Data source and study population

NSW is the most populous state in Australia, with a population of 7.3 million and 84 public acute care hospitals. We performed a retrospective study using NSW data from the Admitted Patient Data Collection (APDC), which includes demographic and diagnostic information on each public and private hospital admission episode. The medical records for each episode of care in the APDC were assigned codes based on the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification (ICD-10-AM).[15] Each public hospital has certified, trained coders who use standardised procedures to generate these codes from information in

Figure 1. Derivation of the study sample



APDC = Admitted Patient Data Collection. NSW = New South Wales.

medical records (ICD-10-AM codes are listed in Appendix 1 and Appendix 2). Our study was approved by the NSW Population and Health Services Research Ethics Committee (LNR/11/CIPHS/64).

We included all elective surgical patients admitted to 82 of 84 NSW public acute care hospitals (excluding two children's hospitals) between 1 January 2002 and 31 December 2009. We identified our study population based on the selection criteria developed by the AHRQ for post-operative sepsis (PSI 13),[16] which targeted elective surgical patients aged ≥ 18 years with a length of stay of more than 3 days. Elective surgical patients were identified as patients who had had any operating theatre procedure performed as a primary procedure, and were not admitted through the emergency department. We excluded patients who were principally diagnosed with sepsis, infection, cancer or an immunocompromised state who needed immunocompromised state-related procedures at admission, because these patients had potential specific confounding factors. We excluded those who were assigned major diagnostic category 14 (pregnancy, childbirth and puerperium). Finally, we excluded patients with missing data on discharge status, sex, age, year or principal diagnosis (Figure 1). Patient demographic information included age, sex, country of birth, marital status, and advantage and disadvantage index scores of the Socio-Economic Indexes for Areas (SEIFA).[17] Hospital characteristics included location and peer groups (detailed descriptions are in Appendix 3).

Case definition and classification

Cases of sepsis were identified according to the AHRQ-defined diagnosis codes (ICD, Ninth Revision, Clinical Modification [ICD-9-CM]).[16] Because of the difference between coding systems in the US (ICD-9-CM) and Australia (ICD-10-AM), all diagnosis and procedure codes in the AHRQ definitions were translated to ICD-10-AM codes by referring to the OECD technical manual for PSIs.[18] We derived outcome variables using 54 non-principal diagnostic fields in the medical record by ICD-10-AM codes matched from the OECD manual (Appendix 1). We also categorised infectious organisms into gram-positive, gram-negative, mixed (gram-positive and gram-negative together) and unspecified organisms (Appendix 1).

Study outcomes

We studied the following outcomes from 2002 to 2009:

- incidence rate of post-operative sepsis: defined as the number of sepsis cases divided by the total study population, expressed per 1000 admissions
- sepsis case fatality rate: defined as the number of deaths among patients with sepsis divided by the number of sepsis cases, reported as a percentage
- incidence rate of sepsis-related deaths: defined as the number of deaths among patients with sepsis divided by the total study population, expressed per 1000 admissions
- proportion of sepsis-related deaths among all deaths in the study population, reported as a percentage
- incidence rates of sepsis cases involving specific infectious organisms: defined as the number of patients with specific infectious organisms divided by the study population, expressed per 1000 admissions.

Statistical analysis

We used the Rao–Scott χ^2 test to measure the association between categorical variables while adjusting for the hospital cluster effect. We derived adjusted rate ratios (RRs) for outcome variables using Poisson mixed models, which take into account the hospital cluster effect. We assessed crude and adjusted linear trend for the outcome variables after excluding a possible quadratic effect, using the study year as a continuous variable. We also derived an adjusted trend for each outcome variable, including calendar year, as a set of indicator variables (with 2002 as the baseline reference year).

Table 1. Distribution of study population and sepsis, by patient and hospital characteristics (pooled 2002–2009 data, *N* = 229 918)

Characteristic	Total (%)	Post-operative sepsis, *n* = 3563			Sepsis-related deaths, *n* = 875		
		n (%)	Incidence rate†	*P*	*n* (%)	Case fatality (%)	*P*‡
Age, years							
18–35	6.9%	218 (6.1%)	13.7	< 0.001**	29 (3.3%)	13.3	< 0.001**
35–55	20.9%	584 (16.4%)	12.1		67 (7.7%)	11.5	
55–75	44.4%	1531 (43.0%)	15.0		361 (41.3%)	23.6	
≥ 75	27.8%	1230 (34.5%)	19.2		418 (47.8%)	34.0	
Sex							
Male	46.3%	2159 (60.6%)	20.3	< 0.001**	497 (56.8%)	23.0	0.008*
Female	53.7%	1404 (39.4%)	11.4		378 (43.2%)	26.9	
Country of birth							
Australia or New Zealand	68.2%	2444 (68.6%)	15.6	< 0.001**	595 (68.0%)	24.3	0.214
UK, US or Canada	7.6%	218 (6.1%)	12.4		61 (7.0%)	28.0	
Non-English-speaking Europe	11.2%	387 (10.9%)	15.0		105 (12.0%)	27.1	
North Africa	2.0%	61 (1.7%)	13.5		16 (1.8%)	26.2	
Asia	2.6%	91 (2.6%)	15.0		26 (3.0%)	28.6	
Other	7.2%	260(7.3%)	15.8		54 (6.2%)	20.8	
Unknown	1.2%	102 (2.9%)	37.6		18 (2.1%)	17.6	
Marital status							
Married	56.2%	1920 (54.0%)	14.9	< 0.001**	469 (53.7%)	24.4	0.952
Single	41.6%	1476 (41.5%)	15.5		364 (41.6%)	24.7	
Unknown	2.2%	161 (4.5%)	31.6		41 (4.7%)	25.5	
SEIFA quartile							
1st (most disadvantaged)	25.5%	947 (27.0%)	16.1	< 0.001**	232 (26.5%)	24.5	0.518
2nd	24.4%	839 (23.6%)	14.9		191 (21.8%)	22.8	
3rd	24.9%	868 (23.4%)	15.1		219 (25.0%)	25.2	
4th (most advantaged)	24.4%	841 (23.6%)	15.0		219 (25.0%)	26.0	
Unknown	0.7%	68 (1.9%)	40.6		14 (1.6%)	20.6	
Local health district of facility							
Metropolitan	67.7%	2579 (72.4%)	16.6	< 0.001**	624 (71.3%)	24.2	0.416
Rural and regional NSW	32.3%	984 (27.6%)	13.3		251 (28.7%)	25.5	
Peer hospital group							
Principal referral group	62.0%	2658 (74.3%)	18.7	< 0.001**	671 (76.7%)	25.2	0.024*
Ungrouped acute care	2.3%	29 (0.9%)	5.4		7 (0.8%)	24.1	
Major metropolitan and non-metropolitan	28.3%	798 (22.6%)	12.3		190 (21.7%)	23.8	
District group 1	6.1%	62 (1.7%)	4.4		6 (0.7%)	9.7	
District group 2	1.3%	16 (0.4%)	5.4		1 (0.1%)	6.3	

SEIFA = Socio-Economic Indexes for Areas. UK = United Kingdom. US = United States. NSW = New South Wales. † Per 1000 admissions. ‡ Using Rao–Scott χ^2 test. * $P < 0.05$. ** $P < 0.01$.

We adjusted for patient demographic variables (age, sex, country of birth, marital status and SEIFA score) and hospital characteristics (location and peer groups).

To ensure the robustness of our findings, we conducted a sensitivity analysis by removing codes R57.8 and T81.8 from sepsis coding (results are shown in Appendix 4). As a preliminary step, we examined the Elixhauser and Charlson comorbidity indices, based on the ICD-10 coding scheme,[19] but did not include them in the adjusted model because of recent reports of potential biases introduced in using these indices for risk adjustment in epidemiological studies.[20-22]

We have considered $P < 0.05$ to be statistically significant, and we show 95% confidence intervals. We performed all analyses using Stata version 13 (StataCorp).

Results

Patient characteristics

Of 229 918 selected elective surgical admissions between 2002 and 2009, 72.2% were patients who were 55 years or older, almost half were men, most were born in Australia or New Zealand (68.2%) and most were married

Table 2. Observed trends, incidence rate and adjusted rate ratio of post-operative sepsis and sepsis-related deaths (*N* = 229 918)

Group	Total	2002	2003	2004	2005	2006	2007	2008	2009	Trend *P*
All admissions										
Patients, *n*	229 918	28 352	28 701	28 696	29 630	30 422	29 952	28 193	25 972	–
Deaths, *n*	3304	409	438	450	386	441	451	397	332	–
Incidence rate†	14.4	14.4	15.3	15.7	13.0	14.5	15.1	14.1	12.8	0.018*
Adjusted RR (95% CI)	–	1.00	1.03 (0.90–1.18)	1.03 (0.90–1.18)	0.84* (0.73–0.97)	0.94 (0.82–1.07)	0.95 (0.83–1.08)	0.86* (0.74–0.99)	0.82* (0.71–0.95)	–
Post-operative sepsis										
Patients, *n*	3563	360	409	481	445	487	501	470	410	–
Incidence rate†	15.5	12.7	14.3	16.8	15.0	16.0	16.7	16.7	15.8	Quad†
Adjusted RR (95% CI)	–	1.00	1.13 (0.98–1.30)	1.33** (1.15–1.52)	1.14 (0.99–1.32)	1.23** (1.07–1.41)	1.27** (1.10–1.45)	1.27** (1.10–1.46)	1.23** (1.06–1.42)	–
Sepsis-related deaths										
Patients, *n*	875	97	131	124	87	122	120	111	83	–
Case fatality (%)	24.6	26.9	32.0	25.8	19.6	25.1	24.0	23.6	20.2	0.006**
Adjusted RR (95% CI)	–	1.00	1.17 (0.90–1.53)	0.95 (0.72–1.24)	0.74* (0.55–0.99)	0.91 (0.69–1.19)	0.89 (0.68–1.17)	0.84 (0.64–1.12)	0.73* (0.54–0.98)	–
Incidence rate†	3.8	3.4	4.6	4.3	2.9	4.0	4.0	3.9	3.2	0.28
Adjusted RR (95% CI)	–	1.00	1.35* (1.03–1.76)	1.28 (0.98–1.67)	0.84 (0.63–1.13)	1.14 (0.87–1.49)	1.13 (0.86–1.48)	1.07 (0.81–1.42)	0.90 (0.67–1.22)	–
Proportion of all surgical deaths (%)	26.5	23.7	29.9	27.6	22.5	27.7	26.6	28.0	25.0	0.96
Adjusted RR (95% CI)	–	1.00	1.29 (0.99–1.68)	1.20 (0.91–1.57)	0.99 (0.73–1.32)	1.19 (0.91–1.57)	1.12 (0.85–1.47)	1.25 (0.95–1.66)	1.12 (0.83–1.50)	–

RR = rate ratio. Quad = quadratic. † Quadratic (linear = 0.004; quadratic = 0.022). * $P \leq 0.05$, ** $P < 0.01$.

(56.2%) (Table 1). Most patients were admitted to facilities in the metropolitan area (67.7%), and more than half the admissions were patients who had had surgery in principal referral hospitals (62.0%).

Of 3563 cases of post-operative sepsis (1.6%), 77.5% of patients were 55 years or older, and 2159 were men (60.6%) (Table 1). The incidence rate of post-operative sepsis in men was nearly twice the rate in women (20.3 v 11.4 per 1000 admissions, $P < 0.001$). Patients born in the United Kingdom, US, Canada and North Africa had a lower incidence rate than other country groups ($P < 0.001$). Patients who were single or lived in the most disadvantaged areas had higher incidence rates of post-operative sepsis (all $P < 0.001$). Hospitals in metropolitan areas or classed as principal referral hospitals reported greater incidence rates of post-operative sepsis compared with hospitals in rural and regional NSW or their peers ($P < 0.001$). Among patients who developed post-operative sepsis, 875 (24.6%) died during hospitalisation. Of these, higher rates of case fatality were observed among those 55 years or older ($P < 0.001$), women (26.9% v 23.0%, $P = 0.008$) and patients admitted to principal referral hospitals ($P = 0.024$).

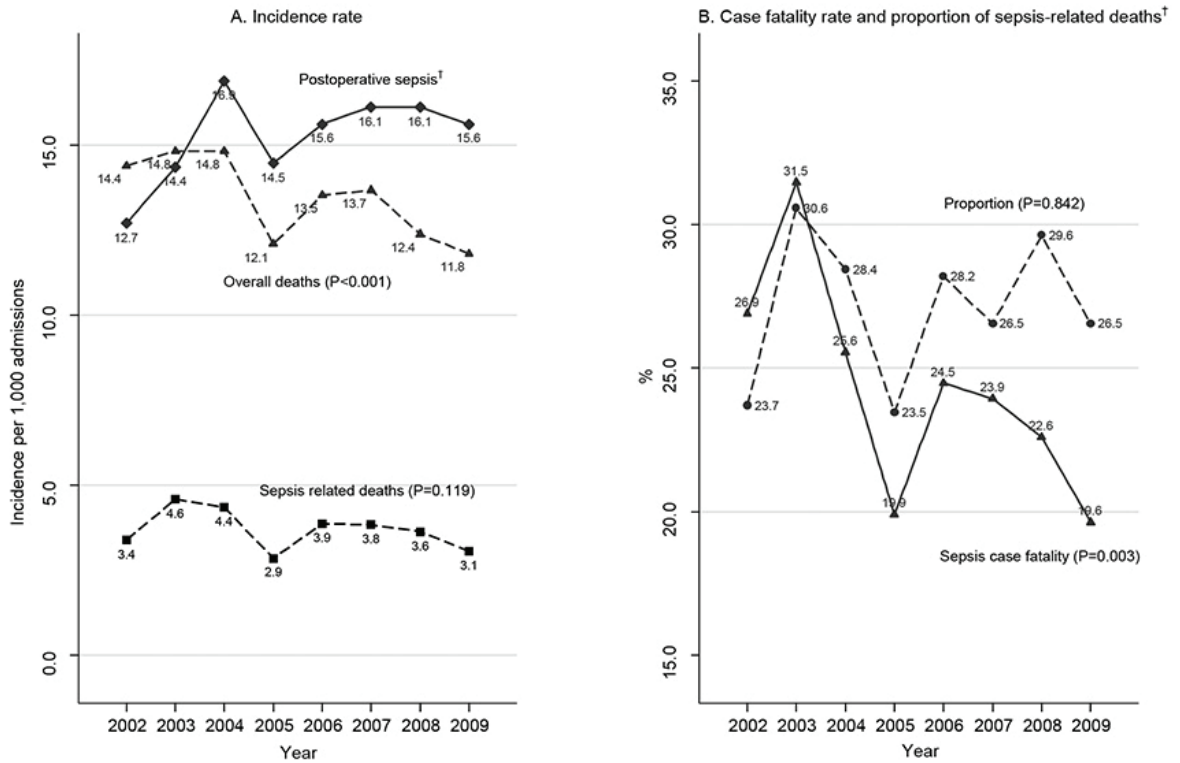
Trends in post-operative sepsis rates and related outcomes

Among the whole study population, 3304 patients (1.4%) died in hospital (Table 2). The overall surgical mortality rate decreased from 1.4% in 2002 to 1.3% in 2009 ($P = 0.018$). There was a significant increase in the incidence rate of post-operative sepsis, from 12.7 per 1000 admissions in 2002 to 15.8 per 1000 admissions in 2009 (adjusted RR, 1.23; 95% CI, 1.06–1.42), and a significant decrease in the case fatality of sepsis (from 26.9% in 2002 to 20.2% in 2009; $P = 0.006$ for adjusted trend). The incidence rate of sepsis-related deaths was not significantly different in 2009 (3.2 per 1000 admissions) compared with 2002 (3.4 per 1000 admissions; adjusted RR, 0.90; 95% CI, 0.67–1.22). There was no significant change in the proportion of sepsis-related deaths among overall deaths during the same study period ($P = 0.96$ for adjusted trend) (Table 2 and Figure 2).

Types of infectious organisms

There was no significant change in the incidence rate of gram-positive infections between 2002 and 2009 ($P = 0.742$ for trend) (Figure 3). The incidence rates of gram-negative and mixed infections showed quadratic trends during the

Figure 2. A. Risk-adjusted incidence rates of post-operative sepsis and overall surgical deaths
B. Sepsis-related case fatality rate and proportion of sepsis-related deaths among overall surgical deaths

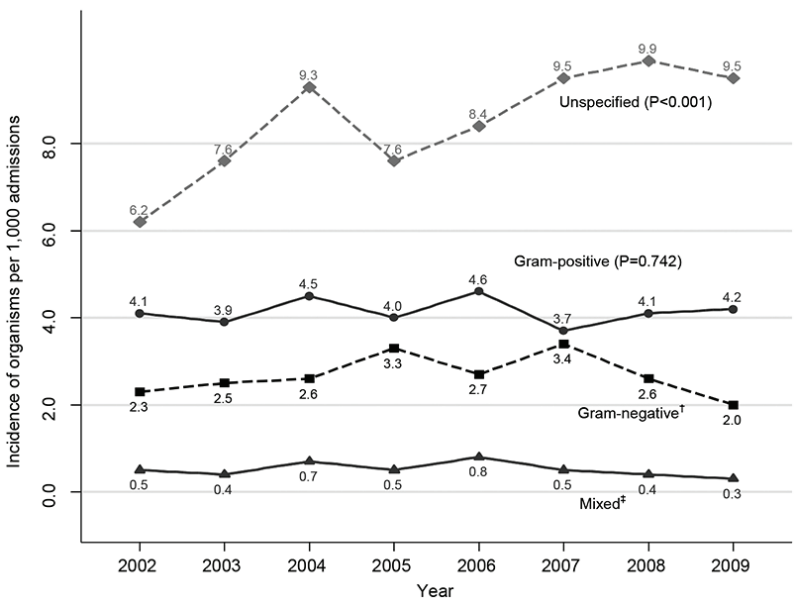


† Proportion of post-operative sepsis-related deaths among overall surgical deaths.

same period (initially increasing then decreasing), but there was a significantly increasing trend in the incidence rate of unspecified infections (from 6.2 per 1000 admissions in 2002 to 9.5 per 1000 admissions in 2009; P = 0.001 for trend).

Among all patients with sepsis, 26.7% contracted gram-positive infections, 17.4% were infected with gram-negative bacteria, 3.3% had mixed infections of gram-positive and gram-negative bacteria, and 52.6% were diagnosed with unspecified infections (Table 3). The incidence rate of unspecified infections was twice the rate of gram-positive infections (8.5 v 4.1 per 1000 admissions, P < 0.001) and three times the rate of gram-negative infections (8.5 v 2.7 per 1000 admissions, P < 0.001).

Figure 3. Observed trends in incidence rate of infecting organisms in post-operative sepsis



† P: linear = 0.002, quadratic = 0.002. ‡ P: linear = 0.064, quadratic = 0.031.

Table 3. Observed post-operative sepsis-related mortality and adjusted rate ratio, by type of infectious organism (pooled data 2002–2009; *N* = 229 918)

	Cases of sepsis (*n* = 3563)		Sepsis-related deaths (*n* = 875)		
Infectious organism	*n* (%)	IR*	*n* (%)	Mortality rate (%)†	Adjusted RR (95% CI)
Gram +ve	952 (26.7%)	4.1‡	194 (22.1%)	20.4	1.00
Gram –ve	620 (17.4%)	2.7§	104 (11.9%)	16.8	0.79 (0.62–1.01)
Mixed	117 (3.3%)	0.5¶	30 (3.4%)	25.6	1.29 (0.87–1.93)
Unspecified	1874 (52.6%)	8.5	547 (62.5%)	29.2	1.33** (1.13–1.57)

IR = incidence rate. RR = rate ratio. * Per 1000 admissions. † $P < 0.001$. ‡ Unspecified v gram +ve ($P < 0.001$; 95% CI, 3.9–4.8). § Unspecified v gram –ve ($P < 0.001$; 95% CI, 5.4–6.2). ¶ Unspecified v mixed ($P < 0.001$; 95% CI, 7.6–8.4). ** $P < 0.01$.

Compared with patients with gram-positive infections, patients with unspecified infections were more likely to die (29.2% v 20.4%; adjusted RR, 1.33; 95% CI, 1.13–1.57). Patients with gram-negative infections (16.8% v 20.4%; adjusted RR, 0.79; 95% CI, 0.62–1.01) and mixed infections (25.6% v 20.4%; adjusted RR, 1.29; 95% CI, 0.87–1.93) were similar to those with gram-positive infections.

Discussion

We conducted a large retrospective cohort study of the epidemiology of post-operative sepsis in adult patients having elective surgery in NSW, Australia, from 2002 to 2009. We found that post-operative sepsis was more common in men; that patients who were single or lived in disadvantaged areas had the highest incidence rate among social groups; that metropolitan or principal referral hospitals reported the greatest incidence among health care facilities; and that a higher case fatality rate was observed among older people, women and principal referral hospital patients. Importantly, we found that the incidence rate of post-operative sepsis increased in 2009 compared with 2002, while the sepsis case fatality rate decreased by a quarter. As a result, the overall population incidence rate of sepsis-related deaths did not change significantly, and the proportion of sepsis-related deaths among all elective surgical deaths remained unchanged. Finally, we found that infections in which no organism was specified accounted for more than half of overall cases of sepsis and that such patients had almost double the risk of death.

Based on the same AHRQ definition of post-operative sepsis as we used, and using US state-wide administrative data, Vogel and colleagues[10] found an increasing trend in the incidence rate of post-operative sepsis after elective surgery (from 0.67% to 1.74%), with an average rate of 1.1%, which was slightly lower than the rate in our study (1.6% in 2006). They also found a decreasing sepsis case fatality rate (from 27.1% to 23.9%), and we found a decrease from 26.9% to 20.2%. Another study by Bateman and colleagues[11] also focused on elective surgical patients and was based on a nationally representative sample in the US. Using a similar definition to the AHRQ one, Bateman and colleagues reported an increasing post-operative sepsis incidence rate, from 0.7 per 1000 admissions in 1997 to 1.3 per 1000 admissions in 2006, with a lower overall average rate than the rate in NSW (0.9 v 1.6 per 1000 admissions). Other studies have also reported that post-operative sepsis is more common in men,[10,11] and in people from more disadvantaged social groups[10,11] or institutions dealing with more complex surgery.[11] No comparable data exist for non-English-speaking Europeans as an at-risk ethnic group. The higher case fatality rate among older people and women and among people in centres that perform more complex surgery has also been previously reported.[11]

Previous studies have reported changes in the predominant organisms that cause sepsis. Before 1987, gram-negative bacteria were the most common cause, after which gram-positive bacteria became dominant, accounting for 52.1% of all sepsis infections, with an annual rate of increase of 26.3%.[23] Another study in the US found that sepsis caused by gram-positive bacteria was more likely to lead to acute organ dysfunction than sepsis caused by gram-negative bacteria (31% v 25%, $P < 0.01$).[24] None of these studies focused on elective surgical patients. Our study is the first to suggest that gram-positive bacteria are the most frequently specified infectious organism in post-operative septic patients in NSW adult public acute care hospitals; that the majority of infectious organisms causing post-operative sepsis were unspecified; and that unspecified organisms are increasing as a proportion of causative agents. The most common situation now is therefore that the infectious organism is not isolated, and such patients have the highest mortality.

Strengths and limitations

This is the first large epidemiological study in Australia and outside the US to provide evidence of a steady increase in the incidence rate of post-operative sepsis, with a simultaneous reduction in its case fatality leading to an unchanged incidence rate of sepsis-related deaths. It is also the first to show a persistently high incidence of failed microbiological identification and its associated higher mortality. These findings imply that there has been significant progress in the treatment of sepsis, but that this progress has not been matched by similar progress in the

prevention of post-operative sepsis or in the diagnosis of the responsible infectious agent.

We used the internationally adopted definition of sepsis[25] and highlight the unresolved challenges of preventing the development of sepsis. Our inclusion of only elective surgical patients reduced the possibility of community-acquired sepsis being a confounding factor, and made our results more specific and relevant for clinicians and policymakers. Our finding that a specific microbiological diagnosis is not achieved for more than 50% of patients implies that there is a need to develop better microbiological identification techniques. Finally, the higher mortality in patients with unspecified infectious organisms provides a specific focus for future investigations and interventions.

Our study also has limitations. First, the results were based on NSW acute care hospital surgical patient data and may not be generalisable to other settings, but it seems unlikely that such findings would materially differ from other states in Australia. Second, we studied the period 2002–2009 specifically because it provided important evidence to understand the background to and impact of a designated "Sepsis Kills" program, introduced in 2010 by the Clinical Excellence Commission of NSW. This program aimed to achieve better prevention, earlier identification and timely treatment of sepsis. Third, despite the use of professional and certified coders to extract chart data, the absolute accuracy of such data extraction cannot be guaranteed. Finally, because post-operative sepsis can occur after hospital discharge, the true incidence of post-operative sepsis in our study may have been underestimated.

Conclusion

Post-operative sepsis remains a major health care problem contributing to a significant proportion of deaths after elective surgery. Despite a reduced case fatality rate, and due to an increased incidence rate of sepsis, the overall population incidence rate of post-operative sepsis-related deaths has not decreased. It is important to note that, in patients with post-operative sepsis, the rate of non-diagnosis of a specific microbiological causative agent remains high and associated with greater mortality. Improved prevention and microbiological diagnosis should together be the focus of future research and interventional strategies to decrease post-operative sepsis-related deaths.

Author details

Lixin Ou, Research Fellow[1]
Jack Chen, Associate Professor[1]
Tony Burrell, Clinical Advisor[2]
Arthas Flabouris, Clinical Associate Professor,[3] and Staff Specialist[4]
Kenneth Hillman, Professor of Intensive Care[1]
Rinaldo Bellomo, Professor,[5] and Director[6]
Michael Parr, Director,[7] and Professor[8]

1 Simpson Centre for Health Services Research, University of New South Wales, Sydney, NSW, Australia.
2 Clinical Excellence Commission, Sydney, NSW, Australia.
3 Intensive Care Unit, Royal Adelaide Hospital, Adelaide, SA, Australia.
4 Faculty of Health Sciences, School of Medicine, University of Adelaide, Adelaide, SA, Australia.
5 Intensive Care Medicine, Monash University, Melbourne, VIC, Australia.
6 Intensive Care Research, Austin Medical Centre, Melbourne, VIC, Australia.
7 Intensive Care Unit, Liverpool Hospital, Sydney, NSW, Australia.
8 Intensive Care Medicine, University of New South Wales, Sydney, NSW, Australia.

Correspondence: lixin.ou@unsw.edu.au

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Appendices. These appendices are part of the submitted manuscript and have been peer reviewed. They are posted as supplied by the authors.

Appendix 1. ICD-10-AM codes used to define postoperative sepsis

ICD 10 AM Code	Diagnosis	Type of infection*
A40.0	Sepsis due to streptococcus, group A	G+
A40.1	Sepsis due to streptococcus, group B	G+
A40.2	Sepsis due to streptococcus, group D	G+
A40.3	Sepsis due to Streptococcus pneumonia	G+
A40.8	Other streptococcal sepsis	G+
A40.9	Streptococcal sepsis, unspecified	G+
A41.0	Sepsis due to Staphylococcus aureus	G+
A41.1	Sepsis due to Coagulate-negative staphylococcus	G+
A41.2	Sepsis due to unspecified staphylococcus	G+
A41.3	Sepsis due to Haemophilus influenza	G-
A41.4	Sepsis due to anaerobes	N
A41.50	Gram-negative septicaemia NOS	G-
A41.51	Sepsis due to Escherichia coli	G-
A41.52	Sepsis due to Pseudomonas	G-
A41.58	Sepsis due to other Gram-negative organisms	G-
A41.8	Other specified sepsis	N
A41.9	Sepsis unspecified, septicaemia	N
R57.2	Septic shock	N
R57.8	Other shock	N
R65.0	SIRS of infectious origin without acute organ failure	N
R65.1	SIRS of infectious origin with acute organ failure	N
T81.1	Shock during or resulting from a procedure, not elsewhere classified	N

**G+: Gram positive; G-: Gram negative; N: unspecified;*

SIRS=Systemic inflammatory response syndrome

Appendix 2. Codes used for exclusion criteria

1. Cancer codes

ICD–10	Code description
C00.0	Malignant neoplasm: External upper lip
C00.1	Malignant neoplasm: External lower lip
C00.2	Malignant neoplasm: External lip, unspecified
C00.3	Malignant neoplasm: Upper lip, inner aspect
C00.4	Malignant neoplasm: Lower lip, inner aspect
C00.5	Malignant neoplasm: Lip, unspecified, inner aspect
C00.6	Malignant neoplasm: Commissure of lip
C00.8	Malignant neoplasm: Overlapping lesion of lip
C00.9	Malignant neoplasm: Lip, unspecified
C01	Malignant neoplasm of base of tongue
C02.0	Malignant neoplasm: Dorsal surface of tongue
C02.1	Malignant neoplasm: Border of tongue
C02.2	Malignant neoplasm: Ventral surface of tongue
C02.3	Malignant neoplasm: Anterior two-thirds of tongue, part unspecified
C02.4	Malignant neoplasm: Lingual tonsil
C02.8	Malignant neoplasm: Overlapping lesion of tongue
C02.9	Malignant neoplasm: Tongue, unspecified
C03.0	Malignant neoplasm: Upper gum
C03.1	Malignant neoplasm: Lower gum
C03.9	Malignant neoplasm: Gum, unspecified
C04.0	Malignant neoplasm: Anterior floor of mouth
C04.1	Malignant neoplasm: Lateral floor of mouth
C04.8	Malignant neoplasm: Overlapping lesion of floor of mouth
C04.9	Malignant neoplasm: Floor of mouth, unspecified
C05.0	Malignant neoplasm: Hard palate
C05.1	Malignant neoplasm: Soft palate
C05.2	Malignant neoplasm: Uvula
C05.8	Malignant neoplasm: Overlapping lesion of palate
C05.9	Malignant neoplasm: Palate, unspecified
C06.0	Malignant neoplasm: Cheek mucosa
C06.1	Malignant neoplasm: Vestibule of mouth

C06.2	Malignant neoplasm: Retromolar area
C06.8	Malignant neoplasm: Overlapping lesion of other and unspecified parts of mouth
C06.9	Malignant neoplasm: Mouth, unspecified
C07	Malignant neoplasm of parotid gland
C08.0	Malignant neoplasm: Submandibular gland
C08.1	Malignant neoplasm: Sublingual gland
C08.8	Malignant neoplasm: Overlapping lesion of major salivary glands
C08.9	Malignant neoplasm: Major salivary gland, unspecified
C09.0	Malignant neoplasm: Tonsillar fossa
C09.1	Malignant neoplasm: Tonsillar pillar (anterior)(posterior)
C09.8	Malignant neoplasm: Overlapping lesion of tonsil
C09.9	Malignant neoplasm: Tonsil, unspecified
C10.0	Malignant neoplasm: Vallecula
C10.1	Malignant neoplasm: Anterior surface of epiglottis
C10.2	Malignant neoplasm: Lateral wall of oropharynx
C10.3	Malignant neoplasm: Posterior wall of oropharynx
C10.4	Malignant neoplasm: Branchial cleft
C10.8	Malignant neoplasm: Overlapping lesion of oropharynx
C10.9	Malignant neoplasm: Oropharynx, unspecified
C11.0	Malignant neoplasm: Superior wall of nasopharynx
C11.1	Malignant neoplasm: Posterior wall of nasopharynx
C11.2	Malignant neoplasm: Lateral wall of nasopharynx
C11.3	Malignant neoplasm: Anterior wall of nasopharynx
C11.8	Malignant neoplasm: Overlapping lesion of nasopharynx
C11.9	Malignant neoplasm: Nasopharynx, unspecified
C12	Malignant neoplasm of piriform sinus
C13.0	Malignant neoplasm: Postcricoid region
C13.1	Malignant neoplasm: Aryepiglottic fold, hypopharyngeal aspect
C13.2	Malignant neoplasm: Posterior wall of hypopharynx
C13.8	Malignant neoplasm: Overlapping lesion of hypopharynx
C13.9	Malignant neoplasm: Hypopharynx, unspecified
C14.0	Malignant neoplasm: Pharynx, unspecified
C14.2	Malignant neoplasm: Waldeyer's ring
C14.8	Malignant neoplasm: Overlapping lesion of lip, oral cavity and

	pharynx
C15.0	Malignant neoplasm: Cervical part of oesophagus
C15.1	Malignant neoplasm: Thoracic part of oesophagus
C15.2	Malignant neoplasm: Abdominal part of oesophagus
C15.3	Malignant neoplasm: Upper third of oesophagus
C15.4	Malignant neoplasm: Middle third of oesophagus
C15.5	Malignant neoplasm: Lower third of oesophagus
C15.8	Malignant neoplasm: Overlapping lesion of oesophagus
C15.9	Malignant neoplasm: Oesophagus, unspecified
C16.0	Malignant neoplasm: Cardia
C16.1	Malignant neoplasm: Fundus of stomach
C16.2	Malignant neoplasm: Body of stomach
C16.3	Malignant neoplasm: Pyloric antrum
C16.4	Malignant neoplasm: Pylorus
C16.5	Malignant neoplasm: Lesser curvature of stomach, unspecified
C16.6	Malignant neoplasm: Greater curvature of stomach, unspecified
C16.8	Malignant neoplasm: Overlapping lesion of stomach
C16.9	Malignant neoplasm: Stomach, unspecified
C17.0	Malignant neoplasm: Duodenum
C17.1	Malignant neoplasm: Jejunum
C17.2	Malignant neoplasm: Ileum
C17.3	Malignant neoplasm: Meckel's diverticulum
C17.8	Malignant neoplasm: Overlapping lesion of small intestine
C17.9	Malignant neoplasm: Small intestine, unspecified
C18.0	Malignant neoplasm: Caecum
C18.1	Malignant neoplasm: Appendix
C18.2	Malignant neoplasm: Ascending colon
C18.3	Malignant neoplasm: Hepatic flexure
C18.4	Malignant neoplasm: Transverse colon
C18.5	Malignant neoplasm: Splenic flexure
C18.6	Malignant neoplasm: Descending colon
C18.7	Malignant neoplasm: Sigmoid colon
C18.8	Malignant neoplasm: Overlapping lesion of colon
C18.9	Malignant neoplasm: Colon, unspecified
C19	Malignant neoplasm of rectosigmoid junction

C20	Malignant neoplasm of rectum
C21.0	Malignant neoplasm: Anus, unspecified
C21.1	Malignant neoplasm: Anal canal
C21.2	Malignant neoplasm: Cloacogenic zone
C21.8	Malignant neoplasm: Overlapping lesion of rectum, anus and anal canal
C22.0	Malignant neoplasm: Liver cell carcinoma
C22.1	Malignant neoplasm: Intrahepatic bile duct carcinoma
C22.2	Malignant neoplasm: Hepatoblastoma
C22.3	Malignant neoplasm: Angiosarcoma of liver
C22.4	Malignant neoplasm: Other sarcomas of liver
C22.7	Malignant neoplasm: Other specified carcinomas of liver
C22.9	Malignant neoplasm: Liver, unspecified
C23	Malignant neoplasm of gallbladder
C24.0	Malignant neoplasm: Extrahepatic bile duct
C24.1	Malignant neoplasm: Ampulla of Vater
C24.8	Malignant neoplasm: Overlapping lesion of biliary tract
C24.9	Malignant neoplasm: Biliary tract, unspecified
C25.0	Malignant neoplasm: Head of pancreas
C25.1	Malignant neoplasm: Body of pancreas
C25.2	Malignant neoplasm: Tail of pancreas
C25.3	Malignant neoplasm: Pancreatic duct
C25.4	Malignant neoplasm: Endocrine pancreas
C25.7	Malignant neoplasm: Other parts of pancreas
C25.8	Malignant neoplasm: Overlapping lesion of pancreas
C25.9	Malignant neoplasm: Pancreas, unspecified
C26.0	Malignant neoplasm: Intestinal tract, part unspecified
C26.1	Malignant neoplasm: Spleen
C26.8	Malignant neoplasm: Overlapping lesion of digestive system
C26.9	Malignant neoplasm: Ill-defined sites within the digestive system
C30.0	Malignant neoplasm: Nasal cavity
C30.1	Malignant neoplasm: Middle ear
C31.0	Malignant neoplasm: Maxillary sinus
C31.1	Malignant neoplasm: Ethmoidal sinus
C31.2	Malignant neoplasm: Frontal sinus

C31.3	Malignant neoplasm: Sphenoidal sinus
C31.8	Malignant neoplasm: Overlapping lesion of accessory sinuses
C31.9	Malignant neoplasm: Accessory sinus, unspecified
C32.0	Malignant neoplasm: Glottis
C32.1	Malignant neoplasm: Supraglottis
C32.2	Malignant neoplasm: Subglottis
C32.3	Malignant neoplasm: Laryngeal cartilage
C32.8	Malignant neoplasm: Overlapping lesion of larynx
C32.9	Malignant neoplasm: Larynx, unspecified
C33	Malignant neoplasm of trachea
C34.0	Malignant neoplasm: Main bronchus
C34.1	Malignant neoplasm: Upper lobe, bronchus or lung
C34.2	Malignant neoplasm: Middle lobe, bronchus or lung
C34.3	Malignant neoplasm: Lower lobe, bronchus or lung
C34.8	Malignant neoplasm: Overlapping lesion of bronchus and lung
C34.9	Malignant neoplasm: Bronchus or lung, unspecified
C37	Malignant neoplasm of thymus
C38.0	Malignant neoplasm: Heart
C38.1	Malignant neoplasm: Anterior mediastinum
C38.2	Malignant neoplasm: Posterior mediastinum
C38.3	Malignant neoplasm: Mediastinum, part unspecified
C38.4	Malignant neoplasm: Pleura
C38.8	Malignant neoplasm: Overlapping lesion of heart, mediastinum and pleura
C39.0	Malignant neoplasm: Upper respiratory tract, part unspecified
C39.8	Malignant neoplasm: Overlapping lesion of respiratory and intrathoracic organs
C39.9	Malignant neoplasm: Ill-defined sites within the respiratory system
C40.0	Malignant neoplasm: Scapula and long bones of upper limb
C40.1	Malignant neoplasm: Short bones of upper limb
C40.2	Malignant neoplasm: Long bones of lower limb
C40.3	Malignant neoplasm: Short bones of lower limb
C40.8	Malignant neoplasm: Overlapping lesion of bone and articular cartilage of limbs
C40.9	Malignant neoplasm: Bone and articular cartilage of limb, unspecified
C41.0	Malignant neoplasm: Bones of skull and face

C41.1	Malignant neoplasm: Mandible
C41.2	Malignant neoplasm: Vertebral column
C41.3	Malignant neoplasm: Ribs, sternum and clavicle
C41.4	Malignant neoplasm: Pelvic bones, sacrum and coccyx
C41.8	Malignant neoplasm: Overlapping lesion of bone and articular cartilage
C41.9	Malignant neoplasm: Bone and articular cartilage, unspecified
C43.0	Malignant neoplasm: Malignant melanoma of lip
C43.1	Malignant neoplasm: Malignant melanoma of eyelid, including canthus
C43.2	Malignant neoplasm: Malignant melanoma of ear and external auricular canal
C43.3	Malignant neoplasm: Malignant melanoma of other and unspecified parts of face
C43.4	Malignant neoplasm: Malignant melanoma of scalp and neck
C43.5	Malignant neoplasm: Malignant melanoma of trunk
C43.6	Malignant neoplasm: Malignant melanoma of upper limb, including shoulder
C43.7	Malignant neoplasm: Malignant melanoma of lower limb, including hip
C43.8	Malignant neoplasm: Overlapping malignant melanoma of skin
C43.9	Malignant neoplasm: Malignant melanoma of skin, unspecified
C45.0	Mesothelioma of pleura
C45.1	Mesothelioma of peritoneum
C45.2	Mesothelioma of pericardium
C45.7	Mesothelioma of other sites
C45.9	Mesothelioma, unspecified
C46.0	Kaposi's sarcoma of skin
C46.1	Kaposi's sarcoma of soft tissue
C46.2	Kaposi's sarcoma of palate
C46.3	Kaposi's sarcoma of lymph nodes
C46.7	Kaposi's sarcoma of other sites
C46.8	Kaposi's sarcoma of multiple organs
C46.9	Kaposi's sarcoma, unspecified
C47.0	Malignant neoplasm: Peripheral nerves of head, face and neck
C47.1	Malignant neoplasm: Peripheral nerves of upper limb, including shoulder

C47.2	Malignant neoplasm: Peripheral nerves of lower limb, including hip
C47.3	Malignant neoplasm: Peripheral nerves of thorax
C47.4	Malignant neoplasm: Peripheral nerves of abdomen
C47.5	Malignant neoplasm: Peripheral nerves of pelvis
C47.6	Malignant neoplasm: Peripheral nerves of trunk, unspecified
C47.8	Malignant neoplasm: Overlapping lesion of peripheral nerves and autonomic nervous system
C47.9	Malignant neoplasm: Peripheral nerves and autonomic nervous system, unspecified
C48.0	Malignant neoplasm: Retroperitoneum
C48.1	Malignant neoplasm: Specified parts of peritoneum
C48.2	Malignant neoplasm: Peritoneum, unspecified
C48.8	Malignant neoplasm: Overlapping lesion of retroperitoneum and peritoneum
C49.0	Malignant neoplasm: Connective and soft tissue of head, face and neck
C49.1	Malignant neoplasm: Connective and soft tissue of upper limb, including shoulder
C49.2	Malignant neoplasm: Connective and soft tissue of lower limb, including hip
C49.3	Malignant neoplasm: Connective and soft tissue of thorax
C49.4	Malignant neoplasm: Connective and soft tissue of abdomen
C49.5	Malignant neoplasm: Connective and soft tissue of pelvis
C49.6	Malignant neoplasm: Connective and soft tissue of trunk, unspecified
C49.8	Malignant neoplasm: Overlapping lesion of connective and soft tissue
C49.9	Malignant neoplasm: Connective and soft tissue, unspecified
C50.0	Malignant neoplasm: Nipple and areola
C50.1	Malignant neoplasm: Central portion of breast
C50.2	Malignant neoplasm: Upper-inner quadrant of breast
C50.3	Malignant neoplasm: Lower-inner quadrant of breast
C50.4	Malignant neoplasm: Upper-outer quadrant of breast
C50.5	Malignant neoplasm: Lower-outer quadrant of breast
C50.6	Malignant neoplasm: Axillary tail of breast
C50.8	Malignant neoplasm: Overlapping lesion of breast
C50.9	Malignant neoplasm: Breast, unspecified
C51.0	Malignant neoplasm: Labium majus
C51.1	Malignant neoplasm: Labium minus

C51.2	Malignant neoplasm: Clitoris
C51.8	Malignant neoplasm: Overlapping lesion of vulva
C51.9	Malignant neoplasm: Vulva, unspecified
C52	Malignant neoplasm of vagina
C53.0	Malignant neoplasm: Endocervix
C53.1	Malignant neoplasm: Exocervix
C53.8	Malignant neoplasm: Overlapping lesion of cervix uteri
C53.9	Malignant neoplasm: Cervix uteri, unspecified
C54.0	Malignant neoplasm: Isthmus uteri
C54.1	Malignant neoplasm: Endometrium
C54.2	Malignant neoplasm: Myometrium
C54.3	Malignant neoplasm: Fundus uteri
C54.8	Malignant neoplasm: Overlapping lesion of corpus uteri
C54.9	Malignant neoplasm: Corpus uteri, unspecified
C55	Malignant neoplasm of uterus, part unspecified
C56	Malignant neoplasm of ovary
C57.0	Malignant neoplasm: Fallopian tube
C57.1	Malignant neoplasm: Broad ligament
C57.2	Malignant neoplasm: Round ligament
C57.3	Malignant neoplasm: Parametrium
C57.4	Malignant neoplasm: Uterine adnexa, unspecified
C57.7	Malignant neoplasm: Other specified female genital organs
C57.8	Malignant neoplasm: Overlapping lesion of female genital organs
C57.9	Malignant neoplasm: Female genital organ, unspecified
C58	Malignant neoplasm of placenta
C60.0	Malignant neoplasm: Prepuce
C60.1	Malignant neoplasm: Glans penis
C60.2	Malignant neoplasm: Body of penis
C60.8	Malignant neoplasm: Overlapping lesion of penis
C60.9	Malignant neoplasm: Penis, unspecified
C61	Malignant neoplasm of prostate
C62.0	Malignant neoplasm: Undescended testis
C62.1	Malignant neoplasm: Descended testis
C62.9	Malignant neoplasm: Testis, unspecified
C63.0	Malignant neoplasm: Epididymis

C63.1	Malignant neoplasm: Spermatic cord
C63.2	Malignant neoplasm: Scrotum
C63.7	Malignant neoplasm: Other specified male genital organs
C63.8	Malignant neoplasm: Overlapping lesion of male genital organs
C63.9	Malignant neoplasm: Male genital organ, unspecified
C64	Malignant neoplasm of kidney, except renal pelvis
C65	Malignant neoplasm of renal pelvis
C66	Malignant neoplasm of ureter
C67.0	Malignant neoplasm: Trigone of bladder
C67.1	Malignant neoplasm: Dome of bladder
C67.2	Malignant neoplasm: Lateral wall of bladder
C67.3	Malignant neoplasm: Anterior wall of bladder
C67.4	Malignant neoplasm: Posterior wall of bladder
C67.5	Malignant neoplasm: Bladder neck
C67.6	Malignant neoplasm: Ureteric orifice
C67.7	Malignant neoplasm: Urachus
C67.8	Malignant neoplasm: Overlapping lesion of bladder
C67.9	Malignant neoplasm: Bladder, unspecified
C68.0	Malignant neoplasm: Urethra
C68.1	Malignant neoplasm: Paraurethral gland
C68.8	Malignant neoplasm: Overlapping lesion of urinary organs
C68.9	Malignant neoplasm: Urinary organ, unspecified
C69.0	Malignant neoplasm: Conjunctiva
C69.1	Malignant neoplasm: Cornea
C69.2	Malignant neoplasm: Retina
C69.3	Malignant neoplasm: Choroid
C69.4	Malignant neoplasm: Ciliary body
C69.5	Malignant neoplasm: Lacrimal gland and duct
C69.6	Malignant neoplasm: Orbit
C69.8	Malignant neoplasm: Overlapping lesion of eye and adnexa
C69.9	Malignant neoplasm: Eye, unspecified
C70.0	Malignant neoplasm: Cerebral meninges
C70.1	Malignant neoplasm: Spinal meninges
C70.9	Malignant neoplasm: Meninges, unspecified
C71.0	Malignant neoplasm: Cerebrum, except lobes and ventricles

C71.1	Malignant neoplasm: Frontal lobe
C71.2	Malignant neoplasm: Temporal lobe
C71.3	Malignant neoplasm: Parietal lobe
C71.4	Malignant neoplasm: Occipital lobe
C71.5	Malignant neoplasm: Cerebral ventricle
C71.6	Malignant neoplasm: Cerebellum
C71.7	Malignant neoplasm: Brain stem
C71.8	Malignant neoplasm: Overlapping lesion of brain
C71.9	Malignant neoplasm: Brain, unspecified
C72.0	Malignant neoplasm: Spinal cord
C72.1	Malignant neoplasm: Cauda equina
C72.2	Malignant neoplasm: Olfactory nerve
C72.3	Malignant neoplasm: Optic nerve
C72.4	Malignant neoplasm: Acoustic nerve
C72.5	Malignant neoplasm: Other and unspecified cranial nerves
C72.8	Malignant neoplasm: Overlapping lesion of brain and other parts of central nervous system
C72.9	Malignant neoplasm: Central nervous system, unspecified
C73	Malignant neoplasm of thyroid gland
C74.0	Malignant neoplasm: Cortex of adrenal gland
C74.1	Malignant neoplasm: Medulla of adrenal gland
C74.9	Malignant neoplasm: Adrenal gland, unspecified
C75.0	Malignant neoplasm: Parathyroid gland
C75.1	Malignant neoplasm: Pituitary gland
C75.2	Malignant neoplasm: Craniopharyngeal duct
C75.3	Malignant neoplasm: Pineal gland
C75.4	Malignant neoplasm: Carotid body
C75.5	Malignant neoplasm: Aortic body and other paraganglia
C75.8	Malignant neoplasm: Pluriglandular involvement, unspecified
C75.9	Malignant neoplasm: Endocrine gland, unspecified
C76.0	Malignant neoplasm of other and ill-defined sites: Head, face and neck
C76.1	Malignant neoplasm of other and ill-defined sites: Thorax
C76.2	Malignant neoplasm of other and ill-defined sites: Abdomen
C76.3	Malignant neoplasm of other and ill-defined sites: Pelvis

C76.4	Malignant neoplasm of other and ill-defined sites: Upper limb
C76.5	Malignant neoplasm of other and ill-defined sites: Lower limb
C76.7	Malignant neoplasm of other and ill-defined sites: Other ill-defined sites
C76.8	Malignant neoplasm of other and ill-defined sites: Overlapping lesion of other and ill-defined sites
C77.0	Secondary and unspecified malignant neoplasm: Lymph nodes of head, face and neck
C77.1	Secondary and unspecified malignant neoplasm: Intrathoracic lymph nodes
C77.2	Secondary and unspecified malignant neoplasm: Intra-abdominal lymph nodes
C77.3	Secondary and unspecified malignant neoplasm: Axillary and upper limb lymph nodes
C77.4	Secondary and unspecified malignant neoplasm: Inguinal and lower limb lymph nodes
C77.5	Secondary and unspecified malignant neoplasm: Intrapelvic lymph nodes
C77.8	Secondary and unspecified malignant neoplasm: Lymph nodes of multiple regions
C77.9	Secondary and unspecified malignant neoplasm: Lymph node, unspecified
C78.0	Secondary malignant neoplasm of lung
C78.1	Secondary malignant neoplasm of mediastinum
C78.2	Secondary malignant neoplasm of pleura
C78.3	Secondary malignant neoplasm of other and unspecified respiratory organs
C78.4	Secondary malignant neoplasm of small intestine
C78.5	Secondary malignant neoplasm of large intestine and rectum
C78.6	Secondary malignant neoplasm of retroperitoneum and peritoneum
C78.7	Secondary malignant neoplasm of liver
C78.8	Secondary malignant neoplasm of other and unspecified digestive organs
C79.0	Secondary malignant neoplasm of kidney and renal pelvis
C79.1	Secondary malignant neoplasm of bladder and other and unspecified urinary organs
C79.2	Secondary malignant neoplasm of skin
C79.3	Secondary malignant neoplasm of brain and cerebral meninges
C79.4	Secondary malignant neoplasm of other and unspecified parts of

	nervous system
C79.5	Secondary malignant neoplasm of bone and bone marrow
C79.6	Secondary malignant neoplasm of ovary
C79.7	Secondary malignant neoplasm of adrenal gland
C79.8	Secondary malignant neoplasm of other specified sites
C80	Malignant neoplasm without specification of site
C81.0	Hodgkin's disease: Lymphocytic predominance
C81.1	Hodgkin's disease: Nodular sclerosis
C81.2	Hodgkin's disease: Mixed cellularity
C81.3	Hodgkin's disease: Lymphocytic depletion
C81.7	Hodgkin's disease: Other Hodgkin's disease
C81.9	Hodgkin's disease: Hodgkin's disease, unspecified
C82.0	Non-Hodgkin's lymphoma: Small cleaved cell, follicular
C82.1	Non-Hodgkin's lymphoma: Mixed small cleaved and large cell, follicular
C82.2	Non-Hodgkin's lymphoma: Large cell, follicular
C82.7	Other types of follicular non-Hodgkin's lymphoma
C82.9	Follicular non-Hodgkin's lymphoma, unspecified
C83.0	Non-Hodgkin's lymphoma: Small cell (diffuse)
C83.1	Non-Hodgkin's lymphoma: Small cleaved cell (diffuse)
C83.2	Non-Hodgkin's lymphoma: Mixed small and large cell (diffuse)
C83.3	Non-Hodgkin's lymphoma: Large cell (diffuse)
C83.4	Non-Hodgkin's lymphoma: Immunoblastic (diffuse)
C83.5	Non-Hodgkin's lymphoma: Lymphoblastic (diffuse)
C83.6	Non-Hodgkin's lymphoma: Undifferentiated (diffuse)
C83.7	Burkitt's tumour
C83.8	Other types of diffuse non-Hodgkin's lymphoma
C83.9	Diffuse non-Hodgkin's lymphoma, unspecified
C84.0	Mycosis fungoides
C84.1	Sezary's disease
C84.2	T-zone lymphoma
C84.3	Lymphoepithelioid lymphoma
C84.4	Peripheral T-cell lymphoma
C84.5	Other and unspecified T-cell lymphomas
C85.0	Lymphosarcoma

C85.1	B-cell lymphoma, unspecified
C85.7	Other specified types of non-Hodgkin's lymphoma
C85.9	Non-Hodgkin's lymphoma, unspecified type
C88.0	Waldenstr¸m's macroglobulinaemia
C90.0	Multiple myeloma
C90.1	Plasma cell leukaemia
C90.2	Plasmacytoma, extramedullary
C91.0	Acute lymphoblastic leukaemia
C91.1	Chronic lymphocytic leukaemia
C91.2	Subacute lymphocytic leukaemia
C91.3	Prolymphocytic leukaemia
C91.4	Hairy-cell leukaemia
C91.5	Adult T-cell leukaemia
C91.7	Other lymphoid leukaemia
C91.9	Lymphoid leukaemia, unspecified
C92.0	Acute myeloid leukaemia
C92.1	Chronic myeloid leukaemia
C92.2	Subacute myeloid leukaemia
C92.3	Myeloid sarcoma
C92.4	Acute promyelocytic leukaemia
C92.5	Acute myelomonocytic leukaemia
C92.7	Other myeloid leukaemia
C92.9	Myeloid leukaemia, unspecified
C93.0	Acute monocytic leukaemia
C93.1	Chronic monocytic leukaemia
C93.2	Subacute monocytic leukaemia
C93.7	Other monocytic leukaemia
C93.9	Monocytic leukaemia, unspecified
C94.0	Acute erythraemia and erythroleukaemia
C94.1	Chronic erythraemia
C94.2	Acute megakaryoblastic leukaemia
C94.3	Mast cell leukaemia
C94.4	Acute panmyelosis
C94.5	Acute myelofibrosis
C94.7	Other specified leukaemias

C95.0	Acute leukaemia of unspecified cell type
C95.1	Chronic leukaemia of unspecified cell type
C95.2	Subacute leukaemia of unspecified cell type
C95.7	Other leukaemia of unspecified cell type
C95.9	Leukaemia, unspecified
C96.0	Letterer-Siwe disease
C96.1	Malignant histiocytosis
C96.2	Malignant mast cell tumour
C96.3	True histiocytic lymphoma
C96.7	Other specified malignant neoplasms of lymphoid, haematopoietic and related tissue
C96.9	Malignant neoplasm of lymphoid, haematopoietic and related tissue, unspecified
C97	Malignant neoplasms of independent (primary) multiple sites
Z85.0	Personal history of malignant neoplasm of digestive organs
Z85.1	Personal history of malignant neoplasm of trachea, bronchus and lung
Z85.2	Personal history of malignant neoplasm of other respiratory and intrathoracic organs
Z85.3	Personal history of malignant neoplasm of breast
Z85.4	Personal history of malignant neoplasm of genital organs
Z85.5	Personal history of malignant neoplasm of urinary tract
Z85.6	Personal history of leukaemia
Z85.7	Personal history of other malignant neoplasms of lymphoid, haematopoietic and related tissues
Z85.8	Personal history of malignant neoplasms of other organs and systems
Z85.9	Personal history of malignant neoplasm, unspecified

2. Infection codes

ICD–10	**Code description**
A00.0	Cholera due to Vibrio cholerae 01, biovar cholerae
A00.1	Cholera due to Vibrio cholerae 01, biovar eltor
A00.9	Cholera, unspecified
A01.0	Typhoid fever
A01.1	Paratyphoid fever A
A01.2	Paratyphoid fever B

A01.3	Paratyphoid fever C
A01.4	Paratyphoid fever, unspecified
A02.0	Salmonella enteritis
A02.1	Salmonella septicaemia
A02.2	Localized salmonella infections
A02.8	Other specified salmonella infections
A02.9	Salmonella infection, unspecified
A03.0	Shigellosis due to Shigella dysenteriae
A03.1	Shigellosis due to Shigella flexneri
A03.2	Shigellosis due to Shigella boydii
A03.3	Shigellosis due to Shigella sonnei
A03.8	Other shigellosis
A03.9	Shigellosis, unspecified
A04.0	Enteropathogenic Escherichia coli infection
A04.1	Enterotoxigenic Escherichia coli infection
A04.2	Enteroinvasive Escherichia coli infection
A04.3	Enterohaemorrhagic Escherichia coli infection
A04.4	Other intestinal Escherichia coli infections
A04.5	Campylobacter enteritis
A04.6	Enteritis due to Yersinia enterocolitica
A04.7	Enterocolitis due to Clostridium difficile
A04.8	Other specified bacterial intestinal infections
A04.9	Bacterial intestinal infection, unspecified
A05.0	Foodborne staphylococcal intoxication
A05.1	Botulism
A05.2	Foodborne Clostridium perfringens [Clostridium welchii] intoxication
A05.3	Foodborne Vibrio parahaemolyticus intoxication
A05.4	Foodborne Bacillus cereus intoxication
A05.8	Other specified bacterial foodborne intoxications
A05.9	Bacterial foodborne intoxication, unspecified
A20.0	Bubonic plague
A20.1	Cellulocutaneous plague
A20.2	Pneumonic plague
A20.3	Plague meningitis
A20.7	Septicaemic plague

A20.8	Other forms of plague
A20.9	Plague, unspecified
A21.0	Ulceroglandular tularaemia
A21.1	Oculoglandular tularaemia
A21.2	Pulmonary tularaemia
A21.3	Gastrointestinal tularaemia
A21.7	Generalized tularaemia
A21.8	Other forms of tularaemia
A21.9	Tularaemia, unspecified
A22.0	Cutaneous anthrax
A22.1	Pulmonary anthrax
A22.2	Gastrointestinal anthrax
A22.7	Anthrax septicaemia
A22.8	Other forms of anthrax
A22.9	Anthrax, unspecified
A23.0	Brucellosis due to Brucella melitensis
A23.1	Brucellosis due to Brucella abortus
A23.2	Brucellosis due to Brucella suis
A23.3	Brucellosis due to Brucella canis
A23.8	Other brucellosis
A23.9	Brucellosis, unspecified
A24.0	Glanders
A24.1	Acute and fulminating melioidosis
A24.2	Subacute and chronic melioidosis
A24.3	Other melioidosis
A24.4	Melioidosis, unspecified
A25.0	Spirillosis
A25.1	Streptobacillosis
A25.9	Rat-bite fever, unspecified
A26.0	Cutaneous erysipeloid
A26.7	Erysipelothrix septicaemia
A26.8	Other forms of erysipeloid
A26.9	Erysipeloid, unspecified
A28.0	Pasteurellosis
A28.1	Cat-scratch disease

A28.2	Extraintestinal yersiniosis
A28.8	Other specified zoonotic bacterial diseases, not elsewhere classified
A28.9	Zoonotic bacterial disease, unspecified
A32.0	Cutaneous listeriosis
A32.1	Listerial meningitis and meningoencephalitis
A32.7	Listerial septicaemia
A32.8	Other forms of listeriosis
A32.9	Listeriosis, unspecified
A33	Tetanus neonatorum
A34	Obstetrical tetanus
A35	Other tetanus
A36.0	Pharyngeal diphtheria
A36.1	Nasopharyngeal diphtheria
A36.2	Laryngeal diphtheria
A36.3	Cutaneous diphtheria
A36.8	Other diphtheria
A36.9	Diphtheria, unspecified
A37.0	Whooping cough due to Bordetella pertussis
A37.1	Whooping cough due to Bordetella parapertussis
A37.8	Whooping cough due to other Bordetella species
A37.9	Whooping cough, unspecified
A38	Scarlet fever
A39.0	Meningococcal meningitis
A39.1	Waterhouse-Friderichsen syndrome
A39.2	Acute meningococcaemia
A39.3	Chronic meningococcaemia
A39.4	Meningococcaemia, unspecified
A39.5	Meningococcal heart disease
A39.8	Other meningococcal infections
A39.9	Meningococcal infection, unspecified
A40.0	Septicaemia due to streptococcus, group A
A40.1	Septicaemia due to streptococcus, group B
A40.2	Septicaemia due to streptococcus, group D
A40.3	Septicaemia due to Streptococcus pneumoniae
A40.8	Other streptococcal septicaemia

A40.9	Streptococcal septicaemia, unspecified
A41.0	Septicaemia due to Staphylococcus aureus
A41.1	Septicaemia due to other specified staphylococcus
A41.2	Septicaemia due to unspecified staphylococcus
A41.3	Septicaemia due to Haemophilus influenzae
A41.4	Septicaemia due to anaerobes
A41.5	Septicaemia due to other Gram-negative organisms
A41.8	Other specified septicaemia
A41.9	Septicaemia, unspecified
A42.0	Pulmonary actinomycosis
A42.1	Abdominal actinomycosis
A42.2	Cervicofacial actinomycosis
A42.7	Actinomycotic septicaemia
A42.8	Other forms of actinomycosis
A42.9	Actinomycosis, unspecified
A43.0	Pulmonary nocardiosis
A43.1	Cutaneous nocardiosis
A43.8	Other forms of nocardiosis
A43.9	Nocardiosis, unspecified
A46	Erysipelas
A48.0	Gas gangrene
A48.1	Legionnaires' disease
A48.2	Nonpneumonic Legionnaires' disease [Pontiac fever]
A48.3	Toxic shock syndrome
A48.4	Brazilian purpuric fever
A48.8	Other specified bacterial diseases
A49.0	Staphylococcal infection, unspecified
A49.1	Streptococcal infection, unspecified
A49.2	Haemophilus influenzae infection, unspecified
A49.3	Mycoplasma infection, unspecified
A49.8	Other bacterial infections of unspecified site
A49.9	Bacterial infection, unspecified
A54.0	Gonococcal infection of lower genitourinary tract without periurethral or accessory gland abscess
A54.1	Gonococcal infection of lower genitourinary tract with periurethral

	and accessory gland abscess
A54.2	Gonococcal pelviperitonitis and other gonococcal genitourinary infections
A54.3	Gonococcal infection of eye
A54.4	Gonococcal infection of musculoskeletal system
A54.5	Gonococcal pharyngitis
A54.6	Gonococcal infection of anus and rectum
A54.8	Other gonococcal infections
A54.9	Gonococcal infection, unspecified
B95.0	Streptococcus, group A, as the cause of diseases classified to other chapters
B95.1	Streptococcus, group B, as the cause of diseases classified to other chapters
B95.2	Streptococcus, group D, as the cause of diseases classified to other chapters
B95.3	Streptococcus pneumoniae as the cause of diseases classified to other chapters
B95.4	Other streptococcus as the cause of diseases classified to other chapters
B95.5	Unspecified streptococcus as the cause of diseases classified to other chapters
B95.6	Staphylococcus aureus as the cause of diseases classified to other chapters
B95.7	Other staphylococcus as the cause of diseases classified to other chapters
B95.8	Unspecified staphylococcus as the cause of diseases classified to other chapters
B96.0	Mycoplasma pneumoniae [M. pneumoniae] as the cause of diseases classified to other chapters
B96.1	Klebsiella pneumoniae [K. pneumoniae] as the cause of diseases classified to other chapters
B96.2	Escherichia coli [E. coli] as the cause of diseases classified to other chapters
B96.3	Haemophilus influenzae [H. influenzae] as the cause of diseases classified to other chapters
B96.4	Proteus (mirabilis)(morganii) as the cause of diseases classified to other chapters
B96.5	Pseudomonas (aeruginosa)(mallei)(pseudomallei) as the cause of diseases classified to other chapters
B96.6	Bacillus fragilis [B. fragilis] as the cause of diseases classified to

	other chapters
B96.7	Clostridium perfringens [C. perfringens] as the cause of diseases classified to other chapters
B96.8	Other specified bacterial agents as the cause of diseases classified to other chapters
D73.3	Abscess of spleen
E32.1	Abscess of thymus
G00.0	Haemophilus meningitis
G00.1	Pneumococcal meningitis
G00.2	Streptococcal meningitis
G00.3	Staphylococcal meningitis
G00.8	Other bacterial meningitis
G00.9	Bacterial meningitis, unspecified
G03.8	Meningitis due to other specified causes
G03.9	Meningitis, unspecified
G04.2	Bacterial meningoencephalitis and meningomyelitis, not elsewhere classified
G06.0	Intracranial abscess and granuloma
G06.1	Intraspinal abscess and granuloma
G06.2	Extradural and subdural abscess, unspecified
G07	Intracranial and intraspinal abscess and granuloma in diseases classified elsewhere
H00.0	Hordeolum and other deep inflammation of eyelid
H01.0	Blepharitis
H01.8	Other specified inflammation of eyelid
H04.0	Dacryoadenitis
H04.3	Acute and unspecified inflammation of lacrimal passages
H04.4	Chronic inflammation of lacrimal passages
H05.0	Acute inflammation of orbit
H10.0	Mucopurulent conjunctivitis
H10.2	Other acute conjunctivitis
H10.3	Acute conjunctivitis, unspecified
H10.5	Blepharoconjunctivitis
H10.8	Other conjunctivitis
H10.9	Conjunctivitis, unspecified
H13.1	Conjunctivitis in infectious and parasitic diseases classified elsewhere

H44.0	Purulent endophthalmitis
H60.0	Abscess of external ear
H60.1	Cellulitis of external ear
H60.2	Malignant otitis externa
H60.3	Other infective otitis externa
H60.9	Otitis externa, unspecified
H66.0	Acute suppurative otitis media
H66.1	Chronic tubotympanic suppurative otitis media
H66.2	Chronic atticoantral suppurative otitis media
H66.3	Other chronic suppurative otitis media
H66.4	Suppurative otitis media, unspecified
H66.9	Otitis media, unspecified
H68.0	Eustachian salpingitis
H70.0	Acute mastoiditis
H70.2	Petrositis
H73.0	Acute myringitis
H83.0	Labyrinthitis
I30.1	Infective pericarditis
I30.8	Other forms of acute pericarditis
I30.9	Acute pericarditis, unspecified
I32.0	Pericarditis in bacterial diseases classified elsewhere
I33.0	Acute and subacute infective endocarditis
I33.9	Acute endocarditis, unspecified
I40.0	Infective myocarditis
J01.0	Acute maxillary sinusitis
J01.1	Acute frontal sinusitis
J01.2	Acute ethmoidal sinusitis
J01.3	Acute sphenoidal sinusitis
J01.4	Acute pansinusitis
J01.8	Other acute sinusitis
J01.9	Acute sinusitis, unspecified
J02.0	Streptococcal pharyngitis
J02.8	Acute pharyngitis due to other specified organisms
J02.9	Acute pharyngitis, unspecified
J03.0	Streptococcal tonsillitis

J03.8	Acute tonsillitis due to other specified organisms
J03.9	Acute tonsillitis, unspecified
J05.1	Acute epiglottitis
J13	Pneumonia due to Streptococcus pneumoniae
J14	Pneumonia due to Haemophilus influenzae
J15.0	Pneumonia due to Klebsiella pneumoniae
J15.1	Pneumonia due to Pseudomonas
J15.2	Pneumonia due to staphylococcus
J15.3	Pneumonia due to streptococcus, group B
J15.4	Pneumonia due to other streptococci
J15.5	Pneumonia due to Escherichia coli
J15.6	Pneumonia due to other aerobic Gram-negative bacteria
J15.7	Pneumonia due to Mycoplasma pneumoniae
J15.8	Other bacterial pneumonia
J15.9	Bacterial pneumonia, unspecified
J17.0	Pneumonia in bacterial diseases classified elsewhere
J18.0	Bronchopneumonia, unspecified
J18.1	Lobar pneumonia, unspecified
J18.8	Other pneumonia, organism unspecified
J20.0	Acute bronchitis due to Mycoplasma pneumoniae
J20.1	Acute bronchitis due to Haemophilus influenzae
J20.2	Acute bronchitis due to streptococcus
J34.0	Abscess, furuncle and carbuncle of nose
J36	Peritonsillar abscess
J39.0	Retropharyngeal and parapharyngeal abscess
J39.1	Other abscess of pharynx
J40	Bronchitis, not specified as acute or chronic
J44.0	Chronic obstructive pulmonary disease with acute lower respiratory infection
J85.0	Gangrene and necrosis of lung
J85.1	Abscess of lung with pneumonia
J85.2	Abscess of lung without pneumonia
J85.3	Abscess of mediastinum
J86.0	Pyothorax with fistula
J86.9	Pyothorax without fistula

J90	Pleural effusion, not elsewhere classified
J98.5	Diseases of mediastinum, not elsewhere classified
K04.0	Pulpitis
K04.6	Periapical abscess with sinus
K04.7	Periapical abscess without sinus
K05.0	Acute gingivitis
K05.2	Acute periodontitis
K10.2	Inflammatory conditions of jaws
K11.3	Abscess of salivary gland
K12.2	Cellulitis and abscess of mouth
K35.0	Acute appendicitis with generalized peritonitis
K35.1	Acute appendicitis with peritoneal abscess
K35.9	Acute appendicitis, unspecified
K36	Other appendicitis
K37	Unspecified appendicitis
K57.0	Diverticular disease of small intestine with perforation and abscess
K57.1	Diverticular disease of small intestine without perforation or abscess
K57.2	Diverticular disease of large intestine with perforation and abscess
K57.3	Diverticular disease of large intestine without perforation or abscess
K57.4	Diverticular disease of both small and large intestine with perforation and abscess
K57.5	Diverticular disease of both small and large intestine without perforation or abscess
K57.8	Diverticular disease of intestine, part unspecified, with perforation and abscess
K57.9	Diverticular disease of intestine, part unspecified, without perforation or abscess
K61.0	Anal abscess
K61.1	Rectal abscess
K61.2	Anorectal abscess
K61.3	Ischiorectal abscess
K61.4	Intrasphincteric abscess
K63.0	Abscess of intestine
K65.0	Acute peritonitis
K65.8	Other peritonitis
K65.9	Peritonitis, unspecified

K67.1	Gonococcal peritonitis
K75.0	Abscess of liver
K75.1	Phlebitis of portal vein
K80.0	Calculus of gallbladder with acute cholecystitis
K80.3	Calculus of bile duct with cholangitis
K80.4	Calculus of bile duct with cholecystitis
K81.0	Acute cholecystitis
K81.8	Other cholecystitis
K81.9	Cholecystitis, unspecified
K82.2	Perforation of gallbladder
K83.0	Cholangitis
K83.2	Perforation of bile duct
K85.0	Idiopathic acute pancreatitis
K85.1	Biliary acute pancreatitis
K85.2	Alcohol-induced acute pancreatitis
K85.3	Drug-induced acute pancreatitis
K85.8	Other acute pancreatitis
K85.9	Acute pancreatitis, unspecified
L00	Staphylococcal scalded skin syndrome
L01.0	Impetigo [any organism] [any site]
L01.1	Impetiginization of other dermatoses
L02.0	Cutaneous abscess, furuncle and carbuncle of face
L02.1	Cutaneous abscess, furuncle and carbuncle of neck
L02.2	Cutaneous abscess, furuncle and carbuncle of trunk
L02.3	Cutaneous abscess, furuncle and carbuncle of buttock
L02.4	Cutaneous abscess, furuncle and carbuncle of limb
L02.8	Cutaneous abscess, furuncle and carbuncle of other sites
L02.9	Cutaneous abscess, furuncle and carbuncle, unspecified
L03.0	Cellulitis of finger and toe
L03.1	Cellulitis of other parts of limb
L03.2	Cellulitis of face
L03.3	Cellulitis of trunk
L03.8	Cellulitis of other sites
L03.9	Cellulitis, unspecified
L04.0	Acute lymphadenitis of face, head and neck

L04.1	Acute lymphadenitis of trunk
L04.2	Acute lymphadenitis of upper limb
L04.3	Acute lymphadenitis of lower limb
L04.8	Acute lymphadenitis of other sites
L04.9	Acute lymphadenitis, unspecified
L05.0	Pilonidal cyst with abscess
L08.0	Pyoderma
L08.8	Other specified local infections of skin and subcutaneous tissue
L08.9	Local infection of skin and subcutaneous tissue, unspecified
L30.3	Infective dermatitis
M00.0	Staphylococcal arthritis and polyarthritis
M00.1	Pneumococcal arthritis and polyarthritis
M00.2	Other streptococcal arthritis and polyarthritis
M00.8	Arthritis and polyarthritis due to other specified bacterial agents
M00.9	Pyogenic arthritis, unspecified
M03.0	Postmeningococcal arthritis
M03.1	Postinfective arthropathy in syphilis
M03.2	Other postinfectious arthropathies in diseases classified elsewhere
M03.6	Reactive arthropathy in other diseases classified elsewhere
M46.2	Osteomyelitis of vertebra
M60.0	Infective myositis
M63.0	Myositis in bacterial diseases classified elsewhere
M72..6	Necrotizing fasciitis
M73.0	Gonococcal bursitis
M86.0	Acute haematogenous osteomyelitis
M86.1	Other acute osteomyelitis
M86.2	Subacute osteomyelitis
M86.3	Chronic multifocal osteomyelitis
M86.4	Chronic osteomyelitis with draining sinus
M86.5	Other chronic haematogenous osteomyelitis
M86.6	Other chronic osteomyelitis
M86.8	Other osteomyelitis
M86.9	Osteomyelitis, unspecified
M90.1	Periostitis in other infectious diseases classified elsewhere
N10	Acute tubulo-interstitial nephritis

N12	Tubulo-interstitial nephritis, not specified as acute or chronic
N13.6	Pyonephrosis
N15.1	Renal and perinephric abscess
N30.0	Acute cystitis
N30.8	Other cystitis
N30.9	Cystitis, unspecified
N34.0	Urethral abscess
N39.0	Urinary tract infection, site not specified
N41.0	Acute prostatitis
N41.2	Abscess of prostate
N41.3	Prostatocystitis
N41.8	Other inflammatory diseases of prostate
N41.9	Inflammatory disease of prostate, unspecified
N43.1	Infected hydrocele
N45.0	Orchitis, epididymitis and epididymo-orchitis with abscess
N45.9	Orchitis, epididymitis and epididymo-orchitis without abscess
N48.1	Balanoposthitis
N48.2	Other inflammatory disorders of penis
N49.0	Inflammatory disorders of seminal vesicle
N49.1	Inflammatory disorders of spermatic cord, tunica vaginalis and vas deferens
N49.2	Inflammatory disorders of scrotum
N49.8	Inflammatory disorders of other specified male genital organs
N49.9	Inflammatory disorder of unspecified male genital organ
N51.0	Disorders of prostate in diseases classified elsewhere
N51.1	Disorders of testis and epididymis in diseases classified elsewhere
N61	Inflammatory disorders of breast
N70.0	Acute salpingitis and oophoritis
N70.1	Chronic salpingitis and oophoritis
N70.9	Salpingitis and oophoritis, unspecified
N71.0	Acute inflammatory disease of uterus
N71.9	Inflammatory disease of uterus, unspecified
N72	Inflammatory disease of cervix uteri
N73.0	Acute parametritis and pelvic cellulitis
N73.1	Chronic parametritis and pelvic cellulitis

N73.2	Unspecified parametritis and pelvic cellulitis
N73.3	Female acute pelvic peritonitis
N73.5	Female pelvic peritonitis, unspecified
N73.9	Female pelvic inflammatory disease, unspecified
N75.1	Abscess of Bartholin's gland
N76.0	Acute vaginitis
N76.1	Subacute and chronic vaginitis
N76.2	Acute vulvitis
N76.3	Subacute and chronic vulvitis
N76.4	Abscess of vulva
N76.8	Other specified inflammation of vagina and vulva
O03.0	Spontaneous abortion, incomplete, complicated by genital tract and pelvic infection
O03.5	Spontaneous abortion, complete or unspecified, complicated by genital tract and pelvic infection
O04.0	Medical abortion, incomplete, complicated by genital tract and pelvic infection
O04.5	Medical abortion, complete or unspecified, complicated by genital tract and pelvic infection
O05.0	Other abortion, incomplete, complicated by genital tract and pelvic infection
O05.5	Other abortion, complete or unspecified, complicated by genital tract and pelvic infection
O06.0	Unspecified abortion, incomplete, complicated by genital tract and pelvic infection
O06.5	Unspecified abortion, complete or unspecified, complicated by genital tract and pelvic infection
O07.0	Failed medical abortion, complicated by genital tract and pelvic infection
O07.5	Other and unspecified failed attempted abortion, complicated by genital tract and pelvic infection
O08.0	Genital tract and pelvic infection following abortion and ectopic and molar pregnancy
O23.0	Infections of kidney in pregnancy
O23.1	Infections of bladder in pregnancy
O23.2	Infections of urethra in pregnancy
O23.3	Infections of other parts of urinary tract in pregnancy
O23.4	Unspecified infection of urinary tract in pregnancy

O23.5	Infections of the genital tract in pregnancy
O23.9	Other and unspecified genitourinary tract infection in pregnancy
O41.1	Infection of amniotic sac and membranes
O86.1	Other infection of genital tract following delivery
O86.2	Urinary tract infection following delivery
O86.3	Other genitourinary tract infections following delivery
O86.4	Pyrexia of unknown origin following delivery
O91.0	Infection of nipple associated with childbirth
O91.1	Abscess of breast associated with childbirth
O91.2	Nonpurulent mastitis associated with childbirth
O98.2	Gonorrhoea complicating pregnancy, childbirth and the puerperium
O98.8	Other maternal infectious and parasitic diseases complicating pregnancy, childbirth and the puerperium
O98.9	Unspecified maternal infectious or parasitic disease complicating pregnancy, childbirth and the puerperium
P36.0	Sepsis of newborn due to streptococcus, group B
P36.1	Sepsis of newborn due to other and unspecified streptococci
P36.2	Sepsis of newborn due to Staphylococcus aureus
P36.3	Sepsis of newborn due to other and unspecified staphylococci
P36.4	Sepsis of newborn due to Escherichia coli
P36.5	Sepsis of newborn due to anaerobes
P36.8	Other bacterial sepsis of newborn
P36.9	Bacterial sepsis of newborn, unspecified
P38	Omphalitis of newborn with or without mild haemorrhage
P39.0	Neonatal infective mastitis
P39.2	Intra-amniotic infection of fetus, not elsewhere classified
P39.3	Neonatal urinary tract infection
P39.4	Neonatal skin infection
P39.8	Other specified infections specific to the perinatal period
P39.9	Infection specific to the perinatal period, unspecified
P77	Necrotizing enterocolitis of fetus and newborn
R02	Gangrene, not elsewhere classified
R57.8	Other shock
T80.2	Infections following infusion, transfusion and therapeutic injection
T81.4	Infection following a procedure, not elsewhere classified

T82.6	Infection and inflammatory reaction due to cardiac valve prosthesis
T82.7	Infection and inflammatory reaction due to other cardiac and vascular devices, implants and grafts
T83.5	Infection and inflammatory reaction due to prosthetic device, implant and graft in urinary system
T83.6	Infection and inflammatory reaction due to prosthetic device, implant and graft in genital tract
T84.5	Infection and inflammatory reaction due to internal joint prosthesis
T84.6	Infection and inflammatory reaction due to internal fixation device [any site]
T84.7	Infection and inflammatory reaction due to other internal orthopaedic prosthetic devices, implants and grafts
T84.9	Unspecified complication of internal orthopaedic prosthetic device, implant and graft
T85.7	Infection and inflammatory reaction due to other internal prosthetic devices, implants and grafts
T87.4	Infection of amputation stump
T88.0	Infection following immunization
U04.9	Agent resistant to penicillin and related antibiotics
U80.0	Penicillin resistant agent
U80.1	Methicillin resistant agent
U80.8	Agent resistant to other penicillin-related antibiotic
U81.0	Vancomycin resistant agent
U81.8	Agent resistant to other vancomycin-related antibiotic
U88	Agent resistant to multiple antibiotics
U89.8	Agent resistant to other single specified antibiotic
U89.9	Agent resistant to unspecified antibiotic

3. Immunocompromised state codes

ICD–10	**Code description**
B20.0	HIV disease resulting in mycobacterial infection
B20.1	HIV disease resulting in other bacterial infections
B20.2	HIV disease resulting in cytomegaloviral disease
B20.3	HIV disease resulting in other viral infections
B20.4	HIV disease resulting in candidiasis
B20.5	HIV disease resulting in other mycoses

B20.6	HIV disease resulting in Pneumocystis carinii pneumonia
B20.7	HIV disease resulting in multiple infections
B20.8	HIV disease resulting in other infectious and parasitic diseases
B20.9	HIV disease resulting in unspecified infectious or parasitic disease
B21.0	HIV disease resulting in Kaposi's sarcoma
B21.1	HIV disease resulting in Burkitt's lymphoma
B21.2	HIV disease resulting in other types of non-Hodgkin's lymphoma
B21.3	HIV disease resulting in other malignant neoplasms of lymphoid, haematopoietic and related tissue
B21.7	HIV disease resulting in multiple malignant neoplasms
B21.8	HIV disease resulting in other malignant neoplasms
B21.9	HIV disease resulting in unspecified malignant neoplasm
B22.0	HIV disease resulting in encephalopathy
B22.1	HIV disease resulting in lymphoid interstitial pneumonitis
B22.2	HIV disease resulting in wasting syndrome
B22.7	HIV disease resulting in multiple diseases classified elsewhere
B23.1	HIV disease resulting in (persistent) generalized lymphadenopathy
B23.2	HIV disease resulting in haematological and immunological abnormalities, not elsewhere classified
B23.8	HIV disease resulting in other specified conditions
B24	Unspecified human immunodeficiency virus [HIV] disease
B59	Pneumocystosis
D47.1	Chronic myeloproliferative disease
D70	Agranulocytosis
D71	Functional disorders of polymorphonuclear neutrophils
D72.0	Genetic anomalies of leukocytes
D80.0	Hereditary hypogammaglobulinaemia
D80.1	Nonfamilial hypogammaglobulinaemia
D80.2	Selective deficiency of immunoglobulin A [IgA]
D80.3	Selective deficiency of immunoglobulin G [IgG] subclasses
D80.4	Selective deficiency of immunoglobulin M [IgM]
D80.5	Immunodeficiency with increased immunoglobulin M [IgM]
D80.6	Antibody deficiency with near-normal immunoglobulins or with hyperimmunoglobulinaemia
D80.7	Transient hypogammaglobulinaemia of infancy
D80.8	Other immunodeficiencies with predominantly antibody defects

D80.9	Immunodeficiency with predominantly antibody defects, unspecified
D81.0	Severe combined immunodeficiency [SCID] with reticular dysgenesis
D81.1	Severe combined immunodeficiency [SCID] with low T- and B-cell numbers
D81.2	Severe combined immunodeficiency [SCID] with low or normal B-cell numbers
D81.3	Adenosine deaminase [ADA] deficiency
D81.4	Nezelof's syndrome
D81.5	Purine nucleoside phosphorylase [PNP] deficiency
D81.6	Major histocompatibility complex class I deficiency
D81.7	Major histocompatibility complex class II deficiency
D81.8	Other combined immunodeficiencies
D81.9	Combined immunodeficiency, unspecified
D82.0	Wiskott-Aldrich syndrome
D82.1	Di George's syndrome
D82.2	Immunodeficiency with short-limbed stature
D82.3	Immunodeficiency following hereditary defective response to Epstein-Barr virus
D82.4	Hyperimmunoglobulin E [IgE] syndrome
D82.8	Immunodeficiency associated with other specified major defects
D82.9	Immunodeficiency associated with major defect, unspecified
D83.0	Common variable immunodeficiency with predominant abnormalities of B-cell numbers and function
D83.1	Common variable immunodeficiency with predominant immunoregulatory T-cell disorders
D83.2	Common variable immunodeficiency with autoantibodies to B- or T-cells
D83.8	Other common variable immunodeficiencies
D83.9	Common variable immunodeficiency, unspecified
D84.0	Lymphocyte function antigen–1 [LFA–1] defect
D84.1	Defects in the complement system
D84.8	Other specified immunodeficiencies
D84.9	Immunodeficiency, unspecified
D89.8	Other specified disorders involving the immune mechanism, not elsewhere classified
D89.9	Disorder involving the immune mechanism, unspecified
E40	Kwashiorkor

E41	Nutritional marasmus
E42	Marasmic kwashiorkor
E43	Unspecified severe protein-energy malnutrition
I12.0	Hypertensive renal disease with renal failure
I13.1	Hypertensive heart and renal disease with renal failure
I13.2	Hypertensive heart and renal disease with both (congestive) heart failure and renal failure
K91.2	Postsurgical malabsorption, not elsewhere classified
N18.0	End-stage renal disease
N18.8	Other chronic renal failure
T86.0	Bone-marrow transplant rejection
T86.1	Kidney transplant failure and rejection
T86.2	Heart transplant failure and rejection
T86.3	Heart-lung transplant failure and rejection
T86.4	Liver transplant failure and rejection
T86.8	Failure and rejection of other transplanted organs and tissues
T86.9	Failure and rejection of unspecified transplanted organ and tissue
Y83.0	Surgical Operation with transplant of whole organ or tissue
Z49.0	Preparatory care for dialysis
Z49.1	Extracorporeal dialysis
Z49.2	Other dialysis
Z94.0	Kidney transplant status
Z94.1	Heart transplant status
Z94.2	Lung transplant status
Z94.3	Heart and lungs transplant status
Z94.4	Liver transplant status
Z94.8	Other transplanted organ and tissue status
Z94.9	Transplanted organ and tissue status, unspecified

Appendix 3. Patient demographic and hospital characteristics

Patient demographic information included age, gender, country of birth, marital status, and advantage and disadvantage index scores of Socio-Economic Indices For Areas (SEIFA). Hospital characteristics included the location and peer groups.

- The SEIFA scores were categorised into four classes (1st quartile = most disadvantaged areas and 4th quartile = most advantaged areas) representing patient socio-economic position.
- Location of health care facilities categorised by metropolitan and rural or regional NSW.

Five peer hospital groups are classified by:

A1: principal referral, usually teaching hospitals

A3: ungrouped acute

B: major metropolitan and non-metropolitan

C1: district group 1

C2: district group 2.

Peer hospital groups are divided into those of similar type and size , ranging from treating 25,000 or more acute case-mix weighted separations per annum in the principal referral group through to treating 2,000 or more (but less than 5,000) acute case-mix weighted separations per annum in district group 2.

Appendix 4. Results from sensitive analysis

Table S1 Distribution of study population and sepsis by patient and hospital characteristics (pooled 2002 to 2009, n=229,918)

Characteristics	Total	Postoperative sepsis (n=3,368)			Sepsis-related deaths (n=826)		
		N (%)	IR	P-value	N (%)	Case fatality	P-value
Age groups							
>=18yr&<35yr	6.9%	213 (6.3)	13.4	<0.001**	28 (3.4)	13.1	<0.001**
>=35yr&<55yr	20.9%	557 (16.5)	11.6		66 (8.0)	11.8	
>=55yr&<75yr	44.4%	1442 (42.8)	14.1		339 (41.0)	23.5	
>=75yr	27.8%	1156 (34.3)	18.1		393 (47.6)	34.0	
Gender							
Male	46.3%	2060 (61.2)	19.4	<0.001**	470 (56.9)	22.8	0.004*
Female	53.7%	1308 (38.8)	10.6		356 (43.1)	27.2	
Country of birth							
Australia and New Zealand	68.2%	2297 (68.2)	14.6	<0.001**	556 (67.3)	24.2	0.215
UK, US & Canada	7.6%	204 (6.1)	11.6		58 (7.0)	28.4	
Non-English Europe	11.2%	372 (11.1)	14.5		101 (12.2)	27.2	
North Africa	2.0%	59 (1.8)	13.1		16 (1.9)	27.1	
Asia	2.6%	87 (2.6)	14.3		25 (3.0)	28.7	
Others	7.2%	249 (7.4)	15.1		52 (6.3)	20.9	
Unknown	1.2%	100 (3.0)	36.9		18 (2.2)	18.0	
Marital status							
Married	56.2%	1809 (53.8)	14.0	<0.001**	444 (53.8)	24.5	0.959
Single	41.6%	1396 (41.5)	14.6		341 (41.3)	24.4	
Unknown	2.2%	157 (4.7)	30.8		40 (4.9)	25.5	
The quartiles of SEIFA							
1st quartile (most	25.5%	884 (26.3)	15.1	<0.001**	220 (26.6)	24.9	0.482
2nd quartile	24.4%	796 (23.6)	14.2		178 (21.6)	22.4	
3rd quartile	24.9%	811 (24.1)	14.2		206 (24.9)	25.4	
4th quartile (most	24.4%	810 (24.1)	14.4		208 (25.2)	25.7	
Unknown	0.7%	67 (2.0)	40.0		14 (1.7)	20.9	
Local health district of							
Metropolitan	67.7%	2512 (74.6)	15.9	<0.001**	605 (73.2)	24.4	0.839
Rural & Regional NSW	32.3%	892 (26.5)	12.0		221 (26.8)	24.8	
Peer hospital group							
Principal referral group	62.0%	2512 (74.6)	17.6	<0.001**	627 (75.9)	25.0	P=0.078
Ungrouped acute	2.3%	27 (0.8)	5.0		7 (0.9)	25.9	
Major metro- and non-	28.3%	759 (22.5)	11.7		185 (22.4)	24.4	
District group 1	6.1%	55 (1.6)	3.9		6 (0.7)	10.9	
District group 2	1.3%	15 (0.5)	5.0		1 (0.1)	6.7	

IR=Incidence rate, reported per 1,000 admissions; SEIFA= Socio-Economic Indices For Areas;

P-value is for Rao-Scott chi-squared test *P<0.05; **P<0.01

Table S2 Observed trends and adjusted incidence rate ratio (RR) in the rates of postoperative sepsis and sepsis-related deaths (n=229,918)

	Total	2002	2003	2004	2005	2006	2007	2008	2009	P-value for
All admissions										
No. of cases	229918	28352	28701	28696	29630	30422	29952	28193	25972	
No of deaths	3304	409	438	450	386	441	451	397	332	
IR†	14.4	14.4	15.3	15.7	13.0	14.5	15.1	14.1	12.8	0.018*
Adjusted RR(95%CI)		1.00	1.03 (0.90 - 1.18)	1.03 (0.90 - 1.18)	0.84* (0.73 - 0.97)	0.94 (0.82 - 1.07)	0.95 (0.83 - 1.08)	0.86* (0.74 - 0.99)	0.82** (0.71 - 0.95)	
Postoperative sepsis										
No. of cases	3368	335	387	452	428	459	484	443	380	
IR†	14.6	11.8	13.5	15.8	14.4	15.1	16.2	15.7	14.6	Quadratic†
Adjusted RR(95%CI)		1.00	1.15(0.99 - 1.33)	1.34**(1.16 - 1.55)	1.18*(1.02 - 1.37)	1.25**(1.08 - 1.44)	1.32**(1.15 - 1.52)	1.29**(1.12 - 1.49)	1.23**(1.06 - 1.43)	
Sepsis-related deaths										
No. of cases	826	90	127	114	82	117	114	107	75	
Case fatality (%)	24.5	26.9	32.8	25.2	19.2	25.5	23.6	24.2	19.7	0.006**
Adjusted RR(95%CI)		1.00	1.21 (0.92 - 1.59)	0.93 (0.70 - 1.23)	0.73* (0.54 - 0.99)	0.93 (0.70 - 1.23)	0.88 (0.66 - 1.16)	0.86 (0.65 - 1.15)	0.72* (0.52 - 0.98)	
IR†	3.6	3.2	4.4	4.0	2.8	3.8	3.8	3.8	2.9	0.29
Adjusted RR(95%CI)		1.00	1.41* (1.07 - 1.86)	1.27 (0.96 - 1.69)	0.86 (0.63 - 1.16)	1.18 (0.89 - 1.56)	1.16 (0.87 - 1.53)	1.12 (0.84 - 1.50)	0.89 (0.65 - 1.21)	
Proportion among all surgical deaths (%)	25.0	22.0	29.0	25.3	21.2	26.5	25.3	27.0	22.6	0.99
Adjusted RR(95%CI)		1.00	1.35* (1.03 - 1.78)	1.2 (0.91 - 1.59)	1.01 (0.75 - 1.37)	1.24 (0.94 - 1.64)	1.15 (0.87 - 1.53)	1.32 (0.99 - 1.76)	1.09 (0.80 - 1.49)	

†Quadratic=(linear=0.001; quadratic=0.006); *P<=0.05, **P<0.01

Table S3 Observed postoperative sepsis case mortality and adjusted rate ratio (RR) by the type of infectious organisms (pooled 2002-2009; n=229,918)

Infectious organism	Sepsis cases (n=3,368)		Sepsis-related deaths (n=826)		
	Frequency, N(%)	IR[§]	Frequency, N(%)	Mortality rate (%)[†]	Adjusted RR (95% CI)
Gram-positive	952 (28.3)	4.1	194 (23.5)	20.4	1.00
Gram-negative	620 (18.4)	2.7	104 (12.6)	16.8	0.79 (0.62 - 1.00)
Mixed	117 (3.5)	0.5	30 (3.6)	25.6	1.34 (0.90 - 1.99)
Unspecified	1679 (49.9)	7.5	498 (60.3)	29.7	1.35** (1.14 - 1.60)

IR=Incidence rate, reported per 1,000 admission.

[§]Unspecified vs Gram-positive: P<0.001; 95% CI: 3.0-3.8;

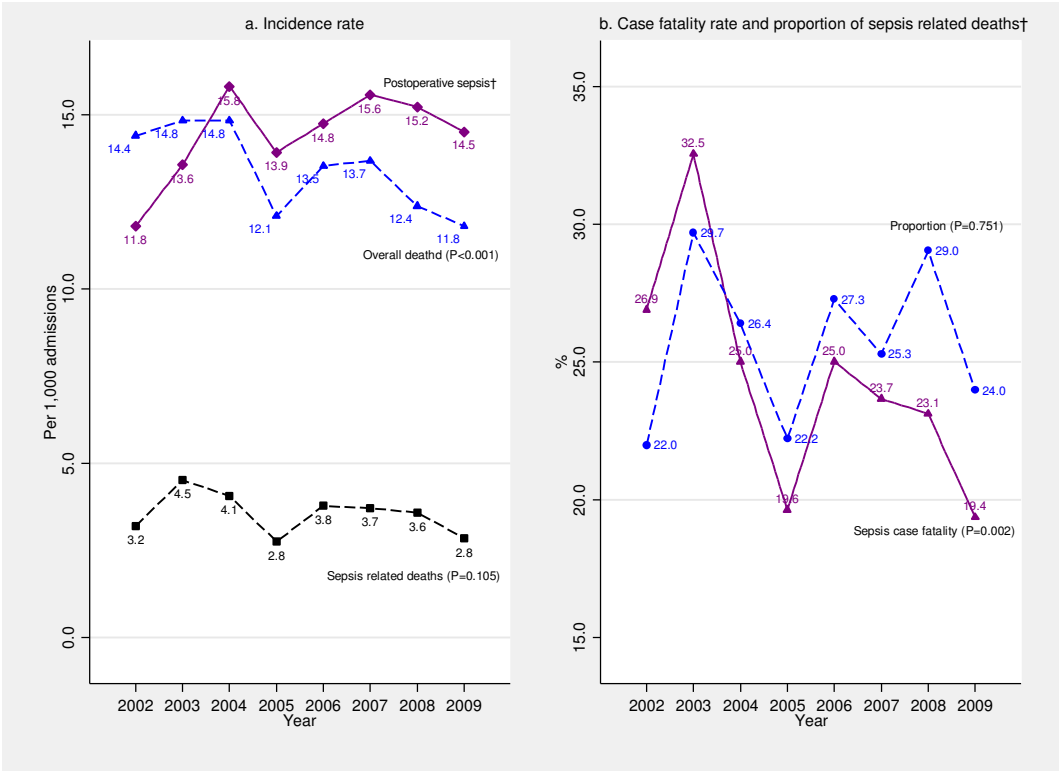
Unspecified vs Gram-negative: P<0.001; 95% CI: 4.4-5.3;

Unspecified vs mixed: P<0.001; 95% CI: 6.7-7.4.

[†]Rao-Scott Chi-square P<0.001;

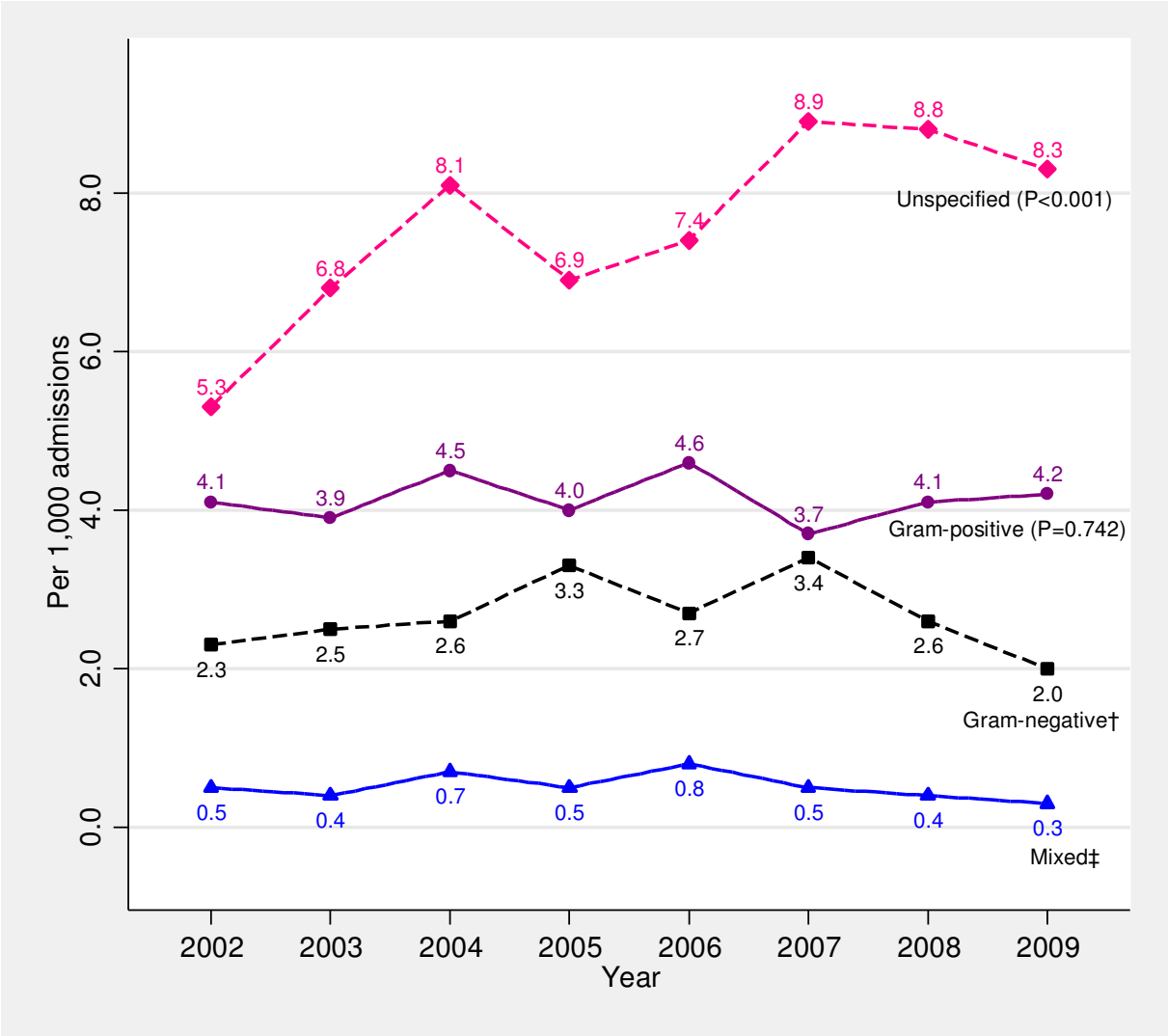
*P<=0.05, **P<0.01

Figure S1 Risk-adjusted incidence rates of postoperative sepsis and overall surgical deaths (a), and sepsis related case fatality rate and the proportion of sepsis related deaths among overall surgical deaths (b)



†The proportion of postoperative sepsis-related deaths among overall surgical deaths.

Figure S2 Observed trends in the incidence rate of infecting organisms of postoperative sepsis



†P-value: linear=0.002, quadratic=0.002;
‡P-value: linear=0.064,quadratic=0.031