

A comparison of two sources of data on fungaemia in two hospitals

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Abstract

Fungal bloodstream infection (BSI) is of increasing concern in the hospital environment. This study compared routine hospital discharge data at two inner Sydney hospitals with a pathology database over a 6-year period. A high level of underreporting was found, with only 42% of the pathology database cases assigned an appropriate code in the hospital discharge data despite evidence of the infection being found in 97% of the medical records identified from the pathology database. The location of the evidence in the medical record had an impact on whether or not the infection was assigned a code. There was a greater likelihood that a code would be assigned if the infection was documented on the front sheet of the medical record. Improvements can be made to the reporting of fungal BSI if clinicians record it on the front sheet and if coders review the whole medical record before coding.

Keywords: *Candidaemia; fungaemia; hospital discharge data; coding*

Introduction

Over the past three decades, the incidence of fungal bloodstream infection (BSI) (also known as fungaemia) has been increasing, particularly among immunocompromised patients, surgical patients, transplant patients and the critically ill. The increasing use of two medical advances has added to the problem. Vascular access devices provide an entry point for the opportunistic organism to enter the bloodstream, and broad-spectrum antibiotics allow the fungus to proliferate following the elimination of bacterial species (Clark & Hajjeh 2002; Garbino et al. 2002). *Candida* spp., the main fungal species associated with BSI, is the fourth most common organism recovered from the blood and it accounts for 8% to 15% of all BSIs in the United States (Kao et al. 1999).

In Australia, the incidence rate is comparable with those found in the US and other countries, which range from 0.1 to 0.3 per 1000 separations (Slavin & the Australian Mycology Interest Group 2002). A local study reported a mortality rate of 34% for patients diagnosed with *Candida* spp. in the blood, with 62% of these deaths attributable to the infection (Stratov et al. 1998). A higher mortality rate (44%) was reported in a recent 3-year Spanish review where 30% of deaths were attributable to candidaemia (Viudes et al. 2002). In addition, fungal BSIs have been estimated to increase the length of stay by an average of 22 days and they cost between US\$34 123 and US\$44 536 per episode of care (Rentz, Halpern & Bowden 1998). The nature of infection and potential to cause a life-threatening sepsis syndrome (Niewerth & Korting 2002) has led to the consensus that all cases of fungal BSI should be treated with antifungal therapy (Macphail et al. 2002).

The emergence of fungal BSI as an adverse hospital event raises the question as to whether it has been accurately described in the hospital discharge data. Ideally, hospital discharge data should contain an accurate summary of the type of patients seen as well as the care provided. This information can be used to determine the epidemiology of fungal BSI, the type of patient at risk and the appropriate treatment

therapy. Previous studies (Alechna, Westbrook & Roberts 1998/1999; Donoghue 1992; Powell, Lim & Heller 2001) have raised doubts about the reliability and accuracy of hospital discharge data because of the high rates of error in the way that codes have been assigned. The use of coded data for casemix-based funding means that accurate coding of all the complications and comorbidities has financial as well as research implications.

Most studies on coding accuracy use a blind recoding methodology. However, an alternative approach is to compare two different sources or coded outputs to determine the degree of concordance between them (Reid 1991).

This study examined how well fungal BSI was reported in two data sources; the hospital discharge data and the pathology database. Pathology databases contain the reports of all pathology tests performed on individual patients, and these reports are used by the attending clinician for treatment decisions. The study also examined what factors can contribute to the assignment of the codes, and whether these codes were appropriate for the identification of fungal BSI in the hospital discharge data.

Data and Methods

The study sample included all patients listed on the pathology database who tested positive for a fungal BSI during the financial years of 1996–1997 to 2001–2002 and who had been an inpatient at one of two major Sydney hospitals. A fungal BSI was defined as at least one positive blood culture that yielded a yeast or fungus specimen (Garbino et al. 2002). The 6-year period was chosen as it included all fungal BSI cases since the inception of the pathology database up to the end of the 2001–2002 financial year. Both hospitals, one a public 326-bed tertiary teaching hospital and the other a private 230-bed facility, are located on the same campus and use the same pathology service.

Approval to conduct the study was granted by the institutional human research ethics committee that governs both hospitals.

Fungal BSI cases identified in the pathology database

A list of patients from the two hospitals who had a positive fungal blood culture was obtained from the pathology database and sent to the medical record departments of both hospitals with a request to retrieve the patients' notes. The pathology database was chosen as the gold standard because it identified all positive blood results. The medical records were reviewed to check whether and where the fungal BSI was reported in the record, and whether a disease code was allocated to the condition. The study period covered data coded in the International Classification of Diseases, 10th Revision, Australian Modification (ICD-10-AM) implemented in 1998 and the now superseded ICD-9-CM classification system (National Coding Centre 1996). Codes in ICD-9-CM were recoded to ICD-10-AM for consistency (Health Information Management Association of Australia 2002). Written evidence included the use of terminology such as 'yeast in the blood', 'fungaemia', 'candidaemia', 'Candida spp. found in the blood' and other similar wordings. The location of the written evidence was noted to identify which section of the medical record, such as the clinical progress notes, would likely lead to the coding of the fungal BSI. Evidence of sepsis syndrome was also documented because some of the codes related to the presentation of the BSI. A data collection form was used to record the codes used, demographic information and some clinical outcome information. The data were entered onto a database and analysed using SPSS (Statistical Package for the Social Sciences) version 10.0.7.

Possible fungal BSI cases identified in the hospital discharge data

To identify the fungaemia cases in the hospital discharge data, six ICD-10-AM diagnosis codes were selected which could indicate a possible fungal BSI (Table 1). The only specific code for fungal BSI is B377, which refers to *Candida* spp. being found in the blood. The remaining codes either include other organisms in the blood, or sites not confined to the blood. Code P37.52 (neonatal candidiasis) was not included because neither of the hospitals treat patients from this age group.

The hospital discharge data, from the implementa-

Table 1: Diagnosis codes for fungaemia

ICD-10-AM Code	Description
A418	Other specified septicaemia
B377	Candidal septicaemia
B3788	Candidiasis of other sites
B379	Candidiasis, unspecified
B459	Cryptococcosis, unspecified
B49	Unspecified mycosis, including fungaemia not otherwise specified

tion of ICD-10-AM in 1998 onwards, were used to identify any cases with one of the selected ICD-10-AM codes, either as a principal or secondary diagnosis code. These cases were then matched with those obtained from the pathology database. The matched cases were analysed to see which codes were more sensitive in identifying true fungal BSI cases as reported in the pathology database.

Results

Fungal BSI cases identified in the pathology database

During the 1996–1997 to 2001–2002 period, the pathology database identified 63 patients from the two hospitals with a positive blood culture for *Candida* spp. or *Cryptococcus* spp. This represented an average of 10 cases per year. Of the 63 cases, 60 records were located and reviewed. The cases per financial year, the number of separations and cases per 1000 separations are set out in Table 2.

Table 2: Fungal BSIs in the two hospitals per financial year

Financial Year	No. of hospital separations	No. of cases of fungal BSI	Cases per 1000 separations
1996–1997	42 203	6	0.1
1997–1998	39 757	8	0.2
1998–1999	40 701	12	0.3
1999–2000	43 559	8	0.2
2000–2001	44 799	8	0.2
2001–2002	45 945	18	0.4
Total	256 964	60	0.2

The majority of cases were hospital-acquired infections, as they were acquired 48 hours following the admission (Australian Infection Control Association 2001). In 88% of cases, the infection was considered to be important and warranted treatment with an anti-fungal agent. For the remaining patients, treatment was not provided as the patients were discharged prior to the results being known or treatment would have not improved the patient's deteriorating condition. In only one case was the positive blood culture considered a possible contaminant, due to the leakage of the specimen bottle.

The mortality rate was 28% (17/60) (Table 3) and examination of the death certificates for 16 of the deaths revealed that the fungaemia or sepsis syndrome was a contributing cause of death in 38% of these 16 cases. Only one record did not include a death certificate. The demographic profile of patients with fungal BSI is shown in Table 3.

Evidence to support the coding of fungal BSI was found in the medical records of 58 of the 60 cases (97%) identified from the pathology database. However, only 25 (42%) had been given a fungal BSI code. Forty-two of the 58 records (72%) contained both written evidence and pathology results, 6 (10%)

Table 3: Demographic profile of patients with fungaemia

No. of Cases	60
Mean age (SD)	55 (18.0) years
Sex	
Male	33 (55%)
Female	27 (45%)
Mean length of stay in days (SD)	36 (27) (Range: 1–116)
Mean no. of days after admission that fungaemia was diagnosed (SD)	17 (19)
Mean no. of days following diagnosis before the patient was discharged (SD)	20 (22)
No. of deaths	17 (28%)

Table 4: Location of written evidence of fungaemia in the medical records

	N (%)
No. of cases with written evidence in the record	48
Location of evidence:	
Front sheet	20 (42)
Clinical progress notes	45 (94)
Doctors consultation notes	16 (33)
Death certificate	4 (8)
Others	4 (8)

Table 5: Codes assigned to patients with fungal bloodstream infections

Code	Description of code	N	No. of cases with evidence of sepsis per code (%)
A418	Other specified septicaemia	1	1 (100)
B377	Candidal septicaemia	11	11 (100)
B3788	Candidiasis of other sites	5	3 (60)
B379	Candidiasis, unspecified	6	4 (67)
B459	Cryptococcosis, unspecified	2	1 (50)
Total		25	20 (80)

had only written evidence and the remaining 10 (17%) only had the pathology results. Table 4 sets out the location of the evidence in the 48 records with written evidence (not just a pathology report).

When fungal BSI was recorded on the front sheet, 80% (16/20) were coded compared to only 29% (8/28) when the infection was not reported on the front sheet. This resulted in an odds ratio of 10 (95% CI: 2.5–39.2) in favour of the fungal BSI being coded if it was reported on the front sheet. If it was reported in the progress notes only, 30% (8/27) were coded

Table 6: Ratio of identified cases from the hospital discharge data and the pathology database

Code	Description of code	Cases identified in hospital discharge data: cases identified on the pathology database
A418	Other specified septicaemia	15:1
B377	Candidal septicaemia	1:1
B3788	Candidiasis of other sites	24:1
B379	Candidiasis, unspecified	23:1
B459	Cryptococcosis, unspecified	4:1

compared to 76% (16/21) if it was mentioned in the progress notes and on the front sheet or on the front sheet alone. An odds ratio of 0.1 (95% CI: 0.0–0.5) indicated that it was unlikely that fungal BSI would be coded if it was mentioned solely in the progress notes. There was no difference in the coding pattern if the patient died during the episode of care (odds ratio: 1.0, 95% CI: 0.3–3.0).

For cases that were coded, the most frequently used code was B377, candidal septicaemia (Table 5). This code identified *Candida* spp. found in the blood as being associated with the manifestation of the sepsis syndrome. All records assigned to B377 had documented evidence of sepsis syndrome being present and that *Candida* spp. were isolated from the blood. One record was coded to A418 (other specified septicaemia), where B377 would have been more appropriate because *Candida* spp. were found in the blood. However, since no pathology results were found in the medical record for this patient, the coder probably did not know the organism that caused the sepsis syndrome and the decision to use the general sepsis code was understandable.

Possible fungal BSI cases identified in the hospital discharge data

The hospital discharge data yielded 194 cases with the codes listed in Table 1 from 1998 onwards. Of these only 20 were also found in the pathology database. As expected, code B377 was the most useful code in identifying cases of fungal BSI. There were 11 cases with this code on the hospital discharge data and there were also 11 cases from the pathology database. The remaining codes produced large numbers of cases that were not fungal BSI or cases where the infection was caused by another organism or occurred at another site. A summary of cases found in the hospital discharge data compared with the pathology database is shown in Table 6.

Discussion

In this 6-year study, the fungal BSI incidence rate was 0.2 per 1000 separations with a mortality rate of 28%.

This is comparable to a review of nine tertiary hospitals in Australia that found the incidence rate to be from 0.1 to 0.3 per 1000 discharges with a mortality rate of 28% (Slavin & the Australian Mycology Interest Group 2002). Age and sex distribution in both Australian studies were also similar to a Canadian study examining candidaemia over a 5-year period (Macphail et al. 2002). The mean length of stay of 36 days for fungal BSI patients is considerably longer than the national mean for all patients of 4 days for the period 1996–1997 to 1999–2000 (Australian Institute of Health and Welfare 2002). While fungal BSI may not be the sole reason for the increase in the length of stay it is a likely contributing factor that would not have been identified if it had not been coded.

The results of the present study suggest there is a high level of underreporting of fungal BSI in hospital discharge data. It found that only 42% of cases identified by the pathology database were eventually assigned a code for this condition. This occurred despite the presence of evidence in the medical records that indicated the development of fungal BSI during the episode of care. Nearly all (97%) of the records reviewed had pathology reports and/or written evidence to support the coding of fungal BSI. In addition, 88% of patients were prescribed an antifungal agent following the diagnosis, suggesting that the infection warranted treatment and was not considered to be a contaminant or clinically insignificant.

Previous studies that reviewed coding practices have found that poor documentation was a contributing factor for coding discrepancies (Donoghue 1992; Alechna, Westbrook & Roberts 1998/1999). This study on the other hand, found that fungal BSI was well documented in the records but this did not lead to all relevant cases being coded appropriately. The location in the record of the evidence for fungal BSI was important for coding. If the infection was reported on the front sheet, there was a high probability that it would be coded. Written evidence in the progress notes and pathology reports had little bearing on whether it was coded. The outcome of care, such as death, also had no impact on the decision to code.

These findings are in line with the Australian Coding Standard 0010, which emphasises that it is the responsibility of the clinician to list the diagnoses to be coded on the front sheet of the patient's medical record. Coders must verify the information they code by reviewing pertinent documentation in the body of the record. If a discrepancy is found, then the coder must seek advice from the clinician. The standard recommends that abnormal pathology results should not be assigned a code unless verified by the clinician (National Centre for Classification in Health 2004). As the blood is a sterile site, and any positive blood results for any organism are clinically important, coders should confirm these results with the clinician if the clinician has yet to document them.

This study found that fungaemia meets the criteria for inclusion as an additional diagnosis according to Australian Coding Standard 0002. This standard states that additional diagnosis codes can be used if the complication or comorbidity requires further clinical evaluation, therapeutic treatment, diagnostic procedures, monitoring, or increases the length of stay

(National Centre for Classification in Health 2004). In the majority of cases, fungaemia meets these requirements and thus should be included as an additional diagnosis. It is mainly a health care associated infection, a complication that is due to the hospital admission. Following the positive blood culture, the standard treatment protocol would require the use of antifungal drugs and the removal of any pre-existing central vascular access devices. Further monitoring and diagnostic tests such as blood screening and radiological studies may be required to determine whether the infection has been cleared from the circulatory system or whether it has infected other body sites. All these events impact on the increase in hospital admissions as well as the use of hospital resources. Additional diagnoses are collected to reflect hospital activity and incidence, not prevalence, of disease.

In general, there are perhaps two valid reasons to exclude fungaemia from being coded as an additional diagnosis. First, if the fungaemia is a community acquired infection and the patient presents with sepsis syndrome and there is no other reason for the hospital admission, the fungaemia should be coded as the principal diagnosis. Second, if there are no signs of sepsis syndrome and the clinician states that the positive blood culture is likely to be a contamination and is not clinically significant, the fungaemia does not meet the criteria for an additional diagnosis because the contamination is an incidental result and not the cause of the diagnostic test.

When fungal BSI was coded, most of the codes, except B377 (candidal septicaemia), were appropriate but not specific enough to identify the organism involved or whether it was a bloodstream infection. The other codes, except B377, included cases where the organism was found at a site other than the blood, and thus were not useful for identifying cases of fungal BSI (Table 6). If a search for fungal BSI cases were conducted using the hospital discharge data, the use of codes such as B3788 and B379 would produce many cases that were not blood borne. Clearly, it is not easy to locate all fungal BSIs using hospital discharge data but this is true for many diseases. ICD-10-AM is a classification system and hence it will be often the case that relatively rare diseases, such as this one, will not have a unique code assigned to them. It is interesting to note that no cases were assigned the general code of B49 (unspecified mycosis, including fungaemia not otherwise specified). This code would have been appropriate if the organism was not known. This would indicate that coders are able to specify the organism involved in the infection but perhaps are unclear as to the site of the infection and hence use a less specific code.

The low rate of coding of fungal BSI (Table 5) indicates that hospital discharge data do not provide an accurate representation of the number of fungal BSI cases at these two hospitals. This underreporting would also obscure associations between fungal BSI and other diseases and procedures. Given the mortality and the greater length of hospital stay compared to the national average, it is argued that a greater effort is needed to code fungal BSI accurately. The code for candidal septicaemia, B377, is allocated to the most severe complexity level in the Australian Refined Dia-

gnosis Related Groups (AR-DRGs) system (version 5.0) when used as a secondary diagnosis (Commonwealth of Australia 2002). The implications of not coding the BSI for the casemix group assigned to each record were not investigated in this project. However, it is plausible that this may have affected the casemix complexity levels of at least some of the cases where the BSI was not coded.

The results of the study suggest three recommendations to improve the coding of this condition. First, clinicians should document fungal BSI on the front sheet to increase the likelihood that it will be coded. Second, coders should not rely too heavily on the front sheet, especially where there is a long length of stay, and should review the progress notes and pathology reports for pertinent data. When coding, the unavailability of test results and clinicians to confirm data in the record will impact on the quality of the coding, and procedures are needed to address these problems. Third, education on the coding of bloodstream infection should be improved. Australian coding standard 0111 covers bacteraemia but does not mention fungaemia (National Centre for Classification in Health 2004). This is despite both conditions being an infection of the blood that could be fatal. In fact, patients with fungaemia are more likely to die than patients with bacteraemia (relative risk: 1.8, 95% CI: 1.7–1.9) (Fridkin & Jarvis 1996). While bacteraemia occurs more frequently, and is better known, the same principle and standards should be applied when coding fungemia, as both conditions have clinical significance. Consideration should be given to mentioning fungaemia in the standard.

This observational retrospective study focused on how well fungal BSIs were being reported and coded. Considerable time, approximately 45 minutes per record, was spent reviewing each patient's notes compared to the average 14 minutes that coders usually spend (Dimitropoulos, Bennett & McIntosh 2001). However, the information collected for the study was different from that normally collected by coders, and the time spent in examining each record was needed to achieve the objectives of the study. Other studies focusing on a particular condition and conducted in the same manner may also experience the need to spend more time examining the medical records than is usual when coding.

A potential limitation of the study is the number of cases examined. This is a small study, confined to two hospitals, but there were sufficient cases to achieve the objectives of the study. The low incidence of cases may be a reflection of how successful the infection control strategies were at these two hospitals. It may also be due to the prophylactic use of antifungal agents. These possibilities could be explored in further studies.

Conclusion

The results of this study highlight the problems in using hospital discharge data to identify episodes of fungal BSI. Fungal BSIs are adverse hospital events yet they are difficult to identify precisely using ICD-10-AM codes. This is because less than half of all possible fungal BSIs were coded and, with the exception of one

code, the codes assigned did not indicate that the infection was in the blood.

There is a need to recognise the importance of fungal BSI in terms of risk to patients, the contribution to the increase in length of stay, and cost implications for the episode of care. This should be reflected in the coding standards as well as in the awareness of the clinical coders. To improve the coding rate, clinicians should be encouraged to record fungal BSI in discharge summaries, and coders should use the complete medical record as well the front sheet to obtain information regarding each episode of care especially where patients have longer than average stays. Adopting these recommendations would improve the way fungal BSIs are reported in hospital discharge data.

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