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Burden of Hospital Candidemia in France: Diagnostic Performance of an Administrative Hospital Database for Case Identification in a French University Hospital

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INTRODUCTION AND OBJECTIVES

- Candidemia and invasive candidiasis (C/IC) are serious fungal infections associated with high mortality rates.[1] C/IC annually affects over 1.5 million people worldwide, including 6,000 people in France where 2,300 have confirmed blood infections (candidemia) and approximately 3,700 have infections that cannot be detected in blood cultures (e.g. deep-seated invasive candidiasis, false negatives).[1]
- The associated economic burden of C/IC is largely due to prolonged length of stay (LoS) in hospital and intensive care unit (ICU) treatment.[2]
- C/IC events are routinely recorded in the French national hospital discharge database, Programme de Médicalisation des Systèmes d'Information (PMSI), using the International Classification of Diseases 10th revision (ICD-10) coding system. Any misclassification bias within the PMSI will impact the accuracy of those data used to inform health economic models for diseases, such as C/IC.
- This study explores the relevance and accuracy of PMSI-reported data for C/IC events at a large tertiary hospital and the associated implications when quantifying the economic burden of disease.

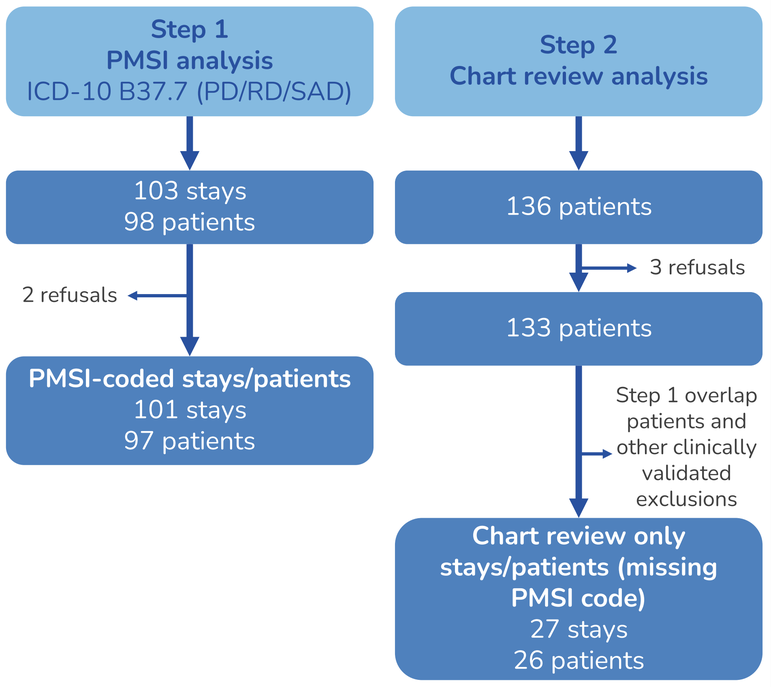
METHODS

- A retrospective, observational, single-center study, conducted between 2018–2020 (before the COVID-19 outbreak), collected PMSI data and patient-level data from a large, tertiary hospital in France.
- Due to the complexity of the chart review, a single ICD-10 code (B37.7 *Candida* sepsis) was used to identify patients with candidemia.
- The population of interest was selected via two independent stepwise processes:
  - **Step 1:** PMSI-reported data were extracted for all adults (aged ≥18 years) with a primary, related or associated diagnosis coded as B37.7 (*Candida* sepsis).
  - **Step 2:** a specific search algorithm (based on textual features) identified all adults with confirmed, unconfirmed and possible *Candida* sepsis, using chart information (limitation of this approach may be attributed to breadth and precision of textual search).
- In addition to hospital stays for confirmed candidemia cases, this approach allowed the identification of:
  - **False negatives:** hospital stays if clinical evidence of candidemia was recorded but case was not reflected in the PMSI database (missing PMSI code).
  - **False positives:** hospital stays that were reflected in the PMSI database but no clinical evidence of candidemia was found in the chart.
- Analyses compared patient demographics, antifungal treatment and healthcare resources, including LoS and cost per stay.
  - LoS in the ICU was based upon critical care supplement reporting (intensive care, continuous care, mechanical ventilation).
  - Cost per stay was calculated using French DRG (Diagnosis Related Group) tariffs specified by the Agence technique de l'information sur l'hospitalisation (ATIH) for the year 2020.
- Descriptive analyses were employed specifying the proportion of missing data. No imputation was made for missing data.
- Hospital stays for patients who had refused consent for their data to be used for research purposes were excluded (referred to as "refusals").

RESULTS

- The total population of interest comprised 123 patients who had 128 hospital admissions (Figure 1).

Figure 1. Flowchart for selection of patients



Abbreviations: ICD-10: International Statistical Classification of Diseases and Related Health Problems; PD: primary diagnosis; PMSI: Programme de Médicalisation des Systèmes d'Information; RD: relied diagnosis; SAD: associated diagnosis.

- Mean age was 58 years and 39% were female. The most prevalent *Candida* species detected were *C. albicans* (65%), *C. glabrata* (19%), *C. tropicalis* (5%) and *C. parapsilosis* (5%)
- Antifungal regimens included echinocandin + azole (34.4%), azoles only (23.4%) or echinocandins only (21.1%). Overall, 5.5% had no recorded antifungal treatment.
- PMSI-reported data showed that the majority of B37.7-coded cases were associated diagnoses and just 9% had a primary diagnosis of B37.7 (*Candida* sepsis), highlighting the clinical complexity of those patients.
- In the entire population, 22% (27/123) of patients had hospital stays that were missing the relevant PMSI code.
- False positives accounted for 9% (9/101) of PMSI-coded hospital stays and 5% (9/123) of stays in the total population (Table 1).

Table 1. Summary of hospital stays

Population	Clinical determination of *Candida* sepsis			Total
	Confirmed	Possible	Not confirmed	
PMSI-coded	75	17	9	101
Missing PMSI code (charts)	10	17	0	27

Abbreviations: ICD-10: International Statistical Classification of Diseases and Related Health Problems; PMSI: Programme de Médicalisation des Systèmes d'Information.

Health-care resource use

- Despite being younger, chart review patients (Step 2) appeared to be more complex (Table 2). These patients consumed more resources associated with intensity of care, compared with PMSI-coded (Step 1) patients:
  - Median hospital LoS for chart review only (missing PMSI code) patients was 13 days longer than PMSI-coded patients (Figure 2).
  - Duration of ICU stay was 22.5 days longer for chart review only (missing PMSI code) compared with PMSI-coded cases.
  - A larger proportion of chart review only (missing PMSI code) patients required mechanical ventilation.
- Observed differences between the populations translated into noticeable variations in total cost per stay. The median cost per chart review only (missing PMSI code) patient was €18,330 more expensive than the cost per PMSI-coded patient (Table 3).

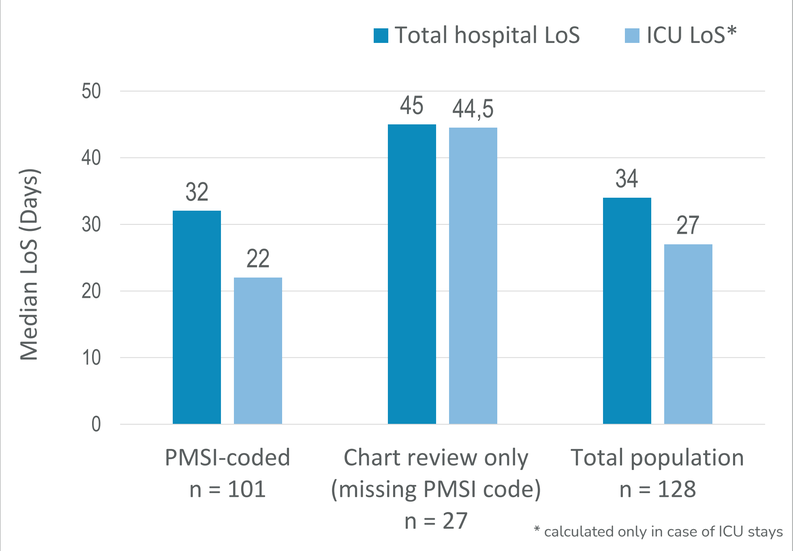
Table 2. Patient demographics/characteristics and use of healthcare resources

Characteristic	All 123 PTS / 128 stays	PMSI-coded 97 PTS / 101stays	Missing PMSI code 26 PTS/ 27 stays
Age			
Mean (SD), years	58.1 (16.7)	59.3 (16.4)	53.3 (17.4)
<65 years, %	62.6	57.7	80.8
Female Sex, %	39.0	42.3	26.9
Hospital LoS, Days			
Median	34	32	45
Q1; Q3	19; 63	15; 59	36; 67.5
Minimum/maximum	1/276	1/224	22/276
Admission to ICU, n (%)	99 (77.0)	75 (74.3)	24 (88.9)
ICU LoS, Days			
Median	27	22	44.5
Q1; Q3	12; 52	8.5; 45.5	25.5; 58.5
Minimum/maximum	1/276	1/199	9/276
Mechanical ventilation, %	55.0	47.5	81.5
Continuous monitoring, %	62.0	59.4	74.1

Note: quantitative variables are presented median (with minimum, maximum, 25th; 75th percentile) as their distribution is not normal

Abbreviations: ICU: intensive care unit; LoS: length of stay; PMSI: Programme de Médicalisation des Systèmes d'Information; PTS: patients; Q: quartile; SD: standard deviation.

Figure 2. Median LoS across populations



Abbreviations: ICU: intensive care unit; LoS: length of stay; PMSI: Programme de Médicalisation des Systèmes d'Information.

Table 3. Calculated healthcare cost per patient

Population	Min	Q1	Median	Q3	Max
PMSI-coded	€1,530	€12,676	**€23,386**	€34,654	€96,327
Missing PMSI code	€6,472	€33,488	**€41,716**	€82,518	€96,327
Total population	€1,530	€13,129	**€25,101**	€41,994	€96,327

Abbreviations: ICU: intensive care unit; LoS: length of stay; Max: maximum; Min: minimum; PMSI: Programme de Médicalisation des Systèmes d'Information; Q: quartile.

CONCLUSIONS

Analysis of PMSI-reported and chart review data from a large tertiary hospital identified coding inconsistencies that could result in underestimation of hospital admission costs for candidal sepsis, if economic calculations were based only on PMSI-coded cases.

Multicenter research is required to fully evaluate how missing data or coding limitations/omissions may impact understanding of the incidence, costs and trends in candidal sepsis as well in other invasive *Candida* infections.

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Disclosures

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