Analysis of Bacteraemia Data in Swiss Hospitals

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Background and Aim

Sampling blood cultures (BCs) is a standard diagnostic practice for bloodstream infections [1]. Although BC analyses are crucial in clinical microbiology laboratories, ordering BCs is not standardised among hospitals and contamination is frequent, which may lead to unnecessary antibiotic therapy, as well as additional workload for laboratories and increased costs [2]. In this study, we performed a systematic analysis of national BC data available from the Swiss antibiotic resistance database of ANRESIS.

Methods

In this retrospective, observational, descriptive study, we analysed ANRESIS data from 2022, the last year, for which complete hospital occupation data were available. BCs were grouped into episodes, defined as a seven-day window following a positive BC result, to account for variability in BC sampling practices. A contaminant episode was defined according to the ANRESIS algorithm (possible contaminant in one sample only within one episode) [3]. Incidences, positivity rates (excluding contaminated BCs) and contamination rates were calculated and stratified by hospital size, hospital K-type, language region and ownership type. All analyses were repeated at the sample (= BC) level.

Data cleaning was performed in five steps to achieve comparable datasets (Figure 1):

1. Exclusion of 40 hospitals that only submitted positive BC results and were not covered by ANRESIS.
2. Exclusion of 6 non-acute care hospitals (K-Types 211, 212, 221, 235).
3. Exclusion of 3 small hospitals, defined as hospitals with < 20 beds.
4. Exclusion of 19 hospitals with < one sample per bed in 2022.
5. Exclusion of 33 hospitals with positivity rates > 25 %.

The primary dataset after the first four exclusion steps proved to be very heterogeneous, with positivity rates showing a rather bimodal distribution, with peaks at 10 - 15% and 65 - 70% (Figure 2). After contacting hospitals with positivity rates between these two ranges, we added the fifth exclusion step, using a cut-off of 25 % positivity rate. This cut-off was chosen to separate hospitals performing BCs on site from those sending only presumed positive BCs to the laboratory.

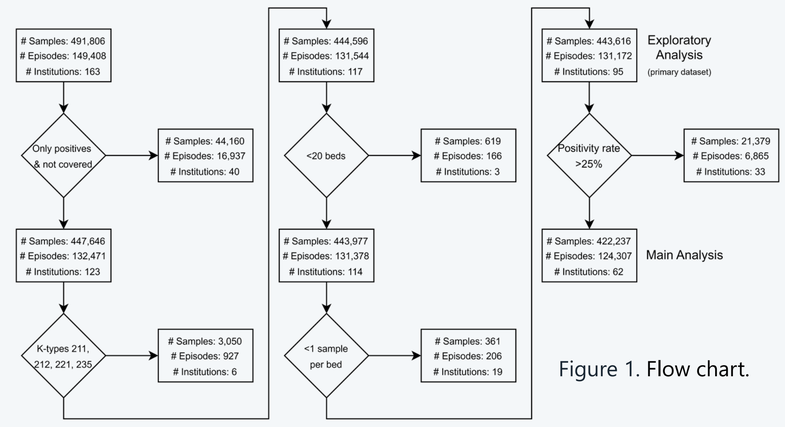

Figure 1. Flow chart.

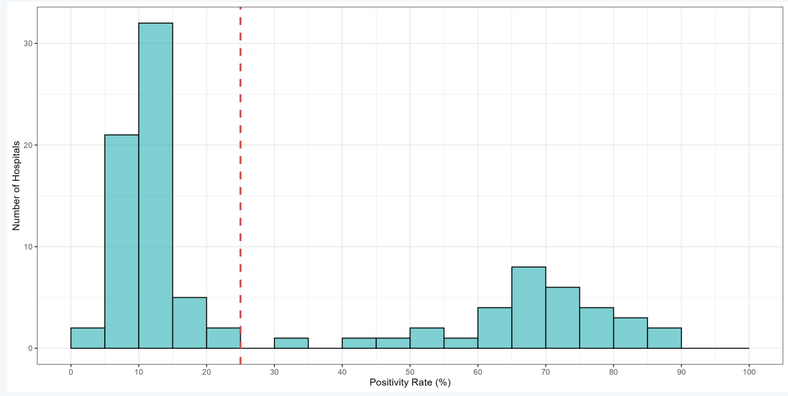

Figure 2. Illustration of the dichotomy in the primary dataset that led to the fifth exclusion step (red dotted line = positivity rate cut-off of > 25%).

62 Hospitals

124,307 Episodes

422,237 Samples

4 Stratifications

Results

Incidence of Positive Episodes

The median incidence of positive blood culture episodes (per 1,000 patient-days [PDs]) across all hospitals was 3.3, increasing from 2.2 in small hospitals (< 100 beds) to 4.2 in hospitals with 200 – 349 beds; the remaining categories ranged from 3.3 to 3.8 per 1,000 PDs (Figure 3).

Incidence was lower in the Latin than in the German part of Switzerland (medians of 2.6 vs. 3.6 / 1000 PDs, respectively, data not shown).

Positivity Rate

Overall, 9.9 % of episodes were positive. The median positivity rate decreased with hospital size, from 11.6 % in hospitals with < 100 beds to 9.0 % in those with ≥ 350 beds. In 53 / 62 hospitals, the positivity rate was 5 – 15 % (blue range, Figure 4), consistent with published rates in adult febrile patients [4]. Note that rates reported in the literature are typically based on samples, whereas our rates are based on episodes. When calculated at the sample level, our rates ranged from 1.2 to 16.7 %, with 46 / 62 hospitals falling between 5 and 15 %.

15.9 % of all positive episodes were polymicrobial (i.e., contained > 1 species), with hospitals with ≥ 350 beds having the highest proportion of episodes containing ≥ 4 species (1.1 %).

Contamination Rate

Contamination occurred in 3.2 % of all clinical episodes across the surveyed hospitals. The contamination rate did not differ significantly between hospitals of different sizes but was highest in paediatric clinics (K233, median of 3.6 %). In 34 of the 62 hospitals, the contamination rate was below the internationally recommended maximum of 3.0 % (red dotted line, Figure 5) [2]. Again, data reported in the literature are based on the sample level. In our study, contamination rates at the sample level ranged from 0.0 to 3.2 %, with 61 of 62 hospitals having contamination rates below 3.0 %.

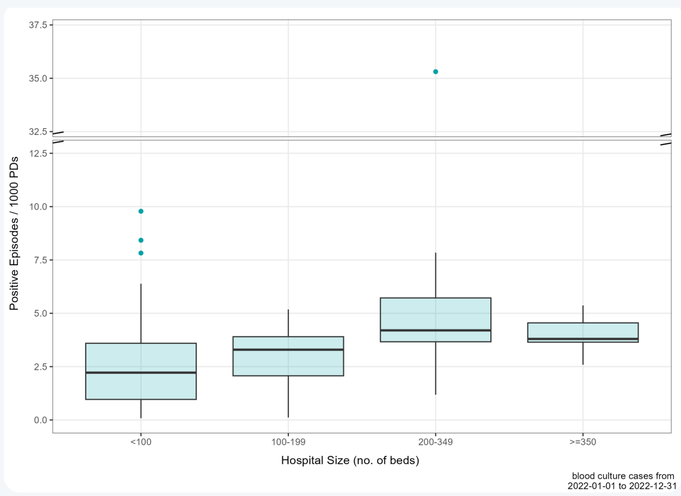

Figure 3. Incidence of positive episodes per 1,000 patient-days stratified by hospital size.

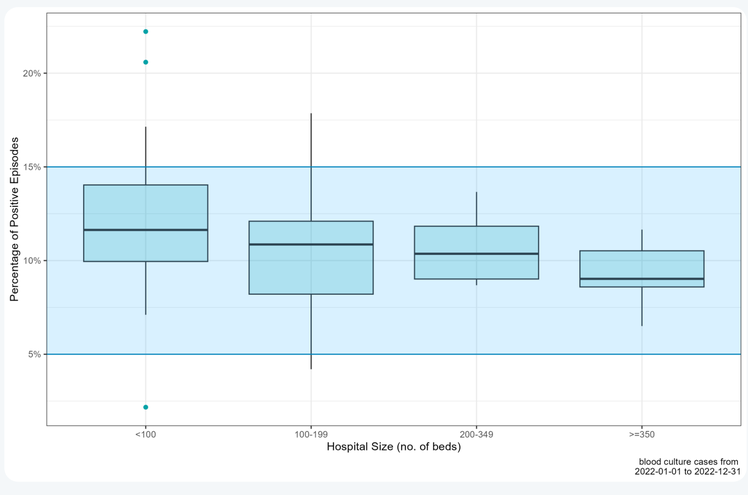

Figure 4: Positivity rates (proportion of positive episodes among all episodes) stratified by hospital size. The blue range indicates the suggested range of sample positivity rates based on data from adult febrile patients [4].

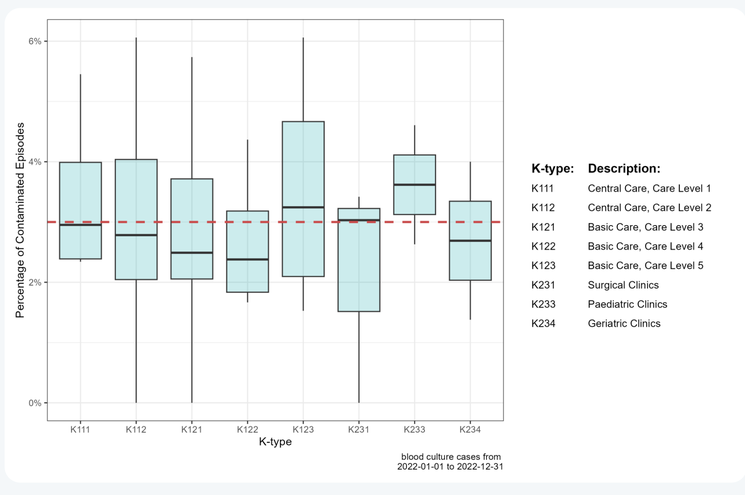

Figure 5. Contamination rates (proportion of contaminated episodes among all episodes) stratified by K-type. The red dotted line indicates the recommended maximum sample contamination rate for hospitals reported in the literature [2].

Conclusion

- Dataset homogenisation has proven to be difficult. Summarising samples into episodes improves data comparability but hinders comparison with existing literature.
- Sending only positive blood culture results to the laboratory is a practical approach used by many hospitals but hinders data analysis.
- The higher incidence of positive blood cultures and the higher proportion of polymicrobial episodes in larger hospitals reflects the higher complexity of their cases.
- Consequently, larger hospitals may obtain blood cultures more readily, resulting in lower positivity rates.
- Overall, the analysis of ANRESIS data provides insights into important BC indicators. Data homogenisation and standardised definitions are crucial for meaningful benchmarking.

Future perspectives

- Adapted thresholds for positivity and contamination rates need to be defined for analysis of blood culture episodes in the Swiss setting.
- Implementing continuous analysis of ANRESIS bacteraemia data in the framework of a dashboard (see the poster by Gasser et al.) will deliver an additional tool for infection prevention and control among Swiss hospitals.

References

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