Blood culture quality and turnaround time of clinical microbiology laboratories in Chinese Teaching Hospitals: A multicenter study

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BACKGROUND

- Bloodstream infections are one of the main causes of morbidity and mortality worldwide, and have been raised a global public health problem.[1]
- KPIs are essential tools for monitoring and evaluating laboratory performance throughout the pre-analytical, analytical, and post-analytical phases.
- Although blood cultures (BCs) play a crucial role in detecting bloodstream infections, few studies have explored ways to improve the turnaround time of BC results.

OBJECTIVE

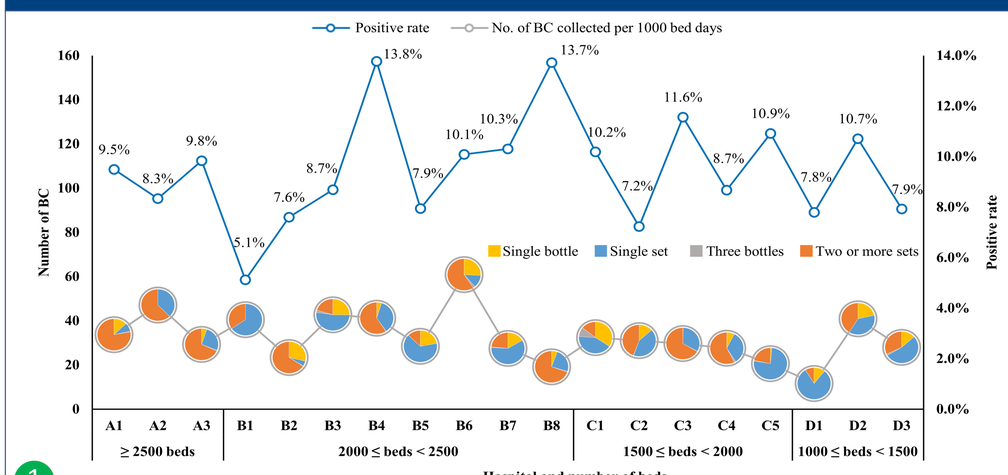
- Improving the quality of clinical BC samples, optimizing BC performance, and accelerating antimicrobial susceptibility test (AST) results are essential for the early detection of bloodstream infections and specific treatments.
- The present study aims to provide an updated overview of BC key performance indicators (KPIs) and turnaround times (TATs) in microbiology laboratories operating in 19 tertiary hospitals in Guangdong Province, China.

METHODS

- **Data collection:** We conducted a retrospective multicenter study using 450,845 BC specimens from clinical laboratories obtained from 19 teaching hospitals between 1 January 2021 and 31 December 2021.
- We evaluated key performance indicators (KPIs), turnaround times (TATs), and frequency distributions of processing in BC specimens. We also evaluated the AST results of clinically significant isolates for four different laboratory workflow styles.
- **Workflows of blood culture in the hospitals:**

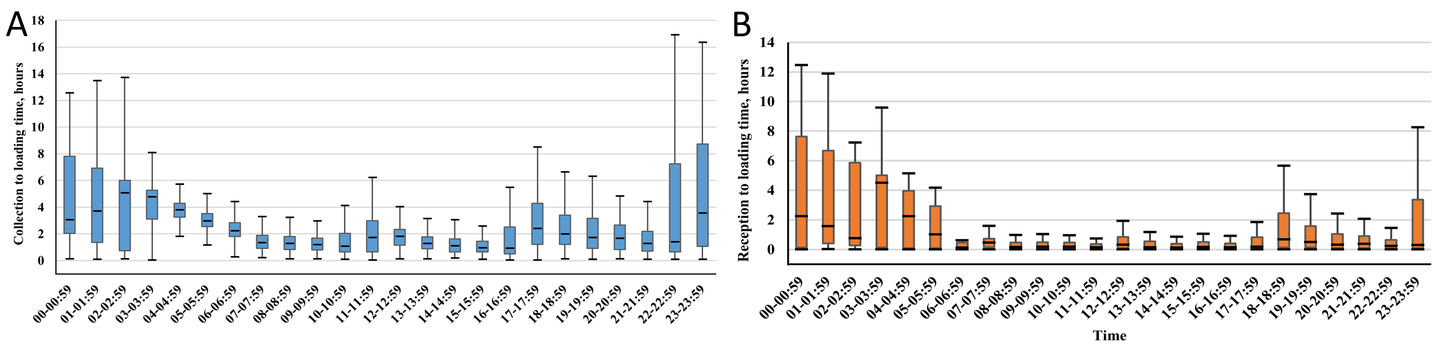
Group	Workflow style	Lab no.
I	**24h/7 on duty in a central clinical microbiology lab**	3 hospitals (B1, B4, C1)
II	**Day shift（08:00-17:30）in a clinical microbiology lab Night shift（17:30-08:00）in an emergency lab with BSC**	4 hospitals (B7, C2, C3, D1)
III	**Day shift（08:00-17:30）in a clinical microbiology lab Night shift（17:30-08:00）in an emergency lab without BSC**	4 hospitals (B2, B8, C4, C5)
IV	**Day shift（08:00-17:30）in a clinical microbiology lab, with delayed specimen loading or delayed processing of positive BCs.**	5 hospitals (A1, A2, B3, B6, D2)
Abbreviations: BSC, biological safety cabinet;		

RESULTS



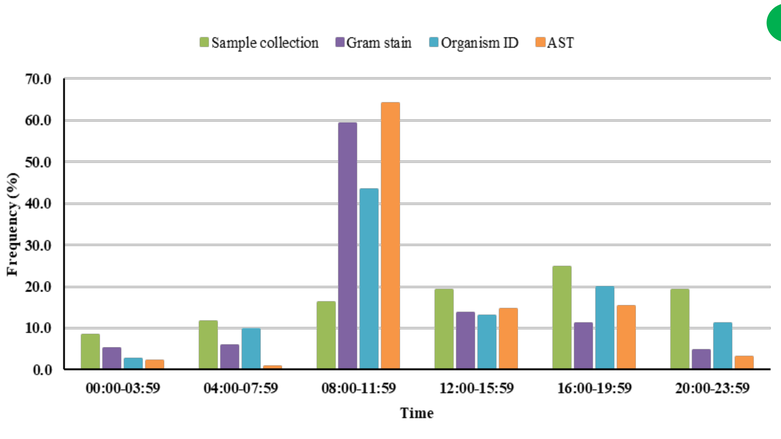
1 key performance indicators for blood culture：

- The positive rate of BC bottles ranged from 5.1% to 13.8%.
- The number of BCs ordered per 1000 bed days ranged from 12 to 61, which did not reach the standard range of 103–188.[2]
- The proportion of episodes with two or more BC sets ranged from 8.6% to 77.8%, with an average of 44.5%.
- The rate of two or more BC sets was more than 55% in nine hospitals and less than 25% in six hospitals.



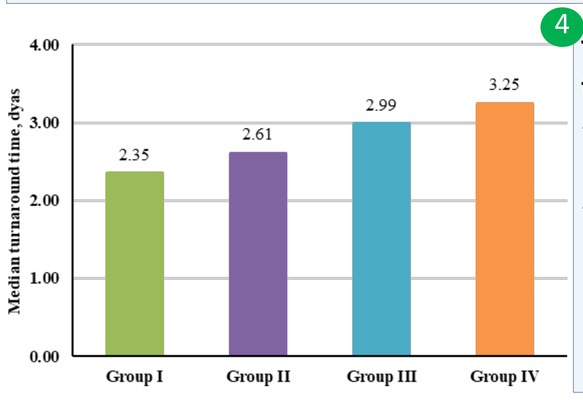
2 TATs of positive blood culture pre-analytical times (collection times, reception times, and loading times:

- **Figure A:** The median TAT between blood specimen collection in wards and specimen loading in the microbiology laboratory was mainly less than 2 h from 07:00 to 22:59, **but mainly greater than 2 h from 23:00 to 06:59 the next day.**
- **Figure B:** The median TAT from blood specimen reception to specimen loading in the microbiology laboratory was less than 0.2 h from 08:00 to 17:59. However, **a significant delay in specimen loading occurred between 00:00 and 06:00, with the median TAT being greater than 2 h.**
- The longest TAT between blood specimen reception and loading was greater than 12 h. delays



3 Turnaround time analysis of tiered report in blood culture：

- The laboratory reporting times were concentrated between 8:00 and 11:59 for Gram staining (59.3%), organism ID (43.3%), and AST(64.2%) results.
- The lowest numbers of Gram staining (4.8%) were reported between 20:00 and 23:59, organism ID (2.7%) between 0:00 and 3:59, and AST (0.7%) results between 04:00 and 07:59.



4 TTR of antimicrobial susceptibility test in different workflows：

- 16 hospitals were divided into four groups
- The time from specimen collection to the antimicrobial susceptibility testing reports (TTR) in each group gradually increased by nearly 6 h.

DISCUSSION

- The importance of BC quality and TATs should not be underestimated. Audit and feedback can be an effective tool for influencing institutional practices and improving BC quality.
- Our results have shown that the proportion of hospitals with two or more sets of BCs was still insufficient, according to the international guidelines which recommend that adults should have two or three sets collected each time.
- The results clearly demonstrated that the proportion of blood specimen reception and loading in each laboratory was very low at 00:00–07:59. Due to the off-site location, insufficient transport personnel and microbiological laboratory workflows, it was challenging to transfer, receive, and load specimens in time at night.
- Optimizing and timely processing of any steps, TTR could be shortened by 6 h, such as BC loading, positive BC inoculations, Gram staining, rapid identification with mass spectrometry, and review of antimicrobial sensitivity reports.
- Besides, placing the automatic blood culture instrument systems outside the microbiological laboratory, with automated and continuous loading was beneficial in shortening the delay of time to incubation, increasing the number of positive cultures, and decreasing the time to BC results.[3]

CONCLUSIONS

- This study shows the related BC KPIs and workflows in different Chinese hospitals, suggesting that laboratory workflow optimization can play important roles in shortening time to AST reports and initiation of appropriate timely treatment.

DISCLOSURES

- We certify that we have answered every question and have not altered the wording of any of the questions on this form.

REFERENCES

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