Clin. Lab. 2026;72:XXX-XXX

SHORT COMMUNICATION

Quarterly Trends in Blood Culture Collection Practices: A Two-Year Analysis in a Regional Hospital

Ya-Yun Liao [1], Ying-Ju Chen [1], Yu-Wei Tseng [1], Hsiang-Ling Chen [1], Tze-Kiong Er [1, 2]

[1] *Division of Laboratory Medicine, Asia University Hospital, Asia University, Taichung, Taiwan*
[2] *Department of Medical Laboratory Science and Biotechnology, Asia University, Taichung, Taiwan*

ABSTRACT

Background: **This study aimed to evaluate blood culture collection practices in both hospital-wide and emergency department (ED) settings at a regional hospital in Taiwan over an eight-quarter period (2023Q1 to 2024Q4). The primary focus was adherence to best practices regarding single-set versus two-set blood culture collection, assessed using standardized key performance indicators (KPIs).**
Methods: **A retrospective descriptive analysis was conducted using quarterly laboratory surveillance data. Key metrics included the total number of blood culture sets collected, the proportion of single-set collections, and the proportion of two-set collections. Data were stratified by collection setting (hospital-wide and ED), and bar charts were used to illustrate quarterly trends in single-set and two-set blood culture collections over time.**
Results: **Over the two-year period, blood culture collection practices demonstrated fluctuation rather than consistent improvement. In the ED, the single-set collection rate remained relatively stable, from 65.1% in 2023Q1 to 65.9% in 2024Q4, while two-set adherence slightly declined from 34.6% to 33.6%. Hospital-wide, the single-set rate increased modestly from 51.1% to 55.8%, and two-set adherence decreased from 47.8% to 43.2%. Notably, the ED exhibited a transient improvement in two-set adherence, peaking at 37.8% in 2024Q3, though this was not sustained. These trends indicate a lack of consistent, long-term progress in aligning with recommended two-set collection practices.**
Conclusions: **This two-year analysis highlights that while temporary gains in two-set blood culture adherence were achieved mid-study, these were not maintained through the end of 2024. Although the ED showed slightly better performance during certain quarters, both ED and hospital-wide data revealed persistently high single-set rates and only modest stability in two-set adherence. These findings underscore the need for continuous quality improvement initiatives, regular staff training, and systemic changes to align with international standards, thereby improving diagnostic accuracy and minimizing contamination risk.**
(Clin. Lab. 2026;72:xx-xx. DOI: 10.7754/Clin.Lab.2025.250833)

Correspondence:
Tze-Kiong Er, PhD
Division of Laboratory Medicine
Asia University Hospital
No. 222, Fuxin Rd.
Wufeng Dist., Taichung City 413
Taiwan
Phone: +886 4-37061668 ext. 1297
Email: tzekiong92@gmail.com
ORCID ID: https://orcid.org/0000-0002-7068-1652

Short Communication accepted August 21, 2025

KEYWORDS

blood culture, single-set blood culture, two-set blood culture, quality improvement, blood culture collection

INTRODUCTION

Blood cultures are essential in the diagnosis and clinical management of patients with suspected bloodstream infections. With ongoing advancements in collection protocols and technology, the accuracy and diagnostic yield of blood cultures have improved substantially. These

cultures are usually obtained when a systemic infection is suspected, whether bacterial or fungal in origin [1]. Several factors affect the detection rate of blood cultures, including sampling time, skin antisepsis, the number of sets collected, and the volume inoculated per bottle [2,3]. In our previous study, implementation of PDCA cycle management increased the average volume from 6.3 mL to 8.6 mL and raised the positive culture rate from 13% to 15%, underscoring the importance of adequate collection practices [4]. Current recommendations for adult patients advise collecting at least two blood culture sets to enhance the likelihood of pathogen identification. In specific clinical situations such as suspected infective endocarditis, up to four sets may be warranted [3]. Each set generally includes both aerobic and anaerobic bottles to ensure comprehensive detection of a broad range of microorganisms.

This study aims to evaluate trends in blood culture collection at a regional hospital in Taiwan from 2023Q1 to 2024Q4, with a focus on the rates of single-set versus two-set collections in both hospital-wide and emergency department (ED) settings.

MATERIALS AND METHODS

Study design and setting

This was a retrospective observational study based on quarterly laboratory quality reports from Asia University Hospital. Each report contains KPI indicators for blood culture collection, categorized by collection setting (hospital-wide and ED). The data included total blood culture sets collected, number and percentage of single-set collections, and number and percentage of two-set collections. These indicators were evaluated quarterly from 2023Q1 through 2024Q4.

Blood culture detection system

The BD BACTEC™ FX system enables rapid identification of microorganisms in blood cultures. Patient samples are inoculated into culture vials, which are then incubated and automatically monitored by the instrument. Each vial contains a sensor that detects carbon dioxide released during microbial metabolism. The instrument checks the sensor approximately every 10 minutes, measuring changes in fluorescence that correlate with rising CO_2 levels. A positive signal indicates microbial growth, while vials without detectable changes are reported as negative after a 5-day incubation period [5].

Data analysis

Chi-squared tests were used to examine the association between collection setting (hospital-wide vs. emergency department) and collection practice (single-set vs. two-set) for each quarter of the study period. The analyses were conducted using IBM SPSS Statistics for Windows, Version 31.0 (IBM Corp., Armonk, NY, USA). A two-sided p-value < 0.05 was considered statistically significant.

RESULTS

This retrospective 2-year study analyzed 21,323 blood cultures to evaluate adherence to paired (two-set) versus single-set collection protocols across hospital-wide and emergency department (ED) settings. To assess temporal trends, we examined quarterly proportions of single-set and two-set collections from 2023Q1 to 2024Q4 using internal key performance indicator (KPI) data. Figure 1 presents the quarterly trends in collection practices, while Figure 2 shows the corresponding positive culture rates. The results reveal persistently higher rates of single-set collections and fluctuating adherence to the two-set protocol over the study period.

Across the two-year period, Asia University Hospital exhibited some fluctuations in blood culture collection performance, as measured by standardized KPI indicators. In 2023Q1, of the 2,522 hospital-wide blood cultures performed, 1,289 (51.1%) were single sets and 1,206 (47.8%) were two sets. By 2024Q4, among 2,616 cultures, 1,461 (55.8%) were single sets and 1,130 (43.2%) were two sets, indicating a slight decrease in two-set adherence over time rather than improvement. *Note: Totals include a small number of cases with three or more blood culture sets; therefore, the sum of single-set and two-set collections may not equal the overall total.*

In the ED, a similar pattern was observed. In 2023Q1, 882 out of 1,354 cultures (65.1%) were single sets and 469 (34.6%) were two sets. By 2024Q4, the single-set count was 1,005 out of 1,525 cultures (65.9%) and two-set adherence was 512 (33.6%), again showing no sustained improvement compared to the beginning of the study period. While two-set samples generally showed more favorable positive rate trends, these rates fluctuated rather than showing a steady increase. For example, in the ED, the two-set positive rate peaked at 29.3% in 2023Q3 and reached a similar level of 28.9% in 2024 Q4. Similarly, the hospital-wide two-set positive rate reached its highest point at 22.1% in 2023Q3, but later decreased to 19.1% in 2024Q4. These fluctuations reinforce that the proportion of collections adhering to the two-set standard did not improve over time, and even showed a mild decline in some quarters, despite the higher diagnostic yield associated with this practice. Notably, the ED consistently outperformed the hospital-wide setting in terms of positive rates for two-set cultures, suggesting better diagnostic yield. However, the proportion of ED patients receiving two-set collections remained largely unchanged. The data revealed minor quarter-to-quarter fluctuations in two-set adherence, with temporary improvements observed in 2024Q1 and 2024Q3 that were not sustained. These inconsistencies underscore the need for continuous and systematic reinforcement of blood culture collection protocols to achieve long-term improvement.

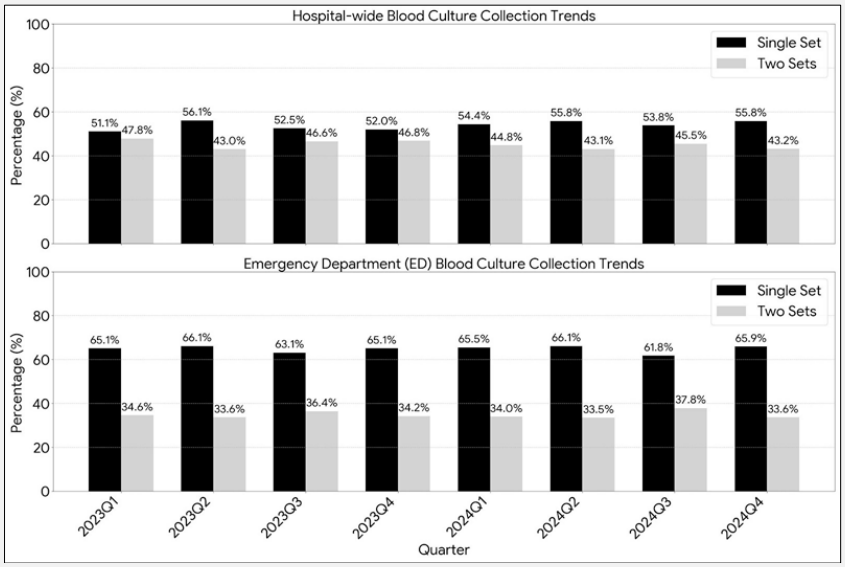

Figure 1. Quarterly trends in blood culture single-set and two-set collection rates for the hospital-wide and emergency department (ED) settings from 2023Q1 to 2024Q4.

The charts show the percentage of single-set (black bars) versus two-set (gray bars) blood cultures collected in each quarter. The top panel represents data for hospital-wide, while the bottom panel shows the data for the ED collections. The data highlight the consistently higher rate of single-set collections and fluctuations in two-set adherence over the two-year period.

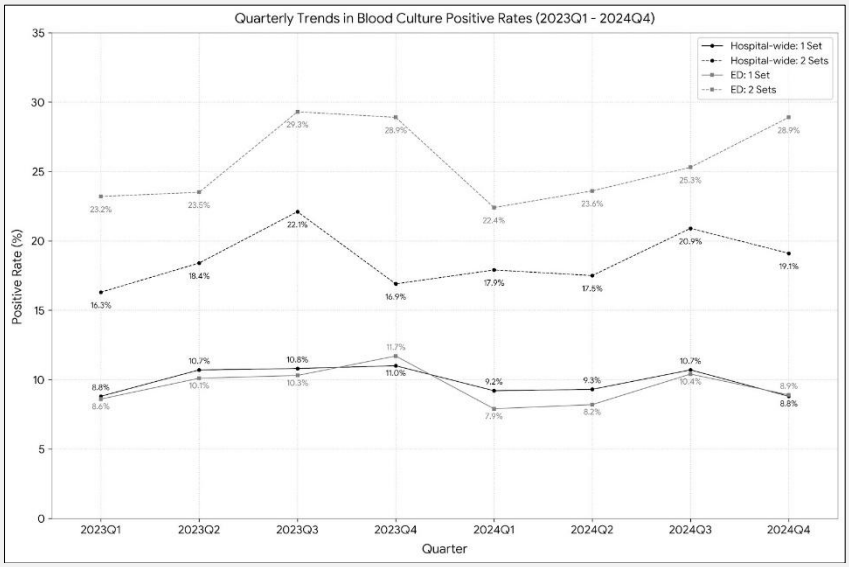

Figure 2. Quarterly trends in blood culture positive rates across hospital-wide and emergency department (ED) settings from 2023Q1 to 2024Q4.

The lines show the positive rates (%) for single-set (solid lines) and two-set (dashed lines) blood cultures. Black lines represent data from the hospital-wide while gray lines represent data from ED settings. The two-set cultures consistently show a higher diagnostic yield compared to the single-set cultures in both settings.

Chi-squared tests were performed for each quarter between 2023Q1 and 2024Q4 to assess the association between collection setting (hospital-wide vs. emergency department) and collection practice (single-set vs. two-set). The analyses consistently demonstrated a highly significant association across all quarters ($p < 0.001$), indicating a persistent difference in collection practices between the two settings. Throughout the study period, the emergency department maintained a higher proportion of single-set collections compared with hospital-wide data. This finding is noteworthy, as it contrasts with the recommended practice of collecting at least two blood culture sets to improve diagnostic yield and reduce contamination. Targeted efforts to increase two-set collections in the emergency department are therefore needed to better align with international guidelines and enhance blood culture accuracy.

DISCUSSION

A retrospective 5-year study involving 112,570 blood cultures demonstrated that paired blood cultures (PBC) yield significantly higher positivity rates and microbial recovery compared to single blood cultures (SBC), reinforcing the importance of collecting adequate blood volume and adhering to established collection protocols [6]. In our analysis, the hospital-wide single-set collection rate increased slightly from 51.1% in 2023Q1 to 55.8% in 2024Q4, reflecting a modest decline in compliance with the recommended two-set collection practice. Collecting two blood culture sets not only improves the sensitivity of pathogen detection but also enables better differentiation between true bacteremia and contamination [7]. These findings underscore the need for more targeted and sustained quality improvement efforts to bring two-set collection practices into closer alignment with international guidelines.

Two-set adherence showed a modest decline in both settings over the two-year period. Specifically, hospital-wide adherence decreased from 47.8% in 2023Q1 to 43.2% in 2024Q4, while ED adherence declined from 34.6% to 33.6% over the same period. These trends underscore the need for more sustained and reinforced quality improvement interventions to reverse the declining trajectory and achieve meaningful long-term progress.

Although temporary improvements in two-set adherence were observed, sustained progress was not achieved. Several factors may have contributed to the short-term gains. First, ongoing education for phlebotomy and nursing staff on the importance of proper blood culture collection may have improved awareness and compliance. Second, the introduction of visual feedback tools, such as performance dashboards and KPI posters, likely promoted short-term transparency and accountability within clinical teams. Third, periodic internal audits and interdisciplinary feedback meetings between the laboratory, infection control, and clinical departments may have fostered a culture of improvement and open communication. However, the lack of sustained adherence suggests that these measures were insufficient on their own and require reinforcement through continuous monitoring and system-level interventions.

Despite these positive developments, several limitations should be acknowledged. This study was conducted at a single institution, which may limit the generalizability of the findings. The retrospective design relied on administrative data, which, although reliable for process monitoring, lacked clinical outcome measures such as contamination rates, time to positivity, and the impact on patient care or antimicrobial stewardship. Additionally, potential confounding factors, such as seasonal variation, staff turnover, and fluctuations in workload, were not formally assessed, though they may have influenced collection practices.

Nonetheless, this study provides a strong foundation for future quality improvement initiatives in blood culture collection practices. Moving forward, efforts should aim to link KPI metrics with clinical outcomes to evaluate the impact of improved collection methods on diagnostic yield, contamination rates, and clinical decision-making. Expanding benchmarking efforts to include other institutions or regional hospital networks may also enable broader quality comparisons and facilitate collaborative learning.

In conclusion, this study demonstrates that systematic monitoring of blood culture KPIs, coupled with targeted quality improvement initiatives, can significantly enhance diagnostic practices across both hospital-wide and emergency department (ED) settings. Although temporary improvements in two-set collection rates were observed, particularly within the ED, these were not sustained. This highlights the need for ongoing and reinforced interventions. These findings underscore the importance of integrating evidence-based practices into routine workflows and continuing to prioritize staff training, process optimization, and interdisciplinary collaboration. Such efforts are essential to maintaining and further advancing the quality and reliability of blood culture collection.

Acknowledgment:
This study was supported by grants from Asia University Hospital (ASIA-114-51018).

Declaration of Interest:
There are no conflicts of interest associated with this paper.

References:

1. Chela HK, Vasudevan A, Rojas-Moreno C, Naqvi SH. Approach to Positive Blood Cultures in the Hospitalized Patient: A Review. Mo Med 2019;116(4):313-7. (PMID: 31527981)

2. Cockerill FR 3rd, Wilson JW, Vetter EA, et al. Optimal testing parameters for blood cultures. Clin Infect Dis 2004;38(12):1724-30. (PMID: 15227618)

3. Lee A, Mirrett S, Reller LB, Weinstein MP. Detection of bloodstream infections in adults: how many blood cultures are needed? J Clin Microbiol 2007;45(11):3546-8. (PMID: 17881544)

4. Tseng YW, Chen CC, Liao YY, Er TK. Optimizing Blood Culture Volumes by Implementing PDCA Cycle Management. Clin Lab 2023;69(4). (PMID: 37057938)

5. Wang MC, Lin WH, Yan JJ, et al. Early identification of microorganisms in blood culture prior to the detection of a positive signal in the BACTEC FX system using matrix-assisted laser desorption/ionization-time of flight mass spectrometry. J Microbiol Immunol Infect 2015;48(4):419-24. (PMID: 24388584)

6. Tarai B, Jain D, Das P, Budhiraja S. Paired blood cultures increase the sensitivity for detecting pathogens in both inpatients and outpatients. Eur J Clin Microbiol Infect Dis 2018;37(3):435-41. (PMID: 29327210)

7. Weinstein MP. Blood culture contamination: persisting problems and partial progress. J Clin Microbiol 2003;41(6):2275-8. (PMID: 12791835)