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Original Research

ENHANCING COMPLIANCE WITH ELECTRONIC PATIENT AND SPECIMEN IDENTIFICATION IN A PEDIATRIC TERTIARY HOSPITAL: A QUALITY IMPROVEMENT INITIATIVE

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Abstract

Background

Errors in patient and specimen identification during *ABO and Rh typing* collection are critical causes of transfusion-related adverse events. “Wrong blood in tube” (WBIT) incidents remain a preventable risk in clinical practice despite existing verification systems. This quality improvement initiative aimed to enhance compliance with *Electronic Positive Patient Identification (ePPID)* and *Positive Accession Identification (PAID)* during specimen collection by non-phlebotomy staff in a pediatric tertiary hospital.

Methods

A *Plan-Do-Study-Act (PDSA)* model was implemented over two cycles. Interventions included development of a real-time compliance dashboard, equipment calibration, competency-based education, and introduction of governance measures such as a “hard stop” policy for non-compliant specimens. Baseline data, surveys, and root cause analyses guided the actions.

Results

Initial ePPID/PAID compliance among non-phlebotomy staff was 59.7%. Following targeted interventions, compliance increased to 97.0% for *ABO/Rh* specimens. The “hard stop” policy significantly reduced identification errors, while e-learning modules improved staff competency. The multidisciplinary taskforce and data-driven monitoring ensured sustainability and integration across clinical units.

Conclusion

A structured, multidisciplinary quality improvement approach effectively enhanced compliance with electronic patient and specimen identification. Combining technology, governance, and education fostered a sustainable safety culture in transfusion medicine, reducing the risk of WBIT events.

Keywords: Patient Identification Systems; Specimen Handling; Transfusion Safety; Quality Improvement; Electronic Health Records; Medical Errors Prevention

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INTRODUCTION

A previous study conducted at Al-Eshaq identified low compliance with electronic Positive Patient Identification (PPID) and Positive Accession Identification (PAID) systems during specimen collection for ABORh testing (Al-Eshaq et al., 2023). The findings prompted the initiation of a secondary Quality Improvement Project (QIP) to address factors contributing to non-compliance, particularly among non-phlebotomy staff. This report outlines strategies implemented to enhance overall compliance and ensure patient safety through improved identification accuracy.

A *wrong blood in tube* (WBIT) event is a potentially fatal incident where the blood sample collected does not correspond with the identity indicated on the specimen label. Such events can lead to incompatible blood transfusions, resulting in life-threatening outcomes. The occurrence of WBIT has been well documented, with most cases attributed to human error, emphasizing that these events are preventable (Rogers et al., 2018). WBIT events fall under the category of “never events” (NE), as they are both preventable and carry serious implications when they occur in clinical settings (NHS England, 2021). Evidence indicates that approximately one in 7.14 million red blood cell (RBC) transfusions results in death from ABO incompatibility (Rogers et al., 2018), and near-miss events are estimated to occur 79 times more frequently than actual incompatible transfusions (Hendrickson et al., 2020).

Globally, healthcare systems are increasingly burdened with higher workloads and staffing shortages. A strong correlation has been identified between workforce insufficiency and the rise in human error (Kidd et al., 2020). Given that WBIT events predominantly arise from human mistakes, hospitals are encouraged to implement systematic safeguards to prevent patient misidentification incidents. The use of PPID and PAID technologies has emerged as an effective mitigation strategy within Transfusion Medicine services to ensure safe specimen collection for ABO testing (Rogers et al., 2018). Evidence suggests that a well-implemented PPID/PAID system can reduce WBIT incidents by up to 78.69% (Stanworth et al., 2020). Moreover, compared to manual or verbal identification methods, PPID/PAID systems have been shown to decrease the risk of misidentification from 1 in 14,606 to 1 in 3,046 (Bashir et al., 2018).

Beyond improving patient safety, the PPID/PAID system also eliminates the need for repeated blood draws for ABORh verification. According to the *College of American Pathologists* and the *Association for the Advancement of Blood and Biotherapies*, to issue non-group O, ABO-compatible RBCs, two independent determinations of a patient’s blood group

are required. One determination must be based on a current blood sample, while the second may be obtained from re-testing the same specimen if patient identification was electronically verified at the time of collection. AABB guidelines further emphasize that “utilizing an electronic identification verification system ensures that the patient from whom the pre-transfusion specimen was collected is the same patient who is about to be transfused” (Gálvez et al., 2020).

The implementation of PPID/PAID systems is particularly beneficial in pediatric healthcare settings, where blood collection can be technically challenging and psychologically distressing for both patients and healthcare providers. Therefore, enhancing PPID/PAID compliance is critical to ensuring specimen integrity, reducing human error, and improving overall transfusion safety. Aim this study to improve compliance with electronic PPID and PAID procedures during specimen collection for ABORh orders in a tertiary care women’s and children’s hospital.

METHODS

Research design

A dashboard to monitor the PPID and PAID compliance was developed in 2019, but never actively used for compliance monitoring. The dashboard enables a transparent real time view of PPID and PAID compliance across all specimens and collectors across the organization, and was initially validated for ABORh specimens. Further validations enabled the ability to include all specimen types. As part of a drive to increase the compliance across the organization, an interdisciplinary task force was created to address the low compliance for non-Phlebotomy staff for the collection of Pathology specimens.

Initially, to maximize the impact of introduced measures a project charter was developed, which had the input from numerous stakeholders, including Pathology, clinical teams, nursing education, quality, IT and data analytics. The initial project established in September 2023, used Hemato-Oncology (HO) as the pilot site. Weekly action-based taskforce meetings identified several factors as barriers to compliance, with baseline data, workflow and fishbone analysis, staff surveys and PDSA cycles as the main driver for barrier identification and change.

1st PDSA cycle

A fishbone analysis identified 5 key areas as barriers for compliance, where three were identified as significant, resulting in a focus on IT/Equipment, governance and education PDSA cycles. A survey used in 2020 was re-distributed to staff to better understand the reasons for

poor compliance. A total of 329 responses (22%) were received, with “Scanner not working” and “Scanner unable to read barcode” as the top two reason for overriding PPID and PAID.

Equipment / IT

A review of all collection stations within the HO unit was undertaken, to ensure all printers and scanners were configured correctly. Staff were educated in huddles and by unit champions on the correct process for calibrating scanners, and quick guides were placed by each collection station. Daily calibration checks were introduced, as part of the patient care partners duties. Any issues identified as part of the checks were immediately raised via the IT service desk.

Education

The survey also indicated that 33.9% of staff had not received training on how to collect Pathology specimens using PPID/PAID, so an educational training program was developed. This included establishing an e-learning module, with mandatory completion of the module for all nurses and midwives by 30th May 2024. The e-learning was made available to staff in March 2024. In addition, face to face training was provided by the Pathology accessioning team, to all new staff at the general mandatory nursing orientation.

Governance

Dashboard data was shared with unit manager, as well as the collecting personnel. Monthly data was displayed on the unit improvement board, and individual staff compliance were addressed in cases of persistent non-compliance.

Patient identification was introduced as an organizational quality objective, as part of a focus on JCIA’s International Patient Safety Goals (IPSG).

2nd PDSA cycle

Based on the pilot results, a decision was made to expand the project to all areas of the organization. Additional measures were identified aimed to improve compliance, including the introduction of a hard stop for non-compliant ABORh specimens, whereby any specimen received into Pathology with PPID and/or PAID overridden, would be rejected and a new specimen requested. This hard stop was introduced on 1st April 2024. In addition, a competency pathway for specimen collection was implemented, to ensure standardization across all nursing and midwifery staff.

Equipment / IT

A review of all clinical areas within the organization, where specimen collection took place, was undertaken by unit managers. Some areas, e.g. operating rooms had hardware issues, which required additional IT support to resolve. Previously established measures, e.g. scanner calibrations, immediate IT service desk reporting of issues were introduced across all areas.

Education

After approval had been obtained from CNO and CMO for the introduction of a hard stop, all clinical areas received communication of the change. In addition to Intranet and organizational newsletter communication, face to face communication with all clinical nurse managers/midwives was undertaken by the Pathology transfusion safety nurse (TSN). A reminder communication was sent to ensure staff completed the mandatory e-learning module.

The competency pathway included all staff to undertake the e-learning module (PDSA cycle 1), with the additional requirement of the completion of a competency checklist. The competency checklist was devised by the taskforce in collaboration with Pathology and Nursing Education staff. Clinical area specimen champions were identified, trained and competency assessed, and given the role as competency validators. The competency was assigned to all nursing and midwifery staff and made available on the Nursing Education electronic competency dashboard for tracking.

Governance

Measures introduced in HO, was also incorporated into other areas. A in-depth review of the existing collection procedure was undertaken, to ensure it aligned with proposed new practices. This went through stakeholder review and was approved at organizational level. A downtime workflow was developed (Insert figure 1 below), to prevent unnecessary rejections, in cases where there was a system issue, rather than a compliance issue.

Monitoring of PPID/PAID compliance by Transfusion Medicine Technologists upon receipt of the ABORh specimens were introduced prior to the enforcement of the hard stop, with the TSN following up on any orders not complying with the requirements.

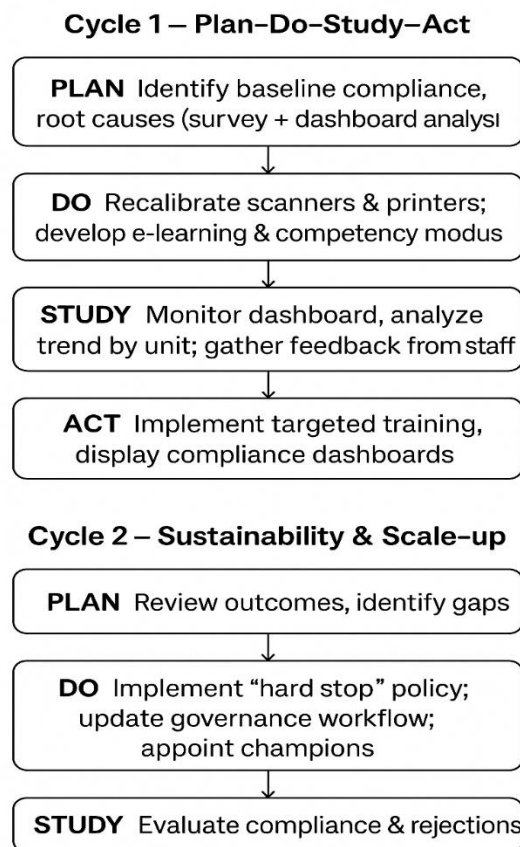


Figure 1. PPID/PAID workflow for specimen collection.

RESULT

The first PDSA cycle identified a total of 7 out of 17 (41.2%) scanners as having at least one issue, preventing staff from complying with PPID/PAID requirements. All printers were able to print the specimen label as expected.

A total of 663 staff have completed the e-learning module (75.9%), with 221 in progress by the 30th May 2024 deadline. 2 staff members failed the assessment and had the e-learning module re-assigned.

Baseline data analysis identified an 73.8% (n=470) PPID/PAID compliance amongst non-Phlebotomy staff in the HO unit in relation to all Pathology specimens and 72.7% (n=55) for ABORh specimens. Compliance for the same time period for Phlebotomy staff was 96.3% (n=25) and 96.0% (n=588) respectively. The same data for all staff in May show a 100% compliance (n=60).

PPID/PAID compliance for ABORh specimens (all locations) increased from 59.7% (n=352) in August 2023 to 97.0% (n=371) in May 2024. For the Operating Room, compliance

has gone from 0% to 100% since implementation. For all specimens there has been a 19.5% increase in compliance amongst non-Phlebotomy staff (Figure 2).

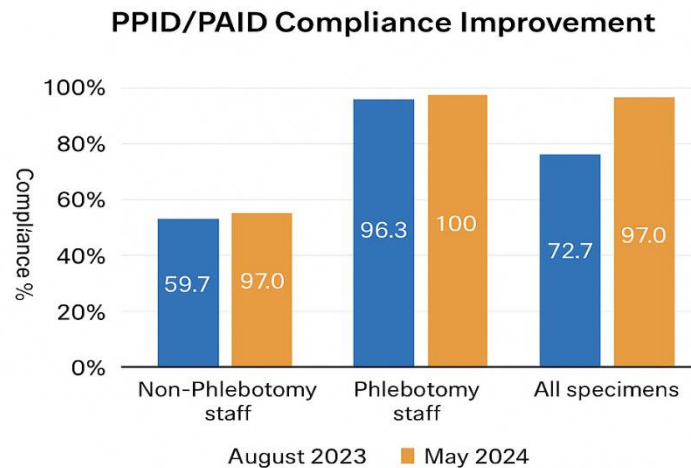


Figure 2. PPID/PAID compliance improvement across staff categories and specimen types between August 2023 and May 2024. Compliance for ABORh specimens increased from 59.7% (n = 352) to 97.0% (n = 371). Overall, compliance improvement from 0% to 100%.

DISCUSSION

The implementation of a structured taskforce combined with the Plan-Do-Study-Act (PDSA) methodology resulted in a remarkable improvement in PPID/PAID compliance, reaching 98% for ABORh specimens and 90% for all pathology samples. This finding aligns with prior quality improvement studies demonstrating that PDSA cycles enhance healthcare processes by promoting iterative testing, real-time learning, and stakeholder engagement (Taylor et al., 2014; (Reed & Card, 2016). The use of a real-time PPID/PAID dashboard served as a critical innovation, enabling visibility of compliance data, identification of gaps, and timely feedback—consistent with digital transformation strategies that improve patient safety and accountability (Ji et al., 2021).

Collaboration between the clinical and IT departments played a crucial role in resolving technical barriers such as scanner and printer malfunctions. Previous studies have emphasized that interdisciplinary teamwork and technology optimization are key to sustaining electronic health record (EHR)–driven interventions (Kadi et al., 2017; (Alotaibi & Federico, 2017). Direct engagement with stakeholders through face-to-face communication further accelerated issue resolution and enhanced ownership, a strategy widely recognized for improving adherence to digital compliance systems (Nedergaard et al., 2018).

Another factor contributing to the success of this initiative was the strict enforcement of the transfusion medicine laboratory (TML) policy to reject specimens that bypassed

PPID/PAID verification. Such “hard-stop” policies have proven to be highly effective in minimizing preventable errors by reinforcing compliance through system-level accountability (Kadi et al., 2017). This deterrence mechanism motivated staff to follow standard protocols to avoid specimen rejection or patient re-bleeding—both of which carry clinical and ethical implications (Güner et al., 2025).

Education and training also emerged as central drivers of improvement. Evidence shows that well-structured educational interventions enhance healthcare workers’ competence and adherence to digital safety tools, particularly in laboratory and transfusion medicine (Jeong & Lee, 2020). This QIP successfully contextualized the role of PPID/PAID in reducing wrong blood in tube (WBIT) incidents and strengthened staff competency, reflecting the principles of continuous professional development recommended by the WHO (WHO, 2019).

The broad support from hospital leadership and multidisciplinary stakeholders underscores the growing institutional commitment to patient safety culture (Ree & Wiig, 2020). Interestingly, focusing on ABORh specimens had a positive spillover effect, improving compliance across other specimen types. This suggests that targeted QIPs can yield system-wide benefits when they address fundamental workflow and safety principles (Ramaswamy et al., 2018).

Future audits should ensure sustainability of compliance through periodic review of ID band availability, system usability, and human–technology interaction, as these are recurring challenges in long-term implementation (Carayon et al., 2020). Continuous monitoring, staff feedback, and adaptive learning will be essential to maintaining the gains achieved through this QIP.

For teams aiming to replicate these results, the following are critical: integrate dashboards into clinical workflows (not as an add-on); ensure hardware reliability and a clear IT escalation pathway; combine enforcement policies with safe downtime procedures; and make education competency-based and tracked. Embedding these elements within organisational governance helps convert short-term improvements into sustained practice change (Wilson et al., 2025).

Strengths and Limitations

This QIP presented several notable strengths. First, the multidisciplinary taskforce approach integrated multiple stakeholders from clinical, laboratory, and IT backgrounds, ensuring that both technical and human factors were addressed comprehensively. Such

collaborative frameworks have been proven effective in enhancing compliance and improving patient safety outcomes (Anderson et al., 2022).

Second, the real-time digital dashboard facilitated data transparency and timely feedback, allowing rapid corrective action and targeted support for underperforming units. Evidence suggests that interactive dashboards improve performance accountability and foster continuous improvement in healthcare organizations (Coiera et al., 2025).

Third, the policy of hard-stop specimen rejection served as a powerful behavioral and procedural reinforcement mechanism, aligning staff practice with safety standards. Research confirms that automated verification systems can substantially reduce misidentification and transfusion-related errors (Hendrickson et al., 2020; (Rogers et al., 2018).

Finally, education and competency-based training were integral to the project's success. Continuous professional development enhances awareness of patient safety practices and reduces procedural variability (Ejaz et al., 2021).

Despite its success, the project has several limitations. First, it was conducted within a single tertiary care hospital, limiting the generalizability of findings to other institutions with differing infrastructures or digital readiness levels. Prior studies indicate that organizational culture and IT maturity strongly influence the outcomes of digital interventions (Jones et al., 2018).

Second, the QIP employed a quasi-experimental PDSA design without a formal control group, thereby limiting causal inference. While PDSA cycles effectively support iterative improvement, they are less robust than randomized or controlled designs for attributing causality (Taylor et al., 2014).

Third, the sustainability of compliance was not evaluated beyond the project's 6-month timeframe. Long-term adherence typically depends on ongoing monitoring, system updates, and continuous staff engagement (Coiera et al., 2025).

Lastly, the study did not explore behavioral or psychosocial factors influencing staff compliance, such as workload, cognitive load, or attitudes toward digital monitoring. Future QIPs could benefit from integrating behavioral science frameworks to understand the human dimensions of compliance (Carayon et al., 2020).

CONCLUSION

This QIP demonstrated that combining technology, education, and governance through a structured, multidisciplinary framework can substantially improve compliance with electronic patient identification processes.

The implementation of real-time dashboards, strict verification policies, and stakeholder engagement effectively enhanced PPID/PAID compliance and reduced the potential for WBIT incidents.

Sustained improvement will require continued leadership support, periodic re-auditing, and integration of feedback mechanisms to maintain compliance across all departments.

Ultimately, this initiative reinforces the essential role of human-technology integration in advancing patient safety and fostering a culture of quality in healthcare.

Conflict of Interest

The authors declare no conflict of interest related to the conduct of this research or the publication of this article.

REFERENCES

- Al-Eshaq, D. H., Bradley, R. T., McBride, E. R. A., & Ford, J. C. (2023). Patient and specimen identification in a tertiary care pediatric hospital: Barcodes do not scan themselves. *Transfusion*, 63(7), 1310–1317. <https://doi.org/10.1111/trf.17399>
- Alotaibi, Y. K., & Federico, F. (2017). The impact of health information technology on patient safety. *Saudi Medical Journal*, 38(12), 1173–1180. <https://doi.org/10.15537/smj.2017.12.20631>
- Anderson, J. L., Reamey, R. A., Levitan, E. B., M. Asif, I., S. Aswani, M., Fletcher, F. E., G. Hall, A., Kennedy, K. C., Long, D., Redden, D., Tunagur, A., Wasko, M., Willig, J., Wyatt, M., & Mugavero, M. J. (2022). The University of Alabama at Birmingham COVID-19 Collaborative Outcomes Research Enterprise: Developing an institutional learning health system in response to the global pandemic. *Learning Health Systems*, 6(2). <https://doi.org/10.1002/lrh2.10292>
- Bashir, S., Meli, A., & Cardigan, R. (2018). *In vitro* quality of apheresis platelets divided into paediatric-sized units and stored in PVC bags plasticised with TOTM, BTHC or DINCH. *Transfusion Medicine*, 28(5), 380–385. <https://doi.org/10.1111/tme.12528>
- Carayon, P., Wooldridge, A., Hoonakker, P., Hundt, A. S., & Kelly, M. M. (2020). SEIPS 3.0: Human-centered design of the patient journey for patient safety. *Applied Ergonomics*, 84, 103033. <https://doi.org/10.1016/j.apergo.2019.103033>
- Coiera, E., Chan, A., Brooke-Cowden, K., Rahimi-Ardabili, H., Halim, N., & Tufanaru, C. (2025). Clinical and economic impact of digital dashboards on hospital inpatient care: a systematic review. *JAMIA Open*, 8(4). <https://doi.org/10.1093/jamiaopen/ooaf078>

- Ejaz, K., Roback, J. D., Stowell, S. R., & Sullivan, H. C. (2021). Daratumumab: Beyond Multiple Myeloma. *Transfusion Medicine Reviews*, 35(3), 36–43. <https://doi.org/10.1016/j.tmr.2021.06.002>
- Gálvez, J., Hsu, G., Dubow, S., Obermeier, L., Blair, P., Friedman, D., & Sesok-Pizzini, D. (2020). How do I...Incorporate a two-sample blood type verification in a pediatric hospital? *Transfusion*, 60(12), 2787–2792. <https://doi.org/10.1111/trf.15997>
- Güner, Y., Güner, E. K., Üçüncüoğlu, M., & Yüksel, H. (2025). Evaluation of specimen rejection rates in the preanalytical phase and nurses' experiences: a mixed design study. *BMC Nursing*, 24(1), 705. <https://doi.org/10.1186/s12912-025-03426-w>
- Hendrickson, J. E., Mendoza, H., Ross, R., Siddon, A. J., Gowda, L., Hauser, R. G., Schulz, W. L., & Tormey, C. A. (2020). Investigation of increased platelet alloimmunization screening in the era of pathogen-reduced platelets treated with psoralen/UV light. *Transfusion*, 60(3), 650–651. <https://doi.org/10.1111/trf.15691>
- Jeong, S., & Lee, O. (2020). Correlations between emergency code awareness and disaster nursing competencies among clinical nurses: A cross-sectional study. *Journal of Nursing Management*, jonm.13086. <https://doi.org/10.1111/jonm.13086>
- Ji, Q., Qian, Z., Ren, L., & Ren, L. (2021). Torque Curve Optimization of Ankle Push-Off in Walking Bipedal Robots Using Genetic Algorithm. *Sensors*, 21(10), 3435. <https://doi.org/10.3390/s21103435>
- Jones, D., Bennett, M., & Smith, T. (2018). Summary-Implementation science in low-resource settings: using the interactive systems framework to improve hand hygiene in a tertiary hospital in Ghana. *International Journal for Quality in Health Care*, 30(9), 1–1. <https://doi.org/10.1093/intqhc/mzy238>
- Kadi, I., Idri, A., & Fernandez-Aleman, J. L. (2017). Knowledge discovery in cardiology: A systematic literature review. *International Journal of Medical Informatics*, 97, 12–32. <https://doi.org/10.1016/j.ijmedinf.2016.09.005>
- Kidd, H., Rankin, S., & Gillman, L. (2020). Developing the Next Generation in Electronic Clinical Auditing. *Journal of Nursing Care Quality*, 35(4), 317–322. <https://doi.org/10.1097/NCQ.0000000000000461>
- Nedergaard, H. K., Haberlandt, T., Reichmann, P. D., Toft, P., & Jensen, H. I. (2018). Patients' opinions on outcomes following critical illness. *Acta Anaesthesiologica Scandinavica*, 62(4), 531–539. <https://doi.org/10.1111/aas.13058>
- NHS England. (2021). *Never events policy and framework*. NHS England. <https://www.england.nhs.uk/patient-safety/never-events/>
- Ramaswamy, R., Reed, J., Livesley, N., Boguslavsky, V., Garcia-Elorrio, E., Sax, S., Houleymata, D., Kimble, L., & Parry, G. (2018). Unpacking the black box of improvement. *International Journal for Quality in Health Care*, 30(suppl_1), 15–19. <https://doi.org/10.1093/intqhc/mzy009>

- Ree, E., & Wiig, S. (2020). Linking transformational leadership, patient safety culture and work engagement in home care services. *Nursing Open*, 7(1), 256–264. <https://doi.org/10.1002/nop2.386>
- Reed, J. E., & Card, A. J. (2016). The problem with Plan-Do-Study-Act cycles. *BMJ Quality & Safety*, 25(3), 147–152. <https://doi.org/10.1136/bmjqs-2015-005076>
- Rogers, K. A., Huang, Y., Ruppert, A. S., Salem, G., Stephens, D. M., Heerema, N. A., Andritsos, L. A., Awan, F. T., Byrd, J. C., Flynn, J. M., Maddocks, K. J., & Jones, J. A. (2018). A single-institution retrospective cohort study of first-line R-
<scp>EPOCH</scp> chemoimmunotherapy for Richter syndrome demonstrating complex chronic lymphocytic leukaemia karyotype as an adverse prognostic factor. *British Journal of Haematology*, 180(2), 259–266. <https://doi.org/10.1111/bjh.15035>
- Stanworth, S., Haspel, R., & Mack, J. (2020). Journal Club. *Transfusion Medicine Reviews*, 34(4), 294–300. <https://doi.org/10.1016/j.tmr.2020.10.001>
- Taylor, M. J., McNicholas, C., Nicolay, C., Darzi, A., Bell, D., & Reed, J. E. (2014). Systematic review of the application of the plan–do–study–act method to improve quality in healthcare. *BMJ Quality & Safety*, 23(4), 290–298. <https://doi.org/10.1136/bmjqs-2013-001862>
- WHO. (2019). *Patient safety incident reporting and learning systems: Technical report and guidance*. World Health Organization Press. <https://www.who.int/patientsafety>
- Wilson, N., Eljiz, K., Hogden, A., & Greenfield, D. (2025). Factors influencing embedding of organization-wide culture change programs in health care: a scoping review. *JBIM Evid Implement*.