

Web-Based Laboratory Registration for Referral Tests in Indonesian Tertiary Hospitals: A Qualitative Technology Acceptance Study

**Lyana Setiawan^{1,2}, Susilowati¹, Guardian Yoki Sanjaya¹,
Widi Budianto², Yudhi Dwi Cahyo², Meidina Fajrin^{2*}**

¹ Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia

² Dharmas National Cancer Center, Jakarta, Indonesia

*Corresponding author: meidinaf1@gmail.com

ARTICLE INFO	ABSTRACT
Keywords: Interoperability; Laboratory referral; Web-based registration Article History: Received: 6/10/2026 Revised: 7/27/2026 Accepted: 7/31/2026	Introduction: The Clinical Pathology Laboratory of Dharmas Cancer Hospital serves as a referral laboratory for oncology and HIV testing. However, the existing manual registration process for referral examinations was inefficient and frequently resulted in errors in patient demographic data. This study aimed to develop, implement, and evaluate a web-based laboratory registration system integrated into the Dharmas Cancer Hospital Information System (SIRSKD) to improve referral laboratory services. Methods: This qualitative study employed an action research design. Twelve purposively selected informants, including hospital and primary healthcare IT staff, laboratory personnel, hospital marketing staff, and referring health center representatives, participated in focus group discussions (FGDs) conducted during the problem identification, pre-implementation, and evaluation phases. Data were audio-recorded, transcribed verbatim, and analyzed using thematic analysis. Results: Ten themes emerged from the analysis: human resources, leadership, organizational governance, digital transformation regulation, partial referral systems, hospital-laboratory networking, information quality, system quality, laboratory referral service improvement, and increased customer potential. The implementation demonstrated that users accepted the web-based registration system and perceived it as easy to use, with no major operational barriers during the implementation period. The system reduced dependence on manual registration, streamlined referral workflows, and was considered to have the potential to improve service efficiency and support future interoperability among healthcare facilities. Conclusion: The web-based laboratory referral registration system was feasible and well accepted by users, demonstrating its potential to improve the efficiency and quality of referral laboratory services. Nevertheless, broader implementation with a longer evaluation period and quantitative assessment is needed to determine its impact on service performance and laboratory outcomes.

How to cite this article:

Setiawan, L. Susilowati. Sanjaya, G. Y. Budianto, W. Cahyo, Y. D. Fajrin, M. (2026). Web-Based Laboratory Registration for Referral Tests in Indonesian Tertiary Hospitals: A Qualitative Technology Acceptance Study, 11(1). 536–543. <https://doi.org/10.51851/jmis.v11i1.1064>

This article is licensed under aCreative Commons Attribution-ShareAlike4.0 International License ©2026 by Lyana Setiawan.

INTRODUCTION

Clinical laboratory services play a vital role in supporting disease diagnosis, treatment decisions, therapeutic monitoring, and continuity of patient care. The rapid advancement of digital health technologies has encouraged healthcare organizations to adopt integrated laboratory information systems that improve service quality, enhance patient safety, reduce medical errors, and increase operational efficiency (WHO, 2019; Scott et al., 2023). However, many healthcare institutions continue to experience fragmented information systems and limited interoperability, resulting in duplicate data entry, inefficient workflows, delayed services, and an increased risk of transcription errors (Patel et al., 2017; Ayaz et al., 2021).

The Clinical Pathology Laboratory of Dharmais Cancer Hospital functions as a referral laboratory for oncology and HIV examinations. In 2021, the laboratory processed 48,260 referral examinations, representing 7.3% of all laboratory tests and contributing 16.3% of the total clinical pathology laboratory revenue (Instalasi Sistem Informasi Manajemen Rumah Sakit Kanker Dharmais, 2021). Despite its strategic role, the referral registration process remained predominantly manual, requiring couriers to complete administrative procedures at multiple service counters before specimen submission. This process prolonged service time and frequently resulted in demographic data entry errors, including incorrect patient names, dates of birth, sex, and guarantor information. Between January 10 and January 21, 2022, twelve registration errors were identified through routine monitoring by laboratory staff, consisting of four misspelled names, three incorrect dates of birth, two incorrect gender entries, one prefix–age mismatch, and one incorrect guarantor entry (Laboratorium Patologi Klinik Rumah Sakit Kanker Dharmais, 2022). Similar findings have been reported in previous studies showing that manual registration processes and fragmented laboratory information systems contribute to patient identification errors, transcription mistakes, and reduced efficiency of laboratory services (Lau et al., 2012; Delvaux et al., 2017).

The integration of electronic medical records with laboratory information systems has been shown to reduce manual data entry, shorten turnaround time, minimize transcription errors, and improve patient safety (Delvaux et al., 2017; Lau et al., 2012). Furthermore, interoperability enables healthcare providers to exchange laboratory requests and examination results electronically, thereby improving service coordination, reducing administrative workload, and enhancing continuity of care (WHO, 2019; Ayaz et al., 2021). Nevertheless, implementing interoperable laboratory referral systems remains challenging because many healthcare organizations continue to rely on heterogeneous information systems that cannot seamlessly exchange standardized clinical and laboratory data (Patel et al., 2017; Scott et al., 2023).

To address these challenges, Dharmais Cancer Hospital developed a web-based laboratory referral registration system integrated into the Dharmais Cancer Hospital Information System (SIRSKD). The system enables referring healthcare facilities to register examination requests and specimens electronically before specimen delivery, allowing couriers to proceed directly to the laboratory without additional administrative registration. In addition, interoperability facilitates the automatic transmission of authorized laboratory results to referring institutions, thereby reducing staff workload, minimizing transcription errors, and improving service efficiency.

HIV referral examinations were selected as the pilot implementation because they represent one of the largest referral service segments managed by Dharmais Cancer Hospital and are regulated under the Indonesian Ministry of Health Regulation No. 15 of 2015 concerning HIV testing laboratories and opportunistic infections (Kementerian Kesehatan Republik Indonesia, 2015). During 2020, a total of 3,956 HIV specimens were referred to Dharmais Cancer Hospital from healthcare facilities in West Jakarta and surrounding areas. Although previous studies have demonstrated the benefits of laboratory information systems and interoperability in improving healthcare services, evidence regarding the implementation and user acceptance of an integrated web-based laboratory referral registration system in Indonesian tertiary referral hospitals remains limited. Therefore, this study aimed to develop, implement, and evaluate a web-based laboratory

referral registration system using an action research approach to assess its feasibility, user acceptance, and potential contribution to improving referral laboratory services.

METHOD

Research Design

This study employed a qualitative approach using an action research design. Action research was selected because it enables researchers and stakeholders to collaboratively identify problems, develop and implement solutions, and evaluate their effectiveness through iterative cycles of planning, action, observation, and reflection (Utarini, 2020). This approach was considered appropriate because the study aimed not only to explore existing problems in the referral laboratory registration process but also to develop and evaluate a web-based registration system within the actual service setting.

Setting

The study was conducted at the Clinical Pathology Laboratory of Dharmais Cancer Hospital, Jakarta, Indonesia, from October 2022 to February 2023. Data collection was performed after institutional approval through focus group discussions (FGDs) conducted either face-to-face or online using the Zoom platform, depending on participants' availability.

Participants

Twelve informants were recruited using purposive sampling based on their involvement in referral laboratory services and the implementation of the web-based registration system. Eligible participants were those who: (1) understood the referral laboratory procedures between Community Health Centers (Puskesmas) and Dharmais Cancer Hospital; (2) were directly involved in referral laboratory services; (3) were able to communicate their experiences and opinions; and (4) agreed to participate voluntarily. The participants included hospital and Puskesmas information technology staff, clinical pathology laboratory personnel, hospital marketing staff, representatives from the West Jakarta Health Sub-department, and representatives from referring Puskesmas involved in HIV referral services.

Data Collection

Data were collected through focus group discussions (FGDs) guided by a semi-structured interview guide. The action research process consisted of three sequential stages: (1) problem identification to explore challenges in the existing referral registration process; (2) pre-implementation discussions to identify user requirements and support system development; and (3) post-implementation evaluation to assess user experiences and system performance. All discussions were audio-recorded with participants' permission and transcribed verbatim for analysis.

Research Instruments

The primary research instrument was a semi-structured FGD guide developed according to the study objectives. Additional data sources included audio recordings of the discussions and hospital information system records documenting referral specimens and registrations submitted through the web-based system during the implementation period.

Data Analysis

Data were analyzed using thematic analysis. Audio recordings were transcribed verbatim, and transcripts were read repeatedly to achieve data familiarization. Meaningful statements were coded, grouped into categories, and subsequently synthesized into themes representing participants' experiences and perceptions regarding the implementation of the web-based laboratory registration system (Braun & Clarke, 2006; Utarini, 2020). To enhance the trustworthiness of the findings, member checking was conducted by confirming the interpretation of findings with selected participants, while peer debriefing was performed through discussions among researchers to improve analytical consistency and credibility.

Ethical Considerations

Ethical approval was obtained from the Health Research Ethics Committee of Dharmais National Cancer Center (No. 053/KEPK/II/2023; February 3, 2023). Written informed consent was obtained from all participants prior to data collection. Participation was voluntary, confidentiality was maintained by anonymizing participant information, and all collected data were used solely for research purposes in accordance with the principles of respect for persons, beneficence, non-maleficence, and justice.

RESULTS AND DISCUSSION

Results

Characteristic Participants

A total of 12 informants participated in this study, comprising nine end users and three information technology (IT) personnel involved in the implementation of the web-based laboratory referral registration system. Most participants were female (66.7%), younger than 40 years (66.7%), and represented referring institutions outside Dharmais Cancer Hospital (75%). Detailed participant characteristics are presented in Table 1.

Table 1. Informant Characteristics

Characteristic	Category	n (%)
Sex	Male	4 (33%)
	Female	8 (67%)
Age group	<40 years	8 (67%)
	>40 years	4 (33%)
User type	System end-user	9 (75%)
	System manager/developer	3 (25%)
Employment status	Hospital staff	3 (25%)
	Non-hospital staff	9 (75%)

Thematic Analysis

Thematic analysis of the focus group discussions identified ten major themes related to the implementation of the web-based laboratory referral registration system. These themes comprised human resources, leadership, organizational governance, digital transformation regulation, partial referral systems, hospital–laboratory networking and partnerships, information quality, system quality, laboratory referral service improvement, and customer growth potential. The findings demonstrated that the existing referral registration process was constrained by fragmented information systems, repeated manual data entry, limited interoperability, and inefficiencies in laboratory referral services. In addition to these operational challenges, participants also highlighted organizational and human factors, including staff readiness, leadership support, and the quality of referral information, as important determinants of successful system implementation. These findings informed the design, implementation, and evaluation of the web-based laboratory referral registration system. The main findings identified during the focus group discussions are summarized in Table 2.

Table 2. Thematic Findings from the Focus Group Discussions

No.	Theme	Main Findings
1	Human resources	Differences in users' digital competencies and readiness for adopting the new registration system indicated the need for continuous training and technical support.
2	Leadership	Strong leadership commitment and cross-sector coordination were considered essential to facilitate decision-making and support successful system implementation.
3	Organizational governance	Coordination with the Ministry of Health's Digital Transformation Office was required to support interoperability and system integration.
4	Digital transformation regulation	Referral registration required repeated manual data entry into multiple applications (SITRUST, SIHA, and SIKDA) because these systems were not yet integrated.
5	Partial referral system	Referral laboratory examinations were limited to selected services provided under specific government health programs.
6	Hospital-laboratory networking and partnerships	Existing information systems (SIKDA, SITRUST, SIHA, and SIRSKD) operated independently, resulting in limited interoperability and duplicate data entry.
7	Information quality	Referral information was generally accurate; however, incomplete integration among existing applications limited automatic data exchange and information consistency.
8	System quality	Users experienced intermittent network interruptions and occasional disruptions of the SITRUST application during referral registration.
9	Laboratory referral service improvement	The existing registration process resulted in delayed laboratory result delivery, inefficient administrative procedures, and expectations for faster turnaround times.
10	Customer growth potential	Participants perceived that improving registration efficiency and service quality could strengthen collaboration with referring healthcare facilities and potentially increase referral volumes.

The themes identified through thematic analysis are presented in the following sections. Each theme describes participants' experiences and perceptions regarding the implementation of the web-based laboratory referral registration system. The interpretation of these findings in relation to previous studies is presented in the Discussion section.

Discussion

This study identified ten interrelated themes influencing the implementation of a web-based laboratory referral registration system at Dharmais Cancer Hospital. The findings demonstrate that successful implementation is influenced not only by technological capability but also by organizational readiness, leadership support, interoperability, information quality, and user acceptance. These findings reinforce previous evidence that digital transformation in healthcare requires the integration of technological, organizational, and human factors to ensure sustainable implementation and improve healthcare delivery (Alzghaibi et al., 2023; Li et al., 2025).

Organizational readiness emerged as one of the most influential factors affecting system implementation. The themes of human resources, leadership, and organizational governance indicated that successful implementation depended on effective collaboration among healthcare professionals, information technology personnel, and institutional leaders. Participants emphasized that management commitment facilitated decision-making, strengthened coordination across departments, and encouraged stakeholder engagement throughout the implementation process. These findings are consistent with previous studies reporting that leadership commitment and organizational readiness are fundamental prerequisites for successful implementation of digital health systems (Alzghaibi et al., 2023). Likewise, workforce readiness and digital competencies have been recognized as important determinants of successful adoption of interoperable health information systems (Ait Gacem et al., 2025). Scott et al. (2023) further highlighted that healthcare professionals require adequate digital health competencies to effectively adopt and sustain digital technologies in clinical practice. Collectively, these findings suggest that investment in organizational capacity, workforce development, and digital competencies is equally important as investment in technological infrastructure.

Interoperability was another major challenge identified in this study. Participants reported that laboratory referrals still required repeated manual entry into several independent applications, including SITRUST, SIHA, and SIKDA, resulting in fragmented workflows, increased administrative workload, and the potential for inconsistencies in patient information. Similar challenges have been widely reported in health information systems, where limited interoperability

restricts efficient information exchange and increases duplicate documentation (Torab-Miandoab et al., 2023). The implementation of interoperability standards such as Fast Healthcare Interoperability Resources (FHIR) has been recommended to facilitate standardized data exchange and improve coordination among healthcare organizations (Li et al., 2025). Furthermore, Standley et al. (2019) demonstrated that well-coordinated specimen referral systems supported by integrated information systems improve specimen tracking, strengthen laboratory networks, and increase the efficiency of diagnostic services. In Indonesia, Narolita and Darma (2020) similarly emphasized that digital transformation in clinical laboratory services requires integrated information systems capable of supporting efficient, patient-centered care. These findings indicate that strengthening interoperability should become a strategic priority to improve laboratory referral services, enhance data quality, and ensure continuity of patient care.

Positive user acceptance of the web-based laboratory referral registration system was also evident. Participants perceived that electronic registration simplified the referral process by enabling referring healthcare facilities to submit patient information before specimen delivery. The system reduced repetitive administrative tasks, improved coordination between Dharmais Cancer Hospital and referring Community Health Centers (Puskesmas), and accelerated laboratory referral workflows. These findings are consistent with the systematic review by Lau et al. (2012), which demonstrated that electronic medical record systems improve documentation quality, facilitate access to patient information, and enhance workflow efficiency in healthcare settings. Similarly, healthcare professionals are more likely to adopt digital technologies when they perceive them as useful, easy to integrate into routine practice, and capable of reducing administrative burden (Alzghaibi et al., 2023; Ait Gacem et al., 2025). The present findings therefore suggest that perceived usefulness and improvements in workflow efficiency contributed substantially to user acceptance of the web-based registration system.

Information quality also emerged as an important determinant of successful implementation. Participants reported that the web-based registration system produced more complete, consistent, and accessible referral information than the previous manual registration process. However, incomplete integration with external health information systems remained a barrier to seamless information exchange. Martins et al. (2017) demonstrated that standardized electronic laboratory ordering systems improve data quality while reducing unnecessary laboratory testing and promoting more efficient utilization of healthcare resources. Likewise, Khalifa et al. (2021) reported that interoperable laboratory information systems improve reporting accuracy, communication among healthcare providers, and overall information quality. These findings suggest that improving information quality through integrated laboratory information systems may also contribute to patient safety by minimizing documentation errors associated with repeated manual data entry and facilitating more timely clinical decision-making.

The findings of this study have important implications for healthcare organizations implementing digital laboratory referral systems. Successful implementation requires not only appropriate technological infrastructure but also organizational commitment, effective leadership, continuous user training, and collaboration among healthcare institutions. Strengthening interoperability through standardized health information exchange should also become a strategic priority to support integrated laboratory services and national digital health transformation. These findings may assist hospital managers and policymakers in developing evidence-based strategies for implementing interoperable laboratory referral systems in Indonesia.

This study has several limitations. First, the findings were derived from a relatively small number of participants recruited from a single tertiary referral hospital and its collaborating healthcare facilities, which may limit the transferability of the findings to other healthcare settings. Second, the study relied primarily on participants' perceptions obtained through focus group discussions rather than objective measures of system performance. Finally, interoperability with several national health information systems had not yet been fully achieved during the study period. Future studies should evaluate the long-term implementation of interoperable laboratory referral

systems across multiple healthcare organizations and examine their impact on service efficiency, information quality, user satisfaction, cost-effectiveness, and patient outcomes.

CONCLUSIONS

This study demonstrated that the implementation of a web-based laboratory referral registration system at Dharmais Cancer Hospital has the potential to improve laboratory referral services by enhancing registration efficiency, information quality, and coordination among healthcare facilities. Successful implementation was influenced by organizational readiness, leadership support, interoperability, information quality, and user acceptance. Although the system showed promising benefits, continuous improvement is needed to strengthen interoperability and optimize system performance. Future studies should evaluate the system across multiple healthcare organizations using quantitative or mixed-methods approaches to assess its impact on service quality, operational efficiency, user satisfaction, and laboratory performance.

ACKNOWLEDGMENT

The author would like to express sincere gratitude to all those who provided support, assistance, and contributions throughout the course of this research. Special appreciation is extended to Mrs. Eti Supriati of the West Jakarta District Health Office (Sudinkes Jakarta Barat) for her support, guidance, and facilitation of access to information throughout this study; to Mrs. Erni Wijayanthi for her invaluable assistance, input, and contribution to the completion of this research; and to Dra. Tenni Triwidiastuti Mrihoetami of the Clinical Pathology Laboratory, Rumah Sakit Kanker Dharmais, for her guidance, technical assistance, and willingness to share data and knowledge that greatly supported this research. May all the assistance, support, and kindness they have extended be rewarded accordingly.

REFERENCES

- Ait Gacem, S., Huri, H. Z., Wahab, I. A., & Abduelkarem, A. R. (2025). Investigating digital determinants shaping pharmacists' preparedness for interoperability and health informatics practice evolution: A systematic review. *International Journal of Clinical Pharmacy*, 47(4), 921–931. <https://doi.org/10.1007/s11096-024-01851-6>
- Alzghaibi, H., Alharbi, A. H., Mughal, Y. H., Alwheeb, M. H., & Alhlayl, A. (2023). Assessing primary health care readiness for large-scale electronic health record system implementation: Project team perspective. *Health Informatics Journal*, 29(1). <https://doi.org/10.1177/14604582231152790>
- Ayaz, M., Pasha, M. F., Alzahrani, M. Y., Budiarto, R., & Stiawan, D. (2021). The Fast Healthcare Interoperability Resources (FHIR) standard: Systematic literature review of implementations, applications, challenges, and opportunities. *JMIR Medical Informatics*, 9(7), e21929. <https://doi.org/10.2196/21929>
- Delvaux, N., De Sutter, A., Van de Velde, S., Ramaekers, D., Fieuws, S., & Aertgeerts, B. (2017). Electronic laboratory medicine ordering with evidence-based order sets in primary care (ELMO study): Protocol for a cluster randomized trial. *Implementation Science*, 12(1), Article 147. <https://doi.org/10.1186/s13012-017-0674-1>
- Instalasi Sistem Informasi Manajemen Rumah Sakit Kanker Dharmais. (2021). *Data Rumah Sakit Kanker Dharmais 2021*. Rumah Sakit Kanker Dharmais.
- Kementerian Kesehatan Republik Indonesia. (2015). *Peraturan Menteri Kesehatan Republik Indonesia Nomor 15 Tahun 2015 tentang laboratorium pemeriksaan HIV dan infeksi oportunistik*. Kementerian Kesehatan Republik Indonesia.

- Khalifa, A., Mason, C. C., Garvin, J. H., Williams, M. S., Del Fiol, G., Jackson, B. R., Bleyl, S. B., & Huff, S. M. (2021). A qualitative investigation of biomedical informatics interoperability standards for genetic test reporting: Benefits, challenges, and motivations from the testing laboratory's perspective. *Genetics in Medicine*, 23(11), 2178–2185. <https://doi.org/10.1038/s41436-021-01301-y>
- Laboratorium Patologi Klinik Rumah Sakit Kanker Dharmais. (2022). *Catatan diskrepansi data registrasi pasien rujukan Januari 2022*. Rumah Sakit Kanker Dharmais.
- Lau, F., Price, M., Boyd, J., Partridge, C., Bell, H., & Raworth, R. (2012). Impact of electronic medical record on physician practice in office settings: A systematic review. *BMC Medical Informatics and Decision Making*, 12, Article 10. <https://doi.org/10.1186/1472-6947-12-10>
- Li, J., Maddock, E., Hosking, M., Ebrill, K., Sullivan, J., Loi, K., Tavares-Rixon, D., Jayasena, R., Grieve, G., & Delaforce, A. (2025). Identifying and optimizing factors influencing the implementation of a Fast Healthcare Interoperability Resources accelerator: A qualitative study using the Consolidated Framework for Implementation Research–Expert Recommendations for Implementing Change approach. *JMIR Medical Informatics*, 13, e66421. <https://doi.org/10.2196/66421>
- Martins, C. M. S., da Costa Teixeira, A. S., de Azevedo, L. F. R., Sá, L. M. B., Santos, P. A. A. P., do Couto, M. L. G. D., & da Costa Santos, C. M. N. (2017). The effect of a test ordering software intervention on the prescription of unnecessary laboratory tests: A randomized controlled trial. *BMC Medical Informatics and Decision Making*, 17, Article 20. <https://doi.org/10.1186/s12911-017-0416-6>
- Narolita, D., & Darma, G. S. (2020). Prodia: Disruption in clinical laboratory service system. *International Research Journal of Management, IT and Social Sciences*, 7(1), 9–18. <https://doi.org/10.21744/irjmis.v7n1.811>
- Patel, V., McNamara, L., Dullabh, P., Sarkar, R., Chattopadhyay, M., & Hebner, C. (2017). Variation in interoperability across clinical laboratories nationwide. *International Journal of Medical Informatics*, 108, 175–184. <https://doi.org/10.1016/j.ijmedinf.2017.09.007>
- Scott, I. A., Shaw, T., Slade, C., Wan, T. T., Coorey, C., Johnson, S. L. J., Sullivan, C. M., Kocaballi, A. B., Cvejic, E., Banas, C., Mclachlan, S., & Magrabi, F. (2023). Digital health competencies for the next generation of physicians. *Internal Medicine Journal*, 53(6), 1042–1049. <https://doi.org/10.1111/imj.16122>
- Standley, C. J., Muhayangabo, R., Bah, M. S., Barry, A. M., Bile, E., Fischer, J. E., Heegaard, W., Koivogui, L., Lakiss, S. K., Sorrell, E. M., VanStelandt, A., Dahourou, A. G., & Martel, L. D. (2019). Creating a national specimen referral system in Guinea: Lessons from initial development and implementation. *Frontiers in Public Health*, 7, Article 83. <https://doi.org/10.3389/fpubh.2019.00083>
- Torab-Miandoab, A., Samad-Soltani, T., Jodati, A., Rezaei-Hachesu, P., & Riahi, L. (2023). Interoperability of heterogeneous health information systems: A systematic literature review. *BMC Medical Informatics and Decision Making*, 23, Article 18. <https://doi.org/10.1186/s12911-023-02115-5>
- World Health Organization. (2019). *WHO guideline: Recommendations on digital interventions for health system strengthening*. World Health Organization.