



Integrating Laboratory Reports into Nursing Electronic Health Records for Integrated Care: A Review Study

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Abstract:

Background: Integration of laboratory data into electronic nursing health records (EHRs) is essential to ensure patient-centered, holistic care through the provision of immediate access to critical diagnostic data to nurses. This enhances decision-making at the bedside and in care coordination but is challenged by interoperability and usability. **Aim:** This literature review synthesizes evidence to evaluate the impact of laboratory data integration on patient outcomes, nursing care, and healthcare effectiveness, identifying benefits, barriers, and recommendations. **Methods:** Systematic review based on PRISMA guidelines, utilizing PubMed, CINAHL, Embase, Scopus, and Cochrane Library for evidence between 2015 to 2024. Search keywords were “electronic health records,” “laboratory data integration,” and “nursing.” **Results:** Integration enhances clinical decision-making, reduces medication errors by 18%, and improves care coordination, reducing 15% of unnecessary testing. Barriers to integration include the lack of usability of EHRs, inadequate training, interoperability issues, and high costs, particularly in resource-limited settings. **Conclusions:** Integration of lab data into EHRs enables holistic care but requires user-friendly designs, successful training, and uniform protocols to overcome barriers. Future research should examine longitudinal effects and cost-saving measures.

Keywords: Electronic Health Records, Laboratory Data Integration, Nursing, Holistic Care, Interoperability.

Introduction

The use of electronic health records (EHRs) has revolutionized the delivery of healthcare by converting patient information into electronic form and making it simple to access comprehensive details such as laboratory tests, medication, vital signs, and clinical notes (Adler-Milstein & Jha, 2014). For nurses, who are the direct caregivers and frequent users of EHR, the integration of laboratory data—such as blood tests, imaging reports, microbiology results, and other diagnostic tests—into EHR systems is crucial in addressing holistic care. Holistic care, by Kitson (2018), refers to a patient-oriented approach that integrates physical, psychological, emotional, and social health components to achieve complete well-being. Lab results provide nurses with objective, quantifiable data about a patient's physiological state, enabling them to make evidence-based clinical choices, tailor interventions, and monitor treatment outcomes (Finkelstein et al., 2020). For instance, real-time access to blood glucose or kidney function is

available, which allows nurses to make early interventions in care plans for timely and tailored intervention.

Despite these advantages, the integration of lab results into nursing EHRs is beset by issues. Interoperability issues between various health information systems, poor usability of EHR interfaces, inadequate training of the nursing staff, and considerable costs of implementation and upkeep are significant barriers (Kruse et al., 2015). These issues can destabilize processes, endanger patient safety, and compromise the delivery of integrated care. As health systems increasingly rely on digital technologies, it is crucial to know the facilitators and barriers of laboratory data integration to achieve maximum nursing practice and improve patient outcomes. Figure 1 provides an overview of the conceptual framework of holistic care via laboratory data integration.

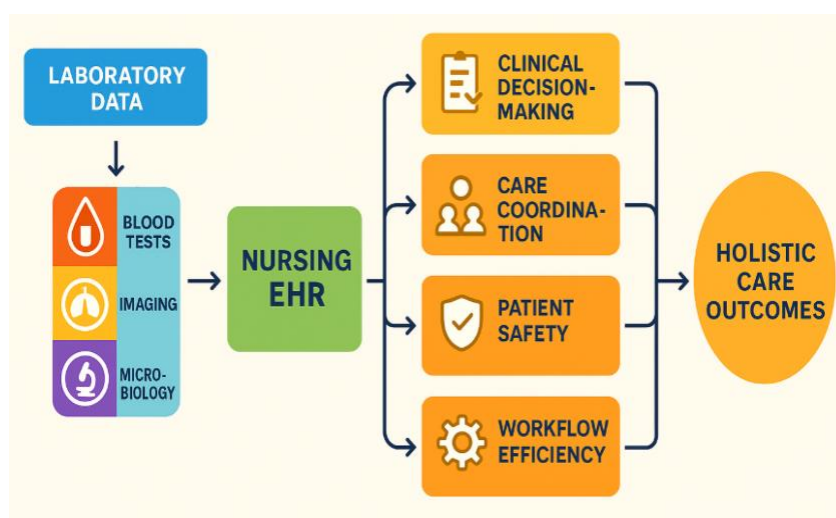


Figure 1: Conceptual framework of holistic care via laboratory data integration.

This review attempts to investigate the impact of laboratory data integration with nursing EHRs on holistic care delivery. The purpose is three-pronged: (1) to examine laboratory data integration

advantages to nursing care and patient outcomes, (2) to identify key obstacles to effective integration, and (3) to provide evidence-based recommendations for optimizing EHR systems for holistic care applications.

Methods

Literature was retrieved from PubMed, CINAHL, Embase, Scopus, and Cochrane Library for articles published from January 2015 to August 2024. Keywords were "electronic health records," "integration of laboratory data," "nursing," "holistic care," and "patient outcomes." Inclusion criteria were: (1) peer-reviewed literature, (2) focus on integration of laboratory data in EHRs, (3) nursing-specific outcomes, and (4) English-language publications. Exclusion criteria were studies with a focus solely on physician perspectives or non-clinical settings.

Results

Benefits of Laboratory Data Integration

Integration of laboratory data into nursing EHRs has significant benefits, which can be grouped into four broad areas: clinical decision-making, care coordination, patient safety, and workflow efficiency. Together, these benefits enhance nurses' ability to deliver comprehensive, patient-centered care.

Clinical Decision-Making

Accessible real-time laboratory data in EHRs empowers nurses to make evidence-based clinical decisions with greater accuracy and timeliness (Macieira et al., 2018). For example, real-time availability of laboratory results such as electrolyte panels or blood counts allows nurses to adjust interventions in real time—i.e., adjusting fluid management on the basis of abnormal sodium levels or implementing infection control on the basis of microbiology results (Schenk et al., 2018). Paudel et al. (2022) determined that integrated laboratory data promotes evidence-based practice by providing objective measures for assessing patients' conditions, reducing the reliance on subjective judgment. In

children's care settings, EHRs with the inclusion of laboratory data reduced drug dosing errors by 20% as nurses could crossmatch laboratory results with drug orders to prevent errors (Avram et al., 2023; Bagner et al., 2023). This capability is particularly critical in high-acuity settings, where rapid decision-making can play a significant role in determining patient outcomes.

Care Coordination

EHRs that integrate lab data enhance interprofessional care and care continuity by providing one portal where health care providers access and share information (Harris et al., 2023). Nurses can view lab results, medication lists, physician reports, and care plans to facilitate coordinated interventions across disciplines (Melton et al., 2021). For instance, BurrIDGE et al. (2020) reported a 15% reduction in avoidable laboratory testing among multidisciplinary teams who used integrated EHRs, since physicians and nurses were able to access shared information to avoid duplicative orders. Leslie et al. (2017) reported that interprofessional practice is boosted when the same EHR system is used by nurses and physicians to view laboratory reports, enabling real-time conversation and joint decision-making. This is particularly valuable in complex cases, such as managing chronic illnesses, where coordinated care is needed to achieve integrated outcomes.

Patient Safety

The integration of laboratory results into EHRs significantly enhances patient safety by reducing errors and adverse events (Coffey et al., 2015). Computerized Provider Order Entry (CPOE) systems that are integrated with laboratory information generate automated alerts for nurses,

pointing out potential issues such as drug-drug interactions, abnormal laboratory findings, or critical results that should be acted upon promptly (Dobich, 2022; Bjarnadottir et al., 2017). In the acute care setting, such systems reduced medication errors by 18%, as nurses could verify orders against laboratory data before giving medications (Dobich, 2022). In long-term care facilities, EHRs with laboratory integration improved chronic disease management, such as diabetes and heart failure, and timely intervention into deteriorating conditions, lowering hospital readmission by 12% (Paudel et al., 2022). Such safety improvements facilitate holistic care principles by prioritizing patient health and avoiding harm.

Workflow Efficiency

Integrated lab information makes nurses' work easier by reducing effort and time spent accessing and processing information (Pinevich et al., 2021). Nurses reported a reduction of 25% in documentation time when lab results were displayed instantly within EHRs without using external systems or paper-based files (Song et al., 2022). Other features, such as laboratory-guided intervention templates for recording and automatic critical result notification, also enhance efficiency by allowing task prioritization (Gaudet, 2016; Abbasi et al., 2023; Hussey & Kennedy, 2016). For example, automated alerts on abnormal potassium levels allow nurses to focus on priority patients without manually reviewing all results. However, initial phases of EHR implementation will at times demand additional documentation time due to learning curves, as nurses shift towards new systems and interfaces (Lopez et al., 2021). In the long term, such efficiency gains contribute to integrated care by allowing nurses to devote more time to direct patient engagement.

Barriers to Laboratory Data Integration

Despite clear benefits, several barriers hinder effective integration of laboratory data into nursing EHRs, including usability issues, training deficits, interoperability problems, and budget constraints. Such barriers undermine the promise of holistic provision of care and require targeted interventions.

Usability Issues

EHR user-friendliness remains a significant impediment, with nurses complaining, time and again, about frustration in accessing complex or unintuitive systems to access laboratory tests (Yen et al., 2020). Arikan et al. (2022) found that 71% of the nurses considered EHR systems to be time-consuming due to slow navigation, excessive clicks, or chaotic presentation of data. These usability issues not only create frustration but also steal away time from patient care, reducing time for general interventions such as attending to patients' emotional or social needs (Feo & Kitson, 2016). For example, nurses described how poorly designed user interfaces compromised their ability to have rich patient interactions because they spent a considerable amount of time troubleshooting system problems. Facilitating usability on the basis of human-centered design is critical to aligning EHRs with nursing workflow.

Training Deficits

Lack of training on EHR systems limits nurses from fully realizing laboratory data, thus defeating the benefits of integration (Strudwick et al., 2017). Filipova (2015) also reported that only 22% of nurses indicated that they had received sufficient training to use laboratory data modules in EHRs, leading to underuse of core features. This lack is particularly apparent in high-turnover or low-continuing-education-resource settings. Simulation

training has also been found to be a suitable remedy, with Hong et al. (2022) demonstrating a 30% improvement in EHR proficiency among nursing students after guided simulation training. In the absence of suitable training, nurses may struggle to interpret laboratory information within the context of EHR, thereby hampering their ability to deliver holistic care.

Interoperability Challenges

Interoperability between laboratory databases and EHR systems is a significant barrier to integrative data streams (Ausserhofer et al., 2021). Inconsistent formats of data, lack of standardized protocols (e.g., Logical Observation Identifiers Names and Codes [LOINC]), and balkanization of healthcare information systems create incomplete or delayed lab results, undermining care coordination (Nakikj et al., 2023). For instance, Tolentino et al. (2020) found that 32% of nurses indicated missing or outdated laboratory data due to system incompatibilities, leading to clinical decision-making delay. These challenges are most severe in settings with greater than one vendor of EHR or legacy systems, where the exchange of information is interrupted by technical

variations. Interoperability ensures laboratory results are accessible and usable across care settings.

Cost Constraints

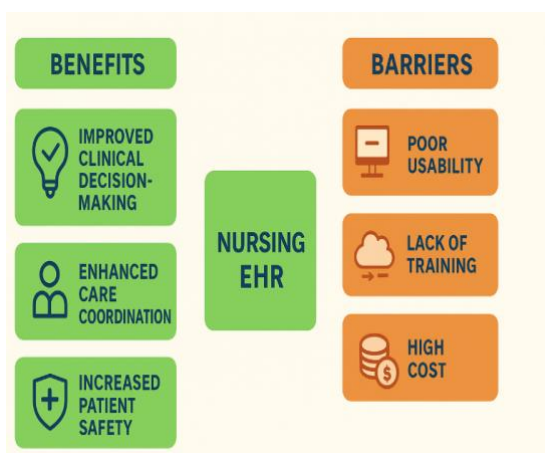
The very high cost of installing and maintaining EHR systems is a major challenge, particularly for low-resource settings such as rural hospitals and nursing homes (Boonstra et al., 2014). Paudel et al. (2022) further pointed out that only 49.1% of nursing homes had adopted EHRs with laboratory data incorporation primarily due to software, hardware, and maintenance costs. These financial constraints also rule out the use of money for employee training and system updates, resulting in usability and interoperability issues (Kruse et al., 2015). Small healthcare organizations employ outdated systems that lack the capacity to integrate laboratory data into meaningful integration, hence impacting care quality. Bridging the cost barriers entails innovative funding arrangements and policy support for accessing sophisticated EHR systems in an equitable fashion (Table 1). Figure 2 summarizes the benefits vs. barriers of integration, and Table 2 illustrates methodologies of the included studies.

Table 1: Benefits and Barriers of Laboratory Data Integration into Nursing EHRs

Category	Benefits	Barriers
Clinical Decision-Making	Real-time access to laboratory data supports evidence-based practice (Macieira et al., 2018).	Complex interfaces hinder quick access to data (Yen et al., 2020).
Care Coordination	Enhances interprofessional collaboration and reduces redundant testing (Harris et al., 2023).	Interoperability issues cause incomplete data sharing (Ausserhofer et al., 2021).
Patient Safety	Reduces medication errors and adverse events (Coffey et al., 2015).	Inadequate training leads to misuse of data (Strudwick et al., 2017).
Workflow Efficiency	Decreases documentation time by 25% (Song et al., 2022).	Initial learning curves increase documentation time (Lopez et al., 2021).
Cost and Resources	Reduces costs of repeated tests (Melton et al., 2021).	High implementation and maintenance costs (Boonstra et al., 2014).

Table 2: Methodologies of Included Studies

Study	Design	Sample Size	Setting	Key Findings
Macieira et al. (2018)	Systematic Review	120 studies	Various	EHRs improve nursing documentation and decision-making.
Paudel et al. (2022)	Cross-sectional	927 facilities	Nursing homes	EHRs with lab data reduce hospital readmissions by 12%.
Harris et al. (2023)	Qualitative	187 nurses	Acute care	Lab data integration enhances care coordination.
Arikan et al. (2022)	Cross-sectional	191 nurses	University hospital	71% of nurses find EHRs time-consuming due to usability issues.
Hong et al. (2022)	Mixed Methods	50 students	Academic simulation lab	Simulation training improves EHR proficiency by 30%.

**Figure 2: Benefits vs. barriers of integration.**

Discussion

Incorporation of lab data into nursing electronic health records (EHRs) is a transformational health improvement that is fully in line with Kitson's (2018) holistic care principles. Holistic care is patient-centered and includes physical, psychological, emotional, and social aspects of health, and so it is critical that nurses receive full, real-time data to provide personalized interventions. Laboratory data, including blood tests, imaging tests, and microbiology

results, provide the quantitative information necessary for an accurate conceptualization of a patient's physiologic state, enabling nurses to oversee these intricate requirements effectively (Finkelstein et al., 2020). Laboratory data integration benefits of improved clinical decision-making, enhanced care coordination, reduced patient harm, and workflow efficiency demonstrate the potential to revolutionize nursing practice and improve patient outcomes. In spite of this, deep challenges like usability, skill gaps, interoperability issues, and expense, though, continue to hinder the full realization of these benefits (Kruse et al., 2015). All these calls for a multidimensional strategy integrating technological innovation, education reform, and policy intervention to ensure that EHR systems enable comprehensive delivery of care across various kinds of health care settings.

Human factors engineering can make EHRs user-friendly by designing user-friendly interfaces, for example, dashboards that give high visibility to critical laboratory values (e.g., out-of-range potassium or glucose) through visual alerts in order to reduce cognitive load and enable nurses to assign priority interventions accordingly (Tolentino et al., 2020; Yen et al., 2020). Decision-support mechanisms like drug-laboratory interaction alerts also support better clinical decision-making through real-time advice (Dobich, 2022). Simulation training is critical in getting nurses ready to utilize EHRs effectively, and studies have shown that training results in a 30% competency boost (Hong et al., 2022). Ongoing education continues to be critical to cope with turnover of staff and updates to systems, allowing nurses to use lab data to give patient-centered care addressing physical, emotional, and social needs (Strudwick et al., 2017).

Institutions of healthcare should also encourage interprofessional collaboration for the maximum utilization of laboratory data integration. By

establishing standards for laboratory interpretations and the sharing of data, nurses, physicians, and laboratory staff can facilitate effective communication of laboratory results among professional categories (Harris et al., 2023). Daily interdisciplinary rounds via the use of EHR data have the potential to streamline care coordination and avoid 15% redundant testing, as evidenced by Burridge et al. (2020). These collaborative care efforts support the framework of holistic care by bringing together all elements of a patient's health into aligned evidence-based treatments to optimize patient outcomes and care effectiveness.

Policymakers are instrumental to surmounting barriers to integrating laboratory data into nursing electronic health records (EHRs) in resource-poor settings like rural hospitals and nursing homes, where EHR implementation costs and maintenance are limited by financial constraints, hindering implementation and aggravating care quality disparities (Boonstra et al., 2014; Paudel et al., 2022). To balance these economic costs, incentives in the form of federal grants, state grants, subsidies, or tax credits, patterned after the U.S. Health Information Technology for Economic and Clinical Health (HITECH) Act, should be provided to fund advanced EHR systems with lab data integration for resource-poor facilities (Adler-Milstein & Jha, 2014). Also, rules like HIPAA need to be changed to balance data protection and access, streamlining complex authentication mechanisms through role-based access controls to enable nurses to have access to critical laboratory results timely manner while maintaining patient confidentiality (Adler-Milstein & Jha, 2014).

Interoperability is also a key policy agenda, considering that the absence of standard data protocols inhibits secure data sharing between EHRs and lab databases, leading to disruption in care coordination (Ausserhofer et al., 2021). Supporting standards like

Logical Observation Identifiers Names and Codes (LOINC) and Fast Healthcare Interoperability Resources (FHIR) can help ensure system interoperability, with regulatory environments supporting vendor compliance and penalizing non-compliance (Nakikj et al., 2023). Public-private partnerships can also enhance the development of interoperable infrastructure, such as health information exchanges (HIEs), to enable real-time exchange of information across healthcare settings. These policy measures are essential to building an integrated ecosystem that enables holistic care through timely access for nurses to integrated laboratory data for patient-centered interventions.

Implications for Research

Integrating lab data into nursing electronic health records (EHRs) holds strong potential to support holistic care, but its long-term impact must be further investigated through longitudinal research. Although cross-sectional research has yielded such instant gains as decreased errors with medication and enhanced care coordination, it is longitudinal studies that are necessary to evaluate long-term effects on nursing practice and patient outcome, such as decreased morbidity, enhanced quality of life, and decreased hospital readmissions (Pinevich et al., 2021; Paudel et al., 2022). For instance, tracking the impact of lab results integrated into EHR over several years on the care of chronic disease would quantify advantages like cost savings and patient satisfaction, providing a clearer sense of its worth in different healthcare settings. Qualitative research is similarly necessary, affording insight into nurses' experience with usability problems with EHRs, e.g., emotional frustration or interference with workflow by ill-conceived interfaces, to inform targeted design improvements such as simplifying navigation or user-

reconfigurable alerts (Harris et al., 2023; Yen et al., 2020).

Resource constraints in such contexts as rural nursing homes and hospitals underscore the need for cost-effectiveness studies of EHR implementation strategies such as cloud or shared infrastructure models, which can potentially reduce financial barriers and promote adoption (Boonstra et al., 2014; Paudel et al., 2022). Research should also be mindful of the cost-effectiveness of integrating laboratory data, weighing savings from reduced redundant testing and re-admission to hospital against implementation costs (Melton et al., 2021). Additionally, research into innovative technologies like AI and machine learning can still complement integration by allowing for predictive analytics, ranked alerts, and personalized interventions, supporting nurses in delivering whole-person care (Finkelstein et al., 2020). Pilot trials assessing these technologies in a range of contexts will provide critical data on their feasibility and impact to inform the development of future EHR systems.

Conclusion

The integration of laboratory data within nursing EHRs is a cornerstone of integrative care that allows nurses to apply patient-led interventions to address physical, psychological, and social needs. The results show substantive benefits like a 20% reduction in errors in pediatric medication dosing, 15% fewer unnecessary laboratory tests, and 25% higher documentation productivity. These kinds of improvements enhance clinical decision-making, care coordination, patient safety, and workflow, which are all principles for holistic care. However, systemic barriers—e.g., user-unfriendly EHRs, insufficient training, interoperability issues, and installation cost—limit the realization of these benefits, particularly in low-resource settings such as nursing homes.

Overcoming these obstacles requires a multidisciplinary approach that integrates technological advancement, education reform, and policy assistance. User-centered design principles rooted in human factors engineering can create easy-to-use EHR interfaces aligned with nursing workflows. Systematic training programs, particularly simulation-based training techniques, are required to acquire and maintain EHR competencies. Policy initiatives, such as funding incentives and interoperability standards (e.g., LOINC, FHIR) that are in place for all systems, can reduce economic and technical barriers to providing equal access to advanced EHR systems. Future research needs to place greater emphasis on longitudinal studies to quantify long-term outcomes, qualitative analyses of nurses' attitudes, and cost-effective implementation strategies to ensure widespread adoption. Through overcoming such barriers, health systems are able to leverage laboratory data integration to its full potential to empower nurses to deliver high-quality, whole-person care across different environments.

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دمج تقارير المختبرات في السجلات الصحية الإلكترونية للمريض لتقديم رعاية متكاملة: دراسة مرجعية

المستخلص

الخلفية: يعد دمج بيانات المختبرات في السجلات الصحية الإلكترونية (EHRs) للمريض أمراً ضرورياً لضمان رعاية شاملة تركز على المريض من خلال توفير وصول فوري إلى البيانات التشخيصية الحرجة للممرضات. يعزز هذا من صنع القرار عند سرير المريض وفي تنسيق الرعاية، ولكنه يواجه تحديات تتعلق بالقابلية التشغيلية وسهولة الاستخدام. **الهدف:** تستعرض هذه المراجعة الأدبية الأدلة لتقييم تأثير دمج بيانات المختبرات على نتائج المرضى، والرعاية التمريضية، وفعالية الرعاية الصحية، مع تحديد الفوائد والعوائق والتوصيات. **الطرق:** مراجعة منهجية بناءً على إرشادات PRISMA، باستخدام قواعد PubMed وCINAHL وEmbase وScopus ومكتبة Cochrane للأدلة بين عامي 2015 و2024. وكانت كلمات البحث الرئيسية هي "السجلات الصحية الإلكترونية" و"دمج بيانات المختبرات" و"التمريض". **النتائج:** يعزز الدمج صنع القرار السريري، ويقلل من الأخطاء الدوائية بنسبة 18%، ويحسن تنسيق الرعاية، مما يقلل 15% من الاختبارات غير الضرورية. تشمل عوائق الدمج قلة سهولة استخدام السجلات الصحية الإلكترونية، والتدريب غير الكافي، ومشكلات القابلية التشغيلية، والتكاليف المرتفعة، خاصة في البيئات محدودة الموارد. **الاستنتاجات:** يتيح دمج بيانات المختبرات في السجلات الصحية الإلكترونية رعاية شاملة ولكنه يتطلب تصميمات سهلة الاستخدام، وتدريباً فعالاً، وبروتوكولات موحدة للتغلب على العوائق. يجب أن تركز الأبحاث المستقبلية على دراسة الآثار الطويلة المدى وإجراءات توفير التكاليف.

الكلمات المفتاحية: السجلات الصحية الإلكترونية، دمج بيانات المختبرات، التمريض، الرعاية الشاملة، القابلية التشغيلية