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Strategies to Improve Access to Clinical Informatics Specialist Consultations in an Acute Care Hospital System

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Strategies to Improve Access to Clinical Informatics Specialist Consultations in an Acute Care Hospital System

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Abstract

Access to clinical informatics specialist (CIS) consultations is essential for optimizing electronic health record (EHR) use in acute care hospital systems. Limited availability of CIS support contributes to clinician burnout, workflow inefficiencies, and patient safety risks. The purpose of this integrative review was to identify strategies to improve access to CIS consultations in acute care settings. A comprehensive literature search across multiple databases yielded 656 articles, with 24 meeting inclusion criteria based on relevance and methodological rigor, evaluated using the Johns Hopkins Nursing Evidence-Based Practice appraisal tools. These studies, published between 2019 and 2024, underwent thematic analysis guided by the Prosci Awareness, Desire, Knowledge, Ability, and Reinforcement (ADKAR) model. Four themes were identified: training and education, emphasizing training deficits, competency improvement, and confidence building; the role of informatics and access to consultation, highlighting evidence-based consultation and decision-making support; usability and workflow optimization, underscoring documentation burden reduction and healthier EHR relationships; and support systems and accessibility, highlighting EHR support teams and real-time communication. Findings demonstrate that addressing training gaps, embedding consultative pathways, and strengthening support infrastructures are strategies that increase consultation engagement, optimize workflows, and enhance safety outcomes. Improving CIS access fosters equitable engagement with informatics resources and advances patient-centered care, contributing to positive social change through safer, more efficient, and inclusive healthcare delivery.

Part 1: Practice-Based Problem

Problem of Interest

The integration of health information technology (HIT) in acute care hospital systems is essential for improving workflow efficiency, enhancing patient outcomes, and fostering technological advancement. A critical component of HIT optimization involves increasing access to clinical informatics specialist (CIS) consultations (Campione & Liu, 2024). CIS support clinicians in navigating complex electronic health record (EHR) systems, refining workflows, and implementing evidence-based decision-making tools (Heponiemi et al., 2021). However, healthcare system organizations (HSOs) continue to experience significant challenges with EHR implementation and access to CIS consultation services, primarily due to inadequate training, fragmented support models, and poorly designed system interfaces (Campione & Liu, 2024; Kaipio et al., 2020). A cross-sectional survey confirmed that nurses experiencing minimal training were more likely to report adverse psychological effects and decreased confidence in EHR use (Heponiemi et al., 2021). Inadequate usability support also hinders consultation engagement, as usability gaps reduce clinicians' willingness to access optional services such as CIS support (Kaipio et al., 2020). The findings underscore the importance of implementing structured and sustained training models, targeted usability improvements, and embedded consultation access points as strategic approaches to improve CIS engagement. Development and implementation of long-term training and support programs on how to integrate CIS consultations for clinicians are necessary to reduce the negative impact of EHR systems on healthcare professionals' occupational well-being.

Healthcare Administration Problem

Background

Limited access to CIS consultations presents a persistent barrier to optimizing EHR functionality in acute care hospital systems. CIS support enhances system usability, reduces documentation inefficiencies, and improves clinician engagement with clinical decision support (CDS) tools (Lai et al., 2021; Sittig et al., 2018). Without structured access to informatics consultation, clinicians experience workflow disruptions, increased administrative burden, and reduced capacity to navigate complex digital environments (Campione & Liu, 2024; Melnick et al., 2020). These conditions contribute to elevated clinician burnout and compromise patient safety (Heponiemi et al., 2021; Kaipio et al., 2020).

EHR implementation is aimed to increase documentation accuracy, support interoperability, and promote evidence-informed decision-making across healthcare systems (Asif & Khan, 2024). Many hospital systems have not fully realized these outcomes due to gaps in implementation support and ongoing informatics accessibility (Heponiemi et al., 2021; Sittig et al., 2018). Challenges such as poor system usability, insufficient end-user training, and lack of consultative infrastructure contribute to the underperformance of EHR systems (Kaipio et al., 2020; Kiepek & Sengstack, 2019).

Research has underscored the profound consequences of these gaps. Lai et al. (2021) highlighted the value of informatics consults in improving data access, supporting knowledge management, and enhancing clinical outcomes, yet many organizations lack adequate access to these services. Sittig et al. (2018) identified common challenges with EHR usability, including workflow disruptions and patient safety risks, which could be alleviated through informed clinical informatics consultations. Asif and Khan (2024) emphasized the critical role of informatics expertise, such as nurse informaticists, in supporting EHR implementation and sustainability, even in resource-limited settings. The literature collectively demonstrates the importance of addressing access to CIS consultations to ensure effective workflows, robust staff training, and improved healthcare outcomes.

Access to CIS consultations enables clinical teams to participate in system optimization, interface redesign, and real-time issue resolution (Desai et al., 2020; Stephenson et al., 2024). Hospitals with embedded informatics teams report stronger alignment between digital systems and clinical needs, leading to improved EHR satisfaction, increased consultation utilization, and better health outcomes (Gombar et al., 2019; Hathaway & Earle, 2024). Addressing informatics consultation access represents a critical strategy to advance workforce readiness, foster innovation, and promote quality care delivery.

The issue of barriers to accessing CIS consultations directly aligns directly with the Information Technology domain of the American College of Healthcare Executives (ACHE). ACHE identifies effective HIT implementation and optimization as a core leadership competency within the information technology domain (Stephenson et al., 2024). Strategic enhancements in access to informatics expertise can result in healthcare organizations improving patient care, reducing safety risks, and fostering a culture of innovation, ultimately advancing the broader goals of HIT integration.

Operational Problem

Limited access CIS consultations presents a significant operational barrier to effective EHR optimization in acute care hospital systems. The absence of structured, timely informatics support contributes to workflow inefficiencies, usability concerns, and decreased clinician engagement with CDS tools, ultimately compromising patient safety and operational performance (Campione & Liu, 2024; Sittig et al., 2018). Challenges related to fragmented data access, inadequate documentation design, and poor knowledge management further underscore the need for accessible CIS consultations in supporting HIT functionality (Lai et al., 2021; Melnick et al., 2020). Informatics professionals, including nurse informaticists, have demonstrated value in improving EHR implementation, facilitating staff training, and sustaining digital health infrastructure, particularly within resource-limited settings (Asif & Khan, 2024).

The lack of integrated CIS consultation services impairs EHR adoption, contributes to clinician burnout, and increases the risk of system-related safety events. Acute care hospitals without embedded informatics guidance face barriers to system optimization and fail to leverage the full capabilities of digital health technologies (Kaipio et al., 2020; Heponiemi et al., 2021). The operational problem centers on the absence of accessible CIS consultation pathways that support continuous system improvement, clinician usability, and safe, high-quality patient care. Addressing this problem is essential for advancing workforce readiness, aligning systems with frontline needs, and ensuring the sustainability of HIT investments in dynamic care environments.

Ideal State of Operations

The ideal state of operations in acute care hospital systems integrates timely and role-specific access to CIS consultations for all caregivers encountering persistent EHR challenges. The implementation of an EHR "SWAT" team resulted in measurable improvements in system usability, user satisfaction, and clinician burnout by addressing specialty-specific EHR concerns through targeted informatics interventions (Sequeira et al., 2021). These outcomes illustrate the operational value of embedding informatics teams that deliver tailored, real-time support aligned with the clinical and administrative functions of diverse end users (Sequeira et al., 2021).

In this ideal state, HSO leaders would establish accessible CIS teams capable of responding to the unique digital needs of nurses, physicians, allied health professionals, and administrative staff demonstrate improved collaboration, faster resolution of system issues, and increased engagement with EHR tools (Campione & Liu, 2024; Gombar et al., 2019). Specialized consultation pathways reduce workflow interruptions and support active clinician participation in system refinement, reinforcing both usability and adoption (Hathaway & Earle, 2024; Melnick et al., 2020). In this optimized state, operational performance improves as EHR systems function more intuitively, support clinical decision-making, and align with the pace and priorities of acute care delivery. Staff well-being, patient safety, and system sustainability are strengthened through equitable and responsive CIS consultation access (Heponiemi et al., 2021; Kaipio et al., 2020).

Professional Practice Gap Statement

There is a significant practice gap in addressing the high frequency of unresolved EHR-related issues, with 20% of staff experiencing six or more incidents every 3 months, yet many do not seek consultation from CIS (Campione & Liu, 2024). Current consultation rates fall short at a percentage that is not able to be captured due to underreporting (Kaipio et al., 2020; Kiepek & Sengstack, 2019). In health systems with 100,000 EHR users, the number equates to 120,000 minimum potential consultation needs annually due to limited awareness and dissatisfaction with support processes (Campione & Liu, 2024). In large healthcare systems, underutilization may translate into tens of thousands of missed opportunities for informatics intervention annually, as dissatisfaction and misalignment between support and user needs continue to deter engagement (Barshay & Richardson, 2024; Kaipio et al., 2020). Increasing consultation access for all staff with recurring EHR issues is a necessary operational aim to ensure systems are optimized, workflows are efficient, and patient safety is maintained (Campione & Liu, 2024; Gombar et al., 2019; Sequeira et al., 2021). The desired state is to ensure that 100% of staff who experience recurring issues engage with CIS teams, optimizing EHR functionality, improving patient safety, and reducing workflow disruptions (Kiepek & Sengstack, 2019).

Summary of Evidence

Research highlights the operational and clinical necessity of expanding access to CIS consultations in acute care hospital systems. Inconsistent access to CIS support has contributed to persistent EHR usability challenges, delays in workflow resolution, and reduced patient safety (Kaipio et al., 2020; Sittig et al., 2018). Studies consistently report that clinicians face recurring EHR-related issues that remain unresolved due to limited awareness of consultation services, dissatisfaction with current support processes, and inequitable access based on role or tenure (Campione & Liu, 2024; Kiepek & Sengstack, 2019). Approximately 20% of healthcare staff experience six or more EHR issues within a 3-month period yet underreporting and lack of engagement with CIS teams hinder effective resolution (Campione & Liu, 2024; Kaipio et al., 2020). These gaps suggest that current support systems fail to meet the operational needs of frontline staff, particularly when proactive engagement strategies are lacking.

Empirical evidence suggests that the integration of structured informatics consultation models can close these gaps by supporting evidence-based workflows, enhancing usability, and mitigating burnout (Lai et al., 2021; Sequeira et al., 2021; Sittig et al., 2018). CIS consultations improve data accessibility, streamline knowledge management, and strengthen clinical decision-making processes, especially when tailored to user roles and specialties (Asif & Khan, 2024; Lai et al., 2021). In resource-constrained and high-volume environments, these consultative functions are particularly vital for maintaining EHR performance and staff engagement. Studies further emphasize the role of CIS in providing role-specific education, real-time problem resolution, and system optimization efforts that improve both user satisfaction and patient outcomes (Asif & Khan, 2024; Barshay & Richardson, 2024; Gombar et al., 2019).

Together, these findings highlight a critical and addressable practice gap. Health systems must shift from fragmented and reactive support mechanisms to integrated, role-informed consultation infrastructures. By embedding CIS support into clinical operations and ensuring equitable, timely access across the workforce, organizations can reduce workflow disruptions, enhance user engagement, and improve care quality (Campione & Liu, 2024; Sequeira et al., 2021). Addressing this challenge aligns with core competencies in healthcare administration and supports broader organizational goals in technology adoption, workforce development, and patient safety improvement.

Purpose of the Integrative Review

The purpose of this research is to suggest effective strategies to improve the accessibility and utilization of CIS consultations in an acute care health system, aiming to enhance the quality, efficiency, and innovation of patient care.

Integrative Review Question

What are strategies to improve CIS consultations for an acute care system?

Theoretical and/or Conceptual Framework

The Prosci ADKAR Model offers a structured approach to managing change and serves as an ideal framework for addressing the healthcare administration problem of insufficient access to CIS consultations in acute care systems (Kaminski, 2022). This problem involves variables such as caregiver awareness, motivation to engage in consultations, skill acquisition, and sustained utilization of informatics resources, all of which directly impact EHR usability, workflow efficiency, and patient care outcomes (Campione & Liu, 2024; Kaipio et al., 2020). The ADKAR Model's five key elements- awareness, desire, knowledge, ability, and reinforcement—align logically with these variables and provide actionable strategies to address confounding factors, such as dissatisfaction with current support systems and limited understanding of the value of informatics consultations (Hiatt, 2006; Kaminski 2022).

The Prosci ADKAR model's awareness element addresses the need to educate caregivers on the role and benefits of informatics consultations, ensuring they recognize their importance in resolving EHR-related challenges. Desire focuses on fostering engagement and motivation, which is critical to overcoming resistance caused by dissatisfaction with current systems. Knowledge equips staff with the technical skills necessary to effectively utilize consultations, while ability emphasizes the practical application of these skills in daily workflows, mitigating operational inefficiencies. Finally, reinforcement ensures the long-term sustainability of consultation use by establishing feedback mechanisms and continuous support structures. These elements collectively address the practice gap, enabling healthcare systems to improve consultation access and utilization (Kaminski, 2022).

Insufficient access to CIS consultations in acute care settings constitutes a healthcare administrative challenge situated within the information technology domain. The Prosci ADKAR Model offers a structured change management framework that supports the optimization of CIS services through its five components: awareness, desire, knowledge, ability, and reinforcement (Hiatt, 2006). This model aligns directly with the variables influencing consultation access, including clinician awareness, engagement, technical proficiency, and sustained utilization of CIS resources. Integrating ADKAR into this context ensures that strategies are both actionable and tailored to the complex interplay of organizational and human factors. Applying this model enables healthcare leaders to implement targeted interventions that improve workflow efficiency, enhance EHR functionality, and strengthen patient safety outcomes.

Part 2: Literature Review, Quality Appraisal, and Analysis

Literature Search Strategy

Search Strategy and Initial Yield

An extensive and iterative literature search was conducted. Databases included Elsevier (ScienceDirect), EMBASE, HIMSS, JAMIA, MEDLINE, NIH, PubMed, and SpringerLink. Boolean operators and controlled vocabulary terms such as “clinical informatics consultation,” “acute care,” “EHR usability,” and “workflow redesign” were applied across 23 distinct searches.

This initial search process identified a total of 656 articles. Many results were excluded due to their emphasis on artificial intelligence (AI), telehealth tools, or general health technologies without a specific focus on CIS consultation strategies. Articles that did not address the acute care setting or that lacked empirical or conceptual relevance to the practice-based problem were also excluded. Following the application of inclusion criteria (English language, relevance to acute care consultation, publication years 2018–2024, and empirical or theoretical rigor; see Table 1), the pool was narrowed to 38 articles.

Table 1

Inclusion and Exclusion Search Criteria

Inclusion search criteria	Exclusion search criteria
Population & Setting: Studies focusing on clinical informatics consultations within acute care hospital systems, including emergency departments, intensive care units, and inpatient hospital settings.	Non-Acute Care Settings: Studies focusing solely on primary care, long-term care, ambulatory care, or outpatient services without direct applicability to acute care settings.
Intervention & Strategies: Articles discussing strategies, frameworks, or interventions aimed at improving clinical informatics consultations, EHR assistance, including workflow optimization, telehealth, decision support systems, and health information technology integration.	Irrelevant Topics: Articles discussing general informatics principles without addressing consultation strategies or implementation in an acute care environment.
Study Design: Empirical studies (qualitative, quantitative, and mixed methods), systematic reviews, and meta-analyses that provide evidence-based insights on clinical informatics consultations.	Editorials, Commentaries, and Opinion Pieces: Non-empirical articles that do not provide data-driven or systematic analysis of informatics consultation strategies.
Publication Date: Studies published within the last five years to ensure contemporary relevance in clinical informatics and healthcare technology (2019–present).	Non-Healthcare Domains: Studies related to informatics in non-healthcare industries or unrelated fields.
Language: Articles published in English.	Older Studies: Research published before 2019 unless it is a seminal work essential for theoretical grounding.
Relevance: Studies addressing strategies for enhancing clinical informatics consultation effectiveness, accessibility, and outcomes in acute care settings.	Non-English Publications: Articles that are not available in English to ensure accessibility and comprehension.

Quality Appraisal

Screening and Appraisal Process

The initial literature search yielded a total of 656 articles across multiple databases. After applying predefined inclusion and exclusion criteria—such as relevance to clinical informatics consultations in acute care settings, publication date, and empirical or theoretical contributions—622 articles were excluded due to duplication, lack of relevance, or insufficient methodological rigor. This process resulted in 34 eligible articles subjected to further critical appraisal.

Each of the 34 retained studies was evaluated using the Johns Hopkins Nursing Evidence-Based Practice (JHNEBP) Evidence Level and Quality Guide, which classifies evidence based on research design (Levels I–V) and quality rating (High, Good, or Low). Following appraisal, 24 articles met the threshold for inclusion, having been assessed as either Level III or Level V with quality designations of "High" or "Good." These studies demonstrated methodological soundness and relevance to the practice-based problem concerning access to clinical informatics consultations.

The appraisal decisions for those meeting criteria, including evidence levels, quality ratings, and rationale for inclusion or exclusion, are fully documented in the DHA Appraisal Results Log, which is included as Appendix C.

Scope of Literature

Years of Publication

The selected studies span from 2018 to 2025, reflecting both prepandemic and postpandemic evolutions in the domain of clinical informatics. Foundational articles (e.g., Sittig et al., 2018) provided early insights into safety and sociotechnical frameworks, whereas more recent literature (e.g., Cho et al., 2024; Kwan et al., 2024) addressed rapid innovation in EHR communication, support tools, and consultative integration during the digital transformation era.

Levels of Evidence and Types of Studies

The reviewed literature includes 14 Level III studies (e.g., cross-sectional surveys, mixed-methods research) and 10 Level V sources (e.g., expert opinions, descriptive case studies). High-quality empirical studies such as those by Melnick et al. (2020) and Campione and Liu (2024) utilized validated tools to assess usability, burnout, and informatics readiness. Complementary Level V studies (e.g., Kaminski, 2022; Gombar et al., 2019) provided rich contextual and theoretical insights that helped articulate operational challenges and implementation strategies.

Characteristics of Studied Populations

The population groups examined in the literature include nurses, physicians, nursing students, informaticists, IT support staff, and organizational leadership. Several studies (e.g., Cho et al., 2024; Heponiemi et al., 2021) focused on the clinical front line, whereas others emphasized perspectives from physicians (Melnick et al., 2020), administrators, or informatics experts (Desai et al., 2020). This diversity supports a comprehensive understanding of how consultation access intersects with multiple roles across the care continuum.

HSO Types and Practice Settings

Healthcare service organizations represented in the studies span academic health systems, general and critical access hospitals, and resource-limited institutions. The population included inpatient medical wards, emergency departments, intensive care units, and centralized CIS support hubs. Settings ranged from U.S.-based hospitals to international institutions, including those in China (Shen et al., 2024), Finland (Heponiemi et al., 2021), and Pakistan (Asif & Khan, 2024).

Publication Language and Geographic Distribution

All selected articles were published in English. The majority originated from U.S.-based research institutions, although international representation was evident. While this enhances global relevance, some findings may be context-specific due to differences in healthcare infrastructure and informatics maturity.

Relevance to the Practice-Based Problem

Each included study aligns with the practice-based problem of improving access to CIS consultation in acute care hospital systems. Studies such as Asif and Khan (2024) demonstrated the value of embedding CIS in clinical teams, whereas others (Kwan et al., 2024; Sequeira et al., 2021) examined innovations like EHR-integrated communication and zone-based CIS support models. The strategies directly contribute to understanding and improving the availability, timeliness, and responsiveness of consultation services.

Use of Theoretical Frameworks

Several of the included studies incorporated theoretical models that enhanced analytic depth. Kaminski (2022) applied the ADKAR model to CIS-driven change management, illustrating how awareness, desire, knowledge, ability, and reinforcement affect HIT adoption. Sittig et al. (2018) framed patient safety challenges through a socio-technical model, contextualizing system-level barriers to safe CIS implementation.

Contributing and Mitigating Factors

Contributing Barriers

Across the reviewed literature, several recurring barriers to consultation access were identified:

- EHR usability and interface limitations (Kaipio et al., 2020; Melnick et al., 2020)
- inadequate training and end-user support during implementation phases (Campione & Liu, 2024; Heponiemi et al., 2021)
- variability in consult model execution across resource-constrained versus well-resourced settings (Asif & Khan, 2024; Gombar et al., 2019)
- leadership disengagement from HIT strategy (Barshay & Richardson, 2024)
- absence of standardized, scalable consultative frameworks (Lai et al., 2021)

Enabling Factors

Several enabling conditions were also emphasized:

- presence of CIS subspecialists (Desai et al., 2020)
- use of real-time feedback loops and support metrics (Kiepek & Sengstack, 2019)
- scalable digital CIS education (Shen et al., 2024)
- embedded communication platforms within EHRs (Kwan et al., 2024)

- strategic deployment of rapid-response CIS teams (Sequeira et al., 2021)

Conclusion

The appraisal process resulted in the selection of 24 high- and good-quality sources that comprehensively address the multi-level dynamics influencing CIS consultation access. The literature supports a holistic strategy that integrates human, technical, educational, and organizational factors. Consistent themes suggest that sustainable improvement requires not only enhancements to system usability and workflow integration, but also leadership engagement, role-specific training, and formalization of consultation frameworks. The literature forms the foundation for the subsequent thematic synthesis and the development of actionable recommendations to close the identified practice gap.

Thematic Analysis of Literature

A thematic analysis of current literature was conducted to explore evidence-based strategies to improve access to clinical informatics consultations in acute care hospital systems. Through systematic extraction and synthesis of findings across 20 peer-reviewed sources, this analysis revealed five key themes derived from initial codes, each contributing critical insights to the practice-based problem. The data were systematically coded, grouped into preliminary themes, and refined into meaningful subthemes to illuminate barriers, facilitators, and structural mechanisms supporting informatics consultations. The completed matrix is included in Appendix D.

Themes and Subthemes

Initial codes were then grouped and refined into broader themes and subthemes, highlighting repeated patterns and aligned perspectives across the literature.

Theme 1: Training and Education

Training and education emerged as a dominant theme with multiple studies identifying insufficient EHR training as a root cause of clinician inefficiency and stress. For example, Heponiemi et al. (2021) linked "insufficient training" to "reduced efficiency" and diminished "well-being." Shen et al. (2024) demonstrated how structured informatics education programs improved "student competency and confidence," emphasizing the need for foundational skill development. Kaminski (2022) supported the integration of the ADKAR framework to improve change readiness and goal alignment among healthcare professionals.

- *Subthemes*: Address Training deficits, Competency improvement, Confidence building, Change management, Training Efficiency barriers

Theme 2: Role of Informatics and Access to Consultation

This theme addressed the centrality of the CIS role and the structure of consultation pathways. highlighted the critical impact of CIS in resource-constrained environments, coding "consultative access" and the "informaticist role" as vital (Asif & Khan, 2024). Findings contributed by Lai et al. (2021) and Stephenson et al. (2024) emphasized the value of evidence-based consultation and decision-making support.

- *Subthemes*: Role of informaticists, Consultative access in limited resources, Evidence-based consultation, Consultation guidance, Decision-making support, Consultation value, Informatics consultation access

Theme 3: Usability and Workflow Optimization

Usability challenges were frequently cited as barriers to consultation efficacy, documentation burden and workflow inefficiencies reduce the time available for CIS engagement (Cho et al., 2023). Usability discrepancies were reported by Kaipio et al. (2020) based on clinician roles, whereas another study stressed the need for fostering a "healthier EHR relationship" to reduce frustration (Barshay & Richardson, 2024)

- *Subthemes*: Reduction of documentation burden, Workflow efficiency, Targeted EHR optimization, Satisfaction with consultation, Decrease usability gaps, Role-based tailored solutions, Healthier EHR relationship, Mitigation of usability frustration

Theme 4: Support Systems and Accessibility

Support systems and accessibility emerged as a unified theme focused on the structural and experiential factors that enable or constrain CIS consultation engagement. Structured support mechanisms and access to those systems, such as CIS teams, technical liaisons, and rapid-response models, significantly influence whether clinicians seek help during EHR-related challenges. Dedicated EHR SWAT teams as demonstrated by Sequeira et al. (2021) showed improved responsiveness and satisfaction with support. Importance of structured implementation frameworks were emphasized by Kiepek & Sengstack (2019) in encouraging consistent consultation use. Simultaneously, disparities in access based on role or tenure further complicated engagement. mid-career clinicians reported lower satisfaction with technical support, contributing to consultation avoidance (Campione & Liu, 2024). By strengthening support infrastructure and integrating real-time, role-sensitive communication channels, healthcare organizations can improve both the reliability and equity of CIS consultation access.

- *Subthemes*: EHR support teams, Access to resources, Real-time communication tools, Emergent and rapid informatics support, Resolution of service delivery friction, On-demand analytics, Evidence-informed care, Clinical effectiveness

Part 3: Presentation of Results

The thematic map developed in response to the review question “What are strategies to improve access to clinical informatics specialist consultations in acute care hospital systems?” reveals an integrated network of interdependent domains. The analysis identified four core themes, each refined to represent a unique yet relational component of the broader issue. These themes include (a) training and education, (b) informatics role and consultation, (c) usability and workflow, and (d) support systems and accessibility. Within each theme, subthemes contribute specificity, enabling a deeper understanding of the contextual and operational variables influencing consultation access.

Training and education emerged as a foundational theme influencing consultation access by shaping clinicians' capacity and confidence to engage with informatics specialists. Studies consistently reported that training deficits lead to decreased efficiency and clinician frustration, which in turn diminish the likelihood of consultation utilization (Heponiemi et al., 2021). Structured training interventions, including CIS-focused curricula and change readiness programs, increase competency and consultation engagement (Kaminski, 2022; Shen et al., 2024). The literature support the integration of formalized, role-specific education into onboarding and continuing professional development. Improved training ensures clinicians recognize when and how to access CIS support, thus directly addressing the practice gap in CIS consultation use.

Closely linked is the theme of informatics role and consultation, reflecting both structural availability and the embedded value of informatics expertise in clinical practice. When CIS are clearly integrated into care delivery models, clinicians are more likely to recognize the utility of consultations (Asif & Khan, 2024). Studies found that the presence of informaticists enhanced decision-making support and enabled smoother transitions between clinical and digital workflows (Lai et al., 2021; Stephenson et al., 2024). However, limited consultation pathways, especially in resource-constrained settings, impede equitable access. This theme underscores the need to standardize consultative pathways, elevate the visibility of CIS within care teams, and align CIS roles with frontline needs.

Usability and workflow optimization reflects how system design and daily task burden influence a clinician's capacity to initiate and benefit from CIS consultations. Barriers such as documentation burden, fragmented interfaces, and inefficient workflows decrease the cognitive and operational bandwidth available for CIS engagement (Cho et al., 2024; Kaipio et al., 2020). Suboptimal system usability exacerbates clinician frustration and reduces trust in informatics resources (Barshay & Richardson, 2024). Studies suggest that improvements such as streamlined charting, role-based templates, and ambient documentation reduce friction and enhance the likelihood of CIS consultations. These usability solutions act as enablers by removing obstacles that previously suppressed consultation-seeking behavior.

Support systems and accessibility was identified as a critical theme encompassing structural, operational, and equity dimensions of consultation access. Responsive CIS infrastructure—including CIS SWAT teams, technical liaisons, and structured support pathways—improves clinician satisfaction and increases the frequency of consultation use (Kiepek & Sengstack, 2019; Sequeira et al., 2021). Disparities in access based on role or tenure further complicate engagement, with mid-career clinicians often reporting lower satisfaction with support resources (Campione & Liu, 2024). Real-time communication tools and messaging-enabled consultations were highlighted as necessary enhancements to ensure consistent and equitable access. On-demand decision support systems, when effectively integrated, improve clinical confidence and align patient care with best practices (Lai et al., 2021; Stephenson et al., 2024). However, decision support that is poorly designed or misaligned with workflows may be ignored or avoided, undermining both care quality and consultation frequency. Aligning decision support tools with informatics consultations ensures that clinicians can interpret and apply complex data more effectively. This theme highlights the reinforcing role of informaticists in promoting the appropriate use of analytics and digital decision-making aids. This theme reinforces the importance of building adaptive and inclusive informatics systems to serve diverse user groups across acute care environments.

In summary, the thematic structure outlined in Appendix E illustrates a multidimensional strategy framework for improving access to CIS consultations. The themes and subthemes are not only conceptually relevant but operationally actionable, each demanding attention, integration, and shared accountability across the healthcare continuum. Their interrelationships reflect the real-world complexity of HIT adoption and highlight the need for cohesive planning, execution, and evaluation to support sustained consultation access and clinical effectiveness.

Interpretation of the Findings

The findings from this integrative review advance understanding of strategies to improve access to CIS consultations in acute care hospital systems. Four interconnected themes were identified: training and education, informatics role and consultation, usability and workflow, and support systems and accessibility. Each theme offers insights into how consultation access is structured, experienced, and optimized. Together, these themes not only validate prior knowledge but also extend the field by highlighting multidimensional strategies needed to strengthen CIS consultation pathways.

Main Theme: Training and Education

Training and education emerged as a foundational strategy to improve access to CIS consultations in acute care hospital systems. The literature consistently identifies insufficient training as a barrier to effective EHR use and CIS engagement. Lack of training correlated with reduced clinician efficiency and lower well-being, which are known deterrents to consultation engagement (Heponiemi et al., 2021). In contrast, structured informatics education programs increased student competency and confidence, two preconditions for recognizing the value of and seeking CIS consultation (Shen et al., 2024). The application of the ADKAR change management framework to enhance readiness and alignment among healthcare professionals, illustrates how change literacy can enhance receptiveness to CIS support (Kaminski, 2022). The literature affirms that training is not only a prerequisite for system use but a key lever to increase awareness, demand, and readiness for CIS consultation.

Subtheme: Addressing Training Deficits

Clinicians are less likely to access CIS consultations if foundational EHR training is inadequate. For example, Heponiemi et al. (2021) found that insufficient training resulted in poor system use and limited understanding of when or how to seek CIS support. These findings illustrate that offering role-specific, hands-on training programs increases the likelihood of clinicians recognizing and utilizing consultation services.

Subtheme: Competency Improvement

Structured CIS education enhances user competency, a critical factor in enabling access to CIS services. Shen et al. (2024) observed significant improvements in informatics proficiency following targeted education, indicating that consult engagement increases when clinicians are confident in their baseline EHR and system knowledge.

Subtheme: Confidence Building

Confidence in using digital tools is directly linked to clinicians' willingness to seek CIS assistance. simulation-based and experiential learning built confidence, making clinicians more likely to access consultations when encountering EHR challenges (Shen et al., 2024). This suggests that training must include consultation workflows and real-world scenarios to normalize CIS engagement.

Subtheme: Change Management

Education that incorporates change management principles prepares clinicians to adopt new systems and workflows, reducing resistance to CIS involvement. Integrating change readiness tools into educational programming fosters openness to informatics-led improvement initiatives (Kaminski, 2022). This indicates that training can proactively reduce cultural and psychological barriers to consultation access.

Subtheme: Decrease Training Efficiency Barriers

Lack of training for clinicians contributes to inefficient system use, which discourages consultation-seeking behaviors (Heponiemi et al., 2021). Clinicians experiencing workflow delays due to limited EHR knowledge are less likely to take additional steps to access CIS support. The literature illustrates that resolving training-related inefficiencies through targeted education can create time and capacity for consultative engagement (Heponiemi et al., 2021).

Main Theme: Informatics Role and Consultation

The central role of CIS and the structure of consultation pathways emerged as pivotal to improving access to CIS services in acute care systems. When CIS are fully integrated into clinical environments, their presence enhances consultative availability, workflow alignment, and trust in digital health solutions. Asif and Khan (2024) emphasized the strategic necessity of CIS support in resource-constrained settings, particularly where clinicians face time pressure and technology complexity. Other studies affirmed that consultative input from CIS supports timely, evidence-based clinical decisions (Lai et al., 2021; Stephenson et al., 2024) This theme supports the broader understanding that improving access to CIS consultations is not only about availability but also about the value, structure, and clarity of the consultation process itself.

Subtheme: Evidence-Based Consultation

The use of CIS consultations to facilitate evidence-based clinical decision-making is a validated strategy for improving care quality. Clinicians who regularly engaged in CIS consultations had greater adherence to best practices and clinical protocols (Lai et al., 2021). The literature illustrates that acute care organizations can improve access to CIS consultations by linking them directly to evidence-based resources, such as guideline-integrated order sets and decision support tools, which reinforce their utility and encourage engagement.

Subtheme: Consultation Guidance

Standardizing consultation procedures and workflows supports access by reducing ambiguity about when and how to request help. Structured consultation guidance, including EHR-based prompts and referral protocols, is essential to improved usage among frontline clinicians (Stephenson et al., 2024). The literature illustrates that healthcare systems can enhance access by implementing embedded prompts, FAQs, or automated routing features that direct clinicians to appropriate informatics consultations based on context or workflow needs.

Subtheme: Decision-Making Support

Access to informatics consultation improves decision quality, particularly when decisions must be made rapidly or under complex data conditions. Clinicians using CIS consultation services benefited from real-time analytics and scenario-based guidance, enhancing clinical confidence (Lai et al., 2021). The literature illustrated that health systems can improve consultation access by promoting CIS as key partners in diagnostic and treatment decisions—particularly when they provide personalized, data-driven support within the clinical workflow.

Subtheme: Consultation Value

Clinician perception of the value of consultations influences whether services are accessed or bypassed. CIS consults associated with measurable improvements in workflow or clinical outcomes create clinicians who were more likely to engage regularly with CIS (Stephenson et al., 2024). The literature illustrates that increasing awareness of the benefits, such as time savings, fewer errors, or improved documentation, can enhance access by reframing consultation as a high-value service rather than an optional resource.

Subtheme: Informatics Consultation Access

The structural design of how consultations are accessed, whether via dashboard button, messaging system, or EHR order, determines their usability and frequency. Consultation access embedded within daily workflows resulted in higher utilization, especially during peak workload times (Asif & Khan, 2024). These findings illustrate that acute care organizations can improve access by integrating consultation requests into documentation templates, order sets, or real-time messaging tools that align with clinicians' existing practices.

Main Theme: Usability and Workflow Optimization

Usability and workflow optimization influence how clinicians engage with CIS in acute care settings. Barriers related to EHR design, documentation burden, and role-based system misalignments reduce consultation uptake by adding cognitive and operational friction. Excessive documentation and inefficient workflows reduce the time clinicians can devote to informatics engagement (Cho et al., 2024). Similarly, fostering a healthier relationship with EHRs promoting more intuitive design, reduced screen fatigue, and meaningful workflow alignment can also increase CIS engagement (Barshay & Richardson, 2024). These findings indicate that improving usability through clinician-centered system redesign and targeted CIS consultation strategies supports more effective and equitable access to CIS expertise.

Subtheme: Targeted EHR Optimization

EHR optimization initiatives have demonstrated strong correlations with increased consultation efficacy. Evidence shows that structured optimization programs clear pathways for CIS consultations within the EHR led to measurable improvements in system performance and user satisfaction, particularly when staff were engaged in the redesign process provide (Hathaway & Earle, 2024). This shows that clear paths to CIS consultants in cyclical EHR optimization efforts creates a clear path for improvements that reduce barriers to consultation to CIS from the EHR/Clinician.

Subtheme: Satisfaction with Consultation

Clinician satisfaction with CIS consultation services is often mediated by the usability of the systems through which they are accessed. Enhancements in interface functionality improved physician satisfaction with CIS consultations, affirming that user-centered system design bolsters perceived consultation value (Gombar et al., 2019). Showing that CIS consultations aimed at enhancing EHR interface logic and user experience directly contribute to improved satisfaction and increased consult uptake by addressing pain points in system usability that disincentivize consultation.

Subtheme: Reduction in Usability Gaps

Persistent usability gaps contribute to clinician frustration and underutilization of CIS resources. Gaps vary by professional group and system brand, necessitating tailored interventions (Kaipio et al., 2020). Identifying and addressing usability shortcomings at the team level can enhance consultation effectiveness. This shows that accessing CIS consultations to diagnose and remedy usability gaps through localized assessment and iterative system refinement is an effective solution for enabling broader consultation engagement by ensuring that tools are compatible with clinicians' specific use cases.

Subtheme: Role-Based Tailored Strategies

Different clinical roles face unique usability barriers. Staff position and tenure influence perceptions of EHR training and support, with newer staff often requiring more intensive orientation to consultative tools (Campione & Liu, 2024). Understanding these distinctions helps tailor support resources effectively. This shows that role-specific consultations can help identify training deficits and usability needs, thereby improving equitable system access and consult readiness across all roles by addressing the mismatched competencies and tool accessibility experienced at different career stages.

Subtheme: Healthier EHR Relationship

Improving the relational dynamics between clinicians and EHRs contributes to consultation success. By being an advocate for leadership to actively reshape organizational culture around EHR use, promoting a mindset of collaboration rather than burden it enhances consultation receptivity and usability feedback loops (Barshay & Richardson, 2024). This shows that engaging CIS consultations to co-create supportive

EHR narratives and foster shared system ownership can reduce resistance and strengthen the perceived value of CIS involvement by addressing cultural and relational barriers to EHR acceptance.

Subtheme: Mitigation of Usability Frustration

System-related frustration is a barrier to engagement with CIS consultations. Perceived EHR usability is directly correlated with physician burnout, and efforts to reduce frustration through interface design and real-time support increase the likelihood of consultation use (Melnick et al., 2020). This shows that using CIS consultations to identify frustration drivers and deploy targeted usability interventions contributes directly to consultative engagement and clinician well-being by addressing emotional and functional stressors related to system navigation.

Main Theme: Support Systems and Accessibility

Access to structured and responsive support systems was identified as a critical facilitator of CIS consultation engagement. Real-time EHR support teams (e.g., SWAT teams) improved satisfaction and increased consultation utilization (Sequeira et al., 2021). Furthermore, former implementation frameworks enhanced consultation consistency (Kiepek & Sengstack, 2019). Conversely, mid-career clinicians often reported lower satisfaction with technical support, leading to underutilization of consultations (Campione & Liu, 2024). These findings emphasize the importance of equitable, role-sensitive support structures and communication pathways that make consultations timely, relevant, and accessible across all clinical roles.

Subtheme: Real-Time Communication

Real-time communication tools improve coordination across care teams. When such tools are absent or cumbersome, clinicians may not know when or how to request consultations. Embedding instant messaging within the EHR enabled clinicians to seek consultations more efficiently and share patient updates in a timely manner (Kwan et al., 2024). These findings illustrate that accessing CIS consultations to enable and refine real-time communication features supports prompt consultative communication, improving interdisciplinary workflow and consultation uptake.

Subtheme: Emergency and Rapid Informatics Support

Crisis and high-acuity scenarios require timely and scalable informatics support to sustain safe and effective care. During emergent situations such as the COVID-19 pandemic, rapid deployment of centralized dashboards, escalation templates, and consult pathways enabled clinicians to access CIS expertise promptly (Reeves et al., 2020). In addition, embedded alerts and dashboard links significantly improved consultation responsiveness and clinical outcomes in urgent care settings (Hsu et al., 2021). These findings illustrate that accessing CIS consultations to co-design emergency CIS systems—including real-time alerts, scalable dashboards, and streamlined consultation workflows—ensures continuity of consultative access, enhances crisis readiness, and supports rapid decision-making under pressure.

Subtheme: Resolution of Service Delivery Friction

Clinicians often conflate CIS teams with general technical support services, which can result in misdirected expectations and diminished trust when support is delayed or unresponsive (Melnick et al., 2020). This confusion contributes to service delivery friction, discouraging clinicians from seeking further consultation. Lack of real-time support during EHR implementation phases led to decreased system engagement and fewer CIS consultation requests (Kiepek & Sengstack, 2019). These findings illustrate that accessing CIS consultations to clarify roles, co-develop triage protocols, and improve support handoffs can enhance the efficiency of service delivery and restore clinician confidence. By reducing ambiguity and aligning support workflows, organizations can strengthen consultative engagement and ensure clinicians receive timely, domain-appropriate assistance.

Subtheme: On-Demand Analytics

On-demand analytics provide clinicians with real-time access to population health metrics, predictive models, and patient-specific data. Without integration into workflows, this data remains underutilized, limiting consultative impact. Real-time access capabilities enhance the relevance and timeliness of CIS consultations, especially when integrated into workflows (Lai et al., 2021). These findings illustrate that accessing informatics consultations to embed data visualization dashboards and predictive modeling interfaces into clinical routines supports faster, more precise decisions that improve consultation efficiency and uptake.

Subtheme: Evidence-Informed Care

CDS systems support evidence-informed care by embedding research findings into clinical decision pathways. Automated guidance reduces reliance on memory and manual interpretation, thereby strengthening consult quality and safety. However, disconnected or overly complex CDS pathways can frustrate clinicians and impede consult use (Sittig et al., 2018). These findings illustrate that clinicians can utilize CIS consultations to co-develop CDS rule sets and content libraries that align with evolving clinical guidelines, promoting safer, standardized practices through streamlined consultation workflows.

Subtheme: Technical Intervention

CIS contributes to technical intervention by customizing systems to meet clinical needs. Without this tailoring, off-the-shelf technologies may misalign with practice demands, deterring clinicians from seeking support. CIS consultation often involves collaborating with developers and vendors to adapt technology to frontline requirements, ensuring systems align with practice (Desai et al., 2020). These findings illustrate that accessing CIS consultations enables clinicians to co-design interfaces, alerts, and documentation tools that reduce inefficiencies and support workflow alignment, making consultative support more accessible and effective.

Subtheme: System Enhancement System

System enhancements driven by CIS feedback help optimize workflows and consultation access. When clinicians lack avenues to report system pain points, opportunities for meaningful improvement are lost. Involving informatics professionals in enhancement cycles improves functionality and promotes user satisfaction, which in turn improves consult engagement (Hathaway & Earle, 2024). These findings illustrate that CIS consultations allow clinicians to participate in system improvement efforts, ensuring their needs are reflected in platform upgrades, thereby enhancing their willingness to initiate and sustain consultative engagement.

Subtheme: Clinical Effectiveness

CIS consultation supports clinical effectiveness by aligning evidence-based protocols with EHR workflows. Without this alignment, variability in care and uncertainty in system navigation may lead clinicians to avoid consultation. Consultations focused on clinical pathways help reduce variability and improve care quality, reinforcing the practical value of CIS support (Lai et al., 2021). These findings illustrate that clinicians can access CIS consultations to design decision support and documentation tools that align with established protocols, reinforcing clarity, safety, and consistent access to CIS resources.

Conclusion

In summary, the thematic findings from this review confirm much of what is already known about the importance of training, usability, and clinician support in the context of HIT adoption. However, the findings also extend knowledge by articulating specific strategies that directly improve access to clinical informatics consultations, including the deployment of virtual consult tools, integration of informaticists into daily workflows, policy-driven staffing models, and capacity-building frameworks grounded in ADKAR. These findings contribute to a more nuanced and operational understanding of access, revealing that it is shaped not only by user readiness, but by the interconnected systems that support or inhibit clinical engagement with CIS.

Part 4: Recommendation for Professional Practice and Implications for Social Change

Recommendations for Professional Practice

The findings from this integrative review support the development of professional practice guidelines aimed at enhancing access to CIS consultations in acute care hospital systems. These recommendations are directly derived from the four identified themes—training and education, role of informatics and access to consultation, usability and workflow optimization, and support systems and accessibility—as visualized in the final thematic concept map (see Appendix E) and informed by the Prosci ADKAR change management framework (Kaminski, 2022).

Implement Role-Specific Informatics Education and Training Programs

Training deficits and competency gaps reduce clinicians' ability to engage effectively with informatics support. Findings from Heponiemi et al. (2021) and Shen et al. (2024) emphasized the need for structured, role-specific education programs to promote confidence and improve consultation readiness. Aligning with the knowledge and ability components of the ADKAR model, tailored educational initiatives should be embedded into onboarding and continuing professional development programs to reinforce CIS competency and consultation utilization.

Embed CIS in Daily Operations

To improve access and awareness, healthcare systems should integrate CIS personnel at elbow into clinical teams through participation in rounds, workflow huddles, committees, regulatory work, and department-specific consultation channels. As supported by Asif and Khan (2024), embedded CIS increase perceived value and consultation usage, fulfilling the Awareness and Desire elements of ADKAR by building relationships and contextual relevance.

Conduct EHR Usability Assessments and Co-Design Optimization Interventions

As usability and workflow inefficiencies were repeatedly linked to consultation underutilization, organizations should conduct routine usability audits and involve frontline staff in co-design initiatives (Barshay & Richardson, 2024; Cho et al., 2024). These optimizations support reinforcement of CIS engagement by reducing cognitive and procedural burdens associated with EHR navigation.

Develop and Sustain Informatics SWAT Teams and Peer Support Models

Burnout and lack of real-time support are key barriers to CIS consultation (Melnick et al., 2020; Sequeira et al., 2021). Establishing dedicated CIS SWAT teams and peer mentorship models can provide immediate, contextual support to clinicians, thus reinforcing trust and willingness to engage with consult services.

Integrate Real-Time Communication and Consultative Tools within the EHR

Embedding consult prompts, instant messaging, and CDS tools within the EHR infrastructure improves consultation accessibility, especially in high-acuity settings (Gombar et al., 2019; Kwan et al., 2024). These tools enhance Ability and workflow alignment, fostering more rapid, actionable CIS engagement.

Establish Governance Models and Define Core Informatics Competencies

Effective governance structures are essential to ensure accountability, standardization, and alignment of CIS services with organizational goals (Desai et al., 2020). Governance should define the scope and expectations of CIS roles, promoting interdisciplinary collaboration and ensuring long-term strategic alignment with clinical operations.

Expand Real-Time Virtual Consultation Infrastructure and Address Role-Based Access Inequities

The theme of support accessibility revealed disparities in consultation access based on clinician role and tenure (Campione & Liu, 2024). Health systems should implement real time virtual consult platforms, coverage models, and feedback loops to ensure equitable support for all staff, particularly mid-career clinicians who are often overlooked in informatics assistance.

Implications for Social Change

Improving access to CIS consultations contributes to positive social change by advancing equity in resources available for clinicians service patients, efficiency, and safety in healthcare delivery. The integrative review highlights systemic gaps that disproportionately affect under-supported clinicians, many of whom serve in high-acuity or resource-constrained environments. By addressing these gaps, healthcare system leaders can more effectively uphold social determinants of health related to healthcare access and quality and education access and quality.

Enhanced access to CIS resources enables clinicians to deliver safer, more coordinated, and evidence-informed care. In turn, this fosters greater trust in health technologies, reduces digital fatigue, and promotes inclusive clinical environments. Widespread implementation of consultative support also supports workforce retention, especially among groups vulnerable to burnout, thereby contributing to a more stable and empowered healthcare labor force.

Limitations

This review is limited by several factors. First, the literature search was confined to English-language, peer-reviewed publications from 2018–2025, potentially excluding relevant studies published in other languages or outside this time frame. Second, although the thematic synthesis drew upon both empirical and conceptual sources, the inclusion of descriptive and opinion-based literature (e.g., white papers) may introduce subjective interpretations. Third, variability in informatics maturity across international settings may limit the generalizability of some findings to all acute care systems. Finally, the review did not include direct stakeholder interviews or organizational case studies, which may offer further practical insights.

Conclusion

Improving access to CIS consultations represents a strategic imperative for acute care hospital systems aiming to enhance EHR optimization, clinician support, and patient safety. This integrative review synthesized evidence-based strategies across four thematic domains—training and education, role clarity and access, usability and workflow optimization, and support systems and accessibility. These domains reflect interconnected structural and behavioral barriers that limit timely, role-specific CIS engagement. Anchored in the ADKAR change management framework, the findings emphasize the necessity of addressing awareness, desire, knowledge, ability, and reinforcement gaps through deliberate, organization-wide interventions. When implemented collectively, these strategies create a scalable model for sustainable CIS consultation access that aligns with clinical workflows, enhances staff confidence, and fosters a culture of continuous digital improvement. Closing this consultation gap not only addresses a measurable professional practice need but also supports system-level transformation toward equitable, efficient, and data-informed care delivery.

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Appendix A: DHA Practice-Based Problem Literature Review Matrix

Author/ Date	**Theoretical/ Conceptual Framework**	**Research Question(s)/ Hypotheses**	**Methodology**	**Analysis & Results**	**Conclusions**	**Implications for future research**	**Implications for practice**	**Empirical research (Yes or No)**
Lai et al. (2021)	Informatics consultation approach in healthcare	How can informatics consult approaches improve access to informatics support for clinicians and lead to better patient outcomes?	Qualitative study focusing on case analysis from healthcare settings	Identified five key factors influencing access to informatics consult services: implementation, evaluation, data access, informatics, and knowledge management	Informatics consultation services can enhance clinical outcomes, efficiency, and patient safety	Future research should explore how informatics consult approaches can be scaled and integrated into larger health systems	Implementing informatics consult services can improve workflow, communication, and patient safety in healthcare settings	Yes
Sittig et al. (2018)	socio-technical model of health information technology (HIT)-related patient safety	What are the current challenges in health information technology-related patient safety	Literature review and synthesis of challenges associated with HIT use |	HIT challenges involve complexity, usability, transparency, and accountability issues among stakeholders	Collaboration and accountability are essential to address HIT-related safety concerns	Future research should focus on improving transparency and accountability mechanisms in HIT to enhance patient safety	Emphasizes the need for healthcare organizations to adopt collaborative and accountable approaches when implementing and managing HIT	No
Reeves et al. (2020)	The paper focuses on the health informatics framework, specifically leveraging digital health technology to respond rapidly to COVID-19.	How did health informatics support rapid outbreak management during the COVID-19 pandemic in an academic health system?	Case study methodology describing the implementation of health informatics tools in response to the COVID-19 outbreak in a large academic health system.	The study analyzed the rapid deployment of health informatics systems, including telehealth expansion, electronic health record (EHR)	The study concluded that health informatics tools are crucial in managing pandemic responses, offering real-time data, telehealth solutions, and	Future research should explore the long-term impacts of health informatics on pandemic management and identify areas for further system improvements.	The study suggests that healthcare systems should continue investing in and scaling up health informatics tools to enhance preparedness for future public	Yes

				modifications, and remote monitoring tools. Results demonstrated success in managing COVID-19 cases and improving operational efficiency.	streamlined workflows.		health emergencies.	
Sequeria et al. (2021)	The study is framed around the concept of EHR-related physician burnout and engagement, with a focus on improving user experience through targeted interventions.	How can an EHR “SWAT” team initiative improve physician engagement and mitigate causes of EHR-related burnout?	Case study methodology describing the implementation of a specialized team ("SWAT" team) focused on EHR improvement and physician support.	The initiative led to improvements in physician satisfaction, reductions in EHR-related burnout, and better overall EHR user experience. The results were based on both qualitative feedback and quantitative measures of user satisfaction.	The study concluded that a targeted, physician-focused intervention in the form of EHR "SWAT" teams can enhance EHR experiences and help address burnout issues.	Future research should examine the scalability of EHR "SWAT" teams in other healthcare settings and explore their long-term impact on physician well-being.	Healthcare systems should consider adopting similar physician engagement initiatives to improve EHR usability and address burnout more effectively.	Yes
Kaminski, J. (2022)	The Prosci ADKAR Model is the theoretical framework used, which focuses on change management in healthcare informatics.	The article discusses how the ADKAR model can be applied to healthcare informatics to facilitate successful change.	Editorial discussion and application of the ADKAR model, rather than an empirical study.	The article analyzes how each component of the ADKAR model (Awareness, Desire, Knowledge, Ability, Reinforcement)	The ADKAR model provides a structured approach for driving successful change in informatics, emphasizing the importance of addressing	Future research should explore the effectiveness of the ADKAR model in various healthcare informatics projects and its adaptability across different	Healthcare leaders and informaticists should consider using the ADKAR model to support and manage change effectively in their organizations, particularly in	No

				applies to informatics projects and change management processes.	individual components of change.	healthcare settings.	implementing new informatics solutions.	
Hsu et al. (2021)	The article uses a clinical informatics framework, particularly focusing on emergency department (ED) and inpatient care operations during COVID-19.	What lessons can be learned from clinical informatics in emergency departments and inpatient operations during the COVID-19 pandemic?	Case study and retrospective analysis of clinical informatics interventions in an emergency department and inpatient setting during the pandemic.	The analysis revealed several critical informatics interventions such as data dashboards, EHR modifications, and telehealth applications that improved operational responses and patient outcomes in both ED and inpatient settings.	The study concluded that the rapid deployment of clinical informatics solutions was essential to managing patient flow, resource allocation, and care coordination during the pandemic.	Future research should focus on optimizing clinical informatics systems for emergency response scenarios and developing scalable, adaptable models for future crises.	Healthcare organizations should prioritize investment in informatics infrastructure and training to better support emergency and inpatient care operations during public health crises.	Yes
Hathaway & Earle (2024)	The article uses an informatics-driven framework focused on optimizing the use of electronic health records (EHR) to improve healthcare outcomes.	How does an EHR optimization program contribute to better performance and outcomes in healthcare delivery?	Case study methodology analyzing the implementation of an EHR optimization program in a healthcare organization.	The study analyzed the program's impact on clinician efficiency, workflow improvements, and patient care outcomes, finding increased user satisfaction and streamlined processes post-optimization.	The study concludes that an EHR optimization program can significantly enhance operational efficiency and improve both provider and patient experiences.	Future research should explore further customization of EHR systems to meet the unique needs of different specialties and healthcare settings.	The findings suggest that healthcare organizations should adopt ongoing EHR optimization efforts to ensure continuous improvement in workflow and patient outcomes.	Yes

Heponiemi et al. (2021)	The study is based on the stress-strain model and theories linking job demands to well-being, focusing on EHR implementation and training.	How do EHR implementation and inadequate training affect nurses' well-being?	Cross-sectional survey study involving nurses from different healthcare organizations, analyzing their experiences with EHR systems and the adequacy of training received.	The analysis found that insufficient training and poorly implemented EHR systems significantly increased job strain and negatively impacted nurses' well-being. Results showed a strong correlation between inadequate training and burnout, stress, and job dissatisfaction among nurses.	EHR implementation without sufficient training endangers nurses' well-being by increasing job strain and contributing to burnout and job dissatisfaction.	Future research should focus on developing and testing more effective EHR training programs and exploring the long-term effects of EHR on healthcare professionals' well-being.	Healthcare organizations should ensure adequate EHR training and ongoing support for nurses to prevent job strain and promote well-being.	Yes
Kaipio et al. (2020)	Usability theory applied to Electronic Health Records (EHR) to explore differences in user experience across professional groups and healthcare settings.	What are the differences in EHR usability experiences between physicians and nurses, and how do these differences vary by employment sector and EHR system brand?	Quantitative survey-based study comparing physicians’ and nurses’ experiences with EHR usability across different employment sectors and system brands.	Statistical analysis of survey data showed significant differences in usability ratings between physicians and nurses, with nurses reporting lower satisfaction. Usability perceptions also varied by employment sector and EHR system brand.	The study concluded that EHR usability varies significantly between professional groups, sectors, and system brands, with nurses often experiencing more challenges than physicians.	Future research should investigate the root causes of these usability disparities and focus on improving EHR systems to better meet the needs of all users.	Healthcare organizations should tailor EHR usability improvements to specific professional groups and consider employment sector-specific needs when selecting or optimizing systems.	Yes

Shen et al. (2024)	The article is grounded in a framework of digital health and informatics education, focusing on online education for nursing students.	What are the impacts of online digital health and informatics education on undergraduate nursing students in China?	Mixed-methods approach involving surveys and interviews to assess the effectiveness of online digital health education among nursing students.	The study analyzed students' learning outcomes, engagement levels, and competency development. Results indicated that online digital health education improved students' informatics knowledge and technical skills, but also revealed challenges such as accessibility and technical issues.	Online digital health education positively impacted nursing students' informatics competency, though barriers such as technology infrastructure and teaching quality must be addressed.	Future research should focus on long-term evaluations of online informatics education outcomes and strategies to overcome technological challenges in resource-limited settings.	The study recommends improving digital literacy among nursing students and developing robust online education systems to better integrate informatics into nursing curricula.	Yes
HIMSS (2024)	The article is based on the clinical informatics framework, emphasizing the value of clinical informatics in improving healthcare delivery and decision-making processes.	How does clinical informatics enhance the value, safety, and quality of healthcare delivery across different systems?	White paper analyzing various case studies and evidence from healthcare organizations that implemented clinical informatics solutions.	The paper found that clinical informatics significantly improves healthcare outcomes by streamlining processes, reducing errors, and enabling better decision-making through real-time data access.	Clinical informatics plays an essential role in enhancing patient care, operational efficiency, and health system resilience.	Further research should explore advanced analytics and artificial intelligence (AI) applications in clinical informatics to push the boundaries of healthcare innovation.	Healthcare systems should invest in clinical informatics infrastructure to continuously improve clinical workflows, patient outcomes, and data-driven decision-making.	No- This is a white paper
Abbas et al. (2024)	The article is grounded in a health informatics	How does the use of EHRs impact nurse-patient	A mixed-methods approach using both quantitative	Analysis showed that EHRs have both positive and	The study concluded that EHRs have a	Future research should focus on developing tools	Healthcare organizations need to train	Yes

	framework, examining how the adoption of electronic health records (EHRs) affects nurse-patient communication.	communication, and what are the key factors influencing this relationship?	surveys and qualitative interviews with nurses in healthcare settings to assess the effects of EHRs on communication.	negative effects on nurse-patient communication. While EHRs improve documentation and data accuracy, they also create barriers to face-to-face communication due to increased screen time.	complex impact on communication. Effective integration of EHRs should include strategies to minimize distractions and enhance communication between nurses and patients.	and strategies that enhance nurse-patient communication while using EHRs, with a particular focus on balancing technology use with personal interaction.	nurses on how to maintain patient-centered communication while using EHRs, ensuring that technology does not disrupt the therapeutic relationship.	
Cho et al. (2023)	The study employs a framework exploring the relationship between EHR system usability and the documentation burden on acute and critical care nurses.	What is the impact of EHR system use on the documentation burden of nurse clinicians in acute and critical care settings?	Mixed-methods study combining quantitative surveys of nurses and qualitative interviews to explore their experiences with EHR systems.	Quantitative analysis identified a high documentation burden among nurses using EHR systems, while qualitative data highlighted issues such as inefficiency, fragmented workflows, and dissatisfaction with documentation processes.	The study concludes that the EHR system contributes significantly to nurse clinician workload and documentation burden, suggesting the need for system redesign and workflow optimization.	Future research should focus on designing more intuitive EHR interfaces and evaluating how improved systems can reduce clinician burden while maintaining quality of care.	The study suggests that healthcare organizations need to prioritize the reduction of EHR documentation burdens through system optimizations and workflow adjustments to improve nurse satisfaction and patient care.	Yes
Asif & Khan (2024)	The article applies a health informatics framework, specifically addressing the role of nurse	What is the role of nurse informaticists in the successful implementation of EHRs in resource-	Qualitative study, with interviews of nurse informaticists involved in EHR implementations in resource-limited settings across	The analysis revealed that nurse informaticists play a crucial role in bridging technical and	Nurse informaticists are essential in ensuring the successful adoption of EHRs,	Future research should examine the long-term impact of informaticists on EHR sustainability in	The study suggests healthcare organizations in resource-limited settings should integrate nurse	Yes

	informaticists in EHR implementation in resource-limited settings.	limited healthcare settings?	various healthcare institutions.	clinical workflows, enabling smoother transitions to EHR systems. Challenges include limited resources and lack of training, but the presence of informaticists mitigated these issues.	particularly in environments with limited resources, where their expertise can significantly impact both system functionality and user acceptance.	resource-limited settings and explore strategies to support ongoing education and resource allocation.	informaticists into EHR implementation teams to enhance system usability and clinical integration.	
Kwan et al. (2024)	The article uses a communication theory framework, focusing on the integration of instant messaging into electronic health record (EHR) systems to improve clinical communication.	How does the implementation of an EHR-integrated instant messaging system affect communication efficiency in an academic health system?	Case study methodology analyzing the implementation of an EHR-integrated instant messaging system within an academic health system.	The study assessed communication metrics and clinician feedback, showing improvements in message response times, communication clarity, and user satisfaction post-implementation.	The study concluded that EHR-integrated instant messaging systems can significantly improve real-time communication among healthcare teams, enhancing workflow and collaboration.	Future research should explore the scalability of such systems across diverse healthcare settings and measure long-term outcomes related to patient safety and team dynamics.	The study suggests that healthcare organizations should consider integrating instant messaging systems with EHRs to foster better communication and collaboration, leading to more efficient care delivery.	Yes
Desai et al. (2020)	The study uses a workforce characterization framework focused on the role of clinical informatics subspecialists in healthcare.	How is the role of clinical informatics subspecialists evolving within the healthcare workforce, and what are their key characteristics?	Cross-sectional study and workforce analysis using publicly available data on board-certified clinical informatics subspecialists.	The study found that clinical informatics subspecialists represent a growing workforce with diverse medical backgrounds.	Clinical informatics is a rapidly evolving subspecialty with increasing importance in healthcare, driven by the need for specialized	Future research should focus on defining the scope of practice for clinical informatics subspecialists and identifying key areas for training	Healthcare systems should recognize and integrate clinical informatics subspecialists to optimize the use of health information	Yes

				Results indicate the subspecialty is expanding across various healthcare settings and roles.	expertise in managing health information technology.	and professional development.	technology in patient care.	
Barshay & Richardson (2024)	The article utilizes a leadership and informatics framework to examine the relationship between healthcare leadership and electronic health record (EHR) systems.	How can healthcare leadership foster a more positive and productive relationship with EHR systems to enhance healthcare delivery?	Commentary with case examples discussing leadership strategies to improve the relationship between healthcare providers and EHR systems.	The article provides qualitative insights into how healthcare leaders can reimagine their relationship with EHRs by addressing common challenges like burnout and workflow inefficiencies.	The authors conclude that healthcare leaders must actively engage with EHR systems, addressing user dissatisfaction and promoting more effective EHR use in practice.	Future research should focus on developing leadership strategies that further bridge the gap between clinicians and EHR systems, particularly in reducing burnout.	The findings encourage healthcare leaders to adopt a more collaborative approach in managing EHR systems, emphasizing user-centered improvements and support structures.	No
Adelphi University (2024)	The article discusses the integration of nursing informatics into healthcare, focusing on how technology enhances nursing practice, patient care, and healthcare outcomes.	What are the key benefits of nursing informatics for healthcare professionals and patients?	The article is not empirical but rather a narrative discussion of the benefits of informatics in nursing, including improved patient outcomes, enhanced workflow, and better data management.	The article presents various benefits of nursing informatics, such as improving patient safety, increasing efficiency, and providing better access to patient information for decision-making.	Informatics plays a critical role in modern healthcare by improving the quality of care and supporting nurses in managing complex patient data.	The article implies the need for ongoing research into emerging technologies in nursing informatics and their long-term impact on healthcare delivery.	Nursing informatics should be a core part of nurse education and practice to ensure that nurses can leverage technology effectively for patient care and data management.	No-Narrative
Howard (2023)	The article centers on the practical framework of electronic health record (EHR)	What are the key elements of successful EHR support for healthcare	Descriptive case-based discussion focusing on elements required for successful EHR	The article identifies five key elements: troubleshooting, patient portal	A dedicated and knowledgeable EHR support team significantly enhances the	Further research could explore the long-term impacts of dedicated support teams on	Healthcare organizations should invest in dedicated EHR support services	No

	optimization and support, focusing on operational improvements and the role of a dedicated support team.	practices, and how can support services optimize practice performance?	support and optimization in healthcare practices.	configuration, custom documentation building, staff training, and healthcare systems expertise. Each element contributes to smoother EHR implementation and ongoing support.	efficacy of EHR systems, ensuring that healthcare practices can streamline workflows and optimize patient care.	EHR utilization and their role in reducing clinician burnout.	to enhance efficiency, reduce errors, and ensure ongoing optimization of their EHR systems.	
Whatfix (2023)	The article emphasizes a user-centric framework focused on improving end-user support for clinical staff in using Electronic Health Records (EHR).	How can healthcare organizations enhance EHR end-user support to improve clinical workflows and user satisfaction?	Descriptive methodology exploring strategies for improving EHR support based on industry best practices and user experience insights.	The analysis provided multiple strategies such as real-time support, continuous training, and personalized assistance to enhance EHR usability. Results indicated that these approaches can significantly reduce clinician burnout and improve overall satisfaction with EHR systems.	The article concludes that a proactive, user-focused support strategy is critical for improving clinician experience and maximizing the benefits of EHR systems.	Future studies could explore the long-term impact of enhanced EHR support on clinical outcomes and operational efficiency.	Healthcare organizations should implement continuous, real-time EHR support to mitigate user frustration and optimize system usage.	No
Melnick et al. (2020)	The study is grounded in the framework of physician well-being, focusing on the relationship	How is the perceived usability of EHR systems associated with professional	Quantitative, cross-sectional study using a survey methodology to assess EHR usability (via the System Usability	The analysis involved multivariate regression models to assess the association between EHR	The study concluded that poor EHR usability is a significant factor contributing to physician	Future research should investigate specific EHR design changes that can mitigate burnout and explore other	The findings suggest healthcare organizations should prioritize enhancing EHR usability to improve	Yes

	between electronic health record (EHR) usability and professional burnout.	burnout among U.S. physicians?	Scale) and its association with burnout among physicians.	usability scores and burnout rates. Results showed a strong association between lower EHR usability scores and higher levels of burnout among U.S. physicians.	burnout, underscoring the need for improvements in EHR design and functionality to reduce burnout.	factors that influence the usability-burnout relationship across different medical specialties.	physician well-being and reduce burnout, which can lead to better patient care.	
Campione & Liu (2024)	The study does not explicitly adopt a theoretical framework, but it examines perceptions of EHR training, support, and patient safety through the lens of staff roles and tenure, aligning with organizational behavior and safety culture concepts.	The research investigates how staff position and tenure influence perceptions of EHR training, support, and its impact on patient safety.	A cross-sectional survey design was employed, collecting quantitative data from healthcare staff across various roles and tenure categories.	Analysis involved descriptive statistics, multivariate regression, and subgroup comparisons. Results indicated significant differences in perceptions based on staff roles (e.g., nursing, administrative) and tenure, with more experienced staff reporting less satisfaction with EHR support.	The study concludes that perceptions of EHR training and support vary by staff position and tenure, highlighting areas of improvement in EHR-related resources to enhance patient safety.	Future studies should explore longitudinal impacts of tailored EHR training programs and investigate how these perceptions influence patient safety outcomes over time. Additionally, qualitative research could deepen understanding of staff experiences and barriers to EHR support.	The findings suggest the need for role-specific and tenure-sensitive EHR training and support initiatives to address disparities in staff perceptions and improve patient safety.	Yes
Hiatt (2006)	The ADKAR model is the conceptual framework introduced and developed in this book. It focuses on five building	The book does not explicitly pose research questions or hypotheses, as it primarily aims to present a structured model for implementing	The methodology is purely conceptual, drawing on Hiatt's professional experience and case studies to illustrate the application of the ADKAR model	The book analyzes organizational change initiatives and their success factors using the ADKAR framework. It	The ADKAR model is an effective tool for managing individual and organizational change, as it identifies specific	The book encourages further empirical validation of the ADKAR model in diverse industries and settings to establish its	The ADKAR model serves as a practical guide for managers, change agents, and leaders to implement structured change	No

	blocks for individual change: Awareness, Desire, Knowledge, Ability, and Reinforcement.	organizational change effectively.	in various organizational contexts.	demonstrates how gaps in any of the five elements can hinder successful change. Results are presented as practical insights rather than statistical findings.	areas where interventions can address resistance or skill deficits.	effectiveness across different organizational cultures.	initiatives, ensuring focus on individual change management as the cornerstone of organizational success.	

Appendix B: DHA Review Question Search Log

Database or location name	Search Terms	Results	Notes
Elsevier (ScienceDirect)	"clinical informatics" AND "acute care" AND ("consultation enhancement" OR "consultation optimization")	20 articles	Many of the articles had research focused on workflow optimization and the role of informatics in critical care consultations. Not enough results, need to broaden search.
Elsevier (ScienceDirect)	("Clinical informatics services" OR "Health informatics consultation") AND ("Acute healthcare settings" OR "Inpatient care") AND ("Implementation" OR "Best practices")	32 articles	A few studies addressed workflow optimization and the integration of electronic health records (EHR) in acute care environments. Some articles focused on informatics solutions enhancing interprofessional collaboration. Still need to broaden search, try adding in about the EHR or health systems”

Database or location name	Search Terms	Results	Notes
Elsevier (ScienceDirect)	("Clinical informatics consultation" OR "Health information systems consultation") AND ("Inpatient informatics consultation" OR "Emergency department informatics") AND ("EHR usability improvement" OR "Health IT workflow redesign" OR "Interoperability in acute care informatics")	45 articles	Addressed workflow optimization, EHR usability enhancements, and the importance of interoperability in acute care environments.
EMBASE	"clinical informatics" AND "acute care" AND ("consultation improvement" OR "consultation strategies")	30 articles	Several studies focused on the integration of clinical decision support systems and their impact on acute care consultations. Possibly not great search criteria, need to broaden.
EMBASE	("Digital health consultation" OR "Telehealth informatics support" OR "Medical informatics intervention") AND ("Acute care decision support" OR "Emergency department health IT" OR "Critical care informatics") AND ("AI-driven	50 articles	Included studies on the effectiveness of AI-driven decision support systems and EHR integration in critical care consultations. Don’t want AI so

Database or location name	Search Terms	Results	Notes
	decision support" OR "Machine learning in healthcare informatics" OR "Real-time data analytics")		need to figure out best exclusion criteria to take those out.
HIMSS	("Clinical informatics consultation" OR "Medical informatics support") AND ("Acute care" OR "Critical care" OR "Emergency department") AND ("Optimization" OR "Implementation" OR "Best practices")	25 articles	Many of the articles focused on technology versus clinical informatics as a role.
HIMSS	("Clinical informatics support" OR "Healthcare informatics services" OR "Health IT consultation") AND ("Emergency medicine informatics" OR "Hospital-based informatics" OR "ICU informatics solutions") AND ("Workflow automation" OR "Optimizing decision support systems" OR "Reducing clinician burden")	25 articles	Emphasized the role of clinical decision support systems (CDSS) and electronic health record (EHR) integration in enhancing patient outcomes and workflow efficiency in acute care settings. Is this relevant to the search or tech focused? Might straddle the line.

Database or location name	Search Terms	Results	Notes
JAMIA	("Clinical informatics consultation" OR "Medical informatics support") AND ("Acute care" OR "Critical care" OR "Emergency department") AND ("Optimization" OR "Implementation" OR "Best practices")	30 articles	Many articles focused on technology, several articles about base line knowledge for informatics. A few great articles that were relevant to the search.
JAMIA	("Clinical informatics consultation" OR "Health information systems consultation") AND ("Inpatient informatics consultation" OR "Emergency department informatics") AND ("EHR usability improvement" OR "Health IT workflow redesign" OR "Interoperability in acute care informatics")	30 articles	Focused on the implementation of informatics solutions to improve clinical workflows, patient safety, and decision-making processes in critical care environments.
MEDLINE	("Clinical informatics consultation" OR "Health information systems consultation") AND ("Inpatient informatics consultation" OR "Emergency department informatics") AND ("EHR usability improvement" OR "Health IT	38 articles	Focused on strategies to improve informatics competencies among healthcare professionals and enhance interoperability in acute care settings.

Database or location name	Search Terms	Results	Notes
	workflow redesign" OR "Interoperability in acute care informatics")		
NIH (National Institutes of Health)	"clinical informatics" AND "acute care" AND ("consultation strategies" OR "consultation improvement")	18 articles	Included studies on the role of informatics in promoting patient-centered care and decision-making in acute settings.
NIH (National Institutes of Health)	("Clinical informatics consultation" OR "Medical informatics support") AND ("Emergency department" OR "ICU") AND ("Optimization" OR "Effectiveness")	22 articles	Great article explored the impact of informatics on patient-centered care and decision-making in acute settings. Findings indicate that real-time data analytics improved consultation efficiency.
NIH (National Institutes of Health)	("Clinical informatics support" OR "Healthcare informatics services" OR "Health IT consultation") AND ("Emergency medicine informatics" OR "Hospital-based informatics" OR "ICU informatics solutions") AND ("Workflow	29 articles	Explored the impact of informatics on patient-centered care and decision-making in acute settings, emphasizing the need for workflow automation.

Database or location name	Search Terms	Results	Notes
	automation" OR "Optimizing decision support systems" OR "Reducing clinician burden")		
PubMed	"clinical informatics consultations" AND "acute care" AND ("strategies" OR "improvement")	25 articles	Several studies focused on the implementation of clinical decision support systems and their impact on acute care settings.
PubMed	("Clinical informatics consultation" OR "Medical informatics support") AND ("Acute care" OR "Critical care" OR "Emergency department") AND ("Optimization" OR "Implementation" OR "Best practices")	35 articles	Many of the articles Focused on integrating clinical decision support systems (CDSS) to enhance decision-making in critical care settings. Several Studies highlighted improved patient outcomes through CDSS implementation. This is the second time this has come up, intersection of clinical decision systems and informaticists?

Database or location name	Search Terms	Results	Notes
PubMed	("Clinical informatics support" OR "Healthcare informatics services" OR "Health IT consultation") AND ("Emergency medicine informatics" OR "Hospital-based informatics" OR "ICU informatics solutions") AND ("Workflow automation" OR "Optimizing decision support systems" OR "Reducing clinician burden")	42 articles	Focused on integrating clinical decision support systems (CDSS) and electronic health records (EHR) to enhance decision-making and reduce clinician workload in acute care settings. More articles, still highly focused in cdss
SpringerLink	"clinical informatics" AND "acute care" AND ("consultation improvement" OR "consultation strategies")	15 articles	Articles included discussions on integrating informatics tools to enhance patient outcomes in acute care.
SpringerLink	("Healthcare technology consultation" OR "Clinical decision support consultation") AND ("Hospital-based care" OR "Intensive care unit") AND ("Enhancement" OR "Effectiveness" OR "Intervention")	28 articles	A few studies discussed the role of informatics tools in improving patient outcomes and care processes in hospital settings. Several studies emphasized electronic health records (EHR)

Database or location name	Search Terms	Results	Notes
			integration for workflow efficiency.
SpringerLink	("Digital health consultation" OR "Telehealth informatics support" OR "Medical informatics intervention") AND ("Acute care decision support" OR "Emergency department health IT" OR "Critical care informatics") AND ("AI-driven decision support" OR "Machine learning in healthcare informatics" OR "Real-time data analytics")	37 articles	Discussed the role of artificial intelligence (AI) and machine learning in improving patient outcomes and care processes in hospital settings. More AI , possibility of intersection of AI and informatics consult?

Appendix C: DHA Appraisal Results Log

Author, date, and title	**Evidence level and quality rating**	**Focus: HSO type, Research Domain, and Specific Problem being addressed**	**Findings that help answer the review question(s)**	**Metrics and Measures if used**	**Source Limitations**
Cho et al. (2024). 'Electronic health record system use and documentation burden of acute and critical care nurse clinicians: A mixed-methods study.'	Level III Quality: High	HSO: Acute and Critical Care Hospital; Research Domain: Informatics; Problem: EHR documentation burden.	Targeted training and workflow optimizations reduce EHR-related stress.	Time spent on documentation, nurse-reported burden, job satisfaction.	Single healthcare system: generalizability limited.
Heponiemi et al. (2021). 'Electronic health record implementations and insufficient training endanger nurses' well-being: Cross-sectional survey study.'	Level III Quality: Good	HSO: General Hospitals; Research Domain: Health IT Implementation; Problem: Lack of adequate EHR training.	Structured, ongoing training programs improve nurse efficiency and well-being.	Nurse well-being, EHR proficiency, training hours.	Self-reported data; cross-sectional study limits causality.
Melnick et al. (2020). 'The association between perceived electronic health record usability and professional burnout among U.S. physicians.'	Level III Quality: High	HSO: Hospital Systems (U.S.); Research Domain: Usability and Burnout; Problem: EHR usability linked to physician burnout.	Improved EHR usability reduces burnout and improves access to consultations.	Burnout rates, EHR usability scores.	Focus on physicians; applicability to other healthcare roles is limited.
Kwan et al. (2024). 'Implementation of an electronic health	Level V Quality: Good	HSO: Academic Health Systems; Research Domain: EHR Communication	Instant messaging systems integrated into EHRs improve	Response time, message volume, clinician satisfaction.	Single academic health system; limited broader applicability.

Author, date, and title	Evidence level and quality rating	Focus: HSO type, Research Domain, and Specific Problem being addressed	Findings that help answer the review question(s)	Metrics and Measures if used	Source Limitations
record-integrated instant messaging system in an academic health system.'		Tools; Problem: Communication inefficiencies in clinical settings.	communication and consultation services.		
Shen et al. (2024). 'Online digital health and informatics education for undergraduate nursing students in China: Impacts and recommendations.'	Level III Quality: Good	HSO: Educational Institutions; Research Domain: Nursing Informatics Education; Problem: Gaps in informatics training for nursing students.	Digital health education enhances nursing students' informatics proficiency, expanding access to consultation services.	Informatics proficiency tests, student-reported confidence levels.	Focuses on nursing students in China; limited global relevance.
Reeves et al. (2020). 'Rapid response to COVID-19: Health informatics support for outbreak management in an academic health system.'	Level V; Quality: High	HSO: Academic Health Systems; Research Domain: Emergency Response; Problem: Informatics support during COVID-19.	Informatics solutions streamline consultative services in crisis management.	Response time, system readiness.	Focus on crisis management; limited applicability to routine operations.
Hathaway & Earle (2024). 'Optimize and thrive: An electronic health record optimization program case study.'	Level III Quality: Good	HSO: Hospitals; Research Domain: EHR Optimization; Problem: Need for continual EHR optimization.	EHR optimization improves system performance and consultative service access.	User satisfaction, system performance, error rates.	Limited Generalizability, Small Sample Size, Subjectivity in Data Collection, No Formal Instrument Validation, No Longitudinal Follow-Up
Kaipio et al. (2020). 'Physicians and nurses experiences	Level III Quality: High	HSO: Hospitals (Public and Private); Research Domain: EHR Usability; Problem:	Improved access to consultative services	Usability scores by profession and sector.	Usability perceptions vary widely by region or system brand.

Author, date, and title	Evidence level and quality rating	Focus: HSO type, Research Domain, and Specific Problem being addressed	Findings that help answer the review question(s)	Metrics and Measures if used	Source Limitations
on EHR usability: Comparison between the professional groups by employment sector and system brand.'		Usability differences across professions and sectors.	helps bridge usability gaps.		
Asif & Khan (2024). 'Role of nurse informaticists in the implementation of Electronic Health Records (EHRs) at resource-limited settings.'	Level V; Quality: Good	HSO: Resource-Limited Hospitals; Research Domain: EHR Implementation; Problem: Resource limitations affecting EHR deployment.	Nurse informaticists enhance EHR implementation and consultative access in resource-limited settings.	EHR adoption rates, nurse informaticist involvement.	Descriptive study; primarily observational findings.
Sittig et al. (2018). 'Current challenges in health information technology "related patient safety.'	Level V Quality: High	HSO: Hospitals; Research Domain: Health IT Safety; Problem: Patient safety concerns related to EHRs.	Better integration of consultative services mitigates EHR-related patient safety risks.	Safety incidents, expert recommendations.	Based on expert opinion, not empirical data.
Abbas et al. (2024). '). The impact of electronic health records on nurse-patient communication.'	Level III ;Quality: Good	HSO: Hospitals; Research Domain: Communication; Problem: EHR impact on nurse-patient communication.	EHR use affects the flow, nature, and quality of nurse-patient communication.	Not specified.	Limited to existing literature; potential publication bias.
Barshay, M., & Richardson, C. R. (2024). 'Friend or Foe? Helping	Level V; Quality: Good	HSO: Hospitals; Research Domain: Health IT Management; Problem:	Emphasizes the need for leadership to view EHRs as integral to patient care and invest accordingly.	Not specified.	Opinion-based; lacks empirical evidence.

Author, date, and title	Evidence level and quality rating	Focus: HSO type, Research Domain, and Specific Problem being addressed	Findings that help answer the review question(s)	Metrics and Measures if used	Source Limitations
Health Care Leadership Reimagine a Healthy EHR Relationship’		Leadership strategies for EHR optimization.			
Campione, J., & Liu, H. (2024). ‘Perceptions of hospital electronic health record (EHR) training, support, and patient safety by staff position and tenure.’	Level III Quality: High	HSO: Hospitals; Research Domain: EHR Training; Problem: Variability in staff perceptions of EHR training and support.	Differences exist in staff perceptions of EHR usability and safety based on position and tenure.	Staff satisfaction scores, perceived usability, and safety metrics.	Self-reported data; cross-sectional design limits causality.
Desai et al. (2020). ‘Clinical informatics subspecialists: Characterizing a novel evolving workforce.’	Level III Quality: Good	HSO: Healthcare Systems; Research Domain: Workforce Development; Problem: Characteristics of clinical informatics subspecialists.	Identifies growth and characteristics of the clinical informatics workforce.	Number of certified specialists, demographic data.	Descriptive analysis; lacks outcome measures.
Stephenson et al. (2024, April 18). ‘The invaluable role of clinical informatics.’	Level V ; Quality: Good	HSO: Healthcare Organizations; Research Domain: Clinical Informatics; Problem: Role of clinical informatics in healthcare improvement.	Highlights the importance of clinical informatics in enhancing patient outcomes and clinician satisfaction.	Not specified.	Based on expert consensus; lacks primary data.
Hsu et al. (2021). ‘Clinical informatics during the COVID-19 pandemic: Lessons learned and	Level V Quality: Good	HSO: Hospitals; Research Domain: Emergency Response; Problem: Application of clinical	Clinical informatics facilitated decision-making, virtual care, and communication during the pandemic.	Response time, system readiness.	Focus on a specific context; may not generalize to non-pandemic situations.

Author, date, and title	**Evidence level and quality rating**	**Focus: HSO type, Research Domain, and Specific Problem being addressed**	**Findings that help answer the review question(s)**	**Metrics and Measures if used**	**Source Limitations**
implications for emergency department and inpatient operations.'		informatics during the COVID-19 pandemic.			
Kaminski, J. (2022). 'Theory applied to informatics – The Prosci ADKAR Model.'	Level V ;Quality: High	HSO: Healthcare Organizations; Research Domain: Change Management; Problem: Applying change management models in informatics.	Discusses the application of the ADKAR model to manage change in health informatics projects.	Not specified.	Theoretical discussion; lacks empirical validation.
Sequeira et al. (2021). 'EHR "SWAT" teams: A physician engagement initiative to improve Electronic Health Record (EHR) experiences and mitigate possible causes of EHR-related burnout'	Level V; Quality: High	HSO: Hospitals; Research Domain: Physician Engagement; Problem: Addressing EHR-related physician burnout.	Implementation of EHR SWAT teams improved physician satisfaction and reduced burnout.	Physician satisfaction scores, burnout rates.	Single institution study; limited generalizability.
Lai et al. (2021). An informatics consult approach for generating clinical evidence for treatment decisions.	Level III ; Quality: Good	HSO: Healthcare Systems; Research Domain: Clinical Informatics and Evidence Generation; Problem: Lack of timely, tailored evidence to support complex treatment decisions.	Informatics Consults can generate real-time, tailored clinical evidence using EHRs and other data to support complex decision-making when RCTs are unavailable.	Hazard ratios for stroke and mortality from trial emulation and meta-analysis; clinician survey on consult usefulness.	Proof-of-concept study; generalizability limited by data source and need for infrastructure to support scalability.

Author, date, and title	Evidence level and quality rating	Focus: HSO type, Research Domain, and Specific Problem being addressed	Findings that help answer the review question(s)	Metrics and Measures if used	Source Limitations
Gombar et al. (2019). The Stanford Informatics Consult Service Handbook.	Level V ; Quality: Good	HSO: Academic Medical Center; Research Domain: Clinical Informatics Implementation; Problem: Lack of structured framework for establishing informatics consult services in healthcare systems.	Provides a step-by-step guide for establishing a clinical informatics consult service, related to technology consultation and CDS including workflows, staffing, data requirements, and integration into clinical practice.	Not applicable (descriptive framework and operational guidance).	Not a peer-reviewed empirical study; based on institutional experience and subject to contextual limitations.
Kiepek & Sengstack (2019). An Evaluation of System End-User Support during Implementation of an Electronic Health Record Using the Model for Improvement Framework	Level V; Quality High	HSO Type: Academic medical center (Vanderbilt University Medical Center). Research Domain: Clinical informatics; EHR implementation support. Specific Problem: Evaluating and optimizing end-user support strategies during the go-live of a vendor-based EHR system to facilitate adoption and mitigate disruptions.	Deployment of internal staff as informatics liaisons familiar with departmental workflows. Use of "zone leaders" to facilitate bi-directional communication and coordinate consultation responses. Centralized command center for real-time issue resolution and triage. Rapid response teams of informatics specialists for high-acuity or high-need areas. Use of satisfaction and effectiveness surveys to allocate consultative resources adaptively.	Daily surveys using a 5-point Likert scale to evaluate: Effectiveness of support personnel Readiness to release support End-user satisfaction Over 4,200 surveys completed in the first 3 weeks. Use of trending metrics to reallocate resources (e.g., support satisfaction rose from 1.9 to 3.55 over two weeks).	Single-organization context; findings may not generalize across settings. No control or comparison group; observational bias possible. External support personnel had varied and sometimes inadequate informatics expertise, highlighting variability in implementation success. Study focuses on implementation period only—long-term access to informatics consultation was not examined.

Appendix D: DHA Thematic Analysis Results

Author(s) and date	Findings with Initial Codes	Code List for Theme Development
Heponiemi et al. (2021)	"Insufficient EHR training was found to impact both efficiency and overall nurse well-being." **Initial Codes:** Insufficient training, reduced efficiency, well-being **Theme**: Training and Education **Subthemes**: Training deficits, Efficiency issues, Nurse well-being	**Training and Education** • Training deficits • Competency improvement • Confidence building • Change Management • ADKAR framework • Training Efficiency Barriers
Shen et al. (2024)	"Informatics education programs improved student competency and confidence in using digital health tools." **Initial Codes**: Informatics education, increased competency and confidence **Theme**: Training and Education **Subthemes**: Informatics education, Competency improvement, Confidence building	**Role of Informatics and Access to Consultation** • Evidence-based consultation • Consultation guidance • Decision-making support • Consultation value • Informatics consultation access **Usability and Workflow Optimization**
Asif & Khan (2024)	"Nurse informaticists played a critical role in EHR implementation, especially in resource-limited settings, enhancing consultative access."	• Targeted EHR optimization • Satisfaction with consultation • Usability gaps • Role-based Tailored Strategies

Author(s) and date	Findings with Initial Codes	Code List for Theme Development
	Initial Codes: Informaticist role, consultative access **Theme**: Role of Informatics and Access to Consultation **Subthemes**: Role of informaticists, Consultative access in limited resources	• Healthier EHR relationship • Mitigation of usability frustration **Support Systems and Accessibility** • Real-time communication • Emergent and Rapid informatics support • Resolution of Service Delivery Friction • Mid-career staff experience • On-demand analytics • Evidence-informed care • Clinical effectiveness
Kiepek & Sengstack (2019)	“The lack of adequate real-time support during the go-live period created frustration and uncertainty among clinical staff.” **Initial Codes:** Lack of real-time support, frustration, uncertainty **Theme:** Implementation Support **Subthemes:** Go-live challenges, Emotional impact on clinicians	
Kaminski (2022)	"ADKAR model applied in informatics training aids in personal change readiness and goal achievement among healthcare workers." **Initial Codes:** ADKAR, change readiness, goal setting **Theme**: Training and Education **Subthemes**: Change management, ADKAR framework	

Author(s) and date	Findings with Initial Codes	Code List for Theme Development
Cho et al. (2023)	"EHR system use and documentation burden significantly impacted clinician time and workflow efficiency." **Initial Codes:** Documentation burden, workflow impact **Theme**: Usability and Workflow Optimization **Subthemes**: Documentation burden, Workflow inefficiency	
Melnick et al. (2020)	"Physicians reported higher burnout associated with low EHR usability scores." **Initial Codes:** Burnout, EHR usability issues **Theme**: Burnout and Support Systems **Subthemes**: Burnout, Usability concerns	
Hathaway & Earle (2024)	"EHR optimization led to better system performance and improved clinician satisfaction with consultative services." **Initial Codes:** EHR optimization, system performance **Theme**: Usability and Workflow Optimization **Subthemes**: EHR optimization, Satisfaction with consultation	

Author(s) and date	Findings with Initial Codes	Code List for Theme Development
Kaipio et al. (2020)	"Nurses and physicians reported varied EHR usability experiences, highlighting usability gaps by role and employment sector." **Initial Codes:** Usability gaps, role differences **Theme**: Usability and Workflow Optimization **Subthemes**: Usability gaps, Role-based challenges	
Barshay & Richardson (2024)	"EHRs need to foster a healthier relationship with healthcare professionals, reducing frustration and enhancing usability." **Initial Codes:** EHR relationship, usability improvement **Theme**: Usability and Workflow Optimization **Subthemes**: Healthier EHR relationship, Frustration reduction	
Sequeira et al. (2021)	"EHR 'SWAT' teams implemented to improve user experience and mitigate EHR-related burnout." **Initial Codes:** EHR support teams, burnout reduction **Theme**: Burnout and Support Systems	

Author(s) and date	Findings with Initial Codes	Code List for Theme Development
	Subthemes: EHR support teams, Burnout reduction	
Kwan et al. (2024)	"Instant messaging integrated into EHR improved real-time communication and streamlined consultative access." **Initial Codes:** Improved communication, consultative access **Theme**: Communication and Patient Interaction **Subthemes**: Real-time communication, Consultative access	
Reeves et al. (2020)	"Rapid deployment of informatics solutions during COVID-19 enabled efficient outbreak management and consultation." **Initial Codes:** Crisis management, rapid consultation access **Theme**: Communication and Patient Interaction **Subthemes**: Crisis informatics, Rapid consultation access	
Sittig et al. (2018)	"Ongoing challenges in health IT safety emphasize the need for improved access to	

Author(s) and date	Findings with Initial Codes	Code List for Theme Development
	informatics consultation to enhance patient safety." **Initial Codes:** Patient safety, informatics consultation access **Theme**: Communication and Patient Interaction **Subthemes**: Patient safety, Informatics consultation access	
Abbas et al. (2024)	"EHR systems impact nurse-patient communication, potentially hindering relational aspects of care." **Initial Codes:** Nurse-patient communication, relational care **Theme**: Communication and Patient Interaction **Subthemes**: Nurse-patient communication, Relational care	
Gombar et al. (2019)	“The Informatics Consult Service provides clinicians with timely, data-driven insights for decision-making.” **Initial Codes:** Timely support, data-driven decisions **Theme:** Clinical Decision Support	

Author(s) and date	Findings with Initial Codes	Code List for Theme Development
	Subthemes: On-demand analytics, Evidence-informed care	
Hsu et al. (2021)	"Informatics support during COVID-19 provided critical consultation access for emergency and inpatient care." **Initial Codes:** Informatics support, emergency consultation **Theme**: Communication and Patient Interaction **Subthemes**: Emergency informatics support, Consultation access	
Lai et al. (2021)	"A consultative informatics approach aids in generating clinical evidence and guiding treatment decisions." **Initial Codes:** Evidence generation, consultative guidance **Theme**: Role of Informatics and Access to Consultation **Subthemes**: Evidence-based consultation, Consultation guidance	
Stephenson et al. (2024)	"Clinical informatics enhances decision-making and provides invaluable consultation access within healthcare systems."	

Author(s) and date	Findings with Initial Codes	Code List for Theme Development
	Initial Codes: Decision support, consultation value **Theme**: Role of Informatics and Access to Consultation **Subthemes**: Decision-making support, Consultation value	
Desai et al. (2020)	"Respondents indicated their work focuses on improving EHR functionality, quality improvement, and clinical decision support." **Initial Codes:** EHR optimization, quality improvement, CDS development **Theme:** Core Practice Domains **Subthemes:** Technical intervention, System enhancement, Clinical effectiveness	
Campione & Liu (2024)	"Technical support satisfaction was lowest among nurses and mid-tenured staff, suggesting uneven distribution or accessibility." **Initial Codes:** Technical support dissatisfaction, role-based support gaps **Theme:** Support Accessibility **Subthemes:** Role inequity, Mid-career staff experience	

Appendix E: Final Concept/Thematic Map