Enhancing Patient-Centered Outcomes: Practical Solutions Hospital Informatics Leaders Use to Enhance Emergency Department Electronic Health Record Systems: A Systematic Review

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Abstract: Some informatics leaders need help managing emergency departments and their electronic health record systems that could affect patient-centered outcomes and the quality of services provided and increase quicker access to information overall. The systematic literature review aimed to research existing practical solutions hospital informatics leaders use to improve emergency department EHR systems to increase quicker access to information, quality of services provided, and patient-centered outcomes. A literature search transpired using three primary databases, the Cumulative Index to Nursing and Allied Health Literature, Public Medline, Medical Literature Analysis and Retrieval System Online, and Web of Science, while closely following the preferred reporting items for Systematics Reviews and Meta-Analysis guidelines. The data from 15 articles were extensively analyzed, categorizing statements related to the research question. Three themes appeared in the literature during the data analysis process. The themes included electronic health records, 80%, emergency departments 60%, and improvements or tools 60%. The findings indicated that electronic health record systems are favorable tools in many healthcare settings, especially emergency departments. The outcomes noted that there is room for improvement and more tools that can be incorporated into the EHR systems and the department. The results demonstrated that many departmental employees rely on emergency department staff to input efficient information and services to help provide patients with the best care if they are transferred to a different department. The implications of these findings offer healthcare leaders and hospital informatics leaders an opportunity to determine ways to improve their departments more efficiently with resources and systems already in place, such as electronic health record systems.

Keywords— *Hospital informatics, EHR systems, and emergency departments.*

1 INTRODUCTION

Electronic health records (EHR) have been an evaluable source that many organizations have incorporated into their systems. Electronic Health Records date back to the 1960s, and they became increasingly adopted when the Health Information Technology for Economic and Clinical Health Act 2009 was established (Dinh-Le et al., 2019; Health IT Legislation/HealthIT.gov, 2023; Rights, n.d.). Over the last several decades, we started increasingly using and adapting EHR systems for meaningful use in organizations (Dinh-Le et al., 2019; Office-based Physician Electronic Health Record Adoption/HealthIT.gov, n.d.). During those 11 years, there was a 39% increase in physicians adopting EHR systems in their workplaces because of how beneficial it became to their organizations (Dinh-Le et al., 2019). Hospital informatics leaders often collaborate to maintain and integrate tools in each EHR system. Electronic health records systems help provide physicians with a wide range of benefits, including accuracy in documentation, the ability to order tests electronically, enhanced care coordination, patient information, and enhanced quality of care (Dinh-Le et al., 2019; Leadership For IT Security & Privacy Across HHS Cybersecurity Program, 2022). Informatics leaders are the ones who are responsible for ensuring effective EHR systems operation, yet there need to be more practical solutions to improve emergency EHR systems (Leaukka et al., 2020).

Research findings show that many organizations adopted EHR systems into their organization by nearly 87%, meaning close to 9/10 adopted EHR systems (Dinh-Le et al., 2019). Especially office-based physicians adopted the EHR systems into their organizations. Choosing the vendor that will best work for the organization is essential. It has been shown that vendors such as Meditech, Epic, and Cerner are prevalent today (Dinh-Le et al., 2019). Various issues, such as emergency departments, can impede the effective operation of a department system. Employee documentation burnout is a significant issue in enhancing department EHR systems, according to Mourkarzel et al., (2019). A lack of proper technology infrastructure and technical issues usually impact emergency EHR systems operations (Moy et al., 2023). Informatic leaders help provide different solutions based on the settings and needs of each department. Therefore, this systematic literature review explores the practical solutions hospital informatics use to improve emergency department EHR systems to increase quicker access to information, quality of services provided, and patient-centered outcomes.

2 METHODS

In Having utilized Google Scholar to narrow the research topic, a collection of articles that had the potential to answer the research question was identified. The research question is summarized as follows: What practical solutions do hospital informatics leaders use to improve emergency department EHR systems to increase quicker access to information, quality of services provided, and patient-centered outcomes? A search of the literature happened using the Cumulative Index to Nursing and Allied Health Literature (CINAHL), Public Medline and Medical Literature Analysis and Retrieval System Online [PubMed (MEDLINE)], and Web of Science databases following the prescribed Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) recommendations (Moher et al., 2009). MEDLINE results were merged with PubMed to yield results from the MEDLINE database. The methodology phase involved the following:

- Searching for relevant studies.
- Utilizing assessment criteria to determine the inclusion and exclusion of studies.
- Retrieving data that aligns with the screening criteria.
- Conducting data synthesis to establish significant themes.

In searching CINAHL, PubMed (MEDLINE), and Web of Science databases, keywords such as *hospital informatics, EHR systems, and emergency departments* were used to narrow further results and yield the best results to review the topic and answer the research question. From these three databases, there was a total of 2,316 articles identified.

Exclusion Criteria

Further review was performed after gathering, collecting, and arranging the 2,316 articles from the databases of CINAHL, PubMed (MEDLINE), and Web of Science. First, filters were applied to eliminate articles outside the desired publication period from 2019-2023, 5 years. Therefore, it brought down the search to 1,030 articles. Secondly, 860 articles were not peer-reviewed, did not have full text, and were not academic journals. The result was a remainder of 170 articles for further review. One hundred and fifty-one articles did not reference emergency department involvement. Nineteen articles remained and were considered for this review (see Figure 1). There was one duplicate, and there were three that were not related to the research and were not accessible at all. Fifteen articles remained and were used for the research.

This study tries to find the practical solutions that hospital informatics leaders use to improve emergency department EHR systems to increase quicker access to information, quality of services provided, and patient-centered outcomes.

Figure 1: Flow Diagram
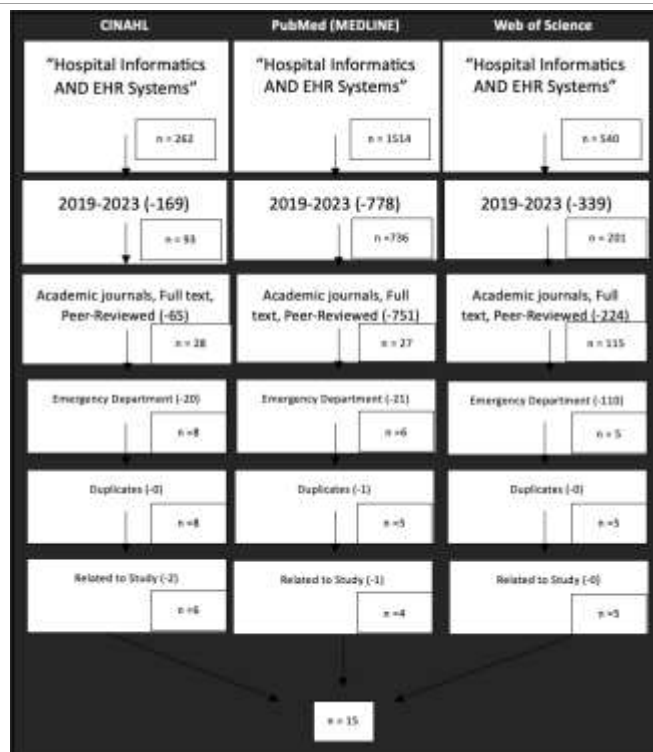
3 RESULTS

The critical research question examined in the systematic literature review was, what practical solutions do hospital informatics use to improve emergency department EHR (Electronic Health Records) systems to increase quicker access to information, quality of services provided, and patient-centered outcome? The research methodology involved an extensive literature search, selection, and data analysis following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021). The review took place and explored three primary databases. The first database used and explored was the Cumulative Index to Nursing and Allied Health Literature (CINAHL), with the results of eight academic and peer-reviewed articles that tied into the research question. The second database explored is Public Medline and Medical Literature Analysis and Retrieval System Online [PubMed (MEDLINE)], which led to acquiring five articles associated with the research question. In addition, the third database utilized in Web of Science led to acquiring five articles associated with the research. Therefore, based on the research, there were 2,316 articles, and only 18 were selected for further analysis related directly to answering the research question.

The further analysis consists of a raters review to analyze the articles further and eliminate the ones that do not land within the research question. All the articles were further analyzed, and three were removed from the literature review process. In addition, themes were developed upon the analysis

of the articles. Therefore, 15 articles were helpful in the research, and each had similar vital findings (Table 1).

Table 1	
Summarises findings of the Literature	
Title	Findings
Identifying and adapting interventions to reduce documentation burden and improve nurses' efficiency in using electronic health record systems (The IDEA Study): protocol for a mixed methods study.	The ability to address the inefficiency and challenges that staff, such as nurses, encounter in EHR systems and improve the efficiency to reduce any EHR-related burden.
User Satisfaction of Using Electronic Medical Record System and Its Associated Factors among Healthcare Professionals in Ethiopia: A Cross-Sectional Study.	Electronic Health Records (EHRs) face challenges in improving efficiency and substituting paper-based medical records in healthcare systems.
Impact of smart pump-electronic health record interoperability on patient safety and finances at a community hospital.	Integration of small pumps in a Hospital in Texas using Electronic Health Records helps reduce medication errors.
Adding continuous vital sign information to static clinical data improves the prediction of length of stay after intubation: a data-driven machine learning approach.	Bedside monitors are used to measure data in actual times and help monitor patients who are critically ill, which is incorporated into EHR systems and seen in Emergency departments as well.
Implementation of an evidence-based electronic health record (EHR) downtime readiness and recovery plan.	Electronic Health Records (EHRs) play a huge role in organizations with patient care, and patient safety can be at risk with the technology incorporated.
Gold standard evaluation of an automatic HAIs surveillance system.	With the help of tools in Electronic Health Records (EHRs), a program of Hospital Acquired Infections (HAIs) has been put in place to measure the effectiveness.
Leveraging remote research associates during a pandemic	During the Covid-19 pandemic, Emergency Departments were trained and gave research associates access to the EHR for clinical research.
System level informatics to improve triage practices for sickle cell disease Vaso-occlusive crisis: a cluster randomized controlled trial.	Quality improvement tools initiatives that are designed for the emergency department to be able to treat crisis individuals with sickle cell disease starting from the triage room upon emergency department arrival.
Illustrating the patient journey through the care continuum: Leveraging structured primary care electronic medical record (EMR) data in Ontario, Canada using chronic obstructive pulmonary disease as a case study	Primary Care Electronic Medical Records (EMR) use and partner with other organizations to create a structured examination of the care continuum, such as in primary care, emergency department visits, and other hospitalizations.
Clinical decision support systems for triage in the emergency department using intelligent systems: a review.	Identifying challenges with triage in emergency departments and improving the quality of care overall in the ED by analyzing how triage contributes to that quality of care.
Designing, conducting, and reporting clinical decision support studies: recommendations and call to action	Clinical decision support (CDS) great took in EHR systems to help make efficient and effective medical decisions based upon other great performances.
Informatics response to address the COVID-19 pandemic in a safety net healthcare system	Informatics respond with the help of health IT to follow up in response to the Covid-19 pandemic in departments such as acute hospitals, trauma centers, ambulatory departments, emergency departments, and more with their EHRS systems.
Systematic review of electronic health records to manage chronic conditions among displaced populations.	The uses of EHR systems to be able to care for individuals with chronic health conditions and determine tools to be incorporated with barriers within EHR systems
Assessing the readiness of digital data infrastructure for opioid use disorder research.	Identifying clinical data elements (CDEs) upon electronic health records to understand the quality of care for opioids used and the epidemiology overall upon departments, with the emergency department being one of them.
Deep learning for temporal data representation in electronic health records: A systematic review of challenges and methodologies.	Understanding the information that EHRs contain and how information is contained for secondary uses such as in chronic disease management and other clinical events predictions.

The key themes that emerged from the articles' data helped to answer the research question. The themes from the literature review were Electronic Health Records (EHRs), Emergency Department, and improvements/tools (Table 2).

Table 1: Frequency of Occurrences in Literature

Themes	Occurrences	Instances of Attributes (n)	Percentage (%)
Electronic Health Records (EHRs)	1,3,5,6,7,8, 10, 11, 12, 13, 14, 15	n= 12	80%
Emergency Departments	4,5,6,7,8,9,10,12,14	n= 9	60%
Improvement/Tools	2,8,9,10,11,12,13,14,15	n= 9	60%

Concerning the discoveries that were made is that 80% of the articles were able to provide evidence on Electronics Health Records (EHRs) [1,3,5,6,7,8,10,11,12,13,14,15]. Also, 60% of articles could offer documentation of the Emergency Departments' findings [4,5,6,7,8,9,10,12,14]. Lastly, 60% of the articles that were selected were able to touch upon improvements or tools that help our research question in any way possible [2,8,9,10,11,12,13,14,15].

4 DISCUSSION

The literature review focused on finding and determining the practical solutions hospital informatics leaders use to improve emergency department EHR systems to increase quicker access to information, quality of services provided, and patient-centered outcomes. Data from 15 relevant articles published between 2019-2023 were analyzed to help answer the research question. Three themes were identified (see Table 2) concerning electronic health records, emergency departments, and improvement/tools.

The primary theme in 80% of the articles showed that electronic health records play a significant role in healthcare and can be a practical solution to enhancing an emergency department [1,3,5,6,7,8,10,11,12,13,14,15]. However, workers often noted that EHR systems are a burden regarding documentation requirements, which takes time away from other clinical care tasks. Therefore, a practical solution to enhancing emergency department EHR systems includes streamlining these systems. Strudwick et al. (2022) mentioned how it is essential to validate that the EHR analytics platform is vital to identify EHR utilization trends and areas for improvement and ideation, which, if done correctly, could lead to actions helping nurses and other clinical staff.

EHR systems can be a practical solution for organizations. For example, continuously updating programs within a system could be a solution to address high-risk issues such as monitoring drug library compliance and other medical concerns (Wei et al., 2021). EHR systems are a practical solution to providing additional services, like protecting information during patient care and helping in triage (Fernandes et al., 2020; Gecomo, 2020; Linton et al., 2021; Yancey & O'Rourke, 2020). EHRs can help users with surveillance, mainly with surveillance of any hospital-acquired infections, which can help in many departments (Villamarin et al., 2019). EHR systems help provide clinical decision support and extract data that can help determine any barriers (Buford et al., 2022; Kawamoto & McDonald, 2020). Electronic health records help clinicians understand specific

areas of study with epidemiology and the quality of care for disorders (Venkatesh et al., 2020).

Electronic health records can be a practical solution to many tasks that clinicians and administrators want to achieve but can be more beneficial if individuals are trained and can remotely help when issues arise (Cronin et al., 2020; Sadasivaiah et al., 2021). However, consideration should be taken because there are challenges with data irregularity, data sparsity, and more when working with EHR systems (Xie et al., 2022).

The second theme is shown in 60% of the articles concerned emergency departments which applied to the research [4,5,6,7,8,9,10,12,14]. An emergency department is a vital tool that is a practical solution because many individuals are admitted through the department before they make their way to the correct department after diagnosis. Individuals who come to the emergency room often end up in other departments, such as the intensive care unit; their visit can be tracked back to early assessment on admission from emergency departments through the system (Castiñeira et al., 2020; Gecomom, 2020; Rayner et al., 2020). Emergency departments provide such information as the basis of the correct documentation to other departments if transferred, which is essential for all administrative data to be updated correctly (Villamarin et al., 2019). In addition, emergency departments are a primary asset to many departments which is essential for feedback from other departments because their ways to improve departments should always be considered (Villamarin et al., 2019; Venkatesh et al., 2020). According to Cronin et al. (2020), it is vital to have volunteers, such as research associates or interns, to have experience and help organizations find improvement areas as another practical solution. Indeed, it is essential always to have an index such as the emergency severity index for individuals with diseases and other precautions that can help the emergency department (Linton et al., 2021). This helps in being able for emergency departments to keep up with anything that needs improvements because the department can be the foundation for many others. In emergency departments, it is essential to identify any hampering that is going on in the department's system because triage systems can be affected, which can cause conflicts in the quality of care provided if patients are transferred to other departments (Fernandes et al., 2019). Information technology representatives are expected to be on top of the building workflows for appointment scheduling, treatment, documentation, billing, and more in emergency departments because they stabilize teams in the emergency department (Sadasivaiah et al., 2021). Therefore, emergency departments having this foundation helps informatics leaders come out with solutions to any issues in EHR systems or the department overall to improve quicker access to information, quality of services, and patient-centered outcomes.

The third theme focused on improvements or tools in the healthcare field, such as emergency departments and EHR systems. Sixty percent of the articles discussed improvement or tools that can be a practical solution for emergency departments and other departments [2,8,9,10,11,12,13,14,15]. Many of the improvements incorporated are learning the departments' cultural orientation before including improvements (Dubale et al., 2023). In addition, it is essential to have a support tool in place, such as an index for clinical decisions, such as triage rooms in emergency departments (Fernandes et al., 2019; Linton et al., 2021). It is critical to partner with other departments to improve and incorporate tools that other departments have incorporated to better any flaws, according to Rayner et al. (2020). It is essential to apply computer-based clinical decision support in EHR systems because it can help emergency departments improve quality, according to Kawamoto & McDonald (2020). Health informatics leaders do their best to provide solutions through the EHR system to stabilize EHR tools and workflows to ensure it can ease many staff worries, according to Sadasivaiah et al. (2021); Buford et al. (2022). It is essential to have or create a standard workflow process that can improve many settings in the hospital setting, which can be a great tool, according to Venkatesh et al. (2020). A significant tool is the EHR system, which is essential to keep up with it and improve the overall processing and data collection (Xie et al., 2021). In addition, it can update the systems and incorporate tools that can be used with the system and be efficient as possible (Xie et al., 2021).

The review had certain limitations. The study took place over 12 weeks, possibly limiting the type and amount of information collected for analysis in the review. A limitation of the study is the subjective nature of the article reviewer, which may have misinterpreted or incorrectly described data within each article. Keywords were used to help guide the search process; however, information could have been overlooked when specific keywords were used to search CINAHL, PubMed (W/ MEDLINE), and Web of Science.

The study adhered to the PRISMA-based systematic review guidelines (Page et al., 2021) to help mitigate the limitations. Numerous articles were collected, and filters were applied from the PubMed and MEDLINE databases until information to advance the research did not exist. Each of the remaining 15 articles was extensively reviewed, and decided whether it could inform the research question. Even though this study has limitations, it is evident from the findings that practical solutions exist that hospital informatics leaders could use to enhance emergency department EHR systems in increasing timely access to information, improving the quality of services provided, and patient-centered outcomes.

Researchers can use these results of the systematic literature review as a basis for future researchers conducting a different type of study, using a more in-depth research method or design incorporating data collection processes utilizing qualitative interviews of participants and quantitative surveys to help further shed light on the research question. Healthcare leaders can use these findings to develop practical solutions hospital informatics leaders use to improve emergency department EHR systems. The findings indicated that hospital informatics leaders could increase quicker access

to information, affecting the quality of services and patient-centered outcomes. Future scholars may narrow the scope of the study to delve deeper into particular aspects of improving emergency department EHR systems.

5 CONCLUSION

There are practical solutions that exist in hospital settings that are a huge help, and other tools are used to build past one to make the quality of care at its best and help staff navigate decisions in the best way possible. The systematic literature review explored practical solutions hospital informatics leaders use to improve emergency department electronic health records systems to increase quicker access to information, quality of services provided, and patient-centered outcomes. The review yielded three themes: electronic health records (EHRs), emergency departments, and improvements or tools. The study identified that electronic health records (EHRs) help hospital employees in being able to function more efficiently. In addition, the results indicated that many patients begin receiving healthcare services in emergency departments. It is essential to have everything documented and be able to incorporate any improvements that can be done to help staff and provide the best care to patients throughout the system. The outcomes noted that there is room for improvement and more tools that can be incorporated into the EHR systems and the department. The results demonstrated that many departmental employees rely on emergency department staff to input efficient information and services to help provide patients with the best care if they are transferred to a different department. The findings offer healthcare leaders and hospital informatics leaders an opportunity to determine ways to improve their departments more efficiently with resources and systems already in place, such as electronic health record systems.

6 REFERENCES

[1] Buford, A., Ashworth, H. C., Ezzeddine, F. L., Dada, S., Nguyen, E., Ebrahim, S., ... & Alahdab, F. (2022). Systematic review of electronic health records to manage chronic conditions among displaced populations. *BMJ open*, *12*(9), e056987.

[2] Castiñeira, D., Schlosser, K. R., Geva, A., Rahmani, A. R., Fiore, G., Walsh, B. K., ... & Santillana, M. (2020). Adding continuous vital sign information to static clinical data improves the prediction of length of stay after intubation: a data-driven machine learning approach. *Respiratory care*, *65*(9), 1367-1377.

[3] Cronin, A. O., Carlile, M. A., Dameff, C. J., Coyne, C. J., & Castillo, E. M. (2020). Leveraging remote research associates during a pandemic. *Western Journal of Emergency Medicine, 21(5), 1114.*

[4] Dubale, A. T., Mengestie, N. D., Tilahun, B., & Walle, A. D. (2023). User Satisfaction of Using Electronic Medical Record System and Its Associated Factors among Healthcare Professionals in Ethiopia: A Cross-Sectional Study. *BioMed Research International*, *2023*.

[5] Fernandes, M., Vieira, S. M., Leite, F., Palos, C., Finkelstein, S., & Sousa, J. M. (2020). Clinical decision support systems for triage in the emergency department using intelligent systems: a review. *Artificial Intelligence in Medicine*, *102*, 101762.

[6] Gecomo, J. (2020). Implementation of an evidence-based electronic health record (EHR) downtime readiness and recovery plan. *On-Line Journal of Nursing Informatics*, *24*(1).

[7] Health IT Legislation-HealthIT.gov. (n.d.). https://www.healthit.gov/topic/laws-regulation-and-policy/health-it-legislation

[8] International Journal of Surgery (OPEN ACCESS) Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. International Journal of Surgery 2021;88:105906. doi: 10.1016/j.ijsu.2021.105906

[9] Kawamoto, K., & McDonald, C. J. (2020). Designing, conducting, and reporting clinical decision support studies: recommendations and call to action. *Annals of internal medicine*, *172*(11_Supplement), S101-S109.

[10] Linton, E., Souffront, K., Gordon, L., Loo, G. T., Genes, N., & Glassberg, J. (2021). System level informatics to improve triage practices for sickle cell disease vaso-occlusive crisis: a cluster randomized controlled trial. *Journal of emergency nursing*, *47*(5), 742-751.

[11] *National Trends in Hospital and Physician Adoption of Electronic Health Records / HealthIT.gov*. (n.d.). https://www.healthit.gov/data/quickstats/national-trends-hospital-and-physician-adoption-electronic-health-records

[12] *Office-based Physician Electronic Health Record Adoption / HealthIT.gov*. (n.d.). https://www.healthit.gov/data/quickstats/office-based-physician-electronic-health-record-adoption

[13] Rayner, J., Khan, T., Chan, C., & Wu, C. (2020). Illustrating the patient journey through the care continuum: Leveraging structured primary care electronic medical record (EMR) data in Ontario, Canada using chronic obstructive pulmonary disease as a case study. *International Journal of Medical Informatics*, *140*, 104159.

[14] Rights, O. F. C. (2021). HITECH Act Enforcement Interim Final Rule. HHS.gov. https://www.hhs.gov/hipaa/for-professionals/special-topics/hitech-act-enforcement-interim-final-rule/index.html

[15] Sadasivaiah, S., Shaffer, E., Enanoria, W., Su, G., Goldman, S., Scarafia, J., ... & Ratanawongsa, N. (2021). Informatics response to address the COVID-19 pandemic in a safety net healthcare system. *JAMIA open*, *4*(3), ooaa057.

[16] Strudwick, G., Jeffs, L., Kemp, J., Sequeira, L., Lo, B., Shen, N., ... & Jankowicz, D. (2022). Identifying and adapting interventions to reduce documentation burden and improve nurses' efficiency in using electronic health record systems (The IDEA Study): protocol for a mixed methods study. *BMC nursing*, *21*(1), 1-8.

[17] U.S. Department of Health and Human Services [Leadership For IT Security & Privacy Across HHS Cybersecurity Program]. (2022.). Electronic Medical Records in Healthcare. In *https://www.hhs.gov/sites/default/files/2022-02-17-1300-emr-in-healthcare-tlpwhite.pdf*. Office of Information Security, United States of America. https://www.hhs.gov/sites/default/files/2022-02-17-1300-emr-in-healthcare-tlpwhite.pdf

[18] Venkatesh, A., Malicki, C., Hawk, K., D'Onofrio, G., Kinsman, J., & Taylor, A. (2020). Assessing the readiness of digital data infrastructure for opioid use disorder research. *Addiction Science & Clinical Practice*, *15*(1), 1-7.

[19] Villamarín Bello, B., Uriel Latorre, B., Fernández Riverola, F., Sande Meijide, M., & González Peña, D. (2019). Gold standard evaluation of an automatic HAIs surveillance system. *BioMed research international.*

[20] Wei, W., Coffey, W., Adeola, M., & Abbasi, G. (2021). Impact of smart pump-electronic health record interoperability on patient safety and finances at a community hospital. *American Journal of Health-System Pharmacy*, *78*(Supplement_4), S105-S110.

[21] Xie, F., Yuan, H., Ning, Y., Ong, M. E. H., Feng, M., Hsu, W., ... & Liu, N. (2022). Deep learning for temporal data representation in electronic health records: A systematic review of challenges and methodologies. *Journal of biomedical informatics*, *126*, 103980.