How to Cite:
Alonayzan, H. H. M., Alenezi, Talal S. S., Alshammari, Khalaf S. F., Albakr, Mohammed S. B., Alshammari, Sanad H. S., Alghadeer, Saleh O. A., ... Alanzi, A. S. B. (2023). The role of medical records in clinical decision-making: Review. *Tennessee Research International of Social Sciences*, *5*(2), 10–18. Retrieved from https://triss.org/index.php/journal/article/view/44

The role of medical records in clinical decision-making: Review

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Tennessee research international of social sciences © 2023.
ISSN: 2766-7464 (Online)
Publisher: Smoky Mountain Publishing
Manuscript submitted: 09 Sept 2023, Manuscript revised: 18 Oct 2023, Accepted for publication: 27 Nov 2023

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***Abstract*---**Background: Clinical decision support (CDS) is a crucial component of electronic medical record (EMR) and provider order entry (CPOE) systems in hospitals. However, research shows conflicting findings due to factors like alert fatigue, design, and usability issues. Drug safety alerts are disregarded in 49%-96% of cases, and irrelevant alerts hinder acceptance. Enhancing alerts is needed to improve efficacy and acceptability while mitigating fatigue issues. Aim of Work: The objective is to analyze and condense the existing internal governance procedures used by hospitals, as documented in literature, for the purpose of choosing, enhancing, and assessing clinical decision support (CDS) alerts, with the aim of identifying successful strategies. Methods: A comprehensive search was conducted across many databases including Medline, Embase, CINAHL, Scopus, Web of Science, IEEE Xplore Digital Library, CADTH, and WorldCat. All English-language papers that documented governance methods for the selection and/or optimization of CDS alerts in hospitals were considered. Results: The review included a total of eight manuscripts. Seven publications particularly addressed medication-related clinical decision support (CDS) alerts. All studies detailed the use of a multidisciplinary committee to enhance the effectiveness of warnings. Additional tactics included the use of physician feedback, alert data, literature and pharmacological references, and a visual dashboard. Out of the 8 articles, 6 conducted assessments of their clinical decision support (CDS) alert changes after implementing optimization methodologies. Among them, 5 publications saw a decrease in the rate of alerts. Conclusion: Hospitals often reported using a multidisciplinary committee, often in conjunction with other methods, as the primary way to enhance the effectiveness of their clinical decision support (CDS) alerts. Given the scarcity of documented methods, inconsistency in system improvements, and lack of assessment data, we were unable to directly evaluate the performance of various techniques. However, it seems that using numerous strategies is a successful way for minimizing the frequency of CDS alerts. Hospitals should provide detailed descriptions and assessments of their governance procedures

in order to identify viable solutions for optimizing clinical decision support (CDS) alerts.

***Keywords*---**Decision Support Systems, Clinical Governance, Alert Fatigue, Clinical Information Systems, Electronic Medical Records.

Introduction

Computerized alerts, known as clinical decision support (CDS), have become a crucial part of electronic medical record (EMR) and computerized provider order entry (CPOE) systems in hospitals. [1,2]. Clinicians are alerted to possible inaccuracies in orders or provided with information to aid in decision-making. Most CDS notifications are intrusive and need the user's acknowledgment before continuing their tasks.[3-7] Research assessing the efficacy of CDS alerts has shown conflicting findings, with factors such as alert fatigue, alert design, and usability problems leading to low user acceptance and use of alerts.[8-10]

A review referenced by 47 papers examining alert overrides in hospitals discovered that drug safety alerts were disregarded in 49%–96% of instances. Additionally, a systematic review published in 2019 identified the primary obstacle to alert acceptance, as reported by prescribers, to be the abundance of irrelevant alerts that are presented.[10] As the number of notifications grows and the importance of alerts falls, clinicians are more inclined to disregard or overrule them.[9-11] The literature reports substantial override rates, indicating the need for enhanced alerts to enhance their efficacy and acceptability while mitigating issues related to alert fatigue.

Clinical Decision Support (CDS) Alerts

Creating clinical decision support (CDS) alerts for integration into a hospital electronic medical record (EMR) and computerized physician order entry (CPOE) system is a complex undertaking. It involves the interpretation, translation, and agreement on the content and specific types of alerts needed. [12-14]. The life cycle of a Clinical Decision Support (CDS) system may vary based on the specific system and the institution in which it is implemented. An example given by Yoshida et al15 starts with individuals or leadership groups submitting a request to include new Clinical Decision Support (CDS) systems. This proposal is then evaluated by a CDS committee. The committee prioritizes requests, and the CDS is created using tools provided by the EMR provider. Subsequently, the CDS undergoes testing, implementation, and monitoring by the observation and tracking of firing patterns. Ultimately, the CDS is assessed, which may lead to modifications or its elimination from the system.[15]

Following the adoption of CDS, rules, regulations, and evidence undergo ongoing evaluation. Periodic checking and refinement of CDS warnings is necessary due to changing rules, new evidence, and updated recommendations.[12] Continuous monitoring of CDS alerts after deployment and rigorous testing enable the detection of problems and chances for improvement. These activities are crucial for ensuring the reliability and effectiveness of CDS warnings. [12, 14, 15]. The

organizational structure of hospitals is complex and varies according on the nation and kind of institution, making governance challenging to quantify and comprehend. Nevertheless, a study of crucial elements of effective transformational change for health information technology concluded that a well-defined, uniform, and enduring governance structure is essential for successful change, and continuous monitoring and assessment of the established procedures is necessary.[16] Several articles have suggested governance methods for CDS [17,18], but there is a lack of specific advice on how to implement these processes, especially when it comes to handling warnings. Hospitals have reported many methods to improve and enhance warnings after their deployment. To reduce the number of unnecessary notifications, many tactics have been used, such as enhancing the specificity and sensitivity of alerts, customizing alerts for individual users, and only displaying severe alerts to users.[19].

Aim of Work

Nevertheless, the manner in which businesses use these tactics and choose which alarms should be included into an EMR remains unclear. This systematic study aims to evaluate the existing internal governance mechanisms used in hospitals for choosing, optimizing, and assessing CDS alerts. The goal is to discover successful techniques. This information is valuable for hospitals in the process of choosing CDS alerts to adopt, as well as for hospitals that have already implemented CDS alerts and are now analyzing the efficacy and acceptability of these warnings.

CDS Studies

This research conducted a comprehensive analysis of the available literature in order to get insight into the strategies used by hospitals to choose and improve their clinical decision support (CDS) alerts. We have only found a limited number of publications, which is probably due to the lack of description or reporting of internal processes in the literature. The bulk of the publications included in the study was from the United States and mostly focused on medication-related clinical decision support (CDS) warnings.[20-28] All publications discussed the presence of multidisciplinary panels, with physicians and pharmacists being the most often participating in the process of alert optimization. The most common modifications made to alerts were decreasing the quantity, reclassifying the degree of severity, and redesigning the interface of the alert system. Out of the six articles, five indicated a decrease in alert rate after using their optimization strategy [20-27].

Except for one study, all the reports focused on the techniques used to optimize medicine warnings, with the bulk of them specifically addressing drug-drug interaction (DDI) alerts.[28] This might be attributed to the fact that drug alerts are a fundamental aspect of several CPOE/EMR systems [29] and, thus, play a significant role in causing alert fatigue. The research also indicates that drug-drug interaction (DDI) notifications are often disregarded, with reported override rates as high as 95%.[30-32]. The high override rates seen are often attributed to a lack of relevance and specificity. [10, 32, 33]. Therefore, it is unsurprising those hospitals that used alert optimization methodologies aimed to increase the

relevance of signals to the local environment. To lower the overall number of warnings and alleviate alert fatigue, it is possible to restrict the notifications that are activated depending on local context and individual users.

All hospitals included in this analysis implemented multidisciplinary committees that included end users, such as physicians and pharmacists. It is widely accepted that including end users in the selection of CDS alerts is advantageous, since the adoption of CDS is closely tied to user participation in CDS development and implementation. [10,34-36] For instance, a qualitative research examining the adoption of Clinical Decision Support (CDS) systems found that including doctors in the process of selecting alerts confirmed the credibility of the CDS in the eyes of the users, since they were involved in generating the evidence.[35] A research involving focus groups of physicians also discovered that the use of Clinical Decision Support (CDS) was enhanced when the CDS system had a dependable knowledge base and when respected colleagues were engaged in its creation.[36]. It is worth mentioning that out of all the studies included in this review, only one study explicitly mentioned includes a junior doctor on their alert-optimization committee. This is noteworthy since previous research has shown that in certain hospital settings, junior physicians (those who have completed 1-3 years of postprimary training) are the main users of CPOE systems. [37-39]. Specifically, research conducted in Australia and the United Kingdom has shown that the bulk of prescriptions are inputted into computerized physician order entry (CPOE) systems by young physicians. [37,38]. While this may not apply universally across all nations and situations, it does emphasize the possible lack of consultation with relevant end users when improving CDS alerts.[40].

As the use of health information technology continues to rise, more and more healthcare professionals, such as doctors, pharmacists, and nurses, are taking on informatics roles. This includes tasks like designing, analyzing, implementing, and evaluating information systems to enhance patient care, improve health outcomes, and strengthen the relationship between clinicians and patients.[41,42] Health professional informaticians play a crucial role in the success of CDS knowledge management. However, our review found that only half of the papers reported utilizing informatics experts in the alert optimization process. This indicates that health professionals with informatics experience are not being fully utilized in the management and governance of CDS. The cause of this uncertainty is not known, but it may be because there is a shortage of professionals who have the necessary competence. Therefore, we suggest that future research should concentrate on identifying and addressing the obstacles that prevent clinical informaticians from participating in governance procedures.

In addition, our analysis emphasized that visual dashboards are a cutting-edge method for monitoring CDS warnings.[22,27] The digitalization of health information has resulted in a growing abundance of data, especially warning data, which might cause an overwhelming amount of information.[43] The emergence of visual analytics has facilitated the real-time visualization and comprehension of vast amounts of information, including alert override rates, by a diverse set of users.[43,44] Clinical Decision Support (CDS) systems, including as chart reviews, observations, user input, and statistical modeling, usually require a significant amount of effort.[45] Utilizing a dashboard enables efficient filtering

and continuous examination of CDS alarm information, even with limited resources. The papers in this evaluation indicated that the use of dashboards facilitated the prompt identification of warning kinds to be focused on for optimization by hospital CDS committees.[22,27].

Limitations of the Study

Constraints of this study include the limited quantity of research incorporated, with the majority of publications being descriptive case reports. Therefore, it was not possible to carry out a quality evaluation of the articles. Additionally, this study only summarized tactics that have been published and may be influenced by publication bias. Hence, the internal governance mechanisms highlighted in this analysis may not necessarily reflect the methods used by all hospitals. The system adjustments implemented varied depending on the specific circumstances of the institutions being reviewed. Regrettably, this resulted in our inability to evaluate governance systems in order to determine which one was the most efficient in optimizing alerts. Based on the information presented in the studies, it is unclear if the tactics described were continuous processes or isolated instances of alert optimization.

In addition, several articles documented the procedure for modifying CDS alerts, but did not assess the actions that were implemented as a consequence of the refining process.[24,28]. Without assessment, it is difficult to determine whether the modifications yielded the intended outcome or led to unforeseen repercussions. For instance, Bhakta et al [21] discovered that their system adjustments led to a reduction in drug-drug interaction (DDI) warnings, but an increase in alerts for repeat treatment. Therefore, it is crucial to closely observe the effects of system modifications in order to ensure that anticipated advantages are realized and unforeseen drawbacks are recognized and resolved.

Conclusion

This research provides a concise overview of the existing governance practices that hospitals have reported in order to maximize clinical decision support (CDS) alerts. The most often reported approach was the use of multidisciplinary committees, sometimes in conjunction with other tactics such as examining literature and medication references. The CDS governance committees consisted of a diverse group of healthcare experts, with 50% of the papers explicitly stating the participation of an informatician. The use of visual dashboards was a groundbreaking method of streamlining intricate data for the purpose of monitoring CDS alert rates and their effects. Due to the inconsistencies in system modifications and the limited access to assessment outcomes, it was not possible to compare the efficacy of various solutions. Our study has provided an overview of the current situation as documented in the literature. However, we suggest that hospitals should document and report both successful and unsuccessful governance processes. This will allow for the identification of effective approaches or combinations of strategies to optimize the use of CDS alerts in hospitals.

References

1. Pedersen CA, Schneider PJ, Scheckelhoff DJ.. ASHP national survey of pharmacy practice in hospital settings: prescribing and transcribing—2016. Am J Health Syst Pharm 2017; 74 (17): 1336–52.
2. Sutton RT, Pincock D, Baumgart DC, et al. An overview of clinical decision support systems: benefits, risks, and strategies for success. NPJ Digit Med 2020; 3 (1): 17.
3. Marcilly R, Ammenwerth E, Vasseur F, et al. Usability flaws of medication-related alerting functions: a systematic qualitative review. J Biomed Inform 2015; 55: 260–71.
4. Makam AN, Nguyen OK, Auerbach AD.. Diagnostic accuracy and effectiveness of automated electronic sepsis alert systems: a systematic review. J Hosp Med 2015; 10 (6): 396–402. [PMC free article] [PubMed]
5. Page N, Baysari MT, Westbrook JI.. A systematic review of the effectiveness of interruptive medication prescribing alerts in hospital CPOE systems to change prescriber behavior and improve patient safety. Int J Med Inform 2017; 105: 22–30.
6. Bright TJ, Wong A, Dhurjati R, et al. Effect of clinical decision-support systems: a systematic review. Ann Intern Med 2012; 157 (1): 29–43.
7. Jaspers MWM, Smeulers M, Vermeulen H, et al. Effects of clinical decision-support systems on practitioner performance and patient outcomes: a synthesis of high-quality systematic review findings. J Am Med Inform Assoc 2011; 18 (3): 327–34.
8. Phansalkar S, Edworthy J, Hellier E, et al. A review of human factors principles for the design and implementation of medication safety alerts in clinical information systems. J Am Med Inform Assoc 2010; 17 (5): 493–501.
9. van der Sijs H, Aarts J, Vulto A, et al. Overriding of drug safety alerts in computerized physician order entry. J Am Med Inform Assoc 2006; 13 (2): 138–47.
10. Van Dort BA, Zheng WY, Baysari MT.. Prescriber perceptions of medication-related computerized decision support systems in hospitals: a synthesis of qualitative research. Int J Med Inform 2019; 129: 285–95.
11. Ancker JS, Edwards A, Nosal S, et al. Effects of workload, work complexity, and repeated alerts on alert fatigue in a clinical decision support system. BMC Med Inform Decis Mak 2017; 17 (1): 36.
12. Wright A, Ai A, Ash J, et al. Clinical decision support alert malfunctions: analysis and empirically derived taxonomy. J Am Med Inform Assoc 2018; 25 (5): 496–506.
13. Boxwala AA, Tu S, Peleg M, et al. Toward a representation format for sharable clinical guidelines. J Biomed Inform 2001; 34 (3): 157–69.
14. Sittig DF, Wright A, Osheroff JA, et al. Grand challenges in clinical decision support. J Biomed Inform 2008; 41 (2): 387–92.
15. Yoshida E, Fei S, Bavuso K, et al. The value of monitoring clinical decision support interventions. Appl Clin Inform 2018; 09 (01): 163–73.
16. Sligo J, Roberts V, Gauld R, et al. A checklist for healthcare organisations undergoing transformational change associated with large-scale health information systems implementation. Health Policy Technol 2019; 8 (3): 237–47.

17. Ash JS, Sittig DF, Guappone KP, et al. Recommended practices for computerized clinical decision support and knowledge management in community settings: a qualitative study. BMC Med Inform Decis Mak 2012; 12 (1): 6.
18. Khalifa M, Alswailem O.. Clinical decision support knowledge management: strategies for success. ICIMTH 2015; 213: 67–70.
19. Tolley CL, Slight SP, Husband AK, et al. Improving medication-related clinical decision support. Bull Am Soc Hosp Pharm 2018; 75 (4): 239–46.
20. Moher D, Liberati A, Tetzlaff J, The PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med 2009; 6 (7): e1000097.
21. Bhakta SB, Colavecchia AC, Haines L, et al. A systematic approach to optimize electronic health record medication alerts in a health system. Am J Health Syst Pharm 2019; 76 (8): 530–36.
22. Chaparro JD, Hussain C, Lee JA, et al. Reducing interruptive alert burden using quality improvement methodology. Appl Clin Inform 2020; 11 (01): 46–58.
23. Liberati EG, Ruggiero F, Galuppo L, et al. What hinders the uptake of computerized decision support systems in hospitals? A qualitative study and framework for implementation. Implement Sci 2017; 12 (1): 113.
24. Hatton RC, Rosenberg AF, Morris CT, et al. Evaluation of contraindicated drug-drug interaction alerts in a hospital setting. Ann Pharmacother 2011; 45 (3): 297–308.
25. Helmons PJ, Suijkerbuijk BO, Nannan Panday PV, et al. Drug-drug interaction checking assisted by clinical decision support: a return on investment analysis. J Am Med Inform Assoc 2015; 22 (4): 764–72.
26. Parke C, Santiago E, Zussy B, et al. Reduction of clinical support warnings through recategorization of severity levels. Am J Health Syst Pharm 2015; 72 (2): 144–8.
27. Simpao AF, Ahumada LM, Desai BR, et al. Optimization of drug-drug interaction alert rules in a pediatric hospital's electronic health record system using a visual analytics dashboard. J Am Med Inform Assoc 2015; 22 (2): 361–9.
28. Zenziper Y, Kurnik D, Markovits N, et al. Implementation of a clinical decision support system for computerized drug prescription entries in a large tertiary care hospital. Isr Med Assoc J 2014; 16 (5): 289–94.
29. Jha AK, DesRoches CM, Campbell EG, et al. Use of electronic health records in US hospitals. N Engl J Med 2009; 360 (16): 1628–38.
30. Phansalkar S, van der Sijs H, Tucker AD, et al. Drug–drug interactions that should be non-interruptive in order to reduce alert fatigue in electronic health records. J Am Med Inform Assoc 2013; 20 (3): 489–93.
31. Cash JJ. Alert fatigue. Am J Health Syst Pharm 2009; 66 (23): 2098–101.
32. Poly TN, Islam MM, Yang H-C, et al. Appropriateness of overridden alerts in computerized physician order entry: systematic review. JMIR Med Inform 2020; 8 (7): e15653.
33. Smithburger PL, Buckley MS, Bejian S, et al. A critical evaluation of clinical decision support for the detection of drug–drug interactions. Expert Opin Drug Saf 2011; 10 (6): 871–82.

34. Baysari MT, Zheng WY, Van Dort B, et al. A late attempt to involve end users in the design of medication-related alerts: survey study. J Med Internet Res 2020; 22 (3): e14855.
35. Liberati EG, Ruggiero F, Galuppo L, et al. What hinders the uptake of computerized decision support systems in hospitals? A qualitative study and framework for implementation. Implementation Sci 2017; 12 (1): 113.
36. Varonen H, Kortteisto T, Kaila M.. What may help or hinder the implementation of computerized decision support systems (CDSSs): a focus group study with physicians. Fam Pract 2008; 25 (3): 162–7.
37. Baysari MT, Reckmann MH, Li L, et al. Failure to utilize functions of an electronic prescribing system and the subsequent generation of 'technically preventable' computerized alerts. J Am Med Inform Assoc 2012; 19 (6): 1003–10.
38. Baysari MT, Westbrook JI, Richardson KL, et al. Optimising computerised alerts within electronic medication management systems: a synthesis of four years of research. Stud Health Technol Inform 2014; 204: 1–6.
39. Cullinan S, Hansen CR, Byrne S, et al. Challenges of deprescribing in the multimorbid patient. Eur J Hosp Pharm 2017; 24 (1): 43–6.
40. Baysari MT. DANGER: this alert might be dangerous. In: The Human Factors of Alert Design. Pharmacy GRIT. Collingwood, VIC, Australia: The Society of Hospital Pharmacists of Australia; 2020.
41. Davies A, Mueller J, Moulton G.. Core competencies for clinical informaticians: a systematic review. Int J Med Inform 2020; 141: 104237.
42. Gardner RM, Overhage JM, Steen EB, et al.; for the AMIA Board of Directors. Core content for the subspecialty of clinical informatics. J Am Med Inform Assoc 2009; 16 (2): 153–7.
43. Caban JJ, Gotz D.. Visual analytics in healthcare–opportunities and research challenges. J Am Med Inform Assoc 2015; 22 (2): 260–2.
44. Stadler JG, Donlon K, Siewert JD, et al. Improving the efficiency and ease of healthcare analysis through use of data visualization dashboards. Big Data 2016; 4 (2): 129–35.
45. McCoy AB, Thomas EJ, Krousel-Wood M, et al. Clinical decision support alert appropriateness: a review and proposal for improvement. Ochsner J 2014; 14 (2): 195–202.