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Providers' Perception of Alert Fatigue After Implementation of User-Filtered Warnings

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Abstract

Alert fatigue is a complex problem that many health institutions face when using an electronic health record (EHR). The addition of user-filtered warnings (UFW) is a physicians' proposed intervention at Inova Health System (IHS), a large 5-hospital health system in Northern Virginia, that allows prescribers to filter out specific drug-drug interactions and pregnancy and lactation medication alerts for a 30-day period. This study aims to determine the impact of UFW on physicians' perception of alert fatigue and to calculate the reduction of medication alerts. It was hypothesized that the reduction in alerts will significantly impact physicians' perception of alert fatigue in a positive manner. Physician perception of alert fatigue was assessed using online surveys before and after the implementation of UFW. Data from Medications Warnings Statistics reports were used to assess the reduction of alerts fired post-implementation of UFW. For the primary outcome, there was no significant difference in the overall perception of alert fatigue before and after the implementation of UFW. For the secondary outcome, the number of medication alerts was decreased by 16.7% post UFW implementation. Overall, the data does not support UFW to reduce alert fatigue.

Introduction

Electronic Health Records (EHR) allow for the reduction of adverse events by generating medication alerts to notify physicians of possible risks such as allergies, inappropriate doses, and drug-drug interactions.[1] EHR helps to improve patient safety and workflow by compiling pertinent information, including a patient's health problems, medications, allergies, and lab results, into one system.[2] However, a high override alert rate has been found, with 49% to 69% of medication alerts are overridden by prescribers.[3] This raises a concern about the efficacy of such alerts in the EHR due to the high override alert rates.

Alert fatigue is one reason for high override rates. Alert fatigue causes physicians to become desensitized to safety alerts and potentially ignore pertinent and useful information.[3,4] According to Ancker et al., studies have shown that alert fatigue is a complex problem with no single standardized method of evaluation due to its vague definition and many causes. Their study described alert fatigue as a result of two phenomena: cognitive overload and desensitization. Cognitive overload is "a large quantity of information [with] insufficient time or cognitive resources to distinguish relevant from irrelevant information" and is caused by uninformative alerts that result in task interruptions and reduce physician's responsiveness towards alerts. Repeated exposure to alerts also results in reduction of physician's response to alerts causing desensitization.[5] Several studies have acknowledged the concept of alert fatigue by examining the reasons of high override rates, but there is still a paucity of data regarding physicians' perception of alert fatigue.

This study focuses on physicians' perception of alert fatigue at Inova Health System (IHS). According to the Medication Warnings Statistics Report at IHS from July 2017, approximately 17% of medication alerts were drug-drug interactions, pregnancy, and lactation. Prior to the addition of UFW, a third-party filtered out specific alerts they

deemed unnecessary based on a set criteria and physicians were not shown these alerts. However, physicians were not capable of filtering alerts that were fired. UFW is an IHS physicians proposed intervention that allows physicians to filter out specific drug-drug interactions, and pregnancy and lactation medication alerts for a 30-day period for all their patients. As shown in Figure 1,when physicians receive a qualifying alert they can select “Don’t Show This Warning for Any Patients” to no longer see the alert for a 30-day period. This intervention was proposed by IHS physicians to reduce the number of alerts they see when ordering medications for patients in hopes to reduce alert fatigue.

Figure 1: User-filtered warnings in the EHR

The primary aim of this study is to determine the impact of UFW on physicians’ perception of alert fatigue. The secondary aim is to calculate the reduction of medication alerts after the implementation of UFW. It was hypothesized that the reduction in medication alerts will significantly impact physicians’ perception of alert fatigue in a positive manner.

Methods

Study site:

This study was conducted at IHS, a 5-hospital health system in Northern Virginia. The health system utilizes an EHR which is an “integrated computerized physician order entry system that includes functionalities for the implementation of clinical decision support”.[6]

Study design:

This is a prospective observational study that analyzed the impact of UFW, shown in Figure 1, implemented by IHS Informatics department on December 6, 2017 in response to the request of IHS physicians. The study was approved by the Institutional Review Board (IRB). Informed consent was not required because all data remained anonymous and was password-protected with access only given to the investigators involved. No patient information was collected. Pilot surveys before the distribution of pre-implementation and post-implementation surveys were sent out to the Medical Director of Informatics at HIS for validation.

Study population:

The study inclusion criteria was limited to physicians at IHS. Mid-level practitioners, medical residents, nurses, and pharmacists were excluded from the study.

Data collection:

Physicians' perception of alert fatigue was assessed using Google Forms surveys before and after the implementation of UFW. UFW was available for two and a half months prior to the distribution of the post-implementation survey to allow providers to utilize UFW before answering the post-implementation survey questions.

The pre- and post- implementation surveys are similar and presented in the Appendix (Table 1). Demographic questions on pre and post- implementation surveys including physicians' years of medical practice and years of experience with the EHR and additional questions regarding familiarity with UFW were asked in the post-implementation survey. Other questions asked about physicians' overall view on alert fatigue, the primary contributor to alert fatigue, and individual views on medication alerts.

Both the surveys were advertised using flyers that were posted throughout Inova Fairfax Hospital. These surveys were emailed to the Vice President and CMO of IHS for distribution to the physicians in the health system. The pre-implementation survey was made available to providers for a two-week period (November 22, 2017 to December 6, 2017) after which data was analyzed. The post-implementation survey was made available to physicians from February 16, 2018 to March 2nd, 2018. Few additional questions, as shown in Appendix (Table 2), were asked in the post-implementation survey to assess if the physicians were aware of UFW and any barriers to use.

To analyze the reduction of medication alerts, Medication Warnings Statistics Reports were obtained for the two-week time periods (November 22, 2017 - December 6, 2017 and February 16, 2018 - March 2, 2018). The parameters from the reports, used for analysis, included number of total medication (drug-drug interactions and pregnancy and lactation) alerts, filtered alerts (alerts filtered by the system and not seen by the physicians), overridden alerts (a user overrode the warning), removed alerts (a user removed the warning by discontinuing an existing order or removing the new order), and viewed alerts (a user viewed the warning but could not override it from the current location) by the physicians.

Data analysis:

To assess the primary aim, respondents were asked "On a typical day, how often do you feel interrupted/stressed by medication alerts?" This question was assessed using a Likert scale (Almost always= 1, Most of the time= 2, Sometimes= 3, Almost never= 4). Due to unequal number of participants in pre- and post- surveys, a non-parametric test, Mann-Whitney U Test was applied to determine the difference in the response trends observed in pre- and post- implementation surveys. Statistical significance was predefined as $\alpha = 0.05$. All analysis was conducted using SPSS.

To assess the secondary aim, the number of alerts fired were filtered by drug-drug interactions, pregnancy and lactation. The difference between the number of alerts was calculated to see if there was a reduction of alerts. The difference in override alerts for

pre- and post-implementation of UFW was also calculated to see if there was a reduction in those alerts.

Results

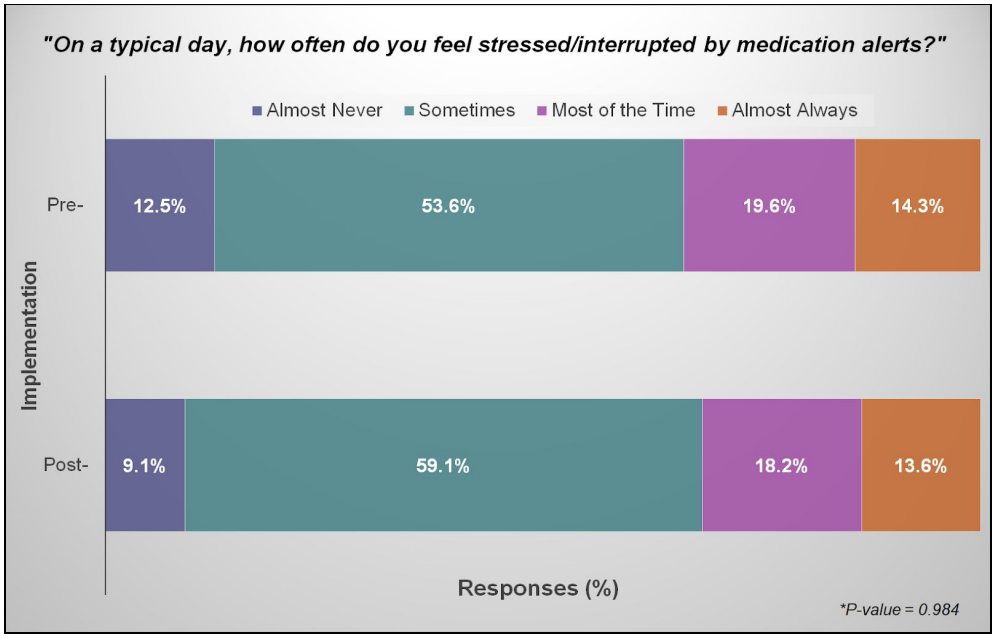
Demographics:

A total of 56 physicians completed the pre-implementation survey and 22 physicians completed the post-implementation survey. A majority of respondents (73% in the pre-implementation and 86% in the post-implementation) had 5-15 years of experience with EHR. A large percentage of respondents in the pre- and post-implementation surveys had 5-15 years of medical practice (43% and 54% respectively).

Primary Outcome:

Figure 2 shows similar response trends observed in the pre- and post-implementation surveys (p value = 0.984), indicating that there was no significant difference in the perception of alert fatigue after the implementation of UFW. The results also showed that the majority (~50-60%) of respondents felt stressed by the medication alerts sometimes, and about 18-20% felt stressed most of the time.

Figure 2: Response Trends Pre- and Post-Implementation Surveys



According to the post-implementation survey, 95.5% of respondents did not use UFW. When the respondents were asked the reason for not using UFW, 72.7% answered that they were unaware of the new implementation in the EHR. Other reasons that prevented physicians from using UFW included not wanting to miss a potentially helpful alert or filtering the alert for all their patients.

Secondary Outcome:
Medication Warnings Statistics reports for the pre- and post- implementation data showed that the total number of alerts (drug-drug interactions, pregnancy and lactation) decreased by 16.7% (Figure 3). Furthermore, the number of overridden alerts were analyzed. Prior to UFW, prescribers overrode 7,937 alerts. After the implementation of UFW, prescribers overrode 7,042 alerts. The percent difference in the alerts overridden between pre- and post-implementation of UFW was 11.3% (Figure 4). Statistical significance could not be determined because of the unequal and inadequate sample size.

Figure 3: Number of Alerts Fired Pre- and Post-Implementation of UFW

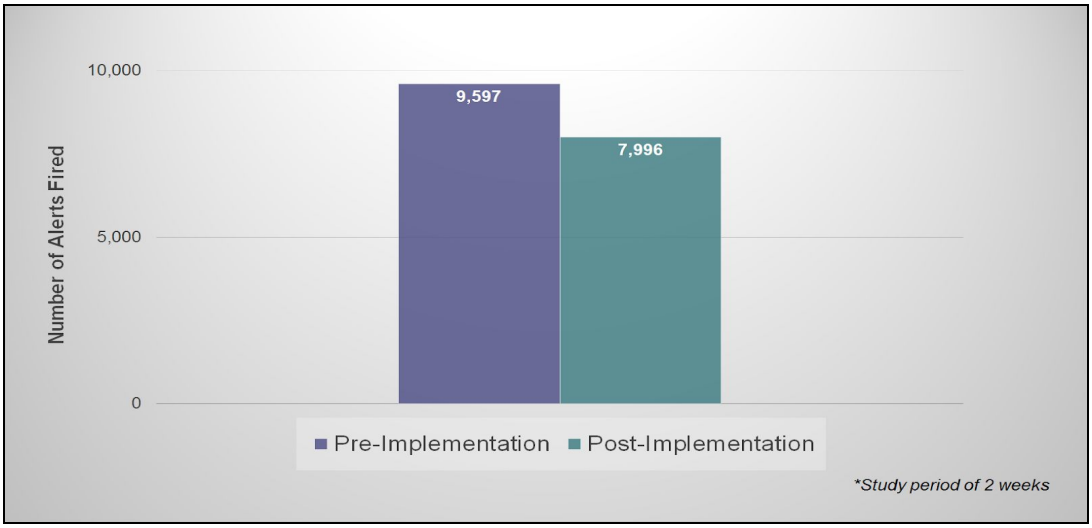
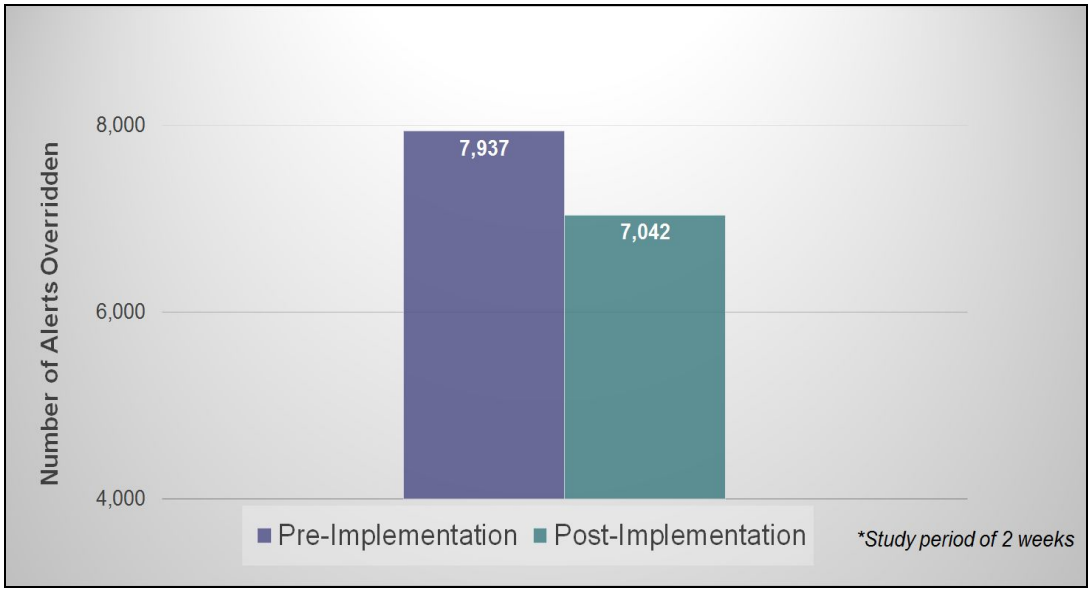


Figure 4: Number of Overridden Alerts Pre- and Post-Implementation of UFW



Discussion

This study evaluated physicians' perception of alert fatigue before and after the implementation of UFW at IHS, to reduce the number of alerts. The questions asked in the pre- and post-implementation survey determined how physicians perceived alerts in the EHR and whether or not their perception changed after the implementation of UFW.

It was hypothesized that UFW would reduce the perception of alert fatigue because it would reduce the number of alerts. Kane-Gill et. al indicated that the value of an alert can be enhanced by improving acceptance of alerts, but the quantity of alerts must be decreased in order to reduce alert fatigue.[7] Tamblyn et al. found that customizing alerts based on physicians need reduces the quantity of alerts and an "on-demand" system reduced the number of alerts from 0.1 to 0.03 alerts per patient.[8] The physicians experiencing traditional alerts ignored up to 87.8%, while the physicians with "on-demand" alerts ignored only 24.4%.[8] However, in our study, the implementation of UFW showed no significant change on physicians' perception of alert fatigue ($p=0.984$). A majority of the respondents still felt "sometimes" interrupted/stressed by the alerts fired from the EHR before and after the implementation of UFW. This shows that the implementation of UFW did not affect the perception of alert fatigue amongst physicians.

Secondary outcome of the study showed a decrease in the number of alerts fired (16.7%). However, it cannot be concluded that this is solely due to UFW because the number of total alerts between the pre- and post-implementation were different within the two-week period. The number of orders entered during those periods may also have been different, giving different results. Kane-Gill et al. stated that the proposed mechanism for reduction of alert fatigue is measured by the proportion of alert quantity and the number of inappropriate overrides due to desensitization.[7] In addition to the total number of alerts, the override rates decreased as well by 11.3% after the implementation of UFW. However, scientific significance cannot be concluded due to inadequate and unequal sample size.

Future studies can incorporate the results from this study to further evaluate other interventions that can help alleviate alert fatigue. Regardless of the interventions from previous studies, there is still no standard metric that allows for evaluating alert fatigue.[7] Standardization of assessing alert fatigue will help in identifying and prioritizing alerts that have meaningful use.[7] Furthermore, results from this study could be utilized by other health-systems to enhance their current EHR.

Limitations

Many limitations exist for this study. Firstly, there was limited and unequal participation in the study. Only 56 physicians took the pre-implementation survey and 22 physicians took the post-implementation survey. There was little control over who received the email. Moreover, advertisement through surveys only occured at Inova Fairfax Hospital. Secondly, despite training materials being sent out to physicians, 95% of the respondents did not use UFW and 72% of the respondents did not know about UFW.

Thirdly, the survey did not ask about the location of the physician which could have been used to see if there is a difference amongst the different types of hospitals. Therefore, equal representation across the entire system cannot be ensured. Finally, UFW only accounts for 17% of the alerts that are fired. If all physicians used UFW, approximately only 6,000 of 35,600 alerts that are fired over a two week period could be filtered out.

Conclusion

UFW was implemented to reduce the alert fatigue experienced by physicians when using the EHR. However, there was no significant difference in the perception of alert fatigue after the implementation of UFW. The results remain inconclusive due to inadequate sample size from surveys, and low utilization of UFW. Low utilization of UFW may be due to a lack of awareness of this function as communication with physicians is a known limitation within the health system. Further investigational studies with a longer duration are necessary to assess the impact of UFW. While the use of UFW did not cause a significant impact on physicians' perception of alert fatigue, the results could be used in improving EHR alerts in other institutions.

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Appendix

Table 1: Questions Asked In The Pre- And Post-Implementation Surveys

Questions	Responses
1. On a typical day, how often do you feel stressed/interrupted by medication alerts?	a. Almost never b. Sometimes c. Most of the time d. Almost always
2. Which of the following is the primary contributor to your alert fatigue?	a. I already know the information given by the alert b. I am overwhelmed by the amount of alerts c. I don't have the ability to choose alternatives for the patient d. The alerts are not relevant to my patient
3. I am satisfied with the number of medication alerts I am asked to review when I work in EHR.	a. Strongly Disagree b. Disagree c. Agree d. Strongly Agree
4. I find the information provided by medication alerts in EHR useful for my practice.	
5. It is easy for me to override medication alerts with the current system.	
6. Prescribers should have the ability to tailor which medication alerts they see when they are entering and signing orders.	

Table 2: Additional Questions Asked In The Post-Implementation Survey

Questions	Responses	% of Responses (n = 22)
Before this survey, I was aware of user-filtered warnings in the EHR	**Yes**	27.3 (6)
	No	72.7 (16)
Do you use user-filtered warnings?	**Yes**	4.5 (1)
	No	95.5 (21)
What prevents you from using user-filtered warnings?	**I am unaware of how to implement user-filtered warnings**	59.1 (13)
	I do not want to miss a potentially helpful alert	41 (9)
	I do not want to filter the alert for ALL of my patients	27.3 (6)

Table 3: Responses to assess physician's perception of alert fatigue and its main contributor

Questions	Responses	Pre-implementation Survey % of Responses (n = 56)	Post-implementation Survey % of Responses (n=22)	Difference in the overall response trends (p-value)
On a typical day, how often do you feel stressed/interrupted by medication alerts?	**Almost Always**	14.3 (8)	13.6 (3)	0.984 (>0.05)
	Most of the time	19.6 (11)	18.2 (4)	
	Sometimes	53.6 (28)	59.1 (13)	
	Almost Never	12.5 (7)	9.1 (2)	

Table 4: Pre-Implementation Survey Responses

Statements	Responses	% (n=56)
I am satisfied with the number of medication alerts I am asked to review when I work in the EHR.	Strongly Agree Agree Disagree Strongly Disagree	3.6 (2) 19.6 (11) 44.6 (25) 32.1 (18)
I find the information provided by medication alerts in the EHR useful for my practice.	Strongly Agree Agree Disagree Strongly Disagree	5.4 (3) 32.1(18) 39.3 (22) 23.2 (13)
It is easy for me to override medication alerts with the current system.	Strongly Agree Agree Disagree Strongly Disagree	19.6 (11) 64.3 (36) 10.7 (6) 5.4 (3)
Prescribers should have the ability to tailor which medication alerts they see when they are entering and signing orders.	Strongly Agree Agree Disagree Strongly Disagree	25 (14) 50 (28) 19.6 (11) 5.4 (3)
Medication alerts are a waste of time.	Strongly Agree Agree Disagree Strongly Disagree	7.1 (4) 10.7 (6) 58.9 (33) 23.2 (13)
On a typical day, how often do you feel stressed/interrupted by medication alerts?	Most of the time Sometimes Almost never Almost always	19.6 (11) 53.6 (28) 12.5 (7) 14.3 (8)
Which of the following is the primary contributor to your alert fatigue?	The alerts are not relevant to my patient I already know the information given by the alert I am overwhelmed by the amount of alerts I don't have the ability to choose alternatives for the patient	24.6 (14) 33.3 (19) 35.1 (20) 5.3 (3)

Table 5: Post-Implementation Survey Responses

Statements	Responses	% (n=22)
I am satisfied with the number of medication alerts I am asked to review when I work in the EHR.	Strongly Agree Agree Disagree Strongly Disagree	0 4.5 (1) 45.5 (10) 50 (11)
I find the information provided by medication alerts in the EHR useful for my practice.	Strongly Agree Agree Disagree Strongly Disagree	0 27.3(6) 45.5 (10) 27.3 (6)
It is easy for me to override medication alerts with the current system.	Strongly Agree Agree Disagree Strongly Disagree	31.8 (7) 54.5(12) 13.6 (3) 0
Prescribers should have the ability to tailor which medication alerts they see when they are entering and signing orders.	Strongly Agree Agree Disagree Strongly Disagree	45.5 (10) 18.2 (4) 27.3 (6) 9.1 (2)
Medication alerts are a waste of time.	Strongly Agree Agree Disagree Strongly Disagree	4.5 (1) 22.7 (5) 54.5 (12) 18.2 (4)
On a typical day, how often do you feel stressed/interrupted by medication alerts?	Most of the time Sometimes Almost never Almost always	18.2 (4) 59.1(13) 9.1 (2) 13.6 (3)
Which of the following is the primary contributor to your alert fatigue?	The alerts are not relevant to my patient I already know the information given by the alert I am overwhelmed by the amount of alerts I don't have the ability to choose alternatives for the patient	40.9 (9) 22.7 (5) 31.8 (7) 4.5 (1)