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Impact of Laboratory Value Flowsheet in Electronic Health Record (EHR) Documentation Time

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Abstract

Research on the use of EHR is contradictory since it presents contradicting results regarding the time spent documenting. There is research that supports the use of electronic records as a tool to speed documentation; and research that found that it is time consuming. The purpose of this quantitative retrospective before-after project was to measure the impact of using the laboratory value flowsheet within the EHR on documentation time. The research question was: "Does the use of a laboratory value flowsheet in the EHR impact documentation time by primary care providers (PCPs)?" The theoretical framework utilized in this project was the Donabedian Model. The population in this research was the two PCPs in a small primary care clinic in the northwest of Puerto Rico. The sample was composed of all the encounters during the months of October 2019 and December 2019. The data was obtained through data mining and analyzed using SPSS 27. The evaluative outcome of this project is that there is a decrease in documentation time after implementation of the use of the laboratory value flowsheet in the EHR. However, patients per day increase therefore having an impact on the number of patients seen per day/week/month. The implications for clinical practice include the use of templates to improve workflow and documentation as well as decreasing documentation time while also increasing the number of patients seen per day.

Keywords

Electronic Health Record, EHR, Laboratory Results Template, Documentation Time

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1. Introduction

The use of medical documentation became standardized practice since the early 1900's. However, the earliest indication of medical documentation dates to Egyptian hieroglyphic inscriptions [1]. Over time and with new technological advances, medical documentation has evolved to catch up with the current times. As legal battles and quality assurance processes are added to the equation, the medical record has become the ground on which legal battles are based and what dictates trends in quality of care. Electronic health record (EHR) implementation in the United States of America (USA) became mandatory by the 2009 stimulus plan's Meaningful Use Initiative [1].

The EHR is meant to improve healthcare practices by keeping clear documentation, avoiding mistakes, and improving overall health care services. However, reality has proven different. Lowes [2] noticed that face time turns into screen time when interacting with patients. In addition, Perry *et al.* [3] concluded that documentation time was longer when using electronic charting versus paper charting. Since its inception, the implementation of the EHR has been and continues to be a hybrid medical record [1].

There are many different software companies that provide EHR solutions. In Puerto Rico, the one that is most utilized by small private practices is NeoMed®, because it is a local company that is compatible with data network exchanges. Like many other EHRs, and what research has proven, electronic documentation takes longer than paper documentation [3]. Time is of the essence when seeing patients in a small rural clinic. The mandatory usage of EHR presents the dilemma on how to comply with federal regulation while still providing quality care. The federal regulation that establishes the implementation of the EHR is the Health Information Technology for Economic and Clinical Health (HITECH) part of a stimulus package signed in 2009 [4]. In addition, how does time and quality of care impact the financial aspect of healthcare? This makes it imperative to find improved ways to use EHR and maximize face time with the patient.

One way to improve time usage and decrease screen time is the utilization of templates within the EHR. Rodriguez-Torres *et al.* [5] documented the importance of EHR template design in documentation improvement and integration of evidence-based medicine into clinical notes. Rodriguez-Torres *et al.* [5] concluded that the quality of the EHR chart template plays an important role in guiding documentation. However, it is important to research the impact the use of EHR templates has on documentation time. The purpose of this project is to measure the impact of using the laboratory value flowsheet within the EHR on the time the primary care provider (PCP) spends documenting. This entails implementing the use of laboratory value flowsheet in a small rural primary care clinic in the northwest of Puerto Rico. Therefore, this project aims to answer the research question, "Does the use of a laboratory value flowsheet in an EHR impact documentation time by PCPs?"

2. Methods

2.1. Design

This quantitative retrospective before-after project measured the impact of using the laboratory value flowsheet in the EHR on the documentation time. The design of this retrospective project was before-after. The before-after included evaluating documentation time before and after implementation of the use of the laboratory value flowsheet. The study variable was implementation of the laboratory value flowsheet in the EHR. Total encounter time was the dependent variable used to determine if the implementation of the laboratory value flowsheet had an impact on documentation time. The instrument utilized to collect the data was the "Encounter Time" report in the NeoMed® built-in reporting tool. The report was run for the periods of 1st to 31st October 2019 and 1st to 31st December 2019. The "Encounter Time" report in the built-in reporting module provides total time of the encounter in hours, minutes, and seconds. The data obtained from the "Encounter Time" report was transferred into a SPSS 27 code book. Once transferred to SPSS, the date time wizard in SPSS was used to calculate encounter time. The data file was checked for errors and descriptive statistics was run on the variables' data. Descriptive statistics included minimum and maximum values, frequency, mean, median, mode and standard deviation. Normality was assessed using skewness and Kurtosis and data was checked for outliners. Significance level was assessed when correlation was run in SPSS and a confidence interval of 95% was utilized and presented in the results.

The pre-post data was evaluated comparing mean scores for documentation time at two different time periods [6]. The data was analyzed with paired sample t-test to compare the mean scores of documentation time before and after implementation of the laboratory value flowsheet within the EHR. Data was not distributed normally, therefore non-parametric test was used to analyze the data, Wilcoxon signed ranked test, also known as the Wilcoxon matched pairs, ranked test.

The sample size was utilized to infer the effect of the implementation of the laboratory value flowsheet has on documentation time. The sample and the setting were not suitable to generalize the findings. Therefore, further research in other health care settings must be conducted to be able to generalize the results. The A-priori sample size (Cohen's $d = 0.5$, statistical power level 0.8, and probability level of 0.05) should be 128 encounters per month [7]. The A-priori number was calculated with an 80% certainty that an effect can be found, if time increased or decreased with the implementation of the laboratory value flowsheet. The desired sample size was obtained; therefore there was no need to extend the data collection period.

The project took place in a small primary care clinic. No demographic information was obtained from the population because the population consisted of two PCPs in a small primary care clinic. Since the population was small, obtaining demographic information would provide enough information to be able to

identify them. The clinic has been in operation for 10 years and the patient base consists of pediatric, adult, and geriatric patients. The clinic has two PCPs, one nurse and one administrative assistant. The clinic provides family and preventive medicine services. Permission to conduct the study was obtained from the small primary care clinic. The clinic's EHR is NeoMed®. The software has a built-in laboratory value flowsheet that was not in use and was implemented in November 2019. This feature auto-populates the laboratory values into the progress note within the encounter in the EHR and creates a historical data chart available within the EHR.

2.2. Ethical Considerations

The project did not involve any type of interaction with the patients since it is a study that utilized data mining as the data collection method. The data collected does not involve any personal or medical information of any of the patients. Therefore, written consent from the patients was not necessary since none of the patient's or medical information from the record was utilized. The Excel spreadsheet generated by the report utility provided PCP that signed the encounter, date of the encounter and duration time of the encounter. None of the information generated in the report was personal information of the patient. However, the IT manager replaced the name of the PCP with a number. For example, Dr. John Doe was replaced by the number 1, Dr. Jane Doe was replaced by the number 2, etcetera. This prevented the researcher from knowing the identity of the PCP that signed the encounter. No demographic information of the population was obtained because the population consisted of the two PCPs in a small primary care clinic. Obtaining demographic information posed a risk of being able to identify them, therefore was not included. The information in the spreadsheet that was utilized in the study was the duration of the encounter and the number of encounters. There were no risks to patients or PCPs regarding exposure to psychological or physical harm.

To comply with Post University's Institutional Review Board (IRB), researcher has completed all required modules in Social and Behavioral Research form the Collaborative Institutional Training Initiative (CITI). Following completion of CITI training, the researcher was assigned a Project Chair. The researcher submitted the completed IRB application form with all required documentation. IRB approval was obtained before data collection initiated. In addition, no funding was procured to conduct the project. Finally, there are no conflicts of interest or disputes regarding this project.

3. Results

There were 381 records from October 2019 and 362 from December 2019. The time range for October 2019 is from 22 seconds to one hour and 45 minutes and 48 seconds and for December 2019 is 8 seconds to three hours and 50 minutes with 33 seconds. The standard deviation for October 2019 is 11 minutes and 51 seconds and for December 2019 is 15 minutes and 40 seconds. The mean for

October 2019 is 16 minutes and 47 seconds and for December 2019 is 15 minutes and 8 seconds. The median for October 2019 is 14 minutes and 51 seconds and for December 2019 is 12 minutes and 15 seconds. The data shows positive skewness and positive kurtosis meaning that scores are clustered to the left at low levels and the distribution is peaked at the center with long thin tails. In the Kolmogorov-Smirnov test, the Sig value of October 2019 and December 2019 is <0.001, suggesting violation of the assumption of normality. Therefore, the data is not normally distributed, and non-parametric tests were used to analyze the data. A Wilcoxon Signed Rank Test revealed a statistically significant reduction in documentation time after implementation of the use of the laboratory value flowsheet, $z = -2.873$, $n = 362$, $p < 0.004$, with a small effect size ($r = 0.151$). The median score on documentation time decreased from October 2019 ($Md =$ 00:14:51) to December 2019 ($Md = $ 00:12:15) (See Tables 1-3).

The purpose of this quantitative retrospective before-after project was to measure the impact of using the laboratory value flowsheet within the EHR on documentation time. The project compared the amount of time required for documentation before and after implementation of the use of the laboratory value flowsheet in the EHR. The research question was: "Does the use of a laboratory value flowsheet in the EHR impact documentation time by PCPs?" There is a statistically significant ($p < 0.05$) decrease in the amount of time it takes to document after implementation of the use of the laboratory value flowsheet i n the EHR. The evaluative outcome of this project is that there is a decrease in documentation time after implementation of the use of the laboratory value flowsheet in the EHR.

Table 1. Descriptive statistics.

	N	Minimum	Maximum	Mean	Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Statistic
Time Before	381	00:00:22	01:45:48	00:16:47	00:00:51
Time After	362	00:00:08	03:50:33	00:15:08	00:15:40
Change Variable	362	−6046.00	13079.00	−121.9530	1194.01491

Table 2. Tests of distribution.

	N Statistic	Skewness		Kurtosis	
		Statistic	Std. Error	Statistic	Std. Error
Time Before	381	2.300	0.125	11.058	0.249
Time After	362	7.508	0.128	98.270	0.256
Change Variable	362	3.284	0.128	42.320	0.256

Table 3. Tests of normality.

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
Change Variable	0.088	362	<0.001	0.776	36281	<0.001

The Donabedian Model is a framework for outcomes research with three tenets to consider. The first tenet, structure, as applied to this project included the nurse scans laboratory reports into the EHR and the PCP inputs laboratory values into the progress notes to justify the ICD-10 diagnosis code. The second tenet, process, as applied to this project included the nurse scans the laboratory reports into the EHR and inputs laboratory results into the laboratory value flowsheet. The third tenet, outcome, as applied to the project was data entered in the laboratory value flowsheet is auto-populated into the progress note without the PCP having to manually input them into the progress note. In addition, other outcomes included the impact on the time the PCP spends documenting into the EHR. Even though the Donabedian Model seems quite simplistic in the presentation of the tenets, it breaks down the pieces to ensure the impact on quality is easily identifiable. This project utilized this framework as it was originally intended, and the results showed that the implementation of the use of the laboratory value flowsheet did impact the outcome.

These findings are aligned with research that found that documentation time decreased with the use of EHR [8] [9] [10]. These findings add to the body of knowledge by providing further evidence of the impact of EHR use on documentation time. The adequate sample was achieved (381 records from October 2019 and 362 from December 2019), the data shows positive skewness and positive kurtosis meaning that scores are clustered to the left at low levels and the distribution is peaked at the center with long thin tails. In the Kolmogorov-Smirnov test suggested violation of the assumption of normality. Therefore, the data is not normally distributed, and non-parametric tests were used to analyze the data. A Wilcoxon Signed Rank Test revealed a statistically significant decrease in documentation time after implementation of the use of the laboratory value flowsheet.

4. Discussion

The study results were aligned with the expectations. It was anticipated that the implementation of the use of the laboratory values flowsheet would reduce the time the healthcare provider spent on the EHR. The key strengths of the project are that well-defined methodology was used, which is important in determining the project objectives [11]. On the other hand, the project had a reliable sample of encounters documented by the healthcare providers at a small rural primary care clinic in the northwest of Puerto Rico. The sample size increased the reliability for the project results. Furthermore, the project used comparators [12]. The laboratory value flowsheet was compared with the manual data entry. The comparison of the two scenarios enabled to clearly identify the effect of the implementation of the laboratory value flowsheet on documentation time in the EHR [11]. The limitation of the project is that it only focused on one aspect of the EHR. The EHR has different fields and flowsheets that can be streamlined and reduce the time spent by healthcare providers in the EHR. This project did

not address other factors that could have contributed to the time spent in the EHR while inputting data. For example, the level of experience and training of the healthcare provider, nursing professionals or administrative personnel or typing skill were not considered. The findings of this research are limited to the setting and the population. This is because each healthcare setting is unique in their own ways, and the one utilized was a small primary care clinic located in the northwest side of Puerto Rico. Puerto Rico has a unique geographical, cultural, and financial aspect that is not comparable to any other location in the United States of America (USA).

5. Conclusion

EHRs present a unique opportunity to improve healthcare services and delivery. However, even though EHRs have a wide variety of advantages, there are also some disadvantages associated with the EHR; like time spent by healthcare providers focusing on the computer monitor while documenting instead of interacting with the patients. This project explored whether the implantation of the laboratory value flowsheet could help in reducing the time spent by healthcare providers documenting into EHR. This project has significant implications for the nursing profession. This project contributed to the nursing informatics profession by promoting the role of the nurse informatics discipline within an area that is not widely known or recognized. In terms of society and provider-patient interaction quality, it presented a decrease in the mean of documentation time of one minute and 39 seconds. There was a statistically significant decrease in documentation time after implementation of the use of the laboratory value flowsheet and improved usage of the EHR. In addition, there was an increase in patients receiving service in less time; resulting in an increase in the capacity of the clinical practice to provide services to more patients. One notable contribution is that by implementing the use of the laboratory value flowsheet, the data was auto-populated into the encounter. These findings paved a new path for further research on how new changes can be implemented in the process in a small rural primary care clinic in the northwest of Puerto Rico to improve patient experience and decrease encounter time. It was identified that the need to manually input the laboratory values into the EHR is lengthy but using the laboratory value flowsheet was a possible solution to decrease encounter time and improve performance. This project presented the opportunity to improve workflow processes and impact documentation time through using the full capabilities of the NeoMed® EHR. The objective was to measure and compare documentation time before and after implementation of the use of the laboratory value flowsheet, but the outcome of the impact was aligned with research that found that documentation time decreased with the use of HER [8] [9] [10] and there was statistically significant decrease in documentation time after implementation of the use of the laboratory value flowsheet. Further research is needed on the fundamental approaches that can help improve healthcare provider and patient in-

teraction as well as documentation time in the EHR.

5.1. Recommendations

The findings of the study clearly indicated that a great amount of time is spent using the EHR systems. Healthcare professionals are spending a great amount of time documenting in the EHR, directly impacting the relationship between the patient and the healthcare provider. Therefore, affecting the delivery of quality healthcare services and presenting a major concern that needs to be addressed. The key recommendations should be geared towards reducing the time spent by the healthcare providers on the EHR and enable them to provide better and personalized care by focusing on improving the workflows related to the EHR. The EHR usage at the small primary care clinic in which the research took place still not using NeoMed® to its full potential, therefore there are opportunities to analyze the workflow and EHR usage to implement changes and streamline the process to be more time effective. Quality improvement promotes analysis of all workflows to promote efficiency. Some areas to consider are processing of laboratory values prior to the appointment date instead of when the patient arrives at the clinic and reviewing patient medication reconciliation and pharmacological treatment adherence with the help of online data exchanges with the pharmacies. A good example of streamlining EHR use and using the tool to its fullest potential would be Haas, Halamka, and Suk, M. [13], where the authors laid a reference to the approaches adopted by Geisinger in Pennsylvania. The provider was able to streamline the whole process of allocating the right musculoskeletal provider to the patients by reducing the multi-click steps to only two steps [13].

There are so many steps in the EHR that do not necessarily add value to the process [13]. Research should focus on the critical areas of the EHR that could be eliminated or simplified. This will save time for the healthcare providers, by reducing the time spent typing, and resulting in healthcare providers spending more time with patients [14]. Another recommendation is that there should be a focus on technological advancements. For example, voice recognition devices, digital scribes, and connected devices can be embedded into the EHR to automate the data input processes. This will enable the healthcare providers to input data into the EHR without trying. This will enhance data input and reduce the time that healthcare providers spend documenting into the EHR [11]. Other research could focus on the key EHR processes that could be eliminated to reduce redundancy in the systems and streamline the processes to reduce time spent on the EHR. Furthermore, the documentation time and time spent on the computers while providing patient care continues to present challenges and researchers may focus on other issues to contribute to decrease time and improve performance [12]. Issues such as lack of experience and sufficient training should be explored in detail to assess their contribution to the impact on documentation time. Conducting similar research in another setting that has a larger number of populations could explore the characteristics of the population and the impact of EHR utilization or the use of templates within the EHR.

5.2. Implications for Nursing Practice

This project measured documentation time before and after implementation of the use of laboratory value flowsheet as a documentation tool within the EHR. The project determined there was a statistically significant difference in time spent documenting between using the laboratory value flowsheet utility or directly typing the laboratory values into the EHR. This project contributed to the nursing informatics profession by promoting the role of the nurse informatics discipline within an area that is not widely known or recognized. Nurse informaticists are impacted by the findings in the research to promote the implementation of templates or software utilities available within the EHR to enhance and support safety and effective clinical practice. In terms of society and provider-patient interaction quality, it presented a decrease in the mean of documentation time of one minute and 39 seconds. There was a statistically significant decrease in documentation time after implementation of the use of the laboratory value flowsheet and improved usage of the EHR. It is important to note that there was a decrease in operational days from October 2019 (22 operational days) to December 2019 (19 operational days). However, there was an increase in patient encounters from October 2019 ($N = 381$) to December 2019 ($N = 362$). Therefore, the number of patient encounters went from an average of 17 per day in October 2019 ($N = 381$ divided by the October 2019 operational days (22 days)) to 19 per day in December 2019 ($N = 362$ divided by the December 2019 operational days (19 days)). That represents an average of 2 additional patients per day, which can be projected for the year 2020 as to an additional 372 patients for the year (234 operational days in 2020). The clinical significance is that after the implementation of the laboratory value flowsheet. In addition, there was an increase in patients receiving service in less time; resulting in an increase in the capacity of the clinical practice to provide services to more patients. Further research must be conducted on the use of templates or utilities within the EHR to improve nursing practice and patient care, the impact it has on the quantity of patients serviced and the quality of the health care provided. In the future, the project should be conducted with a larger population and/or different setting to determine of the use of templates or utilities within the EHR have an impact on documentation time and quantify the impact on the practice. Also, research and testing on template designs must be taken into consideration to determine if template design has an impact on the outcome or statistical analysis.

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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