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Optimization of an EHR and Workflow Redesign at a Small Cancer Center in the Michigan Upper Peninsula

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OPTIMIZATION OF AN EHR AND WORKFLOW REDESIGN AT A SMALL CANCER CENTER IN THE MICHIGAN UPPER PENINSULA

By

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Abstract

This study was performed to examine the efficacy of a newly adopted electronic health record (EHR) system at a small rural cancer center. I evaluated the current system, and interviewed key medical staff members in an attempt to identify issues with the current set up and find solutions to major problems. I uncovered many barriers to the practice success such as user buy in, work redundancy, lack of knowledge and/or training, interoperability and template issues. The physician had issues with obtaining maximum benefit from the system such as inability to generate practice productivity reports and lack of efficiency. In an attempt for optimization, suggestions were made to redesign workflow and focus on key EHR functionalities. Successful optimization of an existing EHR system post implementation is key to efficacious growth of a practice as we move into a new health care environment which is highly reliant on health information technology.

1 Introduction

The Centers for Medicare and Medicaid Services (CMS) has moved towards making EHRs mandatory for all health care professionals and hospitals. The rationale is that the adoption of EHRs will make it easier for physicians, hospitals, and others serving Medicare and Medicaid beneficiaries to evaluate patients' medical status, coordinate care, eliminate redundant procedures, and provide high-quality care. Likewise, "EHR will help speed the adoption of many other delivery system reforms by making it easier for hospitals and doctors to better coordinate care and achieve improvements in quality". [1] Despite the mandate from CMS and the wide spread implementation of EHR, there remain unanswered questions about their efficacy. CMS has a strategy to move from a fee-for-service reimbursement plan to a driven value-based medicine model. A patient-centered medical home (PCMH) model is directed at making healthcare quality and delivery better, improving chronic disease management and payment. The goal is intended to improve chronic disease management and continuing to keep patients healthy at home. An important component of PCMH is EHRs, personal health records, e-prescribing, patient portals, secure messaging, e-visits, HIEs and tele home care. Accountable care organization (ACO) are a group of healthcare providers that undertake the responsibility of providing coordinated top quality of care to patients on Medicare. [2] The main goals are to improve quality of care, reduce cost, increase efficacy and patient safety. In response to these forces, health information technology (HIT) plays an important role to further aid evidence-based medicine, patient engagement, care coordination, quality and cost reports. [3]

At present, EHRs have not risen to the point where they can adequately support clinician's information needs and workflow. Likewise, they do little to improve patient care and, in some cases, have been shown to reduce the quality of care. Thus, much more work needs to be done. Informaticians play a major role in helping reverse this trend. The federal government understands the importance of data and information to make evidence based medical decisions. [3] Despite their ability to positively affect workflow and improve practice efficiency, deterrents to wide spread acceptance include expense of obtaining a system and the advanced training required to optimize the system post implementation.

1.1 Background

UP Health Systems-Portage Cancer Center is a well-established regional Cancer center providing oncologic care for patients in the Michigan's rural Upper Peninsula. Annually the cancer center sees over 300 new cancer patients and over 5800 follow up visits. Likewise, their chemotherapy infusion center administers over $6 million in medication a year. Specific attention is directed at reaching the low-income, underinsured and vulnerable populations in the organizations underserved area. Historically, the cancer center had used paper charts for medical record keeping. However, in October 2016 they implemented an oncology-specific web based EHR system, OncoEMR. It offers services such as electronic prescribing, integrated practice management, PQRS reporting, chemotherapy templates and dosing flowsheets; in addition to, billing services. Currently the system interfaces with two other systems. MEDITECH which is used to enter laboratory orders/results, pharmacy orders, billing and eCW is used for coding.

1.1.1 Problem Statement

The implementation of OncoEMR at Portage Cancer Center has added some complexity to the practice. Patients are expecting quick responses to their calls to physician, laboratory results queries, prescription refill requests during and after clinic hours and same-day access to seeing the physician. This simultaneous asynchronous and synchronous patient care including administrative duties, billing and coding, prior authorizations, complying with new quality programs and population health adds a significant workload burden. This leaves physicians and staff overwhelmed and dissatisfied. Effectively maintaining an EHR is an ongoing task and it is important to understand factors that contribute to the practice excess workload and establish practical resolutions to their challenges. The presence of EHRs alone does not guarantee efficiency or high-quality health care delivery. A few studies have been done that show that optimization of existing EHR is required to ensure improved functionality. [4] Optimization analysts can add value by optimizing EHR templates and redesigning workflows, so physicians can place emphasis on caring for patients. One comparative study showed that sites that committed to optimization after the EHR was implemented lead to enhancing EHR functionality. [5] Improving this understanding is important to refining EHRs as a tool towards improving physician productivity.

1.1.1.1Methodology

This study was conducted to evaluate the impact of EHR use post implementation

on staff members at the Portage Cancer Center. An evaluation of the practice was performed on the use of the current EHR. Focus was placed on optimization activities that can support proficiency of EHR functionality, workflow redesign and population health approaches that can be integrated into the system.

First, I conducted in-person interviews with representatives from each discipline of the team. The team members consisted of front desk, medical assistants, nurses, physician, pharmacy, billing, coding, head of IT and director of risk management. We discussed their perspective of the EHR as it relates to their job title. From this, I was able to obtain their positive and negative opinions about the effects of EHR on their workload and patient care; in addition to, identifying problem areas. The information I gathered allowed me to better ascertain where the cancer center is post implementation. Thus, I was able to put together a design and strategic plan for optimization. Then, I then spoke with representatives from OncoEMR at Flatiron to better understand the capabilities of their EHR system. Finally, I worked collaboratively with the head of the IT department and designed the strategy for optimization.

1.1.1.1.1 Objectives

OncoEMR had been implemented at Portage Cancer Center for over a year and the staff has a good working knowledge of the basics of the system. However, there are several challenges. The purpose of this paper is to evaluate current operations and identify the following challenges to optimize existing OncoEMR functionality. First, I will evaluate and report observations of EHR use on physician and staff at Portage Cancer Center by examining the positive and negative opinions and how it results in

administrative burden, financial loss and productivity. The goals are to assist Portage Cancer Center with redesigning and implementing EHR optimization. My focus is to improve EHR efficiency and functionality within UP Health Systems Portage Cancer Center. The areas to be evaluated are:

-EHR template customization
-Understanding of the workflow
-Running and viewing reports for practice management (billing, drug reports, quality)

The track to effective EHR optimization would start with conducting an evaluation of the team, analyzing the practices workflow and redesign of the current system. The deficiency in proper workflow design is one the biggest contributor to loss of productivity. The steps to different processes is not easy and is time consuming but a well-managed workflow redesign can improve efficiency, leverage EHR capabilities, enhance productivity and care coordination.

2 Related Work

2.1 Literature Review

Electronic health records can offer precise up-to-date information on patients. It has the potential to help providers improve productivity, quality, do population health, administrative efficiency and thus reducing cost of health care. [6-7] Several studies have been done that show the potential of EHRs to improve safety, provide better coordinated care due to reduced medical errors [7], complete documentation [6,8] due to improved commitment to guideline-based care. [9] The federal government including states and payers have initiatives that have aggressively encouraged the transition from paper records to EHRs [10-11] and is changing the course of how health care is delivered throughout the United States. [12-13] The availability of electronic ordering has shown to result in maximizing efficiency [10-11] and can decrease redundant services. [12]

Despite EHRs potential benefits, health care workers have several concerns contributing to administrative workload burdens, “click fatigue” which can unfavorably impact productivity. Several studies have been conducted in large hospital systems show despite more efficient health care delivery following EHR implementation there is an increase in work hours leading to increase in clinical workload. [14-19] Literature reviews performed show physicians are facing pressure to see and admit more patients and reduce patient-physician visit time for reduced Medicare reimbursement due to higher cost of technology and health care. [20-22] However, clinicians are faced with higher patient loads, less dialogue with patients due to EHR usage and lack of proper

guidance on supporting and meeting their demands. This in turn increases demands on physician and staff due to large challenges in workflow and scheduling [21,23].

A number studies have been performed to assess single processes such as integration of EHR into the workflow, time-efficiency and documentation time due to EHR implementation. One would assume that documentation time would be decreased adding an efficiency benefit, however, some studies show an increase. Researchers Poissant, Pereira, Tamblyn and Kawasumi performed a systematic review on the impact of EHR on time efficiency of physicians and nurses and concluded that "the goal of decreased documentation time is not likely to be fulfilled, especially for physicians." [24] Another study performed by Joukes, Abu-Hanna, Cornet and de Keizer measured the time physicians spent documenting structured patient data and showed that there is a significant increase in time inputting data. [25]

Clinicians would regard a system to be efficient if the EHR could decrease documentation time. EHR implementation could enhance clinical workflow in areas such as patient check-in and check-out, appointment scheduling, referral generation, laboratory orders, pharmacy orders and billing. Researchers Menachemi and Collum examined the benefits and drawback of EHRs and showed the system can cause disruption to workflows and can lead to decrease in productivity for medical providers and staff. This can lead to a potential loss in revenue. [26]

Measures toward enhancing efficiency of clinical workflow in the practice using EHRs would have the potential to have significant impact in health care. [23,27] There is growing literature regarding the challenges of EHR optimization experienced by analysts that show that organizations lack time for team members to participate in optimization of

EHR and this is results in high workloads, time pressures and several competing demands. [28-29]

A few clinical practices have EHRs that can combine functions such as quality reporting, population health management systems and billing together, while others separate these functions into different departments. Providers are having issues with processes such running reports for billing or managing population health by chronic conditions or demographics and fulfilling quality reporting requirements. To serve a practice's clinical and financial needs EHR optimization such as workflow redesign may be beneficial to improve efficiency and productivity. [4,29-33] Few studies have been performed that show that EHR optimization can improve efficiency and productivity in a clinical practice. [4,34] Team training, workflow redesign, coordination of work among staff is essential to optimization process. [4]

3 Analysis

3.1 Participants background and challenges

Registration clerk

This person is the first point of contact between the patient and the clinical practice. Thus, they should obtain demographic and insurance information, input active patient insurance cards and driver's license upon initial patient presentation. Likewise, they update demographic and insurance information of existing patients as needed. Also, they are required to register all new patients into the system and responsible for rescheduling.

Challenges:

Template issues: Better view of schedule calendar

Certified Medical Assistant

Main responsibilities are the initiation and direction of patient flow through the office. This includes inputting of appropriate orders for labs, radiologic reports, pathology specimens and referrals into the EHR. Likewise, they document vital signs, height, weight and pain level, performance status of patient, allergy and medical history update in EHR. Also, they schedule and prepare electronic charts.

Challenges:

Interface issues: Often laboratory orders that are input into OncoEMR are not properly interfaced with MEDITECH. Inability to designate STAT orders in OncoEMR, thus requiring the change to be manually made through MEDITECH.

Also, order needs to be inputted twice, once through OncoEMR and also through MEDITECH.

Notification issues: No alert on notifications is received that designates a successful or failed referral when faxed through OncoEMR.

Scheduling issues: The average oncology patient makes several stops in the cancer center on a given day, i.e. port flush, lab visit, injectables, infusion, physician encounter. This creates difficulty with accurately scheduling a patient on the same day through the system.

Desk nurse

Her job consists of being the initial clinical contact for patients who call the office with medical issues. This consists of checking labs, looking for critical labs, radiology reports, drugs, prior authorizations, reviewing consultation requests and referrals.

Challenges:

Alert/notification issues: Lack of alerts of abnormal critical values of patients from OncoEMR.

Nurse Navigator

Educate patients on chemotherapy drugs, regimens and potential side effects. Obtains pre-certification from insurance companies for drug administration. Assists patients in obtaining coinsurance payment assistance for expensive drugs. Arranges referrals to tertiary care cancer center.

Challenges:

Referrals done to Mayo clinic that uses EPIC cannot go through, therefore needs to be done manually. Information needed for educating patients is available in OncoEMR but cannot be pulled.

Chemotherapy Nurse

The role of the infusion nurse is to administer chemotherapy and monitor patient throughout their infusions. Review chemotherapy orders and confirm for accuracy with the pharmacy and physician. Give injectables, educate patients and provide comfort.

Challenges:

Interface/integration issues: Drug orders that are ordered through OncoEMR are printed off by the pharmacy department and then manually inputted to MEDITECH for processing and preparation. Thus, if an order needs to be discontinued it cannot be done through OncoEMR.

Running reports issues: Difficulty on accessing practice analysis reports which would be used for monitoring the practices operations efficiency and quality.

Template issues: Difficulty in developing customized templates for OncoEMR (example, customized PET scan form for Marquette).

Oncology Pharmacist

Review physician chemotherapy orders, mix, prepare and label chemotherapy drugs, transfer drugs to the infusion center for administration. Prepare claim for drugs used.

Challenges: Inability to run reports

Medical Oncology Coder

Review physician dictation for appropriate coding. Identifies primary and secondary diagnosis. Records all diagnostic procedures and assigns appropriate procedure codes.

Challenges: She must reconcile the same note three times. Initially in OncoEMR, the second in eCW and finally in MEDITECH for the Medicare patients.

Billing and Collections

UP Health System Portage financial services handles all the billing and collections for the cancer center. An interface has been created between OncoEMR and MEDITECH. All billing services are done through MEDITECH once charges are pulled from OncoEMR.

Challenges: No access to OncoEMR

Head of IT

She serves as an EHR superuser for OncoEMR, eCW, MEDITECH. This person handles all issues as it pertains to IT support.

Challenges: Lack of true knowledge of the system and access to additional learning or education.

4 System Design

4.1 Current system design and proposed system design

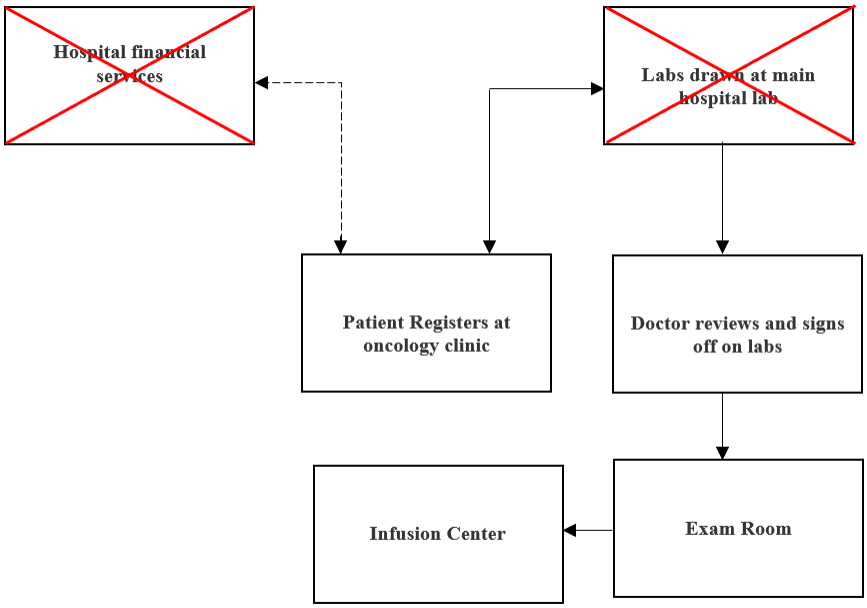

Figure A.1. Current Order Entry: Patient flow

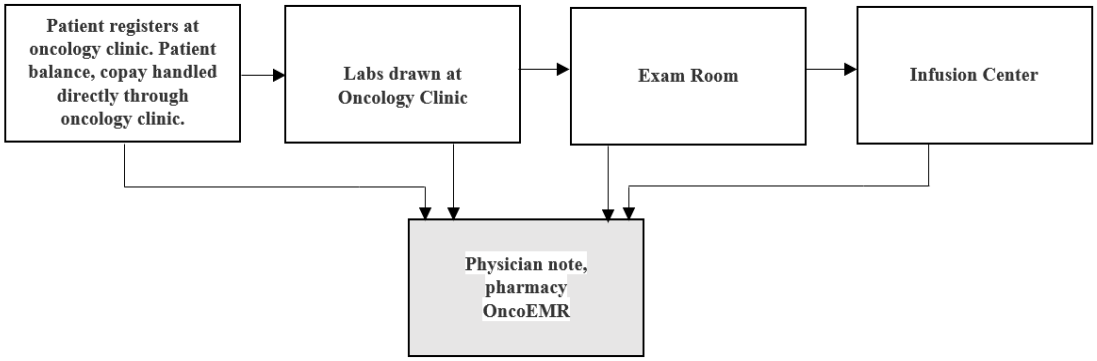

Figure A.2. Streamlined: Order Process for Patient Flow

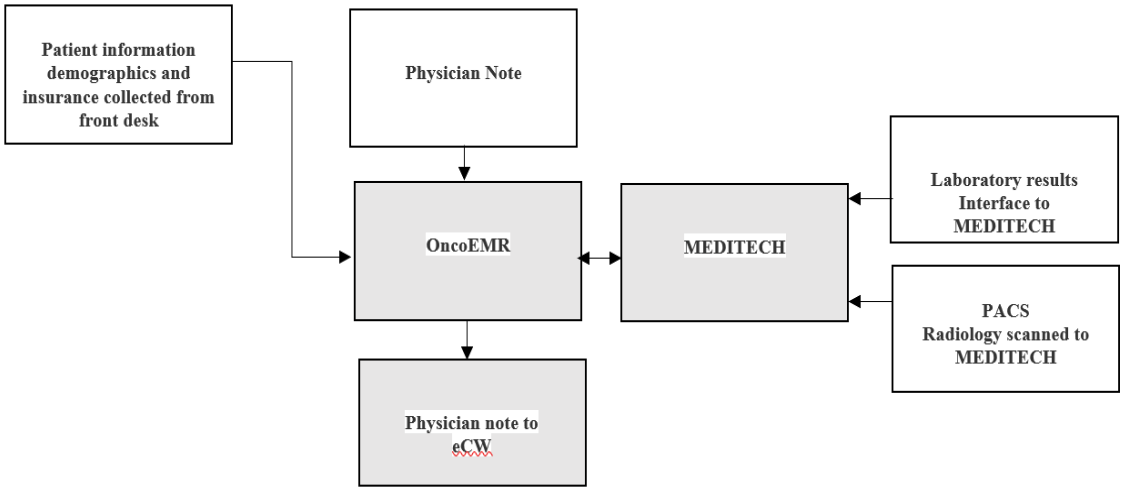

Figure A.3. Current Order Entry: Flow of data

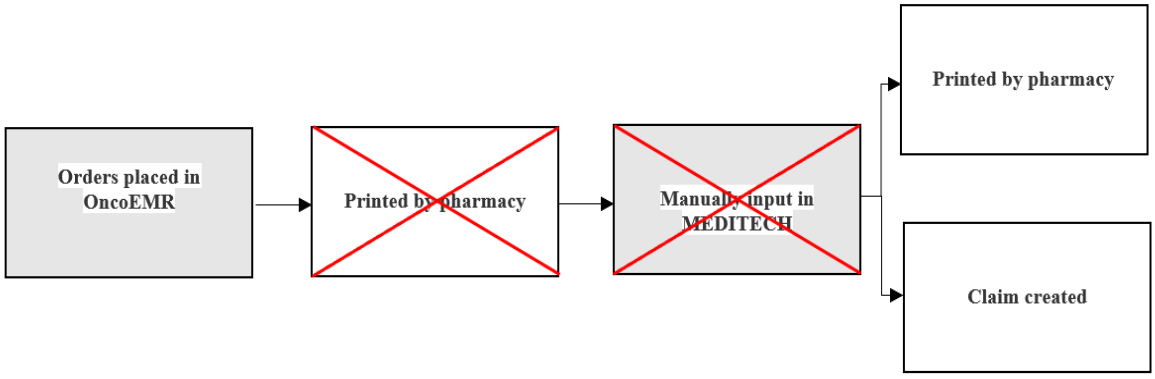

Figure A.4. Current Order Entry: Pharmacy

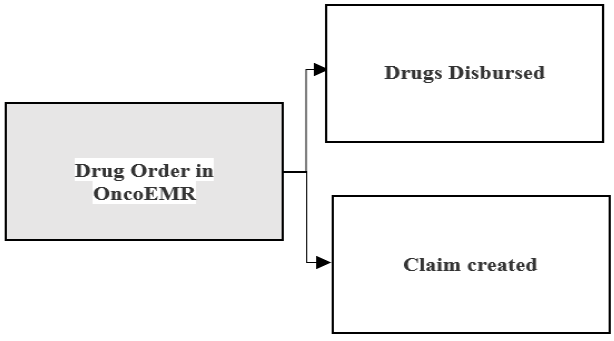

Figure A.5. Streamlined: Pharmacy

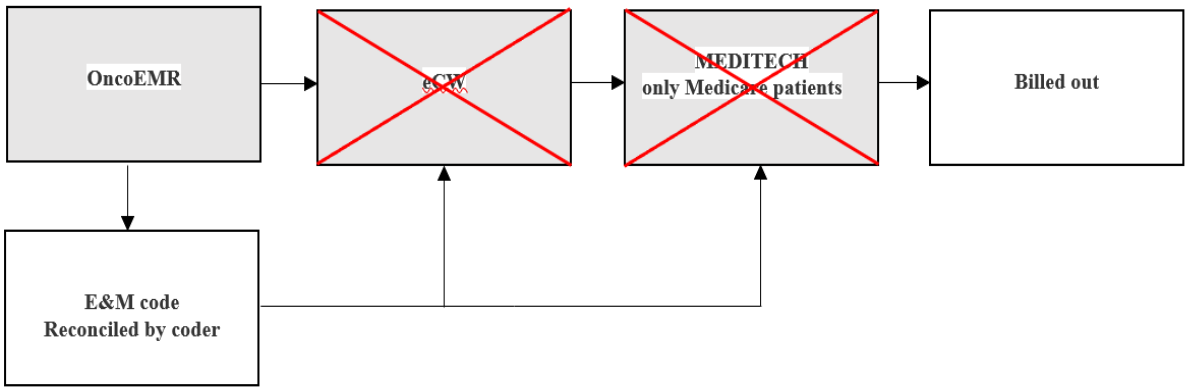

Figure A.6. Current Order Entry: Coding and Billing

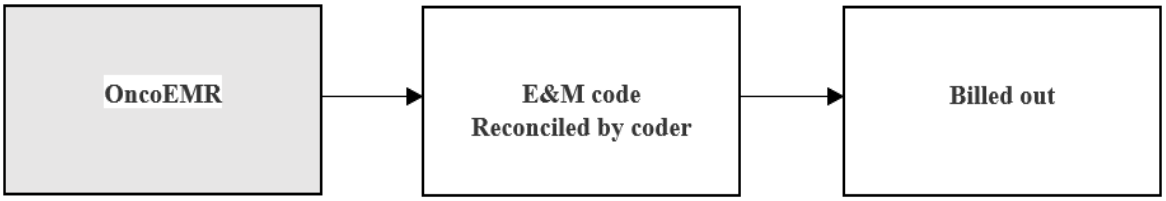

Figure A.7. Streamlined: Order Process for Coding and Billing

5 Discussion

Ultimately this study showed that understanding the need for and truly acknowledging the value of optimization is key to realizing the full benefit of an EHR system. Only then can one strive for practice efficiency. Through this process a system of checks and balances can be developed, by generating analytical reports, which can act as a barometer for the practice; thus, steering it in the right direction as the practice grows. However, to generate useful productivity reports, it takes complete "buy in" from the entire staff. This means that everyone from the registration clerk, CMAs, nurse navigator, chemotherapy nurses, pharmacy department, coders, billing/collections department and physicians must do their part and input accurate information in a timely fashion so that the reports can be easily accessed.

Participants of this study described optimization of EHR as using the system to improve efficiency in the clinical practice. Post implementation of EHR showed increase in requests for fixes and changes to the system. The majority of the staff members felt that they had to do things twice and therefore creating additional workload. This caused an increase in workload which further highlighted a need for optimization. For example, one member expressed that she had to do a triple check on three different systems (OncoEMR, eCW and MEDITECH). Another staff member had issues with pushing laboratory orders from OncoEMR to MEDITECH and having to check and input manually. The physician wants to move in the direction of patient centered care using the oncology medical home model. In this system all of a patients' care from registration laboratory draw, clinical evaluation, financial counselling and chemotherapy infusion is

given all in the same area using one EHR system. This will allow for the best quality of care to be given to the patient in addition to being able to perform better analysis.

The goals to optimizing the practice and improving user satisfaction involve workflow redesign, maintenance/support of EHR or a dedicated IT team and having dedicated resources that allow for optimal use of the EHR system. Based on the thorough analysis made in the study the existing workflow is somewhat disjointed and a workflow redesign is needed to ensure productivity. Figure A.1. shows the patient originally checking in at the cancer center, however they must leave the center to get labs drawn at a centralized location at the hospital. Likewise, the financial services department is in another area of the hospital outside the cancer center and the patient has to travel there. In the redesign process exemplified in figure A.2, the patient would arrive at the Cancer Center where they would receive all clinical treatment in addition to financial services all in the same area. Likewise, all critical data will be entered OncoEMR. Figure A.4 and A.5. illustrates the current order process and redesign for pharmacy. Currently the physician places an order in OncoEMR, this order is then faxed to the pharmacy that is printed off and is then manually inputted into MEDITECH. From there it is printed by pharmacy and a claim is created and the drugs are dispensed to the infusion center. A more efficient process would be to obtain the claim and dispense drugs from OncoEMR. With this process and using OncoAnalytics (analysis), they would be better able to keep track of pharmacy inventory, drug usage and waste; in addition to doing billing and collections. This would save the practice a significant amount of time, decrease errors and be able to obtain much needed analytical data. Figure A.6 exemplifies a somewhat cumbersome coding, billing and collections process the practice uses. With this current

setup extensive time and manpower hours are lost by doing redundant work in using multiple systems. A streamlined and more efficient approach would be to perform all the billing, coding and collections in one system using OncoBilling (billing) as seen in figure A.7.

A well-used EHR system can add value to a practice and improve care processes. The present study showed that the cancer center has not leveraged the system to the fullest. Some of it is based on not having all the components, user knowledge, lack of training and reluctance from staff from different departments. One of the biggest challenges has been resistance to change from different departments at UP Health Systems Portage. This can be improved by better knowledge of the EHR system in addition to better communication, building awareness, engaging management and end users. Another issue with the EHR IT department is training, lack of access to attend workshops in the form of seminars, online tutorials in order to improve knowledge and expertise.

One of the biggest barriers has also been dedicating resources to optimize the EHR system. The cost on dedicating resources by investing in updating the system, adding new features, functions and quality training dramatically increases the efficiency in the practice and will pay for itself exponentially in the long run. Flatiron attained OncoEMR and built the OncoCloud suite which consists of OncoBilling, OncoAnalytics and OncoTrials [35]. The practice system currently does not have the components such as billing, analytics and clinical trial management. OncoBilling is a practice management system that assists with generating, filing claims and auto-allocating payments all in the

same application. It allows the practice to view performance real-time by providing practice productivity reports. OncoAnalytics allows the practice to have insights into their data by identifying unbilled or incorrectly billed drugs, quality performance and tracking reports which will prepare the practice as they move towards value-based reimbursement models. This includes chemotherapy usage, administration and revenue breakdown. Lastly, OncoTrials will allow the practice to keep pace with cutting edge medical science and provide the practice patients access to clinical trials by identifying them quickly using the EHR data. This will also assist with helping the practice do population health management which will improve quality of care.

6 Conclusion

UP Health Systems Portage Cancer Center is a small rural clinic with plans to become a regional cancer center. In 2016, they transitioned from paper charts to EHR, however they will now need to seriously consider optimization to accomplish their goals. In this study we uncovered several barriers to EHR post implementation. The study attempted to address those issues and create workable solutions. We feel that if the practice embraces optimization and invests the time and resources, they can improve quality, efficiency while reducing cost of care.

With the health care reform that is rapidly changing the scope of the health care environment in moving from fee for service to value-based reimbursement healthcare, organizations will need to adopt to these changes to further improve their practice. Several plans are in place to not only use EHR for sharing information but to also use the data generated from the system for clinical research and for data analytics. [36]

7 Reference List

1. Centers for Medicare & Medicaid Services. Lower Costs, Better Care: Reforming our Health Care Delivery System. 2013 Feb 28. Available from: https://www.cms.gov/Newsroom/MediaReleaseDatabase/Fact-Sheets/2013-Fact-Sheets-Items/2013-02-28.html.
2. Hoyt RE, Yoshihashi AK. Health informatics: practical guide for healthcare and information technology professionals. Lulu. com; 2014.
3. Hsiao CJ, Hing E, Socey TC, Cai B. Electronic health records systems and intent to apply for meaningful use incentives among office-based physician practices: United States, 2001-2011. System. 2012;18(17.3):17-3.
4. Romero MR, Staub A. Specialty Task Force: A Strategic Component to Electronic Health Record (EHR) Optimization. InNursing Informatics 2016 (pp. 1051-1052).
5. McAlearney AS, Song PH, Robbins J, Hirsch A, Jorina M, Kowalczyk N, Chisolm D. Moving from good to great in ambulatory electronic health record implementation. Journal for Healthcare Quality. 2010 Sep 1;32(5):41-50.
6. Buntin MB, Burke MF, Hoaglin MC, Blumenthal D. The benefits of health information technology: a review of the recent literature shows predominantly positive results. Health affairs. 2011 Mar 1;30(3):464-71.
7. Buntin MB, Jain SH, Blumenthal D. Health information technology: laying the infrastructure for national health reform. Health Affairs. 2010 Jun 1;29(6):1214-9.
8. Kawamoto K, Houlihan CA, Balas EA, Lobach DF. Improving clinical practice using clinical decision support systems: a systematic review of trials to identify features critical to success. Bmj. 2005 Mar 31;330(7494):765.
9. Gooch P, Roudsari A. Computerization of workflows, guidelines, and care pathways: a review of implementation challenges for process-oriented health information systems. Journal of the American Medical Informatics Association. 2011 Jul 1;18(6):738-48.
10. Blumenthal D. Implementation of the federal health information technology initiative. New England Journal of Medicine. 2011 Dec 22;365(25):2426-31.
11. Blumenthal D, Tavenner M. The "meaningful use" regulation for electronic health records. New England Journal of Medicine. 2010 Aug 5;363(6):501-4.
12. Shea S, Hripcsak G. Accelerating the use of electronic health records in physician practices. New England Journal of Medicine. 2010 Jan 21;362(3):192-5.
13. Boland MV, Chiang MF, Lim MC, Wedemeyer L, Epley KD, McCannel CA, Silverstone DE, Lum F, American Academy of Ophthalmology Medical Information Technology Committee. Adoption of electronic health records and preparations for demonstrating meaningful use: an American Academy of Ophthalmology survey. Ophthalmology. 2013 Aug 1;120(8):1702-10.
14. Torres YR, Huang J, Mihlstin M, Juzych MS, Kromrei H, Hwang FS. The effect of electronic health record software design on resident documentation and compliance with evidence-based medicine. PloS one. 2017 Sep 21;12(9):e0185052.

15. Press A, McCullagh L, Khan S, Schachter A, Pardo S, McGinn T. Usability testing of a complex clinical decision support tool in the emergency department: lessons learned. JMIR human factors. 2015 Jul;2(2).
16. Shanafelt TD, Dyrbye LN, West CP. Addressing physician burnout: the way forward. Jama. 2017 Mar 7;317(9):901-2.
17. Chaudhry B, Wang J, Wu S, Maglione M, Mojica W, Roth E, Morton SC, Shekelle PG. Systematic review: impact of health information technology on quality, efficiency, and costs of medical care. Annals of internal medicine. 2006 May 16;144(10):742-52.
18. Arndt BG, Beasley JW, Watkinson MD, Temte JL, Tuan WJ, Sinsky CA, Gilchrist VJ. Tethered to the EHR: primary care physician workload assessment using EHR event log data and time-motion observations. The Annals of Family Medicine. 2017 Sep 1;15(5):419-26.
19. Poissant L, Pereira J, Tamblyn R, Kawasumi Y. The impact of electronic health records on time efficiency of physicians and nurses: a systematic review. Journal of the American Medical Informatics Association. 2005 Sep 1;12(5):505-16.
20. Blumenthal D. Stimulating the adoption of health information technology. New England journal of medicine. 2009 Apr 9;360(15):1477-9.
21. Kazmi Z. Effects of exam room EHR use on doctor-patient communication: a systematic literature review. Journal of Innovation in Health Informatics. 2014 Jan 22;21(1):30-9.
22. Adler-Milstein J, Jha AK. No evidence found that hospitals are using new electronic health records to increase Medicare reimbursements. Health Affairs. 2014 Jul 1;33(7):1271-7.
23. Bowens FM, Frye PA, Jones WA. Health information technology: integration of clinical workflow into meaningful use of electronic health records. Perspectives in Health Information Management/AHIMA, American Health Information Management Association. 2010;7(Fall).
24. Poissant L, Pereira J, Tamblyn R, Kawasumi Y. The impact of electronic health records on time efficiency of physicians and nurses: a systematic review. Journal of the American Medical Informatics Association. 2005 Sep 1;12(5):505-16.
25. Joukes E, Abu-Hanna A, Cornet R, de Keizer NF. Time Spent on Dedicated Patient Care and Documentation Tasks Before and After the Introduction of a Structured and Standardized Electronic Health Record. Applied clinical informatics. 2018 Jan;9(01):046-53.
26. Menachemi N, Collum TH. Benefits and drawbacks of electronic health record systems. Risk management and healthcare policy. 2011;4:47.
27. Amatayakul M. Why workflow redesign alone is not enough for EHR success: addressing workflow changes has been heralded as vital to electronic health record (EHR) success. Undoubtedly, workflows will change with an EHR and should be anticipated, planned for, and carefully implemented. Healthcare Financial Management. 2011 Mar 1;65(3):130-2.
28. Pandhi N, Yang WL, Karp Z, Young A, Beasley JW, Kraft S, Carayon P. Approaches and challenges to optimizing primary care teams' electronic health record usage. Informatics in primary care. 2014;21(3):142.

29. Zheng K, Haftel HM, Hirschl RB, O'reilly M, Hanauer DA. Quantifying the impact of health IT implementations on clinical workflow: a new methodological perspective. Journal of the American Medical Informatics Association. 2010 Jul 1;17(4):454-61.
30. Khajouei R, Wierenga PC, Hasman A, Jaspers MW. Clinicians satisfaction with CPOE ease of use and effect on clinicians' workflow, efficiency and medication safety. International journal of medical informatics. 2011 May 1;80(5):297-309.
31. Lorenzi NM, Kouroubali A, Detmer DE, Bloomrosen M. How to successfully select and implement electronic health records (EHR) in small ambulatory practice settings. BMC medical informatics and decision making. 2009 Dec;9(1):15.
32. Zaroukian MH, Sierra A. Benefiting from ambulatory EHR implementation: solidarity, six sigma, and willingness to strive. Journal of Healthcare Information Management. 2006;20(1):53.
33. Jamoom EW, Heisey-Grove D, Yang N, Scanlon P. Physician Opinions about EHR Use by EHR Experience and by Whether the Practice had optimized its EHR Use. Journal of health & medical informatics. 2016 Jul 30;7(4).
34. Moon MC, Hills R, Demiris G. Understanding optimization processes of electronic health records (EHR) in select leading hospitals: a qualitative study. Journal of Innovation in Health Informatics. 2018 Jun 30;25(2):109-25.
35. Glorikian H, Branca MA. MoneyBall Medicine: Thriving in the New Data-Driven Healthcare Market. Productivity Press; 2017 Nov 20.
36. Evans RS. Electronic health records: then, now, and in the future. Yearbook of medical informatics. 2016 Aug;25(S 01):S48-61.