QUALITY IMPROVEMENT TARGETING EARLY PHASE OF HEPATITIS C CARE DELIVERY

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A DNP Project Manuscript
Submitted in Partial Fulfillment of the Requirements for the
Doctor of Nursing Practice Degree

University of Maryland School of Nursing
May 2019

Abstract

Background: In the United States, chronic hepatitis C is the leading cause of liver transplantation, and there are more than 3.5 million people infected with hepatitis C virus. Liver fibrosis evaluation is the most important assessment because individuals with hepatitis C are predisposed to liver fibrosis and liver failure. Individuals with advanced fibrosis and cirrhosis are at increased risk of developing advanced liver disease related complications such as variceal bleeding and hepatocellular carcinoma. Therefore, early recognition of these patients and providing recommended imaging surveillance for hepatocellular carcinoma, and gastroesophageal varices are imperative in reducing negative outcomes.

Local problem: In an inner-city infectious disease clinic, more than 30% of patients with hepatitis C did not have complete evaluation for liver fibrosis. The lack of liver fibrosis staging can potentially lead to negative clinical outcomes, such as cirrhosis, liver failure and hepatocellular carcinoma. Hence, the purpose of this quality improvement project was to increase the completion rate of liver fibrosis staging for adult patients with chronic hepatitis C in an outpatient infectious disease clinic.

Intervention: A quality improvement project was developed to improve and standardize liver fibrosis evaluation through the implementation of electronic order set in the electronic medical record. Following education on the evidence-based components of the order set, provider compliance was monitored through electronic reports to determine whether the completion rate of liver fibrosis evaluation for patients with chronic hepatitis C increased.

Result: The implementation of the electronic order set was effective in increasing the fibrosis evaluation completion rate. Before order set implementation, 68.7% of patients had complete fibrosis evaluation as compared with 89.7% after order set implementation (p= 0.016).

Conclusion: The implementation of an evidence-based hepatitis C order set improved liver fibrosis staging completion rates by more than 20%, and improved patient clinical outcomes by reaching evidence-based treatment goals for patients with hepatitis C. Electronic order sets are a sustainable method to implement evidence-based practice guidelines, and to ensure standardization of practice across all providers in a facility.

Keywords: Chronic hepatitis C, liver fibrosis, quality improvement, electronic order set.

Quality Improvement Targeting Early Phase of Hepatitis C Care Delivery

Overview

In the United States (U.S.), chronic hepatitis C (CHC) is the leading cause of liver transplantation (Organ Procurement and Transplantation Network, 2012). Currently there are more than 3.5 million people in the U.S. infected with hepatitis C virus (HCV) (Edlin, Eckhardt, Shu, Holmberg, & Swan, 2015). Individuals with hepatitis C are often of the non-Hispanic black race that have lower income and education levels, and face greater health social injustices, poorer access to health care, and thus, health disparities (Denniston et al., 2014). Patients with CHC with low income and Medicaid for health insurance were considerably less likely to receive therapy. In addition, large numbers of states restrict access for hepatitis C therapy for persons who inject drugs (PWID) or with alcohol disorders, despite multiple health organizations supporting HCV treatment regardless of injection drug or alcohol use based on growing body of evidence (Barua et al., 2015).

For patients with CHC, liver fibrosis evaluation is the most important assessment in determining the stage of disease, the urgency for treatment, and predicting disease progression and clinical outcomes. Because individuals with advanced liver fibrosis are at increased risk of developing complications related to advanced liver disease, such as variceal bleed and hepatocellular carcinoma (HCC), they need frequent follow up. Without early recognition of patients with advanced fibrosis, recommended surveillance for HCC and gastroesophageal varices would not be done, which results in poor clinical outcomes. The American Association for the Study of Liver Diseases and Infectious Diseases Society of America (AASLD/IDSA) HCV Guidance panel indicates that staging of liver fibrosis is vital before initiating HCV therapy (AASLD/IDSA Guidance Panel, 2017).

Based on extrapolated data from an infectious disease (ID) clinic in a large metropolitan city from July 1, 2014 to June 30, 2017, more than 30% of patients with CHC did not have complete evaluation for fibrosis staging. The lack of fibrosis staging can potentially lead to negative outcomes such as cirrhosis, liver failure, or hepatocellular carcinoma (HCC). Therefore, the purpose of this Doctor of Nursing Practice (DNP) project was to implement a quality improvement (QI) project that uses an evidence-based electronic medical record (EMR) HCV order set, to increase the completion rate of liver fibrosis staging for adult patients with CHC in an outpatient ID clinic. The EMR order set was developed for this project, by the project lead, based on AASLD/IDSA HCV guidelines that includes a non-invasive test for fibrosis staging. Studies have shown that the application and use of computerized order sets are effective in improving provider use of evidence-based standardized care, patient outcomes and reducing mortality (Krive, Shoolin, & Zink, 2015). Therefore, the order set (Appendix A) was implemented in the ID clinic in the fall of 2018 as an instrument to achieve this goal.

The short-term goals of this DNP project included (a) 100 % of the clinic providers receive training and education for the order set, (b) 100% of the providers use the order set during HCV evaluation visit, and (c) all patients without results from serum testing for fibrosis staging will be notified by phone or mail. The long-term goal of this DNP project was that every patient with HCV seen after implementation of the order set will have fibrosis staging completed.

Theoretical Framework

The knowledge-to-action (KTA) model (Appendix B) is a conceptual framework developed by Graham and colleagues that can serve as a platform in quality improvement for the process of knowledge translation, and ultimately serve to improve health outcomes by promoting

the application of knowledge generated from sound research (Straus, Tetroe, & Graham, 2013). The Centers for Disease Control and Prevention's National Center for Chronic Disease Prevention and Health Promotion has also adopted the KTA framework to translate scientific knowledge into action to improve the health of the public (Wilson, Brady, & Lesesne, 2011).

The KTA model is a combined model of a knowledge creation process, and knowledge application or action cycle, which is based on a review of more than 30 planned action theories. Knowledge creation process is comprised of three stages: knowledge inquiry, knowledge synthesis and creation of knowledge tools. The action cycle consists of seven sequential or concurrent phases "(a) identify problem; (b) adapt knowledge to local context; (c) assess barriers/facilitators to knowledge use; (d) select, tailor, and implement interventions; (e) monitor knowledge use; (f) evaluate outcomes; (g) sustain knowledge use" (Straus et al., 2013, p 11). Every stage of knowledge creation can influence any phases of the action cycle (Straus et al., 2013). The KTA model depicts the knowledge translation process as being comparable to a funnel, in which the new knowledge advances through different stages until it is accepted and applied (White, 2016).

The KTA model helped to guide the development of the intervention and to provide organizing structure for the implementation plan in the DNP project. For example, the knowledge creation process guided the intervention to develop and implement the EMR order set, and the order set was the knowledge tool, generated based on synthesized knowledge, useful to end users. The action cycle therefore, provided the structure for the implementation plan. The order set was constructed based on the HCV guidelines published by the AASLD/IDSA panel (2017), a living clinical practice guidelines (CPGs). The CPGs are updated regularly, using a laborious review process to appraise the best available evidence, and include biomarker testing

for hepatic fibrosis staging in the panel of the tests. The construction of the order set was a team effort that involved input from a wide array of multidisciplinary personnel. The team and stakeholders included experts in information systems and technology (IS & T), medical assistants, Registered Nurses (RNs), a nurse practitioner (NP) project leader, a physician project leader, staff NPs and technologists. The order set implementation plan included a provider education plan that was flexible in structure and format due to the number and schedule of the providers, and an email from the director to providers about deployment and use of the hepatitis C order set, and an onsite demonstration of the order set. The team also identified and included a champion and/or a super user to assist during the early phase of implementation. Following implementation, providers used the order set for HCV evaluation. With assistance from IS & T the project leader developed an EMR report used as an audit tool to assess provider's compliance throughout the implementation timeline.

Literature Review

The literature review started with evidence from studies about how order set use improves care quality and benefits of using EMR order sets. The second section of the evidence review includes studies about non-invasive diagnostic tests for fibrosis staging, and the lack of fibrosis staging as a deficit in hepatitis C care delivery. Finally, to illustrate the rationale for the component included in the order set, AASLD/IDSA hepatitis C Guidance was referenced.

Ancker et al. (2015) conducted a retrospective cross-sectional study, which included 65 providers and over 60 thousand patients in a network of federally qualified health centers (FQHCs) in New York City. The aim of the study was to assess the relationship between provider use of the EMR functions such as order set and health quality. They found that use of condition-specific order sets was associated with better performance on metrics such as

preventative services and disease management (p = <.005). The researchers determined which elements of the EMR may be associated with quality improvement, which is a strength. Additionally, the data are applicable to inner city clinics where most patients are medically underserved.

Chan et al. (2012) in Toronto, Canada, conducted a systematic review including over 40,000 patients in 18 studies to determine the benefit of order set use in health care. The most consistent finding in all studies indicated that the use of an order set had a constructive effect on provider adherence to practice guidelines with very few negative outcomes.

Kern, Barrón, Dhopeshwarkar, Edwards, and Kaushal (2013) conducted a cross sectional study that included many providers and patients in ambulatory practices in New York. The objective of the study was to determine the effects of EMRs adoption on ambulatory quality. The study showed that the use of an EMR by providers was associated with higher quality of care (p = .008), and a significant higher rate of recommended care. The study took place in clinics that accept payment from several different insurance companies, as is common in most ambulatory practices, therefore this increases the generalizability to clinics in the U.S. However, this study included a self-report adoption of EMRs as one of the predictor variables, so how providers used EMRs could not be entirely obtained.

Krive et al. (2015) conducted a retrospective controlled cohort study, by analyzing five years of CPOE data stored in EMR for over 15 thousand patients with pneumonia, from two cities and two community hospitals in Illinois. The researchers examined and quantified the benefits of evidence-based order sets, by comparing groups with order set used as the intervention, to determine the effectiveness of order sets in reducing mortality and readmission rate, and length of stay (LOS). The researchers determined that order sets were effective in

lowering readmissions (p = .039), LOS (p = .009), and mortality (p = .061), thus supporting the finding that evidence-based order sets have a positive impact on patient outcomes.

Yehia, Schranz, Umscheid, and Lo Re (2014) conducted a systematic review and meta-analysis of 10 studies in the U.S., to identify key deficits in chronic HCV care cascade and to improve the overall care delivery of this disease. The researchers determined that only 17% (CI 16-17%) of an estimated 3.5 million individuals infected with HCV had fibrosis staging, which resulted in downstream insufficiency in care delivery and ultimately affect treatment outcomes. This review identified large disparities between current practice and treatment goals, but it has relatively small number of studies included for analysis.

Poynard et al. (2013) conducted a prospective case controlled-cohort study on 422 adult patients with chronic liver diseases, such as CHC, in a hospital in Paris, France, to assess diagnostic accuracy and clinical applicability/validity of non-invasive tests (FibroTest [FT] and transient elastography [TE]), for fibrosis staging. The specificity for both TE and FT was greater than 95%, and the sensitivity was around 60%. The clinical validity for both tests was greater than 90%. The FibroTest was found to have a higher validity in patients with ascites. The strength of the study was the cohort size, and yet the cohort was not restricted to patients with CHC, which is a threat to internal validity.

Poynard et al. (2014) conducted a 10-year prospective cohort study, which consisted of three different cohorts of patients with CHC from academic liver centers in the U. S. and France, to demonstrate the validity of FT and TE, as markers to predict clinical progression in patients with advanced fibrosis. At 10 years, both FT (p <.0001) and TE (p <.0001) were predictive of severe complications, such as primary liver cancer. The results supported these two non-invasive tests are excellent assessment tools for predicting disease progression and clinical

outcomes. This is the first presentation of FT and TE predicting complications related to advanced liver disease, but the patient population was from tertiary centers, which could affect the external validity.

The hepatitis C guidance, published by the AASLD/IDSA guidance panel (2017), provides the most current evidence-based recommendations for HCV care providers on screening, and management for adults with HCV infection in the U.S. Based on Agree II (Brouwers et al., 2010), the overall quality of the Clinical Practice Guidelines (CPGs) is to be considered the highest possible quality. The CPGs recommend using non-invasive testing, to include FT, and/or TE to assess the degree of fibrosis during initial evaluation on all patients. The exception to this recommendation is for patients with clinical evidence of cirrhosis, the final stage of liver fibrosis, as they do not need additional testing for fibrosis staging. The FibroTest, also known as FibroSure in the U.S., was a combination of biomarkers developed in 2001, that replaced liver biopsy for liver fibrosis testing for hepatitis C. The FibroTest uses the results of six blood serum tests (α2 macroglobulin, haptoglobin, apolipoprotein A1, Gamma-glutamyl transpeptidase, total bilirubin, and alanine transaminase) to generate a score that is correlated with the degree of liver damage (Imbert-Bismut et al., 2001). The transient elastography is a specialized ultrasound machine using elastic shear wave to measure liver stiffness that quantify liver fibrosis (Sandrin et al., 2003). Assessment of fibrosis is critical to make therapeutic decisions and determine the proper follow up for patients. This guidance also recommends following laboratory tests as a part of the evaluation or prior to treatment:

- Hepatitis serology, and Human Immunodeficiency Virus (HIV): coinfection with hepatitis B virus or HIV correlated with unfavorable prognosis of HCV.

- Complete blood cell count (CBC), hepatic function panel, coagulation, and calculated glomerular filtration rate (eGFR): evaluating liver-related health status and monitoring HCV treatment drug-related adverse events.
- Quantitative HCV RNA: monitoring treatment response.
- Genotype: determining treatment agents, and fibrosis progression prognosis (AASLD/IDSA Guidance Panel, 2017).

Based on this review, the studies (Ancker et al., 2015; Chan et al., 2012; Kern et al., 2013; Krive et al., 2015) about CPOE order sets all have ample sample size with different approaches exploring benefits of CPOE order sets. Furthermore, two of the studies (Ancker et al., 2015; Kern et al., 2013) also include how provider use of order sets affect health care quality. The first systematic review about the effects of order set (Chan et al., 2012) confirmed that order set uses have a positive impact on provider adherence to practice guidelines. The studies (AASLD/IDSA Guidance Panel, 2017; Poynard et al., 2013; Poynard et al., 2014; Yehia et al., 2014) reviewed to illustrate rationales for including fibrosis staging as a part of the order set, have high merits. The HCV guidance (AASLD/IDSA Guidance Panel, 2017) is the highest quality CPGs, (Yehia et al., 2014) presented a treatment cascade for HCV care in the U.S., and (Poynard et al., 2013; Poynard et al., 2014) examined the clinical applicability of fibrosis staging. The literature review provided invaluable information for the proposed practice change. Order set use not only reduces mortality and increases delivery of important care practices in hepatitis C care, but also helps improve health care quality by standardizing care delivery and reducing inefficiencies in health care. Moreover, Healthcare Information and Management Systems Society (HIMSS) (2018) indicates that a computerized order set embedded in the EMR, can help clinicians to address specific problems in preventive and chronic care, as well as in

early adverse event recognition and prevention. Based on the evidence, an order set is a critical tool for promoting effective quality improvement, therefore it was utilized to standardize care in this ID clinic. Furthermore, including tests for fibrosis staging will also help lessen the sizable gap between current practice and evidence-based treatment goals for HCV care.

Project Implementation Plan

This project specifically focused on a practice change in the provider use of an EMR HCV order set when conducting evaluation for patients with CHC. The inclusion criteria for the patient population were patients 18 years or older, with a diagnosis of CHC who had not previously been evaluated in this clinic. The inclusion criteria for the provider sample will include Nurse Practitioners (NPs) and Physicians (MDs) providing HCV care, and the sample provider size (n=7) is based on the number of current HCV providers which include three NPs, and four MDs.

Procedures and Timeline

This project was implemented over a 15-week period. During the first week, the project leader (PL) met with medical director to send out an email to HCV providers about upcoming training for the order set and briefly describe how it would be used. The PL then met with the champions (an MD, an NP, and an RN), who were identified during the strategizing phase to finalize the coordination plan (Figure 1). The PL and/or a provider champion completed training of HCV providers by providing one-on-one 30-minute training sessions on Monday, Tuesday, and Friday during HCV clinic hours. The training consisted of three parts: A PowerPoint presentation (Figure 2) about the purpose and rationale of the project, the trainer demonstration of order set use within the EMR (Epic systems) and return demonstration from the providers. The provider champions completed the pilot user acceptance testing for evaluating functionality

and preliminary use of the order set. Initially the PL proposed the order set to go live on the second week, but because the order set did not display correctly in the EMR, the go live date was delayed.

Upon correction of the display error, the EMR order set went live at week four of the project implementation plan. All providers began using the order set during every HCV initial patient evaluation visit. The project champions monitored and supported the coordination process of implementation. During week four through seven, provider compliance in using the order set was assessed during every HCV evaluation visit. The PL monitored the ratio between the number of order sets used, and the number of HCV evaluation visits weekly. The number of order sets used was extracted by using a specific EMR workbench reporting, and the number of HCV evaluation visits was generated by an EMR report analyst.

During week eight to 11, to evaluate and track data of fibrosis evaluation completion, the PL and the NP champion performed EMR chart audits on those patients that order sets were used. The chart audits included age of the patients (must be 18 years or older), diagnosis of hepatitis C was in the problem list, date of the evaluation, names of ordering providers, and if laboratory results of the order set were available. To notify those patients without fibrosis staging results, the PL sent email messages in the EMR to provider-specific RNs, to alert them of the need for contact and follow up for those patients from the previous month. Additionally, based on the number of patient visits from the first four weeks (week 4 to 7), and historical data, this clinic has greater than 30% patient no-show rates, the NP champion started to place appointment reminder calls two days in advance of their appointments to improve appointment attendance and increase the sample size. Furthermore, when a laggard in adoption to the practice change was identified, a provider champion was engaged to intervene and encourage adoption of

the HCV order set. During week 12 through 15, the PL continued to monitor the progress of order set adoption by reviewing provider compliance rate over time, and monitored the fibrosis staging completion rate on patients.

Data Collection and Tools

A sign in log (Appendix C) with training dates, and signatures of trainer and trainee was created to capture structure measure data that included the number of providers who have received training and demonstrated competency by returned demonstration in using the order set during the first week. Data collection for process measures were done biweekly during week four to 15 utilizing electronic data and electronic chart audits. Electronic data included, order set usage extracted from a workbench report and the number of HCV evaluation visits pulled by an EMR report analyst. The PL and the NP champion conducted the EMR chart audits that included the completion status of fibrosis staging evaluation (yes=1, no=0, indeterminate=2) (Appendix D), and the confirmation of patient notification in the EMR among those without fibrosis staging results.

Data Analysis

The PL generated a coded data report based on data collected on structure and process measures, and the coded data were entered in an Excel program for further analysis. Data were analyzed through descriptive statistics including the mean, frequency, and percentage of order set usage among providers. Additionally, the percentage of providers using order sets during the study period were calculated by number of order sets used divided by the number of HCV evaluation visits. Finally, the Chi-square (X^2) test was used to determine the difference in fibrosis staging completion rates between pre and post order set implementation (*p* value less than .05 was considered statistically significant).

Human Subjects Protection/Approval Processes

A password protected and encrypted laptop computer was used to store and analyze data. Microsoft Excel was used to track and trend data. The final data report excluded use of patient identifiable information (PII) to ensure there was minimum to no threat to confidentiality. The project description and inquiry were submitted to the local Institutional Review Board (IRB), and was determined to be a Non-Human Subjects Research (NHSR).

Results

To ensure visibility and ease of use of the order set during the project period, a request was made to the IS & T team to automatically display the HCV order set option under the plan section of the provider note on all scheduled visits to this ID clinic (Figure 3). The electronic data on provider usage of the order set, and number of HCV evaluations were collected for 12 weeks. There were 29 (N =29) hepatitis C evaluation visits over 12 weeks. Chart audits consisted of reviewing data on age of patient (18 and older), visit date, provider, use of order set, and fibrosis staging completion status. The complete data of chart audits were exhibited, and there were no HCV evaluation visits for week 11 (Table 1).

The aggregate data based on the chart audits is displayed showing both provider compliance and number of weekly visits (Figure 4). The trend for provider compliance in using the order set showed the mean was 83.9%, with median at 100%. When below the mean compliance was noted for week three and week five, a laggard in adoption or a barrier was identified. Therefore, a one-to-one meeting, between the laggard and the QI project site lead NP, was arranged in a timely manner to improve compliance with the use of the order set later on (Figure 5). The trend for the number of weekly visits demonstrated the mean was 2.64, with a median of two visits per week (Figure 6).

The fibrosis staging completion rate was significantly better after order set implementation than before order set implementation (89.7% vs 68.7%, respectively, $X^2 = 5.75$; $p = .016$) (Figure 7). It is important to note that, the number of HCV evaluation visits were significantly lower during project period, compare to the period where there was no order set. This was expected as the number of patients needing HCV treatment has dropped significantly since the advent of oral direct-acting antivirals in 2014, offering cure rate as high as 95% (Chhatwal et al., 2016).

Discussion

For this QI project, the application of the KTA model has helped guide the knowledge translation process to move from evidence to practice with demonstrated results. The results of this project showed that all hepatitis C providers received training and education, and the goal of 100 % of trained providers using order set was achieved by project week eight. All patients without staging results were notified for further follow up. Most importantly, after implementation of a CPG-based HCV order set within the EMR, fibrosis staging completion rates among patients with HCV, has improved to almost 90%. This improvement in results after implementation of a disease specific order set, mirrors those found in the available literature. Ancker et al. (2015) found that the use of condition-specific order sets was associated with better performance on disease management metrics. Moreover, Chan et al. (2012) determined that the use of an order set had a constructive effect on provider adherence to practice guidelines. Additionally, a retrospective controlled cohort study conducted by Krive et al. (2015) that analyzed five years of CPOE data stored in an EMR, determined that evidence-based order sets have a positive impact on patient outcomes.

Strengths of this project include the fact that the AASLD/IDSA guidelines for HCV treatment are well established and easy to implement in the form of an HCV order set. Another strength of this study is the multidisciplinary approach that includes stakeholders who work in the clinics: providers, RNs, medical assistants and perhaps most importantly an IS& T team with a strong healthcare background and previous experience developing order sets and disease specific reports to pull the necessary data.

While this data may not be generalizable, it could apply to other similar clinic settings, however it is important to note the limitations of the project. This project was conducted within one inner city medical system in the U.S., and all of the clinics used the same EMR. Moreover, data was collected for only 12 weeks with a small sample size, seven providers and 29 patient visits. Some of the providers expressed resistance to a change in practice and that resistance would most likely be magnified in a larger provider sample. It is also important to note, the number of HCV evaluation visits were significantly lower during the project period as compared to the period when no order set was available. This is because the number of patients who need HCV treatment has dropped significantly since 2014, with the advent of highly effective oral direct-acting antivirals that offer HCV cure rate as high as 95% (Chhatwal et al., 2016).

Finally, having an IS & T team available and knowledgeable about healthcare data to help with building of the order set was a cost-saving benefit. For example, during the testing phase, we discovered that the users were unable to see their lab orders after selecting the order set, which required further intervention by the IS& T team to correct. The IS& T team resolved both display issues, enabling the order set to go live at week four of the project implementation without significant delay.

Despite initial resistance from providers in order set use, providers were ordering test for fibrosis staging without using the order set, which was an unexpected benefit. One could presume that the implementation of HCV order set has helped raise awareness of the importance for liver fibrosis staging in patients with HCV, and subsequently addresses the health disparities encountered by patients with hepatitis C. Therefore, in this inner-city ID clinic, implementation of an evidence-based HCV order set clearly improved the fibrosis staging rates.

Finally, it is imperative to discuss the results for the plan of sustainability. The project is considered sustainable because of the following:

1. A clear need for the practice change to occur in the clinic to improve care delivery.
2. Early engagement of the medical director, and mentors from the clinic in the planning of the project.
3. An integration of a standardized care (order set) of the practice change into EMR.
4. The inclusion of provider champions from the HCV clinic to facilitate the change and continue the process, and ongoing collection of outcome measures data.

Conclusion

This QI project improved fibrosis staging completion rates by more than 20% clearly indicating that implementation of an HCV order set improves fibrosis staging completion rate and potentially improved patient outcomes. Moreover, the implementation of the order set has a positive impact on provider adherence to CPGs, thus reaching the evidence-based care goals for patients with HCV.

The evidence-based HCV order set is now part of the provider note and used by providers on a daily basis, for both established and new patients. The HCV order set allows providers to have the CPGs at their fingertips, and also serves as a reminder to provide evidence-based care.

A similar QI project could be undertaken in any ambulatory care clinic seeking to improve the quality of healthcare delivery. This includes the primary care setting where age-based order sets for annual visits and preventive care could be implemented, or in specialty clinics that treat chronic health conditions where secondary prevention is essential. Future QI projects could include expansion of the HCV order set to other ID clinics within this inner-city medical system. This would provide both a larger provider size and patient cohort and improve internal validity, thereby improving applicability.

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Table 1

Chart Audit Data (N=29)

Week	Patient age	Visit Date	Provider	Order set used	Fibrosis staging result
1	67	9/20/2018	NP2	1	1
	63	9/21/2018	MD2	1	0
2	46	9/24/2018	NP2	1	1
	60	9/24/2018	NP3	1	1
3	46	10/1/2018	NP3	0	1
	59	10/5/2018	MD1	1	1
	61	10/5/2018	NP3	0	1
4	52	10/7/2018	MD2	1	1
	58	10/12/2018	MD1	1	1
	55	10/12/2018	MD4	1	1
5	60	10/15/2018	NP3	0	1
6	59	10/23/2018	NP1	1	1
	57	10/26/2018	MD3	1	1
7	55	10/29/2018	NP3	1	1
	53	10/30/2018	NP1	1	1
	34	10/30/2018	NP1	1	0
	67	10/30/2018	NP1	1	1
	61	10/30/2018	NP1	0	1
	54	10/31/2018	NP1	1	1
8	57	11/6/2018	MD3	1	1
	65	11/8/2018	NP1	1	1
	41	11/8/2018	NP1	1	0
9	58	11/13/2018	MD3	1	1
	60	11/14/2018	MD2	1	1
	62	11/16/2018	NP1	1	1
	63	11/16/2018	NP1	1	1
10	63	11/20/2018	NP3	1	1
12	46	12/3/2018	NP3	1	1
	65	12/4/2018	NP1	1	1

Note. For order set used and fibrosis staging results, 1 = yes; 0 = no. There were no HCV evaluation visits on week 11.

Figure 1. Coordination plan

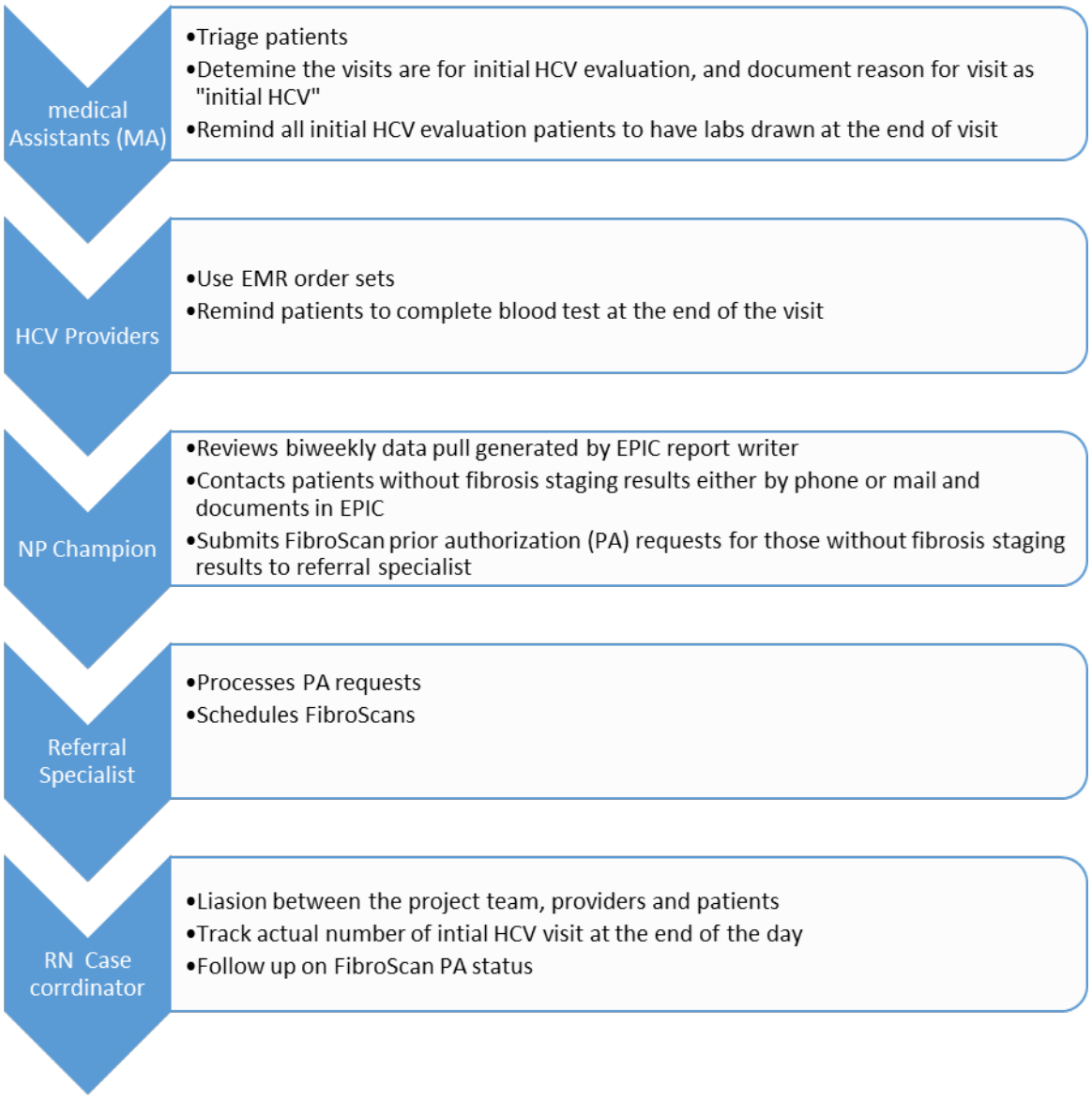


Figure 2. Training PowerPoint slides

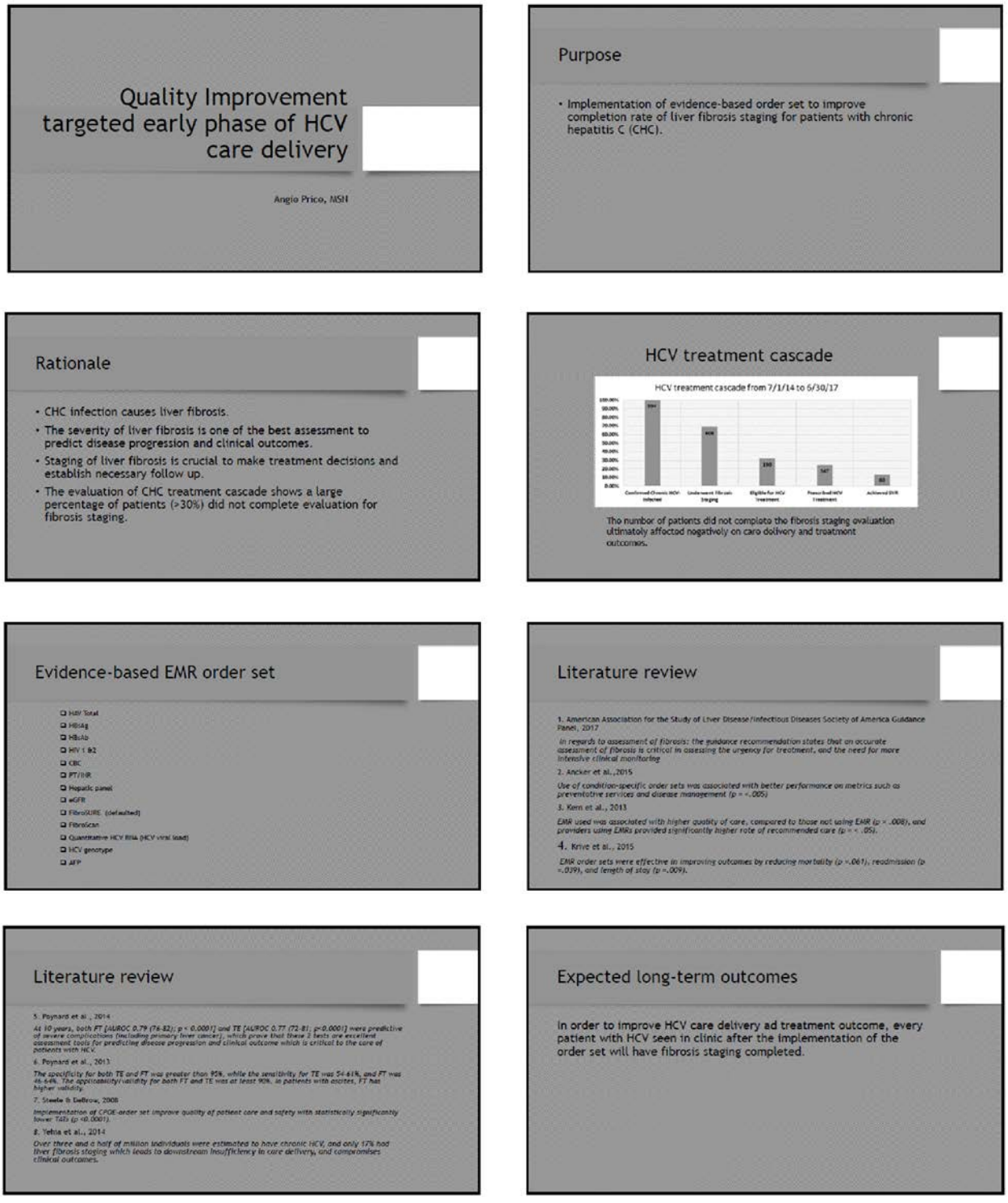


Figure 3. HCV Order Set Option

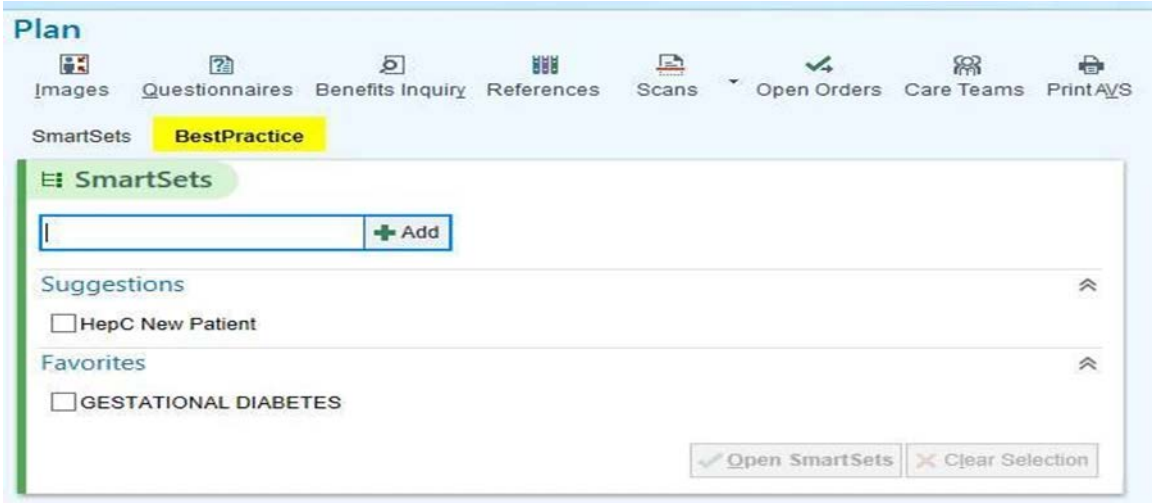


Figure 4. HCV Order Set Usage Data

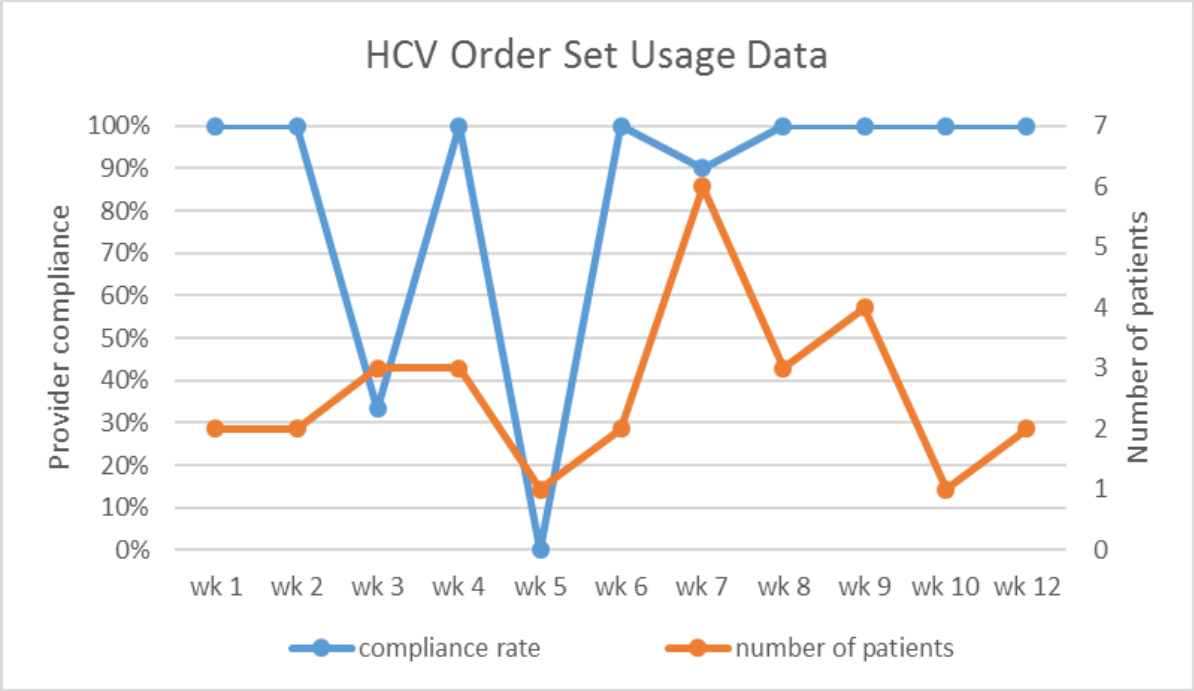


Figure 4. There were no HCV visits on week 11

Figure 5. Provider Compliance in using order set

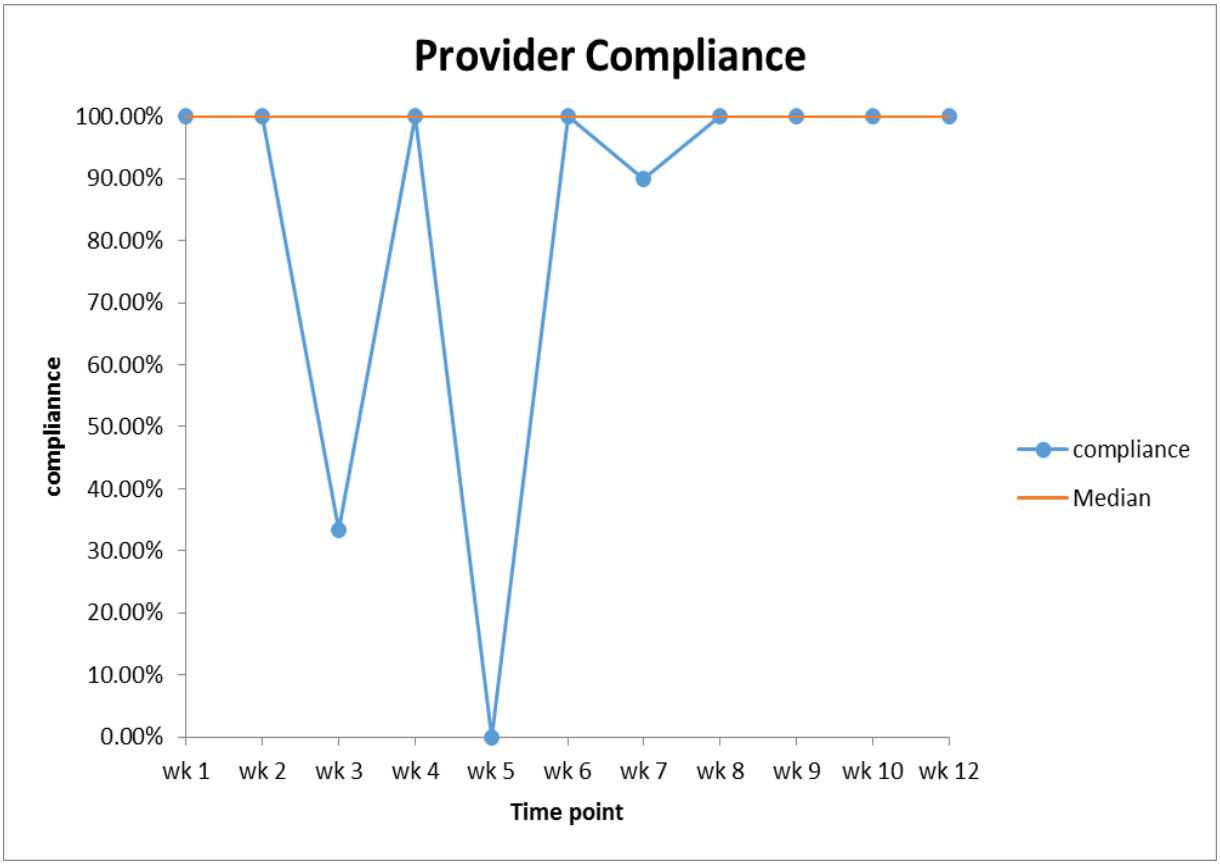


Figure 5. Mode = 100%, Median = 100%, Mean = 83.9%.

Figure 6. Weekly Number of HCV Evaluation

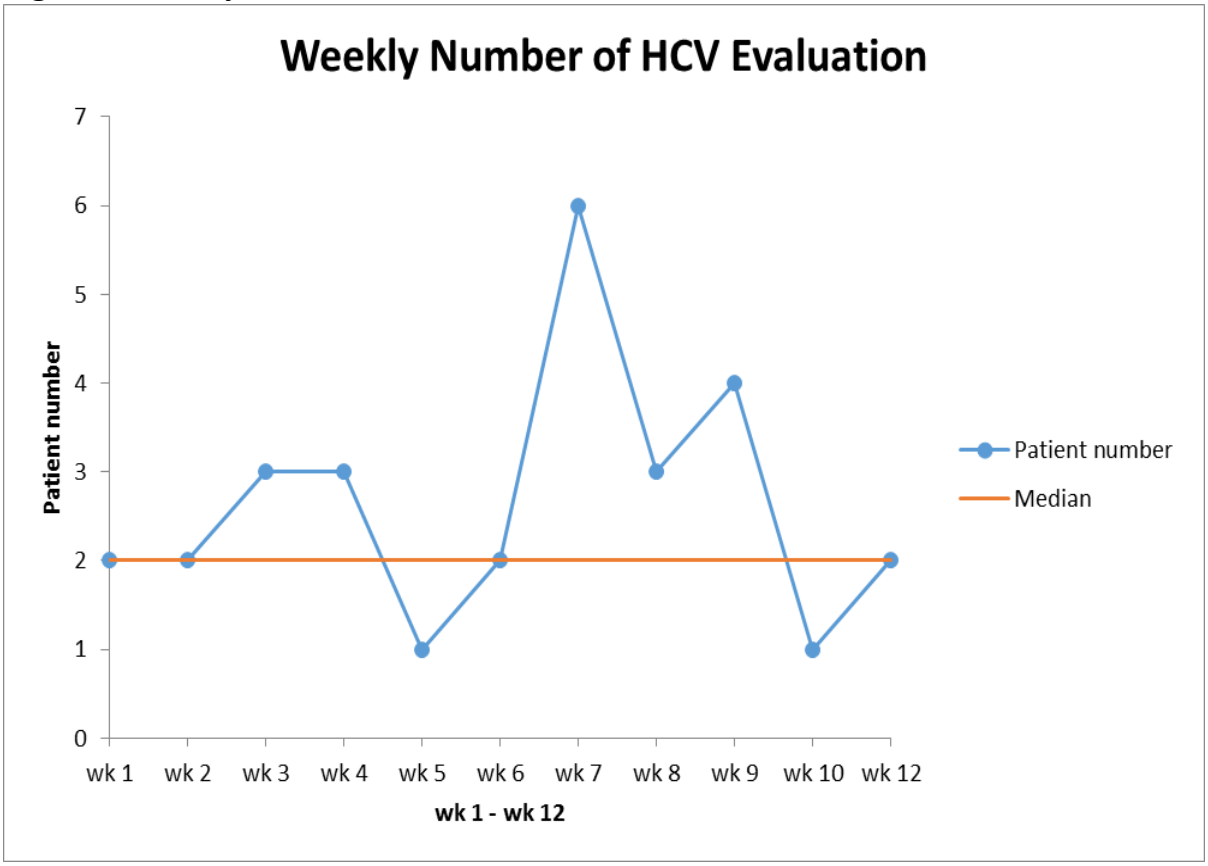


Figure 6. Mode = 2, Median = 2, Mean = 2.64

Figure 7. Comparison of Fibrosis Staging Completion Rate

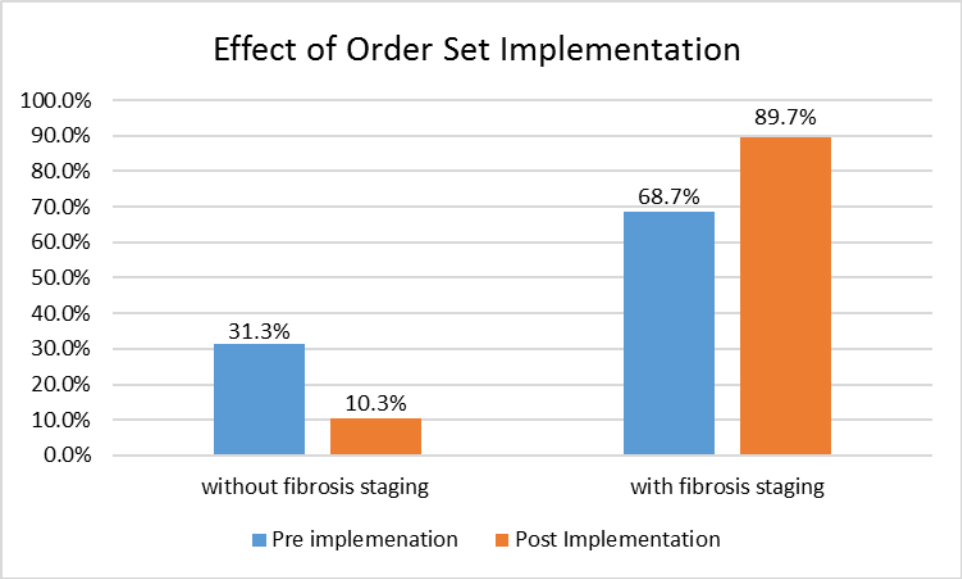
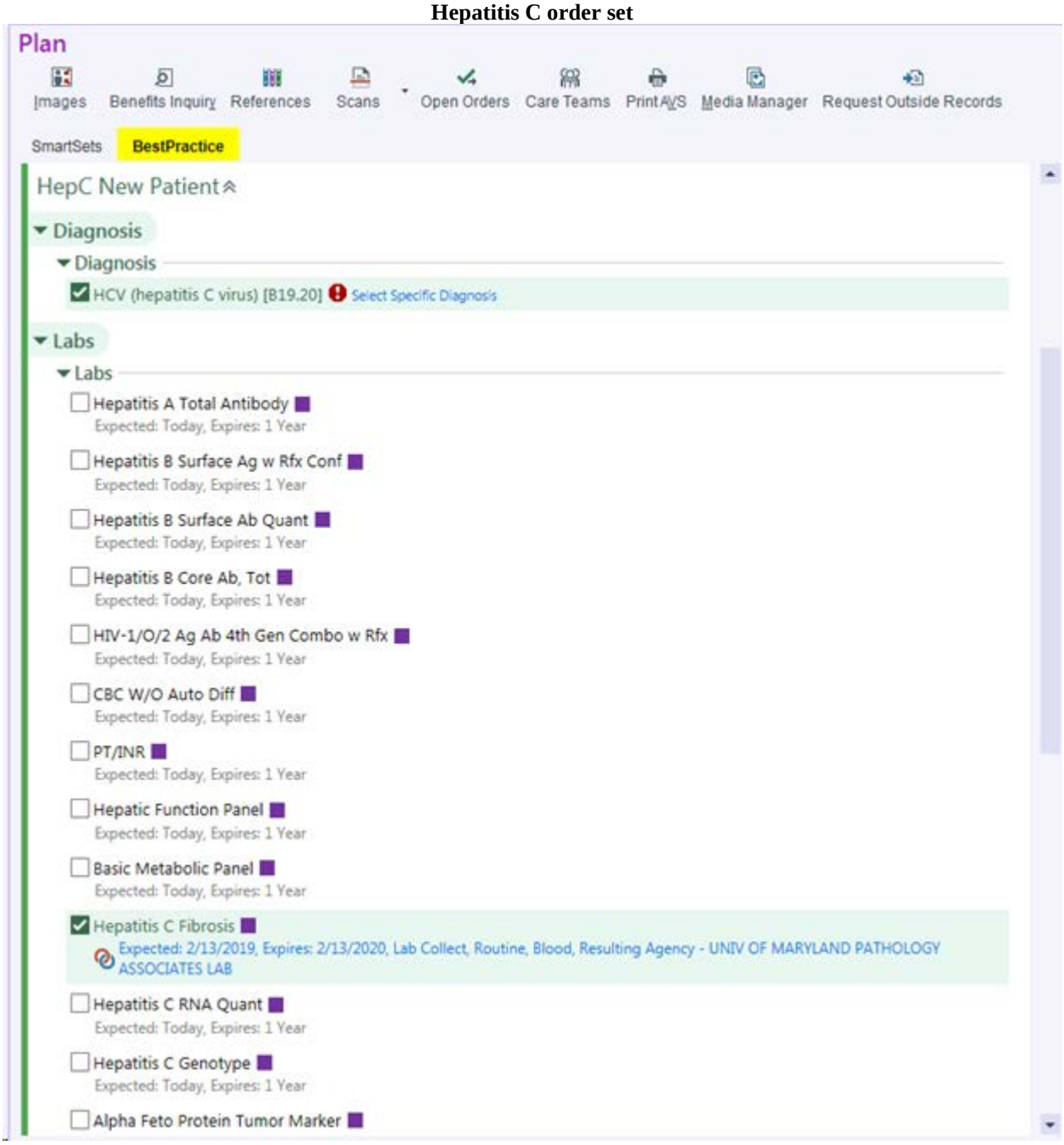


Figure 7. $X^2 = 5.752$, $p = .016$. The result is significant at $p < .05$

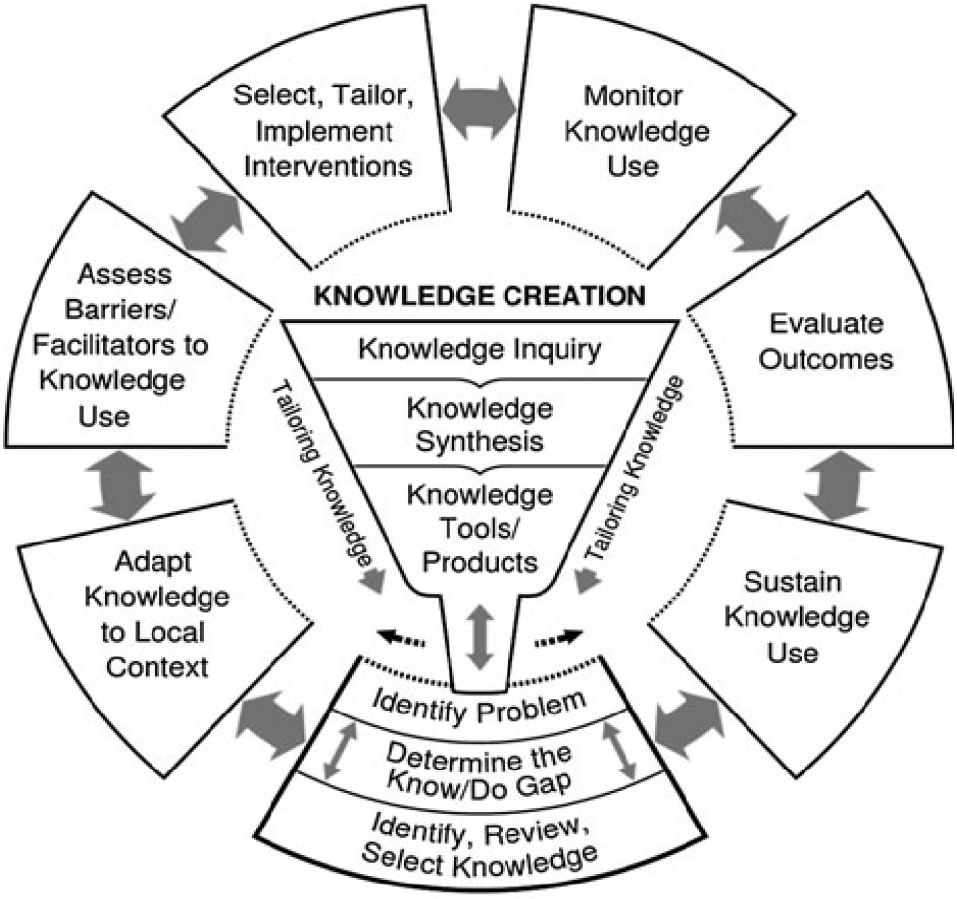
Appendix A

Hepatitis C order set



Appendix B

The Knowledge to Action Model



Straus, S., Tetroe, J., and Graham, I (Ed). (2013). Knowledge Translation in Health Care: Moving from evidence to practice. (2nd ed.) Chichester, United Kingdom: John Wiley & Sons Ltd.

Appendix C

Training log

Date	Provider Name	Provider Signature	Trainer

Appendix D

EMR chart audits on those patients without fibrosis staging results

Patient Name (first 3 letters of first and last name)	Date of initial visit	Follow up contact date	Method
			☐ Phone ☐ Mail
			☐ Phone ☐ Mail
			☐ Phone ☐ Mail
			☐ Phone ☐ Mail
			☐ Phone ☐ Mail
			☐ Phone ☐ Mail
			☐ Phone ☐ Mail