Implementation of a New Cardiology Hospital Service with Nurse Practitioners: a Quality Improvement Project to Improve Patient Access and Outcomes

Submitted to

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Abstract

Background: Patient-access delays due to excessive wait times for clinic consult appointments impair timely diagnosis/treatment, resulting in worse outcomes.

Problem: Average days wait (ADW) for clinic consult appointments for the cardiology group of a regional managed care organization (MCO) was excessive.

Methods and Intervention: Based on the IHI Model for Improvement, a quality improvement project (QIP) was implemented to reduce ADW while improving patient coverage. The QIP entailed a new cardiology hospital service with 11 cardiologists and 3 cardiology NPs who rotated between hospital and clinic service. Two cardiologists and one NP covered all cardiology inpatients, alleviating the need for clinic-assigned cardiologists also to see hospitalized patients and thereby improving capacity. The primary measure was ADW; secondary measures were patient satisfaction with access, hospital readmissions, clinic cancellations, and provider job satisfaction.

Results: All measures were assessed on pre/post 6-month averages. ADW fell from 28 days to 14. Patient satisfaction improved from 39% to 52%. Readmissions dropped from 13.2% to 9.7%. Intervention-related provider job satisfaction was 91%. No significant changes arose in potential confounding factors, and no negative consequences were identified.

Conclusions: Implementation of a cardiology hospital service with NPs was feasible, shortening ADW and improving patient access/associated outcomes.

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Timely access to healthcare services is critical. According to the U.S. Department of Health and Human Services (HHS) 2013 National Healthcare Quality Report (2014), multiple studies demonstrated that expedient care for health issues reduces emotional distress, physical harm, hospitalization rates, mortality and morbidity, and treatment costs for patients. Supporting the importance of this issue, one of the six ongoing goals from the National Academy of Medicine (NAM) is timely access, defined as "reducing waits and sometimes harmful delays for both those who receive and those who give care" (Wolfe, 2001, p. 234). Additionally, a primary objective of the US Government's "Healthy People 2020" program is to "reduce the proportion of persons who are unable to obtain or delay in obtaining necessary medical care" (HHS, 2019, p. 1).

This issue of delayed access can be even more important in specialty medical areas. According to Osborn, Squires, Doty, Sarnak, and Schneider (2016), over 6% of people in the U.S. waited more than 2 months for an appointment with a specialist. In the cardiology area, patient access for initial and follow-up cardiology consultation visits is critical for timely diagnosis and treatment and for improved patient outcomes. Long wait times for initial consults increase risks of adverse events, increase readmission rates, and impact patient satisfaction (Atzema et al., 2018; Bungard et al., 2009; Tanguturi et al., 2016). Multiple challenges can contribute to delayed access, but these issues are often related to lack of available cardiologist time and process inefficiency (Kwong, 2016).

The cardiology group of a regional managed care organization (MCO) had been experiencing this type of access issue for new clinic cardiology consults. Wait times for consult appointments at the primary cardiology clinic began rising in early 2018 and increased to an average of approximately 6 weeks for the second half of 2018, well above the institution's 10 day

target. This problem was related to decreased cardiologist capacity driven by clinical and acute care coverage needs. The delayed access could potentially affect any of the 650,000 patients in the managed care service area who had or developed cardiology health issues. The lack of timely access was also impacting the organization's mission to provide high-quality affordable health care services and to improve the health of its members and the communities it serves.

Existing knowledge about this issue and potential solutions is limited, but the current literature (detailed in Appendix A and summarized below) shows that utilizing Nurse Practitioners (NPs) to their full scope of practice can help address the problem. Specifically, synthesis of the studies reveals several themes related to increased NP scope in this area including (a) improved resource capacity and patient access to care, (b) improved patient outcomes, and (c) improved patient and provider satisfaction. The full scope of NP practice in this context is defined by American Association of Colleges of Nursing (AACN) Adult-Gerontology Acute Care and Primary Care NP Competencies (AACN 2016). The scope includes assessment and diagnosis of health status followed by development and implementation of plans of care, with collaboration among the interdisciplinary health team.

Several studies show that using NPs to this full scope improved resource capacity and patient access. In a Canadian hospital, Béchard, Brouillette, Nadon, Argentin, and Tournoux (2017) determined that expanding roles of NPs increased the number of actively followed patients by 35%. Two additional studies demonstrated capacity improvement through new NP hospitalist programs with over 20% increases in new admission capability (Butcher, 2017; Wells, Coates, Williams & Blackmore, 2017). Linking how this improved capacity can improve access, Kwong (2016) found that extending NP scope reduced referral access times from approximately 4 weeks to 7 days. In a similar study, Bungard et al. (2009) showed a multi-faceted program, including

expansion of NP use, reduced time to initial cardiology consultation from 71 to 33 days and time to definitive diagnosis from 120 to 51 days.

Many studies demonstrated how the improved patient access led to improved clinical outcomes. In an acute care cardiothoracic unit, the addition of NPs reduced intensive care unit (ICU) readmissions from 2.6% to 1.9%, reduced length of stay from 10 to 8 days, and improved overall survival from 96.5% to 98.0% (Southey, Mishra, Nevill, Aktuerk, & Luckraz, 2014). In another study also focused on readmission, Tanguturi et al. (2016) determined that a program including 2 week hospital discharge follow-ups in a cardiology clinic helped reduce hospital readmission rates from 9.6% to 5.3%. Similarly, Atzema et al. (2018) found that clinic follow-ups within 7 days of discharge reduced 90 day readmission rates, hazard ratio (HR) 0.87 (0.80–0.94), and reduced 1 year mortality, HR 0.92 (0.87–0.97), compared to follow-up visits more than 7 days after discharge. Related to a different type of patient outcome improvement, Navarro, Lapiene, and Sivak (2017) showed that reducing cardiology clinic access to less than 2 week wait times decreased appointment no-show rates to 5.8% compared with 29.1% for longer wait times. Van Deventer et al. (2015) revealed similar gains with patient appointment compliance improving from 56% to 90% after a decrease in access wait times from 85 days to 18 days. From a cost perspective, Kapu, Kleinpell, and Pilon (2014) showed the addition of inpatient NP teams increased operating margin and reduced length of stay.

Finally, synthesis of the research also reveals a common theme linking increased NP scope with improved patient and provider satisfaction. In a comprehensive, multi-center review, Kartha et al. (2014) reviewed data from 124 Veterans Affairs (VA) hospitals and found VA hospitals with higher NP utilization had better patient and staff satisfaction with patient coordination and discharge processes. Adding an extended time dimension, Johnson (2011) demonstrated improved patient and medical doctor (MD) satisfaction through expansion of cardiology NP roles over a 14

year analysis at a large medical center. In a different approach using a collective case study, McDonnell et al. (2015) concluded the addition of NPs in acute care settings improved the patient experience, resulted in improved outcomes, as well as improved quality of working life, distribution of workload, and team working.

Supporting the research linking better patient access with improved patient outcomes and patient and provider satisfaction, Peplau's Theory of Interpersonal Relations provides a framework for understanding and explaining the problem and for guiding the focus of access related quality improvements (Peplau, 1992). Peplau's theory focuses on the interpersonal process and partnership between a healthcare provider and patient. Her model emphasizes mutual respect between the patient and healthcare provider as individuals, with both learning and growing as a result of interactions. Thus, the interactions between the patient and healthcare provider are the critical elements. Peplau further defines four phases of interactions which evolve over a patient-provider relationship including (a) orientation, (b) identification, (c) exploitation, and (d) resolution. Through all these phases, time and patient access to the healthcare provider are required for the relationship to mature. As such, Peplau's model helps explain why limited or delayed access to clinical visits is a problem. Without these interactions, the therapeutic relationship between the provider and patient will not develop or will be delayed, and patient outcomes will suffer. The model also guides interventions by providing a theoretical basis for why improved access will improve patient outcomes.

Providing additional theoretical support to guide interventions for increasing NP scope to improve patient access and outcomes, the Kotter 8-Step Change Model can help ensure any interventions achieve the desired results (Kotter, n.d.). From Kotter's work, it is recognized that enhancements such as NP scope expansion will face many organizational and cultural change issues. As Kotter notes, most transformation / change efforts fail. One common reason for the

failure relates to the lack of a well-defined and executed organizational change management plan. To address this need and help ensure more successful access improvement efforts, the Kotter 8-Step Change Model can provide the underlying model for transformations.

Based on these theoretical underpinnings, the existing research, and the local issue, the Institute for Healthcare Improvement's (IHI) Model for Improvement was utilized to explore the problem and develop specific aims for a quality improvement project (QIP). The aim for the QIP was to implement a new hospital cardiology service, with the addition of NPs, to provide additional cardiologist clinic capacity to improve timely patient access. The goal was to reduce the average days wait (ADW) for cardiologist clinic consult appointments from 28 days to 14 days by 6/30/19. Associated with this primary aim were four sub-aims over the same time period including: (1) improve clinic patient satisfaction with access from 39% to 55%; (2) help decrease Centers for Medicare & Medicaid Services (CMS) targeted cardiology related readmissions from 13% to 12%; (3) reduce the average number of patient "cancelled or no-show" cardiology clinic consult visits from 25% to 15%, and; (4) improve job satisfaction of cardiology MD's and NPs as a result of the QIP to 90%. Supporting these outcomes, several process measures were also tracked to ensure compliance with changes. These goals were developed to help address the triple aim of healthcare by improving the patient experience, the health of the cardiology population, and the cost of service. Additionally, the project was intended to help address the knowledge gap related to the specific idea of how use of NPs as inpatient cardiology specialists might improve capacity, reduce patient access times, and improve patient outcomes.

To develop, implement and support efforts to achieve these aims, a core interprofessional project team was formed. Members of the team included the chief of the cardiology group, the director of cardiology services, the cardiology business analyst, and the coordinator for the NP team. The NP team coordinator also functioned as the overall project manager for the QIP.

Methods

Context

Similar to the breadth of the interprofessional project team, the population associated with the QIP is large and diverse. It includes all cardiology patients for a regional MCO seen in the primary cardiology clinic or the primary hospital. Most of the patients live in the Denver metropolitan area but could come from anywhere in Colorado. Outpatient cardiology services for the area are provided by the primary cardiology clinic in the MCO's downtown center, while inpatient care is provided by the MCO's affiliated central hospital (adjacent to the clinic).

Baseline 2H18 data for this population included approximately 5,500 MD and NP visits in the primary cardiology clinic and approximately 3,800 inpatient visits in the associated hospital. All cardiology patients seen in the clinic or requiring cardiology coverage in the associated hospital, with any cardiology related diagnosis, will be affected by the new process. As noted, the project has the potential to affect any of the 650,000 patients in the MCO who require cardiology services.

Intervention and Study of the Intervention

The IHI model for improvement guided analysis of the problem, creation of the aims, and design of the intervention approach. As shown in Appendix B, a fishbone diagram helped define root causes, and a driver diagram (Appendix C) highlighted focus areas for improvement. Lack of cardiologist clinic capacity was identified as a major driver for the delayed clinic access, and cardiologist inpatient requirements were determined to be a primary reason for the reduced capacity. In the model prior to the intervention, cardiologists were responsible for seeing their existing patients anytime the patients were in the hospital. This resulted in cardiologists going between the clinic and hospital every day at a varying level based on how many of their patients

were hospitalized. This level of unpredictable inpatient demand forced limitations on the cardiologist clinic template and capacity, resulting in increased access delays.

To solve the clinic capacity issue, a new inpatient cardiology service was developed. The new service included rotations of two cardiologists and one cardiology NP staffed from the current 11 cardiologists and 3 NPs who practiced in the primary cardiology clinic. The new hospital team met every morning to assign inpatient responsibilities. Cardiologists and NPs were dedicated to the hospital service for 4-6 days and then shifted back to clinic service, with each member rotating on different days of the week to help ensure inpatient continuity.

Through the intervention, the cardiologists on clinic rotation no longer had to go to the hospital to see patients, thus creating additional clinic capacity. The capacity was decreased from the inpatient service staffing requirement but more than offset by the capacity increase from the cardiologists in the clinic. Thus, the intervention's net result was intended to reduce the primary aim, ADW. This intervention was proposed and approved through the MCO's business case process, with a minimal funding requirement since most project time was provided by participants outside of normal work hours. Additionally, an organizational change management plan was developed and implemented based on the Kotter model (show in Appendix D).

Once approved, the core interdisciplinary team connected with the other ancillary groups affected by the initiative. These included (a) Union and HR groups associated with the MCO, (b) cardiology clinic and hospital cardiology unit healthcare staff, (c) hospitalists, and (d) MCO and hospital information technology (IT) staff. Extensive planning and pre-requisite activities occurred in the fourth quarter of 2018. These included (a) definitions and approvals of new NP hospital roles, (b) definitions of new inpatient communication processes, (c) completion of hospital privileging processes, (d) development of system tools, (e) system training, and (f) acute care clinical training for the NPs. As shown by the project plan in Appendix E, these activities were

followed by three Plan-Do-Study-Act (PDSA) cycles, starting 1/1/19. Changes were implemented after each cycle based on the results and follow-up measurements.

Beginning with the PDSAs and continuing for 6 months, pre-post intervention data was compared using run and control charts, percentages, and applicable statistical testing as described in the analysis section. The 2018 baseline data had significant variance on a weekly, monthly, and even quarterly basis. To address this natural variance, a 6 month measurement period was chosen to assess the intervention. Comparison of a shorter period would be less valid due to the variances. For all measures, the pre-post unit of comparison was the average for 2H18 compared to the average of 1H19, although many measures were tracked more frequently to monitor trends.

Measures

Multiple outcome measures assessed the aims, while process measures monitored the implementation and stability of the new intervention. Aggressive goals were set to maximize project impact. Baseline measures were tracked to ensure the intervention did not create unintended negative consequences and to help understand any changes in contextual elements that might skew the results. These measures are summarized below, and operational definitions as well as baseline data and goals are listed in Appendix F.

The two outcome measures directly associated with the primary aim of improved access included ADW for cardiology clinic consults and patient satisfaction with clinic appointment access. For additional associated patient outcomes, the 30 day cardiology readmission rate was tracked to determine any changes in hospital readmission that might be associated with either the improvement in access or the new inpatient service. Many additional factors can contribute to readmission changes, but research showed patient access to be a factor in hospital readmission (Tanguturi et al., 2016). Also based on prior research, patient cancellations were included as an outcome measure to determine whether improved patient access improved the cancellation rate

(Navarro et al., 2017). The final aim of the project related to job satisfaction and was measured to assess changes in job satisfaction for the affected cardiology NPs and MDs.

Supporting the desired aims, process measures monitored the new intervention. To ensure the growth and stability in NP inpatient capacity, the number of daily NP inpatient visits was monitored. Cardiologist clinic capacity was tracked to verify a consistent improvement in the number of cardiologist consult clinic slots. Related to the new hospital service, adherence to the important new inpatient discharge notification process was assessed.

Finally, baseline measures examined if contextual changes confounded the outcomes as well as monitored for unintended effects. For the new hospital service, inpatient satisfaction was assessed to ensure it was not impacted by the addition of inpatient NPs, while tracking cardiology inpatient visits verified the capacity of the new cardiology service compared to the prior approach. ADW for follow-up cardiology clinic visits was monitored to ensure it was not reduced by improvement in ADW for consults. Measurement of total cardiology clinic visits determined if the reduction in NP clinic time due to new NP inpatient duties was offset by increased cardiologist clinic capacity. The total visits also, along with the overall cardiology population size, assessed whether outcome measures were impacted by more/fewer patients.

The data for all these measures was obtained from existing and verified organizational tracking with the exception of the NP inpatient visits, the post-intervention provider satisfaction survey, and the adherence to the new inpatient notification process. For these three measures, two NPs independently reviewed and verified the data for completeness and accuracy.

Analysis Approach

Pre-post intervention average percentages and/or rates for 2H18 compared to 1H19 were utilized for all measures. Descriptive statistics, a comparison of means with confidence intervals, and an independent samples t-test were also used to examine the primary outcome measure of

ADW. Run charts and control charts tracked the trends and progress of the ADW as well as the primary process measure of NP inpatient capacity. Control charts were not utilized for the other two process measures since each had only six data points, but these two measures were tracked monthly compared to their goals. Surveys assessed measures for patient satisfaction with access, NP and MD job satisfaction changes, and inpatient provider satisfaction. Patient volumes and clinic capacity, versus population clinical / demographic characteristics, were determined to be the primary contextual factors affecting ADW and were tracked as baseline measures noted above.

Ethical Considerations

The study was designed as a QIP to implement a new process - an inpatient hospital service. All applicable cardiology patients in the hospital were equally affected by the change, and all patients were included in the new service. No changes were made to the standard of care. Improvements in ADW were available to all patients seeking clinic visits. All data came from existing sources verified by the two institutions for information security, and all data was obtained in aggregate format with no individual patient identifiable data. Based on these characteristics, the project was approved by the organization's institutional review board prior to implementation as "Not Research". It was also reviewed by CU School of Nursing and deemed to not involve human subjects research.

Results

The project followed the timeline in Appendix E without significant variance. Execution of planned PDSA cycles provided additional knowledge, resulting in several ongoing changes. Details of the PDSA's are included in Appendix G. Highlights of these included (a) the need for additional information in the hospital EHR patient tracking tool; (b) the unexpected reluctance of a couple of the cardiologists to adopt some of the new coordination processes; (c) the need to better define the new inpatient discharge notification flow; (d) the ability of the hospital NPs to expand

their scope of practice beyond initial plans, and; (e) the need to reduce the initial clinic and hospital schedule for the cardiologists due to workload concerns. The EHR tool and discharge process were updated, and additional training and information was provided to the cardiologists to better explain the importance of these tools and processes. The scope of NPs in the hospital was expanded to include ICU patients and some emergency room consults, and the cardiologists schedule was reduced slightly. All PDSA issues were resolved through these changes and goal tracking continued after PDSA 3 through 1H19. Table 1 summarizes all measures across the 6 month analysis period. Additional information is reviewed in the following sections.

Outcome Measure Results

The primary outcome measure of ADW experienced a 36% decrease from an average of 28 days for 2H18 to 18 days for 1H19, compared to a goal of 14. The run chart in figure 1 demonstrates this improvement with a defined shift of the measure below the median after PDSA 2, which continued throughout the project. However, there was a small increase in average ADW from 1Q19 to 2Q19, after the cardiologist schedule reductions were implemented based on PDSA insights. This change did not cause a definitive shift in the run rate. Both the 2H18 and 1H19 ADW weekly data revealed an approximately normal distribution, and an independent t-test was executed. The difference in means from 2H18 to 1H19 was statistically significant at -10 (95% CI 6.8-12.8, P<.0001).

All sub-outcome measures also demonstrated improvement, except for clinic appointment cancellations. Patient satisfaction with access improved from 38.5% to 51.5%, a little less than the goal of 55%. Hospital readmissions dropped from 13.2% to 9.7%, significantly better than the 12% goal. Based on the post-only implementation survey, 91% of the providers included in the intervention indicated the change improved their overall job satisfaction, also better than the goal of 90%. Cronbach's alpha for the survey was 0.9178, demonstrating good internal reliability.

Process Measure Results

Figure 2 shows the control and run charts utilized to monitor process measures. NP inpatient capacity improved after PDSA 1 and steadily increased. All 130 daily data points, with one exception, were within the calculated control limits and the expected estimated range. NPs met the goal and saw an average of 35 hospital patients per week (7/day) in the final quarter of analysis. Average monthly clinic consult capacity had some variance, but the 6 months average of 222 exceeded the goal of 216. The final process measure monitored provider adherence to the inpatient discharge process. After PDSA 2 changes, this measure remained within the 90% goal and averaged 91% for 1H19 but demonstrated continued improvement in the 2Q19 to over 94%.

Baseline / Contextual Measure Results

All baseline measures were tracked with quarterly or 6 month averages due to the measurement frequency of this data as well as inter-quarterly variance. Table 1 highlights that all baseline / contextual measures either improved or had no significant change, which were the goals. Inpatient satisfaction was assessed to ensure it was not negatively impacted by the new hospital service, and the satisfaction scores instead increased a small percentage from 86% to 88.6%. Similarly, the improvement in clinic consult ADW did not increase average clinic follow-up ADW, which instead showed a 9.7% reduction to 28. The number of inpatient visits was not affected and maintained at an average of a little over 3,800 for 1H19. Along with the process measure of clinic capacity, the total cardiology population and total clinic visits were the main factors affecting the primary aim of consult ADW. These baseline contextual measures were similar for the pre-post periods, with a slight decrease in each. Additionally, there were no changes in the number of provider (cardiologist and NP) full time equivalents (FTEs) in the pre-post intervention period. As such, the improvement in consult ADW was not confounded by any

significant contextual changes nor did the measures demonstrate any unintended negative consequences. Of note, the MCO was going through significant organizational change in the post intervention period. Through the measurement period, these changes did not demonstrate any evident impacts on the measures.

Missing Data

There was no known missing data except for an issue related to total clinic visits. Based on pre-project analysis of 2H18 data and the rationale for some missing items (which continued in 1H19), a 10% adjustment factor was added to both pre-post intervention total clinic visits to provide a consistent adjustment for this issue. Otherwise, the use of established sources, or two person verification for the few new data sources, helped ensure the completeness of the data. There were, however, two changes to pre-intervention data after the proposal for this project was submitted. The 2H18 data for hospital readmissions was less than the original metric, due to the delay in hospital claims reporting. The original 2H18 readmission rate was provided as 17%, and the associated goal was set at 16%. The corrected actual 2H18 readmission rate was only 13.2%, so the project goal was changed to 12%. Additionally, the initial reported data for 2H18 patient access satisfaction was 42%. After a correction to the MCO's survey data, the actual 2H18 rate was 38.5%. Since this was not a large difference, the project goal of 55% was not changed.

Discussion

Summary

The development and implementation of a new cardiology hospital service with NPs did improve clinic cardiologist capacity and resulted in a substantial 36% reduction in ADW. Improvement in patient satisfaction with clinic access was associated with this reduction in ADW and increased 24%. A 26% reduction in hospital readmission rate was also associated with the intervention. From the affected provider perspective, 91% of the MD cardiologists and NPs felt

the intervention improved their overall job satisfaction. However, there was no significant change in the clinic patient cancellation rate associated with the reduced ADW and improved access.

Interpretation

These results were generally aligned to the expected outcomes and goals. From pre-intervention analysis, cardiologist clinic capacity was known to be a significant driver of excessive clinic consult ADW, and cardiologist hospital demands were determined to be the largest impact on clinic capacity. Achieving full cardiologist staffing in July 2018 had already improved ADW, but it was still well above the MCO's desires through 2H18. With the coverage efficiency improvements from the new hospital cardiology service and the associated increased scope for cardiology NPs, the resulting 1H19 increase in clinic capacity and associated decrease in ADW was a logical result and aligned with prior research (Bungard et al., 2009; Kwong, 2016). However, while the ADW improvement was significant, it did not completely achieve the goal. Through feedback from the PDSA process, the initial clinic capacity improvement, implemented through a more aggressive daily clinical visit schedule, had to be reduced a small amount. This prevented the full ADW improvement from being achieved but alleviated most provider workload concerns. The modification, along with the more dependable clinic schedule enabled by the new hospital coverage service, is likely one reason that 91% of affected providers felt the intervention improved their overall job satisfaction.

The associated improvement in patient access satisfaction was a little below goal for the full 1H19 average. However, 2Q19 was at goal, suggesting this was potentially a lagging indicator. The patient cancellation rate for clinic consults was also theorized to be improved as a result of reduced ADW. This concept was based on prior studies and a logical assumption that longer ADW could cause patients to simply forget/ignore the cardiology issue and result in higher cancellations (Navarro et al., 2017; Van Deventer et al., 2015). Since this measure only improved

a small percentage, it is possible the nature or severity of the conditions was different enough from the prior research to provide different results.

Another unanticipated result was related to the magnitude of the change in hospital readmission rates. Compared to a goal decrease from 13.2% to 12%, the actual 2H19 readmission rate dropped to 9.7%. This was similar or greater than improvements seen in prior research, and it occurred over a shorter period of time without any known additional related interventions (Southey et al., 2014; Tanguturi et al., 2016). Many factors can affect hospital readmission, so the change cannot be presumed to be solely due to the intervention. However, it can be stated that the combination of reduction in clinical consult ADW and the new method for providing cardiology services to inpatients was associated with a significant reduction in hospital readmission rate.

The process measures were all in line with expectations. Although prior research was utilized to help provide an estimate of NP inpatient capacity, none of the prior studies were similar enough to provide a strong basis for projection (Butcher, 2017; Wells et al., 2017; Kapu et al., 2014; Southey et al., 2014). Similarly, adherence to the new discharge process was based on desired results versus baseline data. The adaptability and positive approach of the involved providers were the major reasons for the success of these two new processes and achievement of the aspirational forecasts. The final process measure of clinic capacity was easier to project, but as noted, that capacity had to be reduced a little and trended slightly lower in 2Q19 than 1Q19 as a result, although still at goal.

Strengths and Limitations

The strengths of this project include the population size and the duration of the analysis period. Over 1,200 patient interactions were measured to assess ADW, and over 3,800 patients were affected by the new hospital cardiology service. Additionally, the analysis and comparison periods covered six months each, minimizing any seasonality or other time associated variances.

Finally, while there was prior research on somewhat similar QIPs, none was discovered specifically linking new NP supported hospital services with associated improved clinical capacity and patient outcomes.

The limitations of the project included the design, potential confounding factors, potential lack of generalizability, and frequency and granularity of some of the measures. This study was a pre-post intervention analysis of a QIP. Contextual measures believed to be possible confounding variables were tracked and analyzed, but the analysis did not attempt to control or analyze all potential influencing factors. As such, the generalizability of the results to other similar populations is reduced. Generalizability is also impacted by the specific attributes of the involved clinic and cardiology services, such as the providers, the patient size / mix, and the organizational contexts. Finally, many measures were tracked at only quarterly and half year frequencies. While this was felt to be desirable based on analysis of time period associated variances in the baseline data, it might mask potentially important weekly or monthly variances. Additionally, some of the measures were only available in a precalculated form, and the variables utilized in the calculation were not able to be analyzed. Since these precalculated measures came from verified data sources, this is not believed to be a significant limitation, but it did reduce the level of secondary analysis.

Conclusions

This project demonstrated the implementation of a new cardiology hospital service with an expanded scope for NPs could significantly improve overall capacity, patient access, associated outcomes, and provider job satisfaction. A comprehensive internal review occurred at the end of the 6 month analysis period, and the project was determined to be a significant success. Since the project achieved its results with only a minimal initial cost and no increase in staff, the new cardiology service has been approved to be an ongoing function. The process has been included in the training and process documentation materials for the department. As appendix H shows, the

financial model for the project also has a positive net present value (NPV) if the associated improvements in hospital readmissions and cancellations are included. Even without these factors, the additional cost is minimal for the substantial improvements in outcomes. The approach has been recommended for consideration for use in other specialty areas in the regional MCO.

While there are noted issues for generalizability to other practices or organizations, this work can be utilized for ideas and potential replicability for groups with similar needs. Additionally, it provides another example of the value of utilizing NPs to their full scope and potential. The future evolution of this project could include the development of standardized templates, tools, and a predefined repeatable process for implementation of similar services. If the additional areas considering this approach do proceed, that would be an optimal time to develop those tools to make the approach easier to replicate. It would also be beneficial to track the results of those potential future implementations to assess their outcomes compared to this project.

Funding

As noted, the intervention did not require any additional FTE's or any substantial investment cost. The majority of the project effort was funded through unreimbursed time invested by the participants outside of work hours. There was minimal cost associated with the hospital privileging process for the NPs and for some training and shadowing time – a total of approximately $15,700. These small costs were funded by the regional MCO, and the regional MCO was involved in the overall project decisions.

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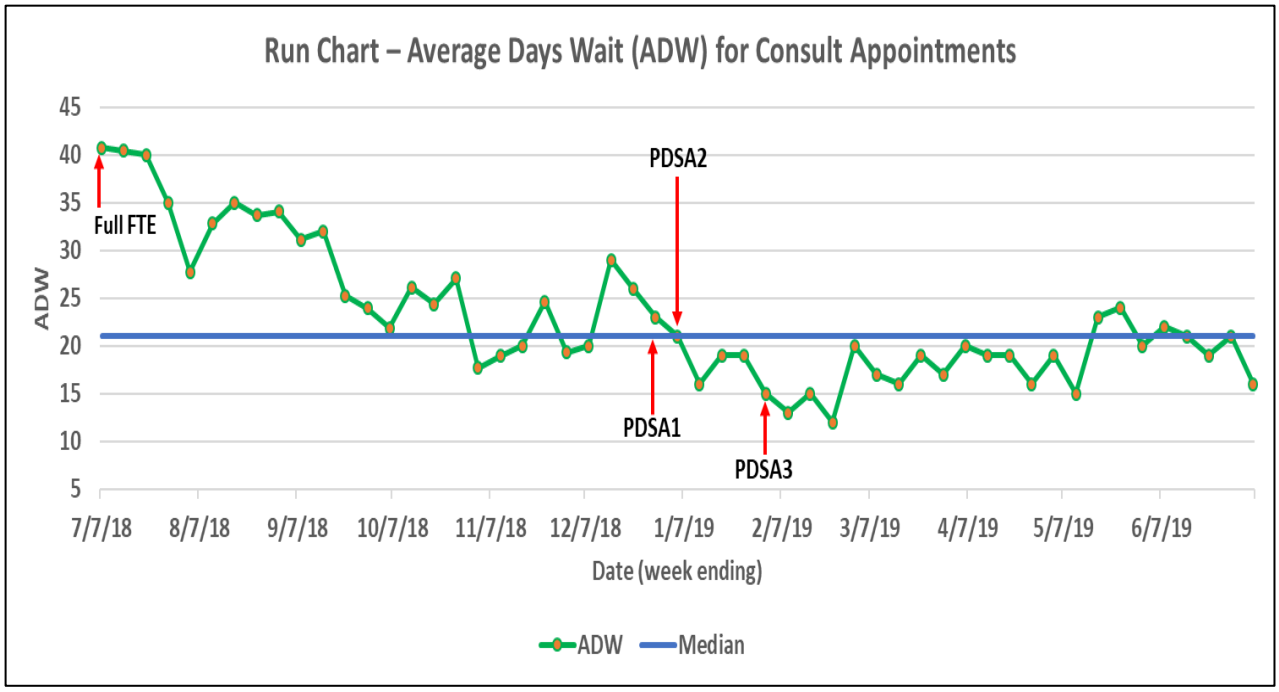


Figure 1. ADW for Consult Appointments

Table 1. Summary of Quarterly and Six Month Average Project Measures

Measure	1Q19	2Q19	1H19		2H18	1H19 vs 2H18	Goal
ADW for consult visits	17	19	18		28	-10 (36% decrease)	14
Patient access satisfaction	48%	55%	51.5%		38.5%	+13 (24% increase)	55%
Hospital readmit rate	10.6%	8.2%	9.7%		13.2%	-3.5 (26% decrease)	12%
Patient cancel rate	25.1%	22.4%	23.8%		25.2%	- 1.4 (6% decrease)	15%
Provider satisfaction	N/A	N/A	91%		N/A	N/A	90%
NP inpatient visits / week	31.3	35.1	33.2		N/A	N/A	35
Clinic consult capacity / month	224	220	222		185	+37 (20% increase)	216
Inpatient discharge process	87%	94%	91%		N/A	N/A	90%
Satisfaction w/ Inpatient Provider	87.2%	89%	88.6%		86%	+2.6 (3% increase)	86%
ADW for Follow-up visits	28	28	28		31	-3 (9.7% decrease)	31
Total Inpatient visits / 6 months	N/A	N/A	3,832		3,800	+32 (0.8% increase)	3,800
Total clinic visits / 6 months	N/A	N/A	5,434		5,550	-116 (2% decrease)	5,500
Cardiology population	N/A	N/A	10.8K		11K	-200 (1.8% decrease)	11K

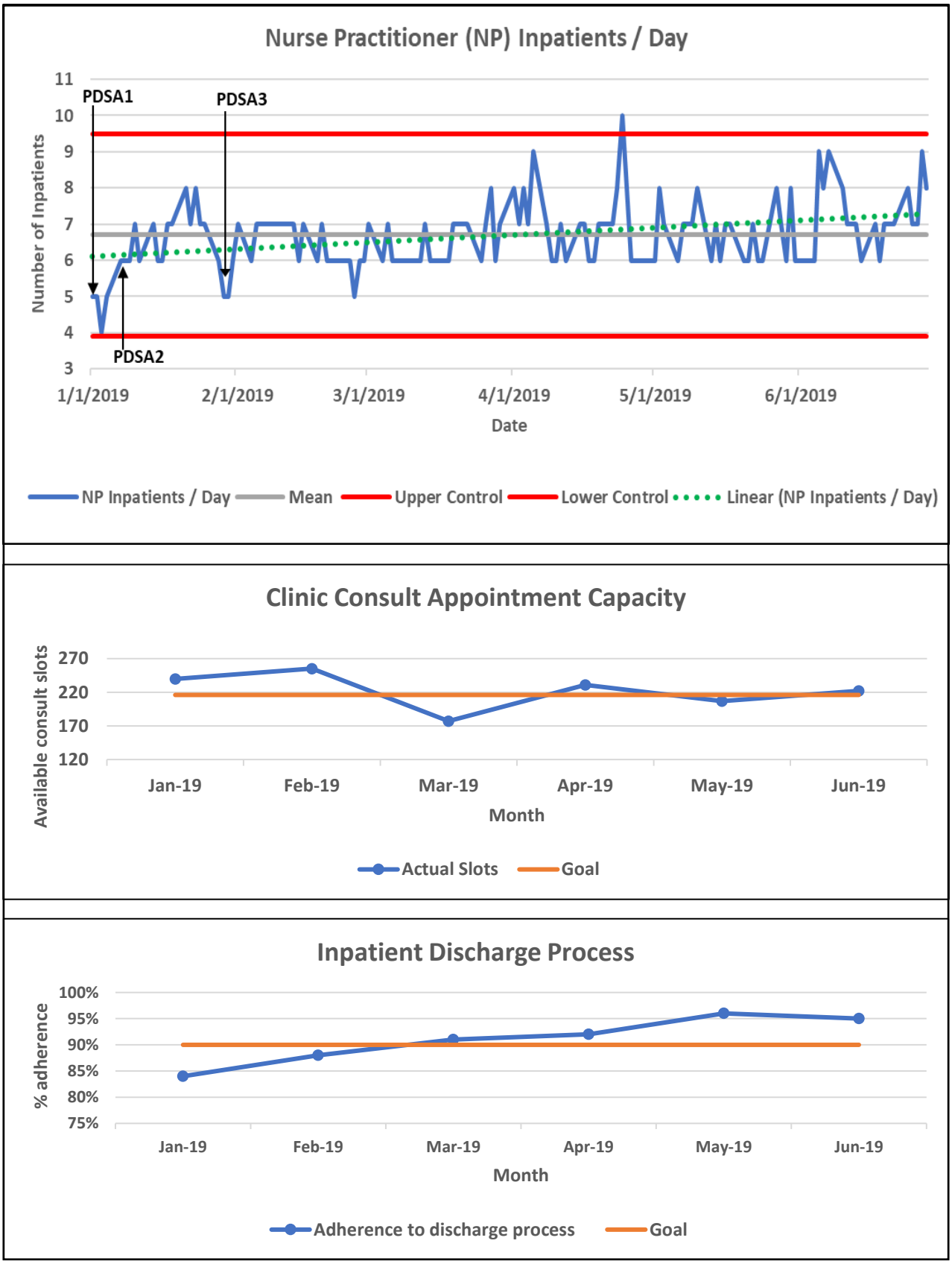


Figure 2. Process Measure Charts

Appendix A. Evidence Table

Author, Year	LoE †	Aim/Purpose	Design / Methods / Interventions	Sample & Setting	Major Variables / Outcomes	Data Analysis	Strengths / Limitations	Relevant findings
Research related to Capacity and Patient Access times								
Béchard, S., et al. (2017).	IV	* Implementation & evaluation of integration of NPs on Pt access to care & medical management	* Implementation of program to add / increase scope of NPs * Pre/post program analysis	* Canadian Hosp HFC * 289 Pts in 2012-13 (pre); 391 in 2013-14 (post)	* Total Pts * Monthly visits * Clinical profile * Pharm profile	* t-test for pre/post characteristics * Run charts for total & monthly visits	S: Detailed pre/post analysis L: One specific Hosp, on general type of Pt	* 35% ↑ in number of Pts actively followed & significant ↑ median number of monthly visits (79 [57-97] between 2012-13 vs 155 [125-172] between 2013-14 * No SS significant change in Pt clinical & pharm profile & results * Introduction of NPs increased access while maintaining quality of care
Bungard, T. J., et al. (2009)	IV	* Implementation & evaluation of new program to improve Card Consultation Appt wait times	* Implementation of improved Card access time program * NP staffed single intake point for triage * Consultative team: Cardiologist, NP, PharmD * Historical control cohort design	* Canadian Card Clinic * Pre-implementation 3/2003-6/2003 (n=311); 1/2004-12/2006 post (n=3096)	* Primary outcome: time to initial consultation * Secondary: time to definitive diagnosis	* t-test for pre/post * Multivariate linear regression to check influence / adjust for baseline imbalances in SS covariates	S: Size, Rigor of analysis L: Non-RCT trial; confounding Vars; similar pre/post Pt characteristics but large difference in n	* ↓ time to initial Card consultation from 71±45 days to 33±19 days * ↓ time to a definitive diagnosis from 120±86 days to 51±58 days) *Annual referrals ↑ from 1512 in 2002 to 2574 in 2006 * No SS differences in pre/post Pt characteristics
Butcher, L. (2017).	IV	* Implementation & evaluation of strategy to address market share loss, driven by PCP on call demands, by implementing a NP HS program	* Implementation and evaluation of new NP HS program * 3 NP HS added to provide 24/7 coverage with 7-7-7 model. * Pre/post analysis	* Small rural Hosp in U.S.	* Primary outcome: admissions	* Run chart for admissions, Pt Sat, NP HS turnover, costs	S: Thorough analysis of QI L: Small Hosp, potentially limited generalizability	* ↑admissions to 417 in 2016, a 23% ↑ from 339 low in 2014 * ↑ Pt Sat from 61% before the NP HS program to 74% * Lessons learned including considering a phased in approach, challenges in NP HS establishing boundaries, initial higher NP HS turnover
Kwong, T. (2016)	IV	* Implementation & evaluation of program adding NP scope to reduce specialty consultation Appt wait times	* Implementation of new practice scheduling processes plus addition of dedicated NPs with increased scope of practice * Pre/post program analysis	* Card/vascular Specialty clinic, 1/2014-6/2014 * 5500 annual Pts, pre/post not provided	* Primary outcome: wait time for consultation Appt * Secondary: Pt Sat	* Run chart of % Pts with Appt within 7 days	S: NP role detail L: One center, lack of detail data, likely confounding Vars	* 50% of new Pts seen in 7 days of referral post-implementation, pre-implementation was 3-4 weeks * ↑ in Pt Sat
Wells, M., et al. (2017)	IV	* Implementation and evaluation of program to redesign HS role & add NP HS to address rising demand & increased admission wait times	* Program implementation using series of Lean quality improvements from multiple PDSA cycles * Process improvements / addition of NP HS * Pre / post analysis	* Large Hosp in U.S. * 6284 Hosp admits from 1/2013 -6/2014 (pre-program) vs 6415 from 7/2014-10/2015 (pos-program)	* Daily admits, ED admit wait time, cost per discharge	* LEAN analysis of admission process * Multiple PDSA cycles * t-test & X2 for pre-post data * Run charts	S: LEAN methodology & analysis L; One center, potential confounding factors, potential Hawthorne effect	* Admitting capacity ↑ (22 to 30/day) * Emergency department mean Pt wait times for admission ↓ 36% (66 to 43 min) * Expenses ↑ due to new NPs, but discharges /month ↑ at faster rate, leading to 49 % ↓ cost/discharge ($367 to 187) * Limited data showed ↑ provider Sat

Author, Year	LoE †	Aim/Purpose	Design / Methods / Interventions	Sample & Setting	Major Variables / Outcomes	Data Analysis	Strengths / Limitations	Relevant findings
Research related to Expanded NP Scope and Patient Outcomes								
Atzema, C. L. (2018)	IV	* Analysis of relationship between timing of HF related hospital discharge f/u to mortality and Readmt	* Retrospective cohort analysis	* Canadian ED from 4/2007 to 3/2014 * 16,274 Pts with f/u care within 7 days and 28,846 within 30 days	* 1-year rate of mortality * 90-day Readmt rate	* Univariate comparisons 1-way analysis of means variance, Kruskal–Wallis test for medians and $\chi 2$ test for proportions	S: Size, rigor of analysis L: Cohort analysis versus RCT	* 7-day f/u cohort ↓lower rate of 1-year mortality over 1 year, HR 0.92 (0.87–0.97) * 7-day f/u cohort ↓ 90 day Readmt rate, HR 0.87 (0.80–0.94)
Baky, V., et al. (2018).	IV	* Implementation & evaluation of new program to reduce readmission rate for ACS Pts	* LEAN QI project with 3 new processes: (1) Improved pre-discharge follow-up Appt (Appt in 1-2 weeks), (2) Pharmacist medication education, (3) Timely discharge planning * Pre/post program analysis	* Card step-down unit at a single Hosp from 2015 to 2016 * Convenience sample - 578 Pts, 402 were diagnosed with ACS	* Primary outcome: all-cause rate of Hosp readmission within 30 days	* Pre/Post Multivariate analysis for factors predictive of readmission rate	S: Rigor of analysis L: Convenience sample, differences in pre/post implementation Pt characteristics	* Readmission rate 14.2% for Pts with heart failure; 7.5% for Pts with ACS * Overall readmission rate similar following the 3 interventions, but Pts with pre-scheduled follow-up Appt had 0.374 ↓ odds of being readmitted * Pre-scheduled timely follow-up Appt associated with reduced readmission rate
Kapu, N. A., et al. (2014)	IV	* Implementation & evaluation of quality & financial impact of adding NP inpatient care teams	* NP's were added to 4 ICU teams and 1 progressive care team * Retrospective, secondary analysis of return on investment after adding NP HS	* Large academic Hosp * 4 ICU (surgical, Card, neuroscience, & medical) & 1 step-down NP teams	* Billing, acuity, LOS, & NP-associated quality metrics	* Comparison of billing data, acuity, LOS for designated years before & after adding NPs * NP-associated quality metrics	S: Thorough data analyses L: One center; pre / post acuity similar but potential other confounding factors	* Revenue vs expenses was ↑ for NP teams (from ↓ in compensation & care cost): $28M/year savings * Average risk-adjusted LOS for the 5 time periods after adding NPs ↓ and charges ↓ * Most clinical outcomes ↑ beyond pre-project baselines * No SS acuity differences in measurement periods
Navarro, M. J., et al. (2017)	IV	* Analysis of relationship between wait time for initial Card Appt compared to no-shows	* Retrospective cohort analysis	* Large Card clinic, 2-week period (6/2015), 228 Pts	* Wait times for initial Appt, No-Show Appts	* Binary analysis comparing no-show rates between Pts with wait time < 2 weeks & > 2 weeks	S: Effect size of results L: One center, limited size/time, confounding Vars	* Significantly ↓ (5.8%) no-show rate in < 2 week wait time group compared with 29.1% in > 2 week wait time group
Tanguturi, V. K. (2016)	IV	* Implementation & evaluation of program to reduce PCI Readmt rates including 2 week d/c f/u	* Implementation of bundle of interventions targeting PCI pre d/c, post d/c, and re-presentation to the emergency department * Pre/post program analysis	* Large tertiary health center in Massachusetts * Avg of 1000 PCI / yr *2011 (implementation) to 2015	* 30-day Readmt rate	* Run chart of monthly Readmt rates	S: Size, length, effect size of results L: One center, confounding Vars	* Significantly ↓ in index hospital readmission rate, from 9.6% prior program implementation to 5.3% after 4 years

Author, Year	LoE †	Aim/Purpose	Design / Methods / Interventions	Sample & Setting	Major Variables / Outcomes	Data Analysis	Strengths / Limitations	Relevant findings
Southey, D., et al. (2014)	IV	* Implementation and evaluation of Pt impact following introduction of NP HS coverage for Card ward, including weekends	* Addition of NP HS Card coverage * Prospective cohort * Pre/post analysis	* Card Pts operated on from 1/2005 to10/2011 * Pts before NP HS (n= 2385) & after (n=3910)	* ICU readmission, Survival after surgery, Mortality	* Mean, standard deviations for p calculation * Logistic regression on predictors of survival	S: Large, long term analysis L: Cohort analysis versus RCT, possible for confounding vars	* ↓ in rate of Card ICU readmission, 2.6% to 1.9% & ↓ LOS, 10 to 8 days * ↑ in overall survival after Card surgery, 96.5% to 98.0% * Presence of NP HS strongest predictor of survival with OR 1.9 (1.23–3.01) * No major SS differences in cohorts
Van Deventer, J. D., et al. (2015)	IV	* Implementation & evaluation of new Card access model to improve access	* Implementation of decentralized program to improve Appt access times * Pre/post program analysis	* Card Pts in one S Africa region, 121 Pts 5/2013 – 5/2014 (post); 64 Pts 10/2012-4/2013 (pre)	* Time to initial Appt, time to diagnosis, Pt compliance with Appts	* Mann-Whitney test for pre/post comparisons	S: Strong data analysis L: Potentially not applicable to many situations	* Significant ↓ in waiting times, 85 days to 18 days * Pt compliance with appointments significantly ↑, 90% vs. 56% * No SS differences in pre/post Pt characteristics
Research related to NP & MD Job Satisfaction								
Athey, E. K., et al. (2016)	IV	* Analysis of how NP autonomy & work setting predict job Sat	* Survey data: satisfaction scale ranges from 1 (very dissatisfied) to 4 (very satisfied).	* 2012 National US Survey of NPs (n = 8311)	* Job Sat, autonomy, work setting	* Bi & multi variate relationships between setting & 3 autonomy Vars (NP skill utilization, independent billing, MD relationship) & job Sat	S; National, size L: Lack of detail; Autonomy measures not validated	* NPs in primary care reported highest levels of autonomy, NPs in Hosp surgical areas reported lowest levels * Autonomy was most predictive of satisfaction by significant margin (avg Sat 3.5 vs 2.6 for high vs low autonomy) * Work setting on it is own only marginally related to job Sat
Bush, C. T. & B. Lowery (2016)	IV	* Evaluation of postgraduate NP education programs on NP job Sat, clinical competency, Pt Sat	* Nonequivalent group study to compare job Sat scores among a convenience sample of 2 NPs groups using MNPJSS	* Convenience sample of 2 groups of diverse NPs (182 total): one with formal postgraduate programs, one without	* MNPJSS categories	* t-tests: job Sat between groups & demographics * Multiple linear regression on job Sat, experience, environment, postgraduate education	S: Rigor of approach, diverse sample L: nonprobability sampling techniques with bias risk	* Postgraduate education has SS ↑ impact on NP job Sat * Factors influencing autonomy were largest contributors to NP job Sat for both study groups * Having > 3 years' experience was also a SS positive influence on job Sat but was more important for NPs without postgraduate education programs
Hoff, T., et al. (2017).	V	* Analysis of literature related to Sat, burnout, stress, & Turnover of NPs	* PRISMA Systematic Review * Search of PubMed, PyschInfo, Business Source Complete, CINAHL, & the Cochrane Review databases 2000 to 2016	* 32 articles, variety of settings * Variety of job Sat scales used – 7 included MNPJSS	* Job Sat, burnout, stress, intent to leave organization	* Low heterogeneity across studies limited analysis results, No MA possible	S: Through PRISMA driven approach L: Heterogeneity across studies limited results	* Lack of robust research found * Generally lower levels of Sat across sample & higher intrinsic versus extrinsic Sat levels * NP role expansion experienced in positive & negative ways * Potential policy or managerial changes required but more research needed

Author, Year	LoE †	Aim/Purpose	Design / Methods / Interventions	Sample & Setting	Major Variables / Outcomes	Data Analysis	Strengths / Limitations	Relevant findings
Hagan, J. & D. L. Curtis (2018).	IV	* Examination of relationship of MNPJSS Sat factors & demographic characteristics with NP retention	* NP Survey to members of the Texas NP Organization.	* 350 NP's from Texas NP Organization	* Years experience * Years at current position * Intention to leave position within 5 years	* Linear regression for factors with duration in current position *Logistical regression for factors with intent to leave	S: Use of proven MNPJSS scale L: Survey style, small size, one state	* Years' experience, salary, & benefits were significantly associated with longer duration of current employment * Higher challenge/autonomy & higher annual salary were associated with significantly lower odds of intention to leave the current position
Johnson, J. H. (2011)	IV	* Implementation & evaluation of a Card NP HS role	* Program implementation of Card NP HS * Monthly result tracking	* Large 1,171 bed urban academic medical center * Growth from 2 to 31 Card specific NP HS over 14 years, with a range of experience	* Growth of program, Pt & MD Sat	* Description of program implementation * Run chart for growth, Sat	S: Thorough description of program L: One specific large academic medical center	* Card NP role evolved as a result of a focused effort at expanding NP HSs * Strategies included strong administrative support, practice relationships, advanced knowledge/skills, & role modeling * Strong yearly growth in number of Card NP HS plus consistently high Pt & MD Sat
Kartha, A., et al. (2014)	IV	* Analysis of NP & PAs roles in Hosp medicine	* Observational cross-sectional cohort study * Survey of Chiefs of Medicine & Nurse Managers for inpatient medicine scope of practice for NPs PAs & perceived healthcare quality	* 118 Chiefs of medicine & 198 nurse managers at 124 VA Hosp * 23% used NPs only; 13% PAs only; 12% used both; 52% neither	* Employment of NPs or PAs * Scope of Practice * Perceived healthcare quality	* Bivariate unadjusted & multivariable adjusted analyses	S: Multi-center survey L: VA only; potential survey bias; no clinical outcomes & cost effectiveness data	* Daily NP HS caseload at 4 to 10 Pts (mean 6.5 Pts) * 58.9% of NPs & 65.4% of PAs functioned primarily autonomously; 23.1% of NPs & 30.8% of PAs worked directly with MD, cowriting orders & making care decisions with MD * NPs associated with ↑ positive Pt discharge & coordination
McDonnell, A., et al. (2015)	VI	* Implementation and evaluation of NP HS roles on Pts, staff, & organizational outcomes	* Addition of NP HS roles into medicine (3 NP HS), surgery (2 NP HS) and orthopedics (1 NP HS) * Collective Qualitative Case Study	* District Hosp England, 2011–2012. * 13 strategic stakeholder interviews * Purposeful sample: 32 nurses, managers, MDs, team members & Pts	* Themes: Impacts on Pts, Impact on staff, Impact on organization	* Interviews * 3 mixed method case studies in clinical areas with NP HS * Included non-participant observation	S: Consistency among case study themes L: Interview, qualitative approach may not be generalizable	* NP HSs had ↑ impact on Pt experience, outcomes & safety * Staff knowledge, skills & competence were enhanced * Quality of working life, distribution of workload & team-working ↑

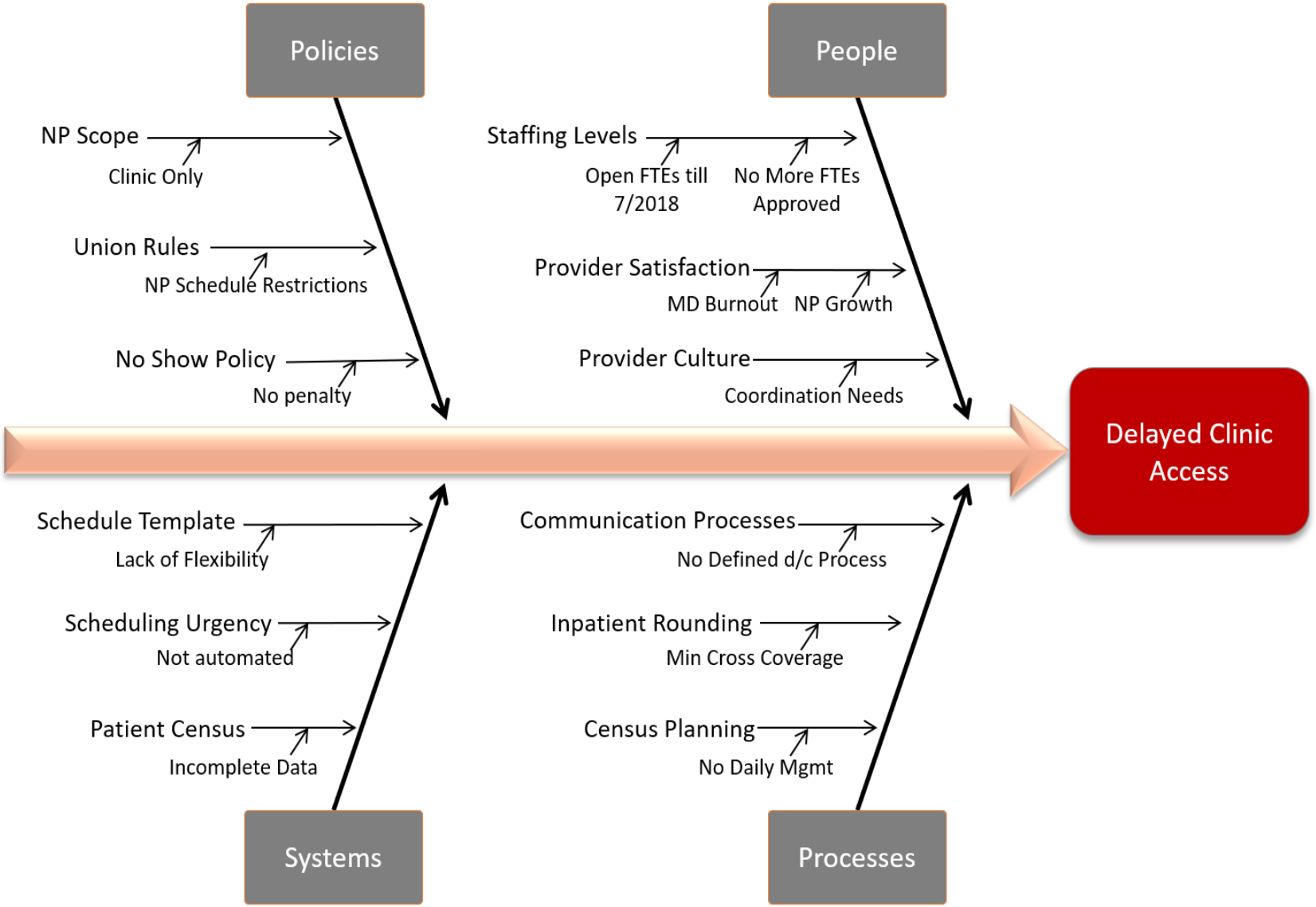
Author, Year	LoE †	Aim/Purpose	Design / Methods / Interventions	Sample & Setting	Major Variables / Outcomes	Data Analysis	Strengths / Limitations	Relevant findings
Panagioti, M., et al. (2018)	V	* Review of evidence on consequences, causes, & EBP interventions for burnout in cardiologists	* Literature review and survey	* 2012 survey of 7288 MDs with extrapolation of cardiologist data	* Major themes: Bureaucratic tasks, work time, computerization, lack of autonomy, training demands	* Extrapolation of cardiologist factors from larger overall MD survey in combination with recent cardiologist specific lifestyle report	S: Large sample size L: Extrapolation of cardiologist specific data	* Burnout in cardiologists is associated with poor healthcare outcomes for Pts * Burnout driven by excessive workload, role complexity, training demands, inefficient compensation model, lack of resources, computerization, loss of autonomy, & difficulties balancing work, personal life
Pasarón, R. (2013)	VI	* Analysis of NP job Sat & association with extrinsic & intrinsic characteristics	* Descriptive-correlational design using survey methodology * Utilized MNPJSS & two investigator-developed Surveys (NP Snapshot Survey, Physician NP Survey)	* Nonprobability convenience sample of NPs & collaborating MDs at one pediatric Hosp * 17 NPs, 22 MDs	* Themes: autonomy, professional interaction & growth; time; benefits	* Cronbach's alpha coefficients for internal reliability * Multiple regression, paired t-tests	S: Approach / analysis rigor & proven scale L: Small sample size; one center, one specialty	* Overall NPs minimally satisfied with job * Dissatisfaction areas included professional & monetary recognition, assertive influence, administrative support & collegial relationships
Ryan, M. E. & D. W. Ebbert (2013)	VI	* Analysis of NP opinions regarding job Sat & barriers	* Descriptive, nonexperimental survey method using MNPJSS	* 522 NPs in 2 states – randomly sampled from state BON listings * 120 returned survey	* Multiple intrinsic & extrinsic Sat variables	* Frequency evaluation of 44 survey questions for intrinsic & extrinsic factors	S: Proven scale L: Not national, relatively small size, potential self-selection bias	* Scores revealed minimal global job Sat * Highest scores included time for direct Pt care, autonomy, & challenge * Dissatisfying factors involved reward opportunities, bonus availability, & research involvement
Travis, A. & B. Oliver (2017)	VI	* Analysis of structural empowerment & Job Sat of Card NPs	* Survey using "Conditions of Work Effectiveness-II Scale" (CWEQ-II) & "Job Satisfaction Subscale" (JSS) of the Michigan Organizational Assessment Questionnaire	* 116 Card NPs representing multiple states * Surveys obtained at Card conference	* Overall Job Sat * Opportunity, Resources, Information, Support, Formal / Informal power	* Frequency eval for survey * Linear regression for correlation of factors	S: Detailed proven scales; diverse sample L: Small sample, potential for survey selection bias	* NPs perceived moderate empowerment * NPs job Sat similar to overall population * "Opportunity" subscale had highest scores * "Resources" subscale had lowest * NPs perceived greater informal power than formal power * Correlation between structure empowerment & job Sat
Research related to Implementation of Expanded NP Scope								
Bryant, S. (2018).	VI	* Implementation & review of a HS-focused educational model for NPs	* New HS-focused NP education program,	* Site Specific AGACNP program	* Number of successful graduates	* No specific data analysis * Description of program & overall results	S: Applicable program L: Not research, rather an applicable program description	* 5 years of success for AGACNP HS education
Burleson, D. (2014).	VI	* Examination of NP & MD HS & Pt perceptions of	* Observational case study	* Two tertiary care Hosp	*Communication challenges themes	* NVivo 91's coding process for theme analysis	S: 5-year analysis with appropriate	* During interviews, HS reported their communication challenges related to Pts & their families.

Author, Year	LoE †	Aim/Purpose	Design / Methods / Interventions	Sample & Setting	Major Variables / Outcomes	Data Analysis	Strengths / Limitations	Relevant findings
		communication challenges * Examine how the challenges affect HS	* Group/individual Interviews of Hosp Administrators & HSs * Observation of HS interactions with one another & other medical personnel * Interviews of staff who surveyed & interviewed Pts	* Similar characteristics, plus both implemented HS about 10 years ago * Conducted over 5 years * Used purposeful & convenience sampling			observational study rigor L: Two Hosp, limited sample; Indirect Pt information	* In group sessions, HS reported <1/3 of their communication challenges related to Pts & their families. * Potential need to allow more open HS communication * Comparison of Pts' & HSs' perceptions demonstrated critical gaps in Pt education that affect Pt care & trust in caregivers
David, D., et al. (2018)	VI	* Analysis and comparison of HF Pt discharge instructions written by NPs vs MDs	* Descriptive comparative design * Blinded retrospective medical records review	* 50 HF Hosp Pts (location not provided) * Instructions written by NP (n 31) & MD (n 19) * Subset from a larger investigation	* Self-Care maintenance & symptom perception Vars in discharge document	* Content analysis to evaluate presence HF self-care components in discharge document * 2 blinded PhD-trained researchers independently reviewed documents	S: Detailed documentation analysis L; Content analysis approach, subset of large study at single center	* NPs placed greater emphasis on symptom identification, & were more likely to advise & schedule follow-up appointments with PCP & Card providers * No SS differences in Pt characteristics among NP, MDs
Hurlock-Chorostecki, C., et al. (2014)	V	* Analysis of NP HS role & its enactment within interprofessional teamwork	* Scoping review utilizing providing quality summaries of existing research & non-research knowledge * Explored primary research, reviews, & gray literature from 1/2005 – 7/2012	* 29 articles for NP review, 19 for Interprofessional concepts review	* Themes: role integration, workforce description, role outcomes, & role perception	* Hosp-based NP literature thematically summarized * Interprofessional concepts from literature, mapped to the NP studies	S: Extensive literature review L: Lack of heterogeneity in research	* Understanding of NP HS role remains limited due to lack of research & standardization of NP HS role title * Inconsistent concepts within NP HS research * Research on role enactment needed to understand the uniqueness of NP HS role

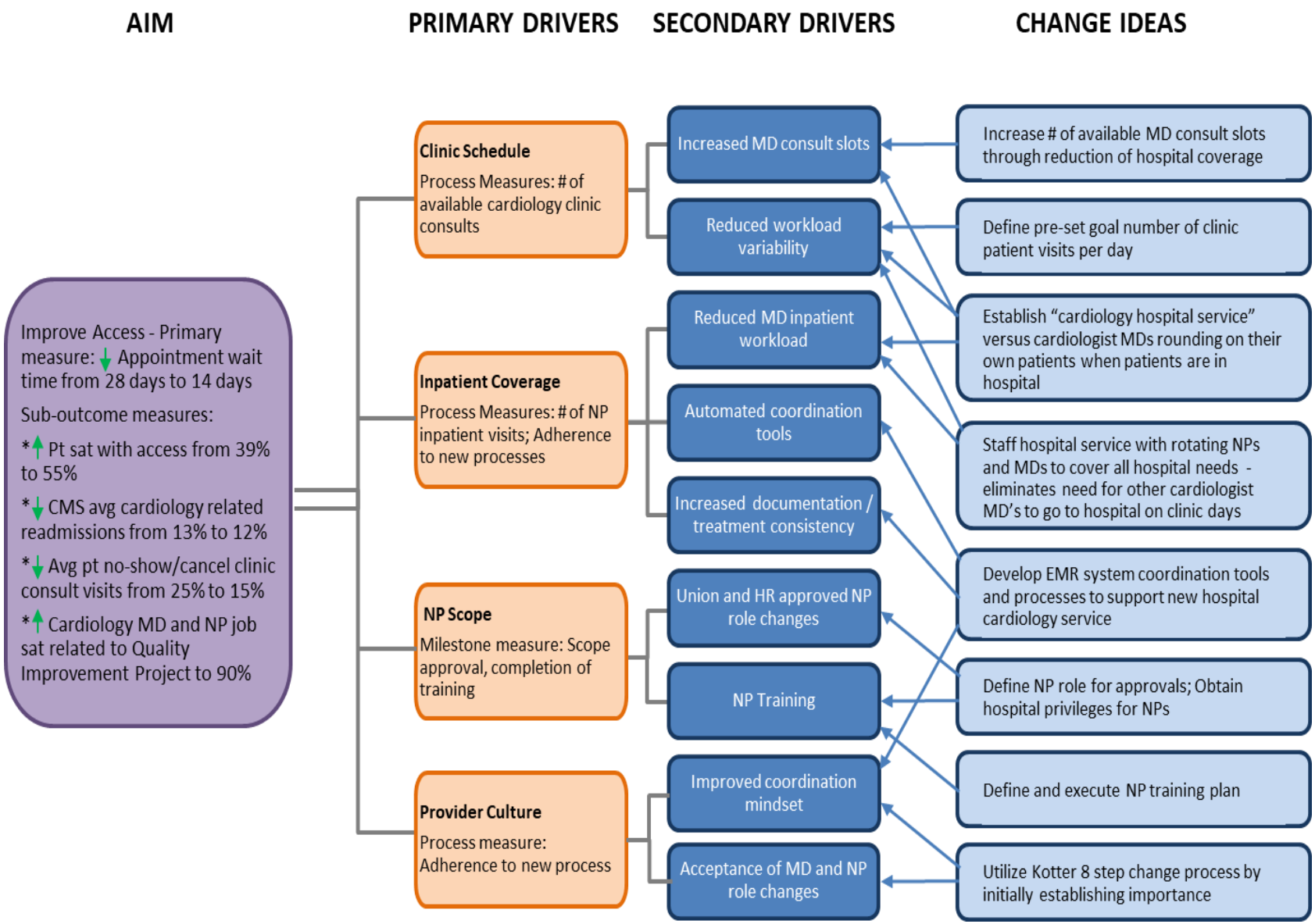
ACS, Acute Coronary Syndrome; Appt, Appointment; BON, Board of Nursing; Card, Cardiology; d/c, Discharge; EBP, Evidence Based Practice; f/u, Follow-up; HR, Hazard Rate; HF, Heart Failure; HFC, Heart Failure Clinic; HS, Hospitalist; Hosp, Hospital; ICU, Intensive Care Unit; LOS, Length of Stay; L, Limitations; MA, Meta-Analysis; MD, Medical Doctor; MNPJSS, Misener Nurse Practitioner Job Satisfaction Scale; NP, Nurse Practitioner; OR, Odds Ration; Pt, Patient; PCI, Percutaneous Coronary Intervention; Pharm, Pharmacological; PA, Physician Assistant; PDSA, Plan-Do-Study-Act; PCP, Primary Care Physician; QI, Quality Improvement; Readmt, Readmission; Sat, Satisfaction; SS, Statistically Significant; S, Strengths; Vars, Variables

† Evidence rating based on scale from Ackley, B. J., Swan, B. A., Ladwig, G., & Tucker, S. (2008). Evidence-based nursing care guidelines: Medical-surgical interventions. (p. 7). St. Louis, MO: Mosby Elsevier.

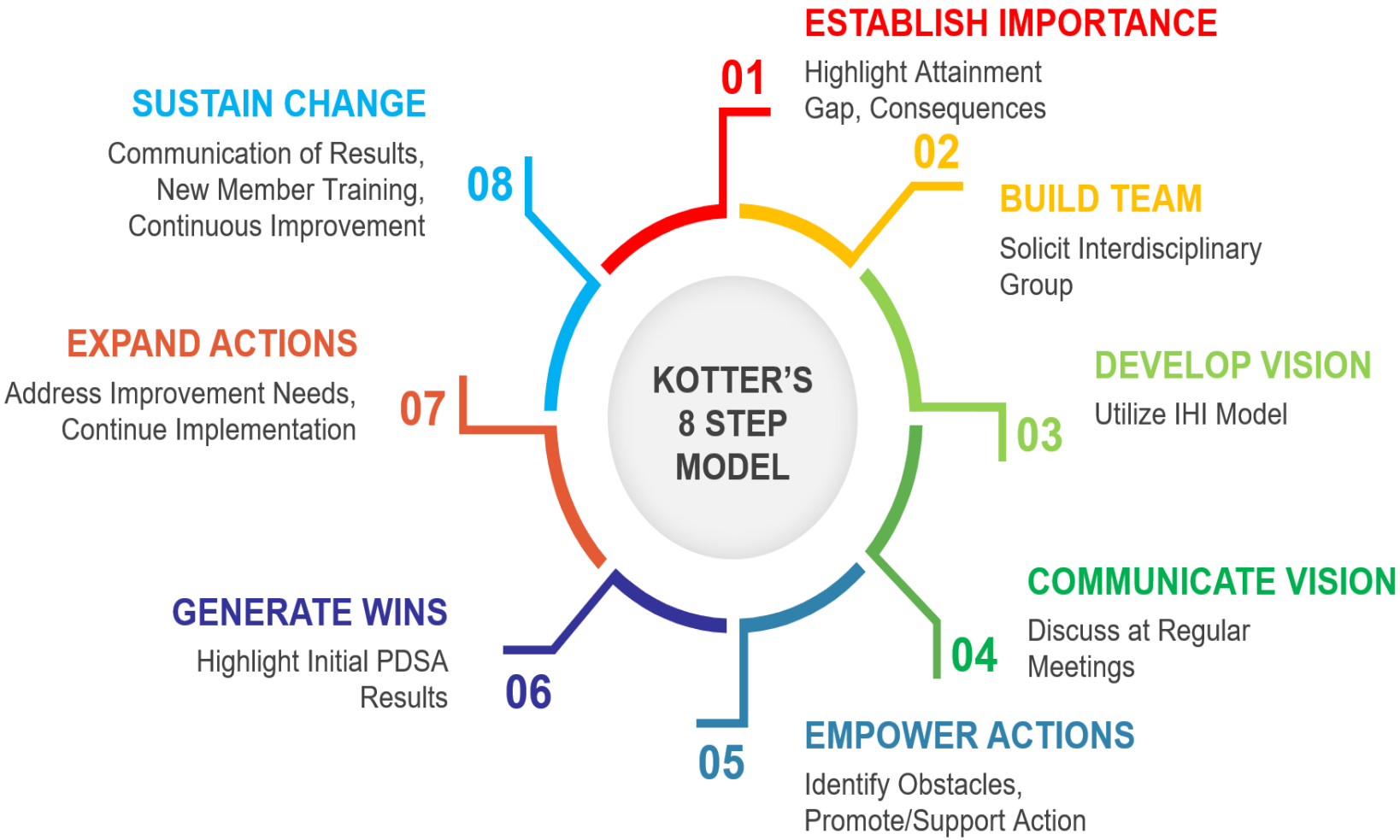
Appendix B. Fishbone Diagram of Root Causes



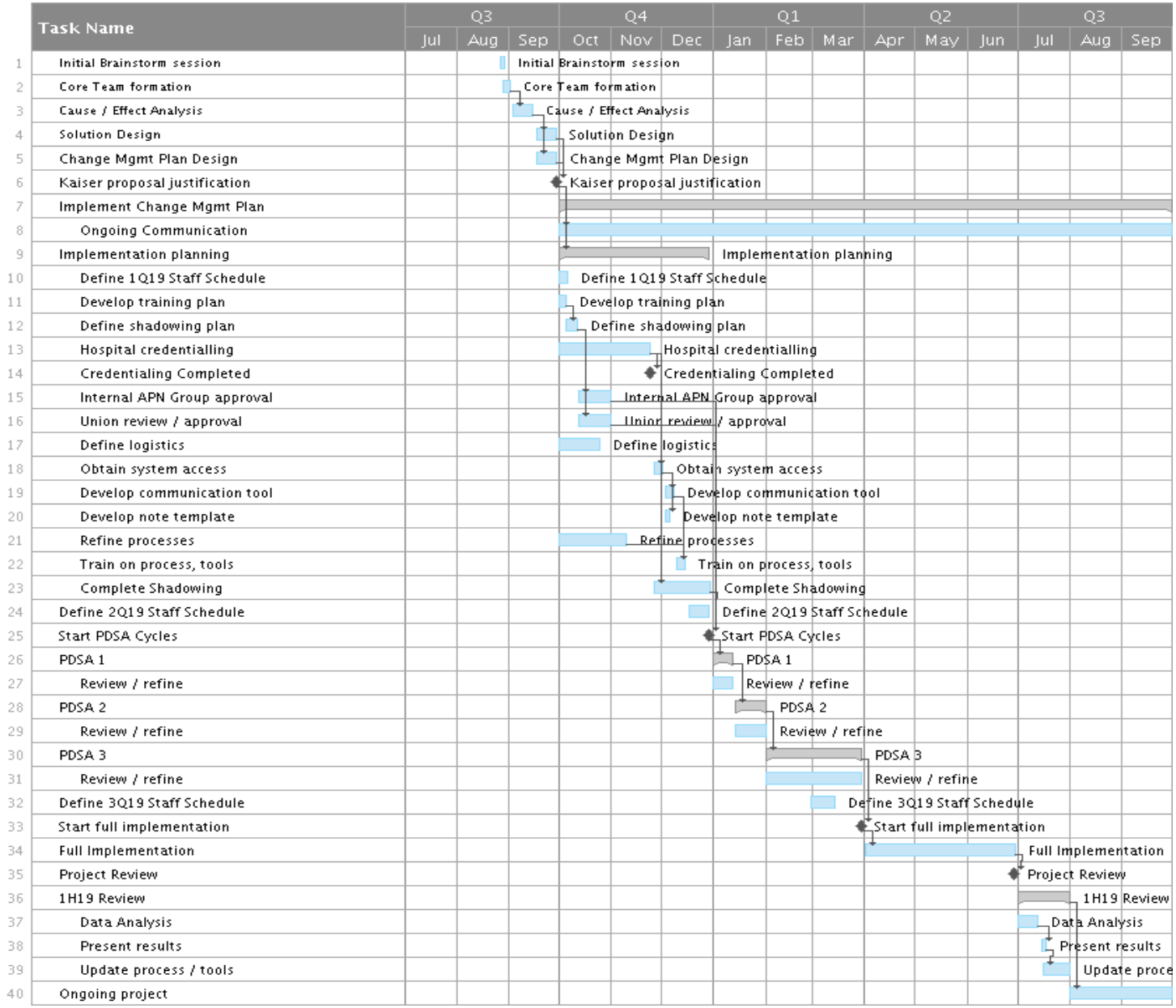
Appendix C. Driver Diagram



Appendix D. Kotter Change Management Approach



Appendix E. Project Plan



Appendix F. Operational Definition of Measures; Baseline and Goals

Measure	Operational Definitions	Base	Goal
Outcome Measures			
ADW for Consults	Calculated weekly; Numerator - sum of the days wait for each consult appointment request over a 1 week period; Denominator - number of consult visit requests over the same period	28	14
Patient Access Satisfaction	Assessed quarterly from existing patient surveys; Numerator - number of patients responding indicating "very satisfied" ("5" on a 1-5 scale); Denominator - number of patients responding to survey; Sampling strategy has demonstrated internal/external validity (Thomas Rehring, personal communication, 7/23/19)	38.5%	55%
Hospital Readmit Rate	Calculated quarterly through hospital claims data; Numerator - patients with custom composite set of diagnosis codes related to heart failure (HF) and Acute Coronary Syndrome (ACS) admitted to the target hospital who were then readmitted to any hospital within 30 days of discharge; Denominator – total applicable admitted patients	13.2%	12%
Patient cancel	Calculated monthly; Numerator - number of "no-show" or cancelled cardiology consult visits; Denominator - total number of consult visits scheduled for the same period	25.3%	15%
Provider Satisfaction	Assessed with new post intervention survey; Numerator - number of providers indicating job satisfaction "improved" or "significantly improved" ("4" or "5" on 1-5 scale); Denominator - total number of providers responding to the survey; Not previously validated but a basic 3 question survey; Internal reliability to be assessed	N/A	90%
Process Measures			
NP Inpatient Visits	Collected daily with weekly summary tracking as the total number of NP inpatient visits each week	0	35
Capacity	Calculated per month as the total number of cardiologist consult clinic slots available	185	216
Inpatient Discharge Process	Calculated monthly; Numerator - number of samples adhering to process; Denominator - number of samples taken; Based on 150 discharges/month, 30 samples/month to assess for 90% average adherence (95% confidence level, 10% margin of error); Systematic sampling of every fourth discharge to ensure all providers included in sample	N/A	90%
Baseline and Contextual Measures			
Satisfaction w/Inpatient Provider	Assessed quarterly by existing hospital patient survey; Numerator - number of patients responding indicating "very satisfied" ("5" on a 1-5 Likert scale); Denominator - total number of patients responding; Sampling strategy / results demonstrated internal/external validity - details proprietary (Sarah Owen, personal communication, 7/23/19).	86%	86%
ADW for Follow-ups	Calculated weekly; Numerator - sum of days wait for each follow-up appointment request over a 1 week period; Denominator - number of follow-up visit requests over the same period	31	31
Inpatient Visits	Tracked weekly but measured as the baseline total number total number of inpatient cardiology visits performed by cardiology NPs or cardiologists for the pre/post 6 month periods	3,800	3,800
Clinic Visits	Tracked weekly but measured as the baseline total number of cardiology clinic visits (consults and follow-ups) in the primary cardiology clinic for the pre/post 6 month periods	5,550	5,550
Population	Calculated as the average total size of the MCO's primary cardiology clinic population for pre/post 6 month periods	11K	11K

Note: All baseline and goal numbers are the averages for 2H18 and 1H19, respectively, regardless of the frequency of measurement.

Appendix G. PDSA Series and Results

PDSA series	AIM	Measure of success	Number of cycle	Cycle dates	Major cycle activity	PDSA Results/Plan
A	Process measure: Evaluate use and efficacy of new communication processes / tools for the new inpatient cardiology service	Qualitative – Feedback from MDs and NPs on value and use of the new EHR inpatient tracking tool; Goal is for all providers using tool and receiving value from it by the end of PDSA3, based on qualitative feedback	1 2 3	12/31-1/6 1/7-1/27 1/28-3/31	• Version 1 of new EHR tool implemented; Initial feedback on new processes and tools • Feedback/observation on Version 2 of the tool • Sampling of adherence to redefined d/c flow (identified in cycle 1,2) • Continued feedback on process acceptance	• Common EHR tracking tool needed additional/different data; Feedback on version 2 was successful with no new needs • Additional review/training of processes was needed for many cardiologists; Was provided • Some cardiologists reluctant to use the new processes; More change mgmt. activities provided • The inpatient discharge notification flow was not clearly defined; Flow was formally defined, and adherence was tracked in PDSA 3 • Adherence to inpatient discharge flow increased to goal of >90%. • All cardiologists were using new processes by end of PDSA 3
B	Process measure: Evaluate NP inpatient capacity; determine and address issues limiting capacity	Quantitative: Number of inpatients seen per day by NPs. Goal of 6 by end of PDSA 3: 6-10 for 1H19	1 2 3	12/31-1/6 1/7-1/27 1/28-3/31	• NPs start seeing inpatients; Tracking / analysis of initial NP inpatient capacity • Additional EHR training for NPs • Expansion of NP inpatient scope	• NPs saw 4-6 patients/day week one; Additional EHR training identified as a need and added • NPs capacity increased to an avg of 6.5/day in PDSA 2; Scope was broadened • NP's started seeing ICU patients and some new consults, PDSA3 avg of 6.8

PDSA series	AIM	Measure of success	Number of cycle	Cycle dates	Major cycle activity	PDSA Results/Plan
C	Outcome measure: Evaluate improvement in patient access	Quantitative: Average Days Wait (ADW) for cardiologist clinic consult appointments; Goal of 18 by end of PDSA 3; 14 for 1H19	2	1/7-1/27	• Implementation of new cardiologist clinic schedule	• ADW reduced by 30% over first 3 weeks to 18 (from prior 3 weeks) • Some concerns from MDs on new scheduled demands; Schedule adjustment (capacity reduced a little) made but not in effect till 2Q19
			3	1/28-3/31	• Adjustment of clinic schedule after PDSA 3 based on MD feedback	• ADW 17 avg for full 1Q19, prior to schedule adjustments noted above
D	Baseline measure to verify no degradation: ADW for follow-up (not new consult) cardiology clinic visits	Quantitative: ADW for follow-up clinic appointments; Goal is no increase for all PDSA's and 1H19	2	1/7-1/27	• Implementation of new cardiologist clinic schedule	• ADW for follow-up visits reduced by 10% over first 3 weeks, so there was no negative impact on this baseline measure
			3	1/28-3/31	• Updates to cardiologist clinic schedule after PDSA 3	• ADW for follow-up visits remained at 10% reduction for 1Q19
E	Outcome measure: Avg number of patient "cancelled or no-show" clinical consult visits	Quantitative: No-show rate for clinic consults; Goal is 20% by end of PDSA 3; 15% for 1H19	2	1/7-1/27	• Implementation of new cardiologist clinic schedule / reduction in ADW	• Cancel rate with no significant change in first month – no clear driver; likely not enough data yet for trend; no changes made
			3	1/28-3/31	• Update to cardiologist clinic schedule after PDSA 3	• No show rate with slight 1% reduction to 24% in PDSA3

PDSA series	AIM	Measure of success	Number of cycle	Cycle dates	Major cycle activity	PDSA Results/Plan
F	Outcome measure: Evaluate change in patient satisfaction with clinic access	Quantitative: Quarterly average patient satisfaction with access; Goal is 50% by end of PDSA 3; 55% for 1H19	3	1/28-3/31	• Implementation of new cardiologist clinic schedule in PDSA 2 and schedule adjustments after PDSA 3	• Patient satisfaction with appointment access improved from 41% 4Q18 to 48% 1Q19
G	Outcome measure: Evaluate change in cardiology patient readmission rate	Quantitative: Quarterly readmission for CMS defined cardiology conditions; Goal is 12.5% by end of PDSA 3; 12% for 1H19	3	1/28-3/31	• Implementation of new cardiologist clinic schedule from PDSA 2 and schedule adjustments after PDSA 3	• Cardiology readmission rate improved from 13.2% 2H18 to 11.7% 1Q19.
H	Baseline measure: to verify no degradation: Inpatient satisfaction with cardiology medical provider	Quantitative: Quarterly average patient satisfaction with inpatient provider; Goal is no increase for all PDSA's and 1H19	3	1/28-3/31	• Implementation of new cardiologist clinic schedule from PDSA 2 and schedule adjustments after PDSA 3	• Inpatient satisfaction increased from 85% 4Q18 to 87% 1Q19)

Note: Results are for PDSA cycles only. Full project, 1H19, results are discussed in the report

Appendix H. Five Year Incremental Project Income and Expense Model and Metrics

Project Incremental Income and Expense Statement						
	2019	**2020**	**2021**	**2022**	**2023**	**Total**
Incremental Income	$ 1,485	$ 1,530	$ 1,575	$ 1,623	$ 1,671	$ 7,884
Incremental Expense Reduction	$ 27,714	$ 28,545	$ 29,402	$ 30,284	$ 31,192	$147,137
Incremental Expense Increase	$ (15,700)	$ 600)	$ (618)	$ (637)	$ 656)	$ (18,210)
Additional net income	**$ 13,499**	**$ 29,475**	**$ 30,359**	**$ 31,270**	**$ 32,208**	**$136,811**

Initial credentialing / training investment $15,700
Ongoing credentialing annual cost $600

NPV, using initial investment and 9% weighted average cost of capital (WACC) as discount rate: $102,424.96
IRR using initial investment and future cash flows above: 187%, compared to 9% WACC

Notes:

1. The model only shows the incremental annual income and expense related to the project intervention.
2. The analysis is based on direct organization cost. It is not an "economic" analysis, which would include the economic value of the "free" invested NP and MD time.
3. The project was approved and funded based on the potential benefit of improved access (ADW reduction) alone and the small investment cost. Revenue gain / cost savings were not required for the internal approval or the ongoing approval (after the project ended) based on ADW improvement.
4. The incremental income was calculated based on the number of additional clinic visits associated with the reduction in cancellations multiplied by the average copay for the visits.
5. The incremental expense reduction was calculated based on the reduction in the number of cardiology readmissions multiplied by the average readmission cost.
6. The reduction in cancellation rate and readmissions may be related to other factors in addition to the project intervention.
7. The model assumes 3% inflation on all costs and income and assumes no material changes in total cardiology population.
8. The project was also associated with an improvement in patient satisfaction and provider satisfaction. Both of those improvements provide additional intangible benefits, that were not included in this analysis, in terms of reduced patient and provider attrition due to improved satisfaction. Those benefits were not able to be quantified but it is agreed they exist.