Final Progress Report

Coordinating Transitions: HIT Role in Improving Multiple Chronic Disease Outcomes

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Abstract

Purpose

The Coordinating Transitions pilot study aimed to improve care transitions from the hospital to home for low-income persons with multiple chronic conditions using health information exchange (HIE).

Scope

The project provided clinical decision support tools to an urban, single primary care practice that serves a large Medicaid population. The nurse care coordinator in the study practice received automated care transitions alerts via secure email and this triggered an outreach phone call to high-risk discharges. During the call, the nurse assessed the impact of social and behavioral determinants of health and a web-based version of the Patient Centered Assessment Method (PCAM) highlighted health concerns.

Method

This pragmatic clinical trial compared the study site and two control practices to the regional Medicaid population in the year before (baseline 2014) and during implementation (2015) to determine effectiveness of the intervention. The clinical algorithm defined the target population as adult Medicaid recipients with chronic disease, and counted inpatient (IP), emergency (ED) and outpatient (OP) visits using de-identified claims from the Medicaid Data Warehouse.

Results

The project successfully modified practice workflow and implemented HIE through the regional health information organization (HEALTHeLINK). The practice developed a tracking mechanism and expanded the intervention to include ED discharges. The study practice achieved a statistically significant reduction in IP (25%) and ED utilization (35%), as well as a significant increase in OP visits that added revenue to the practice. The study outcome resulted in higher value utilization than in both comparison practice sites and the regional Medicaid population.

Purpose

The long-term goal of the Coordinating Transitions project is to improve the quality of transitions of care of adults with multiple chronic diseases, from the hospital to primary care settings. The project employed health information technology (HIT) to systematically facilitate and improve two-way communication of critical information, resulting in fewer hospitalizations and lowering costs. Population-level health outcomes analysis methodology compared the effectiveness of transitional care coordination after implementation of HIT interventions, at the study and comparison primary care practices. The central hypothesis of the study is that patient-centered, risk-stratified care management, supported by integrated and interoperable information, would have better outcomes than usual care. The rationale that underlies the proposed research is that immediate notification regarding hospital discharges will enable timely, systematic, low-cost, telephonic outreach by nurse care coordinators in primary care to high-risk patients.

The specific aims of the project were to:

1. Improve risk-stratified care management model fit through customization of the clinical algorithm and the Patient-Centered Assessment Method (PCAM) for Medicaid primary care.
2. Develop interoperable Health Information Exchange (HIE) that integrates discharge information, risk stratification, and social factors to support telephonic care coordination.
3. Evaluate HIT implementation's impact on practice workflow, care quality and health outcomes.

Scope

Background. Readmission within 30 days of discharge due to inadequate care coordination is costly, potentially unsafe, and wasteful, particularly for individuals with multiple chronic conditions. Regionally, electronic discharge summaries can take seven to fourteen days to reach primary care and are not transmitted electronically by some hospital networks. Reliance on the recovering patient to convey information across settings during the transition from hospital to primary care contributes to high rates of readmission for these individuals. Current knowledge demonstrates that enhanced care management of the most complex cases can improve transitions between settings (1-3). Recent studies identify widespread gaps in transitional care coordination for persons with chronic disease, including medication reconciliation (4), primary care follow-up (5, 6), and self-care knowledge (7); problems that could be ameliorated with health informatics and telehealth. Failure to get the right information to the right person in the right place at the right time to intervene before there is a crisis, thwarts effective transitional care coordination for patients with multiple-chronic disease.

Context. The conceptual model for this project (Figure 1) bridges macro and micro-level approaches to improve management of care transitions for individuals with multiple chronic diseases (8). Specifically, the model connects population health management with clinical management of individual patients using a clinical algorithm (9, 10), which divides the population into cohorts based on co-morbid chronic disease patterns using either practice billing or de-identified claims data. Once segmented into a cohort, the algorithm allocates the group

with multiple chronic diseases to receive fully integrated care. The Patient Centered Assessment Method (PCAM) provides additional information about social risk factors that are critical in developing a patient-centered plan of care for complex patients with multiple chronic diseases (11, 12).
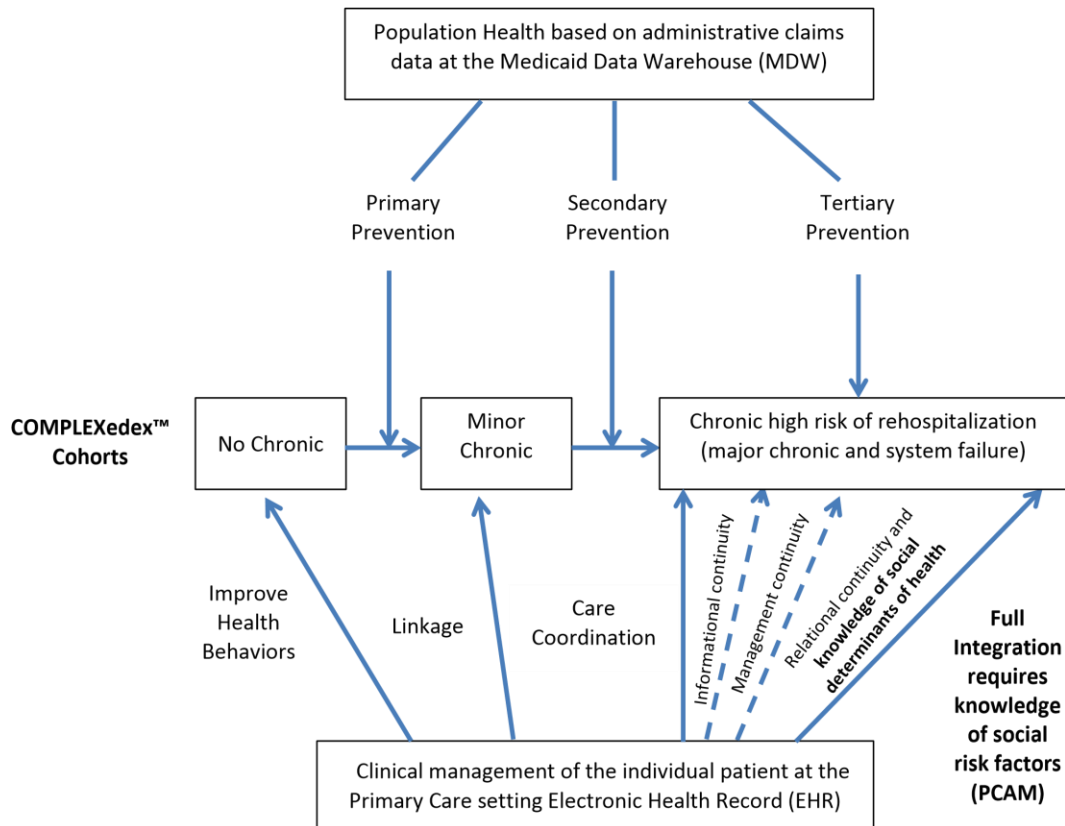

Figure 1. Conceptual model of risk-stratified care management

Dividing the population into cohorts based on their level of need is critical for evaluating health outcomes at the population level. The Bridges to Health model (13) divides the population into segments to identify priorities for the use of interoperable health information. At the population level, health promotion and disease prevention interventions vary based on the presence of chronic disease (14). Interventions also vary within the primary care setting, ranging from health behavior modification to fully integrated care that includes informational, managerial and relational continuity (15). However, within primary care, it is difficult to identify the patients who require fully integrated care management (16). Although these models resonate with clinicians and provide direction to the type of service needed, they do not suggest how to use either the EHR or administrative claims to divide the population into risk-standardized cohorts (17, 18). A further drawback is that they do not attempt to use the segments to evaluate program effectiveness or cost savings at a population level, making the link between health outcomes and clinical intervention very difficult at the practice level (19).

Outreach from the primary care practice maximizes relational continuity, based on the long-term relationship with the individual, including knowledge of the home situation and social factors. Managerial continuity, or the ability to navigate the complex healthcare system, is

improved by providing clinical decision support tools that address social complexity. Incorporating this information into the EHR by submitting information to the Regional Health Information Organization (RHIO) in the continuity of care document (CCD) further promotes managerial continuity. Informational continuity, through exchange of critical health information across the healthcare continuum, is improved through case identification and incorporation of a discharge alert for individuals with multiple chronic diseases in the primary care EHR. Receipt of the alert triggers an outreach phone call from the care coordinator to assess the patient's immediate needs and facilitates follow-up.

Settings. We delivered the intervention at Elmwood Health Center, a single Patient Centered Medical Home (PCMH) in urban Buffalo, NY. We chose this practice site because of their interest in using HIT to improve health outcomes and because of their history of collaborating with HEALTHeLINK, the local RHIO. The project used two similar PCMHs in urban Buffalo as comparison sites for the outcomes analysis. In addition, the team evaluated outcomes in the 8-county region of Western New York to understand secular trends in Medicaid utilization using the Medicaid Data Warehouse (MDW). This was particularly important because the region received funding in 2014 as part of the New York State Delivery System Reform Incentive Plan (DSRIP) with the goal of reducing hospital admissions in the Medicaid population by 25% by the year 2019 (20).

Participants. The participants in this pragmatic clinical trial were individuals who generated a Care Transitions Alert (CTA) who received care at the study practice site. All participants had consented to have their health information shared through the RHIO to participating providers. In order to generate a CTA, discharged persons needed to have a major chronic disease as determined by the COMPLEXedex™ algorithm. The study excluded children under the age of 18 from the intervention. We considered staff at the study PCMH as participants in the workflow analysis portion of the study.

Incidence. At baseline, the eligible Medicaid population in each of the sites included individuals over the age of 18, who had a major chronic illness, and who were not dually eligible for Medicare. Figure 2 shows the baseline rate of utilization for inpatient (IP), emergency department (ED), and outpatient (OP) encounters. Utilization in the four groups is similar at baseline. The rate of hospitalization ranges from 279/1,000 for comparison site B, to 358/1,000 or all other Medicaid recipients, with the intervention practice falling between those rates with 90 IP encounters for 266 individuals.

Prevalence. The study used risk stratification based on the International Classification of Disease (ICD) codes contained in the claims database (either the MDW or the PCMH report). Clinical Classification Software (CCS) developed by the Healthcare Cost and Utilization Project (H-CUP) (21) provides a way to classify diagnoses into a limited number of categories using International Classification of Disease codes (both ICD-9 and ICD-10). A clinical algorithm developed by our team at the University at Buffalo, School of Nursing creates a hierarchy of 31 chronic conditions using data definitions in the CCS. The hierarchy divides the population into segments, defined as individuals without major chronic disease, those with chronic disease, and those with system failure. The algorithm also counts the number of IP, ED and OP events in a single year.
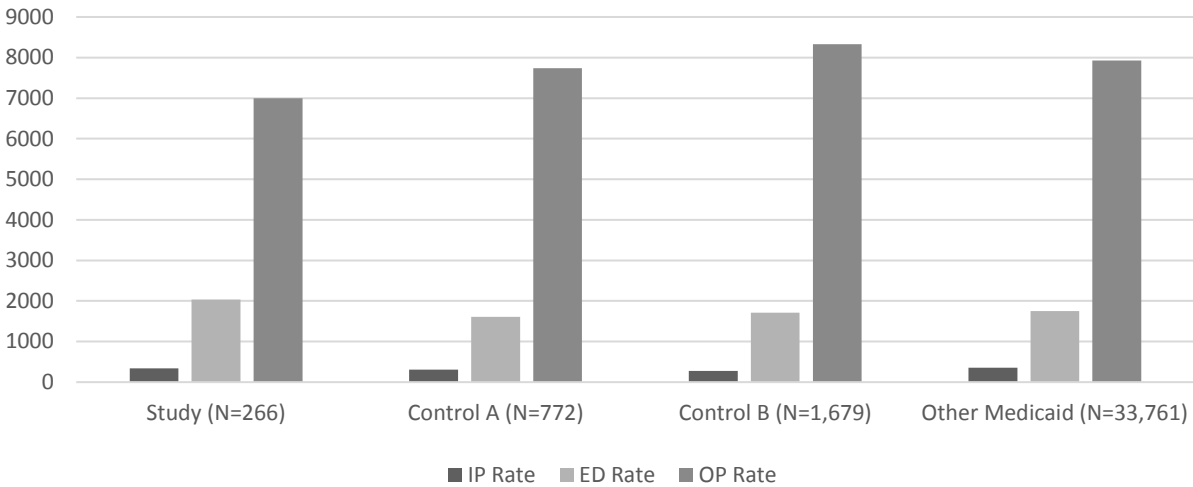
Figure 2. Baseline utilization rates, 2014

Figure 3 shows the prevalence of chronic conditions in the four populations at baseline. The intervention primary care site has a higher rate of Mental Health (MH) conditions because it provides medical care for a large intellectual and developmentally delayed population. The disease categories are asthma (ASTH), substance abuse (SA), chronic obstructive pulmonary disease (COPD), diabetes (DM), coronary artery disease (CAD), heart failure (HF) and chronic kidney disease (CKD). There are categories for comorbid CAD & DM, HF & DM, HF & CAD, and HF & DM & CAD. The algorithm assigns individuals to the highest disease category based on their comorbidity patterns.

Figure 3. Prevalence of Chronic Conditions for Medicaid Population at Baseline, 2014
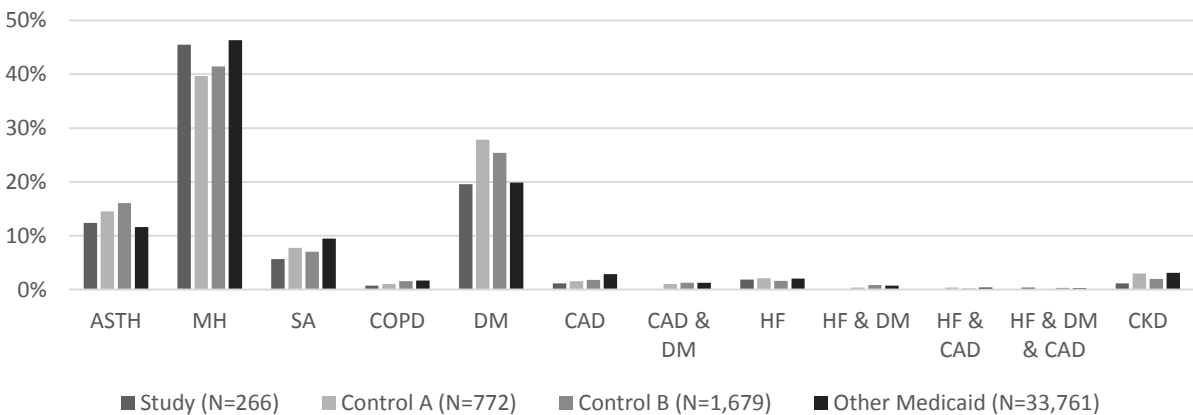
Methods

The project employed observational comparative effectiveness research to demonstrate improved utilization patterns after implementing the intervention. In addition, we used qualitative methods to evaluate changes in practice workflow in the intervention practice. The project also included review of the EHR of the participants to evaluate the impact of the intervention on readmission.

Study Design. The study is a pragmatic clinical trial that compares the utilization patterns in the intervention site to usual care in the three control populations. The team completed observational analysis of workflow in the study practice at baseline (2014) and throughout the implementation year (2015). A research assistant completed retrospective chart review in the EHR of cases that triggered a care transitions alert for 90 days after discharge. Annual utilization in the Medicaid population with chronic conditions was evaluated for 2014 (baseline) and 2015 (implementation).

Data Sources/Collection. Research assistants completed observations and chart reviews for patients who triggered an alert in the intervention practice only. The research team evaluated utilization patterns in both study and comparison populations using de-identified claims data from the New York State MDW. The principal investigator has a Data Exchange Application and Agreement (DEAA) with the New York State Department of Health to access a limited data set, stripped of identifying information in compliance with the Health Insurance Portability and Accountability Act (HIPAA). The University at Buffalo Institutional Review Board (IRB) determined that the de-identification process resulted in a dataset that was not human subject research.

Interventions. The research team developed interoperable clinical decision support tools to improve care continuity during transitions for recently discharged individuals with multiple chronic diseases. Three critical elements of the decision support are:

1. Notification of discharge within 24 hours,
2. Evaluation of social determinants of health in outreach calls, and
3. Exchange of information across the healthcare continuum.

The coordinating transitions project used HIE to alert the practice's nurse care coordinator about high-risk discharges. The RHIO linked admission, discharge and transfer (ADT) notifications to the roster of patients cared for by the intervention practice to a cohort table which identified cases with major chronic conditions (22), and pushed a secure email out to the practice for patients who gave consent to share their information. The alert triggered an outreach phone call to the patient to assess their ability to manage in the home, arrange for timely follow-up, and to evaluate social factors that might affect recovery.

In addition, after making the outreach phone call, the nurse care coordinator completes the Patient Centered Assessment Method (PCAM) assessment of social and behavioral determinants of health. The PCAM is a 12-item 4-point Likert scale that includes domains for physical and mental health, social support, health literacy and engagement with services (23, 24). After completing a post-discharge telephone call with the patient and/or caregiver, the nurse selects the response that most closely matches his/her perception for each question. Staff without

extensive psychiatric background are able to complete the PCAM, and the assessment is used in settings around the world with good ability to identify serious social issues affecting health.

Measures. The pragmatic trial compared the effectiveness of the intervention under real world conditions. Within the region, there are multiple concurrent interventions designed to reduce readmissions that make it difficult to isolate the impact of the intervention in improving outcomes. In order to improve the internal validity, the study employed a pre-test, post-test design comparing the rates of IP, ED and OP utilization during the years before and after implementation. In addition to identifying the study and comparison practices, we compared results to those of the regional Medicaid population using the MDW. The study measures the intervention's success in both the actual rate, and magnitude of change in rates of utilization. High value post-discharge utilization consists of low IP rates, low ED rates and high OP rates (25, 26).

Limitations. One limitation of the study is that utilization data is available for Medicaid recipients only. Thus, it is not possible to generalize the outcomes analysis to Medicare and commercially insured populations. The assumption was that if the intervention is effective in the high-risk Medicaid population with social factors that influence recovery, then it should also work in chronically ill populations with greater social and economic resources. A second limitation is the inability to control for other interventions in the region to reduce readmissions. We cannot conclude that the coordinating transitions intervention caused improved utilization.

Results

The project was able to achieve the three specific aims: 1) improvement of risk-stratified care management through the development of clinical decision support tools, 2) enabling health information exchange across healthcare settings during care transitions, and 3) evaluating workflow, care quality and utilization outcomes. The project was successful in developing and implementing the clinical decision support tools, and in sharing results across healthcare settings. These results have been reported elsewhere (22, 27).

Principal Findings. Figure 4 demonstrates the risk-stratification of the Medicaid population. The project targeted the 20% of the population with major chronic disease. However, the study practice expanded the intervention to include telephone outreach by the triage nurse to individuals treated and released from the ED. This aligned with the practice's quality initiatives and the delivery of admission, discharge and transfer notifications made this outreach possible.

Figure 4. Alignment of population complexity segments with outreach
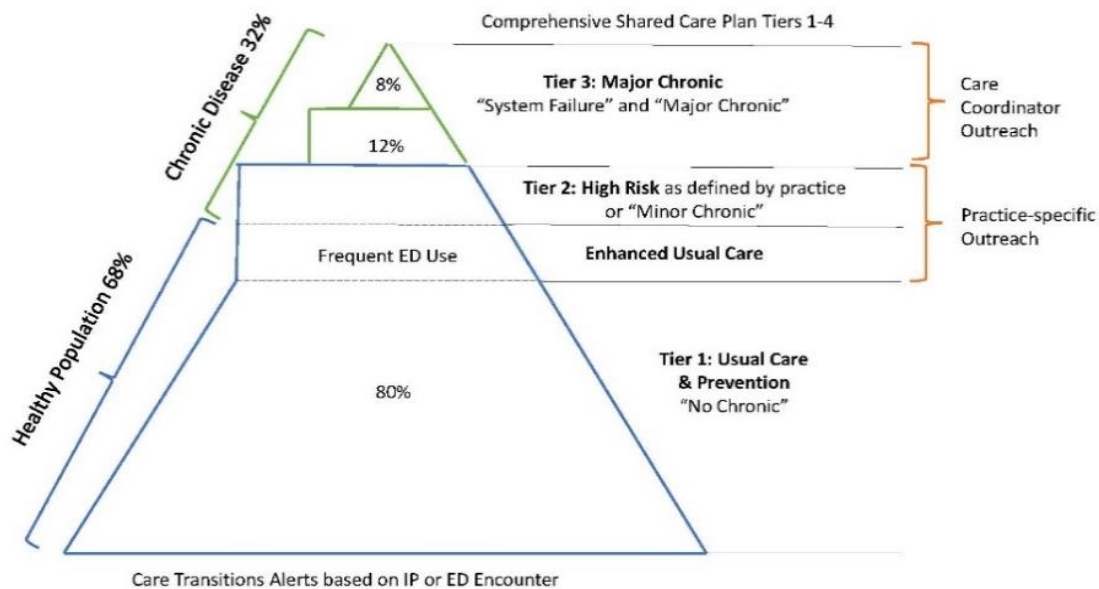
Rather than developing a care transitions dashboard within the practice's EHR, we utilized the capabilities of the existing clinical data repository at HEALTHeLINK. The change from locally adapting the practice EHR to meet outreach goals, to integrating the solution in the regional HIE system, creates an interoperable solution for dissemination to primary care practices throughout the region. The information pathway illustrated in Figure 5 is as follows: At discharge, the hospital sends an automated electronic Admission, Discharge or Transfer (ADT) message to HEALTHeLINK; the ADT is shared with the Clinical Data Repository (CDR) and the primary care practice. The CDR compares the ADT with the cohort table that is updated monthly using the COMPLEXedex™ algorithm and the practice's roster of patients with consent to share their information. For discharged patients who are on the roster and have a chronic

condition, the system sends a secure CTA message to the nurse care coordinator in the primary care practice. The care coordinator makes an outreach phone call, and after the call completes the ePCAM (28). The ePCAM summarizes PCAM responses indicating a moderate or severe problem on the final page of the web-based tool, and the care coordinator copies and pastes the text into the transitions of care note. A CCD transmits this information to HEALTHeLINK to close the information feedback loop. We are working on a more elegant solution to copy-and-paste; however, this is much easier than manually entering the responses into a laboratory test.

Figure 5. Information flow in the *Coordinating Transitions* Intervention
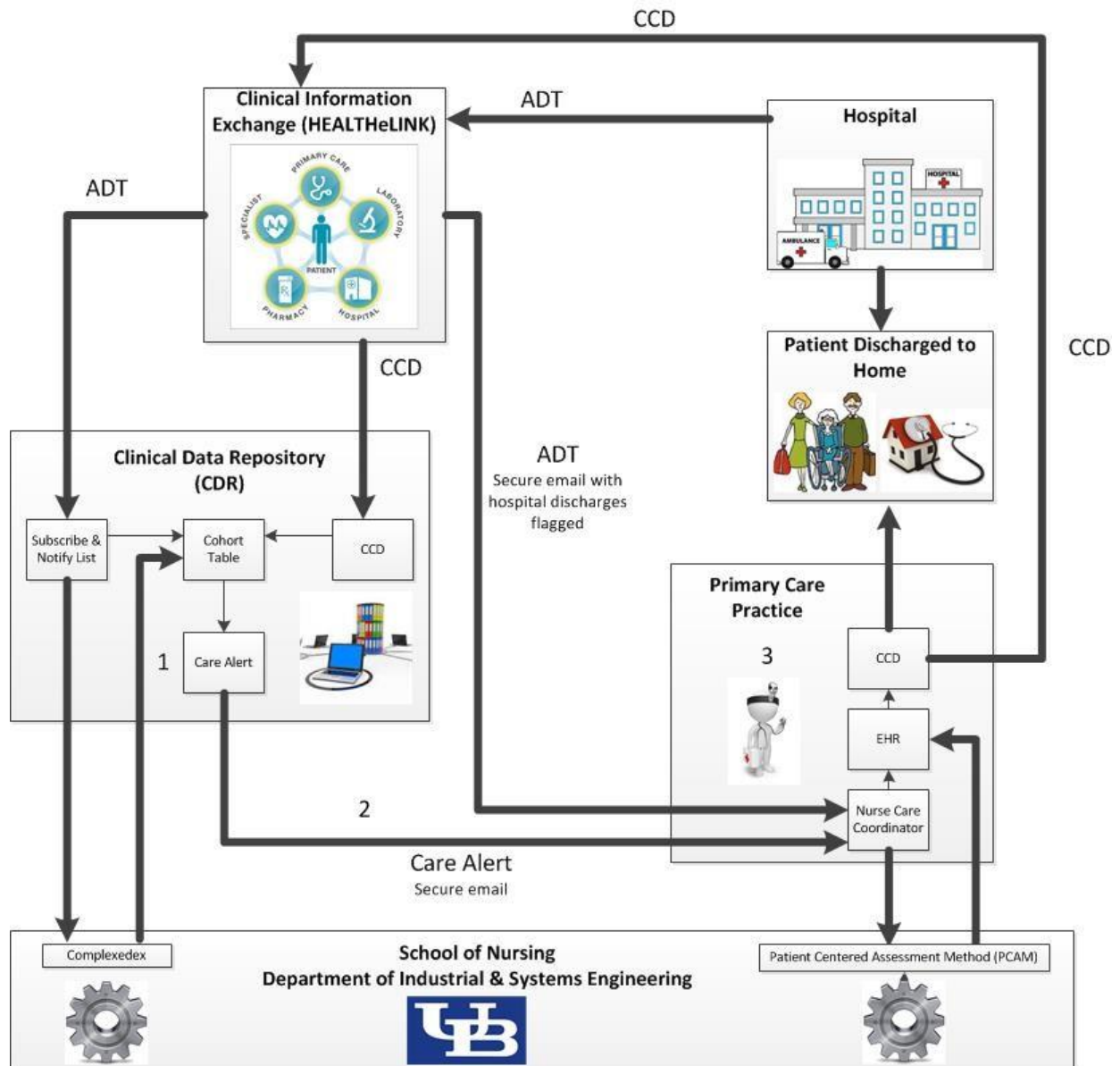
The outcomes analysis looks at OP, ED, and IP utilization in the practice at baseline and after the implementation year (2015). Figures 6 – 8 compare the 2014 and 2015 rates in the four populations. The study practice has changed from a pattern of low-value utilization at baseline (with high IP and ED rates, and low OP rates) to higher value (with low IP and ED, and high OP rates per 1,000 individuals).

Figure 6. Comparison of inpaitent (IP) rate per 1,000, 2014-2015

Figure 7. Comparison of emergency department (ED) rate per 1,000, 2014-2015

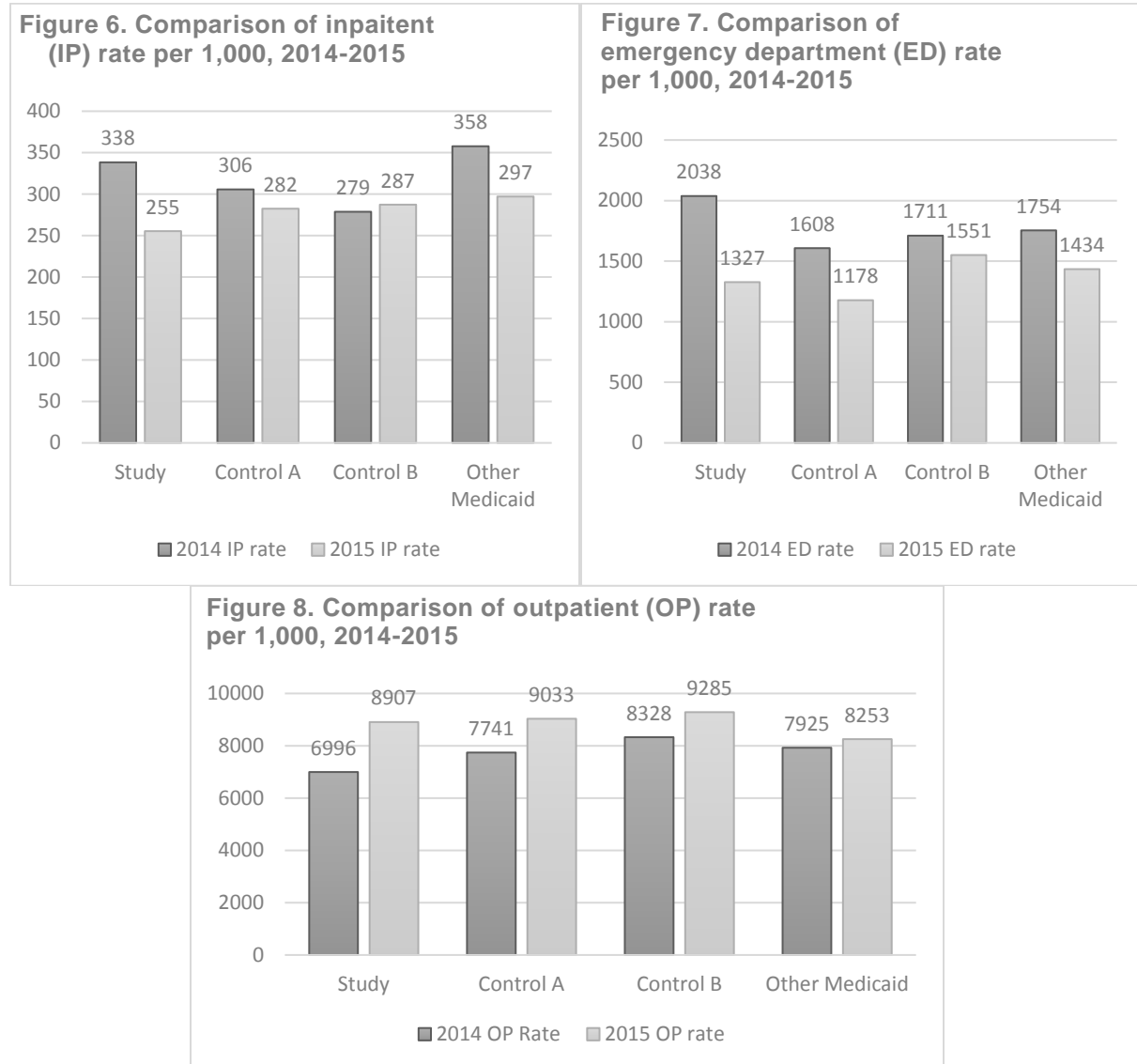Figure 8. Comparison of outpatient (OP) rate per 1,000, 2014-2015

Figure 9 shows this graphically as the growth rate change from baseline to implementation. The largest rate change is a 35% reduction in ED utilization in the study (intervention) practice site. The study site also had a 25% reduction in IP hospitalizations and a 27% increase in OP visits. Control practice B had the worse results with a 3% growth in IP rates, and only 9% reduction in ED rates. However, both control site A and the remaining Medicaid population all trended toward higher value utilization, although not to the extent of the intervention population.

Figure 9. Inpatient (IP), emergency department (ED) and outpatient (OP) growth rate comparison for populations between baseline and intervention years, 2014 to 2015
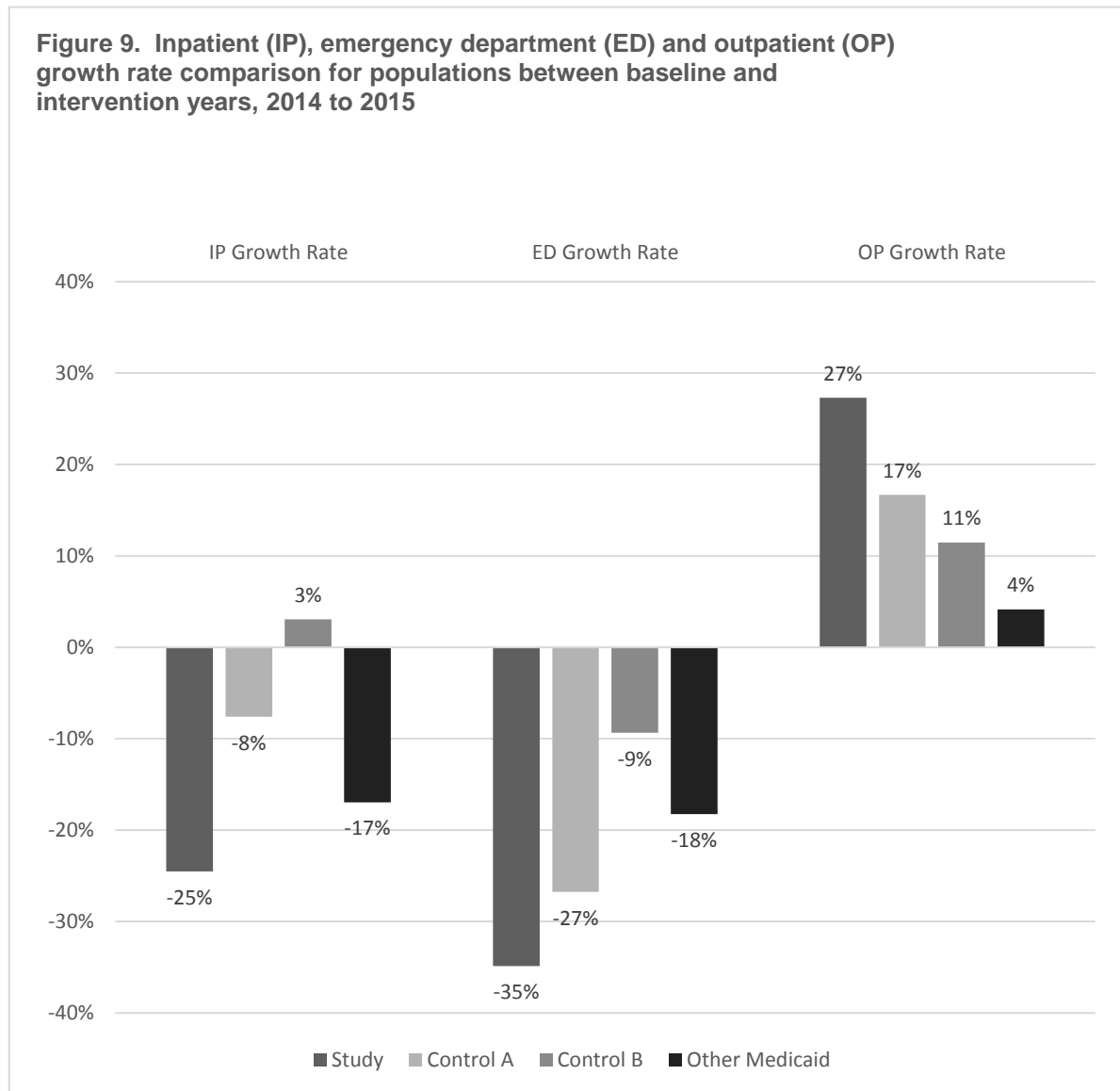
We translate the change in utilization rates to avoided events and project a potential avoided expense to the healthcare system using national average costs per encounter from the H-CUP project data in Table 1. The difference between the expected rate of utilization (IP, ED or OP) based on 2014 rates and the actual rate in 2015 is the change in rate. The change in rate is multiplied by the population size in 2015 to determine the number of avoided events. The avoided events are multiplied by the national average cost per event in 2014 (the most recent data available at https://hcup-us.ahrq.gov/). For example, the potential savings for the study population for IP avoided events is -35 x $10,855 = -$378,438, for avoided ED is -298 x $1,077 = -$320,679, and for additional OP is 801 x $89 = $71,251. These values added together are -$627,865 and divided by 419 persons in the target population that result in a $1,498 average savings per adult Medicaid recipient with chronic disease.

Table 1. Avoided events based on the difference between expected IP, ED and OP utilization rates based on 2104, and actual rates in 2015 for the population size in 2015

Population and Target Population Size in 2015	Avoided IP @ $10,855*	Avoided ED @ $1,077*	Additional OP @ $89	Total expense related to Avoided Events (IP + ED – OP)	Cost avoided per person
Study (N=419)	-35	-298	801	-$ 627,865	-$1,498
Control A (N=963)	-22	-414	1,244	-$578,857	-$601
Control B (N=2,085)	18	-333	1,995	$12,484	$6
Other Medicaid (N=38612)	-2,341	-12,354	12,674	-$37,664,215	-$975
***rates for IP, ED from national average cost data in 2014 from HCUP.net.**					

Statistical analysis using the x^2 two-sample test for equality of proportions with continuity correction, demonstrates that there is no significant difference in IP utilization between the study and control populations in either 2014 or 2015 (*p* value set at .05). However, the difference in IP rates between 2014 and 2015 in the study population is statistically significant (x^2 = 5.07, 95% CI = 0.009 – 0.157, p = 0.02). The change is not significant in either control population, but in the other Medicaid population the difference is statistically significant (x^2 = 301.46, 95% CI = 0.054 – 0.068, p < .001). The reduction in the IP rate is greatest in the study population where there were 83 fewer IP stays per 1,000 individuals than expected based on 2014 rates.

Outcomes. Overall, the team has surpassed the project's specific aims and has demonstrated improved outcomes over usual care. Specifically, we:

1. Adapted the COMPLEXedex™ algorithm to include mental health and substance abuse as new categories to align with the needs of the Medicaid population. We were able to update the algorithm to ICD10 using the H-CUP Clinical Classification Software. We have applied the algorithm to data in the MDW to understand the impact of managed care and accountable care organizations on IP and ED utilization (29-31). The broader research team is using this work to understand opioid abuse and lung cancer compliance with guidelines.
2. Developed an interoperable and fully automated system to deliver CTAs to the Care Coordinator in the primary care setting. Our partner, HEALTHeLINK deployed the system as part of their growing HIE capabilities and have introduced delivery of ADT notifications to multiple practice sites based on the approach developed in this project. We continue to collaborate with them on implementing an approach to share comprehensive shared care plans (CSCP) across healthcare settings, and our intervention practice, Elmwood Health Center is the exemplar for that effort.
3. Integrated assessment of social and behavioral determinants of health into the care coordination process for recently discharged persons with major chronic conditions. Initially, the care coordinator had to enter the PCAM results into the medical record as a laboratory test to accommodate space limitations within the EHR. However, there was no way to incorporate the problems identified into the care planning process and the PCAM results were meaningless without reference to the tool. Our solution was to have students develop a web-based ePCAM tool that had the advantage of assigning a score to the

qualitative PCAM tool. The scoring mechanism facilitated the process of defining specific problems that required intervention, enabling the Care Coordinator to incorporate the identified problems into his/her transitions of care note. We continue to work on incorporating discrete results of the ePCAM responses and summary scores into the EHR. We are collaborating with the Regenstrief Institute and Dr. Susan Matney, an expert in the field, to develop standardized nomenclature in the form of Logical Observation Identifiers Names and Codes (LOINC codes) and will work on Systematized Nomenclature of Medicine -- Clinical Terms (SNOMED-CT codes) for the electronic exchange of interventions and problems (32).

4. Redesigned the workflow at Elmwood Health Center to support transitional care. Elmwood developed a tracking mechanism to be sure that recently discharged individuals had their care needs addressed in a timely fashion. The practice expanded the outreach to include high-risk (their definition) discharges from the ED. This contributed significantly to reducing expenses from what was expected and to the high-value utilization pattern. The practice has continued to expand their risk-stratified care management program and maintain the use of the decision support tools developed for the project.

5. Shared the care plan and transitions of care note as a CCD. The care plan is a discrete part of the encounter that is available to all providers through HEALTHeLINK. HEALTHeLINK currently archives the entire EHR, sent as a Continuity of Care Document Archive (CCD-A), and the archive is stored in the Clinical Document Architecture (C-CDA R2) developed by Health Level Seven (HL7).

6. Demonstrated improved utilization outcomes over usual care.

Discussion. Elmwood Health Center significantly achieved the target results in the adult Medicaid population with chronic disease set by the New York State DSRIP. The DSRIP baseline year starts in April 1, 2014 ended on March 30, 2015. The DSRIP goal was to achieve a 25% reduction in avoidable hospitalizations. Regionally, the Medicaid population improved significantly in 2015 with a 17% reduction in IP utilization and 18% reduction in ED visits. However, the rate of OP utilization is stagnant. Currently the DSRIP is in the 3rd year of implementation with the expectation that they reach their goal by 2019.

Conclusions. Population-based risk-stratified care management supported by HIE and CDS resulted in improved value of utilization in the target population of Medicaid adults with pre-existing chronic conditions who were not dually enrolled in Medicare. The intervention used existing personnel in the practice site and existing capabilities at the RHIO. The practice developed a sustainable workflow and maintained it for the past 15 months without additional support from the research team. Additional OP utilization has increased revenue for the primary care practice without the need for additional direct care staff. The staff are enthusiastic about the program and it has become a regional model for how to meet DSRIP goals for the Medicaid population.

Significance. This successful pilot project demonstrates the potential impact of adding timely notification and decision support to enhance care coordination in primary care. Because the project used the RHIO to support HIE, we believe that the intervention could be implemented regionally as practices are able to receive ADT notification and to send their CCD to the RHIO.

More widespread adoption of the intervention is then possible in other areas of the country with functional HIE.

Implications. The role of the registered nurse (RN) care coordinator has been critical to the success of the program as the RN has the skill set need to assess problems and develop a care plan shared across settings. Using data to identify the population where there is the potential for significant reduction in cost and improvement in the patient experience of care is an emerging skill set, and all nurses need to understand how to use data to improve decision making at the point of care. The CTA allowed the care coordinator to see the potential for population-based care management, and once there were a few averted hospitalizations, the practice expanded the intervention without needing the support of the research team. This hands-on experience is critical to the success of the program.

The success of the intervention points to the need for policy to support efforts at population-based care management. If the regional Medicaid population reached the study practice post-intervention utilization rates, they would have saved over $30 million in avoided expenses. However, to reach those goals we need to consider changing the primary care workforce to include RNs. Incentives such as payment for outreach phone calls or higher reimbursement for successful transitional care are needed in the challenging Medicaid population.

There is a need for ongoing research in the area of technology supported care coordination. Developing educational programs to prepare both nursing students and practicing RNs to become care coordinators is critical to sustaining the program. Embedding care coordinators in the primary care practice where they have an on-going relationship with the chronically ill individual and their caregivers in addition to access to the rest of the care team is critical to making care patient-centered. An additional area for research is in development and implementation of an interoperable care plan shared across settings. Our recent scoping review demonstrates that we still have much to learn about how to incorporate social and behavioral determinants of health into an interprofessional care plan that transcends a single care team (33).

The coordinating transitions pilot project successfully demonstrated the potential for using existing HIT to deliver alerts and support clinical decision making for chronically ill individuals during care transitions. Key elements in the success included development of an interoperable solution and expansion of the role of the nurse care coordinator in primary care. Furthermore, the regional DSRIP project provides an ideal platform for dissemination of the intervention. Finally, continued support to development of HIE capability at RHIO's across the country is needed to achieve a transformed care delivery system that reduces cost, improves quality, and is centered on the individual's experience of care.

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