

Grand Valley State University  
**ScholarWorks@GVSU**

---

Doctoral Projects

Kirkhof College of Nursing

---

8-2016

# Population Health Management Risk Assessment Tool Validation: Directing Resource Utilization

Sonya L. Christensen

Grand Valley State University, christso@mail.gvsu.edu

Follow this and additional works at: [http://scholarworks.gvsu.edu/kcon\\_doctoralprojects](http://scholarworks.gvsu.edu/kcon_doctoralprojects)

 Part of the [Nursing Commons](#)

---

## Recommended Citation

Christensen, Sonya L., "Population Health Management Risk Assessment Tool Validation: Directing Resource Utilization" (2016).  
*Doctoral Projects*. Paper 12.

This Project is brought to you for free and open access by the Kirkhof College of Nursing at ScholarWorks@GVSU. It has been accepted for inclusion in Doctoral Projects by an authorized administrator of ScholarWorks@GVSU. For more information, please contact [scholarworks@gvsu.edu](mailto:scholarworks@gvsu.edu).

Population Health Management Risk Assessment Tool Validation:

Directing Resource Utilization

Sonya L. Christensen

Kirkhof College of Nursing

Grand Valley State University

Co-Chair: Karen Burritt

Co-Chair: Barbara Hooper

Committee Member: Raymond Higbea

Committee Member: Tammy Awald

August 26, 2016

### Abstract

The Affordable Care Act (ACA) of 2010 is transforming health care across the nation into a value-based system that emphasizes quality and continuity with reimbursement tied to patient outcomes. The shift in emphasis is best realized through the strategy of Population Health Management, a change from traditional episodic treatment of illness to management of the health needs of populations throughout the continuum of health. The goal of care is to ensure that patients, especially the chronically ill, receive effective attention to their health needs in order to improve outcomes, decrease costs, and provide a positive patient experience. An important component of coordinating care in Population Health Management is identifying those at risk for adverse outcomes or unplanned healthcare utilization, particularly at transitions of care. The purpose of this quality improvement project was to apply the LACE risk assessment tool in the emergency department (ED). Seventeen months of retrospective data was examined and Poisson regression used to examine and validate variables for use in the ED. The variables Length of Stay was modified to Length of Time between ED admissions, named Length of Stay Out of the ED (LOSO), and the Emergency Severity Index (ESI) scale of acuity was used. An ED-LACE score was calculated and validated using logistic regression. The model was found to have robust predictive ability with a with a *c-statistic* of 0.948.

**Keywords:** Population Health Management, risk assessment, Bundled Payments for Care Improvement, LACE index, Critical Success Factors, early emergency department visits, Length of Stay Out of the ED (LOSO), Emergency Severity Index (ESI)

Table of Contents

Abstract.....2

Table of Contents.....3

Executive Summary.....5

Introduction and Background.....6

Problem Statement.....11

Evidence-Based Initiative.....11

Conceptual Models.....14

Organizational Assessment.....29

Project Plan.....31

    a. Purpose of Project with Objectives.....31

    b. Type of Project.....32

    c. Setting and Needed Resources.....32

    d. Design for the Evidence-based Initiative.....34

    e. Participants.....44

    f. Ethics and Human Subjects Protection.....44

    g. Steps for Implementation of Project and Timeline.....45

    h. Project Outcome Measures.....47

    i. Cost Analysis.....49

Project Implementation.....49

Data Analysis.....60

Project Outcomes.....60

    a. Key Facilitators and Barriers.....61

    b. Unintended Consequences.....61

c. Implications for Practice.....	62
d. Stakeholder support and sustainability.....	63
e. Recommendations.....	63
f. Limitations and Next Steps.....	64
g. Reflection on enactment of DNP Essentials competencies.....	64
Dissemination of Outcomes.....	66
References.....	68
Appendices.....	81

### Executive Summary

The reforms of the Affordable Care Act (ACA) are increasingly shifting the responsibility of coordinating patient care to healthcare systems, resulting in the reality of increased financial risk. However, the reality and risks of the Bundled Payment for Care Initiative under the ACA also carries provisions for shared savings and the benefit of improved health of the population. The change in focus of care and reimbursement provides the structure for Population Health Management. A strategic transition is necessary, from episodic volume based treatment of illness, to coordinated healthcare and maintenance across the lifespan. Cost saving will be achieved from increased patient and care team engagement, efficient use of resources, decreased unplanned healthcare utilization, and effective coordination of care. Implementation of the highly predictive ED-LACE tool into the routine workflow of the emergency department (ED) is recommended to provide an objective system for identifying those with potential risk for unplanned ED visits after discharge. It improves patient outcomes by providing a foundation for complex coordination of care to decrease readmissions, helps to decrease cost and minimize organizational financial risk through optimal use of healthcare resources, and improves patient experience by focused engagement with patients at greatest risk for unplanned use of healthcare resources. Ultimately, the tool supports the transition to Population Health Management and the goals of the Triple Aim.

Population Health Management Risk Assessment Tool Validation:  
Directing Resource Utilization

Out of control healthcare costs, poor patient outcomes, and healthcare disparities have been identified as drivers of healthcare reform across the nation (Institute for Health Technology Transformation [IHTT], 2012). Reforms have focused on restructuring financial reimbursement to promote accessibility, quality, collaboration, and efficiency. Population Health Management (PHM) is a strategy that enables healthcare organizations and providers to take responsibility for the health of populations as well as individuals (Centers for Medicare and Medicaid Services [CMS], 2010). This has radically altered the way healthcare is delivered. IHTT (2012) pointed out that “while PHM focuses partly on the high risk patients who generate the majority of health costs, it systematically addresses the preventive and chronic care needs of every patient” (p. 7).

### **Background**

Following 25 years of skyrocketing health care costs, out of proportion to inflation, the United States Congress passed the Tax Equity and Responsibility Act of 1982, placing caps on per patient operating revenues for Medicare patients (Kahn et al., 1990). A prospective payment system (PPS) was introduced in 1983, transitioning Medicare reimbursement from a fee-for-service payment system to a per-admission flat rate payment system based on diagnosis related groups (DRG). The new reimbursement system changed the fundamental management of patient care in America (Rogers et al., 1990). The system created incentive for shorter hospital stays and earlier discharge. Seven years after implementation of the DRG based PPS, a review by Rogers et al. (1990), of the quality of patient care, concluded that the condition in which patients were discharged from the hospital had been adversely effected. Patients were being discharged in

unstable condition, “sicker-and-quicker.” Recommendations were made at that time, to begin a systematic process to assess for discharge readiness (Kosecoff et al., 1990).

Nine years later in 1999, the Institute of Medicine Report *To Err Is Human*, revealed the growing gaps in quality of care (Kohn, Corrigan, & Donaldson, 2000). Patients continued to be discharged “sicker-and-quicker” with little incentive for quality (Kosecoff et al., 1990). Hospital readmissions were soaring, healthcare was riddled with errors, and the health of the nation was spiraling into an epidemic of obesity, diabetes, and heart disease (Fuster, 1999; Kohn et al., 2000; Wang, Beydoun, Liang, Caballero, & Kumanyika, 2008; Zimmet, Alberti, & Shaw, 2001).

The Medicare Payment Advisory Commission (MedPAC) reported to Congress in 2007 that an estimated 17.6% of hospitalized Medicare patients are readmitted within 30 days, for an estimated cost of 17 billion dollars annually. As much as 76% of readmissions were considered avoidable (Forster, Murff, Peterson, Gandhi, & Bates, 2003; MedPAC, 2007). Unplanned hospital readmissions were seen as an indicator of poor care and missed opportunity for better coordination of care. Additionally, up to 20% of discharged hospital patients experience an adverse event after discharge (Forster et al., 2003). Forster et al. (2003) determined that approximately 60% of the adverse events were preventable or ameliorable, with system problems contributing to all of the preventable and ameliorable adverse events. The most common factor contributing to adverse events was poor communication with the primary provider. Forster et al. (2003) identified four key areas of opportunity for improvement:

1. Assessment and communication of unresolved problems at the time of discharge.
2. Patient education regarding medications and other therapies.
3. Monitoring of drug therapies after discharge.
4. Monitoring of overall condition after discharge (p. 165).



The realities of healthcare indicated that America needed a new vision for improved healthcare performance.

In 2008 the Institute for Healthcare Improvement (IHI) outlined the Triple Aim framework, a deliberate focus on three key healthcare goals: improved health of the population, improved patient experience, and lower cost (Berwick, Nolan, & Whittington, 2008). The authors were clear; it was imperative that all three goals be met in order for America to realize a sustainable healthcare system.

In the wake of the 2008 financial crisis and recession, the United States faced soaring health insurance costs, thousands of Americans without jobs, and millions losing insurance coverage. In 2010 the Affordable Care Act (ACA) was signed into law (Burtless & Milusheva, 2012; Obama, 2010; Stolbert, Zeleny, & Hulse, 2010). The new legislation was designed to enable access to affordable healthcare for all Americans. The ACA outlined provisions to improve access to care, protect the benefits of Medicare recipients, improve quality in healthcare, modernize the healthcare system, and decrease waste and fraud. The ACA was the first step in the movement from a volume-based model of care to a population based model.

Population Health Management (PHM) represents a shift from the traditional disease driven approach of illness management for individuals and groups, to a broader healthcare perspective that considers the influence of determinants such as “social, economic, and physical environments, personal health practices, individual capacity and coping skills, human biology, early childhood development, and health services” (Dunn & Hayes, 1999, p. S7). Population health encompasses the delivery of care in a manner that meets the needs of populations through the lifespan and influences public policy to contribute to improved health care (Dunn & Hayes, 1999; Kindig & Stoddart, 2003). The foundation of PHM is improving health outcomes by

engaging individuals in the responsibility of their own healthcare, and by engaging providers, healthcare organizations, communities, business, and government in a coordinated fashion to promote a healthier, medically supported population toward improved health outcomes (Fielding, Kumanyika, & Manderscheid, 2014; Kindig & Stoddart, 2003). PHM is the Triple Aim operationalized (Berwick, 2008; CMS, 2010).

Provisions for the healthcare reforms of the ACA of 2010 were designed to move healthcare delivery toward the Triple Aim (Berwick, 2008; CMS, 2010). Legislation reform included: penalties for 30-day hospital readmissions and hospital acquired complications, measures to decrease cost, including bundled payments for end stage renal disease care, and methods to decrease fraud and overpayment. The law also established the Medicare and Medicaid Innovation Center to support ongoing development of new models of care and payment methods (CMS, 2010; DeMichele, n.d.). Innovations rising from the ACA included value-based purchasing, a payment system based on quality measures rather than volume, provisions to reduce healthcare costs through the establishment of the Medicare shared savings program, and the creation of accountable care organizations (ACO). Accountable care organizations were to:

Create delivery systems that encourage and support teams of physicians, hospitals, and other health care providers to collaboratively manage and coordinate care for Medicare beneficiaries. If these providers meet certain quality and efficiency benchmarks, they may receive a share of any savings from reducing duplicative services, improving productivity, minimizing paperwork, or otherwise improving cost efficiency (CMS, 2010, p. 6).

The initial CMS innovative reimbursement models in the Medicare shared savings program was the Bundled Payments for Care Improvement (BPCI) initiative (CMS, 2015a). This

reimbursement model provided the financial framework to support the transition to PHM (Kocher & Adashi, 2011). The BPCI initiative, now into the second phase, Model 2, involves a single comprehensive reimbursement fee for an episode of care which is triggered by an acute inpatient hospital admission. Reimbursement for the episode of care is based on the admitting DRG diagnosis (CMS, 2015a; Kocher & Adashi, 2011). After discharge, all the healthcare needs of the patient are considered a part of the initial episode of care for 90 days, thereby shifting the responsibility of subsequent healthcare costs to the hospital (CMS, 2015a; Kocher & Adashi, 2011). Ultimately it becomes the duty of the hospital to control healthcare utilization costs and ensure patient care is coordinated to provide optimal outcomes. The BPCI initiative promotes PHM by establishing a financial framework for ACOs to decrease costs through heightened primary care collaboration, implementation of preventative care, increased patient engagement, efficient healthcare utilization and decreased waste. The goal of the BPCI initiative is increased quality of care, improved patient outcomes and greater patient satisfaction (IHTT, 2012; Kocher, Emanuel, & DeParle, 2010; Louis et al., 2014). The success of the BPCI initiative depends on the effective control of costs and elimination of waste in healthcare resources (Kocher & Adashi, 2011; Larkin, 2014). A systematic process for identifying patients at risk for adverse outcomes provides opportunity to implement evidence-based interventions to mitigate risk, coordinate care, and effectively direct resources to those at greatest risk (IHTT, 2012; Louis et al., 2014; Tusso et al., 2013). The LACE index is a simple and widely accepted tool developed to identify those at risk for readmission after hospital discharge (van Walraven et al., 2010). Although the tool was prepared to identify those at risk for readmission after hospital admission in order to help direct effective coordination of care, this DNP quality improvement project involved the examination and validation of the tool for use in the emergency department (ED).

### **Problem Statement**

The focus of healthcare across the nation is improved outcomes through a population based model of care. Identifying those at risk for unplanned use of healthcare resources is needed to mitigate risk, direct use of resources, and ensure effective coordination of care. A risk assessment tool is needed to identify patients at risk for unplanned return to the emergency department.

### **Evidence-based Initiative**

This DNP project was done in the setting of a small, 58 bed acute care rural community hospital in northern Indiana. In early 2015, CMS moved to the next step toward PHM with release of model 2 of the BPCI initiative (CMS, 2015a). Enrollment into the new model was elective, and the organization was selected to enroll in the initiative. The first step in preparing for the BPCI initiative and the move toward PHM, was to conduct an organizational assessment and develop a strategic plan to prepare for the change. Patient care processes were evaluated and transitions of care targeted for redesign in order to improve the care coordination needed for PHM. One of the first changes made was implementation of an evidence-based admission and discharge process with daily multidisciplinary rounds (MDR) to facilitate communication and collaborative discharge planning. The case management department was restructured to manage the increased coordination needs. The strategic goal was to improve transitions of care in order to minimize poor outcomes, decrease readmission or unplanned healthcare utilization, and guide resource utilization (Tuso, 2013).

With an evidence-based discharge process in place, and Model 2 of the BPCI initiative underway, the organization needed to integrate a readmission risk assessment tool. The LACE index tool is the elegantly simple, evidence-based model derived and validated by van Walraven et al. (2010) in Canada. The tool incorporates four variables which are easily retrieved from

electronic medical records (EMR) or administrative data. When incorporated into an evidence-based discharge planning process, the tool has demonstrated effectiveness in decreasing 30-day unplanned readmissions and adverse events at transitions of care (Tuso et al., 2013). The simplicity and effectiveness of the tool made it useful in screening for risk of unplanned readmission.

### **The LACE Index Tool: Literature Review**

With the rising cost of healthcare, less than optimal health outcomes, passage of the ACA, and major financial penalties looming, health care systems across the nation began instituting effective ways to decrease hospital readmissions (Berwick et al., 2008; Kahn, 1990; Kocher & Adashi, 2011). Finding an effective model to identify patients at risk for hospital readmission and unplanned healthcare utilization became an ongoing effort. A systematic review of 26 published risk prediction models was completed by Kansagara et al. (2011). The authors found that models using readily accessible administrative data were moderately predictive, *c-statistic* ranged from 0.66 to 0.72. Although the predictive ability was moderate, high and low risk scores were found to be associated with readmission rates in a clinically meaningful manner. The tool was potentially useful to identify patients at risk for readmission or unplanned healthcare use, and helpful in directing resources to those at risk. (Kansagara et al., 2011; Tuso, 2013).

The LACE index tool, derived and validated by van Walraven et al. (2010) included four variables: Length of Stay of the index admission (L), Acuity of admission (A), Comorbidities as measured by the Charlson co-morbidity (CCM) score (C), and Number of Emergency Department (ED) visits in the previous six months (E). The study examined a cohort of 4,812 cognitively intact middle-aged medical and surgical patients discharged home. Almost 95% were independent in activities of daily living and 75% had a CCM score of zero. The model was

validated by a cohort of about 1,000,000 hospital patients discharged home. The cohort had a mean age of 59.1 years and a mean co-morbidity score of 0.5. A follow up study established a validated algorithm to stratify the scores to identify those at risk for poor outcomes or readmission (Gruneir et al., 2011). Au et al. (2012) modified the LACE index incorporating age, and examined the use of the modified LaCE index in heart failure patients,  $N = 59,652$ . The modified index was found to have comparable discrimination with two, more complicated CMS endorsed models.

The LACE model was established as one of the earliest, and most user friendly models developed for evaluating risk for hospital readmission (Yu et al., 2015). The LACE index was easy to use and had been validated in large studies across three countries for middle aged, medical and surgical patients, age  $\bar{x} = 61.3$  (vanWalraven et al., 2010). It remained reliable for more complicated adult internal medicine patients, age  $\bar{x} = 65$ . A later study, expanded on the LACE index with the addition of two variables, Number of Inpatient Medications, and Number of Ambulatory Medications. The expanded LACE index study showed some improved discrimination,  $c = 0.74$  (Gildersleeve & Cooper, 2013). Two small studies showed the LACE index to have less predictive ability in older adults, age  $\bar{x} = 81.1$  and 85 respectively (Ben-Chetrit, Chen-Shuali, Zimran, Munter, & Neshet, 2012; Cotter, Bhalla, Wallis, & Biram, 2012). Kaiser Permanente, a large healthcare system in Southern California (KPSC), successfully incorporated the LACE index risk assessment tool into a discharge planning bundle, as part of a performance improvement for 300,000 hospital discharges (Tuso, 2013). The study showed a decrease in readmissions from 12.8% to 11% in six months.

This DNP quality improvement project was developed as one component of the strategic plan to move the organization to PHM and Model 2 of the BPCI Medicare initiative. The

purpose of the project was to integrate the LACE risk assessment tool into the discharge planning process to provide clarity and structure to patient risk assessment and coordination of care at transitions.

### **Conceptual Models**

As the United States moves toward PHM, the Triple Aim remains the tripartite foundation of care (Berwick et al., 2008) with the provisions of the ACA providing the economic structure to support the model (CMS, 2010; Kessler, Tomoyasu, & Conway, 2015). Populations of patients with multiple medical comorbidities and complex social needs can be high utilizers of healthcare resources and provide the greatest opportunity for improved coordination of care, particularly at transitions (Arbaje et al., 2014; Donzé, Lipsitz, Bates, & Schnipper, 2013; Naylor et al., 1999). Effective coordination of care, efficient healthcare utilization, and decreased hospital admissions are the key to improved outcomes and shared cost savings (Burke, 2011; Burke, Kripalani, Vasilevskis, & Schnipper, 2013; Kessler et al., 2015). Therefore, identifying the factors associated with early or unplanned readmissions are important. This section examines the Care Transitions Model which provided the theoretical framework to validate risk assessment, guide coordination of care in the context of PHM, and focus the interventions needed to reduce early readmissions.

#### **Care Transitions Model: A Clinical Care Model**

The Care Transitions conceptual model (see Figure 1) was developed by Arbaje et al, (2008) from a retrospective cohort study involving a sample of 1,351 discharged patients. The scientific underpinning provided by this model conceptualize the complexities of care transitions and reinforce this DNP risk assessment project. Ultimately, the model guides the clinical process

needed to identify the factors associated with risk, and informs the interventions needed to impact unplanned readmissions.

Figure 1. Care Transitions Model

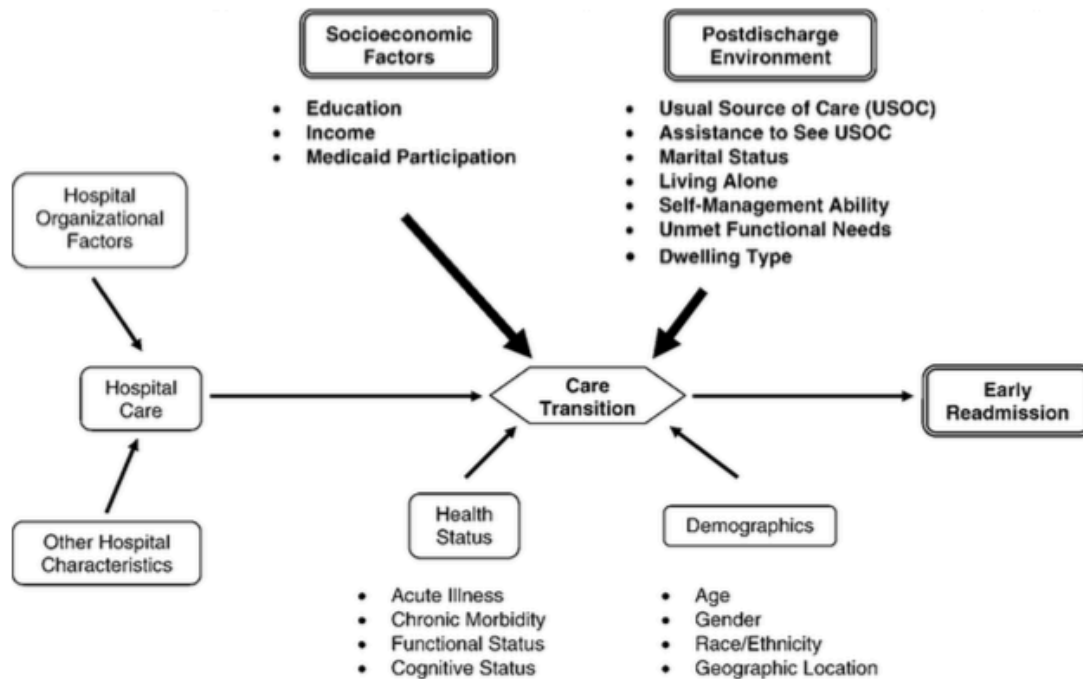


Figure 1. Factors affecting care transitions. From “Postdischarge environmental and socioeconomic factors and the likelihood of early hospital readmission among community-dwelling Medicare beneficiaries,” by A. I. Arbaje et al., 2008, *The Gerontologist*, 48, p. 497. Copyright 2008 by the Gerontological Society of America. Reprinted with permission.

The study examined four key constructs: socioeconomic status (SES), post discharge environment (PDE), health status, and demographics. The constructs were further divided into covariates to determine their impact on transitions of care. Three factors measured in the SES construct were (a) education, (b) income, and (c) Medicaid participation. Seven factors measured in the PDE construct were:

1. Usual source of cares (USOC).
2. Assistance to access care USOC.



3. Marital status.
4. Living alone.
5. Self-management ability.
6. Unmet functional needs.
7. Dwelling type.

The covariates measured were demographics and health status. From the model, a total of six factors were significant predictors of risk for early readmission: (a) education; (b) living alone; (c) self-management ability; (d) unmet functional needs; (e) length of stay of the index admission; and (f) general health status. None of the demographic factors were found to be significant predictors of risk for early readmission (Arbaje et al., 2008). The study also identified, self-reported poor general health status to be associated with risk for early readmission. The authors found that substituting the Charlson comorbidity score (CCM) could reliably be substituted for self-reported general health status.

This model conceptually explains the factors and relationships within three key domains of practice activity:

1. Effective Population Health Management (PHM).
2. Successful use of the BPCI initiative.
3. Assessment of risk for unplanned healthcare resource utilization or readmission.

First, the model supports effective PHM by identifying the important factors that impact positive patient care outcomes as well as critical areas of concern for patient care coordination. Second, the model promotes successful use of the BPCI initiative by highlighting the factors amenable to intervention for cost savings. Finally, the model conceptually supports the LACE index as a tool to evaluate for risk of early readmission. The variables LOS of the index

admission and CCM score were identified as important risk predictors in both the LACE index tool and in the care transitions model.

A limitation of this model is the unclear impact that SES factor Income has on readmissions. In the model, Medicaid use was used as surrogate for income, and did not demonstrate a statistically significant association with readmission. van Walraven, Wong, & Forster (2013) also found no clear association between income and early hospital readmission. However, Tan, Low, Yang, and Lee (2013) found that patients with high LACE tended to be associated with lower SES. Kangovi and Grande (2011) note that the socioeconomically vulnerable experience increased hospital readmissions due to “limited access to socioeconomic resources that enable self-care and to outpatient medical follow-up” (p. 1796). Additionally, the socioeconomically vulnerable are less likely to receive timely follow up care and are more likely to be referred to the emergency department. There is growing interest, and evidence of the importance that social determinants and health disparities have on health and health behaviors (Pampel, Krueger, & Denney, 2010). The study authors cite inadequate statistical power as a potential explanation for lack of significance in the study and recognize income could still be an important factor (Arbaje et al., 2008). Clinically, SES should not be disregarded, nor should it be used as the sole indicator for dictating allocation of resources. Continued attention and monitoring of patient need is necessary to ensure there is effective coordination of care regardless of SES (Garg, Boynton-Jarrett, & Dworkin, 2016).

### **Application of the Care Transitions Model**

The implications of this model are significant for PHM, the BPCI initiative, and the LACE risk assessment project at the organization hosting this project. PHM includes the safe transition of patients from one level of healthcare to another or the community. This model

provided the framework for assessing factors found to be important for safe transitions. Arbaje et al. (2008) identified and defined six factors predicting safe transitions and early readmission:

1. Education. Not having high school diploma.
2. Living alone. Having limited social support or inadequate access to caregivers.
3. Limited self-management ability. Lack of ability or confidence in completing four tasks: (a) identifying when medical care was needed; (b) identifying medication side effects; (c) following self-care instructions; and (d) changing habits as recommended.
4. Unmet functional needs. Limited ability to perform activities of daily living (ADLs) such as walking, eating, bathing, dressing, transferring from a bed to a chair, using the toilet. Unmet functional needs also included having limited abilities with instrumental activities of daily living (IADLs) such as difficulty using the telephone, preparing meals, performing housework, shopping, or managing finances and having limited assistance or caregivers.
5. Length of stay of the index admission, that is, preceding the readmission.
6. General health status, substituted by the CCM score.

The Transitions Model provides the framework for the success of the BPCI initiative by adding evidence of the patient information needed in the resigned admission and discharge process to effectively assess risk factors of readmission. The predictor factors can then be addressed, to decrease the risk of early readmission, minimize poor outcomes, and decrease cost.

The Transitions Model also conceptually supports the LACE risk quality improvement process as a component of the BPCI initiative. The process of intentional risk assessment coupled with ongoing identification of SES and PDE factors associated with readmission, provide a systematic, evidence based discharge process for managing the complex task of care

transitions in a multidisciplinary fashion. Careful attention to patient needs, and effective coordination of care are important for minimizing risk, improving patient outcomes, and decreasing cost (Larkin, 2014; Soong et al., 2013; Tuso, 2013).

The Transitions Model provided the framework to guide risk assessment at transitions of care, while the Critical Success Factor (CSF) model is the conceptual framework that provided the scientific underpinnings guiding this quality initiative by explaining the phenomenon of risk assessment in the context of readmissions and quality improvement in healthcare. The framework explains the relationships tying this project to the BPCI initiative, transitions of care, the ACA, PHM, and the national Triple Aim. The framework also provides the conceptual model that guides implementation of this DNP quality initiative.

### **Critical Success Factor Model: Conceptual and Implementation Model**

The CSF model has been used extensively in business administration and information technology as part of strategic planning and is increasingly becoming utilized in healthcare (Eni, 1989). The CSF model guides programs and processes by focusing on the most essential factors related to organizational success and outcomes. It is a model of choice for several reasons:

1. It is driven by organizational mission, vision, and goals (Eni, 1989);
2. It influences strategic planning (Leidecker & Bruno, 1984);
3. It directs attention, communication, and resources (Gates, 2010);
4. It is applied at multiple levels (Bullen & Rockart, 1981);
5. It is hierarchical in nature (Bullen & Rockart, 1981);

Critical success factors were introduced by Daniel in 1961 (as cited in Bullen & Rockart, 1981) when Daniel discussed the model in terms of the lack of adequate information available to senior leadership for setting objectives, making strategic decisions, and measuring goals. The

concept was expanded by Rockart in 1979 (as cited in Gates, 2010) as a guide for gathering the information needed for decision making and strategic planning. Critical success factors (CSFs) were defined by Daniel as the limited number, usually “three to six factors that determine success...key jobs [that] must be done exceedingly well for a company to be successful” (as cited in Gates, 2010, p. 9). Rockart explained that CSFs are about “defining and managing a set of objectives that will lead to achieving the goals of the organization . . . about sorting the most important things from the important things” (as cited by Eni, 1989, p. 13). CSFs are process oriented; they guide communication, direct productivity, and inform resource usage; they are the activities that should receive continuous attention from managers and leaders.

**Driven by mission, vision, and goals.** Vision is a broad statement of the contribution an organization wishes to make to society and describes the organization’s general purpose. It represents how the organization leaders and members want to impact their environment (Lusthaus, Adrien, Anderson, Carden, & Montalvan, 2002). The vision is the standard used to determine the effectiveness of the organization. Mission is an expression of how the organization will operationalize or enact the vision. Mission “exists within the context of the vision” (Lusthaus et al., 2002, p. 93). Mission guides the organization’s strategies, activities, programs, and utilization of resources. Goals are the actions to be taken to fulfill the mission (see Figure 2) “The CFS method results in an identified set of organizational actions that represent key performance areas that are essential for the organization to accomplish its mission” (Gates, 2010, p. 2).

**Influences strategic planning.** Strategic planning begins with strategic thinking at the senior leadership level by establishing the vision, mission, and goals. It involves an assessment of the current state of the organization and an identification of the desired future (Gates, 2010).

The strategic plan defines the steps the organization will take to accomplish its mission and achieve its goals. CSFs are a description of the actions or activities that must be done in order to achieve success, they are concrete and specific, and they serve to provide the structure for the strategic plan (see Figure 3). By identifying CSFs, it becomes clear where to focus attention, resources, and time in order to achieve success. Therefore, they become the focus of the communication needed for making decisions and tracking progress (Eni, 1989; Bullen & Rockart, 1981).

Figure 2. CSF Relationship to Strategic Planning

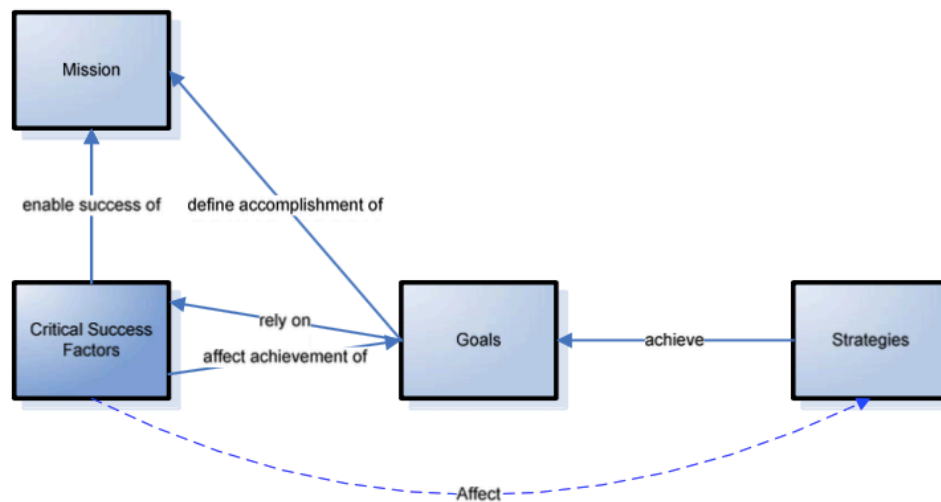


Figure 2. CSF relationship with strategic planning elements. From *Strategic planning with critical success factors and future scenarios: An integrated strategic planning framework* (p. 27), by L. P. Gates, 2010, Pittsburg, PA: Carnegie-Mellon University, Software Engineering Institute. Copyright 2010 by Carnegie Mellon University. Reprinted with permission.

**Directs attention, communication, and resources.** CSFs represent a limited number of areas which must excel in order to achieve organizational success. CSFs are aligned with the organization’s mission and vision, consequently they guide the organization’s strategies, activities, programs, and resource utilization. Well defined CSFs are action oriented and specific, providing direction regarding the “activities that must receive concentrated attention

from management to ensure future success” (Eni, 1989, p. 13). CSFs are factors to ensure success at any level of the organization, determining CSFs serve to direct the allocation of resources to ensure success in each CSF

Figure 3. The Strategic Planning Process

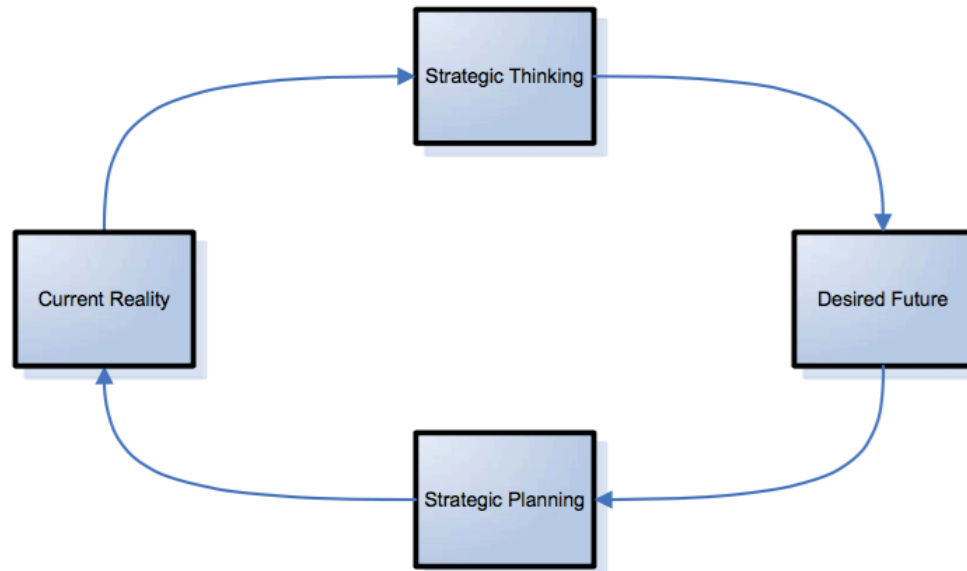


Figure 3. The Strategic Process: Strategic Planning and Strategic Thinking. From *Strategic planning with critical success factors and future scenarios: An integrated strategic planning framework* (p. 22), by L. P. Gates, 2010, Pittsburg, PA: Carnegie-Mellon University, Software Engineering Institute. Copyright 2010 by Carnegie Mellon University. Reprinted with permission.

**Applied at multiple levels.** CSFs are the essential variables that will most affect the success or failure toward the goals set by an industry, an organization, a division, a department, or an individual leader (Eni, 1989). CSFs are specific to a situation, and they change as the environment, the industry, the problems, and the opportunities change (See Figure 4). Each industry has its own set of CSFs “determined by the characteristics of the industry itself” (Bullen & Rockart, 1981, p. 14). CSFs at every level are influenced by unique environmental factors which are beyond immediate control. At the industry level, environmental factors include economy and national politics. CSFs are also influenced by temporal factors, issues that

are out of the ordinary but temporary, such as natural disasters or sudden extreme changes in personnel (Caralli, Stevens, Willke, & Wilson, 2004).

Figure 4. CSF Hierarchy

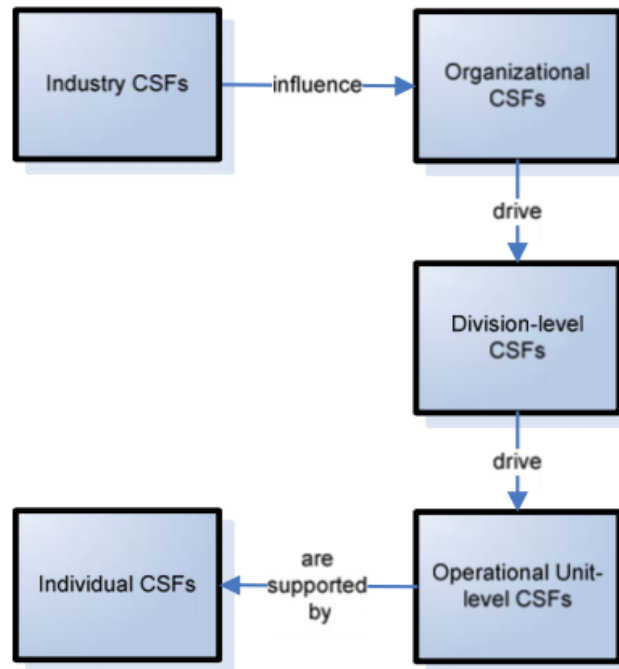


Figure 4. Critical Success Factor Hierarchy. From *Strategic planning with critical success factors and future scenarios: An integrated strategic planning framework* (p. 10), by L. P. Gates, 2010, Pittsburg, PA: Carnegie-Mellon University, Software Engineering Institute. Copyright 2010 by Carnegie Mellon University. Reprinted with permission.

**Driven from a hierarchy of sources.** The CSFs at each level of the organization are influenced by environmental and temporal factors, and also by the CSFs along the hierarchy. (See Figure 5). The CSFs inherent to an industry, influence organizations within the industry and becomes integrated into the strategic planning. Each organization has its own unique environment and situation which impact the CSFs. The vision, mission, and goals of the whole organization influence the CSFs of each division or unit. The activities, programs, and projects in each division or unit affect the environment of the whole organization and contribute in turn to



Figure 5. CSF Levels and Strategic Planning

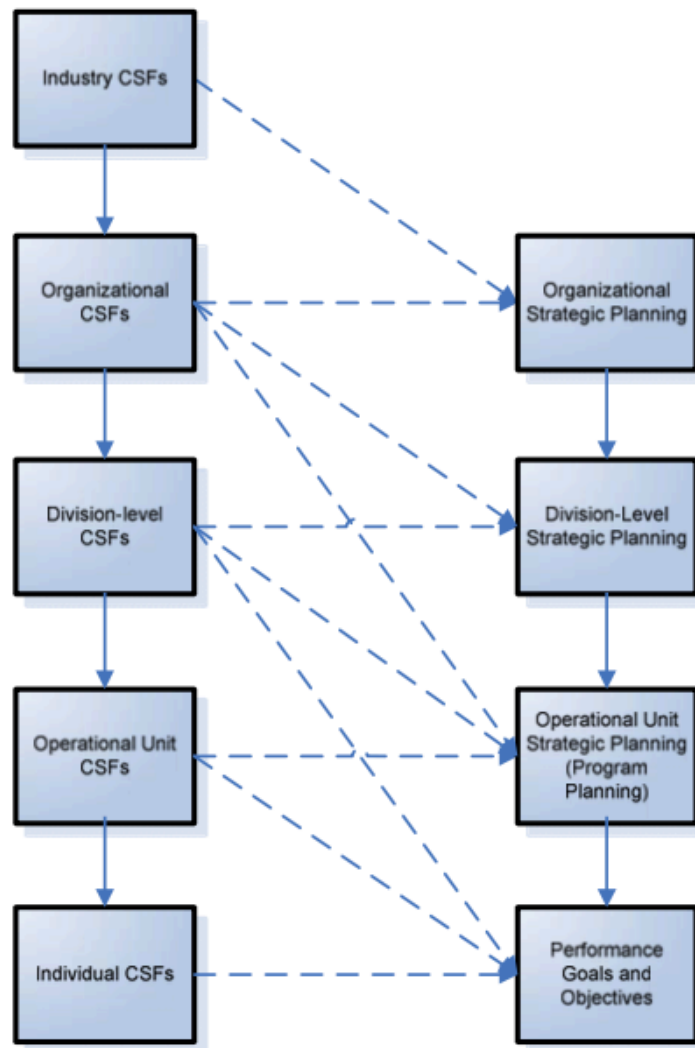


Figure 5. Critical Success Factor Levels and Strategic Planning. From *Strategic planning with critical success factors and future scenarios: An integrated strategic planning framework* (p. 26), by L. P. Gates, 2010, Pittsburg, PA: Carnegie-Mellon University, Software Engineering Institute. Copyright 2010 by Carnegie Mellon University. Reprinted with permission.

the overall success of the organization. Each activity and project in a department or unit has its own particular environmental and temporal factors which affect the strategy, objective, goals and CSFs. Additionally, individual leaders or managers have unique CSFs influenced by their role, temporal factors, and the organizational hierarchy which guide the activities and projects in their

department. At the individual and department level there tends to be less influence from industry and environmental factors (Bullen & Rockart, 1981; Caralli et al., 2004; Gates, 2010).

### **Determining Critical Success Factors**

CSFs are context specific, therefore there is no predetermined list of CSFs and no preset algorithm for determining CSFs for a given situation. Instead, determining CSFs is a process. Bullen & Rockart (1981) confidently declared that CSFs are routinely determined by leaders and managers. Dobbins (2001) states that “managers leading the programs at any point in development may identify what they believe to be, at that time, the most significant activities upon which program success depends” (p. 48). Determining CSFs may begin as an intuitive process, but when the CSFs are communicated, they become a part of the program, add value to the program or process by explicitly conveying what is considered important. CSFs must be analyzed periodically, adjusted as necessary, and evaluated with outcomes. They become a part of the organization’s history, a component to be evaluated, measured, validated, and passed along to add to the stability of the program (Caralli et al., 2004). Identifying and articulating CSFs is a process to be learned, then the process is generalized to other projects and programs.

### **Application of the Critical Success Factor Model**

At the industry level, healthcare across the nation has been facing decades of skyrocketing health care costs, declining patient outcomes, and increasing fragmentation in care (Forster et al., 2003; Kahn et al., 1990; Kohn, et al., 2000; Kosecoff et al., 1990). Nationally, the critical success factor for improvement in healthcare and the health of populations has been explicitly articulated through the IHI Triple Aim (Berwick et al., 2008). This national CSF influences every organization in the industry and drives the transition of care from volume based healthcare to PHM (CMS, 2010; Kassler, 2015). The national Triple Aim CSF has been

impacted by a number of environmental factors, including the economic downturn of 2008 and the ACA of 2010 (Catalano, 2009; CMS, 2010; Kassler, 2015; Obama, 2010). The BPCI initiative, developed by the Innovation Center of the ACA, can be viewed as a CSF of the ACA and the transition to PHM (CMS, 2015b; Kocher, & Adashi, 2011).

At the organizational level, the CSF for organizational success in the changing economic and healthcare environment involves remaining in alignment with national factors through implementation of the PHM strategy and successful adoption of the BPCI initiative. The BPCI initiative in turn supports the corporate mission to deliver people centered care by 2020 (T. Awald, personal communication, January 17, 2016).

At the local level, effective coordination of patient care is a CSF of the BPCI initiative. A CSF for successful coordination of patient care includes systematic assessment of patient needs, identification of risk for unplanned resource utilization, and application of evidence-based interventions to help decrease the risk (Louis et al., 2014; Tuso et al, 2013). The LACE risk assessment tool can be used to improve coordination of care and direct effective utilization of healthcare resources. When those at risk for unplanned readmission are identified, interventions to mitigate risk can be instituted. Some strategies discussed by Tuso (2013) to improve coordination of care include: early follow up at a post hospital discharge clinic, establishment of multidisciplinary complex patient care conferences, or timely consultation to palliative care or hospice care. In instances of limited follow up options or other resources, the stratified risk score can be used to prioritize use of resources (Tuso, 2013).

The CSF model, drawn from the domains of business administration and information technology (IT), was a fitting framework for this DNP process improvement project and guided the work in two important ways. First, the hierarchical nature in the framework provided the

conceptual theory to explain the hierarchy of relationships inherent in healthcare. From this framework, the factors driving the project can be identified by examining the national goals, corporate mission, and organizational strategic planning. The project, in turn, affects the successful coordination of patient care, effective use of resources for the organization, financial implications for the corporation, and contributes to the goals of the Triple Aim at the national level. The model sets the view of the potential for far reaching effects of the project in the healthcare hierarchy (See Figure 6).

Figure 6. Application of the CSF Model with Strategic Planning



Figure 6. Application of the Critical Success Factor Model and Strategic Planning. Adapted from *Strategic planning with critical success factors and future scenarios: An integrated strategic planning framework* (p. 26), by L. P. Gates, 2010, Pittsburg, PA: Carnegie-Mellon University, Software Engineering Institute. Copyright 2010 by Carnegie Mellon University. Adapted with permission.

Second, the CSF model provides the framework to guide implementation of the project. Although the CSFs are unique to each context and individually identifies factors for the success at that setting, the model has been studied extensively to guide project implementation (Müller & Jugdev, 2012; Pinto and Slevin, 1987). Schultz, Slevin, and Pinto (1987) identified 10 overarching CSFs for successful implementation of projects and developed a broad theoretical framework of important factors that must be addressed to achieve successful project implementation (see Figure 7). This framework has increasing acceptance in healthcare and is a meaningful model for DNP project implementation (Moran, Burson, & Conrad, 2014).

Figure 7. Ten Key Factors of the Project Implementation Profile

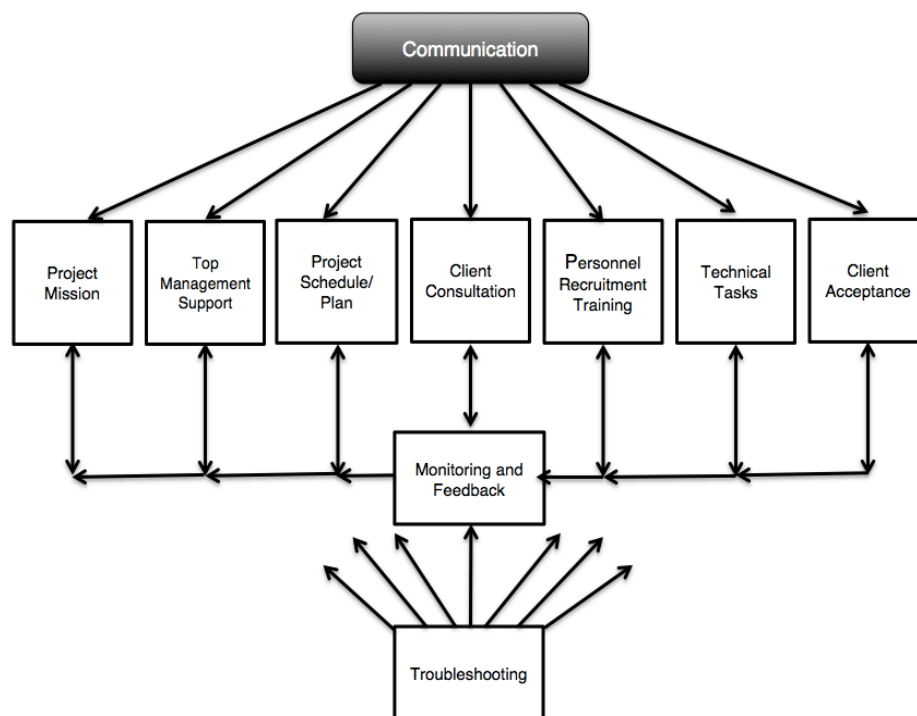


Figure 7. Ten Key Factors of the Project Implementation Profile. From “Critical factors in successful project implementation,” by J. K. Pinto and D. P. Slevin, 1987, *IEEE Transactions on Engineering Management*, p. 26. Copyright 1984 by Randall L. Schultz and Dennis P. Slevin. Reprinted with permission.

**Limitations and strengths of the Model**

A limitation of the model is the ambiguity of determining CSFs. Intuition and insight varies among leaders, consequently precise determination of CSFs and articulation of factors can be inconsistent. However, despite the limitation “CSFs are powerful because they make explicit those things that a manager intuitively, repeatedly, and even perhaps accidentally knows and does (or should do) to stay competitive” (Caralli et al. 2004, p. 12). When CSFs are intentionally expressed they become very specific to the organization, environment, and individual. Caralli et al. (2004) explain, the process of determining, monitoring, validating, and evaluating CSFs add strength and continuity to the program.

**Organizational Assessment**

At the host organization, the potential for cost avoidance and shared cost savings will be realized from decreased readmissions and unplanned utilization of resources that result from effective coordination of patient care. The implication of successful implementation of the BPCI initiative locally will be strengthened financial stability, improved patient outcomes, and role modeling of this innovative model of care to other facilities within the corporation and the healthcare community at large.

The BPCI initiative also carries increased financial risk if healthcare cost reductions are not realized. Organizational needs for successful adoption of Model 2 of the initiative include (a) strategic planning at the organizational level to ensure processes are in place to provide for the health needs of the population throughout the continuum of care; (b) comprehensive assessment of patient social and environmental needs of patients at the clinical level to ensure safe transitions, optimal coordination of care, and prevention of early readmissions (Larkin, 2014); and (c) application of the risk assessment tool to help minimize organizational financial risk

through optimal use of healthcare resources by focused attention to patients at greatest risk for unplanned use of healthcare resources.

### SWOT Analysis

The SWOT analysis is a tool used extensively in business, industry, service, and healthcare for strategic planning (Helms & Nixon, 2010). The tool is useful for analyzing the internal and external environment prior to implementation of new processes to identify favorable and

Table 1. SWOT Analysis

Strengths	Weaknesses
<p><u>LACE Project</u></p> <p>Tool simple to use. Components retrievable from EMR or administrative data.</p> <p><u>BPCI Initiative</u></p> <p>Effective senior leadership. Insightful strategic planning. Financially stable organization.</p>	<p><u>LACE Project</u></p> <p>Moderate discrimination.</p> <p><u>BPCI Initiative</u></p> <p>Small organization with limited resources to handle additional responsibilities of new processes. Limited capacity for large volumes.</p>
Opportunities	Threats
<p><u>LACE Project</u></p> <p>Improved patient care outcomes. Decreased healthcare costs.</p> <p><u>BPCI Initiative</u></p> <p>Improved organizational communication and collaborative care. Staff buy-in through the development of the new BPCI processes. Enhanced staff commitment to the organization mission and vision due to an increased understanding of the process.</p>	<p><u>LACE Project</u></p> <p>Inconsistent use of the tool. Ineffective integration into EMR. Small organization with many changes.</p> <p><u>BPCI Initiative</u></p> <p>Inadequate buy-in and participation of Hospitalists and inpatient staff or outpatient providers. Inadequate case management to meet patient needs. Ineffective stewardship of current resources.</p>

unfavorable issues in order to minimize risks and optimize outcomes (Helms, Moore, & Ahmadi, 2008). This SWOT analysis reviewed the factors important to the LACE risk assessment quality improvement project as well as factors from the comprehensive BPCI initiative (see Table 1).

### **Project Plan**

In the 2011 report, *The Future of Nursing: Leading Change, Advancing Health*, the Institute of Medicine (IOM) acknowledged many challenges facing healthcare today: management of chronic conditions, shortages in access to primary care, concerns for effective coordination of care and safe transitional care, disease prevention and wellness promotion to name a few. The report also recognized that “most of the near-term challenges identified in the ACA speak to traditional and current strengths of the nursing profession in care coordination, health promotion, and quality improvement” (IOM, 2011, p. xi). The report called for nursing education to

better prepare them [nurses] to deliver patient-centered, equitable, safe, high-quality health care services; engage with physicians and other health care professionals to deliver efficient and effective care; and assume leadership roles in the redesign of the health care system” (IOM, 2011, p. xi).

This DNP quality improvement project represents one response to this call.

### **Purpose of Project with Objectives**

The purpose of this DNP quality improvement project was to complement the BPCI initiative within the local organization by integrating the evidence-based LACE risk assessment tool into the plan of care for inpatient BPCI Medicare recipients in order to improve patient outcomes and decrease unplanned hospital readmissions.



The initial project included two primary objectives:

1. Integrate the LACE assessment tool to the routine patient care processes in order to provide a systematic, structured risk assessment to identify those at risk for readmission and to direct utilization of resource for those at high risk.
2. Automate calculation of the LACE score from patient EMR and administrative data to facilitate retrieval of data for monitoring and evaluation of outcomes.

### **Type of Project**

At the core of healthcare reform in America is the effort to provide high-quality, affordable care to all Americans (U.S. Department of Health and Human Services, 2011). Lynn et al. (2007) identifies quality improvement as an integral and essential part of high quality patient care. In recent years there has been ongoing debate surrounding the boundaries of research and quality improvement (Lynn et al., 2007; Melnyk & Fineout-Overholt, 2015). Quality improvement is a team-based activity that involves the examination of current practice to determine effectiveness and apply best practice intended to improve outcomes (Newhouse, Pettit, Poe, & Rocco, 2006). Quality improvement has been defined as “systematic, data-guided activities designed to bring about immediate improvements in health care delivery in particular settings” (Lynn et al., 2007, p. 666). Alternatively, research extends current knowledge and applies testing new or modified approaches to care (Newhouse, et al, 2006). This DNP project employed a multidisciplinary quality improvement process to enhance coordination of care and improve patient outcomes.

### **Setting and Resources**

Enrollment into Model 2 of the BPCI initiative occurred in March 2015. The initiative is designed to promote PHM and improved patient outcomes through improved coordination of

care and shared cost savings. Seven DRGs were included in the initiative, potentially capturing up to 80% of the inpatient hospital population. The new reimbursement model represents a significant change from the traditional reimbursement model with a major shift in financial risk.

Leading up to the initiation of the BPCI initiative, an extensive strategic plan was put in place to build on the existing inpatient program in order to align patient care with PHM strategies. Included in the strategic plan were five new patient care programs: (a) Hospitalist driven high risk discharge transition clinic; (b) pulmonary outpatient care clinic; (c) pre-operative surgery clearance clinic; (d) limited swing bed inpatient program; and (e) clinical decision unit. The LACE risk assessment project supplemented the strategic programs through systematic assessment of patient risk for readmission to ensure effective appropriation of follow up care and resources (Kansagara et al., 2011; Tuso, 2013).

Although provisions of the ACA included modernization of the healthcare infrastructure through EMR (CMS, 2010) many challenges remain. This project faced the same interoperability challenges found throughout healthcare (Kellermann & Jones, 2013). The technical limitations facing this DNP quality improvement project were relative to the lack of interoperability within the EMR and administrative systems needed to calculate the LACE index score. One objective of the project was to automate calculation of the LACE index score with a method to retrieve scores from the administrative database in order to facilitate outcomes evaluation.

There are three separate data systems operating in the local organization, the electronic patient medical record system, the administrative database, and a clinical documentation coding system. Although portions of data elements needed to calculate the LACE score are present in each system, there is limited interface between the systems. Additionally, there is lack of direct

access to the administrative database and limited advanced technical support to develop an automated process. Accomplishing this technical task needed access to patient data from all three data systems and collaboration with a data warehousing expert.

### **Design for the Evidence-based Initiative**

The method for implementation of this DNP quality improvement project follows the Project Implementation Profile (PIP), a method built on the CSF model. The CSF model was initially developed to improve communication, strategic planning and organizational success (Bullen & Rockart, 1981; Gates, 2010; Leidecker & Bruno, 1984). Pinto and Slevin (1987) recognized the critical success factor model as useful for project implementation. They also identified the need for greater structure in the model to make it “predictive of successful project management” (Pinto and Slevin, 1987, p. 22).

The PIP method was developed by identifying ten CSFs necessary for successful project implementation. The CSFs were found to be sequential, making it useful for moving a project through the implementation process in a systematic fashion and to help identify where a project stands in terms of the lifecycle of the project (Finch, 2003; Pinto, 1990; Pinto & Slevin, 1987).

### **Four Stages of the Project Implementation Profile**

The ten project CSFs of the PIP method are further divided into four project stages: planning, operationalization, continuing, and close out (Moran et al., 2014; Pinto & Slevin, 1987). Three of the stages tend to be sequential and one stage is ongoing throughout the lifecycle of the project (Finch, 2003; Moran et al., 2014; Pinto & Slevin, 1987). Within the stages are the ten factors that make up the CSFs of project management. Each of the stages and factors is discussed.

**Stage one: planning.** Stage one begins with three planning factors, they are: mission, management support, and schedule/plan.

***Mission.*** Establishing a clear mission is the first CSF for project implementation. Project mission is what gives clarity and purpose to the project. It communicates alignment of the project with the mission goals of the organization and allows confirmation of feasibility of the project. (Pinto, 1990; Pinto & Slevin, 1987).

The mission of the local organization and the corporation explicitly includes a commitment to delivering people centered healthcare. Integration of a PHM strategy aligns with this mission, and the BPCI initiative represents a reimbursement model supporting the PHM strategy, and is targeted to lead to higher quality and more coordinated care at a lower cost. The cost savings occurs through engagement of patients and providers to ensure appropriate utilization of resources, improved patient care coordination and reduced waste (Kripalani, Theobald, Anctil, & Vasilevskis, 2014).

The mission of the LACE risk assessment project aligns with the mission of the organization, and serves as an important CSF in the BPCI initiative. Risk assessment offers an objective and consistent way to identify those with high healthcare needs and risk for unplanned readmission, and embraces the PHM strategy by facilitating increased inter-disciplinary collaboration, safe transitions, and enhanced chronic illness management, with a focus on improved patient outcomes.

***Management support.***

The next factor in the PIP method includes securing top management or senior leadership support. Support is essential for the allocation of resources and for the ultimate acceptance or rejection of the project (Pinto & Slevin, 987). From the earliest days of strategic planning for the

BPCI initiative, senior leadership recognized necessity for risk assessment. With the organization actively enrolled in Model 2 of the BPCI initiative there is an established commitment to a transition to PHM. A systematic process for assessing and mitigating readmission risk is a critical factor in the success of the BPCI initiative. The value of incorporating the LACE risk assessment tool was identified as:

1. Systematically identifying the Medicare BPCI patients and informing the patient care team.
2. Communicating patient needs and risks to the care team in order to promote optimum coordination of care.
3. Adding clarity to the BPCI activities by identifying those needing high grade intervention to mitigate risk of adverse outcomes or readmission. Ultimately, directs resources to those at highest risk.

The most effective way to consistently obtain accurate scores is to automate the calculation and integrate the calculated score to the administrative database for evaluation of outcomes. The local organization did not have mechanism automating the LACE calculation in the electronic patient medical record system, the administrative database, or the clinical documentation coding system. There is minimal interoperability between the three separate data systems, and the organization does not have ready accessibility to data warehousing and programming expertise. Therefore, exploring ways to automate the process required senior leadership commitment and resources to allow access to the electronic records and databases to retrieve the information needed for the calculation.

*Schedule/plan.* The third factor of the PIP method is developing the details of the plan with timeline for the project. Schedule/plan refers to articulation of the project details, timeline,

equipment, and personnel needs. The groundwork and indication for this process improvement project occurred when the organization enrolled in the BPCI initiative early in 2015 and risk assessment was included as a part of the strategic plan to support success of the initiative.

This project was to integrate the LACE risk assessment tool into the BPCI initiative, the patient care workflow, and the coordination of care. The schedule/plan is driven by the following questions:

1. Can the BPCI participants be consistently identified?
2. Can the LACE index score be reliably calculated?
3. Can the tool be validated for the local population for 30-day readmissions?
4. Can the tool be used reliably to predict 90-day readmissions?
5. Do the scores define level of risk?
6. How will the risk assessment process be imbedded into the patient care workflow?

After the mission of the project was clarified and senior leadership support secured, developing a schedule and plan for this project aligned with the PIP stages of project implementation. The essential activities of each stage are discussed and the projected steps, with timeline of the project implementation reviewed.

**Stage two: operationalization.** Stage two begins the operational stage of the project. The three factors of this stage are client consultation, personnel selection, and technical tasks (Pinto, 1990; Pinto & Slevin, 1987).

***Client consultation.*** Key stakeholder input is the essential concept of client consultation, ensuring that the appropriate stakeholders have been identified and engaged in the planning process. Pinto and Slevin (1987) note that engagement, participation, and enthusiasm of the stakeholders has an important impact on their support and acceptance of the project. The needs of the

stakeholders must be met for project support to occur (Pinto & Slevin, 1987). Ongoing interaction is important to ensure all the stakeholders understand how the process changes will impact their work flow and patient care. Engagement involved soliciting input and recommendations from the stakeholders, understanding their needs and confirming their expectations. As the project progressed, it was necessary to have regular communication and collaboration to ensure that the project fit with the daily workflow of patient care (Finch, 2003). Networking with key stakeholders and facilitating communication between departments was a major part of this project (Pinto, 1990).

The key stakeholders for this project were the case managers; they coordinate discharge planning, have the greatest understanding of the BPCI initiative, and the most insight into the need for risk assessment. Continued engagement of the case managers was necessary to ensure sustainability and acceptance of the project. Other important stakeholders included the manager of the medical/surgical unit, the staff nurses, and the Hospitalist providers.

The unit manager coordinated overall education of the staff nurses, ensured consistency and quality in patient care processes, and directed the scheduling of the staff. The LACE risk assessment tool was to be integrated into the workflow on the unit. The staff nurses provided front line implementation of the risk assessment process. Changes made to the patient care workflow were all nursing dependent.

The Hospitalists are stakeholders in the LACE risk assessment as it influences decisions in patient care, communication with other providers, interactions with patients and families, as well as planning and timing of patient transitions of care. The findings of the LACE score informed how healthcare resources would be utilized in planning and coordinating the patients' transition from the hospital.

**Personnel selection.** Personnel selection requires selecting team members with necessary skills and commitment to develop and implement the process (Pinto & Slevin, 1987). For this quality improvement project, personnel issues revolved around two separate skill sets, individuals with clinical skills and individuals with technical skills. Clinical skills are needed to understand population health management, safe transitions of care, and coordination of care. Technical skills are needed to extract necessary data from the EMR and the administrative database to calculate the LACE score and track outcomes.

**Technical tasks.** Technical tasks include having necessary personnel and technology. In the current healthcare environment of large data and limited interoperability, attention to the technical task is critical (Moran et al., 2014; Pinto & Slevin, 1987). As indicated in the PIP implementation method, technical tasks were found to be a critical success factor for this quality improvement project. Discussions regarding the resources needed to automate calculation of the LACE score centered on the lack of ability to apply this process in the patient EMR where the bulk of the necessary data was housed. The next step was to examine the administrative database, and the clinical documentation coding system to assess if the information needed for LACE score calculation was retrievable there. Since there is no automated calculation of the LACE index score, a data set including all hospital encounters for the previous twelve months was manually extracted and obtained in the form of a spreadsheet. The data elements needed to calculate the LACE score included:

1. Date of admission and date of discharge, to determine LOS.
2. Patient admission orders to find acuity of admission, inpatient vs. observation.
3. List of history of patient diagnoses list by ICD code to calculate the CCM score.
4. All patient encounters for the previous 6 months to find number ED visits.



5. Admitting ICD code which contributes to the CCM score.

For this quality improvement process, the data specialist from the organization extracted twelve months of retrospective data for the initial portion of the plan, from the administrative database and made it available in the form of a spreadsheet file. The sample data included all hospital encounters from January 1, 2015 to December 31, 2015. A LACE score calculation was not available in any of the data systems, therefore a data warehousing expert was engaged to export the manually extracted data into an external database. An automated calculation of the LACE scores for each encounter in the timeframe of the study was done using the Apache Groovy programming language, an open source language and a registered trademark of the Apache Software Foundation.

Automating the LACE score calculation from the extracted data required identifying the ICD codes that define the Charlson comorbidity (CCM) score. Additionally, in October 2015 the transition from ICD-9 to ICD-10 occurred, consequently the historical data set of encounters from January 2015 to December 2015 contained entries from both sets of codes. Sundararajan et al. (2004) and Quan et al. (2005) developed coding algorithms to determine the ICD-9 and ICD-10 codes that define the CCM score. The ICD-9 and ICD-10 algorithm for the CCM score developed by Quan et al. (2005) was used in the program to calculate the LACE risk assessment score.

The data set obtained included 17,603 patient encounters from January 01, 2015 to December 31, 2015. The data set included all encounters for 12 months, it was necessary to reduce the data set to include only Medicare patients, the admissions of interest to this study. When the process to reduce the data to include only variables of interest to this study was completed, the number of patient encounters in the new data set was 2,971. However, since

improved coordination of care and reduced readmissions is the objective for all patients, and in order to enhance robust data analysis, all adult encounters were included in the study. However, the participants specifically included in the BPCI initiative are described in Appendix A.

**Stage three: continuing.** The three factors of Stage three that are continuous throughout the life of the project include monitoring and feedback, communication, and troubleshooting.

**Monitoring and Feedback.** Monitoring and feedback are the critical factors of project progress and allows for anticipation of unexpected problems or obstacles. It involves maintaining ongoing feedback from project personnel on how they see the progress of the project in relation to plans and projections. Although the scope of the BPCI initiative is extensive within the local organization, this DNP process improvement represents a single component, which contributes to the larger initiative. The project required ongoing communication and collaboration with the key stakeholders, but only involved additional project personnel periodically, for brief tasks.

**Communication.** Pinto and Slevin (1987) explain that effective communication creates “an atmosphere for successful project implementation” (p. 25). Communication is essential within the project team, with the stakeholders, with senior leadership, with experts, and between departments. Communication is about managing expectations, discussing problems and solutions, and ensuring that there is adequate transfer and exchange of information. Open communication within the team and within the organization allows for creativity, helps prevent burnout in the team, and encourages best practice (Fink, 2013; Pinto, 1990).

The bulk of ongoing communication primarily revolved around interaction with key stakeholders. Conversations with case managers and unit managers were needed to clarify workflows, reassess needs, and share update on progress. Monthly BPCI steering committee

meetings provided an important forum for clarifying systems issues and communicating the status of the project.

***Troubleshooting.*** Problems and unexpected variations or delays are to be expected in any project. Troubleshooting must be built into the implementation process by continuously monitoring for problems or deviation in plans so early interventions can be initiated to minimize delay and minimize risk of project failure. Attention to this factor also includes networking with experts or specialists in the organization to offer insight or suggestions for potential problems and potential solutions (Finch, 2003; Pinto, 1990; Pinto & Slevin, 1987). For this project, troubleshooting was expected to center primarily around workflow and technical issues. Connecting with external experts was necessary to determine effective ways obtain data and develop an automated process to calculate scores.

Once the process for calculating the LACE score was determined, troubleshooting was done in collaboration with the Chief Nursing Officer/Chief Operating Officer (CNO/COO) to establish a workflow for portions of the process that could not be automated. Two important steps that required early troubleshooting were obtaining a working ICD-10 admitting diagnosis and entering that diagnosis into the administrative database. The ICD codes retrieved from the administrative database to calculate the CCM score and LACE score are drawn from the patient's historical diagnoses coded into each encounter and the admitting ICD diagnosis. The official coding of hospital diagnoses occurs up to two weeks after a patient is discharged. Therefore, any diagnosis codes new to an admission may not be captured in the LACE score calculation. The workable resolution to this issue involved generating a daily report of the working diagnoses codes generated from the ED encounter for new admissions. Entering the working diagnosis code into the administrative database was added to unit clerk's work routine.

This solution ensured that the primary admitting diagnosis was captured. However, this solution could not capture any new diagnosis codes generated during the hospital stay. The projected plan for application of the LACE risk assessment quality improvement project included a re-calculation of the LACE risk score at discharge. Care was taken to ensure that calculation of the final LACE score included new codes assigned during the hospital.

Plans for a short pilot run of the risk assessment process was arranged, to look for potential troubles. Effort was made to maintain regular communication with stakeholders, anticipate problems, and search for acceptable solutions early.

**Stage four: close out.** Stage four contains a single vital factor, client acceptance. The final factor of any project represents more than successful progression through the stages of project implementation or completion of all the other CSF factors. Client acceptance represents end-user satisfaction.

*Client acceptance.* Utilization and sustainability of the project depends on stakeholder acceptance or perceived usefulness of the final product. Stakeholder communication, engagement, and shared ownership is vital to acceptance of the final product (Pinto, 1990; Pinto & Slevin, 1987). Articulating the definition of success during the planning process is one step in identifying success. Ultimately, if the stakeholders do not find the tool meaningful, the process is unlikely to be sustained or considered successful. For this project, client acceptance would be defined as implementation and routine use of the LACE tool by case management, nursing, and Hospitalists. The process could be considered successful when:

1. It was integrated into the general patient care workflow.
2. It facilitated coordination of care by alerting the care team of those at high risk for readmission.

3. It effectively informed the use of healthcare resources by identifying those needing early post hospital follow up at the discharge clinic.

Initially, acceptance appeared to be the factor defining the general character of the project, however, troubleshooting became the most critical factor for the project.

### **Participants**

Medicare patients become a part of the BPCI initiative by virtue of their admitting DRG code. This LACE risk assessment quality initiative is designed to improve coordination of care for those patients with a primary DRG codes targeted in the BPCI initiative (see Appendix A). Participants in the BPCI initiative are informed of the plan for improved coordination of care explained, and consent for enrollment is attempted. However, the consent process must be done with care, as the patient can refuse to participate, but still automatically becomes a part of the BPCI initiative based their diagnosis. The organization is responsible for the healthcare costs of the participants for 90 days, regardless of whether or not the patient consents to engagement or participation. The onus is on the case management team to present the plan in a positive manner by emphasizing the value of the program.

### **Ethics and Human Subjects Protection**

All DNP projects require human subject determination from the University Human Research Review Committee (HRRC) prior to implementation. Human subject determination was also obtained from the organization. This DNP project was determined by the HRRC at the University and the organization, to be a quality initiative and did not require additional internal Institutional Review Board (IRB) approval. Additionally, authorization was received from the organization in which this DNP project was implemented; this DNP project was deemed to be a quality improvement project and required no formal IRB.

### **Planned Steps for Implementation of Project and Timeline**

The following outline explains the steps for implementation of the original plan for this DNP quality improvement project along with the project timeline (see Table 2).

1. Needs established. Enrollment into model 2 of the BPCI initiative precipitated need for a tool objectively assess for risk of readmission, identify patient needs, and guide resource utilization.
2. Population of interest identified. This quality improvement process was initially designed for Medicare participants in the BPCI initiative by virtue of their admitting ICD-10 diagnosis, however, all adult patient encounters were included in the project.
3. Tool selection. A process to assess for readmission risk was determined to be a critical factor in the success of the BPCI initiative and the transition to PHM. The evidence based LACE index risk assessment tool was selected because of its simplicity and evidence of effectiveness when applied to the admission and discharge processes.
4. Outcomes established. Outcomes, in this project, were centered around the Triple Aim. Identification of risk is designed to improve coordination of care, improves outcomes, decreases cost, and improve patient experience, meeting the Triple Aim goals.
5. Key stakeholders identified. This project, as a component of the BPCI initiative impacts all patient care processes. Therefore, stakeholders range from frontline patient caregivers, department managers, and providers to senior leaders. Networking and collaborating with all the stakeholders to the project throughout the organization is required for the success of the project.
6. Retrieval of historical administrative data. Obtaining access to 12 months data was designed for preliminary examination of the population of interest and validation of the

tool for this setting. Data for a total of 2,063 adult inpatients was obtained and all ICD-9 codes were transitioned to ICD-10.

7. Calculate the LACE score. The components of the LACE score were determined to be available in the administrative database. A major component of the project was to establish a mechanism to automate calculation of the LACE index score to ensure accuracy and facilitate evaluation of outcomes.
8. Analyze historical patient data to validate the tool for the local population. The LACE tool was developed and validated with a population in Canada. Analyzing historical patient data provides opportunity to validate the tool for the local population.
9. Validate the tool for use in predicting 90-day readmissions. The LACE tool was developed and validated to predict 30-day readmission. Analyzing 12 months of historical data allowed a preliminary determination of the validity of the tool for predicting 90-day readmissions.
10. Analyze data to validate the risk score stratifications. Using historical patient data, the stratified thresholds could be examined to optimize 90-day predictions.
11. Creation of workflow. A new workflow process to integrate the tool was done through collaboration with stakeholders (See Appendix B). Steps were outlined to integrate the quality improvement process into the patient care workflow to ensure sustainability.
12. Education for key stakeholders. Education relative to the purpose, benefits, the process around the LACE risk assessment tool was created to help ensure user understanding and acceptance of the tool and the project.
13. Interventions to minimize risk. An important part of this quality improvement project was to confirm the feasibility of using the tool to predict readmissions. Once feasibility

confirmed, evidence-based interventions recommended to mitigate risk.

14. A pilot test. A pilot of the tool was planned, to monitor for potential problems.

15. Implementation of the tool. After establishing workflow, arrangements were made for final implementation of the LACE tool risk assessment tool.

16. Disseminate process results. New knowledge generated from the implementation of the process was to be disseminated to allow transfer of knowledge to other settings.

Table 2 Project Timeline

TIMELINE →	Week 3	Week 4	Week 5	Week 6	Week 5	Week 8	Week 10	Week 11	Week 12/13	Week 14	Week 15
TASK ↓	1/24-1/30	1/31-2/6	2/7-2/13	2/14-2/20	2/21-2/27	2/28-3/5	3/13-3/19	3/20-3/26	3/27-4/9	4/10-4/16	4/17-4/21
Develop steps for tool utilization and data collection											
Begin identifying a mechanism for calculating score											
Clarify outcomes and design the plan for data collection											
Assess admit and discharge process											
Introduce education around LACE tool utilization											
Determine risk mitigating interventions											
Begin LACE tool pilot test											
Begin assessing outcomes of LACE pilot											
Implement LACE tool											
Begin evaluating outcomes											
Poster presentation for disseminating early outcomes											

(Week 9: 3/6-3/12; Spring Break)

**Project Outcome Measures**

Because the LACE risk assessment project is a component of the BPCI initiative and the transition to PHM, ultimately the project outcomes were to be measured as part of the broader BPCI initiative and the Triple Aim outcomes. As explained by the Critical Success Factor



framework, the planned programs, such as the LACE risk assessment project, are factors impacting the success the whole organization and the BPCI initiative through improved coordination of care. Improved coordination of care subsequently influences patient experience, cost, and health outcomes. Data for outcomes evaluation was to be tracked through the administrative database. Outcomes to be evaluated included Patient experience, Cost, and Health outcomes. Each variable is discussed below.

**Patient experience.** Evaluation of patient experience and improved patient satisfaction is determined by the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) scores. The HCAHPS survey is a national standardized data collection instrument established in 2006 to measure the patient perspective and satisfaction with hospital care (CMS, 2014). Outcomes related to HCAHPS scores was to be assessed by comparing pre and post intervention scores with independent t-test analysis.

**Cost.** Decreased cost is measured by decreased readmissions, decreased LOS, increased number of discharges before noon, prevented readmissions, cost per patient day by DRG, improved productivity. Discharges before noon, is an organizational goal established one year ago and considered a measure of cost. It is also considered an indicator of effective coordination of care and positive patient experience. Discharges before noon are reported in terms of frequencies and percentages. Productivity scorecards are ongoing standard corporate measures. The scorecards are disseminated monthly. The impact on productivity was to be evaluated before and after implementation of the risk assessment process.

**Health outcomes.** Improved patient health outcomes were to be evaluated through assessment of the number of unplanned hospital and ED readmissions, number of admissions based on level of risk stratification, mortality, cost per case by DRG, number of prevented

readmission, utilization of risk mitigating interventions, and improved quality measures.

Organizational quality measures could be tracked using corporate quality scorecards.

### **Cost Analysis**

As an ACO member, the organization elected to participate in Model 2 of the BPCI initiative with seven DRGs enrolled under the program. This represented a projected 80% of the inpatient population. Under the BPCI initiative, organizations enter into payment arrangements that include financial and performance accountability for episodes of care triggered by an acute inpatient hospital admission. The reimbursement arrangement is based on the admitting DRG and is active up to 90 days after discharge. The BPCI model is targeted to lead to higher quality and more coordinated care at a lower cost. The success of this strategy with shared cost savings requires strategic planning with implementation of evidence-based processes that focuses on improved planning and coordination of care, reduced readmissions, decrease unplanned use of healthcare resources, and engagement of patients and providers (Kripalani et al., 2014).

In 2014, the organization saw more than 200 unplanned 30-day hospital readmissions, equating to 4.4 million dollars in charges. Reducing unplanned readmissions represents an opportunity for potential cost savings and improved coordination of care. In early 2015, the redesigned evidence-based discharge planning process was initiated to improve coordination of care at discharge. Integration of the LACE risk assessment tool into the discharge planning process is designed to provide a framework for improving coordination of care.

### **Project Implementation**

One objective of the project was to automate calculation of the LACE risk assessment score. After extensive discussions with the CNO/COO, the data specialist, and in collaboration with a data warehousing specialist, it was determined that calculation of the score could not be

done with the organization's current EMR. There were inadequate resources and limited interest, at that time to undertake the major hardware and software changes needed to automate the calculation. Leadership in the organization determined that manual calculation of the scores could be done on paper and was sufficient to meet the needs of the BPCI initiative. The scores going forward would be calculated on a paper worksheet and entered into the administrative database. After the initial LACE scores are calculated from the retrieved data, analysis would be done to compare the recommended risk stratification identified in the literature with the local population.

### **Preparing to Implement LACE Tool**

Implementation of the LACE risk assessment project improvement process was one component of the larger strategic plan in the BPCI initiative. An evidence based discharge process had recently been implemented. Five other programs under development as part of the strategic plan included (a) Hospitalist driven high risk discharge transition clinic; (b) a pulmonary outpatient care clinic; (c) a pre-operative surgery clearance clinic; (d) a limited swing bed inpatient program; and (e) a clinical decision unit. The development of all five programs was underway concurrently. The BPCI steering committee meet regularly to discuss the progress for the start of the five new programs. The LACE risk assessment process was intended to help identify patients at risk for early readmission and guide utilization of the discharge transition clinic, which was scheduled to open later in the season. Despite extensive planning, this project underwent several revisions due to difficulties in implementation. Each iteration of the implementation is described in the next section.

**Delayed Implementation: Plan A**

Plans to begin implementation of the LACE risk assessment tool stayed on schedule until implementation of the pilot test. The unit manager felt the pilot was unnecessary, she reported that the short pilot trial of the LACE tool about six months earlier was sufficient. The steering committee agreed, and plans were made to proceed with live implementation of the LACE risk assessment process the next month. Implementation of the process was delayed again the following month when the unit manager voiced concern that without the discharge transition clinic in operation, discharge planning and care coordination for high risk patients would not differ from current practice. Consequently, the manager was reticent to institute a new process without any major changes in discharge planning options. Consequently, the steering committee agreed to postpone implementation of the LACE risk assessment tool.

The BPCI initiative had been underway for more than one year and preventing early readmissions was already a necessity. The steering committee had determined that implementation of the LACE risk assessment tool could be delayed, but would need to occur in conjunction with the opening of the discharge transition clinic. Delayed implementation of the LACE risk assessment tool prompted a reassessment of the needs of the organization and the contribution the LACE risk assessment process could contribute to the strategic plan. A new plan was developed to identify those at risk for early readmission with a revised intervention to improve outcomes and impact readmissions well before the discharge transition clinic.

**Plan B: LACE Tool with Intervention**

Plan B of the LACE risk quality improvement process required immediate implementation of the LACE risk assessment tool, but shifted the focus of discharge care coordination away from the discharge transition clinic. In plan B, those at risk for early

readmission based on the discharge LACE score, would have structured discharge teaching and receive a post discharge follow up phone call within 24 to 48 hours by a nurse. The discharge teaching and follow up call would be structured around four questions:

1. “Do you have any concerns about getting the help you need after leaving the hospital?”
2. “Do you understand the things you are responsible for in managing your health?”
3. “Do you clearly understand the purpose for all the medications you are taking?”
4. “Do you understand what symptoms or health problems to look out for after you left the hospital?”

Discharge teaching would be shared by the discharge nurse and by the case manager, each focusing on two questions. The post discharge follow up phone call would review the same four questions discussed at discharge. Plan B, with emphasis on four questions, would serve a fivefold purpose. First, patients are at highest risk for readmission on day two and three after discharge (Martin-Gill & Reiser, 2004). Post-hospital discharge follow up phone calls had been shown to reduce 30-day readmissions (Harrison, 2011). “Patients who do not receive a call within 14 days after discharge are 1.3 times more likely to be readmitted to the hospital within 30 days of discharge than those who do receive calls” (Harrison, 2011, p. 29). Second, the questions have been shown to reinforce the essential information patients need for safe transition after hospital discharge (Newbold, Schneidermann, & Horton, 2012). Third, the data collected from the follow up phone calls would help to structure discharge clinic visits by identifying the questions and items to address at follow-up. Fourth, the follow up phone call would reinforce the discharge teaching and offer opportunity to reaffirm the information asked by to HCHAPS questions, potentially improving scores. Fifth, establishing a risk assessment process before

opening the discharge clinic would ensure a mechanism was in place to manage limited clinic capacity.

### **Failure to Implement: Plan B**

Ongoing communication occurred with the unit manager and senior leadership to ensure the needs of the stakeholders were addressed. Plan B was presented to the next steering committee meeting about one month after the initial plan was postponed. The revised plan offered a way to prepare the risk assessment process in anticipation of the clinic opening, decrease early readmissions, impact HCHAPS scores, and begin evaluating data to direct clinic visits. However, the unit manager again voiced concerns that there were too many changes occurring at the time and the revisions of new plan were not sufficient to warrant implementation before the opening of the discharge transition clinic. The unit leader felt the unit was still not ready to begin collecting data for the project. The steering committee agreed to postpone implementation of plan B of the LACE risk assessment process.

### **Plan C: LACE in the ED**

Early in the planning sessions of the steering committee, the ED manager noted the potential value of the LACE risk assessment process and voiced interest in the possibility of implementing the tool, not only for the inpatient discharges, but also for ED discharges. Under the BPCI initiative, once an episode of care is triggered, the cost of all medical care for the Medicare recipient is the responsibility of the organization for 90 days (CMS, 2015a). The discharge transition clinic was expected to include patients discharged from the ED as well as from the inpatient setting. A risk assessment tool for all patients would be beneficial. The steering committee favored having a consistent tool used in multiple departments. The LACE

risk assessment project would meet the needs of the organization and the strategic plan for the BPCI initiative by assessing the validity of the LACE tool in the ED.

### **Early ED Readmissions**

A review of the literature revealed the LACE risk assessment tool has not been studied specifically to predict ED readmissions, however, Wang et al. (2014) found the LACE risk index score to predict early ED visit more accurately than early hospital readmission in patients with heart failure. The authors concluded that the LACE tool was potentially useful for predicting high risk ED visits after hospital discharge.

With the focus of risk assessment shifted from inpatient discharges to ED discharges, a new set of questions emerged: (a) do the ED admission patterns differ from the inpatient patterns? (b) what are the most frequently admitted diagnoses? (c) what are the common comorbidities or characteristics of the those with early ED visits? (d) does the inpatient LACE scores predict early ED visits? (e) is there a relationship between a score and 30-day readmissions? The new objectives were to:

1. Validate the variable of the LACE tool for the ED
2. Assess the feasibility of using the LACE tool to accurately predict early ED visits.
3. Determine if the LACE tool could accurately predict early ED visits.

### **Plan C Process**

The first step of Plan C was to obtain five more months of data, for a total of 17 months of historic data of ED encounters, in order to have a robust sample size for validating the variables of the LACE risk assessment tool for use in the ED. The new ED data set included 16,050 adult encounters, representing 9,293 unique individuals. The collected data included the principle ED visit diagnosis and up to 25 co-morbid diagnoses. All of the ICD 9 diagnoses coded

before October 2015 required conversion to ICD 10 codes. The codes were grouped into categories by systems based on the ICD 10 divisions, to facilitate identifying the commonly admitted diagnoses and co-morbidities. The symptom codes or R codes were divided into respective systems. Injury and trauma codes were grouped together. ICD 10, Z codes relating to medical history or medications were divided into respective systems.

### **LACE Variables**

The four variables of the LACE score were examined and literature reviewed to confirm clinical relevance of the variables to the ED. The four variables used to calculate the LACE risk assessment score include:

1. Length of hospital stay (LOS)
2. Acuity of admission (inpatient admit or observation)
3. Charlson comorbidity score (CCM)
4. Number of ED visits in the previous 6 months (van Walraven et al., 2010)

**Length of stay.** The variable LOS represents the length of hospital stay of the index hospital admission and provides a reverence to patient acuity. Since the ED visits are frequently not referenced to a hospital admission, hospital length of stay (LOS) was a variable not meaningful for the ED setting. Chen et al. (2013) reported that ED LOS is not an indicator of acuity or negative patient outcomes. Determination of an appropriate alternative variable predictive of early ED visit was necessary. Age has been shown to be useful in predicting early hospital readmission or early ED return (Au et al., 2012; Caplan Brown, Croker, & Doolan, 1998; Martin-Gill & Reiser, 2004), however, Wang et al. (2007) found that the effect of age on return ED visits was through the CCM score. The organization's 17 months of historical data was examined using Poisson regression indicated that age was not a statistically significant



variable for early ED visits. The organizational data showed that individuals ages 40 and below accounted for 49% of the ED visits. Instead, the data suggested days between ED visits to be statistically significant. This variable was called Length of Stay Out of ED (LOSO) and was substituted for Length of Stay into the LACE model.

**Acuity of admission.** The variable Acuity of admission, refers to acuity at the time of admission, planned versus emergent or inpatient versus observation admission. This variable is irrelevant to ED visits and therefore not a meaningful variable for predicting early ED visits. A potential alternative was the Emergency Severity Index (ESI), a triage tool to assess severity of patient condition at the time of presentation to the ED. Originally developed in 1998, the tool is a validated, widely used method to predict acuity at the time of presentation to the ED (Elshove-Bolk, Mencl, van Rijswijck, Simons, & van Vugt, 2007; Gilboy, Tanabe, Travers, & Rosenau, 2011). The ESI score was evaluated for use in the model.

**Charlson comorbidity score.** Wang et al. (2011) found that the CCM score was a good indicator of severity of comorbid conditions and correlated with return ED visits. A modified version of the LACE score was used a modified comorbidity score which added renal disease, uncomplicated diabetes, and peptic ulcer disease (Kreilkamp, 2014).

**ED visits in the previous 6 months.** In a systematic review of the determinants of ED visits, McCusker, Karp, Cardin, Durand, & Morin (2003) found number of ED visits to be a significant predictor of ED use.

### **Plan C: Implementation Process**

The 17 month historical data retrieved from the administrative records was to be analyzed to determine the most common diagnoses and characteristics of those with early ED visits, and provide insight into the discharge coordination needs of the frequent ED visitors. A review of the

retrieved data revealed that the ESI index scores had not been included. The planned implementation process for Plan C primarily involved collaborating with the ED manager and educator to establish the workflow for collection of data regarding LOSO and ESI scores, in order to validate the feasibility of modified a LACE tool for ED. Evaluation of outcomes focused on successful establishment of a new workflow and compliance with data collection for analysis.

### **Failure to Implement: Plan C**

As plans moved forward with Plan C, the ED manager mentioned that the ED educator position was vacant and the interview process was still in progress. That role was key to implementation of the plan, and there were no other personnel in the unit ready to champion the project. While the unit manager was willing to implement the plan, it was expected to be several weeks before the resources would be in place and the ED ready to implement Plan C. Implementation of Plan C was abandoned and Plan D was developed.

### **Plan D: Modeling and Validating the ED-LACE Tool**

Plan D was built on the foundation of Plan C. The objective of Plan D was to validate the LACE tool for predicting early return ED visits after ED discharge. PHM involves reducing unplanned healthcare encounters by improving continuity at transitions of care. The ultimate goal was to identify patients at risk for early return visit, direct resources to those at highest risk and prevent early return. The study questions for Plan D were:

1. Can the LACE tool, designed for hospital discharges, be used for ED discharges to reliably predict unplanned return visits?
2. Can the simplicity of the LACE tool be maintained while establishing reliability for predicting early ED visits?

3. What variables are important and how should each of the variables be weighted to accurately predict early visits?
4. Can LOS in the LACE tool be replaced with an acceptable variable to help predict future unplanned ED visits?
5. Is ESI score an accurate indicator of acuity and is it a suitable substitute for acuity of inpatient admission?

### **Plan D Process**

Plan D was presented to the steering committee, approval and support was obtained. The data specialist retrieved ESI scores of the ED encounters for the previous 17 months. Using the universal ID and account number, the ESI scores were merged into the initial dataset. The plan would examine the historical data and review the literature to assess the evidence and evaluate the LACE variables to determine clinical relevance for the ED. The objective of the plan was to identify those at risk for early ED readmission. Variables with clinical relevance for the ED setting were modeled using Poisson regression with SAS 9.4. Poisson Regression was the method chosen for analysis because it supports outcomes expressed as a count, with zero being a meaningful number.

Using the data of ED visits over the previous 17 months, those with repeat visits were examined. The number of repeat visits per individual was determined and time between visits calculated. After assessment of the data using Poisson regression, the variable Length of Stay was replaced with Length of Stay Out of ED (LOSO). This variable represents the number of days between ED visits. The numbers of days between visits was calculated then grouped and ranked as follows: 1 = >60 days; 2 = 31-60 days; 3 = 22-30 days; 4 = 15-21 days; 5 = 8-14 days; 6 = 0-7 days. The ranking for this variable was determined by two factors. First, the data

revealed that the greatest portion of ED return visits were consistently seen within the first seven days of discharge, a finding also noted by Martin-Gill & Reiser (2004). Consequently, the shortest time period between visits was weighted with the highest score of 6. Second, one objective of the project was to maintain the simplicity of the LACE tool. In keeping with the structure of the original tool, LOSO was assigned and tested on a six-point scale with the shortest time period between visits assigned the highest score. Subsequent time periods were divided by weeks up to 30 days, then 30 to 60 days, followed by >60 days. The longest time block, >60 days was assigned the lowest score of 1. Evaluation of the data revealed that shortest time period consistently had the highest frequency, the time longest period, >60 days, had the next highest frequencies. The remaining time periods had similar frequencies. It is likely that if the longest time period had been divided further into weeks, the frequencies may have remained consistent.

The acuity score was determined using the Emergency Severity Index (ESI) triage scoring method, a reliable scoring method, widely accepted and associated with hospitalization, length of stay, resource utilization, and survival (Baumann & Strout, 2007). The ESI triage scoring method assigns the value of one to the most critically ill, and value five to the least critically ill. For use in the ED-LACE tool, the value of the triage scores were reversed with the value five assigned to the most critically ill and the value one to the most stable patients.

The ED-LACE tool, modeled after the modified LACE tool (Kreilkamp, 2014; Montana Rural Healthcare, n.d.; World Health Organization, 2009) included four variables: (a) time between ED visits, named Length of Stay Out of the ED (LOSO), (b) Acuity using the ESI score, (c) modified Charlson comorbidity score, and (d) Number of ED visits in the previous six months (see Appendix C). An ED-LACE score was calculated for every ED encounter and a

weighted ED-LACE mean was calculated based on the number of ED visits for the individual. The ED-LACE mean was found to be representative of the typical ED-LACE score.

### **Data Analysis**

There were 16,050 ED encounters in the 17 month study time period, with 9,293 unique individuals. About 2,000 were admitted at least twice. The initial ED diagnosis has been recognized as a potentially useful predictor of early ED return (Gordon et al., 1998), however the most commonly admitted diagnoses was Injury, followed by Respiratory, Gastro-intestinal, and Musculoskeletal symptoms respectively, with Neurological diagnoses carrying the highest mean ED-LACE scores. Primary diagnosis was not found to be a useful predictor of return ED visits.

The coefficient for ED-LACE mean was found to be 0.1614 or a 0.16 expected increase in log count for a one-unit increase in ED-LACE mean. That means there is a 17.5% increase in the incident rate of early ED visit for every unit increase in ED-LACE mean. Using the ED-LACE mean, logistic regression was run for the binary dependent variable ED visit. The ED-LACE score was found to be a statistically significant predictor of early ED visits,  $p < .0001$ , with robust predicative ability, *c-statistic* of 0.948.

### **Project Outcomes**

The objective of Plan D was to modify the LACE risk assessment tool for ED while maintaining the simplicity of the tool. The final outcome of this project was the validation of four variables meaningful to the ED setting, and the modification of the LACE tool for ED (see Appendix B). Development of the ED-LACE tool for use in the ED constituted successful achievement of project objectives. As noted in the CSF model, reducing unplanned hospital admissions is a critical factor in the BPCI initiative. Martin-Gill and Reiser (2004) point out that preventing early ED visits is one of the most important factors in decreasing hospital

readmission. The ED-LACE tool can be one component in the successful movement toward PHM. Improved identification of those at risk for early ED visit and effective coordination of care are important steps in decreasing return visits, decreasing readmissions, reducing cost, improving patient outcomes, and becoming a role model within the corporation. The local organization and the corporation experience cost savings as designed in the ACA and healthcare moves toward the goals of the Triple Aim.

### **Key Facilitators and Barriers**

The key facilitator for this quality improvement project was the organization's CNO/COO and her focus on decreasing risk to the organization relative to the BPCI initiative. Additionally, the need for a structured plan to provide direction in the utilization of resources, particularly in regard to use of the pending hospital discharge clinic, kept the project in motion.

There were two important barriers encountered in this project. First, was the lack of interoperability of the EMR and administrative data systems with accompanying lack of resources to overcome the barriers. Second, the same factors that became major barriers also facilitated progression of the project. The organization was in the midst of multiple simultaneous changes and projects to minimize risk related to the BPCI initiative. The limitation of resources and personnel that is inherent in a small organization became a barrier to implementation of the quality improvement project. Ultimately, because of the widespread changes needed across the organization related to the BPCI initiative, when barriers were encountered there were plenty opportunities for project adjustment to meet the evolving needs of the organization.

### **Unintended Consequences**

This DNP process improvement project occurred at a time in the organization was saturated with changes. The process improvement project started with the plan to implement the

LACE risk assessment tool to predict hospital readmissions after inpatient hospital discharge. The original project would focus on validating the tool for 90-day versus 30-day readmissions. Timing of the project and changes in the organization prohibited proceeding with the initial plan. However, in keeping with quality improvement, it remained a data driven, multidisciplinary project that examined current practice and examined best practice to apply interventions to bring about immediate improvements. (Lynn et al., 2007; Newhouse, Pettit, Poe, & Rocco, 2006). The most urgent needs of the organization in the setting of the BPCI initiative were determined and the project refocused to meet those needs. While the LACE tool had not been studied directly for predicting early ED visits, the literature implied usefulness of the tool for the ED setting. The primary unintended consequence, which resulted from barriers to implementation of the project, was the expansion of the scope to include modification and validation of the LACE tool for the ED.

### **Implications for Practice**

The ongoing need to improve patient care and reduce costs make the ED-LACE tool relevant to healthcare practice today. The ED-LACE tool identifies who is at risk in a systematic manner. It provides a structured risk assessment process that can be used to direct patient care coordination, enhance safety at transitions, guide the use of resources to optimize the impact of the interventions needed to mitigate risk. Interventions to prevent early ED visits or unplanned admissions requires a multi-faceted approach to coordination of care, including communication with outpatient providers, and coordinated integration of the available community resources available. The tool can be used as for communication with local community Primary Care Providers (PCP) in coordination of patient care at transitions. Failure to engage PCPs and develop seamless communication from the acute to the outpatient setting could mean poor

continuity of care, inefficient utilization of resources, and adverse patient outcomes. The addition of the hospital discharge clinic is expected to be an effective way to bridge the resource gap from the acute setting to the community and the primary care provider. The ED-LACE tool can be used to prioritize use of resources of the hospital discharge clinic.

### **Stakeholder Support and Sustainability**

Although the shift in project focus moved from inpatient discharges to ED discharges, the process provides structure to the discharge planning process throughout the organization. Case managers remain the primary stakeholders, however risk assessment and discharge planning impacts the organization at every level. The ED-LACE tool is easy to use, and uses data that is readily gathered, either prospectively or retrospectively. Sustainability of the project is feasible as the organization integrates the process into the ED workflow.

Modification of the user-friendly LACE tool based on review of the evidence, progression of the Medicare BPCI initiative, and the continued national healthcare goals of the Triple Aim suggest sustainability of the risk assessment process and ED-LACE tool. The tool is intended to offer structure and direction to the care coordination process thereby improving outcomes, improving the patient experience, and decreasing cost.

### **Recommendations**

The most important recommendation to the organization is related to IT support and interoperability of systems. The local organization, as part of a larger corporation, receives pertinent and timely standard reports, however data collection and monitoring at the local level is limited by the lack of interoperability and information technology (IT) support. Greater access to the administrative data base and support from a data warehousing specialist would greatly increase the flexibility and utility of the data. Calculations of the CCM and ED-LACE scores,



and specialized reports would be possible if there was greater accessibility to the database.

### **Limitations and Next Steps**

The primary limitation of this project is that the tool was developed from the retrospective data of a relatively small rural community hospital. The size of the organization and rural environment may yield different results than those of a larger urban or sub-urban organization. Application of the tool prospectively to organizations of varying size at multiple locations is needed to further validate the efficacy of the tool. Additionally, stratification of scores would be beneficial in determining level of risk.

### **Reflections on Enactments of DNP Essentials**

The DNP is a practice doctoral degree designed to prepare advanced practice nurses for the challenges and changes in healthcare. The focus of the DNP project is on innovative, evidence based practice and collaboration (AACN, 2006). The eight DNP essentials (see Table 3) are the competencies to be achieved by each DNP graduate, through course work and the Table 3.

#### The Essentials of Doctoral Education for Advanced Nursing Practice

---

I	Scientific Underpinnings for Practice
II	Organizational and Systems Leadership for Quality Improvement and Systems Thinking
III	Clinical Scholarship and Analytical Methods for Evidence-Based Practice
IV	Information Systems/Technology and Patient Care Technology for the Improvement and Transformation of Health Care
V	Health Care Policy for Advocacy in Health Care
VI	Interprofessional Collaboration for Improving Patient and Population Health Outcomes
VII	Clinical Prevention and Population Health for Improving the Nation's Health
VIII	Advanced Nursing Practice

---

(American Association of Colleges of Nursing, 2006)

scholarly project (Moran et al., 2014). This DNP project was broad in scope, in terms of the DNP essentials. Many of the core competencies were explicitly achieved in the development of the project. The two DNP essentials not directly addressed in this project are advocacy and advanced clinical practice.

**Essential I: Scientific underpinnings.** In this quality improvement project, the Critical Success Factor model, a theory from business and information technology provided the scientific underpinnings to explain the complexities of healthcare. The assumption of interrelationships in healthcare from the local level to the national level guided the scope of the project to allow for transferability from the local organization to interrelated organizations along the hierarchy. The CSF model also provided guidance for developing the plans for implementation.

**Essential II: Organizational and Systems Leadership.** Although the project was a part of a larger initiative, leadership was required to navigate the project through the various barriers and charter a new course at every impasse. This entailed recognizing opportunities, assessing needs, communicating with stakeholders, negotiating with leaders, and collaborating specialists, to see the project to completion. Valuable lessons were learned about flexibility and improvisation.

**Essential III: Clinical Scholarship and Analytical Methods.** Clinical scholarship became increasingly important as the project progressed and changed. Ongoing assessment of organizational needs, appraisal of the evidence, synthesis of the literature was needed to develop a quality improvement project that would improve patient outcomes and contribute to the healthcare and nursing knowledge base.

**Essential IV: Information Systems/Technology.** IT considerations were a major component of this DNP project. The project offered important lesson on data cleaning and integrity. Attention to the details of data collection was evident from the earliest stages of the project. The lack of interoperability and data warehousing revealed the limitations placed on data collection, concise reporting, and innovation. However, the limitations offered opportunity to understand the process more completely, develop temporary solutions to overcome immediate obstacles, and reinforced the concept of careful data collection. In the current state of healthcare with big data driving innovation and outcomes the need for robust IT support is abundantly evident.

**Essential VI: Interprofessional Collaboration.** Interprofessional collaboration and communication is a hallmark of innovation. It inspires creativity and progress (Fink, 2013). In the scope of the project, delays were all connected in some way with ineffective communication, solutions were achieved by forming new collaborative relationships and lines of communication.

**Essential VII: Clinical Prevention and Population Health.** Clinical prevention and population health was a core focus of this DNP project. Meeting the three key health care goals: improved health of the population, improved patient experience, and lower cost, must be done at the population level in order to achieve the broad results needed in healthcare nationally (Berwick et al., 2008). Healthcare today requires an expanded focus to meet the needs of the individuals in the context of the family, communities, and civil policy.

### **Dissemination of Outcomes**

As seen in the CSF model, the successful development of the LACE index risk assessment tool is highly context related. The tool is a CSF of the BPCI initiative at the local organization. Implementation of the tool at the local organization will offer the opportunity to

validate the effectiveness of the tool and influence other facilities within the corporation and in healthcare. The knowledge generated from development and validation of the modified ED-LACE tool has the potential to decrease both ED and hospital readmissions, improve the patient experience, and decrease cost. Dissemination of outcomes is planned through implementation of the tool at the host organization and possibly other constituent organizations with follow up presentation of finding to the organization and the corporate conference. Journal submission and wider conference presentation will be considered after further data collection and analysis is completed.

## References

- Arbaje, A. I., Kansagara, D. L., Salanitro, A. H., Englander, H. L., Kripalani, S., Jencks, S. F., & Lindquist, L. A. (2014). Regardless of age: Incorporating principles from geriatric medicine to improve care transitions for patients with complex needs. *Journal of General Internal Medicine, 29*, 932-939. doi: 10.1007/s11606-013-2729-1
- Arbaje, A. I., Wolff, J. L., Yu, Q., Powe, N. R., Anderson, G. F., & Boulton, C. (2008). Postdischarge environmental and socioeconomic factors and the likelihood of early hospital readmission among community-dwelling Medicare beneficiaries. *The Gerontologist, 48*, 495-504. doi: 10.1093/geront/48.4.495
- American Association of Colleges of Nursing. (2006). The essentials of doctoral education for advanced nursing practice. Retrieved from <http://www.aacn.nche.edu/publications/position/DNPEssentials.pdf>
- Au, A. G., McAlister, F. A., Bakal, J. A., Ezekowitz, J., Kaul, P., & van Walraven, C. (2012). Predicting the risk of unplanned readmission or death within 30 days of discharge after a heart failure hospitalization. *American heart journal, 164*, 365-372. doi: 10.1016/j.ahj.2012.06.010
- Baumann, M. R., & Strout, T. D. (2007). Triage of geriatric patients in the emergency department: validity and survival with the Emergency Severity Index. *Annals of Emergency Medicine, 49*, 234-240. doi: 10.1016/j.annemergmed.2006.04.011
- Ben-Chetrit, E., Chen-Shuali, C., Zimran, E., Munter, G., & Neshet, G. (2012). A simplified scoring tool for prediction of readmission in elderly patients hospitalized in internal medicine departments. *Israeli Medical Association Journal, 14*, 752-756. Retrieved from <https://www.ima.org.il/IMAJ/ViewArticle.aspx?aId=1185>

Berwick, D. M., Nolan, T. W., & Whittington, J. (2008) The triple aim: Care, health, and cost.

*Health Affairs*, 27, 759-769. doi: 10.1377/hlthaff.27.3.759

Bullen, C. V., & Rockart, J. F. (1981, June). *A primer on critical success factors*. (CISR No. 68

& Sloan WP No. 1220-81). Cambridge, Ma: Massachusetts Institute of Technology,

Center for Information Systems Research, Sloan School of Management. Retrieved from

[http://18.7.29.232/bitstream/handle/1721.1/1988/SWP-1220-08368993-CISR-069.pdf?](http://18.7.29.232/bitstream/handle/1721.1/1988/SWP-1220-08368993-CISR-069.pdf?sequence=1)

[sequence=1](http://18.7.29.232/bitstream/handle/1721.1/1988/SWP-1220-08368993-CISR-069.pdf?sequence=1)

Burke, T. (2011). Accountable care organizations. *Public Health Reports*, 126, 875. Retrieved

from <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3185325/>

Burke, R. E., Kripalani, S., Vasilevskis, E. E., & Schnipper, J. L. (2013). Moving beyond

readmission penalties: creating an ideal process to improve transitional care. *Journal of*

*Hospital Medicine*, 8, 102-109. doi: 10.1002/jhm.1990

Burtless, G. & Milusheva, S. (2012, May 9). *Effects of employer health costs on the trend and*

*distribution of social-security-taxable wages*. Brookings. Retrieved from

<http://www.brookings.edu/research/papers/2012/05/09-health-wages-burtless>

Caplan, G. A., Brown, A. N. N., Croker, W. D., & Doolan, J. (1998). Risk of admission within 4 weeks of discharge of elderly patients from the emergency department—the DEED study.

*Age and ageing*, 27, 697-702. doi: 10.1093/ageing/27.6.697

Caralli, R. A., Stevens, J. F., Willke, B. J., & Wilson, W. R. (2004). *The critical success factor*

*method: establishing a foundation for enterprise security management* (No. CMU/SEI-

2004-TR-010). Pittsburg, PA: Carnegie-Mellon University, Software Engineering

Institute. Retrieved from <http://www.sei.cmu.edu/reports/04tr010.pdf>

- Catalano, R. (2009). Health, medical care, and economic crisis. *New England Journal of Medicine*, 360, 749-751. doi: 10.1056/NEJMp0809122
- Centers for Medicare and Medicaid Services. (2010). *Affordable care act update: implementing Medicare cost savings*. Office of the Actuary. Retrieved from <https://www.cms.gov/apps/docs/aca-update-implementing-medicare-costs-savings.pdf>
- Centers for Medicare and Medicaid Services. (2014, September 25). *The HCAHPS survey: Frequently asked questions*. Retrieved from <https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HospitalQualityInits/Downloads/HospitalHCAHPSFactSheet201007.pdf>
- Centers for Medicare and Medicaid Services. (2015a, October 30). *BPCI model 2: Retrospective acute & post acute care episode*. Retrieved from <https://innovation.cms.gov/initiatives/BPCI-Model-2/index.html>
- Centers for Medicare and Medicaid Services. (2015b, October 30). *Bundled payments for care improvement (BPCI) initiative: General information*. Retrieved from <https://innovation.cms.gov/initiatives/Bundled-Payments/index.html>
- Cheng, S. Y., Wang, H. T., Lee, C. W., Tsai, T. C., Hung, C. W., & Wu, K. H. (2013). The characteristics and prognostic predictors of unplanned hospital admission within 72 hours after ED discharge. *The American journal of emergency medicine*, 31, 1490-1494. doi: 10.1016/j.ajem.2013.08.004
- Cotter, P. E., Bhalla, V. K., Wallis, S. J., & Biram, R. W. (2012). Predicting readmissions: Poor performance of the LACE index in an older UK population. *Age and Ageing*, 41, 784-789. doi: 10.1093/ageing/afs073

DeMichele, T. (n.d.). *Summary of provisions in the Patient Protection and Affordable Care Act.*

Obamacare Facts. Retrieved from <http://obamacarefacts.com/summary-of-provisions-patient-protection-and-affordable-care-act/>

Dobbins, J. H. (2001). Identifying and analyzing critical success factors. *Program Manager*, 30,

46-63. Retrieved from <http://www.dau.mil/pubscats/PubsCats/PM/articles01/so-dob.pdf>

Donzé, J., Lipsitz, S., Bates, D. W., & Schnipper, J. L. (2013). Causes and patterns of

readmissions in patients with common comorbidities: Retrospective cohort study. *BMJ*, 347, f7171. doi: 10.1136/bmj.f7171

Dunn, J. R., & Hayes, M. V. (1999). Toward a lexicon of population health. *Canadian Journal of*

*Public Health*, 90, S7-S10. Retrieved from [http://search.proquest.com/openview/](http://search.proquest.com/openview/7589e902b45f7dcbf132a7bc8da17172/1?pq-origsite=gscholar)

[7589e902b45f7dcbf132a7bc8da17172/1?pq-origsite=gscholar](http://search.proquest.com/openview/7589e902b45f7dcbf132a7bc8da17172/1?pq-origsite=gscholar)

Elshove-Bolk, J., Mencl, F., van Rijswijck, B. T., Simons, M. P., & van Vugt, A. B. (2007).

Validation of the Emergency Severity Index (ESI) in self-referred patients in a European emergency department. *Emergency Medicine Journal*, 24, 170-174.

doi:10.1136/emj.2006.039883

Eni, G. O. (1989). The concept of critical success factors (CSFs) as a planning tool for healthcare

managers. *Healthcare Management Forum*, 2(2), 12-17. doi: 10.1016/S0840-4704(10)

61369-5

Fielding, J. E., Kumanyika, S., & Manderscheid R. W. (2014). A perspective on the development

of the healthy people 2020: Framework for improving US population health. *Public*

*Health Reviews*, 35, 1-24. Retrieved from <http://www.publichealthreviews.eu/show/f/136>

Finch, P. (2003). Applying the Slevin-Pinto project implementation profile to an information

systems project. *Project Management Journal*, 34, 32-39.



Fink, S. (2013). *Five days at Memorial*. New York : Crown Publishers

Forster, A. J., Murff, H. J., Peterson, J. F., Gandhi, T. K., & Bates, D. W. (2003). The incidence and severity of adverse events affecting patients after discharge from the hospital. *Annals of Internal Medicine*, 138, 161-167. Retrieved from [http://hospitalmedicine.ucsf.edu/improve/literature/discharge\\_committee\\_literature/reengineering\\_systems/the\\_incidence\\_and\\_severity\\_of\\_adverse\\_events\\_affecting\\_patients\\_after\\_discharge\\_forster\\_ann\\_intern\\_med.pdf](http://hospitalmedicine.ucsf.edu/improve/literature/discharge_committee_literature/reengineering_systems/the_incidence_and_severity_of_adverse_events_affecting_patients_after_discharge_forster_ann_intern_med.pdf)

Fuster, V. (1999). Epidemic of cardiovascular disease and stroke: The three main challenges Presented at the 71st Scientific Sessions of the American Heart Association-Dallas, Texas. *Circulation*, 99, 1132-1137. doi: 10.1161/01.CIR.99.9.1132

Garg, A., Boynton-Jarrett, R., & Dworkin, P. H. (2016). Avoiding the Unintended Consequences of Screening for Social Determinants of Health. *JAMA*, 316(8), 813-814. doi:10.1001/jama.2016.9282

Gates, L. P. (2010). *Strategic planning with critical success factors and future scenarios: An integrated strategic planning framework* (CMU/SEI-2010-TR-037). Pittsburg, PA: Carnegie-Mellon University, Software Engineering Institute. Retrieved from <http://www.sei.cmu.edu/reports/10tr037.pdf>

Gilboy, N., Tanabe, T., Travers, D., Rosenau, A. M. (2011, November). Emergency Severity Index (ESI): A Triage Tool for Emergency Department Care, Version 4. (AHRQ Publication No. 12-0014) In Implementation Handbook 2012 Edition. Rockville, MD: Agency for Healthcare Research and Quality. Retrieved from [http://www.ahrq.gov/sites/default/files/wysiwyg/professionals/systems/hospital/esi/esihan\\_dbk.pdf](http://www.ahrq.gov/sites/default/files/wysiwyg/professionals/systems/hospital/esi/esihan_dbk.pdf)

- Gildersleeve, R., & Cooper, P. (2013). Development of an automated, real time surveillance tool for predicting readmissions at a community hospital. *Applied Clinical Informatics*, 4, 153. doi: 10.4338/ACI-2012-12-RA-0058
- Gordon, J. A., An, L. C., Hayward, R. A., & Williams, B. C. (1998). Initial emergency department diagnosis and return visits: risk versus perception. *Annals of emergency medicine*, 32, 569-573. doi: 10.1016/S0196-0644(98)70034-4
- Gruneir, A., Dhalla, I. A., van Walraven, C., Fischer, H. D., Camacho, X., Rochon, P. A., & Anderson, G. M. (2011). Unplanned readmissions after hospital discharge among patients identified as being at high risk for readmission using a validated predictive algorithm. *Open Medicine*, 5, 104-111. Retrieved from <http://www.sdmeded.com/wp-content/uploads/2012/11/LACE2-unplanned-grtr-than-101.pdf>
- Harrison, P. L., Hara, P. A., Pope, J. E., Young, M. C., & Rula, E. Y. (2011). The impact of postdischarge telephonic follow-up on hospital readmissions. *Population health management*, 14, 27-32. doi:10.1089/pop.2009.0076
- Helms, M. M., Moore, R., & Ahmadi, M. (2008). Information technology (IT) and the healthcare industry: A SWOT analysis. *Medical Informatics: Concepts, Methodologies, Tools, and Applications: Concepts, Methodologies, Tools, and Applications*, 134. Retrieved from <https://pdfs.semanticscholar.org/13a1/e4f3d588dffa38033c0a867dc82ac033482.pdf>
- Helms, M. M., & Nixon, J. (2010). Exploring SWOT analysis-where are we now? A review of academic research from the last decade. *Journal of strategy and management*, 3, 215-251. doi: 10.1108/17554251011064837

- Institute for Health Technology Transformation. (2012, April 25). *Population health management – A roadmap for provider-based automation in a new era of healthcare*. New York, NY: Institute for Health Technology Transformation.
- Institute of Medicine. (2011). *The future of nursing: Leading change, advancing health*. Washington, DC: The National Academies Press. Retrieved from <https://www.nap.edu/read/12956/chapter/1#iii>
- Kahn, K. L., Rubenstein, L. V., Draper, D., Kosecoff, J., Rogers, W. H., Keeler, E. B., & Brook, R. H. (1990). The effects of the DRG-based prospective payment system on quality of care for hospitalized Medicare patients: an introduction to the series. *Jama*, *264*, 1953-1955. doi: 10.1001/jama.1990.03450150053030
- Kansagara, D., Englander, H., Salanitro, A., Kagen, D., Theobald, C., Freeman, M., & Kripalani, S. (2011). Risk prediction models for hospital readmission: a systematic review. *Jama*, *306*, 1688-1698. doi:10.1001/jama.2011.1515
- Kangovi, S., & Grande, D. (2011). Hospital readmissions—not just a measure of quality. *Jama*, *306*, 1796-1797. doi:10.1001/jama.2011.1562.
- Kassler, W. J., Tomoyasu, N., & Conway, P. H. (2015). Beyond a traditional payer—CMS's role in improving population health. *New England Journal of Medicine*, *372*, 109-111. doi:10.1056/NEJMp1406838
- Kellermann, A. L., & Jones, S. S. (2013). What it will take to achieve the as-yet-unfulfilled promises of health information technology. *Health Affairs*, *32*, 63-68. doi: 10.1377/hlthaff.2012.0693
- Kindig, D., & Stoddart, G. (2003). What is population health? *American Journal of Public Health*, *93*, 380-383. doi: 10.2105/AJPH.93.3.380

- Kocher, R. P., & Adashi, E. Y. (2011). Hospital readmissions and the Affordable Care Act: paying for coordinated quality care. *Jama*, *306*, 1794-1795. doi:10.1001/jama.2011.1561
- Kocher, R., Emanuel, E. J., & DeParle, N. A. M. (2010). The Affordable Care Act and the future of clinical medicine: the opportunities and challenges. *Annals of Internal Medicine*, *153*, 536-539. doi: 10.7326/0003-4819-153-8-201010190-00274
- Kohn, L. T., Corrigan, J. M., & Donaldson, M. S. (Eds.). (2000). *To err is human: Building a safer health system*. National Academies Press. Retrieved from <http://www.ncbi.nlm.nih.gov/books/NBK225182/>
- Kosecoff, J., Kahn, K. L., Rogers, W. H., Reinisch, E. J., Sherwood, M. J., Rubenstein, L. V., ... & Brook, R. H. (1990). Prospective payment system and impairment at discharge: the 'quicker- and-sicker' story revisited. *Jama*, *264*, 1980-1983. doi: 10.1001/jama.1990.03450150080035
- Kreilkamp, R. (2014). Modified LACE tool to predict and prevent hospital readmissions [PowerPoint slides]. Retrieved from Lecture Notes Online Web site: <http://greatplainsqin.org/wp-content/uploads/2015/01/Use-of-Modified-LACE-Tool-to-Predict-and-Prevent-Hospital-Readmissions.pdf>
- Kripalani, S., Theobald, C. N., Anctil, B., & Vasilevskis, E. E. (2014). Reducing Hospital Readmission: Current Strategies and Future Directions. *Annual review of medicine*, *65*, 471. doi: 10.1146/annurev-med-022613-090415
- Larkin, H. (2014, October) Population health: Embracing risk. *Hospitals & Health Networks Magazine*, 30-45. Retrieved from <http://www.hhnmag.com/publications/2/editions/16>
- Leidecker, J. K., & Bruno, A. V. (1984). Identifying and using critical success factors. *Long Range Planning*, *17*, 23-32. doi: 10.1016/0024-6301(84)90163-8

- Louis, D. Z., Robeson, M., McAna, J., Maio, V., Keith, S. W., Liu, M., ... & Grilli, R. (2014). Predicting risk of hospitalisation or death: a retrospective population-based analysis. *BMJ open*, 4, e005223. doi:10.1136/bmjopen-2014-005223
- Lusthaus, C., Adrien, M. H., Anderson, G., Carden, F., & Montalvan, G. P. (2002). *Organizational assessment: A framework for improving performance*. Ottawa, Canada: International Development Research Center. Retrieved from <http://www.mtnforum.org/sites/default/files/publication/files/1416.pdf>
- Lynn, J., Baily, M. A., Bottrell, M., Jennings, B., Levine, R. J., Davidoff, F., ... & Agich, G. J. (2007). The ethics of using quality improvement methods in health care. *Annals of Internal Medicine*, 146, 666-673. doi:10.7326/0003-4819-146-9-200705010-00155
- Martin-Gill, C., & Reiser, R. C. (2004). Risk factors for 72-hour admission to the ED. *The American Journal of Emergency Medicine*, 22, 448-453. doi: 10.1016/j.ajem.2004.07.023
- McCusker, J., Karp, I., Cardin, S., Durand, P., & Morin, J. (2003). Determinants of emergency department visits by older adults: a systematic review. *Academic Emergency Medicine*, 10, 1362-1370. doi: 10.1197/S1069-6563(03)00539-6
- Medicare Payment Payment Advisory Commission.(2007, June). Promoting greater efficiency in Medicare: Report to Congress. Retrieved from <http://www.caretransitions.org/documents/MedPAC%20report.pdf>
- Melnyk, B. M., & Fineout-Overholt, E. (2015). *Evidence-based practice in nursing and healthcare: A guide to best practice* (3rd ed.). Philadelphia: Lippincott Williams & Wilkins.

Montana Rural Healthcare, Performance Improvement Network, (n.d.). *Modified LACE Tool*.

Retrieved from <http://www.mtpin.org/docs/ActiveStudies/ReduceReadmit/Nursing%20instruction%20modified%20LACE>

Moran, K., Burson, R. & Conrad, D. (2014) *The doctor of nursing practice scholarly project: A framework for success*. Burlington, MA: Jones & Bartlett

Müller, R., & Jugdev, K. (2012). Critical success factors in projects: Pinto, Slevin, and Prescott—the elucidation of project success. *International Journal of Managing Projects in Business*, 5, 757-775. doi: 10.1108/17538371211269040

Naylor, M. D., Brooten, D., Campbell, R., Jacobsen, B. S., Mezey, M. D., Pauly, M. V., & Schwartz, J. S. (1999). Comprehensive discharge planning and home follow-up of hospitalized elders: a randomized clinical trial. *Jama*, 281, 613-620. doi: 10.1001/jama.281.7.613

Newbold, E., Schneidermann, M., & Horton, C. (2012). The bridge clinic. *AJN The American Journal of Nursing*, 112, 56-59. doi: 0.1097/01.NAJ.0000415966.23169.7e

Newhouse, R. P., Pettit, J. C., Poe, S., & Rocco, L. (2006). The slippery slope: differentiating between quality improvement and research. *Journal of Nursing Administration*, 36, 211-219. Retrieved from [http://journals.lww.com/jonajournal/Abstract/2006/04000/The\\_Slippery\\_Slope\\_\\_Differentiating\\_Between.11.aspx](http://journals.lww.com/jonajournal/Abstract/2006/04000/The_Slippery_Slope__Differentiating_Between.11.aspx)

Obama, B. H. (2010, March 20). Obama's remarks to house democrats [Transcript of remarks] *The New York Times*. Retrieved from <http://www.nytimes.com/2010/03/20/health/policy/20text-obama.html>

- Pampel, F. C., Krueger, P. M., & Denney, J. T. (2010). Socioeconomic disparities in health behaviors. *Annual Review of Sociology*, 36, 349–370. doi:10.1146/annurev.soc.012809.102529
- Pinto, J. K. (1990). Project Implementation Profile: a tool to aid project tracking and control. *International Journal of Project Management*, 173-182. doi:10.1016/0263-7863(90)90020-C
- Pinto, J. K., & Slevin, D. P. (1987). Critical factors in successful project implementation. *IEEE Transactions on Engineering Management*, EM-34, 22-27. doi: 10.1109/TEM.1987.6498856
- Quan, H., Sundararajan, V., Halfon, P., Fong, A., Burnand, B., Luthi, J. C., ... & Ghali, W. A. (2005). Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. *Medical Care*, 1130-1139. Retrieved from [http://www.jstor.org/stable/3768193?seq=1#page\\_scan\\_tab\\_contents](http://www.jstor.org/stable/3768193?seq=1#page_scan_tab_contents)
- Rogers, W. H., Draper, D., Kahn, K. L., Keeler, E. B., Rubenstein, L. V., Kosecoff, J., & Brook, R. H. (1990). Quality of care before and after implementation of the DRG-based prospective payment system: A summary of effects. *Jama*, 264, 1989-1994. doi:10.1001/jama.1990.03450150089037
- Schultz, R. L., Slevin, D. P., & Pinto, J. K. (1987). Strategy and tactics in a process model of project implementation. *Interfaces*, 17(3), 34-46.
- Soong, C., Daub, S., Lee, J., Majewski, C., Musing, E., Nord, P., ... & Bell, C. M. (2013). Development of a checklist of safe discharge practices for hospital patients. *Journal of Hospital Medicine*, 8, 444-449. doi: 10.1002/jhm.2032

- Stolbert, S. G., Zeleny, J., & Hulse, C. (2010, March 20). Health vote caps a journey back from the brink. *The New York Times*. Retrieved from <http://www.nytimes.com/2010/03/21/health/policy/21reconstruct.html>
- Tan, S. Y., Low, L. L., Yang, Y., & Lee, K. H. (2013). Applicability of a previously validated readmission predictive index in medical patients in Singapore: a retrospective study. *BMC Health Services Research*, *13*, 366. doi: 10.1186/1472-6963-13-366
- Tuso, P., Huynh, D. N., Garofalo, L., Lindsay, G., Watson, H. L., Lenaburg, D. L., ... & Kanter, M. H. (2013). The readmission reduction program of Kaiser Permanente Southern California— knowledge transfer and performance improvement. *The Permanente Journal*, *17*, 58. doi: 10.7812/TPP/12-141
- U. S. Department of Health and Human Services. (2011, March) *National Strategy for Quality Improvement in Health Care: Report to Congress*. Retrieved from <http://www.ahrq.gov/workingforquality/reports/annual-reports/nqs2011annlrpt.pdf>
- van Walraven, C., Dhalla, I. A., Bell, C., Etchells, E., Stiell, I. G., Zarnke, K., ... & Forster, A. J. (2010). Derivation and validation of an index to predict early death or unplanned readmission after discharge from hospital to the community. *Canadian Medical Association Journal*, *182*, 551-557. doi: 10.1503/cmaj.091117
- van Walraven, C., Wong, J., & Forster, A. J. (2013). Influence of neighborhood household income on early death or urgent hospital readmission. *Journal of Hospital Medicine*, *8*, 261-266. doi: 10.1002/jhm.2025
- Wang, Y., Beydoun, M. A., Liang, L., Caballero, B., & Kumanyika, S. K. (2008). Will all Americans become overweight or obese? Estimating the progression and cost of the US obesity epidemic. *Obesity*, *16*, 2323-2330. doi: 10.1038/oby.2008.351



- Wang, H. Y., Chew, G., Kung, C., Chung, K., & Lee, W. (2007). The use of Charlson comorbidity index for patients revisiting the emergency department within 72 hours. *Chang Gung medical journal*, 30, 437. Retrieved from <http://memo.cgu.edu.tw/cgmj/3005/300508.pdf>
- Wang, H., Robinson, R. D., Johnson, C., Zenarosa, N. R., Jayswal, R. D., Keithley, J., & Delaney, K. A. (2014). Using the LACE index to predict hospital readmissions in congestive heart failure patients. *BMC cardiovascular disorders*, 14, 1. doi: 10.1186/1471-2261-14-97
- World Health Organization. (2009). *Global health risks: mortality and burden of disease attributable to selected major risks*. Geneva, Switzerland: World Health Organization. Retrieved from [http://www.who.int/healthinfo/global\\_burden\\_disease/GlobalHealthRisks\\_report\\_full.pdf](http://www.who.int/healthinfo/global_burden_disease/GlobalHealthRisks_report_full.pdf)
- Yu, S., Farooq, F., van Esbroeck, A., Fung, G., Anand, V., & Krishnapuram, B. (2015). Predicting readmission risk with institution-specific prediction models. *Artificial Intelligence in Medicine*, 65, 89-96. doi: 10.1016/j.artmed.2015.08.005
- Zimmet, P., Alberti, K. G. M. M., & Shaw, J. (2001). Global and societal implications of the diabetes epidemic. *Nature*, 414, 782-787. doi: 10.1038/414782a

## Appendix A

## DRG Codes included in BPCI Initiative

Acute Myocardial Infarction	
280	Acute myocardial infarction, disease/ discharged alive with <b>major</b> complication or comorbidity
281	Acute myocardial infarction, disease/ discharged alive <b>with</b> complication or comorbidity
282	Acute myocardial infarction, disease/ discharged alive <b>without</b> major complication or comorbidity
Cardiac Arrhythmia	
308	Cardiac arrhythmia and conduction disorders with <b>major</b> complication or comorbidity
309	Cardiac arrhythmia and conduction disorders <b>with</b> complication or comorbidity
310	Cardiac arrhythmia and conduction disorders <b>without</b> major complication or comorbidity
Congestive heart failure	
291	Heart failure and shock with <b>major</b> complication or comorbidity
292	Heart failure and shock <b>with</b> complication or comorbidity
293	Heart failure and shock <b>without</b> complication or comorbidity
Gastrointestinal hemorrhage	
377	Gastrointestinal hemorrhage with <b>major</b> complication or comorbidity
378	Gastrointestinal hemorrhage <b>with</b> complication or comorbidity
379	Gastrointestinal hemorrhage <b>without</b> complication or comorbidity
Major joint replacement of the lower extremity	
469	Major joint replacement or reattachment of lower extremity with <b>major</b> complication or comorbidity
470	Major joint replacement or reattachment of lower extremity <b>without</b> major complication or comorbidity
Other respiratory	
186	Pleural effusion with <b>major</b> complication or comorbidity
187	Pleural effusion <b>with</b> complication or comorbidity
188	Pleural effusion <b>without major</b> complication or comorbidity <b>without</b> complication or comorbidity
189	Pulmonary edema and respiratory failure
204	Respiratory signs and symptoms
205	Other respiratory system diagnoses with <b>major</b> complication or comorbidity
206	Other respiratory system diagnoses <b>without</b> major complication or comorbidity
207	Respiratory system diagnosis with ventilator support <b>96+</b> hours
208	Respiratory system diagnosis with ventilator support <b>&lt;96</b> hours
Simple pneumonia and respiratory infections	
177	Respiratory infections and inflammations with <b>major</b> complication or

	comorbidity
178	Respiratory infections and inflammations <b>with</b> complication or comorbidity
179	Respiratory infections and inflammations <b>without</b> major complication or comorbidity
193	Simple pneumonia and pleurisy with <b>major</b> complication or comorbidity
194	Simple pneumonia and pleurisy <b>with</b> complication or comorbidity
195	Simple pneumonia and pleurisy <b>without</b> major complication or comorbidity

## Appendix B

## Plan A: Expected Workflow

- 1) Admit from ED or Direct Admit
- 2) Order entered by ED or admitting provider for inpatient or observation admission
- 3) Supervisor assigns room
- 4) Admission nurse completes admission assessment process using the following steps:
  - a) Complete the electronic patient admission forms
  - b) Mobility assessment
  - c) Mental health screenings
- 5) A working admission diagnosis is obtained from the ED records and entered into the administrative database by the unit clerk.
- 6) An admitting LACE score is calculated on all patients using default LOS of 3 days. Data elements are available in the administrative database and the calculation will be automated to provide consistency, accuracy, and easy retrievability
- 7) LACE elements
  - a) Length of stay
    - (1) Default admitting LOS is 3 days
    - (2) Predicted LOS is populated in EMR when the admitting DRG is entered by CM
  - ii) <1 day = 0
  - iii) 1 day = 1
  - iv) 2 days = 2
  - v) 3 days = 3 (admit default)
  - vi) 4-6 = 4

- vii)  $7-13 = 5$
- viii)  $\geq 14 = 6$
- b) Acuity of admission – Inpatient or Observation
  - i) Inpatient = 3
  - ii) Observation = 0
- c) Charlson comorbidity score – history of previous hospital DRGs populates in the administrative database, this is the data needed to calculate Charlson score
  - i) 0 = No prior history
  - ii) 1 = DM no complications, Cerebrovascular disease, Hx MI, PVD, PUD
  - iii) 2 = Mild liver disease, DM with end organ damage, CHF, COPD, Cancer, Leukemia, Lymphoma, any tumor, mod/severe CKD
  - iv) 3 = Dementia, connective tissue disease
  - v) 4 = Moderate or severe liver disease or HIV infection
  - vi) 6 = Metastatic cancer
- d) ED visits in the previous 6 months (data available in the administrative database)
  - i) 0
  - ii) 1
  - iii) 2
  - iv) 3
  - v) 4 or more
- 8) Within 24 to 72 hours Case Manager will confirm admitting DRG code, identify BPCI patients, and record the admitting LACE score on white board.
- 9) BPCI patients & admitting LACE Score is communicated daily at MDRs.

- 10) LACE score is used to determine patient risk for readmission or unplanned use of healthcare resources
- 11) LACE score is stratified into level of risk and a process set up to decrease risk.
- 12) Stratification of risk by LACE score
  - a) Low = 0-6
  - b) Medium = 7-10
  - c) High = 11-19
- 13) Daily multi disciplinary rounds
  - a) Use LACE score in MDR to guide continued assessment of patient risk for readmission or unplanned use of healthcare resources an for discharge planning
  - b) Determine key social issues contributing to potential readmission
- 14) LACE score re-calculated based on Actual LOS
- 15) Risk stratification
- 16) Basic Discharge Elements for ALL discharges (Tuso et al, 2013)
  - a) Standardized discharge summary
  - b) Medication reconciliation
  - c) Discharge instructions (clear, concise format) written and explained to patient and family
  - d) A post discharge follow up number made available for patient and family to call for questions.
- 17) Interventions based on risk score
  - a) Low – adhere to basic discharge elements
  - b) Medium – basic discharge elements PLUS Post hospital discharge follow up with PCP or post discharge clinic in  $\leq$  14 days

- c) High (11-14)
  - i) Basic discharge elements PLUS
  - ii) Post hospital discharge follow up with PCP or Post Discharge Clinic in  $\leq 7$  days
- d) High+ ( $\geq 15$ )
- e) Basic discharge elements PLUS Post hospital discharge follow up with PCP or Post Discharge Clinic in  $\leq 7$  days
- f) Consider Palliative care consult
- g) Initiate complex case conference
  - i) Meet with Patient, Family, PCP &/or Hospitalist or discharge clinic Provider, CM, & Discharge Nurse
  - ii) Determine & discuss key social issue contributing to readmissions

Appendix C  
ED-LACE index scoring tool

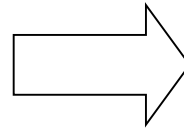
MRN # \_\_\_\_\_  
Date \_\_\_\_\_

**Step 1. Length of Stay Out of ED (LOSO)**

Number of Days between ED visits:

Length of stay (days)	Score (circle as appropriate)
>60	1
31 – 60	2
22 – 30	3
15 – 21	4
8 – 14	5
0 – 7	6

L



**Step 2. Acuity at ED Visit**

Emergency Severity Index Score:

ESI score	Score (circle as appropriate)
1	5
2	4
3	3
4	2
5	1

A

**Step 3. Comorbidities**

Condition (definitions and notes below)	Points per Condition
No prior history	0
Previous MI or CAD	+1
Cerebrovascular disease	+1
Peripheral vascular disease	+1
Diabetes without complications	+1
Alcoholism	+1
Smoking	+1
Congestive heart failure	+2
Diabetes with end organ damage	+2
Chronic pulmonary disease	+2
Mild liver disease	+2
Chronic kidney disease	+2
Any cancer, tumor, lymphoma or leukemia	+2
Dementia	+3
Sickle Cell	+3
Auto-immune disorder	+3
Connective tissue disease, RA, Lupus, etc	+3
HIV infection or AIDS	+4
Severe or end stage renal disease	+4
Moderate or severe liver disease, cirrhosis, hepatitis	+4
Metastatic cancer	+6
<b>TOTAL</b>	

Cumulative to a Maximum of 6 points

C

**Step 4. Emergency department visits**

How many visited to the emergency department in the previous six months \_\_\_\_\_

Enter this number or 4 (whichever is smaller) in Box E

E

Add numbers in Box L, Box A, Box C, Box E to generate LACE score and enter into box below.

LACE



<b>Condition</b>	<b>Definition and/or notes</b>
Previous myocardial infarction	Any previous definite or probable myocardial infarction
Cerebrovascular disease	Any previous stroke or transient ischemic attack (TIA)
Peripheral vascular disease	Intermittent claudication, previous surgery or stenting, gangrene or acute ischemia, untreated abdominal or thoracic aortic aneurysm
Diabetes without microvascular complications	No retinopathy, nephropathy or neuropathy
Congestive heart failure	Any patient with symptomatic CHF whose symptoms have responded to appropriate medications
Diabetes with end organ damage	Diabetes with retinopathy, nephropathy or neuropathy
Chronic pulmonary disease	Hx COPD, long term smoking history
Mild liver or renal disease	Cirrhosis but no portal hypertension (i.e., no varices, no ascites) OR chronic hepatitis Chronic Renal Disease
Any tumor (including lymphoma or leukemia)	Solid tumors must have been treated within the last 5 years; includes chronic lymphocytic leukemia (CLL) and polycythemia vera (PV)
Dementia	Any cognitive deficit
Connective tissue disease	Systemic lupus erythematosus (SLE), polymyositis, mixed connective tissue disease, moderate to severe rheumatoid arthritis, and polymyalgia rheumatica
AIDS	AIDS-defining opportunistic infection or CD4 < 200
Moderate or severe liver or renal disease	Cirrhosis with portal hypertension (e.g., ascites or variceal bleeding) Endstage Renal Disease, Hemodialysis or Peritoneal Dialysis
Metastatic solid tumor	Any metastatic tumour