Introduction:
With an emphasis on both value based care and transitioning care away from the hospital environment to the outpatient clinic setting, outpatient healthcare leaders are seeking to optimize both patient care delivery and the use of healthcare resources, which includes reducing the number of patients who “no-show” for appointments (Eagle, 2016; Hammett, 2017). Patient no-shows for scheduled clinic appointments lead to non-value added staff rework as they react and try to fill open appointment slots. The downstream effects include inefficiencies and disruptions in care delivery (Drewek, Mirea, & Adelson, 2017; Kaplan-Lewis & Percac-Lima, 2013; Steiner, Shainline, Bishop, Stan, & Xu, 2016).

Robust electronic health records (EHR) systems capture not only aspects of patients’ health history but also patient demographics, patient habits, and health system processes (e.g. patient education, etc.). Many times, however, health system leaders are unaware that the data can be modeled to predict patient behaviors. Developing patient prediction models that take advantage of electronic health records data can lead to improved patient outcomes, improved financial performance, and improved delivery of safe patient care.

Background and Problem: Longway clinic, a member of the Michigan Health Specialists Ambulatory clinic system, is a large Flint, Michigan clinic that schedules over 34,000 patient visits per year. Many Longway clinic patients face significant barriers to receiving care. Patients are typically lower social economic status with over 76% unemployed, 21% disabled, and 58% with either Medicaid coverage or no insurance. Longway clinic leadership believes that the barriers are key factors in the 29% patient no-show rate to scheduled appointments. The high no-show rate not only prevents patients from receiving high quality health care but also results in an approximate annual revenue loss of $600,000 and substantial non-value added costs of over $200,000.

Purpose:
The purpose of this quality improvement project is to implement the five phases of the Six Sigma process--Define, Measure, Analyze, Improve, and Control--with an emphasis on the Analyze phase to develop (1) a prediction model that predicts patients at higher risk of appointment no-show and (2) targeted interventions to improve the likelihood of patients completing appointments. The expected outcome is a 50% reduction in the clinic’s no-show rate with a 20% upper specification within three months of implementation.

Methods:
In the Define and Measure phases, the author identified patient no-shows as the improvement opportunity and measured the clinic’s current no-show metrics. In the Analyze phase, the author (1) used both structured brainstorming sessions with key stakeholders to identify and prioritize potential root causes of no-shows and (2) collected and analyzed EHR patient data based on the brainstorming outcomes to confirm the root causes and develop the prediction model. In the Improve and Control
phases, the author integrated findings from the literature, the philosophy and values of the Longway clinic, and the confirmed root causes to develop sustainable interventions to reduce patient no-shows.

**Evaluation:**
Statistical tools used to evaluate the Longway clinic's current no-show rates were Chi-Square, Statistical Process Control, the Capability Index, and the percent defective no-show rate. An Ishikawa diagram, General Linear Models, Binary Logistic Regression, and Interaction models were used to develop the no-show prediction model.

**Results:**
Longway clinic’s current no-show metrics are unacceptable. The Cpk Capability Index is -.45; the Statistical Process Control P Chart indicates an unstable no-show process with several out of control points; and, the overall percent defective no-show rate was 29%. General Linear Models, Binary Logistic Regression, and factor interaction models identified Friday appointments, appointments in June and July, afternoon appointments, lack of insurance, specific visit types, students and minors, appointment lead time, and controlled substance prescriptions as significant predictors of patient no-shows. The prediction model fit $R^2$ was over 56% with an adjusted $R^2$ of 55.9%.

**Interventions:**
Based on the outcomes in the results section, clinic leadership will use the no-show prediction model to divide patients into low, medium, and high risk of no-show categories. Low risk patients (i.e. no-show probability less than or equal to 20%) will receive no interventions. Medium risk patients (i.e. no-show probability greater than 20% and less than or equal to 29%) will be required to engage in a patient navigator program. Patient navigators will help medium risk patients overcome the barriers to completing appointments (Rebecca, Nancy, Allison, R., & Sarah, 2015). High risk patients (i.e. no-show probability greater than 29%) will no longer be allowed to schedule appointments. High risk patients will be required to come to the clinic as a “same day walk in” to avoid the expected revenue loss and the non-value added costs.

**Conclusion:**
Six Sigma is one effective quality improvement model that nurse leaders can implement to improve operational efficiency and effectiveness in the delivery of patient care. In this improvement project, Six Sigma methods were used to develop a model that incorporates significant predictor factors to determine patients’ no-show probability. While the model is targeted toward an inner-city clinic system with lower social economic status patients, other clinics can replicate the process to build a prediction model for their patient population.

---

**Title:**
Using Six Sigma to Reduce Patient No-Show Rates to Clinic Appointments

**Keywords:**
clinic appointments, lean six sigma and patient no-show rates

**References:**


**Abstract Summary:**
Nurse leaders can use Six Sigma to reduce clinic no-show rates along with the associated non-value added activities that negatively impact patient care and clinic financial stability. This presentation will describe the Six Sigma process used to develop a no-show prediction model and interventions to improve patient no-show rates.

**Content Outline:**

1. Introduction

2. Background and Problem

3. Purpose and Expected Outcomes

4. Methods
   - Define Phase-confirm improvement opportunity
   - Measure Phase-measure the current state
   - Analyze Phase-determine root causes
   - Improve Phase-develop and implement interventions
   - Control Phase-develop and implement controls to sustain improvements

5. Evaluation-statistical tools

6. Results
   - Current state no-show metrics
   - Significant predictors
   - Model fit

7. Interventions
o Patient navigator program
o Scheduling

8. Contribution to the Literature

First Primary Presenting Author

**Primary Presenting Author**
John Charles Knight, MSN
University of Michigan--Ann Arbor
School of Nursing
Doctorate of Nurse Practice Student
Ann Arbor MI
USA

**Author Summary:** John Knight is Doctorate of Nurse Practice student with several electronic health record certifications and a Six Sigma Black Belt. His most recent experience focuses on quality improvement aimed at improving the access to care for patients and families of all social economic classes.