

**Clinical Informatics Study Analyzing Unspecified Chest Pain Diagnoses and the Impact of
Physician Staffing at the Phoenix VA Health Care System Emergency Department**

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in partial fulfillment of the requirements for the degree of Doctor of Medicine

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Abstract

Introduction: Emergency department (ED) overcrowding is a reality within healthcare. The emergence of health information systems such as Emergency Department Integration Software (EDIS), provide real-time analysis which supports clinical staff and hospital management teams that aim to improve ED performance and determine appropriate staffing. The purpose of this quality improvement project is to determine if EDIS data can help guide as a predictive model to improve patient flow through the Phoenix VA ED in patients with unspecified chest pain, by examining factors that impact flow: Door to Doc, Admission Decision, Admission Delay, Inpatient Length of Stay (LOS) and ED LOS.

Methods: EDIS data retrieved from the Phoenix VA Health Care System (PVAHCS) was retrospectively collected from EMMT National Reporting Software for April 2016 through December 2016. The data contained the following outcome time measurements: Door to Doc, Admission Decision, Admission Delay, ED LOS, and Inpatient LOS. Provider reports for full-time and fee physician staffing in the ED were obtained for the year of 2016 and specifically in detail for September 12th, 2016 through September 30th, 2016. Data points obtained were de-identified, patients received a diagnosis, and each patient interaction was independent of one another. Patients diagnosed with unspecified chest pain were grouped separately from patients with all other diagnoses collectively for each respective analysis. Descriptive statistics were utilized and analysis included chi-square, Kruskal-Wallis, and simple linear regression for continuous variables.

Results: From April to September, there were a total of 477 patient encounters for unspecified chest pain, and 156 patients were subsequently admitted. There was a significant difference ($p = 0.010$) between Admission Delay times. There was no difference between Door to Doc ($p = 0.63$) and Admission Decision times ($p = 0.80$). September 2016 had the longest Admission Delay average at 132.6 minutes \pm 117.8 minutes. The ED LOS was not statistically significant ($p = 0.52$) between a total of 12, 14, or 15 different physicians staffed per month, respectively. The ED LOS was the longest at 6.2 hours \pm 2.7 hours ($p = 0.05$) in September. Specifically looking at September 12th through September 30th, 2016, there was no difference in ED LOS ($p = 0.48$) when the number of physicians staffed varied from a total of 4, 5, 6, 7, or 8.

Conclusion: EDIS data can be utilized to monitor and serve as a predictive model at the Phoenix VA ED to predict flow throughput. In this predictive model, we noticed that despite ED staffing implementations to increase staffing and obtaining midlevel providers, it did not result in decreased Door to Doc, Admission Decision, Admission Delay times and thus, did not decrease the LOS in the ED. This highlights that throughput through the ED is not a product of understaffing, but possibly related to other confounding variables such as, and not limited to, inadequate recognition of clinical conditions, lack of ancillary labs, imaging in timely manner, and inefficient inner and inter- handoffs. Further implementations to address above, can help predict, and fix ED overcrowding and making ED flow efficient.

Table of Contents

I.	INTRODUCTION	1
II.	METHODS	5
III.	RESULTS	8
IV.	DISCUSSION	18
V.	FUTURE DIRECTIONS	20
VI.	CONCLUSIONS.....	21
VII.	REFERENCES.....	22

List of Tables and Figures

Table 1 Trends in Outcome Measures for Unspecified Chest Pain Diagnoses from April 2016 to September 2016..... 9

Table 2 Unspecified Chest Pain Variables for April 2016 - September 2016 Compared to Number of Physicians..... 11

Figure 1 EDIS Adoption Metrics by Project Week. Approved for use by Colleen Gallogly. (Gallogly, 2015). 13

Table 3 Unspecified Chest Pain Outcome Variables in Comparison to Number of Physicians for September 12th-30th 2016..... 15

Figure 2 Mean Outcome Variables for all Patient Diagnoses presenting to the PVAHCS ED..... 17

I. Introduction

Emergency department overcrowding is a reality that exists within the healthcare system today and is an issue that has been consistently examined in previous research with the first article dating back over 25 years ago.¹ There have been multiple proposed solutions; however emergency department (ED) overcrowding is still an acute and very common problem.⁵ Sun et al. described that periods of high ED crowding are associated with increased inpatient mortality, ED LOS, and costs for admitted patients.¹⁸ Sion et al. also found that increased mortality among admitted critically ill patients is associated with ED crowding.¹⁷ In addition to association with poor quality of care, emergency department overcrowding is a significant patient safety concern since the demand for emergency services outweighs the available resources.⁵ In a systematic review, it was reported that the risk of 10-day inpatient mortality for patients admitted to the hospital via the emergency department during crowding periods was 34% higher.⁵

Even beyond patient outcomes, ED crowding has been speculated to impact medical behavior.^{4, 16} In a one year-long retrospective cohort study published in January 2018 based out of two EDs in Taiwan, there was a positive correlation between ED crowding and decision-making time and LOS within ED.⁷ Additionally, this study showed that with the increase of ED occupancy, the incidence of ED observation, general ward admission, and ICU admission increased, but were not related to mortality within the ED.⁷ The study concluded that “with less time to evaluate, manage, and instruct patients in a crowded ED, physicians tend to keep patients in the ED longer or just admit them to make sure that adverse outcomes do not occur.”⁷

In the United States, emergency department visits account for 11% of outpatient encounters, 28% of acute care visits, and 50% of hospital admissions.³ As a direct result, almost half of the emergency departments within the country report operating at or above capacity.² The issue of emergency department overcrowding also extends as a hospital wide problem due to the availability of inpatient beds. For example, 9 out of 10 hospitals report holding patients in the emergency department while they wait to be admitted.² Resultantly, Emergency Medical

Services are diverted from overcrowded emergency departments to other hospitals that otherwise may not have the necessary resources.²

In the healthcare setting, real-time monitoring has been a promotion of health information technology (health IT). In 2009, the Health Information Technology for Economic and Clinical Health (HITECH) Act was passed that ultimately promotes health IT to improve health care quality, safety, and efficiency.¹³ In the 2015 Federal Health IT Strategic Plan for 2015-2020, the fifth objective is aimed at research focused on how to implement health IT solutions to improve health care and health outcomes. (ONC, 2015). As such, the Institute of Medicine recommends that the within the future of emergency care, information technology should be used to assess patient flow in order to decrease emergency department overcrowding.¹⁰ Current software programs including Emergency Department Work Index (EDWIN), Real-time Emergency Analysis of Demand Indicators (READI), the National Emergency Department Overcrowding Scale (NEDOCS), the Emergency Department Crowding Scale (EDCS), and the Work Score, depict real-time ED overcrowding.¹⁴

The VHA specifically utilizes Emergency Department Integration Software (EDIS) that allows healthcare professionals to track and manage the flow of patient care. EDIS is a browser-based software that requires Windows Vista and can be viewed as a Display Board. In this view, EDIS is a PC-based version of the emergency department's main electronic whiteboard. EDIS includes basic information such as which patients are waiting and which patients are in a room. At the same time, EDIS also provides physician and nursing documentation, results retrieval, print-on-demand electronic prescribing solution, and modules of clinical decision support.¹⁵ Providers in the VA Phoenix Health Care system utilize EDIS and the Computerized Patient Record System (CPRS) to manage the emergency department flow in real-time. VHA policy requires ED Registered Nurses to use the Emergency Severity Index (ESI) to triage patients that present to the ED and are viewed in functionality sets of EDIS views.⁸ The ESI levels range from 1, to the lowest acuity of 5, and thereby indicate whether or not the triaged patients will require additional resources. Patients that are of high acuity, levels 1-3, require more extensive resources within the emergency department, therefore contributing to the disruption of workflow and overcrowding. Patients with unspecified chest pain are assigned an ESI Level 1 or

2 and therefore first evaluated by a medical doctor. Whereas ESI levels of 4-5 can be first evaluated by physician assistants.

The Veterans Health Administration (VHA) focuses on patient flow to promote efficiency and one of the measures utilized is a patient's length of stay (LOS) in the ED.⁸ In specific, the VHA's goal is that less than 10% of patients within the ED have a LOS greater than 6 hours. To achieve this goal, the VHA recommends that the rate of 2 patients per hour be used to determine physician ED staffing.⁸ In addition to this baseline rate, the VHA recommends that patient volumes and hourly visits must be monitored to determine the ideal staffing pattern throughout the day.⁸

In 2015, at the request of Congressman Timothy J. Walz, the VA Office of Inspector General Office of Healthcare Inspections conducted an inspection to assess the validity of allegations at the Phoenix VA Health Care System (VAHCS), Phoenix, AZ, concerning the Emergency Department (ED). The allegations consisted of the following: during a visit to Phoenix VACHS's ED in 2015, a patient experienced a greater than 6-hour length of stay (LOS), and many patients left the ED without being seen after waiting for 6 or more hours.⁹ As a result of this evaluation it was determined that an effective mechanism for the ED staff to quickly recognize, episodic, increased demand events, was not in place.⁹ In 2009, because of increasing ED demand, the Phoenix VAHCS was approved for a construction project including renovation of the pre-existing 24-bed ED by adding 9,333 square feet and renovation of the 13,000 square feet of existing space. In June of 2015 the ED patient flow dashboard was established, but no formal process was in place to address ED LOS. In August of 2015, there were 17.5 full-time equivalent (FTE) physicians, 2 FTE physician assistants, 44 FTE registered nurses for the PVAHCS ED. The ED Medical Director created shift provider coverage as allowed within the 80-hour week, or two week pay period, to cover patient care workload.⁹ At that time a final recommendation was made to design a team to review the Phoenix VAHCS ED processes and develop a plan to improve ED access and flow during times of increased demand.⁹

Real-time analysis supports clinical staff and hospital management that aim to improve ED performance, but are often faced with inadequate performance metrics. (Georgiou, 2013). To standardize monitoring performance, the VHA Directive establishes ED performance metric

goals (targets) and minimum standards (thresholds) on a fiscal year basis. In line with these pre-determined metrics, the outcomes examined within this study include the number of patients diagnosed with unspecified chest pain and the respective Door to Doc, Admission Decision, Admission Delay, ED LOS, and Inpatient LOS times. The reasoning behind specifically examining patients with unspecified chest pain was because it was one of the top 10 diagnoses made at the PVAHCS ED for the year of 2016 and is an acuity level only assigned to physician providers. More importantly, clinicians in the ED are tasked with immediate recognition of life threatening etiologies such as acute coronary syndrome. Results from the National Hospital Ambulatory Medical Survey (1999-2008) showed patients with chest pain were more likely to die, be admitted, or transferred to another facility.⁶

The reason for this study is to determine the impact increased physician staffing has on the flow of the Phoenix VA ED with regard to the described outcome measures. Therefore, examining if unspecified chest pain patients solely seen by physicians have improved flow within the ED. Additionally, EDIS data can be utilized to monitor and serve as a predictive model at the Phoenix VA ED to predict flow throughput including appropriate physician staffing as well as highlighting other areas for quality improvement interventions to prevent ED overcrowding.

II. Methods

Study Design

EDIS data from the PVAHCS was retrospectively collected from EMMT National Reporting Software from April 2016 to December 2016. The data contained the following outcome measurements: Door to Doc, Admission Decision, Admission Delay, ED LOS, and Inpatient LOS. Provider reports for full-time and fee based physician staffing in the ED were obtained for the year of 2016 and specifically in detail for September 12th, 2016 through September 30th, 2016 highlighting specific shift time slots. Fee based physicians are independent contracted part-time physicians.

Definitions

METRIC	DEFINITION
TIME IN	Patient Arrival
DOOR TO DOC	Time in minutes between patient arrival (Time In) and the first assignment of a Provider for all ED/UCC patients seen during the time period specified. ¹⁹
ADMISSION DECISION	Time in minutes between patient arrival (Time In) and a Provider decision to admit a patient signified by entry of an admission disposition (a disposition flagged "VA") in EDIS for patients admitted from the ED/UCC during the time period specified. The calculation does not include records with Admission Delay values <= 15 minutes to avoid inaccuracies caused by improper capture of patient disposition time or records with an instance of an ED Observation status. ¹⁹
ED LOS	Time for all EDIS visits measured from the Time In to the Time Out. Excludes only records "entered in error". (It does include patients with any status of ED Observation.) ¹⁹
ADMISSION DELAY	Time in minutes between Time Out and the time the patient's first admitting-disposition (a disposition flagged "VA") is assigned for patients admitted from the ED/UCC during the time period specified. The calculation does not include records with Admission Delay values <= 15 minutes to avoid inaccuracies caused by improper capture of patient disposition time or records with an instance of an ED Observation status. ¹⁹
INPATIENT LOS	Time in minutes for ED/UCC visits with an admission disposition (a disposition flagged "VA"). Measures from Time In until Time Out. ¹⁹

Subjects

Patients were de-identified and each observation, or patient interaction, was independent of one another. The information kept for each unique interaction included complaint, disposition, Door to Doc, Admission Decision time, Admission Delay time, ED LOS, ED diagnosis, Time In, and Inpatient LOS. Patients diagnosed with unspecified chest pain, an acuity level specific to physicians, were grouped separately from patients with all other diagnoses collectively for each respective analysis. Inclusion criteria consisted of receiving a patient diagnosis and admission to the hospital. Patients that did not meet the inclusion criteria of having a diagnosis and had Admission Delay measurements exceeding >60,000 for psychiatric unit admission were excluded from the data analysis.

Analytic Methods

Outcome measures were assessed using means, standard deviations for continuous variables and frequencies, proportions for categorical variables. Linear Regression was implemented to ascertain any trends in the outcomes from April until September. Chi-Squared analysis was used to ascertain trends in the number of physicians on service within the same time period. Finally, the Kruskal-Wallis Test was used to assess differences in the outcome measurements between categories of the number of physicians on service. All p-values were 2-sided and $p < 0.05$ was considered statistically significant. All data analyses were conducted using STATA version 14 (College Station, TX).

III. Results

Patient Encounters

From April 1st, 2016, to December 31st, 2016, the average number of patient encounters at the PVAHCS ED for all patients was 3,170 patients per month. There was a maximum of 3,380 patients for the month of December and a minimum of 3,014 patients for the month of July 2016. (Figure 2). From April 1st, 2016, to September 30th, 2016, a total of 18,787 patient encounters occurred at the PVAHCS ED. Out of these 18,787 patient encounters, there were a total of 477 individual encounters for unspecified chest pain. Out of these 477 patient encounters, a total of 156 individual encounters were subsequently admitted to telemetry, ICU, VA Ward, or psychiatry, respectively.

Outcomes

For the months of April 1st through September 30th there was no significant trends in the Door to Doc times for patients presenting to the PVAHCS ED with unspecified chest pain ($p = 0.63$). Similarly, there was no significant trend in Admission Decision times for patients presenting to the PVAHCS ED with unspecified chest pain across time ($p = 0.80$). However, there was a significant increase in Admission Delay times for patients presenting to the PVAHCS ED with unspecified chest pain ($p=0.01$). The Admission Delay time was the shortest for the month of April 2016 at an average of 75.8 ± 55.8 minutes. The Admission Delay time was the longest for the month of September 2016 at an average of 132.6 ± 117.8 minutes. (Table 1). Examining the month by month ED LOS, the increase in ED LOS trended towards statistical significance ($p = 0.053$). However, September 2016 had the longest ED LOS at an average of 6.2 hours with unspecified chest pain. For the months of April 1st through September 30th there was no statistical significant trend in Inpatient Length of Stay times for patients presenting to the PVAHCS ED with unspecified chest pain. (Table 1).

Variables (Number of Patients)	Overall N=156	April N=31	May N=27	June N=25	July N=17	August N=28	September N=28	P-value
Number of Doctors: n, (ratio physicians/patients admitted)	25 (16.0)	15 (9.6)	14 (8.9)	12 (7.6)	12 (7.6)	14 (8.9)	12 (7.6)	N/A
Door to Physician in minutes: mean, (%)	31.8 (41.8)	29.8 (45.4)	32.1 (39.0)	29.8 (57.7)	33.0 (34.7)	29.9 (24.8)	36.7 (44.3)	0.63
Admission Decision in minutes: mean, (SD)	219.8 (97.2)	225.4 (108.4)	212.8 (83.8)	228.0 (102.1)	187.6 (55.4)	213.4 (100.4)	238.8 (109.9)	0.80
Admission Delay in minutes: mean, (SD)	96.2 (79.3)	75.8 (55.8)	93.7 (64.4)	77.7 (60.9)	102.5 (81.7)	97.7 (73.1)	132.6 (117.8)	0.010
ED Length of Stay in hours: mean, (SD)	5.2 (2.0)	5.0 (1.9)	5.0 (1.5)	5.0 (1.8)	4.8 (1.6)	5.2 (2.1)	6.2 (2.7)	0.053
Inpatient Length of Stay in hours: mean, (SD)	57.8 (99.9)	81.9 (188.4)	56.0 (43.9)	58.2 (65.6)	31.7 (17.7)	37.5 (22.8)	68.4 (99.7)	0.34

P-values calculated using Chi2 for categorical variables and simple linear regression for continuous variables.

Table 1 Trends in Outcome Measures for Unspecified Chest Pain Diagnoses from April 2016 to September 2016

Physician Provider Variation

The number of physicians varied from 12 to 15 FTE over the 6-month study period. As seen in Table 1, September had the longest ED LOS for patients with unspecified chest pain and also had the lowest number of physicians at 12 total for the month. (Table 2). When examining the monthly average of physicians as seen in Table 2 below, there was no significant difference in the Door to Doc ($p = 0.53$), Admission Decision ($p = 0.81$), Admission Delay ($p = 0.53$), Inpatient LOS ($p = 0.30$) and ED LOS time ($p = 0.52$). With 12 physicians monthly, the Door to Doc time was an average of 33.3 minutes \pm 47.1 minutes. The Door to Doc average time decreased to 31.0 minutes \pm 32.3 minutes when there were 14 physicians per month and subsequently decreased to 29.8 minutes \pm 45.4 minutes with a total of 15 physicians. Additionally, the ED LOS decreased from 5.4 hours \pm 2.3 hours with 12 physicians, to 5.1 hours \pm 1.8 hours with 14 physicians, and finally to 5.0 hours \pm 1.9 hours with 15 physicians. The final average to decrease with increasing number of physicians was the Admission Delay. The Admission Delay decreased from 105.7 minutes \pm 94.1 minutes with 12 physicians, to 95.7 minutes \pm 68.4 minutes with 14 physicians, and finally to 75.8 minutes \pm 55.7 minutes with 15 physicians.

Variables	12 Physicians	14 Physicians	15 Physicians	P-Value
Door to Physician in minutes: mean, (%)	33.3 (47.1)	31.0 (32.3)	29.8 (45.4)	0.53
Admission Decision in minutes: mean, (SD)	222.5 (97.4)	213.1 (91.8)	225.4 (108.4)	0.81
Admission Delay in minutes: mean, (SD)	105.7 (94.1)	95.7 (68.4)	75.8 (55.7)	0.53
ED Length of Stay in hours: mean, (SD)	5.4 (2.3)	5.1 (1.8)	5.0 (1.9)	0.52
Inpatient Length of Stay in hours: mean, (SD)	55.9 (5.3)	46.6 (35.7)	81.9 (188.4)	0.30

P-values calculated using Kruskal-Wallis

Table 2 Unspecified Chest Pain Variables for April 2016 - September 2016 Compared to Number of Physicians

EDIS Adoption Metrics

A specific subset of data from September 2016 was pulled and analyzed separately secondary to implementation of EDIS Adoption Metrics, a project analyzed by Colleen Gallogly MSN, RN, regarding the reliability of EDIS data on a weekly basis beginning in March 21st.¹¹ (Figure 1). Including retraining and ensuring that EDIS metrics were input correctly by various ED personnel including registered nurses and physicians. By Week 25, ending with September 11th, the provider entry assignment, provider entry disposition, and correct admission disposition were at goal, which was 90% reliable.¹¹ (Figure 1).

EDIS Adoption Metrics by Project Week

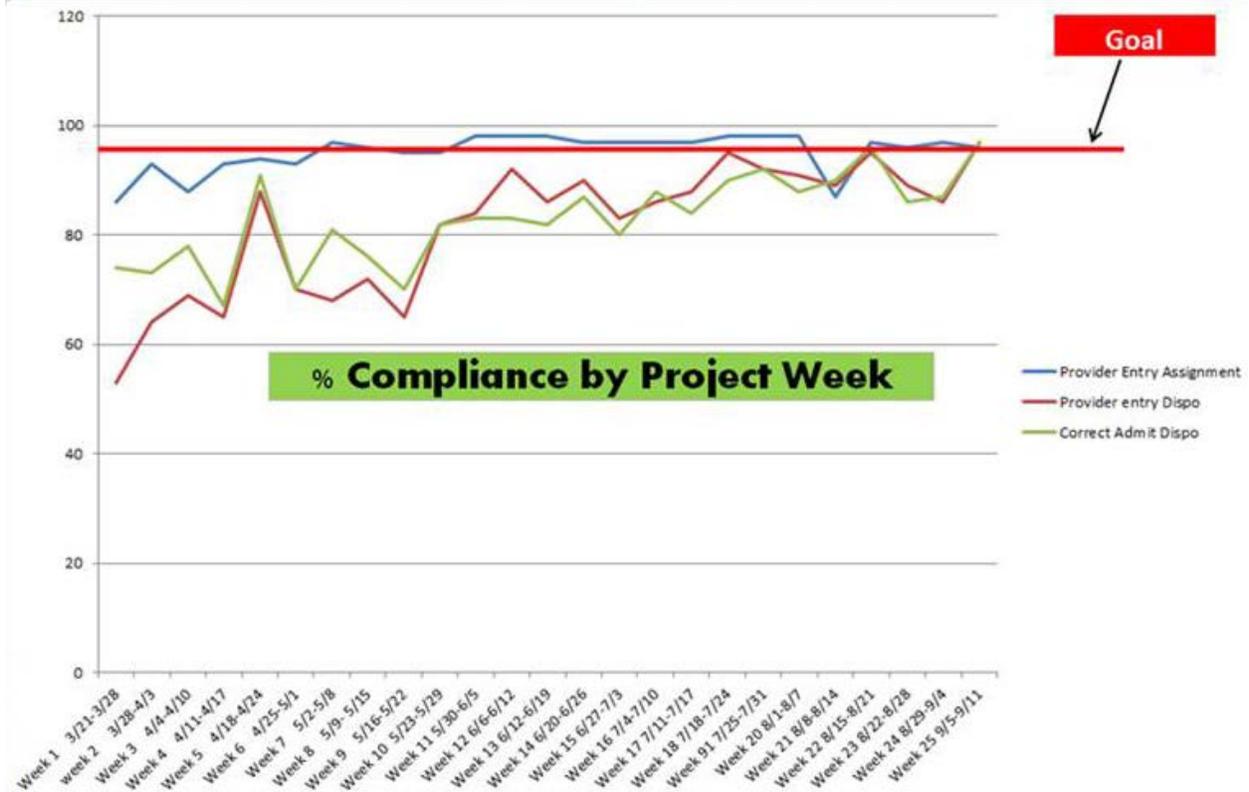


Figure 1 EDIS Adoption Metrics by Project Week. Approved for use by Colleen Gallogly.¹¹

Using reliable data that met the goal of 90% reliability, the physician shift schedule for September 12th through September 30th 2016, led to the creation of Table 3. During this time period, there were a total of 2,130 unique patient encounters at the PVAHCS. Out of these 2,130 interactions, there were 50 encounters of unspecified chest pain. From these 50 interactions, 31 unique unspecified chest pain interactions were subsequently admitted to either Telemetry or the VA Ward. The number of full-time and fee-based physicians ranged from 4, 5, 6, 7, and 8 staffed for the entire 24-hr day at various shifts.

There was no statistical significance determine between the Door to Doc ($p = 0.11$), Admission Decision ($p = 0.13$), Admission Delay ($p = 0.11$), and ED LOS time ($p = 0.43$). (Table 3). There did appear to be a statistical difference for the Inpatient LOS, however this was a population of 1 patient for 7 and 8 physicians staffed, respectively ($p = 0.009$). (Table 3).

Variables	Overall	# of Docs 4	5	6	7	8	P-value ¹
Door to Doc in minutes: (median, IQR)	26 (10, 59)	16 (6, 6, 31)	56 (16, 126)	12.5 (9, 17)	23 (10, 59)	45.5 (25, 61.5)	0.11
Admission Decision in minutes: (median, IQR)	181 (145, 295)	166 (95, 179)	295 (223, 339)	182 (131, 273)	176 (176, 176)*	181 (181, 181)*	0.13
Admission Delay in minutes: (median, IQR)	101 (67, 166)	160 (133, 266)	94 (56, 122)	66.5 (33, 108)	430 (430, 430)*	69 (69, 69) *	0.11
ED Length of Stay in hours: (median, IQR)	4 (3, 5)	4 (3, 6)	4 (4, 8)	4.5 (4, 5)	3 (1, 5)	4.5 (4, 5)	0.48
In Patient Length of Stay in hours: (median, IQR)	36.5 (25, 46)	25 (20, 28)	61.5 (45, 185)	43 (35.5, 69.5)	15 (15, 15) *	20 (20, 20) *	0.009
Whether Patient was Admitted							0.093
Yes	31 (62.0)	5 (45.5)	11 (61.1)	2 (33.3)	10 (90.9)	3 (75.0)	
No	19 (38.0)	6 (54.6)	7 (38.9)	4 (66.7)	1 (9.1)	1 (25.0)	

¹P-Values calculated using Kruskal-Wallis for continuous variables and Fisher's Exact for categorical variables. * Denotes a Sample Size of 1 patient.

Table 3 Unspecified Chest Pain Outcome Variables in Comparison to Number of Physicians for September 12th-30th 2016

Outcome Variables for all Patients of PVAHCS ED

The following figure, Figure 2, depicts the mean outcome variables for all patients presenting to the PVAHCS ED regardless of chief complaint from April 2016 to December 2016. Overlying the Door to Doc line, the total number of patients presenting to the PVAHCS ED are represented. The maximum number of patients were seen in December at 3380 and the minimum in June at 3083, with an average of 3,170 per month. The overall trend for ED LOS appears to decrease overall, outside of the month of May and September at an average of 176 minutes. The months of June and September had changes increased Admission Decision and Inpatient LOS.

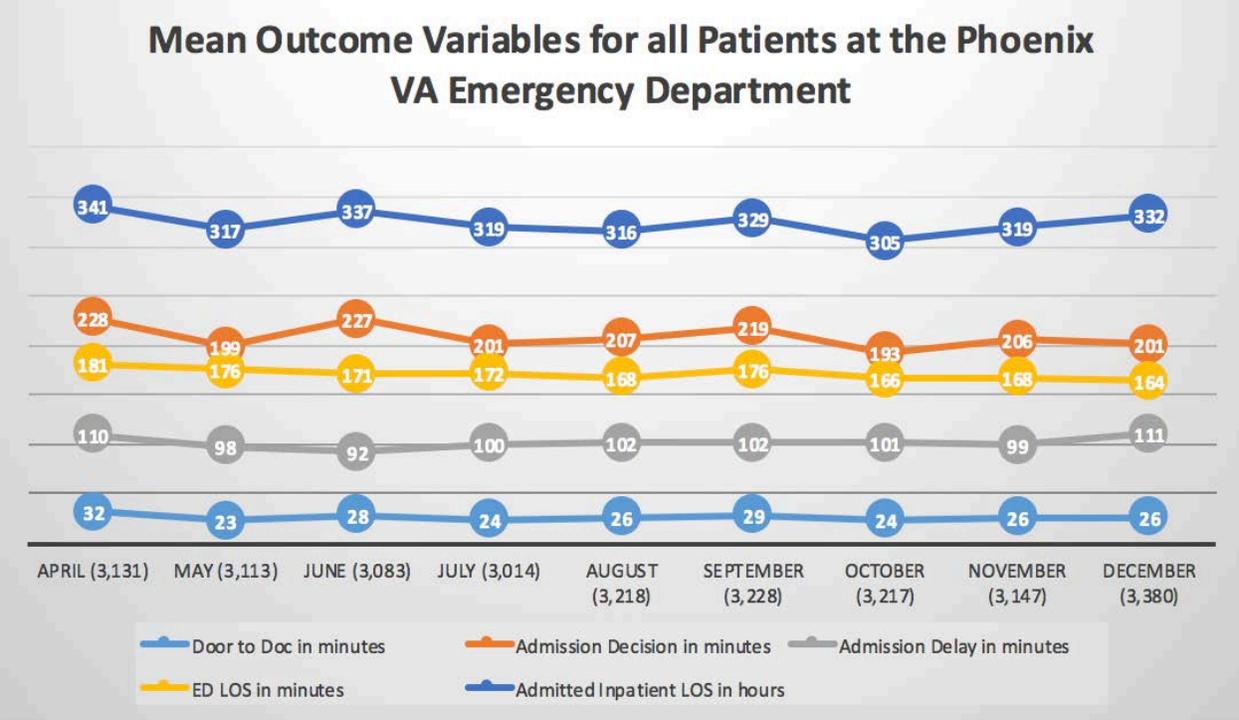


Figure 2 Mean Outcome Variables for all Patient Diagnoses presenting to the PVAHCS ED

IV. Discussion

Overall, PVAHCS ED flow in terms of Door to Doc, Admission Decision, Admission Delay, and ED LOS times from April 2016 through September 2016 in patient encounters with unspecified chest pain were found to be statistically insignificant when compared to the respective month as well as increased physician staffing. By this predictive model, it was recognized that despite ED staffing implementations to increase physician staffing and obtaining midlevel providers, it did not decrease the ED LOS.

As a result of the initial visit made to the PVAHCS ED in 2015 regarding an issue with ED LOS, the full-time physician equivalent increased from 17.5 to 20 FTE's. Over the period of April 2016 to September 2016, two physicians left the department and a total of three were hired, for new total of 21 FTE's. A major limitation of this retrospective review included the inability to obtain average daily provider hours. Emergency Medicine provider hours are uploaded through EM Share Point. The EM Share Point data is then transferred to EDIS to be calculated as provider RVUs. Instead, the uploaded provider hours into EM Share Point were added as planned coverage hours and not the actual physician coverage hours utilized on a monthly basis. This is due in part to staffing variability on a day to day and even month to month basis.

At the same time, the previous 2 PA FTE were increased to a total of 5 FTE's for the 2016 year. For the months of April to September, the average amount of low acuity patients overall seen by PA's was 47.18%.

In terms of the impact from nursing staffing, during the timeline April through September 2016, the nursing coverage hours remained constant at 189 hours per day over the 6-month study period. Additionally, these coverage hours continued through to December 2016.

Specific to the month of September, having had the longest average ED LOS for individual encounters for unspecified chest pain, the average low acuity, or ESI level of 4-5, percentage for that month was 47.66%, similar to the average of 6 months. Therefore, low acuity patients, which do not include patients presenting with unspecified chest pain, are seen generally by a PA. Even with the increased staffing and addition of physician assistant FTE to a

total of 5 as compared to a total of 2 since March of 2013, there was no a significant change found in the outcome measures impacting PVAHCS ED flow.

The retrospective method of data collection within this study to analyze physician staffing did not capture the real-time capability of EDIS. The retrospective review of data metrics compared to patient diagnoses provides the foundation for planned physician coverage, however it does not depict the real-time fluctuations within the ED that EDIS is capable of recording. Projections of metrics and planned physician coverage serves as a starting point for accurate coverage, but needs to have further expansion into daily, or weekly monitoring to plan actual coverage. Additional metrics to incorporate within the methods would include hospital occupancy including ICU beds and ward availability. Moreover, examining unspecified chest pain patients selects a certain subset of presenting chief complaints and can be extended to include more patient diagnoses to have a broader sense of ED flow and capacity as well as greater hospital-wide availability.

With the implementation of an ED information system and computerized provider order entry, such as EDIS, a reduction in medication errors, laboratory and imaging turnaround times, and timing of disposition decisions, should inherently be improved.¹² These results highlight that throughput through the PVAHCS ED is not a product of understaffing, but possibly rather related to other confounding variables, such as, but not limited to inadequate recognition of clinical conditions, lack of ancillary labs, imaging in a timely manner, availability of hospital beds, and inefficient inner and inter- handoffs. Further implementations to address above, can help predict, and fix PVAHCS ED overcrowding and making ED flow efficient while preserving patient safety.

V. Future Directions

Given the major limitation of this retrospective study, the future ability to collect the average daily provider hours within the PVAHCS ED would provide a more accurate representation of provider coverage versus total number of providers per month. To undertake this direction, EM Share Point should be updated on a monthly basis to reflect the actual physician coverage hours rather than the original planned.

VI. Conclusions

With the implementation of an ED information system and computerized provider order entry, such as EDIS, a reduction in medication errors, laboratory and imaging turnaround times, and timing of disposition decisions, should inherently be improved.¹² These results highlight that throughput through the PVAHCS ED is not a product of understaffing, but rather related to other confounding variables, such as, but not limited to inadequate recognition of clinical conditions, lack of ancillary labs, imaging in a timely manner, availability of hospital beds, and inefficient inner and inter- handoffs. Further implementations to address above, can help predict, and fix PVAHCS ED overcrowding and making ED flow efficient while preserving patient safety.

“Measurement is the first step that leads to control and eventually to improvement. If you can’t measure something, you can’t understand it, you can’t control it. If you can’t control it, you can’t improve it.”

-H. James Harrington

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