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Improving BNP turn around times in ED

Ajitha Philip

USF

Abstract

Heart failure (HF) is one of the most common conditions in the United States. Cases of HF has immensely contributed to the number of patients visiting the emergency departments (ED) in healthcare facilities throughout the United States. Patient experience is impacted by several aspects, which includes the length of stay (LOS) and quality of care outcomes. Literature shows that a delay in turn around times (Ekelund, 2014) in laboratory tests affects efficiency and other parameters of quality of healthcare. This project has been completed with the objective of identifying areas in clinical process that can be optimized to keep Betanatriuretic peptide (BNP) test results under a TAT of 60 minutes. Studies done by Hutchinson , 2017 showed SOB or dyspnea as a common presenting symptoms in the ED.

The problem presented in this case is that the TAT for patients with undifferentiated dyspnea is higher, especially for those possibly suffering from HF and COPD. It is crucial to make an accurate diagnosis, which is why the time taken to confirm the problem in many cases is long. The specific description of interventions that would be made to the process includes: To reduce the number of hours taken to complete the lab results, to reduce the time it takes to upload results on the EMR database, and to shorten the time taken to complete the radiological tests. Methods employed included observation of TAT before and after intervention.

The project featured several stakeholders in the internal and external environment that made up the project team. The project focuses on patients that reported to the ED with chief complaints of shortness of breath (SOB) as the primary basis for conductive comprehensive diagnosis.

Findings of the project are vitals towards limiting costs and expenses tied to the ED, reducing the LOS and, improving care outcomes for patients diagnosed with acute congestive heart failure and thus reducing morbidity levels

Abbreviations

ED- Emergency Department

SOB- Shortness of breath- undifferentiated dyspnea

HF- heart failure

COPD- chronic obstructive pulmonary disease

BNP- Beta-natriuretic-peptide

TAT- turnaround time

ECG- electrocardiography

CHF- Congestive heart failure

LOS- Length of Stay

Introduction

In the US, about 3.7 million patients of the 136 million annual visits to the ED complain of dyspnea or shortness of breath (Zanobetti et al., 2017). This means that dyspnea accounts for nearly 3% of the total ED visits. According to a recent study, it was found that 22% of the patients in the ED with shortness of breath had a cardiac problem (Keijzers, Kelly, Cullen *et al.,* 2017). These patients had heart failure as a common cause. As a result, these patients require rapid diagnosis for improved health outcomes such as quick recovery, reduced length of stay at the hospital, and reduced mortality rates.

The ED is, most of the time, one of the first encounters that patients have with hospital environment. Hence the emergency department experience poses a unique opportunity to ensure that the patient experience begins with a productive and positive experience. Patient experience is an essential measure of the quality and efficiency of the care that is offered to a particular patient in a given health facility. According to Ekelund (2014), CHF is one of the leading causes of mortality in the United States. It is approximated that close to five million Americans in the United Stated suffer from the disease, and in each year, an approximated half a million new cases are identified. HF attracts high costs of long term care and including initial cost of treatment and admissions in hospitals. The condition is also one of the most common diseases among patients above 65 years of age (Cowie, 2014). HF remains a severe condition to diagnose, mainly due to the lack of sensitive and particular presenting symptoms that can be used in the process of diagnosis. The risk of misdiagnosis in the ED is very high and, promote the likelihood of increased morbidity and, increased chances of mortality in a dyspnea patient. Efficiency in the provision of health, or rather the provision of quality healthcare, depends on numerous factors which include; reductions of the total test error (accuracy & precision), cost, relevance,

availability and timeliness. Relative to quality and cost, echocardiography is perhaps the fastest and efficient diagnosis of HF in patients that are presenting with complaints of SOB/Dyspnea, Echocardiography is, generally not available in the ED settings, and its usage only attracts high costs towards the management of HF (Ekelund, 2014). Hence there has been an urgent need for an approach through which patients that are at risk for developing HF can be detected and further leading to the establishment of timely therapy to avoid irreversible changes that potentially lead to chronic HF.

The ED of Adventist Health, Glendale sees an average of 200 patients on a daily basis. Majority of the inpatient admission (75%) are through our ED. Our ED data shows almost 70% of these patients visit the ED with a chief complaint of SOB. This can be further classified to panic attacks, anxiety, SOB associated to asthma exacerbation. Data collected for the month of January 2019, showed 45 % of these patients above the age of 50 presented with underlying cardiovascular condition which was undiagnosed and, these patients presented to the ED with a chief complaint of SOB/ dyspnea. Early identification, management of symptoms, throughput and improvement of patient satisfaction including length of stay (LOS) are the key drivers that account for our ED metrics. Improving the throughput and management of inpatient admission data was primarily dependent on the laboratory TAT, hence improving the TAT on BNP was significant for our ED.

Problem Description

The problem presented in this case is that the TAT for patients with possible dyspnea is higher. This time needs to be shortened in order to fast track the diagnosis and treatment options. It is crucial to make an accurate diagnosis, which is why the time taken to confirm the problem in many cases is long. The number of tests and exams administered on the patient with

undifferentiated dyspnea along with the logistics is to ensure everything is accurate. Accuracy of results and diagnosis can reduce patient mortality, increase functional capacity, reduce healing time, and shorten the length of stay at the hospital (Nazerian et al., 2014). Rapid diagnosis, on the other hand, can be a lifesaver for most patients in the ED with the condition. The rapid diagnosis can also allow for creation of a treatment plan even faster. Therefore, it is crucial to create a plan that intervenes and delivers both accuracy and time savings.

The use of BNP measurement to ED patient presenting with SOB has arguably improved the process of diagnosis and prognosis among clinicians. The need for diagnostic tools in HF has been evident for the last few years. Cowie (2014) reports that inaccurate emergency diagnosis of acute respiratory failure, especially among elderly patients, has increased by at least twenty percent in the last few years. Due to misdiagnosis and missed diagnosis, there has been an associated increase in the mortalities hence, an increase in the dire need for diagnostic tools that are highly specific and sensitive, and can be quickly accessed in a busy environment such as an ED. In our ED we admit an average of 37-41 patients on a daily basis fifty percent of these patients are admitted with an admitting diagnosis of CHF exacerbation and, new onset acute CHF. These patients generally end up waiting in the ED with worsening symptoms due to mis management of the cardiovascular status (hypotension) with additional crystalloid fluids, instead of diuretics. HF is a life threatening disease and is a growing public health concern (Kato,2014). Majority of these patients symptoms of SOB are relieved with non invasive therapy such as continuous positive airway pressure (CPAP). Positive airway pressure (PAP) therapy represents a potentially beneficial non-pharmacological approach to the management of HF. PAP has several effects on the hemodynamics of the patient. First it diminishes systemic venous return and right ventricular (RV) preload by increasing intrathoracic pressure (Guyton & Pinsky,

1984). Secondly, PAP alters pulmonary vascular resistance (PVR), which is the major determinant of RV afterload. This significantly improves the patients symptoms of SOB, but on the other hand drops the blood pressure (hypotension). Although crystalloid fluids is the first choice of treatment for hypotension, it has a detrimental affect on patients who have CHF.

Data collected on our inpatient admitted patients with an admitting diagnosis of CHF exacerbation, showed increased length of stay and mortality due to delay and inappropriate management of patients cardiovascular status with crystalloid fluids instead of non invasive therapy and diuretics. Hence improving the TAT on BNP was significant for our clinicians and patients.

The food and drug authority (FDA) has approved the use of BNP in the year 2000, to be used in the evaluation of different types of dyspnea and acute decompensated heart failure (ADHF) that present difficulties in differentiation. The potential for the use of BNP's to establish clinical judgment in patients with SOB has been appreciated and documented by studies in the United States and Europe. By aiding to confirm and possibly rule out a diagnosis of HF, BNP results have helped to inform the clinical team and facilitate the decision making. The project facilitates the use of BNP as the primary method of testing for HF, hence increasing patient experience.

Available knowledge

BNP

Also described as the Brain-Type Natriuretic Peptide, it is a hormone that is produced by the heart. A B-Type Natriuretic Peptide (BNP) test is a measure of the amount of hormone that is found in the blood. In ideal conditions, very low to low levels of BNP can be found in the blood. However, if the activities of the heart, such as an experience of heart failure, the heart will

produce BNP (Lamberta 2016). In HF the level of BNP in the blood will increase, hence it is an ideal measure of heart failure. A decline in the amount of BNP indicates that heart failure has been successfully reversed upon treatment.

BNP and NT-pro BNP tests were developed a decade ago as a measure of HF. Numerous studies indicate that delayed diagnosis of CHF can lead to an increased rate of mortality. The use of patient history and physical examination has not sufficiently been reliable in the past in ruling out or ruling in CHF. The use of BNP has shown a positive effect in the diagnosis of CHF in patients that are only presenting shortness of breath. Meisel et al. (2012) indicated that BNP can significantly reduce the uncertainty surrounding the evaluation of dyspnea. However, there is little or contradicting evidence on its impact on the discharge and other outcomes. There is speculation that TAT spent in BNP testing greatly influence the clinical outcomes of the patients. The use of B-type Natriuretic Peptide (BNP) measurement to triage patients that are presenting with SOB has arguably improved the process of diagnosis and prognosis among clinicians. The need for diagnostic tools in heart failure has been evident for the last few years. Cowie (2014) reports that inaccurate emergency diagnosis for acute respiratory failure, especially among elderly patients, has shown to have increased by at least 20% in the last few years. Due to miss diagnosis and missed diagnoses, there has been an associated increase in the mortalities hence an increase in the dire need for diagnostic tools that are highly specific and sensitive and can be quickly accessed in a busy environment characterized by an ED.

PICO Question

The **patient** group understudy will be all patients presenting o the ED with shortness of breath or undifferentiated dyspnea. According to a recent study in Europe, it was found that 22% of the patients in the ED with SOB had a cardiac problem (Keijzers, Kelly, Cullen *set al.,* 2017). A

majority of these patients had heart failure as a common cause. These patients require rapid diagnosis for better treatment.

The main **intervention** that will be implemented is to reduce the TAT for patients with undifferentiated dyspnea in the ED by collecting an additional lavender tube to improve the TAT for BNP results. The **outcome** of the information is to confirm that a patient's health problem is dependent on laboratory tests and radiological diagnostics. Typically, these take at least 24 hours for them to be available on the electronic medical records. While in many areas this is standard, it might present a challenge if a patient continues to showcase symptoms without a proper cause of action for long. Therefore, the ED must employ rapid procedures by changing the process workflow and other activities to improve the time.

The diagnosis of undifferentiated dyspnea in the ED requires BNP tests and radiological tests such as those of chest X-rays. There is no alternative intervention for the diagnosis to compare with this procedure. It is important to make improvements in the amount of time taken to complete it.

TAT

In line with accuracy, precision, and reliability of medical tests, the time spent to conduct and present laboratory test, also described as turnaround time, is one of the most critical indicators of laboratory quality and the quality of time offered in the laboratory. Laboratory turnaround time is a very important measure of performance by a certain laboratory. Hence, the faster the turnaround time, the faster the clinicians can rely on the information provided to make a decision and subsequently develop a plan to mitigate the underlying patient problem, concludes Marmor (2018). There are different views on what turnaround time is, and that can affect how it is pursued in the objective to attain the quicker provision of healthcare services. For instance,

clinicians tend to view turnaround time as the time between when the test request is made to the lab and the time that the results are presented to them (Ekelund 2014). On the other hand, technicians tend to view this period as the period between the time from which the samples are received for testing in the lab to the time that the results are reported.

Inspection of the existing literature indicates that there are a variety of approaches that are used in the definition of TAT. Hawkins (2017) writes that one of the most important considerations in the ED environment is defining and determining each component of TAT. Using different measures to describe and to define TAT contributes to the complication of comparison for a measure of the most efficient time. Based on an intra-laboratory approach, TAT can include: sample receipt time, registration time, analytical sampling time, results in verification time, transfer of results into electronic records time, and report printing time. A simple classification for TAT that has been used to define and classify errors identifies three main steps; pre-analytical, analytical, and post-analytical. Respectively, each of them represents; order to preparation, analysis, and reporting of the analysis of the data that had been obtained. Lundberg developed the Brain TAT, a nine-step series of the lab testing cycle. They include ordering, collection, identification, transportation, preparation, analysis, reporting, interpretation, and action.

Effect of Turn around times on Clinical Outcomes

With more than 140 million patients in the United States entering the clinical environment through EDs in one-year, long waits, overcrowding is a major healthcare quality concern in the country. Long lengths of stay (LOS) have profound effects on the patients and the patient family members (Lamberta 2016). For instance, long LOS are attributed to the realization of rather avoidable medical errors, increasing costs of treatment, and increasing probability of negative

patient outcomes hence higher rates of mortality. Long LOS in the ED has also been shown to affect the facilities and service providers, which include limited availability of space despite increasing demand. In retrospect, several studies link LOS outcomes in EDs to TAT time in the labs and subsequent procedures.

Kaushik et al. (2018) completed a study to determine the effects of reducing lab TAT on the LOS in the emergency department, by basing their study on analysis of Electronic Health Records (EHR). The study framework relied on several variables, including race, hospital bed size, Rapid Emergency Score, and overall test counts. The study established that there was a correlation between a LOS and TAT, especially among patients that had been admitted to EDs and discharged to their home upon receiving treatment. Particularly, the study indicated that a 0.50 reduction in LOS in the ED was experienced with every one-minute reduction in lab TAT. Hence, a reduction in TAT can have profound effects on hospital LOS.

The impact of TAT on clinical outcomes on a global scale is rather a controversial relationship. There are assumptions among practitioners and other stakeholders that, the more time spent on testing rigorously, will result in a more efficient and effective treatment. There are also numerous conclusions throughout literature showing that performing TAT in the most rapid ways saves on cost and time. Shiferaw & Yismaw (2019) argue that a faster TAT does not automatically translate to improved patient outcomes. Studies performed in the United States regarding the reduction of the TAT time of microbial procedure contradicted with similar studies performed in Europe with reference to the experienced clinical outcomes.

Marmor (2018) explores decentralized testing has one of the approaches that has been pursued by clinicians, to reduce the time spent on TAT and thus promoting general efficiency, as well as to reduce the costs of the function. Thus, decentralized testing as an alternative to reducing TAT

has received a lot of attention in the literature and studies. Theoretically, it has been argued and presented that decentralized testing can promote quicker decision making and increase the length of stay. Decision models have also suggested that the use of decentralized testing to complete a blood gas analysis could lead to positive economic outcomes, improve the detection of avoidable clinical outcomes. On the other hand, real-life studies have challenged the notion associated with TAT that, the fast the procedure, the better. Kaushik et al. (2018) analyzed the use of decentralized testing while performing an experimental Sodium, Glucose, Urea, Potassium, and Chlorine testing. The study showed that there was no reduction in ED LOS. There was only a difference of 8 minutes between the controls and the experiments conducted? The TAT effects on LOS outcomes and the general quality of the care experience are indeed dependent on numerous other factors.

At the ED of Adventist Health Glendale, ED metric, throughput , patient satisfaction, and quality of care are dependent on the TAT of laboratory test and radiology findings. CHF patients being 50 % of the ED admissions needed much attention and focus to improve the overall length of stay and management of these symptoms in urgent settings. Hence the TAT of BNP and improving on collection process by adding an additional lavender tube to the blood draw on patients with presenting symptoms of SOB for patients age above 50 plays a pivotal role.

Rationale

According to Lancellotti et al. (2015), many patients with shortness of breath experience heart failure, and the rest have a host of significant issues such as respiratory problems. Shortness of breath at the ED presents challenges to the medical team, especially when it is referred to as undifferentiated dyspnea. Rapid decisions must be made on how to help the patient, but most are dependent on identifying the root cause of the problem.

The conceptual model implemented is the PDSA cycle that was used to plan and execute the intervention as shown in Appendix 6.1. The PDSA model stands for Plan, Do, Study, Act. In the first phase that is plan, there was an initial multidisciplinary meeting of the staff involved in the intervention to ensure that every aspect has been planned for. After the planning phase, the next phase was the do, which involved carrying out the pilot program that has been agreed upon. The patients were observed for three weeks. The study phase in the cycle involved looking at the results and analyzing their outcomes. The recorded results were tabulated and formed into a graph in order to ensure that the pattern is observed. The act phase involves deciding whether the results realized should be implemented or not.

Specific Project Aim

The specific project aim is to reduce the turnaround time (TAT) for patients with undifferentiated dyspnea presenting in the ED at Adventist Health Glendale in order to improve patients' outcomes. The faster the identification of the problem, the easier it will be to recommend treatment for the patients and this can increase the chances of survival. The project has an ambitious objective of reducing TAT from 2.5 hours to an hour. As per data collected from our lab, the delay was attributed to lack of additional lavender tube specimen in patients with orders for BNP, secondly the test was ordered as an add on after almost 45-60 minutes of patients arrival in ED, delaying the TAT of BNP.

Methods

It was agreed in our ED metrics meeting with the physician group, ED leadership team, respiratory therapy team, radiology and laboratory team to add an additional lavender tube specimen collection to patients presenting to ED with a severity index of 3 or below and with a presenting complaints of SOB. The physicians group had agreed to order and initiate the SOB

protocol which included the BNP testing instead of an add on to improve the TAT of results. The ED leadership group and physicians group was able to approve of the project and allow the implementation of the pilot phase in order to observe whether the recommended intervention would have the desired and expected TAT.

IHI Assessment of Culture

An IHI cultural assessment was perfumed to determine the readiness of the internal cultural environment for the completion of the study. The assessment mainly focused on safety culture, as described in IHI (2019). The IHI cultural assessment determined that the internal environment had deployed enough measures to ensure patient safety, particularly those suspected of heart failure and those admitted in the emergency department. There was, however, a need to increase safety consideration by offering further training to the project team by identifying possible sources of safety issues and mitigation measures to be deployed in the course of the project. The need to reduce TAT was also apparent.

SWOT Analysis

The SWOT analysis will be for analyzing the strengths of the diagnosis process and, to identify areas of improvement. The strength of the BNP testing + radiology process at the ED is that it allows time for accuracy and confirmation of the problem. As has been mentioned, accuracy of results is important for the patient and the hospital. The BNP process also has the strengths of allowing for additional lavender tops to be collected. Another strength demonstrated includes a high level of collaboration and commitment towards the changes from normal operations of the project.

However, the weakness of ED is that it is also time-sensitive, and the faster the results, the better the outcomes. Barriers to change from senior team of nurses are also some of the associated

weakness. Longer TAT correlates to more time taken to diagnose patients, which could lead to a higher rate of complication and even mortality. An opportunity at the ED when diagnosing heart failure can be to identify areas that need improvement and making changes to the microsystem and flow of process. Working in teams and leaders approving and implementing the changes can have significant results. Another opportunity includes streamlining service delivery of the staff and identifying possible sources of redundancy that may be attributed to delays.

Threats to the ED are that the reduction of TAT leads to a decrease in efficiency and accuracy of results. Care should be taken to make sure that the improvement of TAT does not reduce quality and accuracy of results or the efficiency established by the current microsystem. Weaknesses and threats also include high costs of completing the project, and the unwillingness of the staff to undertake in the change as a result of perceiving the project as an increase in their scope of function.

Return of Investment Plan

A return on investment (ROI) plan is necessary to determine the efficiency of the project to realize the benefits of improved healthcare quality and patient experience outcomes as a result of monetary and non-monetary investment towards the project, notes Bukhari *et al.* (2017). Hence, there are two primary aspects of the ROI plan. The first aspect is the cost of investment in completing the project. This includes the cost of facilitating the project stakeholder and offering general administration services in the course of the project time. The second aspect is the benefits of the projects. Benefits are measured relative to a reduction in TAT. It is assumed that a decrease in TAT increases the overall efficiency of the ED, reduces costs of ED services, and reduces the LOS.

At the Adventist Health Glendale, data collected showed that blood draw from a venipuncture is routinely done on every patient that is registered in the ED with a severity index of 3 or below. Drawing an additional lavender tube at the same time of initial blood draw collection would not incur any additional cost for the patient. The cost of an additional tube which is stocked in ED as a bulk supply was just 60 cents according to the lab. This when compared to the improvement in TAT, LOS and patient satisfaction was much higher to the negligible initial cost associated to the additional lavender tube draw.

Microsystem Assessment

The current time it takes to properly diagnose acute dyspnea could take up to 24 hours. According to Lancellotti et al. (2011), it is crucial to make an accurate diagnosis, which is why the time taken to confirm the problem in many cases is long. The number of tests and exams administered on the patient with undifferentiated dyspnea along with the logistics is to ensure everything is accurate. Accuracy of results and diagnosis can reduce patient mortality, increase functional capacity, reduce healing time, and shorten the length of stay at the hospital (Prosen et al., 2011). Rapid diagnosis, on the other hand, can be a lifesaver for most patients in the ED with the condition. The rapid diagnosis can also allow for creation of a treatment plan even faster. Therefore, it is crucial to create a plan that intervenes and delivers both accuracy and time savings.

The current tests to confirm HF and other issues presenting from shortness of breath take long because they include several procedures such as the laboratory tests using BNP and radiological tests from chest X-rays, ECG, and chest radiography. On top of these, a history examination and physical examination are also administered to establish a pattern and get accurate information.

Intervention

The intervention was to reduce TAT for the described group of patients. TAT, in this case, was defined as the time that passed between the start of the first laboratory test that begins with drawing blood from the patient to when the medical records are available electronically. The team followed the time it took patients to complete the tests and have their results available while recording observations at each point. In each segment, points of improvement were identified and new suggestions offered to drastically reduce the time.

The current conditions indicate that currently it takes up to 2.5 hours to get most of the results posted on their electronic medical records, This significantly delays the decision making and management of the critically ill patients waiting in ED, The clinicians depend on these results before clinically treating them with crystalloid fluids for dehydration, antibiotics for elevated WBC or suspected source of infection. The multidisciplinary team identified the causes for the prolonged TAT, and using a fishbone diagram implemented an intervention plan to reduce the time to under an hour.

The specific description of changes that would be made to the process includes:

1. To reduce the number of hours taken to complete the lab results
2. To reduce the time, it takes to upload results on the EMR database
3. To shorten the time taken to complete the radiological tests

In order to reduce the TAT, some key changes have to be made along the process of measuring and confirming HF. The changes can only be made in controllable areas of the process by the multidisciplinary team formed (Appendix 6.5). The identified areas with the most need to change came from improving the time that will be taken to complete the lab results. The improvement of the time, in this case, is dependent on the laboratory equipment, the patient information, as well as the laboratory staff. The intervention process aimed at reducing the number of registration

points that the patients have to register. When the patient arrives at the ED, they are required to provide information, the goal is to reduce redundancy. By identifying patients with shortness of breath, placing the order at the time of assessment instead of an add on lab order and simultaneously drawing an additional lavender along with the other routine blood draw tubes with the intravenous start. We are eliminating the process of redundancy with blood draw. This can assist with eliminating the wait time by the chemistry lab as the second lavender tube can be utilized to process the BNP test thus improving the TAT of BNP.

Educating and onboarding the laboratory staff in this process has provided them with a task to look for an additional lavender tube on patients with BNP tests and call the ED in the event their was an delay or an additional lavender tube not provided. This was noted in the metrics along with the time the sample was received to account for the delay in TAT.

Staff distractions could come even in the smallest areas such as receiving other information or specimen to test. In order to reduce these interruptions, a lab attendant who is already working on a specimen should not be distracted such that they will have to put aside or postpone the process unless there is an emergency. This could imply having more than one staff member a time at the laboratory. The lab is busy because there is always a myriad of processes ongoing. This involves receiving information, uploading results, and compiling reports, receiving samples, and of course preparing and working on samples among other things. The staff at the laboratory also relies on working equipment as well as the availability of the respective equipment, specimen, reagents, and other tools in a timely manner. The availability of specific equipment to measure BNP at the lab such as lavender top tubes should be a priority. The staff should make sure that the equipment is stocked and in working condition.

The next objective to improve during the intervention would be to enhance the time it takes to get the records on the EMR. This process also depends on how the staff works to finish the results as well as move to uploading. Unfortunately, one of the factors increasing TAT is the delay in uploading results to the EMR. Without the lab results, the radiology department cannot proceed with the procedure. Therefore, the lab results should be uploaded to the EMR as soon as the results of an individual are completed. Most of the observation indicated that the results are not uploaded immediately to the EMR because sometimes the staff is shorthanded, distracted, or decides to stack the results for later uploads. The reports have to be completed immediately and uploaded as soon as the lab tests are ready. It is possible to finish the lab results in half an hour, and thus within that time, they should be available for the radiology process to begin.

The third intervention to reduce the amount of time that the radiological tests take in order to have an accurate confirmation of whether the patient has serious problems like HF and COPD, or it is other aspects. The proposed method for improving the results of the outcome at this stage is the use of a multi organ point of care ultrasonography (USG) to differentiate the patients with shortness of breath in the ED into their respective diagnostic categories. The recommendation for this intervention is critical to cut the time short based on many issues that could be related to the radiology department. The USG tool is one that is portable and can be handheld, meaning that it has multiple advantages over other radiological tools that are less portable and require them to be located at certain points. The hand-held USG devices save time for the patient to move to the radiology department, as it can be administered within the ED as soon as the lab tests are available. In some hospitals, the radiology departments are not on site, and thus patients have to make an appointment in another institution. The USG handheld tool to categorize patients with shortness of breath into their specific diagnostic areas can be used in areas that are remote or

resource deficient. It is less expensive as well. In terms of accuracy, empirical results from researchers such as Guttikonda & Vadapalli (2018) have confirmed with 88% accuracy of results that the USG can be used to discern patients carefully with HF, COPD, and other diagnostics. The ability to utilize the tool in limited-resource settings while saving time because the tool can be used in the ED is time-saving and improves the outcomes of patients by providing accurate and time-saving diagnostics.

Study of Intervention

The conceptual model implemented is the PDSA cycle that was used to plan and execute the intervention. The PDSA model stands for Plan, Do, Study, Act, as shown in Appendix 6.1. The intervention process described above depended on the success of the cycle in order to ensure that every phase has been covered. In the first phase that is plan, there was an initial multidisciplinary meeting of the staff involved in the intervention to ensure that every aspect has been planned for. The staff met once a week to talk about the progress of the intervention. During the first meetings, preparations were made on how the process would take place. There were certain tools agreed upon for proper communication, which involved secure messaging applications to protect the confidentiality of the process. There was also an agreement to the roles and responsibilities, such as tracking the patient TAT time. The schedules were communicated through the messaging board designated in one of the rooms to ensure that everyone was up to speed.

After the planning phase, the next phase was the do, which involved carrying out the pilot program that has been agreed upon. The patients were observed for three weeks before intervention to gauge how much time they took in the process. The outcomes of the process presented a unique vantage point to compare with the results after the intervention. The team practiced for the intervention by making preparations and changes as mentioned. This included

creating a central registration point, ensuring the laboratory staff working on a test is not distracted, as well as making sure the lab inventory is fully stocked and functioning. The USG tools were also made available and rechecked for proper functioning before beginning the process. The intervention process lasted for three weeks where the patients presenting in the ED with shortness of breath were diagnosed under the new measure.

The study phase in the cycle involved looking at the results and analyzing their outcomes. The recorded results were tabulated and formed into a graph to ensure that the pattern is observed. The study phase involves deciding whether the intervention reached its goals, and if the resources implemented were necessary. The act phase involves deciding whether the results realized should be implemented or not. It is important to consider the costs, timing, and need for the implementation. Successful projects are more likely to be considered for adoption

Measures

The measures will look at the process of knowing whether the intervention worked. Two measures were used, one of which was the TAT before the intervention, and the other was the TAT after intervention (Appendix 6.2). The time each patient took was recorded to complete the process before the intervention was recorded for the first twenty 25 patients in order to have an understanding of how the process worked and what were the main areas of delay. In the second group of 25 patients where TAT was measured after implementation of the intervention, similar procedures were followed in recording.

The first phase of the project measured the current practices, which was done through observation. Twenty-five patients were observed during the first phase to determine the average time it took to complete the process and results were recorded in a table. Patients observed were

those with weekday appointments only. The problems preventing a faster TAT were recorded along with the times the appropriate interventions set up.

The second phase involved implementing the interventions. The multidisciplinary team agreed to work together to try a pilot study, and the next 25 patients were observed. The TAT was also recorded for the new group of 25 patients. The results are presented in the results section. The reasons why the patients were delayed are an important measuring strategy to consider. For each patient delay, the reasons were recorded and then presented in a graph to show the cumulative as well as individual change in each (Appendix 6.3).

Institute of Healthcare Family of Measures

For this project, three aspects have been used as the family of measures; outcomes, process measure, and balancing measures, as obtained from IHI (2019). The outcome for this project is a reduction of TAT at below 60 minutes. TAT is measured as the difference between the time of requesting for BNP tests by the physicians and the time of receiving the results of the test. The process measure in the project includes the number of patients assessed, evaluated, and duly discharged from the ED in the course of conducting the project. Balancing measures include the difference in the volume of patients that are admitted, complications in diagnosis, and other comorbidities that may affect patient outcomes like LOS.

Ethical Considerations

The project is to feature patients that have presented signs of SOB. Hence, patient information, which includes personal information, will be collected as it is essential in determining the effects of the planned intervention. Several ethical issues have been considered. One of the issues is consent. It is deemed necessary that the patients are informed of the objectives of the project before any information or relevant data is collected from them, as described in Muthuswamy

(2013). Subsequently, patients are expected to sign a consent form. It is paramount to the project to maintain high levels of privacy. Hence, any information that can be directly linked or used to identify a particular patient cannot be collected, suggest Yip, Han, and Sng (2016). Information collected will be stored appropriately and will only be utilized to complete this study and project. The principle of beneficence is a moral obligation to act for the benefit of the patients. At Adventist Health, Glendale , the goal of our ED leadership team is to look for innovative ways to improve our patient satisfaction and provide quality of care with the available resources. Adventist Health, Glendale ED team work on the principle of non maleficence of not to harm any patients and be fair in its course of treatment to its patients regardless of their race, ethnicity, financial ability. Preventing readmissions and exacerbation of CHF symptoms has been the cornerstone for the initiation of this project in ED.

IV Results

Problems causing increased TAT

The fishbone diagram (Appendix) shows the observations in the number and types of problems that increased TAT. The highlighted parts in gray indicate the areas that can be changed through the intervention strategy. For specific analysis of the number of patients delayed by each reason, the charts below explained.

Reasons for TAT patient delays

The reasons for the most number of delays were related to the process. One of them was the multiple places that patients had to register as well as move to different areas for tests. The laboratory and radiology departments are in different areas, and this called for movements and appointments. The delays in uploading the report due to other reasons within the lab such as distraction were also an issue identified for change. (Appendix 4.2).

TAT Observations

The results (appendix 4.3) show the data presentation of the before and after the intervention. Before the intervention, the average time for the patients to get their full diagnostics from shortness of breath was 24.2 hours, while the time after the intervention was 1.9 hours. This shows that the objective of the intervention was attained and that it is possible to drastically reduce TAT while maintaining quality and accuracy of results. By changing the tools and processes on the microsystem, the ED can be significantly improved for patients with dyspnea. The graph above shows comparison for all the patients.

The graph (Appendix 4.3) differentiates on a side by side basis the results of the baseline TAT pre-intervention and the TAT post-implementation. Given the success of the pilot intervention, it would be highly recommended that the interventions are considered as permanent implementations.

V Discussion

Summary

Some of the important metrics in performance improvement in healthcare provision include laboratory TAT and patient wait time, as has thus far been demonstrated. The objective is to enhance patient experience by providing quality healthcare services, and since this paper focuses on patients experiencing shortness of breath, one of the commonest causes of visits to the ED, understanding the ways that TAT can be reduced is a key component to the roadmap of achieving quality healthcare. It was clear that the patients took too long to go through the process of lab testing and obtaining test results, and this included the time it took to complete radiological tests and the time taken to upload results to the EMR database.

The key findings in this project included the determination that the TAT for COPD and HF constituted key steps or tests that needed to be done, and they included BNP (lab test), ECG, physical test, and family history. Therefore, since the aim was to reduce the TAT of BNP, focusing on improving efficiency on each of the aspects above was key. The contribution to a longer TAT, in general, involved machines, processes, people, materials, the environment, and measurement, and focusing on these aspects, particularly by improving the efficiency of drawing an additional lavender tube on patients above the age od 50 with chief complaint of SOB, and getting the physicians to order the BNP test along with the rest of the diagnostics instead of an add on test, was key to reducing TAT.

Some of the other important issues identified were associated with the delays in uploading lab reports to the EMR, BNP lab equipment, multiple information registration points, different tests in different areas, distracted staff, radiology unable to proceed without lab results, late patient arrivals, and radiography location among others. These aspects are all connected, and the ultimate effect is an elongated TAT. The intervention, thus, focused on these key areas. The PDSA cycle, as pointed out, is used in trialing a change, assessing its impact, often on a small scale. The objective is to determine whether or not the proposed change or intervention leads to improvement.

It took up to 24 hours for the results to be posted on the electronic medical records, and it is only after these results have been posted that the physician will be able to come to conclusions and recommend the appropriate treatments. The aim was to improve TAT of BNP from 2.5 hours to 1 hour in ED, and the specific changes or interventions that were put in place included reducing the number of hours taken to complete the lab results, reducing the time it takes to upload results on the EMR database and to shorten the time taken to complete the radiological tests.

TAT of BNP was reduced from 2.5 hours to 75 minutes as per data obtained in November, 2019, so the objectives were achieved, or simply, the intervention worked. By ensuring that issues such as multiple information points and different tests in different areas have been addressed by centralization of these processes, and ensuring that staff have the motivation to stay focused and can handle a task at a time, partly by improving accountability and supervision and partly by ensuring that there are sufficient human resources in every department. The intervention, therefore, focused on the factors identified in the fishbone diagram to reduce the overall TAT.

PDSA cycle essentially focuses on developing a framework that develops, tests, and implements changes that lead to an improvement on a smaller scale. The intervention proposed met the set goals of the pilot project, which was a further demonstration of the power and impact of changing the workflow in a healthcare setting. Changing or improving the workflow in subsets or sections of an entire system could have a significant impact on the overall TAT or wait times. This is largely achieved by increasing throughput and efficiency.

One of the most important lessons is how important reducing TAT is, not just to the patients, but also to the ED and the hospital in general. One of the clear impacts of the intervention was to improve the quality of care provided to these patients who were critical and promote their throughput to inpatient setting, preventing rebound of these patients and reducing overcrowding in the ED. The overcrowding was previously associated with a high rate of patient inflow, and perhaps, strained resources. However, it was clear that the department generally lacked efficiency, and a longer TAT was largely responsible for the long queues and overcrowding. The effect on patient satisfaction and patient experience also exceeded expectations. Patients were willing to express their exuberance at how fast and efficient they have been served and treated.

Aside from providing quality services, reducing TAT by implementing this intervention was an important healthcare as well as a business strategy.

The results showed that by using the resources that the institution already had, patient experience and satisfaction could be enhanced. The costs to the ED also went down significantly because of reduced wait times, and the ability to serve more patients in a relatively shorter period. Therefore, it was largely about efficiency and not more resources. With efficient workflow system, for example, centralizing some aspects such as information points and laboratory tests, a significant amount of time could be saved, and the time taken to upload the information to the EMR also shortened considerably.

The second lesson learned from this project is that an intervention might not work if some sections of the organizational workflow or team fail to do their part as efficiently as they should. It was discovered that the improvement of outcomes for the patients is a multifaceted process and one that is interconnected and interdependent with different parts of the organization. For example, the lab team had to do their work as efficiently as they could, and the transmission of information and records also required to be done without any avoidable delays. Staff in different areas needed to ensure they are focused on their tasks to minimize time wastage, and that information passed to the next department or section had to be comprehensive and clear. The PDSA cycle that showed the most notable impact on TAT was incorporating a centralized system that ensured that the unnecessary multiple information registration points have been eliminated and that most tests were done at the same place as opposed to different areas.

The most important area that was identified to be contributing to a longer TAT was the process of laboratory testing and posting of results. The registration process was also long, and unnecessarily so, with multiple information registration points. With the upsides and downsides

of centralization and centralization of information systems in mind as pointed out by Vitek et al. (2019), this project focused on ensuring that lab tests that could be done in the same area were done in one area, rather than being done in different areas then consolidating the information. This is because the process of consolidating information or records from the same place is much easier compared to when the information is coming from different places. The intervention, therefore, proposed that lab experts coordinate and find a workable way of harmonizing and speeding up their testing process, which led to the reduction of the time taken to obtain lab results and reports.

Registration points were also centralized. Patients had to go to multiple information points to register, and this wasted a lot of time, and as such, had an overall impact of increasing the TAT. The registration department changed their central location to hand held devices and ready to register patients as they walk into the ED. Centralizing information points meant that the patients only required visiting one point, where all their registration is recorded and updated into the system.

It was noted that since confirming CHF will require BNP (lab test), ECG, physical test, and family history, different sections will be dependent on others before proceeding. For example, carrying out a BNP lab test is key before radiology is done and so forth. Staff had to wait for results from the lab, and in the process of waiting, they were distracted with other minor tasks, and in some cases, their preoccupations as they waited for lab results. To address this problem, this intervention ensured that there were sufficient human resources in the radiology department and that each of the members of staff stays alert and committed to executing their duties as urgently as is required. This was key to the successful change.

However, there were other issues that this intervention could not solve. Issues such as surge of patients in ED both walk in and brought in by paramedics could also contribute to an increased TAT, but the scope of this intervention does not address the problem of multiple critical patients with SOB coming in at the same time. Nevertheless, the aforementioned interventions ensured that there were minimal delays in uploading information in the EMR, and the physicians received information in time to make conclusions and recommendations.

The intervention was largely successful in achieving the set objectives. The main aim of the project was to reduce the TAT of BNP for patients with undifferentiated dyspnea presenting in the ED in order to improve patient outcomes. In other words, the problem that the project focused on is that the TAT for patients with possible dyspnea is generally high, and needs to be shortened in order to fast track the diagnosis and treatment options. It has also been reiterated that making an accurate diagnosis is crucial, which is perhaps, why the time taken to confirm the problem in many cases is long.

Using the PDSA cycle to test whether or not the intervention was successful revealed that using this particular intervention could reduce TAT from 2.5 hours to 1 hour. This supersedes expectations. It is also a lesson that making the workflow efficient is fundamental in reducing costs in the ED and enhancing patient experience. Ultimately, reducing TAT leads to better healthcare outcomes. It was established that a lot of time was wasted because of multiple information registration points and carrying out lab tests in different areas, tests that could be done in one area. Centralizing these aspects, as the project establishes, saves a significant amount of time, and the time taken to upload the information to the EMR also shortened considerably.

Conclusion

The emergency department is one of the first encounters that patients have with the hospital environment, especially when a patient has problems such as shortness of breath. Therefore, the emergency department is in a unique position to ensure that the patient experience begins with a productive and positive experience. This includes all the interactions a patent makes in the recovery process. The provision quality healthcare is dependent on reduction of the total test error (accuracy and precision), cost, relevance, availability, and timeliness. This project focused on how TAT can be reduced as an important measure to improve patient outcomes and patient experience.

The pilot intervention was very successful, not just in terms of reducing TAT, but also in terms of improving patient experience and overall satisfaction. The cost implications were also positive, especially to the ED. This means that this intervention should be implemented in the entire hospital since its benefits are not only limited to reducing TAT. The fact that it achieved the objectives set and beyond is sufficient justification that it is an intervention that should fully be implemented.

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EVIDENCE BASED CHANGE OF PRACTICE PROJECT

STUDENT NAME: AJITHA PHILIP

DATE: 9/23/19

SUPERVISING FACILITY; ADVENTIST HEALTH, GLENDALE

Instructions: Answer Yes or No to each of the following statement

PROJECT; IMPROVING BNP TAT IN ED	**YES**	**NO**
The aim of the project is to improve the process or delivery of care with established/ accepted standards, or to implement evidence-based change. There is no intention of using the data for research purposes	**YES**	
The specific aim is to improve performance on a specific service or program and **is a part of usual care**. ALL participants will receive standard of care.	**YES**	
The project is **NOT** designed to follow a research design, e.g., hypothesis testing or group comparison, randomization, control groups, prospective comparison groups, cross-sectional, case control). The project does **NOT** follow a protocol that overrides clinical decision-making.	**YES**	
The project involves implementation of established and tested quality standards and/or systematic monitoring, assessment or evaluation of the organization to ensure that existing quality standards are being met. The project does **NOT** develop paradigms or untested methods or new untested standards.	**YES**	
The project involves implementation of care practices and interventions that are consensus-based or evidence-based. The project does **NOT** seek to test an intervention that is beyond current science and experience	**YES**	
The project is conducted by staff where the project will take place and involves staff who are working at an agency that has an agreement with USF SONHP.	**YES**	
The project has **NO** funding from federal agencies or research-focused	**YES**	

organizations and is not receiving funding for implementation research.		
The agency or clinical practice unit agrees that this is a project that will be implemented to improve the process or delivery of care, i.e., **not** a personal research project that is dependent upon the voluntary participation of colleagues, students and/ or patients.	**YES**	
If there is an intent to, or possibility of publishing your work, you and supervising faculty and the agency oversight committee are comfortable with the following statement in your methods section: *"This project was undertaken as an Evidence- based change of practice project at X hospital or agency and as such was not formally supervised by the Institutional Review Board."*	**YES**	

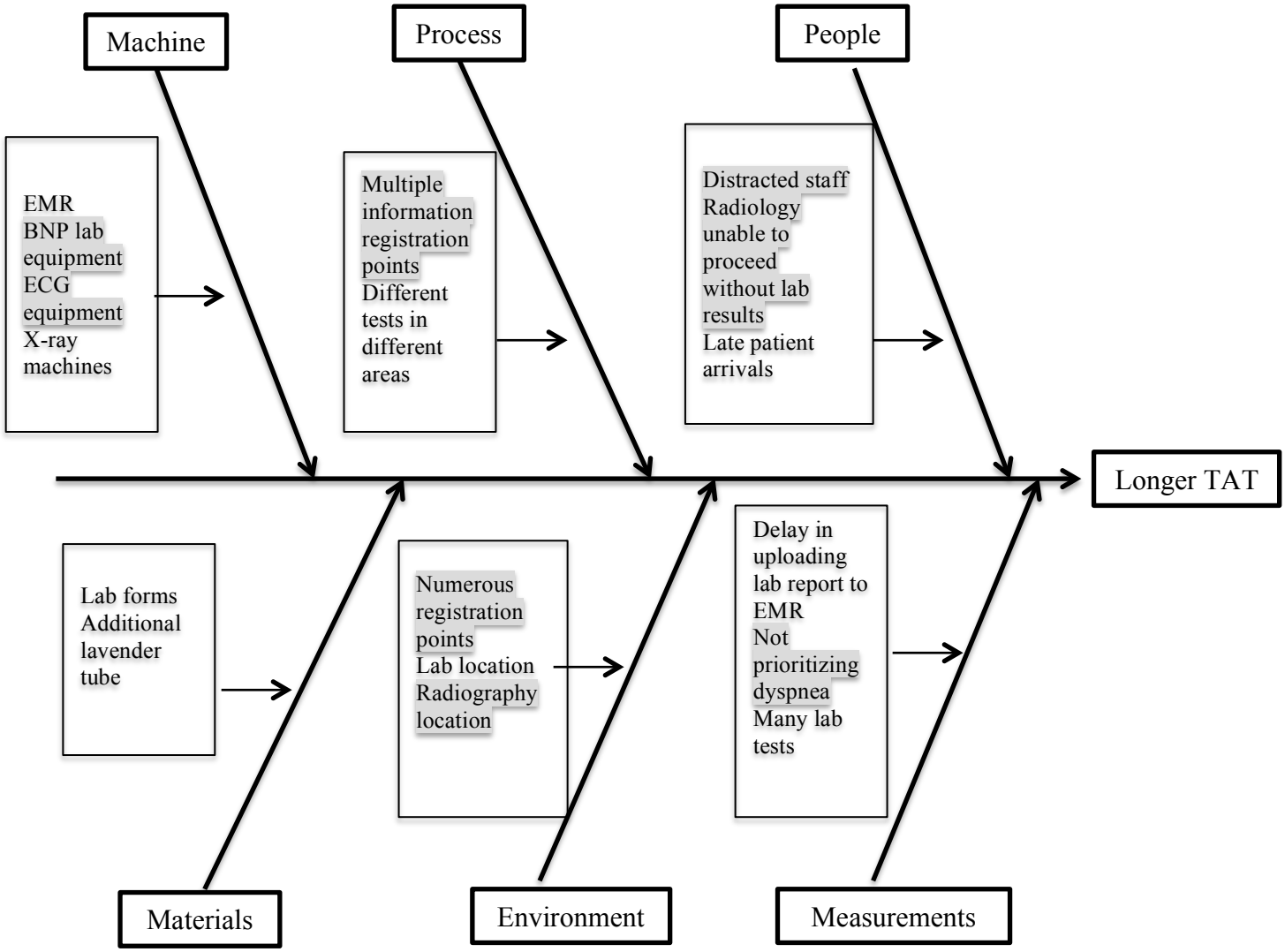
ANSWER KEY: If the answer to **ALL** of these items is yes, the project can be considered an Evidence-based activity that does NOT meet the definition of research. IRB review is not required. Keep a copy of this checklist in your files. If the answer to ANY of these questions is **NO**, you must submit for IRB approval.

Adapted with permission of Elizabeth L. Hohmann, MD, Director and Chair, Partners Human Research Committee, Partners Health System, Boston, MA.

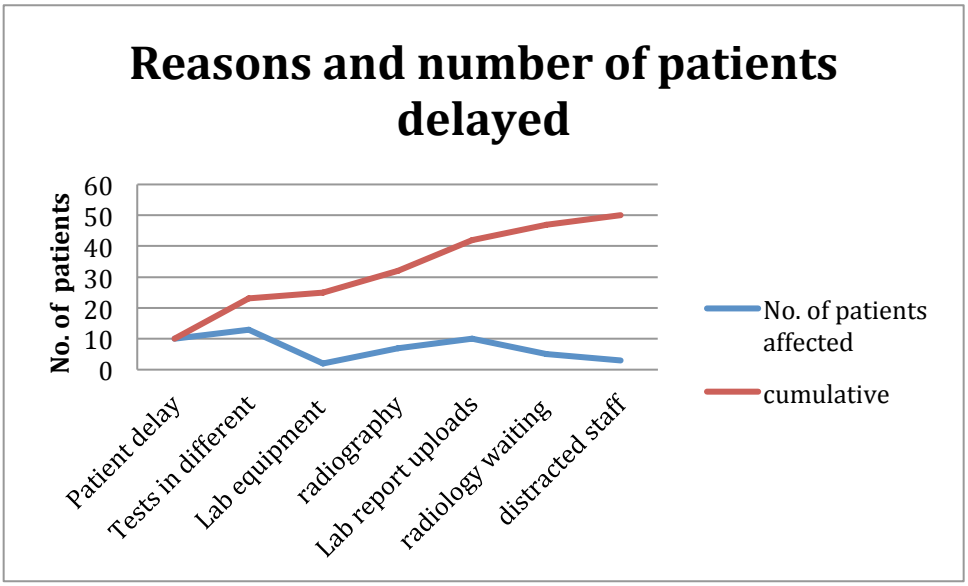
APPENDIX

Appendix 4.1 Problems causing increased TAT

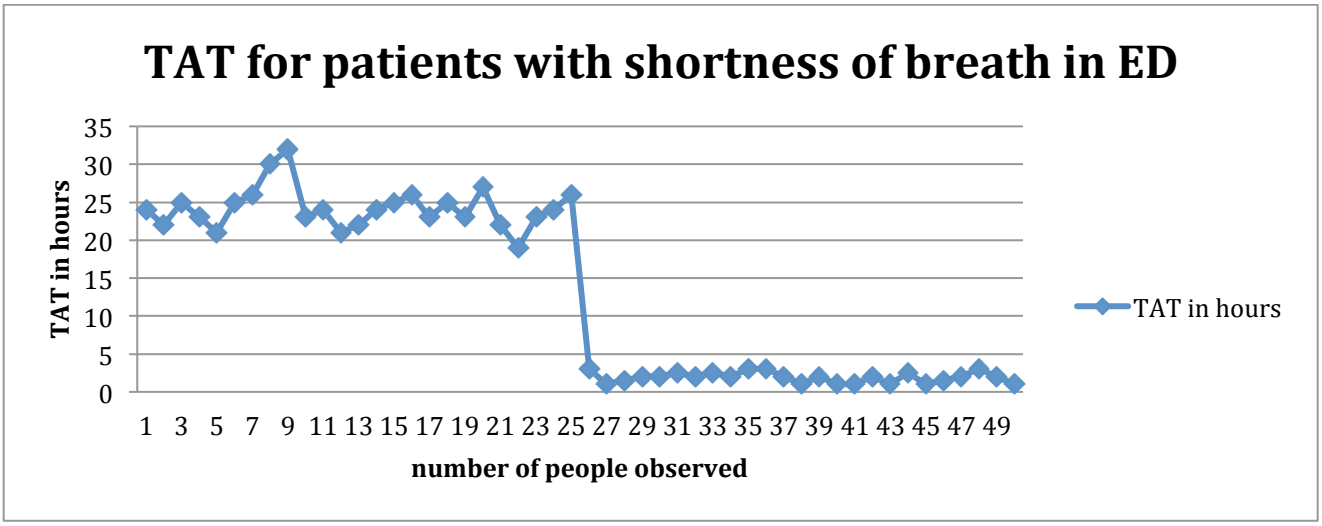
Fish bone diagram



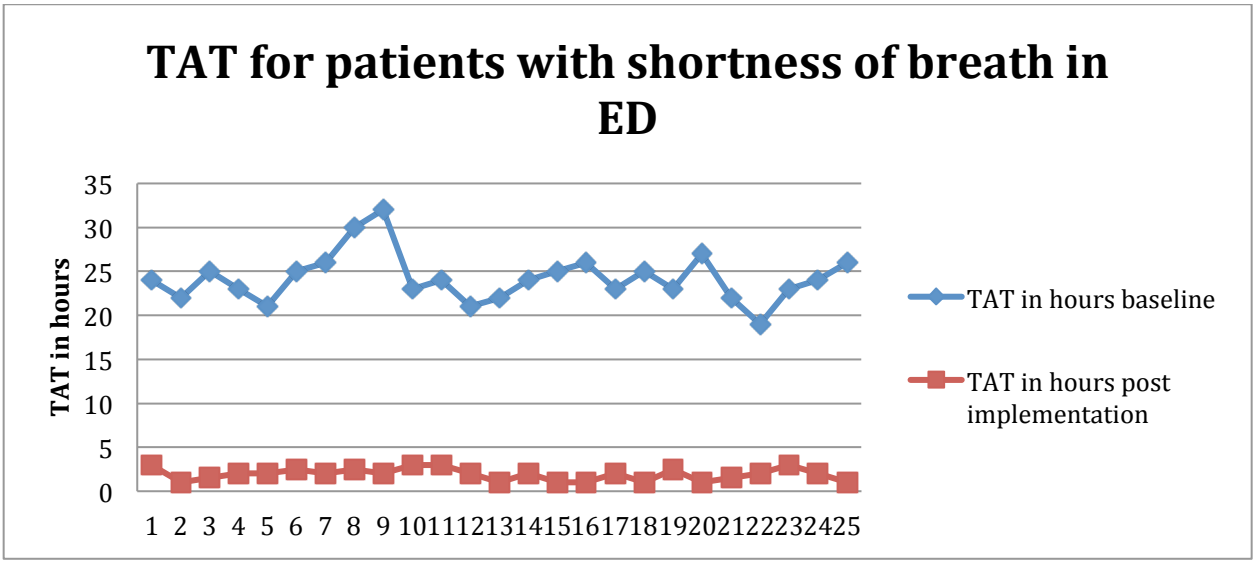
Appendix 4.2 Reasons for TAT for patient delays



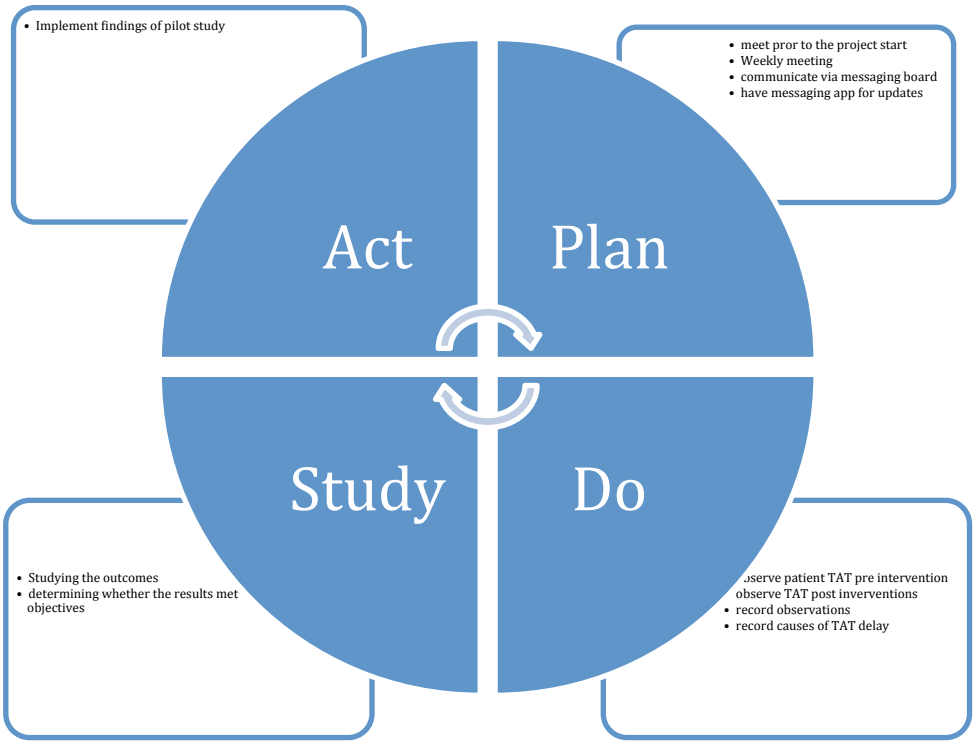
Appendix 4.3 TAT observations



Appendix 4.3


TAT for patients with shortness of breath in ED
TAT in hours
35
30
25
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
TAT in hours baseline
TAT in hours post implementation

PDSA CYCLE (APPENDIX 6.1)



TAT of Patients with Shortness of Breath (Appendix 6.2)

PATIENT	TAT IN HOURS BASELINE	TAT IN HOURS POST-IMP
1	3	1.5
2	2.5	2.5
3	3	1.5
4	3	1.3
5	2	1.25
6	2.5	1.2
7	2.5	1.25
8	2.5	1.1
9	2	1.15
10	2.5	1.2
11	2.5	1.1
12	3	1.1
13	2	1.15
14	2	1.1
15	2	1.2
16	2.5	1.1
17	3	1.2
18	2.5	1.1

19	**2**	**1.2**
20	**2.5**	**1.2**
21	**3**	**1.1**
22	**2.5**	**1.1**
23	**2**	**1.1**
24	**2.5**	**1.1**
AVERAGE	**2.5**	**1.1**

Number of Patients Delayed by Each Reason (Appendix 6.2)

Reasons and number of patients delayed							
Reason	**patient delay**	**Tests in different areas**	**Lab equipment**	**Radiography location**	**Lab report uploads**	**Radiology waiting**	**Distracted staff**
Number of patients affected	**10**	**13**	**2**	**7**	**10**	**5**	**3**
cumulative	**10**	**23**	**25**	**32**	**42**	**47**	**50**

Cost Benefit Analysis (Appendix 6.3)

The cost of the pilot study will not be high, given that the study will be short, and all the observations will be done during week hours when all the staff is in session. The study will be done for three weeks total and will include a multidisciplinary team, as been indicated in the next appendix. The cost will be in the form of time used to record and observe the patient TAT, which will be part of the routine work. The benefits of the study are expected to be in the form of improving efficiency for the ED when conducting diagnostics for patients with undifferentiated dyspnea. The patients will have faster results that are still accurate, which will enable doctors to start treatment options as early as the same day of reporting to the ED within 30 minutes of all diagnostics resulted

Team (Appendix 6.4)

Team Members	Sponsors
Doctors on duty	**Hospital Administrator**
Charge Nurse	**Quality Indicator**
Nursing Staff	
Lab tech	
Radiology tech	
Registration Associate	

Driver Diagram (Appendix 6.5)