Clinical Biochemistry 48 (2015) 308–312

Contents lists available at ScienceDirect

Clinical Biochemistry

journal homepage: www.elsevier.com/locate/clinbiochem

Decreasing troponin turnaround time in the emergency department using the central laboratory: A process improvement study

Arlene M. Boelstler [a], Ralph Rowland [b], Jennifer Theoret [a], Robert B. Takla [a,c], Susan Szpunar [d], Shraddha P. Patel [a], Andrew M. Lowry [a], Margarita E. Pena [a,c,*]

[a] St. John Hospital and Medical Center, Department of Emergency Medicine, 22101 Moross Road, Detroit MI 48236, USA
[b] St. John Hospital and Medical Center, Department of Laboratory Services, 22101 Moross Road, Detroit MI 48236, USA
[c] Wayne State University School of Medicine, 540 E Canfield Street, Detroit, MI 48201, USA
[d] St. John Hospital and Medical Center, Dept. of Medical Education, Detroit MI 48236, USA

ARTICLE INFO

Article history:
Received 7 June 2014
Received in revised form 19 October 2014
Accepted 28 October 2014
Available online 7 November 2014

Keywords:
Troponin
Turnaround time
Emergency department
Central laboratory
Process improvement

ABSTRACT

Objectives: To implement collaborative process improvement measures to reduce emergency department (ED) troponin turnaround time (TAT) to less than 60 min using central laboratory.

Design and methods: This was an observational, retrospective data study. A multidisciplinary team from the ED and laboratory identified opportunities and developed a new workflow model. Process changes were implemented in ED patient triage, staffing, lab collection and processing. Data collected included TAT of door-to-order, order-to-collect, collect-to-received, received-to-result, door-to-result, ED length of stay, and hemolysis rate before (January–August, 2011) and after (September 2011–June 2013) process improvement.

Results: After process improvement and implementation of the new workflow model, decreased median TAT (in min) was seen in door-to-order (54 [IQR43] vs. 11 [IQR20]), order-to-collect (15 [IQR 23] vs. 10 [IQR12]), collect-to-received (6 [IQR8] vs. 5 [IQR5]), received-to-result (30 [IQR12] vs. 24 [IQR11]), and overall door-to-result (117 [IQR60] vs. 60 [IQR40]). A troponin TAT of <60 min was realized beginning in May 2012 (59 [IQR39]). Hemolysis rates decreased (14.63 ± 0.74 vs. 3.36 ± 1.99, $p < 0.0001$), as did ED length of stay (5.87 ± 2.73 h vs. 5.15 ± 2.34 h, $p < 0.0001$). Conclusion Troponin TAT of <60 min using a central laboratory was achieved with collaboration between the ED and the laboratory; additional findings include a decreased ED length of stay.

Introduction

Heart disease is a critical condition that caused nearly 25% of all deaths in the United States in 2008, and each year nearly 785,000 Americans have their first coronary attack [1–3]. Last year over 130 million patients visited the ED [4], with chest pain comprising the second most common complaint [5,6]. Early diagnosis and medical management of patients with acute coronary syndrome (ACS) improves both diagnostic and clinical outcomes in patients presenting to the emergency department (ED) with a complaint of chest pain [7–9]. Cardiac biomarkers are a primary tool to diagnose and stratify risk in patients with chest pain and suspected ACS [8,10]. In particular, cardiac troponin (cTn) has become the biomarker of choice in recognizing patients with ACS and is considered central to the definition of acute myocardial infarction [10–13].

Both physician and laboratory societies recommend a turnaround time (TAT) of <60 min for early detection of ACS [5,14–16] This recommendation, however, is largely not being met [17]. Several studies have suggested that implementation of rapid point-of-care (POC) cardiac biomarker testing may enhance both the clinical and operational efficiency of the ED [18,19]. While point-of-care testing has been proven to reduce the time for test results and medical decision-making, it may be more unreliable, have greater variability, and be more expensive compared to a central laboratory [20,21].

In our ED, utilization review data revealed that our door-to-result troponin time was over 2 h. Consideration was given to obtaining point-of-care testing to help meet the guideline recommendations, however, we decided instead to detail and analyze the workflow process from ED patient arrival to result to see if we could achieve the <60 min TAT goal using current central laboratory. In this way, we could identify which steps were causing the greatest time delays and which steps would benefit from streamlining.

The objective of this quality improvement project was to demonstrate how implementation of effective process improvements and

* Corresponding author at: St. John Hospital and Medical Center, Department of Emergency Medicine, 22101 Moross Road, Detroit, MI 48236. Fax. (313) 343-7620.
E-mail addresses: arlene.boelstler@stjohn.org (A.M. Boelstler), ralph.rowland@stjohn.org (R. Rowland), jennifer.theoret@stjohn.org (J. Theoret), robert.takla@stjohn.org (R.B. Takla), susan.szpunar@stjohn.org (S. Szpunar), nenomole@gmail.com (S.P. Patel), andrew.lowry@providence-stjohnhealth.org (A.M. Lowry), margarita.pena@stjohn.org (M.E. Pena).

http://dx.doi.org/10.1016/j.clinbiochem.2014.10.014
0009-9120/

collaboration between the ED and central lab can reduce the troponin door to result time to less than 60 min without the use of POC testing.

Methods

This was a quality improvement project conducted in an urban teaching hospital with an annual volume of 115,000 ED visits. Project evaluation was done using retrospective lab data collection and chart review. This project was reviewed by the St. John Hospital and Medical Center Institutional Review Board and considered exempt. The goal of the project was to reduce troponin door to result TAT to less than 60 min in adult patients presenting to the ED requiring biomarker evaluation for possible acute coronary syndrome. Process improvement measures were implemented in August and September 2011. Data were collected from the time period between January 2011 and June 2013.

Critical to the project was the creation of a Chest Pain Team (CP Team) consisting of the Chest Pain Coordinator/ED manager, ED Observation Unit Medical Director, ED staff, central laboratory management, and phlebotomy personnel. Members of this multidisciplinary CP Team met weekly, at first, to discuss opportunities and solutions for each step, then monthly to discuss the progress of the process improvement measures implemented. Using a shared governance model, ED nurse volunteers were asked to look at the flow of the ACS patient and identify an area of opportunity. The long TAT of cardiac biomarker results and high hemolysis rates resulting in lab redraws were identified as processes that needed improvement in order to identify ACS patients earlier and within the recommended 60 min. Multi-disciplinary education of the importance of early recognition, treatment and appropriate disposition of ACS was also identified as necessary for process improvement.

Four steps in the process from door to troponin result were identified: door-to-order (step 1), order-to-collect (step 2), collect-to-received (step 3), and received-to-result (step 4). Times were extracted from the hospital laboratory information system and our clinical documentation computer system. Door-to-order was defined as the time the patient presented to the ED front desk to the time the troponin order was placed in the computer. Collect time was the time the blood was drawn, received time was the time the lab received the tube of blood, and result time was the time the troponin result was entered in the computer. A time of 15 min for each step was decided upon so that the total door to troponin TAT would equal 60 min. Hemolysis rate data was reported monthly by lab. Each of the four steps in the process from door to troponin including door-to-result and the hemolysis rate was recorded on a scorecard to identify the most significant time delays and where opportunities for improvement may exist.

Individual level data were collected for each of the four steps and total troponin TAT, i.e. door-to-result for the entire study period. The non-parametric Mann Whitney U test was used to determine median and interquartile ranges. Individual level data for ED length of stay was also collected; the t-test was used to determine the means. Monthly aggregate data of ED volume and ED boarder hours were compared before and after process improvement to evaluate for confounding factors. The t-test was used to determine means for ED volume, ED boarder hours, and hemolysis rate. A 2-tailed probability of less than 5% was used for statistical significance.

Step 1 or door-to-order was first addressed. A new process of an ED triage nurse-initiated cardiac panel blood draw protocol was proposed and drafted by nursing. In this new process, the triage nurse determined if a patient with chest pain required a cardiac panel blood draw and ordered these labs in triage. The patient therefore had labs drawn in ED triage while also undergoing ECG testing. The cardiac panel consisted of a complete blood count, basic metabolic panel, CK/CK-MB and cTnT. Coagulation studies were added if the patient was on anticoagulant therapy. The process prior to process improvement involved the patient being taken from triage to their ED room. Then, the physician would see and evaluate the patient before the cardiac panel was ordered electronically in the patient electronic medical record. The new process would involve bypassing these two steps and empowering the ED triage nurse to order the cardiac panel in the patient electronic medical record.

This process was first piloted to ensure ED physician buy-in to the change in process of nurse-initiated orders. Triage guidelines for cardiac panel blood draws that included signs and symptoms consistent with possible ACS were included on a separate sheet of paper kept in ED triage. If the triage nurse decided that a cardiac panel was indicated, any criteria the patient met would be checked off and the paper attached onto the patient's chart. This checklist also served as an educational tool for nursing of ACS recognition. After the patient was placed in an ED bed and evaluated by the ED physician, the ED physician would check off if the blood draw was or was not appropriate for that patient. All papers were collected at the end of each day. After three weeks, it was noted that only 4 sheets returned with the box for 'blood draw not appropriate' checked off. This information was brought to the ED chief and physicians who approved it for regular practice. These guidelines were incorporated into advanced patient care guidelines for nurse-initiated cardiac panel draws to be used by the ED nurses if a patient arrived by ambulance and was placed in an ED bed.

In order to address step 2 order-to-collect, it was decided that a phlebotomist would be stationed in triage to do the initial cardiac panel blood draw. In the original process, after the nurse received the physician order for a cardiac panel draw, the nurse would draw the blood from the IV catheter immediately after placing the IV such that the patient would therefore only require one venipuncture. In the new process, the patient would have two venipunctures, one for the initial blood draw at triage and then another when the nurse placed an IV after the patient was placed in an ED bed. (See Fig. 1 for a graphical summary of steps 1 and 2.) The separate blood draw could have the benefit of decreasing the hemolysis rate, thus decreasing the number of repeated blood draws and positively impacting TAT.

In step 3 collect-to-received, pre-process improvement laboratory CK/CK-MB and troponin testing were performed on gel tubes (gold top, no anticoagulant). Once collected, an extra 10 min is required to allow for clotting prior to centrifugation. The new process involved replacing the gel tubes with mint green tubes (lithium heparin anticoagulant tubes) which can be spun immediately upon receipt in the

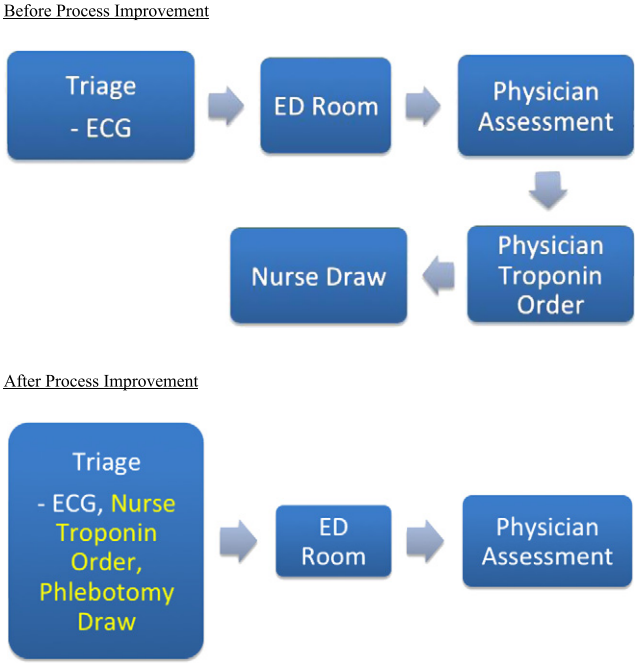

Fig. 1. Flow diagram of door-to-collect before and after process improvement.