Improving Efficiency Using Time-Driven Activity-Based Costing Methodology

SA-CME

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Abstract

Purpose: The aim of this study was to increase efficiency in MR enterography using a time-driven activity-based costing methodology.

Methods: In February 2015, a multidisciplinary team was formed to identify the personnel, equipment, space, and supply costs of providing outpatient MR enterography. The team mapped the current state, completed observations, performed timings, and calculated costs associated with each element of the process. The team used Pareto charts to understand the highest cost and most time-consuming activities, brainstormed opportunities, and assessed impact. Plan-do-study-act cycles were developed to test the changes, and run charts were used to monitor progress. The process changes consisted of revising the workflow associated with the preparation and administration of glucagon, with completed implementation in November 2015.

Results: The time-driven activity-based costing methodology allowed the radiology department to develop a process to more accurately identify the costs of providing MR enterography. The primary process modification was reassigning responsibility for the administration of glucagon from nurses to technologists. After implementation, the improvements demonstrated success by reducing non-value-added steps and cost by 13%, staff time by 16%, and patient process time by 17%. The saved process time was used to augment existing examination time slots to more accurately accommodate the entire enterographic examination. Anecdotal comments were captured to validate improved staff satisfaction within the multidisciplinary team.

Conclusions: This process provided a successful outcome to address daily workflow frustrations that could not previously be improved. A multidisciplinary team was necessary to achieve success, in addition to the use of a structured problem-solving approach.

Key Words: TDABC, time-driven activity-based costing, MR, enterography, efficiency

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INTRODUCTION

As health care organizations continue to experience declining reimbursement, increased complexity, and increased accountability for delivering affordable, high-quality care, leaders must explore all available methods of cost containment and process streamlining. Radiology departments must position themselves appropriately to react to the impending shift from fee-for-service to value-based payment models. According to Lee and Enzmann [1], "to measure and identify areas for providing and improving integrated diagnostic information, radiology must engage clinicians and managers to map the processes and associated costs of episodes of patient care." Time-driven activity-based costing (TDABC) was developed as an alternative to traditional activity-based costing models historically used throughout industry and various organizations. In defining TDABC, Kaplan et al [2] stated, "TDABC enables providers to measure accurately the costs of treating patients for a specific medical condition across a full longitudinal care cycle. It uses two proven management tools: process mapping from industrial engineering and activity-based costing from accounting." In the health care setting, value-stream mapping and other process analysis tools are frequently used, but they do not typically account for the cost component.

The purpose of this article is to inform physicians and administrative leaders how TDABC can be used to identify specific time and cost values for all steps in a given health care event. Unlike the historically used activity-based costing method, which accounts only for

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capturing costs on the basis of certain activities, TDABC leverages the per-unit time allocation for every step of a given process. By identifying non-value-added activities, opportunities exist to reduce or eliminate those activities that may lead to decreased costs and increased process efficiency. An example of TDABC application and outcomes are outlined in this report.

Mayo Clinic radiology leaders requested the division of MRI to apply TDABC to a specific abdominal MRI examination, MR enterography, that was perceived to be fraught with non-value-added steps and duplicated work effort, presenting an opportunity for overall process improvement. A review of existing workflow maps identified opportunities for the staff to work differently. In the original workflow, nurses were contacted by the MRI scanner technologist when glucagon administration was needed. The nurse would prepare the medication and go to the scanner to administer it to the patient. Because of other responsibilities, the nurse may have been busy with other patient care–related tasks during the time the technologist identified that glucagon was needed, creating interruptions for the nurse and inadvertent potential delays in glucagon administration. Timing of the glucagon injection for MR enterography is important because it can affect image quality.

Historically, the department had struggled to keep the cost of providing MR enterography less than the Medicare reimbursement rates. The core objective of the MRI team was to decrease the overall cost to provide MR enterography while decreasing the overall process time. This examination had previously been analyzed using a value-stream map and a swim-lane diagram. Although those two methods helped clearly illustrate the process flows, actual per-step costs were not previously assigned. By identifying the amount of time required for each process step, the radiology finance team was able to apply accurate cost-per-unit amounts to the process steps. The added layers of information quickly allowed the team to target key opportunity areas to reduce cost, reduce process time, and simplify the entire patient experience.

METHODS

A multidisciplinary team consisting of clinical assistants, registered nurses (RNs) and licensed practical nurses (LPNs), radiologists, schedulers, technologists, and a process improvement coach met to review the existing value-stream map and swim-lane diagram of the current state of MR enterography. The team developed a current-state high-level swim-lane diagram that illustrated each process step by role (Fig. 1). Then, observations and data collection provided the necessary process times and staff participation percentages for each process step. Manual timings were completed on randomly selected patients, and median times were used.

Costing

Next, a personnel cost was generated for each step in the swim-lane diagram. Personnel cost was determined by the median number of minutes involved, the type of employee involved, and the percentage of time that step was executed by each type of employee. A midrange salary was used for each different type of allied health employee (clinical assistant, RN, LPN, intravenous technician, and MRI technologist) and resident, and a top-level salary was used for each radiologist process step (consistent with institutional guidelines). Total personnel costs included salary, benefits, and supervisory overhead. The personnel capacity (minutes) was calculated using the available days per year for each different job category (total days less weekends, holidays, vacation, and training) and the available productive minutes per day. These two components, total personnel costs and personnel capacity, were used to determine a rate per minute for each different job category, which was then applied to each swim-lane diagram step.

Equipment costs were calculated on the basis of the annual straight-line depreciation of every piece of equipment used in an MR enterographic examination. A standard annual maintenance cost was also included. The equipment capacity (minutes) was based on the number of days available (less weekends, holidays, and days unavailable because of maintenance) and the number of productive minutes available per day. This equipment cost per minute was then applied to the number of minutes for the actual examination.

Space costs were determined by the total square footage of the space used for an MR enterographic examination, as well as the type of space being used for the examination. Three different types of space, with different rates per square foot, were included in the analysis (storage, office, and imaging). The space capacity and rate per minute were calculated using a similar method as for the equipment.

Supply costs (eg, syringes, medication, linen) were determined by nurses and technologists working with radiology supply chain management. The team developed a list of items and determined the cost and frequency of use for each item used in the examination. All of these cost components (personnel, equipment, space, supplies) were added together to calculate a total cost per examination.

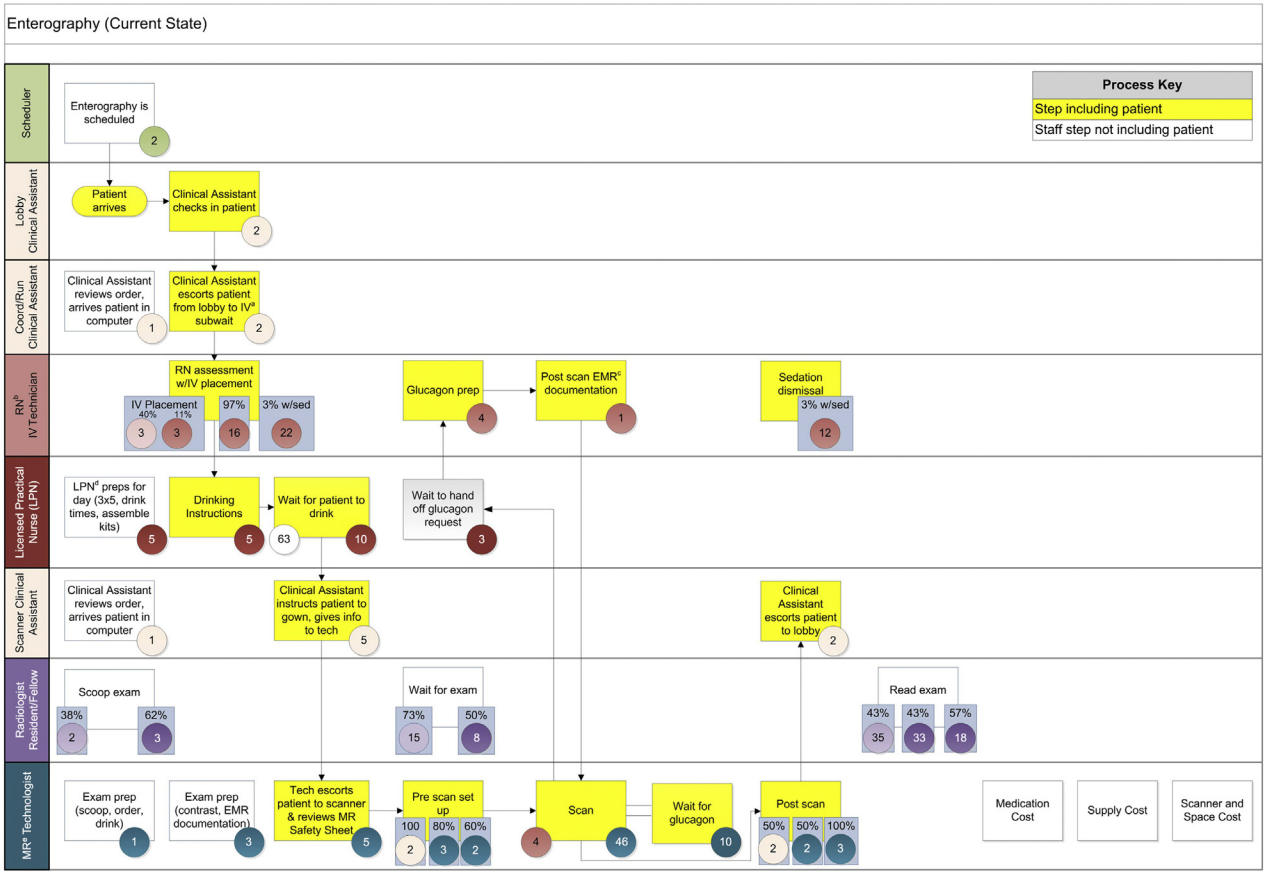

Fig 1. Current-state swim-lane diagram. Figure 1 illustrates the current-state process steps to provide care for a patient undergoing an MR enterographic examination. Each process step shows the median time required for the resource to provide that care and the frequency with which the step occurs. [a]IV = intravenous therapy; [b]RN = registered nurse; [c]EMR = electronic medical record; [d]LPN = licensed practical nurse.

Improvement

Upon completion of the costing process, Pareto analyses based on cost and time were performed to identify opportunities for improvement (Fig. 2). The TDABC oversight group reviewed the swim-lane diagram, Pareto analyses, and comments from the observers and subject matter experts before developing the improvement plan. One suggested improvement that had the potential to affect multiple process steps was to change the workflow to have the MRI technologists administer the glucagon, which was within their scope of practice. Physicians, nurses, and other allied health providers would then be able to work at the top of their licensure, optimizing the use of their knowledge [3]. A future-state swim-lane diagram was developed with this suggested improvement (Fig. 3).

Plan-do-study-act cycles were developed to determine whether changing the workflow for glucagon administration would reduce the overall time the patient was in the scan room. The team hypothesized that this would result in a reduction of scanner cost, space cost, and radiologist waiting time for the completed examination, and would increase the technologist process time for preparing and administering the medication. Successive plan-do-study-act cycles were tested with great success. An implementation and training plan was developed by the RNs and MRI technologists, and the new process was implemented within 4 months. After implementation, observations and timings of the new process were performed on a random sample of patients. Process observation timings were averaged to compare pre- and postimplementation metrics. Figure 3 illustrates the new process times on the basis of the observed median.

RESULTS

The TDABC methodology allowed radiology to develop a process to more accurately identify the cost of providing an MR enterographic examination. The process change reduced the overall time the patient was in the scan room and successfully reduced the overall scan time without adding an incremental full-time equivalent. The baseline total time for the staff to provide the examination was a

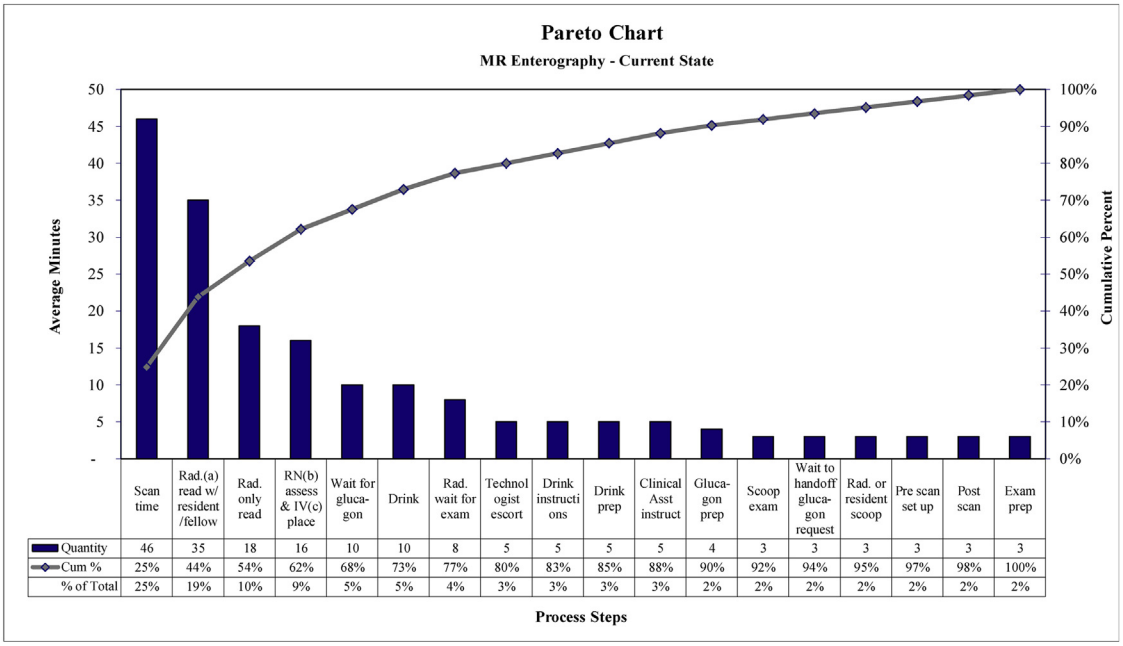

Fig 2. Pareto chart of process time (current state). Figure 2 shows the Pareto analysis performed on the process step times, which helped the team identify the largest opportunity areas. [a]Rad. = radiologist; [b]RN = registered nurse; [c]IV = intravenous therapy.

median of 198 min. By modifying the workflow to allow medication preparation and glucagon administration to be completed by the MRI technologist, several cascading positive impacts resulted.

The staff total process time decreased from a median of 198 to 165 min (a 16% reduction), and the patient in-process time decreased from a median of 102 to 85 min (a 17% reduction) (Fig. 4). Time savings resulted for the radiologist, resident, and fellow at a 22% reduction; the technologist at 18%, and the LPN at 17% (Table 1). The radiologist, resident, and fellow time decreased slightly because of the reduced wait time and was noted to be variable because of observations completed on different radiologist, resident, and fellow teams. The overall radiologist, resident, and fellow time includes the resident and fellow interpretation, radiologist interpretation, and teaching and feedback. Further study would be required to understand the impact of the changes in relation to the variability in provider teams.

Additionally, the scanner time required was reduced, affecting space and equipment costs. The largest cost savings came from the space and equipment time reduction, resulting in a decrease of 21%. In total, this project led to a 13% reduction in the cost to provide an MR enterographic examination. Future data collection will ensure that improvements have been sustained over time.

Anecdotal comments were captured to validate improved multidisciplinary staff satisfaction. Staff were quoted as follows: "It is so nice for the patient, much less waiting" and "It is very helpful for simplifying workflow and streamlining our exams." This process provided a successful outcome for daily workflow frustrations that could not previously be improved. The change was made possible during this project because the TDABC methodology brought together multidisciplinary personnel in a safe environment to discuss how to reduce the cost of the process. The TDABC methodology allowed the team to use data to identify the process inefficiency, and the financial impact heightened the desire to change.

LIMITATIONS

Three primary limitations identified throughout the TDABC process may affect replication in other organizations or practice areas. These include time commitment; the availability of skilled personnel resources to accurately assess current state, actualize TDABC, and implement new methodologies to support sustained change; and the organization's not-for-profit status.

Full appreciation of the benefits of TDABC requires dedicated time and personnel resources with the skills necessary to conduct a detailed outline and analysis of workflow, including space, equipment, personnel, supplies, and time. It is important to note that a significant component of the work had already been completed, a result of prior quality projects focused on the MRI abdominal practice. Current value-stream and workflow

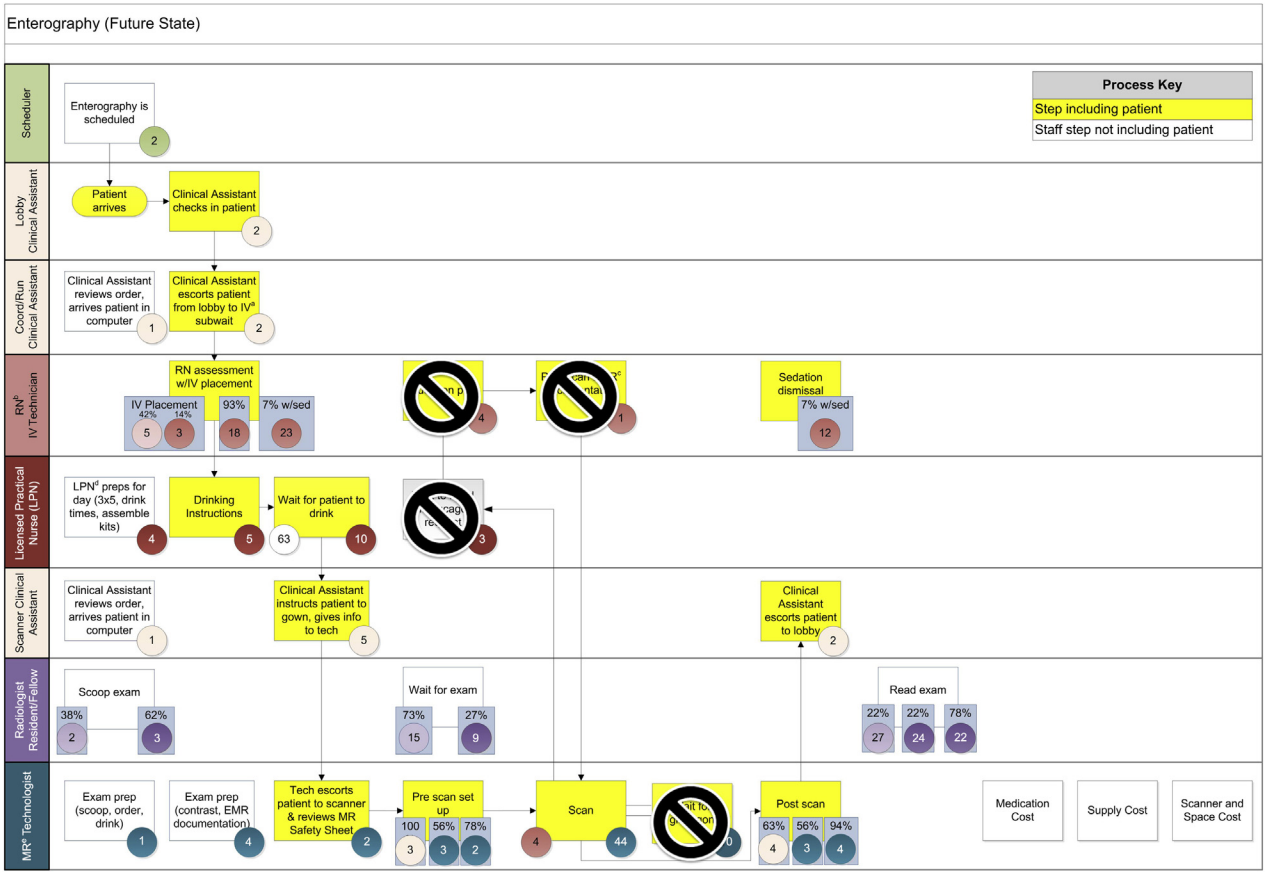

Fig 3. Future-state swim-lane diagram. Figure 3 illustrates the future-state process steps to provide care for a patient undergoing an MR enterographic examination. Four major process steps have been removed or altered to streamline the process. [a]IV = intravenous therapy; [b]RN = registered nurse; [c]EMR = electronic medical record; [d]LPN = licensed practical nurse.

process maps were already available to use as a starting point. Without this prior work, time and resource commitment would have been increased.

A significant amount of time was dedicated to team meetings with stakeholders to understand the TDABC methodology and sequentially analyze and assign cost to each facet of the process. This effort involved specialty resources, including systems engineers, improvement specialists, and financial analysts, as well as nurse, radiologist, and technologist expertise. Once the workflow process was constructed and the improvement target identified, additional resources were required to develop and implement a comprehensive training plan and monitor sustained change. The team did not gather quantitative patient experience data but rather relied on patient process time reduction.

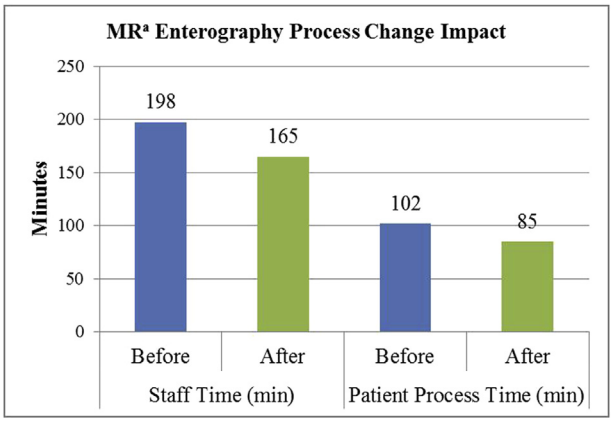

Fig 4. Impact on staff and patient times. Figure 4 demonstrates the outcomes achieved from the implementation on both staff and patient process times.

Another potential limitation of the TDABC process relates to the organization's not-for-profit status and associated buy-in from users who may not see immediate financial outcomes-related benefits. Leaders in not-for-profit organizations may have less ability to dedicate significant resources to support TDABC methodology as a means to reduce health care costs.

Despite these limitations, the radiology cohort recognizes the significance and benefit of assessing practice and workflow to proactively address and reduce health care–associated costs. The focus on practice redesign to

Table 1. Percentage impact change by cost component

Resources	Time (min) (Median Before)	Time (min) (Median After)	% Time Change	% Cost Change
Personnel				
Scheduler	2	2	—	—
Lobby clinical assistant	2	2	—	—
Room clinical assistant	3	3	—	—
RN and IV technician (RN assessment)	23	22	−6%	−4%
LPN	23	19	−17%	−15%
Scanner clinical assistant	8	8	—	—
Radiologist/resident/fellow	57	44	−22%	−14%
Technologist	80	65	−18%	−19%
Personnel total	198	165	−16%	−14%
Space and equipment				−21%
Supplies and medication				—
Total	198	165	−16%	−13%

Note: Table 1 identifies the required time, in minutes, before and after the changes were implemented for each of the personnel resources. It also shows the percentage changes in both time and cost before and after the implemented changes. IV = intravenous; LPN = licensed practical nurse; RN = registered nurse.

respond to marketplace economic pressures is an expectation for the organization. "As health care providers cope with pricing pressures and increased accountability for performance, they should be rededicating themselves to improving the value they deliver to their patients: better outcomes and lower costs" [2].

TAKE-HOME POINTS

- Understanding costs is necessary to thrive in a competitive, increasingly global marketplace in which consumers and purchasers are attempting to optimize the health care value they receive.
- Health care leaders, as stewards of their organizations' resources, will want to use approaches that identify and eliminate, or replace, low or minimal value-added activities, using methods such as TDABC.
- TDABC can be used to identify specific time and cost values for all steps in a given health care event.
- The TDABC methodology allowed radiology to develop a process to more accurately identify and reduce the cost of providing an MR enterography examination.

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