The HEART Pathway and Hospital Cost Savings

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Abstract: Chest pain is a common complaint in emergency departments. Several guidelines and tools exist to help the clinician determine need for hospitalization. For low-risk patients, clinical judgment can underestimate a patient's risk of major adverse cardiac event. Implementation of an advanced diagnostic protocol with the HEART Pathway can reduce hospital cost. For our academic institution, we saw an approximate \$1 million in total savings during the initial implementation year along with increased outpatient visits. In addition, an increase in outpatient visits confirmed previous estimates that implementation of the HEART Pathway results in >20% reduction of hospital costs. We also identify challenges and considerations for facilities looking to repeat our successes.

Key Words: chest pain, emergency department advanced diagnostic protocol, HEART pathway, hospital cost, risk stratification

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Chest pain is a common complaint in the emergency department (ED). On average, 8–10 million people in the United States complain of chest pain, accounting for 5.4% of emergency visits nationally in 2010.^{1–3} Of the myriad of causes of chest pain, physicians are pressured to rule out acute coronary syndrome (ACS) as an etiology. This is true in the young patients and among patients with no risk factors. Rapid identification and management of ACS can result in improved morbidity and mortality; therefore, physicians tend to be conservative when assessing patients presenting for chest pain especially in those with atypical presentations with the absence of biomarker or electrocardiogram abnormalities upon initial presentation.⁴ ED physicians often pursue aggressive diagnostic evaluation to include serial blood tests, specialty referrals, radiology exams, and procedures, which cost 10–13 billion US dollars annually, despite <10% of patients being diagnosed with ACS.^{1–4}

Guidelines from the American Heart Association and other developed risk stratification calculators exist, but many clinicians still rely on clinical judgment. Clinical judgment outperforms the American Heart Association risk stratification for identifying

high-risk patients, but when it comes to identifying low-risk patients, clinicians overestimate their risk of major adverse cardiac events (MACE).⁵ This results in further diagnostic evaluation for the low-risk chest pain population. Due to validation of clinical gestalt when evaluating high-risk patients, clinicians use chest pain protocols can be low. Scoring systems such as the TIMI, PURSUIT, and GRACE were not developed to identify low-risk patients and exclude patients at very high risk and very low risk for MACE.^{6,7} Additionally, depending on socioeconomic factors such as coverage and availability of follow-up, ED physicians may push for admission to mitigate any risks even if low. This is especially true for the uninsured, Department of Defense nonbeneficiaries based on the type of health care insurance, travelers, and weekend and evening encounters despite observational data that should reassure ED providers that discharge from the ED is appropriate.⁷

Incorporating a reliable and proven clinical decision-making process can help physicians be more confident in discharging low-risk chest pain patients. The HEART Pathway was described and validated in 2015 as an accelerated diagnostic protocol to incorporate evidence-based medicine into clinical practice.² It is a decision aid designed to identify ED patients with acute chest pain for early discharge by identifying acute high- and low-risk chest pain with a 30-day MACE of <2.0–2.5% with a 99% sensitivity and high negative predictive value.^{3,4,7,8} The HEART score is a validated tool developed in the Netherlands in 2008 and is used in the HEART Pathway. ED patients with a low HEART score of <3 without elevation in troponin levels at 0 and 3 hours of presentation can be identified as safe for early discharge.² Understanding that the incidence of hospital complications such as nosocomial infections, falls, and venothromboembolic phenomenon is higher than 2%, the risk of hospitalization outweighs the benefit of discharge to outpatient follow-up in patients with low-risk chest pain. Many of these low-risk chest pain patients do not need further risk stratification as their MACE is consistently validated to be much lower than estimated.¹ Identifying these patients eliminates unnecessary testing and imaging thereby decreasing false-positive and nondiagnostic testing and exposure to radiation.⁴

Due to decreased hospital length of stay, utilization of a HEART Pathway reduces health care costs by up to 20%.⁴ Our facility feels the pressure to hospitalize low-risk chest pain. We sought to identify this low-risk chest pain population with the HEART Pathway and establish an outpatient follow-up process while assessing challenges and evaluating cost savings.

METHODS

We employed a prospective cohort study of the implementation of HEART Pathway in our institution as part of a quality improvement. Our facility is a level I academic trauma center with 425 hospital beds and an ED with 53 regular beds and 4 trauma beds. In the same building is an attached Internal Medicine Clinic (IMC) and Cardiology Clinic. Upon presentation to the ED, patients were screened and evaluated in usual fashion. With a chief complaint of chest pain, the ED resident physicians would calculate the HEART score, verified by the attending physician. Patients were excluded from the accelerated diagnostic protocol if diagnosed with ACS; alternative cardiac etiologies, such as atrial fibrillation with rapid ventricular rate or aortic aneurysm; or clear noncardiac etiology,

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FIGURE 1. Emergency department accelerated diagnostic protocol. CCTA indicates coronary computed tomography angiography; ER, emergency room.

such as pulmonary embolus or pneumonia. The HEART Pathway and HEART Pathway Clinic were initiated in November 2015. Data were collected from December 2015 to December 2016 and compared with data from September 2014 to September 2015.

Patients with a HEART score of ≤ 3 with no change in troponin levels at 0 and 3 hours were discharged from the ED, and a consult was placed to the ambulatory Internal Medicine Clinic's HEART Pathway Clinic (Fig. 1). Consults were reviewed by IMC nurses within 2 business days, and patients were booked for appointments within 7 business days from discharge. During follow-up visit, physicians reassessed symptoms, assessed cardiac risk, and need for functional stress testing and determined whether secondary cause for symptoms exist, such as gastrointestinal, pulmonary, neurologic, or other non-ACS cardiac. We did not follow charts of patients who were lost to follow-up.

There was availability to complete same day graded exercise treadmill testing (GXT) in the afternoon. During the morning HEART Pathway Clinic appointment, if further risk stratification with GXT was necessary, the patient would be scheduled for a GXT that afternoon. The afternoon exercise treadmill tests were conducted by an Internal Medicine resident and supervised by an attending physician credentialed for cardiac stress testing. Resident physicians worked with the technician and credentialed physician to monitor the electrocardiogram during exercise and record hemodynamics. Afterward, residents briefed the overall impression, Duke treadmill score, and plan of action to the attending physician who confirmed findings on the GXT tracing and cosigned the report. There was also availability for same week coronary computed tomography angiography

(CCTA) on weekday mornings, nuclear perfusion study on weekday mornings, and stress echocardiogram on weekdays, which were processed through the Cardiology Department. If results were abnormal, Cardiology would notify the referring provider and take over care of the patient. If results were normal, the referring provider would notify the patient.

Patients with high-risk features and no contraindication to CCTA were evaluated with CCTA during their Emergency Department stay if during Cardiology clinic hours. Based on the results, patients were referred to their Primary Care Provider or the Cardiology clinic for further risk factor modification or admitted to the cardiac critical care unit. If unavailable, but desired, the patient was reassessed using the HEART Pathway.

The primary goals of pathway implementation were to reduce hospitalizations for low-risk chest pain regardless of length of stay and reduce inpatient hospital cost. Secondary goals included increasing outpatient revenue and to act as a training platform for residents. The reduction in chest pain admissions were counted as a length of stay day saved. Based on Becker's 2013 Chief Financial Officer's Hospital report, we used the average cost of a government hospital day was reported to be \$2759.⁹ To approximate the revenue gained from the HEART Pathway Clinic visit, we used a published average of \$208 for a level 4 outpatient clinic visit¹⁰ sans cost of procedure of electrocardiogram report and interpretation. No charts were reviewed. We only evaluated number of admissions based on a chest pain admission code and number of patients referred to and seen in the HEART Pathway Clinic. No statistical calculations were performed to compare the studied period against the previously observed period; we only used raw numbers to demonstrate an average percentage of cost savings between the measured and studied period.

RESULTS

Comparing data from our studied year to the prior year (Fig. 2), the measured time period saw a reduction in admissions for a primary diagnosis of chest pain. Admissions shorter than 24 hours for chest pain decreased by 27%, and admissions longer than 24 hours for chest pain decreased by 19%. This resulted in a decrease of approximately 328 hospitalized bed days with a total savings of \$904,952. This corresponded to a decrease of 22% inpatient hospital health care cost using an average cost per hospital day of \$2759.⁹ Meanwhile, the number of hospitalizations on the general wards increased by 6% and telemetry wards increased by 9%.

	September 2014-2015	December 2015-2016	Percent Change	Cost Savings*
Number of Chest Pain Admissions	1471	1148	- 22%	\$904,952
LOS < 24 hrs	555	404	-27%	\$488,343
LOS > 24 hrs	921	744	-19%	\$416,609
Number of Hospital Admissions	12452	13347	+ 7%	
Medical Ward	8108	8622	+ 6%	
Telemetry Ward	4344	4725	+ 9%	

*Average cost per hospital day estimated at \$2,759

FIGURE 2. Hospital admission data and cost savings. LOS indicates length of stay. *Average cost per hospital day estimated at \$2759.

With respect to secondary outcomes, our data show that from December 2015 to December 2016, 986 consults were placed to the IMC HEART Pathway Clinic, and 950 patients were seen. Outpatient appointments increased by approximately 80 appointments per month with a total gained revenue of \$197,600 when using an average cost of a 30 minute appointment ranging from \$208.¹⁰ Combining cost saved from reduced hospital admissions and revenue gained from outpatient visits, this results in a total savings of >\$1 million in our measured time period compared with the prior year.

With respect to our other secondary outcome, there was no change in the number of Internal Medicine postgraduate year (PGY) residents being certified to read GXTs independently. In our facility, each resident must read 50 GXT tracings with attending physician oversight and guidance. The 2016 graduates had 4 of the 24 residents certified, and the 2017 graduates will have an equal incidence with 5 of 24 residents certified.

DISCUSSION

This proof-of-concept study demonstrates that educating and encouraging use of the HEART Pathway by the ED reduces hospitalization of low-risk chest pain patients and results in >20% hospital cost savings.⁴ Implementation of the HEART Pathway improved one of our hospital's initiatives to increase productivity of the Internal Medicine Clinic but did not significantly increase the number of Internal Medicine residents graduating with required number of GXTs to certify in performing them independently.

Given our costs saved is approximated, facilities may find their results to be slightly different. We approximated cost saved for patients hospitalized for length of stays longer than 24 hours based on a 1-day visit, when we know the average hospitalization for chest pain in our facility is 2–3 days. Furthermore, we did not include revenue gained from outpatient clinic procedures such as electrocardiogram record and interpretation and costs saved from presumed reduction of further diagnostic laboratory testing, which would have been completed had the patients been hospitalized. Facilities need to be aware that due to the increase of outpatient workload, clinics need to project forward staffing needs, which may cut into projected savings. Additionally, attending physicians who have limited or long past exposure to GXTs will need to undergo refresher training, which can reduce projected cost savings. At our facility, refresher training includes side-by-side evaluation of 25 GXTs per each staff members and an annual requirement of 25 GXTs per year to remain proficient.

Successes at our facility included adherence to the HEART Pathway and utilization of follow-up appointment in the IMC HEART Pathway Clinic. Other researchers found overtesting to be more likely in risk adverse and older providers who are less likely to change clinical practice.³ Our hospital is a military training facility with graduate medical education training programs in emergency medicine and internal medicine. The average age of our experienced physicians tends to be younger than our civilian counterparts. Having GME training programs may account for high buy in and desire to implement new policies in daily practice. Additionally, there was leadership support and a desire to be part of a quality improvement project by our resident physicians.

Being a military facility, there tends to be high trust and adherence to follow-up appointments. Reliable follow-up is predicated on the ability of secondary evaluation to be completed within 7 working days of initial visit to the ED and the patient–physician relationship. Given that IMC is in the same building as the ED, this facilitates one-on-one communication between providers. Additionally, most providers are physicians or veterans caring for an active duty, veteran, or military-dependent patient. Our data may not be translatable to other facilities

where there is not an Internal Medicine Clinic is colocated with an ED or if multiple electronic health record platforms are being used.

For some hospitals, there is consideration to develop a chest pain unit or short stay unit, in the ED as a cost-effective alternative to hospital admissions.⁵ These units are usually managed by ED staff; however, they are most cost effective and helpful in determining prognosis of intermediate-risk chest pain patients and for hospitals already at capacity.^{5,7} For low-risk chest pain or for hospitals not at capacity, this may end up being a more expensive alternative. Additionally, the benefit of outpatient follow-up can reassure the ED discharging physician¹¹ without spending costs on creating and building a chest pain unit in an already established ED footprint.

We did expect more Internal Medicine PGY residents to be certified in GXTs.

Potential reason for not meeting this expectation is that low-risk chest pain patients did not require further functional testing. Additionally, the curriculum was implemented at the beginning of the current graduating class' PGY 2, which contains multiple inpatient rotations. Many residents needed to catch up on their required ACGME continuity clinics, resulting in a decreased availability to participate in the HEART Pathway Clinic and read GXTs.

Moving forward requires consistency and re-iteration. In a military facility, new staff can come on every 2–3 years at a minimum, sometimes more often, and new residents and staff rotate monthly in the ED. This pathway is successful due to appropriate consults to the ambulatory clinic with HEART scores <3. Additionally, in facilities that transition to or begin to incorporate high-sensitivity troponin levels, more data are needed to determine the sensitivity and specificity with its utilization in the HEART score and to reassess cost effectiveness in terms of the pricing of high-sensitivity versus usual troponin lab tests. This proof of concept demonstrates to educational and noneducational facilities a method to decrease costs by looking at low-risk chest pain hospitalizations.

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