Are Patients Discharged on the HEART Pathway Following Up?

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ABSTRACT
Introduction
The HEART (history, electrocardiogram [ECG], age, risk factors, troponin) pathway is a useful tool in the emergency department to identify patients that are safe for outpatient evaluation of chest pain. A dedicated HEART Clinic to follow-up versus primary care remains a topic that requires further delineation. We sought to identify how many patients discharged on the HEART pathway specifically followed up with the established HEART Clinic.

Materials and Methods
This is a secondary analysis of a previously published dataset. In an initial validation study of the HEART Pathway, 625 consecutive subjects were identified via chart review, 449 of which were included. We identified subjects for inclusion in this study if they were found to have a HEART score of 3 or less. Subjects were excluded if they were admitted or if their follow-up was beyond 6 weeks.

Results
Of the 449 subjects, 185 met criteria for study inclusion. 125 (67.6%) had follow-up with an average time of 7.94 days (95% CI: 6.54-9.34). Of those, half had additional testing such as ECG, cardiac computed tomography angiography, and treadmill stress testing. The most common clinics for follow-up were the Family Medicine, Internal Medicine, and HEART Clinic representing 35.8, 29, and 18% of the follow-ups, respectively. No subject died, had a myocardial infarction, or required reperfusion.

Conclusions
Of the subjects discharged on the HEART Pathway, 67.6% followed up. Of those subjects that followed up, 18% did so at the HEART Clinic.

INTRODUCTION
Chest pain is among the most common chief complaints presenting to the emergency department (ED) accounting for just under 5% of encounters in the United States. Historically, it has been difficult to determine which patients require admission for further evaluation and which ones are safe to discharge for outpatient follow-up and evaluation. The HEART (history, electrocardiogram [ECG], age, risk factors, troponin) score has become a widely used decision-making tool to identify patients that are safe for discharge. This scoring system ranges from 0 to 10 (Table I) with a score of 3 or less being defined as low risk and safe for discharge.

Multiple studies have validated the HEART score as an effective tool for identifying patients who are low risk and safe for discharge. It has also been shown to be superior to similar decision-making tools such as the Global Registry of Acute Coronary Events and Thrombolysis in Myocardial Infarction scores regarding its ability to predict Major Adverse Cardiac Events (MACE), which is defined as death, myocardial infarction, or need for reperfusion with either coronary artery bypass graft or percutaneous stenting. When combined with a repeat troponin at 3 hours, the safety of this decision rule increases and reduces the risk of having a (MACE) to less than 1% within 6 weeks of discharge.

At our institution, a protocol was established in cooperation with the Internal Medicine Department starting in 2016. It dictated that all patients discharged on the HEART Pathway would have a referral placed in our electronic medical record (EMR) to a clinic operated by the Internal Medicine Department called the HEART Clinic. It was specifically created for the purpose of ensuring these patients had follow-up. Patients were only seen in this clinic if they had such a referral. The referral required the Emergency Medicine Physician to include a breakdown of the individual components of the total HEART Score and a contact phone number for the patient. A member of the Internal Medicine Department would then review the consult...
and call the patient to schedule an appointment. The patient was asked to present a copy of the ECG they were provided by the ED at their HEART Score appointment.

**Goal of this Investigation**

Our primary goal was to determine the percentage of patients discharged on the HEART Pathway that followed up in the HEART Clinic versus a non-HEART Clinic and at how many days from ED discharge.

**METHODS**

**Subjects and Setting**

We conducted our study at an urban tertiary care center with a census of greater than 90,000 ED visits annually. In combination with the protocol, all patients with a HEART Score of 3 or less were referred to the HEART Clinic. Of note, our hospital is part of the Military Health Care system in which the patients have access to care at no cost. The Regional Health Command Central Institutional Review Board reviewed and approved protocol C.2016.023d.

**Study Design**

This study represents a secondary analysis with an additional data collection period. In the original study, we performed a retrospective chart review of subjects who presented to the ED with chest pain. We reviewed relevant charts through a systematic review of EMR for all encounters with subjects presenting with a primary complaint of chest pain, chest pressure, or chest tightness. We included all subjects who were 18 years of age or older at the time of presentation. We did not include “chest pain equivalents” such as shortness of breath unless the chief complaint “chest pain” was included along with the related complaint (eg chest pain and shortness of breath). We excluded subjects if they were under the age of 18, there was no documented ECG or troponin, the records had insufficient documentation to calculate the history portion of the HEART score or the chest pain was associated with trauma. Additionally, we excluded subjects with a ST-segment elevation myocardial infarction on initial evaluation in the ED, as the HEART score is not applicable to these high-risk patients. We categorized all subjects who did not have a follow-up or repeat healthcare encounter with a mid-level provider or physician on record in the 6 weeks following their initial ED presentation as lost to follow-up and were also excluded. This requirement for specific 6-week follow-up is consistent with the original HEART score derivation and subsequent papers.

**TABLE I. HEART Score**

| Component          | Grading Criteria         | Points |
|--------------------|--------------------------|--------|
| History            | Highly Suspicious        | 2      |
|                    | Moderately Suspicious    | 1      |
|                    | Slightly Suspicious      | 0      |
| ECG                | Significant ST-depressions | 2    |
|                    | Nonspecific repolarization abnormality | 1    |
|                    | Normal                   | 0      |
| Age                | ≥65                      | 2      |
|                    | 45-65                    | 1      |
|                    | ≤45                      | 0      |
| Risk factors⁰      | 3 or more                | 2      |
|                    | 1-2                      | 1      |
|                    | No risk factors          | 0      |
| Troponin           | ≥3× normal limit         | 2      |
|                    | >1-<3× normal limit      | 1      |
|                    | ≤Normal limit            | 0      |

Total score: 0-3 low risk: 2.5% MACE at 6 weeks; 4-6 moderate risk: 20.3% MACE at 6 weeks; ≥7 high risk: 72.7% MACE at 6 weeks. HEART, history, electrocardiogram [ECG], age, risk factors, troponin; MACE, Major Adverse Cardiac Events.

⁰Risk factors: Hypercholesterolemia, hypertension, diabetes mellitus, smoking, family history, and obesity.

In this secondary analysis, we added five additional data points to the original data dictionary and mirrored the original process of giving our abstractors 1 hour of instruction and orientation to the data dictionary. This was again followed by observing the abstractors successfully abstracting a chart. In this instance, the senior investigator (JJO) once again reviewed any instance of 1 hour of instruction and the point at which its clinical impact occurred.

All variables were identified a priori and all data were abstracted by EM staff and resident physicians (JLJ, MDA, and JJO). The abstractors inputted data into an Excel database (version 14, Microsoft, Redmond, WA). This password- and data-protected Excel file served as the standardized data collection form. In the original study, 76 individual data points were abstracted from each chart and subsequently used to calculate HEART Scores. Each of the abstractors was provided a copy of a study manual that defined each data point and where it could be located in the EMR. Each abstractor was given 1 hour of instruction and then observed to verify they could successfully abstract a chart. A minimum of 10% of each abstractor’s charts was reviewed by a senior investigator to calculate inter-rater reliability via Kappa scores. The results of the original study can be viewed in a previous publication.

In this secondary analysis, we added five additional data points to the original data dictionary and mirrored the original process of giving our abstractors 1 hour of instruction and orientation to the data dictionary. This was again followed by observing the abstractors successfully abstracting a chart. In this instance, the senior investigator (JJO) once again reviewed a minimum of 10% of the other abstractors’ charts; however, a Kappa score was not calculated as no discrepancies were found. The five additional data points that were collected on each chart were as follows: did the subject follow-up, what was the follow-up clinic, how long did it take in days to follow-up following the subjects’ initial ED visit, what testing was
performed at follow-up, and was there evidence of MACE at 1 year. As with the original study, each data point was represented by a drop-down menu of data-protected options determined a priori. Data collection for the secondary analysis was primarily conducted via chart review of the EMR, looking for specific verbiage in the note indicating that the subject was following up for their visit to the ED in regard to their chest pain. If no such note could be found the patient was contacted via telephone to verify if they did or did not follow-up. A subject was only considered to have followed up if seen within 6 weeks of their ED visit for chest pain.5,6,10

**Data Analysis**

Statistical analyses were performed using Microsoft Excel (version 10, Redmond, Washington) and JMP Statistical Discovery from SAS (version 15, Cary, NC). We reported categorical variables as numbers with percentages, ordinal variables as medians with interquartile ranges, and continuous variables as means with standard deviation. We used descriptive and inferential statistics.

**RESULTS**

In the initial validation study, we identified a total of 625 subjects via chart review.16 We included a total of 449 subjects in the study after excluding 176 subjects from the initial pool of 625 most frequently attributable to lack of troponin. Of these 449 subjects, 253 had a HEART score of 3 or less, meriting inclusion in our follow-on study. Of these 253 subjects, 68 were excluded for either being admitted, following up outside of the 6-week window, or lacking enough information to be included. This left 185 subjects for inclusion.

The demographics for this study, which only included the subset of HEART score subjects with a score of 3 or less, are much different than previous HEART Score studies. The subjects are relatively younger and healthier (Table II).10–12 Unlike previous HEART Pathway studies, we did not collect information on race, cocaine use, or insured status.14

Of the 185 subjects included in our study, 125 subjects (67.6%) had a follow-up appointment within the 6-week parameter of the HEART pathway. The average follow-up time for these patients was 7.94 days (95% CI: 6.54-9.34). Although some patients did not have a specific follow-up visit, we were able to review their medical records to 1 year beyond their initial ED visit. None had evidence of MACE. Of those who did have follow-up, the most used clinics were the Family Medicine Clinic, Internal Medicine Clinic, and HEART Clinic representing 35.8, 29, and 18% of the follow-up, respectively (Fig. 1).

The amount and type of testing at follow-up is shown in Figure 2, with no testing being the most common followed in descending order by ECG, cardiac computed tomography angiography (CCTA), and treadmill stress test. Of the 46 subjects that followed up at the Family Medicine Clinic, 12 (26%) had additional testing at follow-up. Of the 37 subjects that followed up at the Internal Medicine Clinic 24 (64.8%) had additional testing. In total, 21 of the 24 (87.5%) subjects that followed up in the HEART Clinic had additional testing. There were eight subjects that followed up at both the Cardiology Clinic and the ED. In both instances five subjects (62.5%) had additional testing. Of the six subjects that followed up in other clinics such as Gastroenterology, Pulmonology, or Rheumatology, two subjects (33.3%) had additional testing.

**DISCUSSION**

We found that just over two-thirds of the included subjects had follow-up with an average follow-up time of just over 1 week from their ED visit for chest pain. However, of the subjects that followed up, less than one-fifth utilized the HEART Clinic, which is dedicated to seeing those patients discharged on the HEART pathway.10,14 Additionally, of those subjects that followed up, only half had additional testing. The fact that half did have additional testing emphasizes that, at follow-up, a medical provider still felt risk stratification was warranted for half the population discharged on the HEART Pathway. Although we did not capture data on why a subject may or may not have followed up, we must note that we operate in a military healthcare system with virtually unlimited access to care at no cost.

It is interesting to note that although a relatively small percentage of patients followed up at the HEART Clinic, it had the highest rate of ordering additional testing at follow-up. When looking at the percentage of subjects that had additional testing at the Internal Medicine Clinic it was over 20% less. Given our small sample size it is difficult to draw any conclusions but it does beg the question, is this increased testing rate simply an artifact of the subjects following up

| Variable | Value |
|----------|-------|
| Mean age, years (95% CI) | 43.3 (41.4-45.3) |
| Male sex, % (95% CI) | 42.2 (35.0-49.3) |
| Diabetes mellitus, % (95% CI) | 4.3 (1.4-7.3) |
| Smoker, % (95% CI) | 13.5 (8.5-18.5) |
| Hypercholesterolemia, % (95% CI) | 9.2 (5.0-13.4) |
| Hypertension, % (95% CI) | 21.6 (15.6-27.6) |
| Family history of CAD, % (95% CI) | 27.6 (21.1-34.1) |
| Obesity, % (95% CI) | 41.6 (34.5-48.8) |
| Mean heart rate, beats per minute (95% CI) | 79.0 (76.8-81.3) |
| Mean systolic blood pressure, mm Hg (95% CI) | 137.8 (135.2-140.5) |
| Mean diastolic blood pressure, mm Hg (95% CI) | 84.7 (82.9-86.5) |
| History of AMI, % (95% CI) | 1.6 (0.0-3.5) |
| History of CABG, % (95% CI) | 0 (0-0) |
| History of stent, % (95% CI) | 1.1 (0.0-2.6) |
| History of CVA, % (95% CI) | 0 (0-0) |
| History of CAD, % (95% CI) | 1.6 (0.0-3.5) |

AMI, acute myocardial infarction; CABG, coronary artery bypass graft; CAD, coronary artery disease; CI, confidence interval; CVA, cerebrovascular accident.
in the HEART Clinic. As mentioned in the introduction, the HEART Clinic and Internal Medicine Clinic both fall under the purview of the Internal Medicine Department. Stated simply, the clinics are staffed by the same clinicians. The Family Medicine Clinic tested significantly fewer subjects at follow-up. Upon reviewing the charts, the explanation for this was likely due to the younger and healthier population this clinic saw. This is especially interesting given that there were no cases of MACE in this study population. It is beyond the scope of this study, but future investigations may want to look into the need for dedicated follow-up at a HEART Clinic. If such a study found that following up with primary care as opposed to a dedicated HEART Clinic was safe, such a finding could lead to a large saving in healthcare spending.

The authors would like to stress that if such a finding presented itself, we are not advocating in the favor of no follow-up, just that specific follow-up in a dedicated HEART Clinic may not be necessary. We emphasize this point in light of the fact that the HEART Pathway remains a deviation from guidelines put forth by the American College of Cardiology and American Heart Association in that patients are leaving a hospital setting without risk stratification with a treadmill stress test or CCTA in anticipation of completing risk stratification as an outpatient.²

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FIGURE 1. The numbers of subjects seen at each follow-up clinic are represented; these are not percentages.

FIGURE 2. The actual number of tests ordered at follow-up is represented; these are not percentages. Additionally, the number of subjects that had no testing at follow-up is represented. Of those subjects who had testing, several had more than one test ordered.
This study has several limitations. Although our study design incorporated the best practices of chart review methodology, the usual retrospective limitations remain. The effects of a chart review study can be seen in the numbers of subjects excluded, many of which were for admission for noncardiac reasons. However, several were due to differences in HEART score ratings between the clinician taking care of the patient in the ED and the data abstractor based on the information available upon chart review, especially given the relatively subjective nature of the history component. In almost all of these cases, the difference was only one point. However, that one point was usually between 3 and 4, which represents the difference between admission and discharge as recommended by the HEART score. When such a difference occurred, we were forced to use the score provided by the data abstractor as the information at our disposal was limited to what was available in the chart. The subjective nature of the History portion of the HEART score has been previously described in the literature. As this was a secondary analysis, the HEART scores we were using had been previously calculated in the original data collection and abstraction. Second, while additional data were collected, this is a secondary analysis of previously published data used to validate the HEART pathway. Finally, our results may have limited generalizability based on our study population. Our hospital primarily serves active duty, retired military personnel, and their dependents. As a result, our population has a relatively lower incidence of pathology than may be encountered in other health care settings, and conversely easier access to health care.

CONCLUSION

Of the subjects discharged on the HEART Pathway, 67.6% followed up within an average of 8 days of ED discharge. Of those subjects that followed up, 18% did so at the HEART Clinic.

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