Editorial

Achieving the Holy Grail of Emergency Department Evaluation for Chest Pain

Keith E. Kocher, MD, MPH

The emergency department (ED) sits at the interface between the inpatient and outpatient delivery arms of the US healthcare system. For each encounter, emergency providers must determine to what extent the patients in their charge would benefit from further care in the hospital. In an ideal state, those decisions are precisely determined, with patients selected to stay who would truly benefit. In reality, those decisions are complex and highly variable.[1]

See Article by Frisoli et al

There is no clinical condition that better symbolizes this challenge in the ED than the symptom of chest pain,[2] which brings with it a heterogeneous mix of patient populations and underlying diagnoses. On the one hand, most chest pain symptoms ultimately have a benign course. On the other hand, some patients with chest pain are diagnosed with serious, life-threatening conditions that require timely interventions. The combination is volatile—we annually spend substantial amounts of healthcare resources endeavoring to discriminate between these 2 groups of patients. As the authors Frisoli et al[3] note in this issue of *Circulation: Cardiovascular Quality and Outcomes*, chest pain is common and costly.

Clinicians and investigators have been hacking away at chest pain for >3 decades,[4] looking for the elusive holy grail solution to this quandary: a single tool or combination of tools that perfectly sorts patients presenting to the ED with chest pain for which acute coronary syndrome (ACS) remains a consideration into those at high enough risk to require further diagnostic work versus those at low enough risk to be safely discharged.[5] The consequences on both sides of the ledger are substantial. On the underdiagnosis side are missed immediate and directly downstream major adverse cardiac events, generally defined as acute myocardial infarction, percutaneous coronary intervention, coronary artery bypass grafting, coronary angiography revealing procedurally correctable stenosis managed conservatively, and death because of any cause. On the overdiagnosis side is unnecessary treatment leading to iatrogenic events, incidental findings, lost productivity, patient anxiety, and low value healthcare spending. To cite just a few of the many strategies studied over the years, we have experimented with combinations of ED-based rapid diagnostic protocols,[6] observation-based care protocols,[7] clinical decision rules,[8] sequencing of services,[9] novel imaging modalities,[10] high-sensitivity troponin,[11] and decision aids.[12] To what extent have we finally found the holy grail?[13]

As a starting point, it is critical to begin with the end in mind by considering those elements that would constitute the ideal solution, whether it is a single tool or set of tools packaged together, to best determine which patients presenting to the ED with chest pain concerning for ACS require further hospital-based care or are safe for discharge. Importantly, the strategy must satisfy at least 3 key stakeholders, emergency providers, patients, and society. The approach must also consider the essential next step in bridging the gap between research and practice where findings are translatable into widespread clinical use.[14] Let us begin by considering the point of view from the emergency provider, where it must meet the following major criteria:

- Timely: Time-to-decision is an imperative within the context of the ED care setting. Secondarily, although observation care options have often been adopted as an adjunct strategy and extend beyond the standard initial ED visit, improvements in the timeliness of disposition under these approaches are also beneficial for system flow.
- Feasible: The approach must be well integrated into the work flow of frontline emergency providers. Therefore, data elements required to calculate risk scores, adoption of new diagnostic test modalities, or use of particular health services must be available 24/7 and across all types of ED care settings, from rural to urban and academic to community practices.
- Sensitive: Whether applying these standards to a diagnostic test, diagnostic protocol, or clinical risk calculator, it must ensure to the extent possible that no cases of major adverse cardiac events are missed, recognizing the inherent limitation of ever achieving a no miss benchmark.

From a patient's perspective:

- Safe: Patients prioritize an approach that best combines sensitivity and specificity, so risks of a missed adverse advent are balanced with risks of exposure to unnecessary testing and health services.
- Maximized health: The end goal of all healthcare encounters is to maximize health. Diagnostic tests and procedural interventions that do not lead to improvements in function, reductions in disease burden, and prevention of future medical events are effort without benefit accompanied by the risk of harm.

The opinions expressed in this article are not necessarily those of the editors or of the American Heart Association.

From the Department of Emergency Medicine, Medical School, Center for Healthcare Outcomes and Policy, and Institute for Healthcare Policy and Innovation, University of Michigan, Ann Arbor.

Correspondence to Keith E. Kocher, MD, MPH, University of Michigan, NCRC Bldg 14, 2800 Plymouth Rd, Ann Arbor, MI 48109-2800. E-mail kkocher@umich.edu

(*Circ Cardiovasc Qual Outcomes.* 2017;10:e004026. DOI: 10.1161/CIRCOUTCOMES.117.004026.)

***Circ Cardiovasc Qual Outcomes* is available at http://circoutcomes.ahajournals.org**

DOI: 10.1161/CIRCOUTCOMES.117.004026

- Optimized care experience: Ideal strategies should lead to reductions in uncertainty, improved patient understanding of risks and care options, greater convenience, and less waiting.
- Cheap: Patients want quality care at the best price.

Finally, from society's perspective:

- Specific: Optimizing the use of resources to ensure the diagnosis of true positives—those with ACS—and limit expenditures on cases without the disease.
- Cost effective: Prioritizing the efficiency in how healthcare dollars are spent so that society derives maximum value for resources consumed.

Now let us apply this admittedly high standard to the clinical trial by Frisoli et al.[3]

At the center of the trial is the HEART (History, ECG, Age, Risk factors, Troponin) score clinical decision rule.[15] However, this original decision rule has been modified and dubbed the Henry Ford Heart Score with the addition of a second troponin at least 3 hours apart from the first and then effectively operationalized as an ED clinical protocol. For those patients with a presentation concerning for ACS and determined by the treating emergency providers to require further management in an observation unit under usual care, the trial randomizes subjects at low risk by the modified HEART score (score ≤3) to either discharge or completion of the observation unit care with accompanying stress testing. According to the authors, the objective of the study was to determine the health service savings derived from this strategy for this group of patients the authors consider truly low risk by evaluating the primary end points of 30-day total charges and hospital dwell time for the index encounter. The authors are commended for looking across the episode of care to quantify the outcomes tied to implementing a strategy for ED chest pain presentations, including related clinical outcomes in conjunction with the balance sheet of health service costs accrued between the intervention and control groups.

Referencing the criteria as previously outlined from the 3 different stakeholder perspectives, the Henry Ford Heart Score strategy generally scores well. The objectives of the trial most directly address society's needs, where it was shown to be more cost effective (reduction in median total charges of care at 30 days, $2953 versus $9616; $P<0.001$) without missed adverse events. For emergency providers, there is upside in the sensitivity of the protocol which missed no major adverse cardiac events, and, potentially, in its feasibility as the modified HEART score on the surface seems relatively straightforward to integrate into practice although this was not formally measured. Meanwhile, the patient's perspective mostly must be inferred because this group's needs were not fully investigated. Nevertheless, improvements in timeliness of care with reductions in wait times (decrease in median hospital length of stay of 6.3 versus 25.9 hours; $P<0.001$) are likely meaningful.

However, there are a few biases to consider within the study design. First is to emphasize what the authors acknowledge in their limitations: (1) the small sample size restricts a full appraisal of accompanying adverse events, and (2) the single health system scope curtails the generalizability of the charge outcome with the potential for leakage of full capture of spending if some patients followed up with external institutions. Next is to recognize that this trial starts one step downstream from where most emergency providers approach this clinical decision in that patients were enrolled after the decision to observe was determined. As a result, we start with a group of chest pain patients thought to be likely at higher risk for ACS on average in the eyes of this particular group of emergency providers. We, therefore, do not have information on how the Henry Ford Heart Score would perform across these same measured outcomes on patients with chest pain who were initially sent home before enrollment—perhaps in the context of this trial, the very low risk.

Finally, all patients placed in the observation unit arm of the study were subject to the intent-to-treat of stress testing with 81% ultimately having received that service. In contrast, only 3 subjects in the intervention arm ultimately underwent outpatient stress testing in the 30 days after ED discharge. This bias easily tilts the healthcare spending outcome finding in favor of the intervention arm and is one of the major drivers of the difference between the 2 groups. It is unknown whether other hospitals and their local healthcare communities would have similar results if this approach was applied to their populations of ED chest pain patients where, for example, there may be lower rates of stress testing under observation, higher rates of follow-up outpatient stress testing, or differences in downstream ED return visit rates and rehospitalizations.

So, what is the take home from this study? Fundamentally, what the trial calls into question is to what extent a population of ED patients presenting with chest pain scored to be at low risk by a small modification to a validated decision rule, the HEART score, should undergo immediate further risk stratification with stress testing within an observation care setting. The corollary is which of the patients within this low-risk group would ultimately derive benefits from stress testing, and, from a health resource and patient safety perspective, does the timing and setting of that testing occur in the hospital or as an outpatient? This is a particularly timely question because recent evidence has called into question the long-term health benefits derived from a routine stress testing strategy.[16] The authors end by calling for a larger multicenter randomized trial to further prove safety and efficacy.

At the end of the day, the Henry Ford Heart Score protocol is promising but requires additional evidence to fully endorse. But the prize is worth the effort. Arriving at a strategy that fully addresses each stakeholder concern, maximizes health outcomes with accompanying cost efficiency while setting up for a potentially smooth translation into widespread routine clinical practice in the ED, will achieve substantial gains for what is a common and costly patient experience.

Disclosures

Dr Kocher is currently supported by an Agency for Healthcare Research and Quality Mentored Clinical Scientist Research Career Development Award (K08 HS024160) and grant from Blue Cross Blue Shield of Michigan/Blue Care Network supporting a statewide quality collaborative in emergency care.

References

1. Sabbatini AK, Nallamothu BK, Kocher KE. Reducing variation in hospital admissions from the emergency department for low-mortality conditions may produce savings. *Health Aff (Millwood)*. 2014;33:1655–1663. doi: 10.1377/hlthaff.2013.1318.

2. Cotterill PG, Deb P, Shrank WH, Pines JM. Variation in chest pain emergency department admission rates and acute myocardial infarction and death within 30 days in the Medicare population. *Acad Emerg Med*. 2015;22:955–964. doi: 10.1111/acem.12728.
3. Frisoli TM, Nowak R, Evans KL, Harrison M, Alani M, Varghese S, Rahman M, Noll S, Flannery KR, Michaels A, Tabaku M, Jacobsen G, McCord J. Henry Ford Heart Score randomized trial: rapid discharge of patients evaluated for possible myocardial infarction. *Circ Cardiovasc Qual Outcomes*. 2017;10:e003617. doi: 10.1161/CIRCOUTCOMES.117.003617.
4. Goldman L, Weinberg M, Weisberg M, Olshen R, Cook EF, Sargent RK, Lamas GA, Dennis C, Wilson C, Deckelbaum L, Fineberg H, Stiratelli R. A computer-derived protocol to aid in the diagnosis of emergency room patients with acute chest pain. *N Engl J Med*. 1982;307:588–596. doi: 10.1056/NEJM198209023071004.
5. Mehta RH, Eagle KA. Missed diagnoses of acute coronary syndromes in the emergency room–continuing challenges. *N Engl J Med*. 2000;342:1207–1210. doi: 10.1056/NEJM200004203421610.
6. Than M, Aldous S, Lord SJ, Goodacre S, Frampton CM, Troughton R, George P, Florkowski CM, Ardagh M, Smyth D, Jardine DL, Peacock WF, Young J, Hamilton G, Deely JM, Cullen L, Richards AM. A 2-hour diagnostic protocol for possible cardiac chest pain in the emergency department: a randomized clinical trial. *JAMA Intern Med*. 2014;174:51–58. doi: 10.1001/jamainternmed.2013.11362.
7. Goodacre S, Nicholl J, Dixon S, Cross E, Angelini K, Arnold J, Revill S, Locker T, Capewell SJ, Quinney D, Campbell S, Morris F. Randomised controlled trial and economic evaluation of a chest pain observation unit compared with routine care. *BMJ*. 2004;328:254. doi: 10.1136/bmj.37956.664236.EE.
8. Antman EM, Cohen M, Bernink PJ, McCabe CH, Horacek T, Papuchis G, Mautner B, Corbalan R, Radley D, Braunwald E. The TIMI risk score for unstable angina/non-ST elevation MI: a method for prognostication and therapeutic decision making. *JAMA*. 2000;284:835–842.
9. Roberts RR, Zalenski RJ, Mensah EK, Rydman RJ, Ciavarella G, Gussow L, Das K, Kampe LM, Dickover B, McDermott MF, Hart A, Straus HE, Murphy DG, Rao R. Costs of an emergency department-based accelerated diagnostic protocol vs hospitalization in patients with chest pain: a randomized controlled trial. *JAMA*. 1997;278:1670–1676.
10. Hoffmann U, Bamberg F, Chae CU, Nichols JH, Rogers IS, Seneviratne SK, Truong QA, Cury RC, Abbara S, Shapiro MD, Moloo J, Butler J, Ferencik M, Lee H, Jang IK, Parry BA, Brown DF, Udelson JE, Achenbach S, Brady TJ, Nagurney JT. Coronary computed tomography angiography for early triage of patients with acute chest pain: the ROMICAT (Rule Out Myocardial Infarction using Computer Assisted Tomography) trial. *J Am Coll Cardiol*. 2009;53:1642–1650. doi: 10.1016/j.jacc.2009.01.052.
11. Pickering JW, Than MP, Cullen L, Aldous S, Ter Avest E, Body R, Carlton EW, Collinson P, Dupuy AM, Ekelund U, Eggers KM, Florkowski CM, Freund Y, George P, Goodacre S, Greenslade JH, Jaffe AS, Lord SJ, Mokhtari A, Mueller C, Munro A, Mustapha S, Parsonage W, Peacock WF, Pemberton C, Richards AM, Sanchis J, Staub LP, Troughton R, Twerenbold R, Wildi K, Young J. Rapid rule-out of acute myocardial infarction with a single high-sensitivity cardiac troponin T measurement below the limit of detection: a collaborative meta-analysis. *Ann Intern Med*. 2017;166:715–724. doi: 10.7326/M16-2562.
12. Hess EP, Hollander JE, Schaffer JT, Kline JA, Torres CA, Diercks DB, Jones R, Owen KP, Meisel ZF, Demers M, Leblanc A, Shah ND, Inselman J, Herrin J, Castaneda-Guarderas A, Montori VM. Shared decision making in patients with low risk chest pain: prospective randomized pragmatic trial. *BMJ*. 2016;355:i6165.
13. Atzema CL, Schull MJ. Finding the holy grail is not a short-term project. *Circ Cardiovasc Qual Outcomes*. 2015;8:135–137. doi: 10.1161/CIRCOUTCOMES.115.001611.
14. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implement Sci*. 2009;4:50. doi: 10.1186/1748-5908-4-50.
15. Backus BE, Six AJ, Kelder JC, Bosschaert MA, Mast EG, Mosterd A, Veldkamp RF, Wardeh AJ, Tio R, Braam R, Monnink SH, van Tooren R, Mast TP, van den Akker F, Cramer MJ, Poldervaart JM, Hoes AW, Doevendans PA. A prospective validation of the HEART score for chest pain patients at the emergency department. *Int J Cardiol*. 2013;168:2153–2158. doi: 10.1016/j.ijcard.2013.01.255.
16. Sandhu AT, Heidenreich PA, Bhattacharya J, Bundorf MK. Cardiovascular testing and clinical outcomes in emergency department patients with chest pain. *JAMA Intern Med*. 2017;177:1175–1182. doi: 10.1001/jamainternmed.2017.2432.

KEY WORDS: Editorials ■ acute coronary syndrome ■ chest pain ■ clinical prediction rule ■ emergency service, hospital ■ outcome assessment (health care) ■ patient discharge

Achieving the Holy Grail of Emergency Department Evaluation for Chest Pain

Keith E. Kocher

Circ Cardiovasc Qual Outcomes. 2017;10:
doi: 10.1161/CIRCOUTCOMES.117.004026
Circulation: Cardiovascular Quality and Outcomes is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

Print ISSN: 1941-7705. Online ISSN: 1941-7713