

EDITORIAL

ST-Segment–Elevation Myocardial Infarction Care in America: Celebration and Anxiety

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More than 20 years ago, a consortium of investigators tested the idea that patients judged to be at low risk for complications following ST-segment–elevation myocardial infarction (STEMI) could be discharged from hospitals faster by relying on angiographic findings rather than routine pre-discharge stress testing, as recommended by guidelines at the time.¹ This change was expected to lower costs of care. Low-risk patients were arbitrarily defined as non-elderly patients (aged ≤ 70 years) without arrhythmias or 3-vessel coronary artery disease who had successful primary percutaneous coronary intervention and well-preserved left ventricular function. They found that these low-risk patients could be discharged safely after 3 days instead of the average of ≈ 7 days with usual care. Hospital costs were $\approx 20\%$ lower with this accelerated care approach. Since then, routine use of invasive therapies and shorter hospital stays have become routine after acute myocardial infarction (AMI).

See Article by Jang et al.

As we have become more aggressive about short hospital stays, some have questioned whether we occasionally put patients at risk. If we send patients home too soon, we might see preventable harm events driving readmissions. This has been a particular concern among heart failure providers² who are eager to keep hospital stays short but who have felt the pressure of publicly reported readmissions and mortality

data, often citing high figures, for more than a decade. Although the conversation around heart failure has been, perhaps, more of a focal point, the Centers for Medicare and Medicaid Services began public reporting of data for AMI at the same time.³ It seems timely, then, to ask a few questions: How are we doing with AMI patients, how long do they stay in hospital, how often do they require readmission, and what is the total cost of caring for them through 30 days? We might also ask: Are there any signals that earlier hospital discharge is unsafe?

In this issue of the *Journal of the American Heart Association (JAHA)*,⁴ Jang et al report their observations about discharge practices, readmissions, and costs in STEMI patients admitted to US hospitals. They sourced information from the Nationwide Readmissions Database (NRD), a federal registry that compiles information from State Inpatient Databases assembled as part of the Healthcare Cost and Utilization Project. The NRD collects information currently from 28 geographically dispersed US states and captures hospital information for $\approx 60\%$ of US residents. Data from all payer types are included. The NRD contains ≈ 100 clinical and administrative data elements that are collected for each hospitalization. It was set up to support just this kind of healthcare research.⁵

Jang et al⁴ report that, between 2010 and 2014, more than half a million Americans had percutaneous coronary intervention for STEMI. The modal length of stay (LOS) for those who survived to hospital discharge was 2 days (the NRD does not measure fractions of days); clearly, short hospital stays are routine after STEMI.

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Patients who stayed longer were sicker: older age, bigger AMIs, greater need for mechanical circulatory support, and more comorbidities. Stratifying patients by LOS and using a 3-day stay as a reference point, they further observed that those with shorter LOS were less likely, and those with longer hospital LOS were more likely, to be readmitted within 30 days. These observations stood after data adjustment. Batching patients into short (1–3 days), medium (4–5 days), and long LOS groups (>5 days), they identified that shorter stays were safe and associated with cumulative care costs over 30 days that were $\approx 15\%$ lower than mean calculated costs for the entire study population. The findings validate current concepts about discharging patients as soon as they demonstrate stability after STEMI.

So far, so good. Then, the article delivered a shocker: subgroup analysis found that anterior wall STEMI (AW-STEMI) patients with LOS <3 days were approximately twice as likely to die within 30 days as those who stayed in hospital for 3 days. This was not seen in patients with non-AW-STEMI. This observation also persisted after adjustment. And although earlier discharge offers greater cost savings, costs were only $\approx 4\%$ lower over 30 days for AW-STEMI discharged at 1 to 2 days instead of 3 days.

What happened? Much of inpatient care is designed to identify risk of early complications after STEMI, and we expect patients stable enough to leave hospital to stay alive. Does this study mean we are being overzealous in our drive to keep hospital stays short? Are we really doubling risk for a 4% reduction in costs? Have we missed opportunities to improve outcomes, through better patient education, medication optimization, and supervised activity escalation, by hurrying AW-STEMI patients out of the hospital? Are there tests or measures (like the routine predischARGE stress studies of long ago) that should be undertaken to risk stratify AW-STEMI patients better? Should a minimum 3-day stay be required?

These questions remain rhetorical, in part because the data presented do not disclose why these patients died. This is understandable, because the focus was on costs and correlates of outcomes, not on the outcomes themselves. Furthermore, by design, the NDR does not contain a field indicating “hospital readmission related to prior hospitalization”; that determination is left intentionally to investigators.⁵ Without details about cause of death, or even the cause of the readmission, we do not know if these patients experienced unexpected complications of AMI or died for unrelated reasons. The *International Classification of Diseases and Procedure Coding System, Ninth Revision (ICD-9)* codes are captured for each hospital admission, so additional information about the readmission patients could be extracted. A survey of the National Death Index would help, too, but that would require probabilistic matching

of patients, possible but challenging, and beyond the scope of the current study. The authors are left simply noting the finding and recommending care when considering early discharge of AW-STEMI patients.

Of course, there is always the chance this was a spurious finding that should not worry us. Furthermore, the only deaths we know about in this study are those that occurred after a hospital readmission. Perhaps other patients died without readmission, or after admission to a hospital in a different state: prior work has found that 20% to 25% of unplanned readmissions within 30 days of cardiac care are to a different hospital than the index hospital,^{6,7} and NRD data are state based, so we cannot know about any out-of-state readmission events. Perhaps readmitted patients died of noncardiac problems: as many as half of readmissions after percutaneous coronary intervention, even when done urgently, occur for noncardiac reasons.⁶ I would feel better about these explanations had the authors not previously reported similar findings for an older US population using a different database linked to Centers for Medicare and Medicaid Services records.⁸ In that analysis of $\approx 34\,000$ STEMI events, a similar “J curve” for mortality and other adverse events was seen: patients in hospital 1 or 2 days were about twice as likely to die within 30 days as those staying 3 days, with even longer LOS (reflecting greater acuity during the index hospitalization) associated with even higher event rates. Unadjusted observations held up in a propensity-matched cohort analysis. A provocative observation from that study was the significantly lower use of guideline-directed medical therapies in the short LOS group. Although medication information was not presented in the study by Jang et al,⁴ cumulative event curves indicate most deaths in the short LOS AW-STEMI patients occurred within the first week. Perhaps relevant, AW-STEMI patients with a hospital stay of ≤ 3 days and who were subsequently readmitted had the highest observed incidence of leaving the index hospitalization against medical advice (1.3% of 10 210 patients). Were these patients getting their medications promptly and properly after leaving hospital? Were they subjected to stress too soon after primary percutaneous coronary intervention?

There is some solace to be found in this distressing observation. Although the 30-day mortality rate of AW-STEMI patients was twice that of those staying in hospital 1 more day, the difference was small in absolute terms: a mortality risk of 0.2% compared with 0.1%. With 64 097 patients discharged after 1 to 2 days and 53 235 discharged at 3 days, this is a difference of 75 lives of 117 332, ≈ 15 excess deaths for each year of study. Not to diminish the concern, but at least the death rate in this cohort was not far out of range. And when bundled with those who stayed for a third day, an overall strategy of early discharge was not linked to

unfavorable outcomes and was cost saving. I suppose planning for a 3-day stay is prudent for AW-STEMI, but until we have a better understanding about this group, we cannot use that extra time wisely. Knowing other uncomplicated STEMI patients can be safely discharged in <3 days, and that the extra day for AW-STEMI patients increases costs only modestly, is reassuring.

Although it is a distracting observation, concerns over this special patient subgroup should not cloud the important broader findings in the article by Jang et al.⁴ This complex and well-executed analysis of a large data set representing approximately half of all hospitalizations in America over a 5-year period demonstrates that hospitals have been working hard to deliver high-quality, efficient care for STEMI patients. That work is paying off, literally, by lowering short-term and 30-day cumulative care costs while producing excellent outcomes for patients. As is always the case, a bit more information is needed to complete the picture. The early discharge AW-STEMI group is ripe for further study.

ARTICLE INFORMATION

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Disclosures

None.

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