



# Recent epidemiologic trends in the incidence of myocardial infarction: what have we learned?

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**KEYWORDS:** epidemiology ■ incidence ■ myocardial infarction ■ trends

Substantial improvements in the primary and secondary prevention of myocardial infarction (MI) have occurred over the previous 20 years, based on results from a number of landmark clinical trials [1–9]. However, over the same period the US population has become less physically active, more obese, more often diabetic and older [10–12]. Understanding the net effect of these disparate trends on the incidence of MI is of critical importance. At the most fundamental level, whether MIs are increasing or decreasing in incidence is the ultimate measure of the success or failure of the efforts of the public health, primary care and cardiology communities to prevent heart disease.

## Data, data, everywhere...

The emergence of large disease-based registries and the increasing use of administrative datasets for clinical research have led to an explosion of highly powered studies examining a broad range of questions relevant to clinical cardiologists. Nevertheless, the literature examining MI incidence has been astonishingly sparse. Why? The most likely explanation is simply that the measurement of disease incidence is extraordinarily challenging, as it not only requires characterizing who has the disease (the numerator), but also who is at risk for the disease (the denominator), rendering the vast majority of registries incapable of answering such questions. As a result, the study of MI incidence has, until recently, been the realm of a handful of modest-sized community-based cohorts [13–17]. However, these cohorts have often been underpowered and have lacked sufficient diversity to estimate trends in the incidence of MI in a definitive and generalizable fashion.

## Filling the void

Two recent studies have begun to fill this void to our knowledge. The Medicare denominator file is able to estimate the number of fee-for-service beneficiaries in a given year. Coupling this information with clinical information from the Medicare Provider Analysis and Review (MEDPAR) files, Chen *et al.* were able to estimate annual incidence rates of hospitalized MI between 2002 and 2007 [18]. They found that MI hospitalizations fell from 1131 per 100,000 person-years in 2002 to 866 in 2007, a 23% relative decline. Notably, black men and women had slower rates of decline compared with their white counterparts [18].

We recently published an analysis examining trends in MI incidence and outcomes in the more than 3 million member population of Kaiser Permanente of Northern California, an integrated health system in the Greater San Francisco Bay Area [19]. Kaiser Permanente maintains monthly updated membership statistics and the vast majority of members are either initially hospitalized within or transferred to a health plan facility, allowing for accurate estimates of disease incidence. Between 1999 and 2008, we found a 24% decline in the incidence of MI, coinciding with steep rises in the use of outpatient medications such as statins and beta blockers. Importantly, we were able to separately characterize trends for ST- and non-ST-elevation MI and found an impressive 62% fall in ST-elevation MI incidence over the study period.

## Disentangling the results

What are we to make of these findings? First, interpreting their meaning is particularly challenging in light of changes in the definition of MI



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and the increasing use of highly sensitive cardiac biomarkers that have occurred during the time periods studied. Within Kaiser Permanente, only 53% of patients diagnosed with MI had troponin I assessed in 1999, compared with 84% in 2004. As a result, presentations that would have been diagnosed as unstable angina previously have undoubtedly been diagnosed as MI in more recent years. It follows that reductions in MI incidence noted in both the Medicare and Kaiser Permanente populations likely are an underestimation, particularly with regard to non-ST-elevation MI. In this way, prevention efforts may have, in fact, been more successful than implied by the observed rates of decline in MI. The flip side of this coin, however, is that MIs diagnosed today are, on average, less severe than they once were, confirmed by declines in median biomarker elevations associated with infarcts over time [19,20]. Studies that have attributed improved outcomes after MI to better medical management without accounting for this fact have likely given more credit to the medical community than we deserve [21].

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However, because ST-elevation MI is not typically dependent on small biomarker elevations for diagnosis, we believe the dramatic decline in ST-elevation MI is real. This finding has truly profound implications for patients, hospitals and communities. Complex and costly systems devoted to the timely transfer of patients with ST-elevation MI to facilities capable of performing primary percutaneous coronary intervention (PCI) have been established throughout the country. Given the high fixed costs of maintaining 24-h catheterization laboratories, such declines in ST-elevation MI incidence should in theory decrease the number of primary PCI centers that are necessary in any given area. As recognition for the need to control healthcare spending becomes more pervasive, findings such as these will need to be included in assessing the cost-effectiveness of our medical interventions.

**Lingering questions**

Both the Medicare and Northern California studies convincingly demonstrated declines in MI incidence in selected populations. However,

several important questions remain. Are these declines occurring elsewhere? Why are they occurring? Will they continue?

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Whether Northern California represents a ‘generalizable’ population is a matter of debate. No inferences can or should be made about non-US populations from these data and certainly not about populations in less developed nations, where rates of cardiovascular disease are known to be on the rise [22]. Even within the USA, significant questions remain. A report by the CDC recently found wide geographic disparities in cardiovascular death rates across the USA [23], and it is well known that the prevalence of certain cardiovascular risk factors such as smoking, obesity and diabetes differ markedly from state to state [24,25]. In examining Kaiser Permanente members, our study was necessarily limited to the insured population, yet at present, more than 46 million US citizens remain uninsured today [101]. Understanding whether the burden of MI is increasingly and disproportionately afflicting particular geographic areas or demographic populations will be a crucial step in promoting greater equity in the USA and other healthcare systems.

Further characterizing the true etiology of these trends is equally important and tremendously challenging. To study this with individual patient data requires complete clinical information on not only the MI population, but also the underlying at-risk population, something that few, if any, datasets can boast of. Alternative methods such as ecological studies may provide insight, but not a complete explanation. Modeling approaches have been utilized previously, yet quantifying precise estimates for the effect of, say, statin use on the incidence of MI outside clinical trials might seem optimistic even with advancement in design and analytic methods to reduce confounding and selective bias [26].

**Known knowns, known unknowns**

Overall, light has been shed on our understanding of recent population trends in MI incidence and outcomes and the findings are encouraging. We now know that despite our enhanced detection of MIs, their incidence is decreasing within the Medicare and Kaiser Permanente populations. Within Kaiser Permanente, we observed

a steep decline in ST-elevation MI incidence in particular, a finding not previously described and one with substantial implications for clinical practice. We have noted concomitant increases in the use of cardioprotective medication, circumstantial evidence that their use has effectively prevented a growth in MIs despite unfavorable trends in obesity and diabetes. Striving for a better understanding of the etiology of these trends and whether they are occurring similarly in other places and populations will be some of the important ongoing challenges in this area.

However, without this understanding predicting whether these trends will continue into the future remains challenging. Already, there are signals that cardiovascular disease may be

on the rebound [27]. It will be our responsibility as researchers and clinicians to ensure that the progress made to date continues to improve to reduce cardiovascular morbidity and mortality nationally and internationally.

#### Financial & competing interests disclosure

*The authors have no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript. This includes employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties.*

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