Decade Long Trends (2001−2011) in the Incidence Rates of Initial Acute Myocardial Infarction

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Despite the magnitude and impact of acute coronary disease, there are limited population-based data in the United States describing relatively recent trends in the incidence rates of acute myocardial infarction (AMI). The objectives of this study were to describe decade long (2001−2011) trends in the incidence rates of initial hospitalized episodes of AMI, with further stratification of these rates by age, sex, and type of AMI, in residents of central Massachusetts hospitalized at 11 area medical centers. The study population consisted of 3,737 adults hospitalized with a first AMI at 11 medical centers in central Massachusetts on a biennial basis between 2001 and 2011. The median age of this study population was 70 years, 57% were men, and 90% were white. Patients hospitalized during the most recent study years (2009/11) were younger, more likely to be men, have more co-morbidities, and less in-hospital complications as compared with those in the earliest study years (2001/03). The overall age-adjusted hospital incidence rates (per 100,000 persons) of initial AMI declined (from 319 to 163), for men (from 422 to 219), women (from 232 to 120), for patients with a ST segment elevation (129 to 56), and for those with an non-ST segment elevation (190 to 107) between 2001 and 2011, respectively. In conclusion, the incidence rates of initial AMI declined appreciably in residents of central Massachusetts who were hospitalized with AMI during the years under study. **(Am J Cardiol 2019;123:206−211)**

Despite the magnitude and impact of coronary heart disease, a limited number of population-based studies in the United States have examined trends in the incidence rates of acute coronary disease.[1−8] The population-based and longitudinal clinical and/or epidemiological studies that have monitored trends in the incidence rates of acute myocardial infarction (AMI) have noted relatively stable rates in the 1980s and 1990s with some evidence of declines thereafter.[1−8] A limited number of studies have furthered our understanding of the descriptive epidemiology of AMI according to its major phenotypic manifestations of ST segment elevation AMI (STEMI) and non-ST segment elevation AMI (NSTEMI).[7,9−12]

The objectives of this community-wide observational study in residents of central Massachusetts hospitalized at all metropolitan Worcester medical centers with an independently validated AMI were to describe decade long trends (2001−2011) in the incidence rates of initial hospitalized episodes of AMI, with further stratification of these rates by age, sex, and type of AMI.

Methods

The Worcester Heart Attack Study is a population-based investigation that is examining long-term trends in the incidence, hospital, and postdischarge case-fatality rates of AMI in residents of the Worcester metropolitan area hospitalized at all 11 greater Worcester medical centers in central Massachusetts on an approximate biennial basis over the past several decades.[2,13−16]

Details of this study have been described previously.[2,13−16] In brief, the medical records of residents of the Worcester metropolitan area hospitalized for possible AMI at all central Massachusetts medical centers on a biennial basis between 2001 and 2011 were individually reviewed and a diagnosis of AMI was validated according to predefined criteria. Because we were interested in examining trends in the magnitude of incident (initial) cases of AMI, patients with a history of previously diagnosed AMI (n = 2,049) were excluded. This study was approved by the Institutional Review Board at the University of Massachusetts Medical School.

Data on patient's demographic characteristics, medical history, clinical, and in-hospital treatment data were abstracted from the hospital medical records of metropolitan Worcester residents with confirmed AMI by trained study physicians and nurses. Information was collected about patient's age, sex, co-morbidities, type of AMI (STEMI vs NSTEMI),[9] and hospital cardiac medications and diagnostic and/or interventional procedures. Information was also collected about the occurrence of clinically significant in-hospital complications including stroke,[17]

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Funding: Grant support for this project was provided by the National Heart, Lung, and Blood Institute (RO1 HL35434). The efforts of Drs. Gore, Goldberg, and Yarzebski were supported in part by funding from the National Heart, Lung and Blood Institute U01HL105268.

See page 210 for disclosure information.

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0002-9149/
https://doi.org/10.1016/j.amjcard.2018.10.002

atrial fibrillation,[18] heart failure,[19] cardiogenic shock,[20] and death.

Data analysis

Differences in the distribution of demographic and clinical characteristics between patients hospitalized for an initial AMI in the respective time periods were examined by using chi-square tests and analysis of variance for categorical and continuous variables, respectively. We pooled our 6 individual study years into three 2-year time periods for purposes of these analyses and for ease of data interpretation. The annual incidence rates of AMI were calculated in a standard manner using available census data for residents of central Massachusetts. Age-adjusted incidence rates of AMI were computed by means of the direct method of standardization, using population census estimates for the greater Worcester population in 2010.

Results

A total of 3,737 residents of central Massachusetts were hospitalized with an incident (initial) independently validated AMI at all 11 greater Worcester medical centers during the 6 study years between 2001 and 2011. The median age of this patient population was 70 years, 57% were men, and 90% were white.

Patients hospitalized during the most recent study years (2009/11) were significantly younger and included an increasingly greater proportion of men and individuals with a history of anemia, chronic kidney disease, hypertension, and hyperlipidemia but a lower proportion of those with previously diagnosed heart failure (Table 1). There was a significant increase in the proportion of individuals who presented with multiple previously diagnosed co-morbidities over time. The risk of developing several major adverse events during the patient's acute hospitalization decreased during the years under study (Table 1).

In examining changing trends in the hospital incidence rates of AMI, the unadjusted incidence rates of initial AMI declined appreciably between our initial study year of 2001 (275 per 100,000) and our most recent study year of 2011 (165 per 100,000) (Figure 1). The age-adjusted incidence rates also decreased appreciably between 2001 (319 per 100,000) and 2011 (163 per 100,000) (Figure 2).

The age-adjusted incidence rates of initial AMI decreased by nearly one half between 2001 (422 per 100,000) and 2011 (219 per 100,000) for both men (Figure 3) and for women (232 per 100,000 in 2001) and (120 per 100,000 in 2011) (Figure 3).

The age-specific incidence rates of initial AMI declined in those less than 65 years old between 2001 (144 per 100,000) and 2011 (83 per 100,000), in individuals aged 65 to 74 years old between 2001 (745 per 100,000) and 2011 (310 per 100,000), and in individuals aged 75 years and older during similar study years (1,265 to 613 per 100,000, respectively) (Figure 4).

The age-adjusted incidence rates of an initial STEMI decreased between 2001 (129 per 100,000) and 2011 (56 per 100,000) as did the age-adjusted incidence rates of an initial NSTEMI (190 per 100,000 in 2001) (107 per 100,000 in 2011) (Figure 5).

Table 1
Characteristics of patients hospitalized with an initial acute myocardial infarction according to time period

Characteristic	2001/03 (n = 1,547) (%)	2005/07 (n = 1,172) (%)	2009/11 (n = 1,018) (%)
Age (years)			
< 65	35.3	35.9	43.3
65–74	20.9	17.8	19.8
≥ 75	43.8	46.3	36.8
Male	56.9	54.9	59.1
White race	87.9	90.6	91.9†
NSTEMI	61.5	64.6	65.5
Length of stay (days, median)	4	4	3
Medical history			
Anemia	4.5	11.8	10.0†
Atrial fibrillation	11.8	12.2	11.0
Chronic kidney disease	11.8	17.5	18.0†
Chronic obstructive pulmonary disease	17.3	13.6	13.3*
Depression	14.5	15.8	16.2
Diabetes	28.0	28.8	31.7
Heart failure	15.0	16.5	12.2*
Hyperlipidemia	44.2	55.5	65.6†
Hypertension	64.8	70.6	69.7*
Stroke	9.3	9.2	7.5†
Number of co-morbidities			
0–1	33.9	29.4	27.9
Any 2	28.1	26.1	24.5
Any 3	20.2	20.4	22.4
4 or more	17.7	24.2	25.3
Complications during hospitalization			
Atrial fibrillation	21.7	21.5	15.1†
Cardiogenic shock	4.9	6.1	4.6
Heart failure	34.4	34.0	28.2*
Stroke	1.7	0.6	1.8*
Death	9.6	9.8	6.5*

* $P < 0.05$.
† $P < 0.01$.

Discussion

The results of this clinical and/or epidemiological study suggest encouraging declines in the incidence rates of AMI during the years under study as well as changing demographic and clinical characteristics of those hospitalized with AMI.

Patients hospitalized with an initial AMI in this primarily Caucasian population tended to be younger, have a greater proportion of most of the previously diagnosed co-morbidities we examined, and experienced favorable declines in hospital death rates and several clinical factors of prognostic importance during the most recent as compared with earliest study years.

In examining changes over time (1987–2006) in the characteristics of patients hospitalized with an incident AMI in Olmsted County, Minnesota, there were declines in the proportion of women, in those diagnosed in a higher Killip class, and in patients who developed a STEMI.[8] In

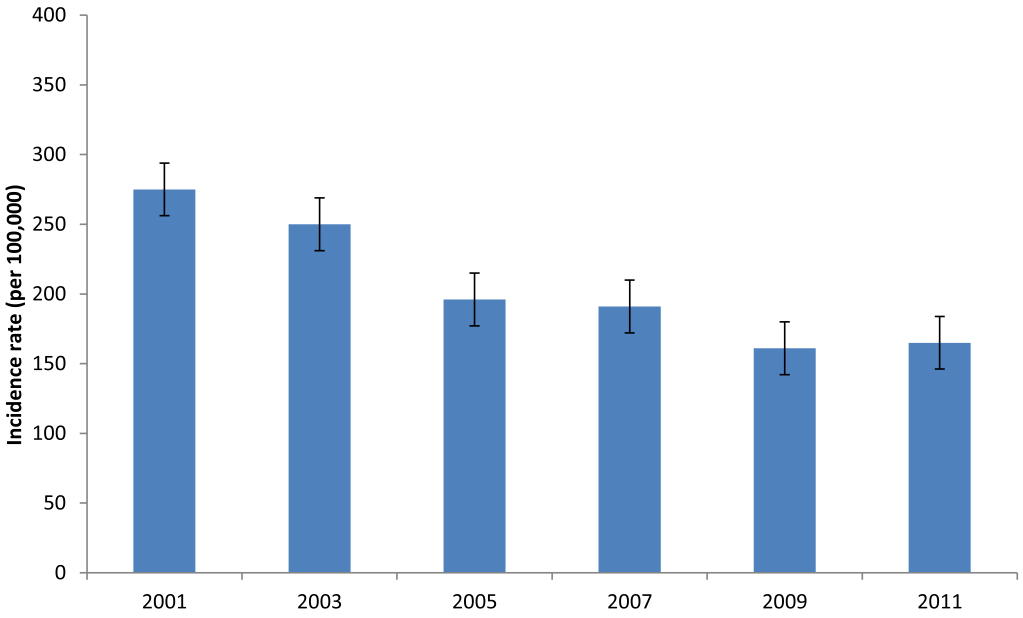

Figure 1. Trends in the hospital incidence rates of initial acute myocardial infarction: Worcester Heart Attack Study.

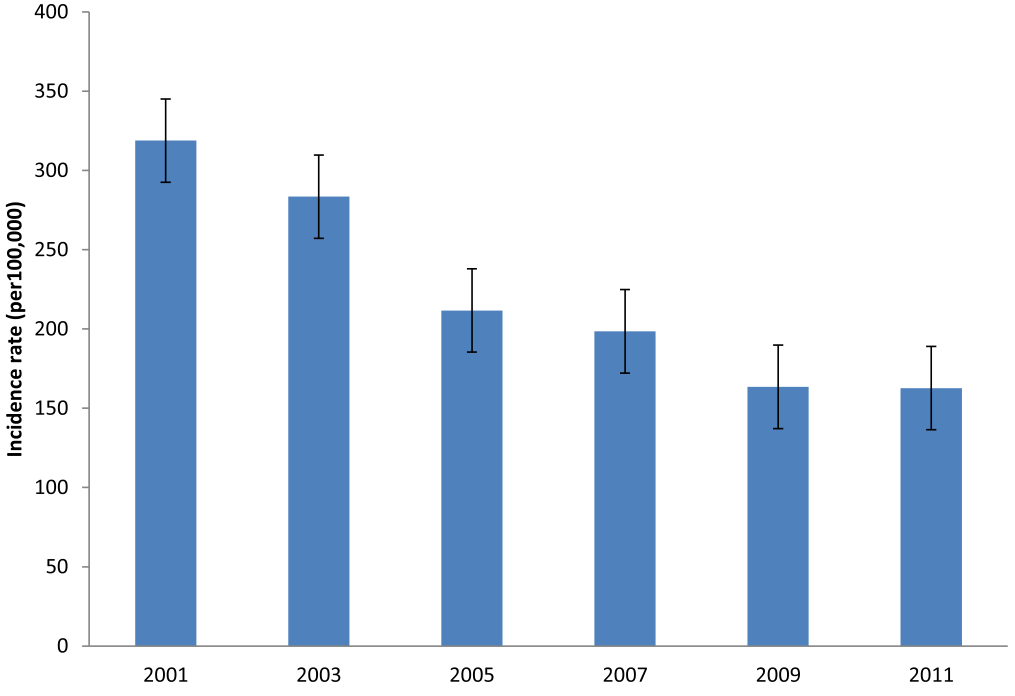

Figure 2. Trends in the age-adjusted hospital incidence rates of initial acute myocardial infarction: Worcester Heart Attack Study.

an analysis of more than 3.4 million patients who had a first listed diagnosis of AMI between 1979 and 2005 in the National Hospital Discharge Survey,[6] there was an increase in the mean age of patients included during this period with an increasing proportion of women and of those with selected co-morbidities. These changing trends in the descriptive epidemiology of AMI underscore the public health and clinical importance of monitoring contemporary trends in patient's demographic and clinical characteristics for purposes of carrying out surveillance of a major chronic disease in the United States.

We observed encouraging declines in the incidence rates of AMI during the years under study overall and in patients further categorized according to their age, sex, and type of AMI. Several other studies have found similar findings. In a study of 3,810 incident AMI's that occurred in residents of Olmsted County, Minnesota between 1995 and 2012, the age and sex adjusted incidence rates of AMI declined over time, with the most notable declines observed during the most recent years under study.[21] Using data from more than 125,000 hospitalizations for AMI in adults enrolled in 13 US health plans in the Cardiovascular Research Network

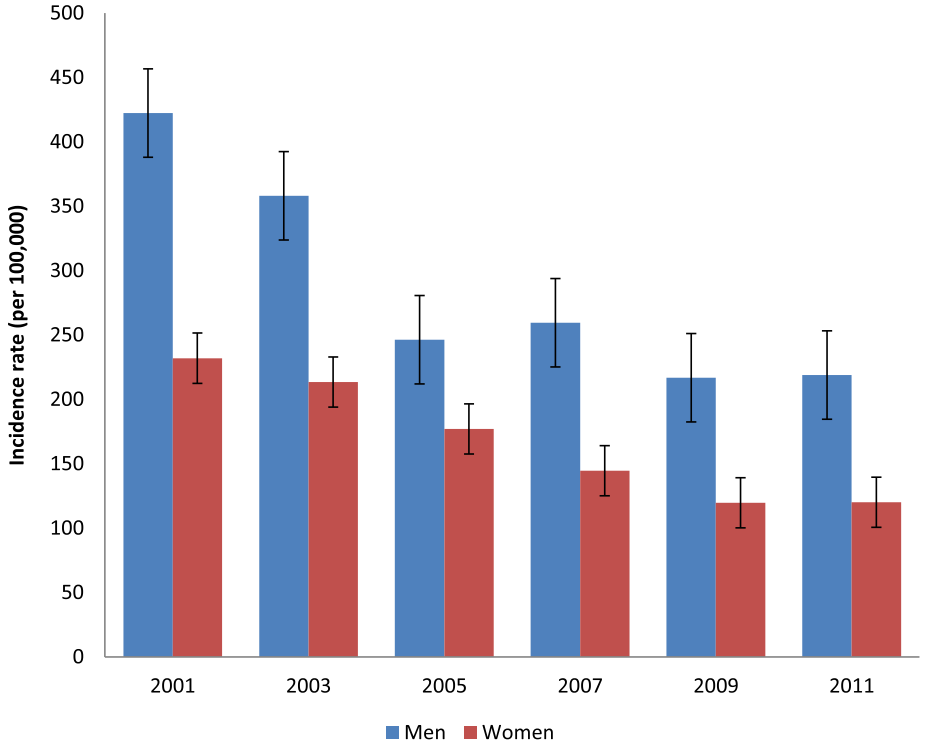

Figure 3. Trends in the age-adjusted hospital incidence rates of initial acute myocardial infarction by sex: Worcester Heart Attack Study.

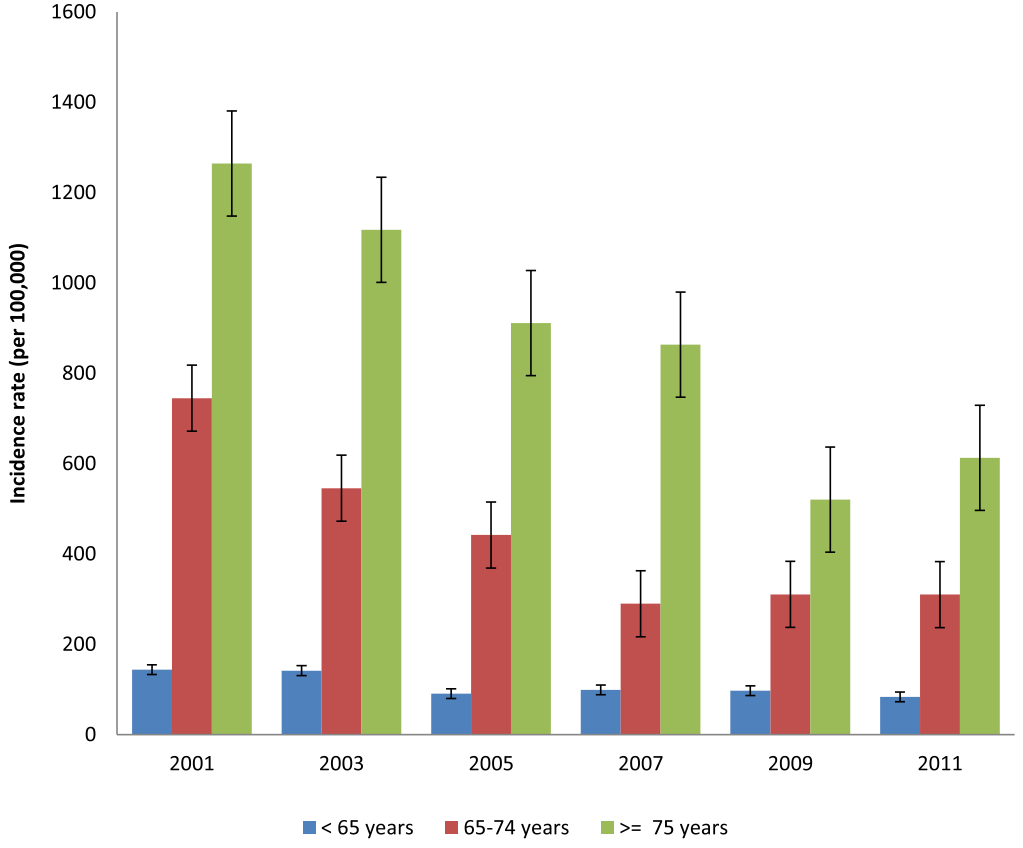

Figure 4. Trends in the age-adjusted hospital incidence rates of initial acute myocardial infarction by age group: Worcester Heart Attack Study.

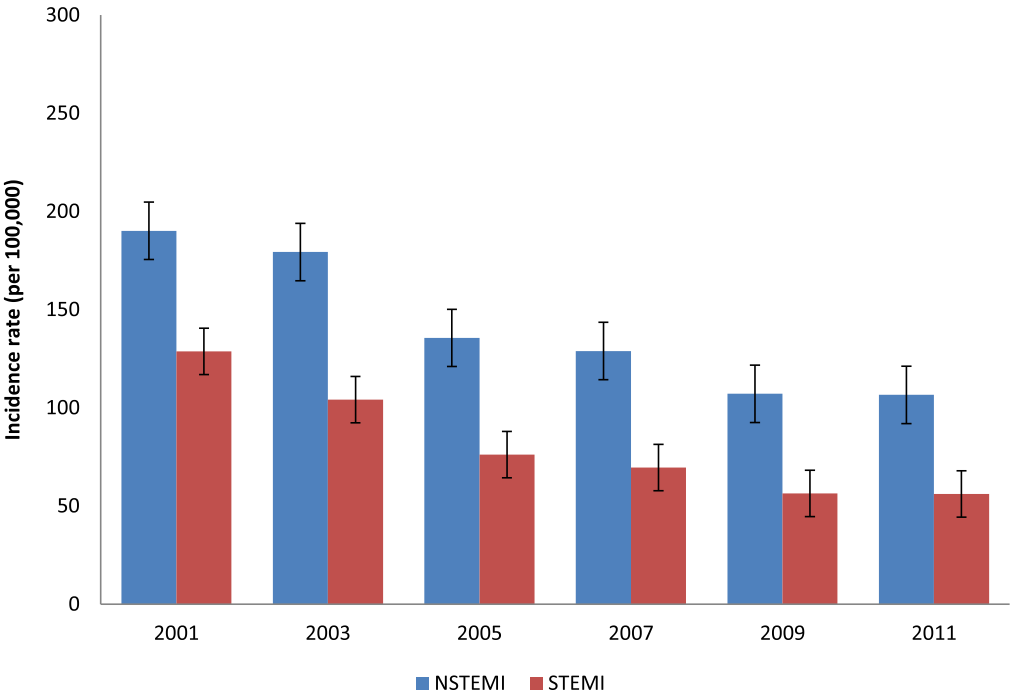

Figure 5. Trends in the age-adjusted hospital incidence rates of initial acute myocardial infarction (AMI) by type of AMI: Worcester Heart Attack Study.

between 2000 and 2008, the age and sex adjusted incidence rates of AMI decreased by an average of nearly 4% annually[22]; the incidence rates of STEMI decreased by nearly 9% annually, whereas the incidence rates of NSTEMI increased and subsequently decreased over time.

Interpretation of trends in the incidence rates of AMI is difficult due to the characteristics of the populations studied, lack of information about the lifestyle and treatment practices of the population from which cases of AMI occurred, years under study, diagnostic criteria for AMI utilized, and whether hospital records were independently reviewed to validate the diagnosis of AMI.

The declines in the incidence rates of AMI that were observed in the present study as well as in previous investigations were most likely due to improvements in primary prevention efforts, including both lifestyle alterations and pharmacological interventions, although we lacked data on the major coronary predisposing factors and preventive practices in residents of central Massachusetts.

We found that the incidence rates of AMI declined for patients hospitalized with an STEMI or NSTEMI, with a larger decrease observed for patients with a STEMI. Other studies using unvalidated diagnostic codes also found similar trends with a larger decline observed in the occurrence rates of STEMI compared with NSTEMI during the periods under study.[10] In a study of more than 125,000 AMI's identified by discharge codes in the Cardiovascular Research Network, the incidence rates of STEMI decreased by more than 50% between 2000 and 2008, whereas the incidence rates of NSTEMI slightly decreased during this period.[22] Since the increased use of laboratory biomarker assays over time may have artifactually affected the observed trends in these incidence rates, it is possible that this effect is greater in patients who develop an NSTEMI where the electrocardiogram is less indicative of an AMI and the diagnosis of AMI is more often based on elevated cardiac biomarker findings.

We found similar relative declines of approximately 45% in the hospital incidence rates of initial AMI in both men and women residents of central Massachusetts between 2001 and 2011. In the Atherosclerosis Risk in Communities (ARIC) Study, the annual incidence rates of AMI declined by 4.3% in white men, 3.8% in white women, 2.9% in black women, and 1.5% in black men between 1987 and 2008.[23] Data from the US and other countries have also shown a decrease in the incidence rates of AMI in both men and women.[4,9,24,25]

We found that the incidence rates of initial AMI declined over time in patients in all age strata, with lesser absolute and relative declines observed in younger as compared with patients 65 years and older. In the Cardiovascular Research Network, the incidence rates of initial AMI declined by more than 4% annually in participants aged 55 years or older which was considerably greater than the annual decline of approximately 1% in younger health maintenance organization (HMO) enrollees.[7]

In the present era of changing patient characteristics, working definitions of AMI, and use of more aggressive lifestyle and treatment approaches to targeted high risk individuals, our findings highlight the importance of surveillance of acute coronary disease at the population level with further in-depth studies needed to attempt to disentangle the reasons for observed trends in AMI incidence rates in the U.S.[26]

Disclosures

There are no conflicts of interest to report on behalf of all the authors.

Acknowledgment

We wish to express our appreciation to all persons involved in the review of data for this project during the years under study. This study was made possible through the cooperation of the administration, medical records, and cardiology departments of participating Worcester metropolitan area hospitals.

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