Impact of Free Universal Medical Coverage on Medical Care and Outcomes in Low-Income Patients Hospitalized for Acute Myocardial Infarction
An Analysis From the French National Health Insurance System

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Background—The type of medical coverage in patients with acute myocardial infarction (AMI) may affect their treatment and outcome.

Methods and Results—We used the reimbursement database from the French National Health Insurance to determine the impact of full medical coverage (Couverture Médicale Universelle Complémentaire, CMUC), a free supplemental insurance for low-income earners <60 years of age, on treatment and outcomes of patients with AMI. The population comprised consecutive patients <60 years of age hospitalized for AMI from January to June 2006 in France. Of 4939 patients with AMI aged <60 years, 587 (12%) were on the CMUC. CMUC and non-CMUC patients were admitted to the same types of institutions, including academic hospitals and private clinics. The use of cardiac catheterization and coronary interventions was similar (adjusted relative risk, 0.97; 95% confidence interval, 0.91–1.05; \( P = 0.45 \)). In-hospital mortality was also comparable (3.1% versus 2.8%, \( P = 0.69 \)). There was no difference in early use of secondary prevention medications after multivariate adjustment. At 30 months, survival and acute coronary syndrome–free survival were lower in CMUC patients (trend, not significant after adjustment). Long-term adherence to statin therapy was lower in CMUC patients (64% versus 77%; adjusted relative risk, 0.82; 95% confidence interval, 0.73–0.92).

Conclusions—Free full coverage for socially deprived people levels inequalities in the acute and midterm treatment of AMI patients. However, full reimbursement per se is not sufficient to ensure optimal patient adherence to secondary prevention medications and may not be enough to prevent an excess of long-term events. (Circ Cardiovasc Qual Outcomes. 2011;4:00-00.)

Key Words: socioeconomic inequities ■ public health ■ acute myocardial infarction ■ health insurance

Socioeconomic conditions are known to affect health status.1–3 Despite the plea of political and health authorities, including the World Health Organization, to reduce health inequalities,4,5 comparatively little information is available on the potential of insurance systems to reduce inequalities in the treatment and outcome of specific diseases. In the United States, there is an ongoing debate on the pros and cons of a universal health coverage system.6–7 The French national health insurance (NHI) is offered to all citizens regularly living in France.8 It supports about 80% of hospital costs and covers medications expenditures between 35% and 65% of their cost; medical consultations are refunded on the basis of an agreed price set by the NHI and reimbursed at 70% of this NHI rate. Supplemental private insurance policies are available for reimbursement for the difference between actual treatment cost and NHI refund, but affiliation to such insurance is highly linked to the patient’s income level. In addition, patients with chronic severe illnesses (a list of 30 so-called “long-term diseases” [LTDs], including coronary artery disease) are entitled to full reimbursement of their treatment, with the exception of a fee per day spent in hospital (€16 per day in 2008) and the difference between the actual physicians honoraria and the NHI rate when the former exceeds the latter (12% of French general practitioners and 40% of specialists demand honoraria exceeding the NHI rate).9 From a practical standpoint, patients are entitled to secondary reimbursement of the expenses specifically related to the LTD, once the presence of the LTD has been

Received December 8, 2010; accepted August 9, 2011.

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Circ Cardiovasc Qual Outcomes is available at http://circoutcomes.ahajournals.org DOI: 10.1161/CIRCOUTCOMES.111.961193
administered and, after they have paid these expenses.

In 2000, the French law extended the system of health coverage and designed a free full universal medical coverage insurance (Couverture Médicale Universelle complémentaire, CMUC), available for low-income persons (annual income $<7447 \text{, increasing according to the number of persons in the beneficiary’s household}) and covering total medical expenditures, including the fee for each day spent in the hospital and not requiring advance payment. 

The purpose of the present study was to determine whether, among patients hospitalized for acute myocardial infarction (AMI), a condition considered to be representative first of acute medical care, then of care for a chronic disease, the CMUC system could level socioeconomic inequalities in treatment and outcomes, that is, whether people with the lower incomes and covered by the CMUC received a level of care similar to that of the other individuals, and whether the CMUC would offer sufficient protection to ensure similar acute and long-term clinical outcomes for socially deprived patients.

**WHAT IS KNOWN**

- Socioeconomic conditions influence health status and are associated with a higher prevalence of risk factors for chronic diseases such as coronary artery disease.
- Social factors may also influence the level of care that patients receive.
- The effect of health insurance coverage on the treatment and clinical outcomes of socially disadvantaged patients with coronary artery disease is the subject of debate.

**WHAT THE STUDY ADDS**

- In acute situations such as acute myocardial infarction, full health insurance coverage appears to permit socially disadvantaged patients to receive a level of care comparable to that of other patients.
- However, long-term adherence to recommended medications is poorer in socially disadvantaged patients, despite full coverage of their health expenses, suggesting that other steps should be taken to improve their long-term outcome.

**Methods**

**Data Source and Collection**

The French general health insurance scheme covers 70% of the population (48 million people in 2006) and 94% of CMUC patients. Its information system (SNIIRAM) contains individualized, anonymous, and exhaustive data on all health spending reimbursements. Other information is also recorded, such as the type of health coverage (CMUC, known presence of 1 of the 30 long-term disorders, or conventional affiliation). The SNIIRAM can be linked to the French hospital discharge medico-administrative database (PMS: program de médicalisation des systèmes d’information), which is used for hospital payment and provides medical information for all patients discharged from both private and public institutions. PMSI incorporates ICD-10 diagnostic coding.

**Study Cohort**

For the present study, all hospitalizations from January to June 2006 with a diagnosis-related-group of MI were selected from the PMSI database (ICD-10 codes I21.0, I21.1, I21.2, I21.3, I21.4, I21.9, I22.0, I22.1, I22.8, I22.9). We selected patients who were covered by the general NHI scheme, and the first hospital admission for MI was used as the index hospital admission. The data were linked, using a common, anonymous patient number, to the corresponding records in the reimbursement database. Of note, the CMUC plan has remained unchanged since 2006.

Because the CMUC does not apply to people 60 years of age or older living in France, because they are entitled to a minimal revenue that exceeds the threshold for getting CMUC, only patients aged <60 years were included in the present analysis. Therefore, the study population comprised all patients aged <60 years at the time of the index AMI, covered by either the CMUC or the general French insurance system.

Patients who received no treatment reimbursement whatsoever 4 to 6 months after the index hospital admission were considered lost to follow-up and excluded from the analyses on the posthospitalization period. Possible reasons for lost contact include death after hospital admission, relocation abroad, changes in social security number (eg, widowed women), and treatment in a follow-up and rehabilitative care establishment after hospital discharge. Overall, 4.6% of CMUC patients and 3.9% of non-CMUC patients were lost to follow-up at 6 months and 6.5% and 3.5%, respectively, were lost to follow-up at 30 months.

**Baseline Data**

The following baseline data were collected: age, sex, use of coronary angiography, coronary stent placement, percutaneous coronary interventions, coronary artery bypass graft procedures during the index hospital stay or within 30 days of discharge, and type of hospital and activity volume, defined as the number of admissions with a discharge diagnosis related group of MI in 2006. Coverage by the CMUC was also recorded. Medication prescription (antihypertensive agents, antithrombotic agents, lipid-lowering drugs, oral anticoagulants, digoxin, nitrates, vasodilators, class III antiarrhythmic agents) at the time of the index hospital admission was based on the reimbursement of these medications during the 6-month period before the admission; because medications are prescribed for 1-month periods in France, we considered that 3 medication deliveries over this 6-month period of time were indicative of medications prescribed before the AMI. Comorbid conditions were sought and defined in several ways: depression and inflammatory diseases were identified through reimbursements of specific medications issued at least 3 times over the 6 months preceding the index hospital admission; patients belonging to the specific “chronic renal disease” LTD and/or treated with dialysis were considered to have chronic kidney failure; chronic obstructive respiratory diseases were characterized by the reimbursement of indicator medications at least twice over the previous 6 months. For cancer, the following indicators were used: radiotherapy and chemotherapy sessions or hospital admission with a main diagnosis of cancer, or specific cancer LTD declared within the past 2 years. Presence of diabetes was characterized by the presence of a specific diabetes LTD or of specific antidiabetic medications refunds. For psychiatric disorders and chronic liver disease, the corresponding specific LTDs were used.

Five-day and in-hospital mortality, as well as in-hospital procedures used during the first 30 days, were used as outcome variables.

**Follow-Up**

All medication reimbursements over the next 6 months were collected; we also collected data on statin reimbursement over the next 30 months. Medications with at least 3 reimbursements over the 6 months after the index episode were considered to be medications prescribed at discharge. Optimal secondary prevention treatment was
defined as patients receiving quadruple secondary prevention medications, i.e., antithrombotic therapy, β-blockers, statins and either angiotensin-converting enzyme inhibitors or angiotensin receptor blockers. Adherence to statin therapy during the follow-up period was studied in patients discharged on statins after the index episode and was defined as ≥80% of expected prescriptions delivered over the follow-up period (i.e., up to 30 months or time of death).

Over the entire 30-month follow-up period, consultations with cardiologists as well as cardiovascular hospital admissions were recorded, based on the reimbursement and PMSI databases.

Long-term survival, acute coronary syndrome hospitalization-free survival, and revascularization-free survival over the 30 months after the acute episode were compared between beneficiaries and nonbeneficiaries of the CMUC.

**Statistical Analysis**

Crude univariate and bivariate analyses were conducted to describe and compare beneficiaries and nonbeneficiaries of the CMUC (Kruskal-Wallis tests for continuous variables and χ² tests for discrete variables). Then, the comparisons were performed with adjustment for sex, age, comorbid conditions, prior hospitalization for cardiovascular conditions, and patient’s region of residence, using multiple Poisson regression analysis. For posthospital medication use, additional adjustment variables were used: stent implantation during index hospitalization, rehospitalization for cardiovascular problems, and associated medications. The adjusted relative risks used to assess treatment and event outcomes were obtained by classic maximum likelihood estimation. We also applied GEE (generalized estimating equations) estimation, accounting for potential patient clustering at the hospital level (345 hospitals). Relative risk estimates using GEE were quite similar, and statistical significance did not change. Adjusted rates (e.g., of stent implantation among patients with or without CMUC) were calculated as follows: (1) first, a logistic regression model for stent implantation was estimated from the overall study population, using all adjustment variables except CMUC status; (2) second, for each patient subgroup of interest (i.e., patients with CMUC on the one hand and without CMUC on the other hand) the ratio between the number of observed stent implantations (O) and the number of expected stent implantations according to the logistic regression model (E) was calculated; and (3) finally, the ratio of O/E was multiplied by the rate of stent implantations in the preceding 6 mo.

**Results**

**Baseline Characteristics of Patients With or Without CMUC**

Of a total of 4939 patients aged <60 years, 587 (12%) were registered with the CMUC. The baseline characteristics of CMUC patients were markedly different from the other patients (Table 1). There were more women (25% versus 14%, P < 0.001), and the patients were significantly younger at the time they presented with AMI (48.1 ± 7.3 years versus 49.7 ± 7.0 years, P < 0.001). CMUC patients had more associated conditions, and in particular more diabetes (21% versus 13%, P < 0.001) and more chronic respiratory diseases (9% versus 5%, P < 0.001). They had received more nonthiazide diuretics (4.9% versus 3.2%, P = 0.03) and more angiotensin-converting enzyme inhibitors (13.6% versus 9.3%, P < 0.001) before the index hospitalization, and a similar trend was observed for nitrates (2.2% versus 1.2%, P = 0.06) and clopidogrel use (8.0% versus 6.1%, P = 0.07).

**In-Hospital Treatment**

The initial treatment of the patients was similar, whatever their coverage status (Table 2): 38% of the patients were admitted to academic public institutions (CMUC: 40% versus non-CMUC: 38%), whereas 23% were admitted to private institutions (CMUC: 22% versus non-CMUC: 23%). Likewise, there were no differences regarding admissions to low-versus high-volume institutions. A vast majority underwent coronary angiography (CMUC: 91% versus non-CMUC: 93%, P = 0.08). Percutaneous coronary interventions, however, were used slightly less often in CMUC patients (73%
versus 78%, P<0.02). Likewise, the use of stents was slightly less (70% versus 75%, P<0.02). However, the difference did not persist after multivariate adjustment for age, sex, previous cardiovascular history, associated conditions, and region (adjusted rates: CMUC: 72% versus non-CMUC: 74%; relative risk, 0.97; 95% confidence interval, 0.91–1.05; P=0.45). Information on the use of drug-eluting stents was available only for the patients hospitalized in private clinics; in keeping with the higher prevalence of diabetes, drug-eluting stents were used more often in CMUC patients (47.6% versus 33.9%, P<0.02). Finally, the duration of hospitalization was similar in the 2 groups (CMUC: 7.41±5.8 days, non-CMUC: 7.42±7.2 days, P=0.98).

Early Outcomes
The 5-day hospital mortality rates were 1.7% (CMUC patients) versus 2.1% (non-CMUC patients). The respective

### Table 2. In-Hospital Treatment and Mortality Rates According to National Health Insurance Status

<table>
<thead>
<tr>
<th>Procedures</th>
<th>Value</th>
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<tbody>
<tr>
<td>Coronary angiography with/without PCI</td>
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<td>Stent</td>
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<td>CABG</td>
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<td>Overall in-hospital mortality</td>
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</table>

CMUC indicates Couverture Médicale Universelle Complémentaire (full universal medical coverage); CI, confidence interval; CABG, coronary artery bypass graft surgery; and PCI, percutaneous coronary intervention.

Data in columns “No CMUC” and “CMUC” are expressed as number of patients (column percentage).

*Adjusted for age, sex, comorbid conditions (cancer, diabetes, renal disease, chronic obstructive respiratory disease, depression, inflammatory disease, chronic liver disease, and psychiatric disorders), hospitalization for cardiovascular reasons in the preceding 6 months, and patient’s region of residence.

### Table 3. Post–Hospital Treatment at 6 Months According to National Health Insurance Status

<table>
<thead>
<tr>
<th>Consultation with a cardiologist</th>
<th>Value</th>
<th>Value</th>
<th>Value</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Medications</td>
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<tr>
<td>Aspirin</td>
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<tr>
<td>Clopidogrel</td>
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<tr>
<td>Aspirin and clopidogrel</td>
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<td></td>
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<tr>
<td>Any antplatelet agent</td>
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<tr>
<td>Statin</td>
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<tr>
<td>β-blocker</td>
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<tr>
<td>ACE inhibitor</td>
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<tr>
<td>ACE-I or ARB</td>
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<tr>
<td>Quadruple therapy</td>
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</tbody>
</table>

CMUC indicates Couverture Médicale Universelle Complémentaire (full universal medical coverage); CI, confidence interval; ACE-I, angiotensin-converting enzyme inhibitor; and ARB, angiotensin receptor blocker.

Data in columns “No CMUC” and “CMUC” are expressed as number of patients (column percentage).

*Adjusted for age, sex, comorbid conditions (cancer, diabetes, renal disease, chronic obstructive respiratory disease, depression, inflammatory disease, chronic liver disease, and psychiatric disorders), hospitalization for cardiovascular problems in the preceding 6 months, and patient’s region of residence. Medications were further adjusted for stent implantation during index hospitalization, hospitalization for cardiovascular problems in the following 6 months, and other medications (nonthiazide and thiazide diuretics, calcium channel blockers, digoxin, class III antiarrhythmic agents, nitrates, vasodilators, fibrates, nonstatin and nonfibrate lipid-lowering drugs, heparins, and oral anticoagulants).
patients ($P=0.0002$); after Cox multivariate adjustment, the difference remained significant, with a hazard ratio of 1.27 ($P=0.0494$).

**Discussion**

Inequalities in health care constitute a major ethical and political issue. The current study suggests that providing access to full medical coverage for socially deprived populations can level such inequalities in patients hospitalized for acute conditions such as AMI. In fact, patients on CMUC with AMI were admitted to the same institutions, including private clinics, as non-CMUC patients; their initial treatment, including invasive coronary interventions, was similar, and their early mortality rates were equivalent. Immediately after the acute phase, secondary prevention medications were prescribed and used in a similar way whatever the type of health coverage of the patients, and the patients consulted cardiologists as often. In the longer term, however, adherence to statin therapy, used as a surrogate for overall medication adherence, was significantly lower in CMUC patients; they also consulted cardiologists less often, and a trend to increased 30-month death or death or hospitalization for acute coronary syndrome was observed.

Providing access to optimal care for socially deprived patients is of particular importance because their health hazards are greater. Thus, a recent study from North West England found that social deprivation was an independent correlate of midterm mortality in patients undergoing coronary artery bypass surgery.\(^{13}\) In our study, patients on the CMUC were younger and had more comorbidities at baseline, suggesting a negative health impact of social deprivation.

In France, the regular health insurance system offered to residents covers 78% of average health costs. However, studies carried out in the 1990s showed that the proportion of low-income people with unmet medical needs was much higher than that in people with higher income levels. This led to the creation of the CMUC, and studies after its implementation showed that it markedly reduced inequalities in terms of access to medical care, although some differences persisted.\(^{14}\) A nationwide survey in 2008 showed that 16.5% of the population ages 18 to 64 years declared having unmet medical needs because of financial reasons; people in the lowest quintile of income had a 3-fold increased risk of unmet medical needs, compared with those in the highest quintile. Affiliation to the CMUC has decreased but not completely erased these inequalities: compared with people without supplemental insurance who had a 30.4% rate of unmet needs, the rate for CMUC-affiliated people was 21%, whereas the rate for people with private supplemental insurance was 15.3%. Likewise, comparing unmet needs in lower income populations before (1998) and after (2002 and thereafter) implementation of the CMUC confirmed its positive impact on access to care.\(^{15}\)

Importantly, however, in our population, although full medical coverage seemed capable of leveling inequalities at the acute stage of MI, it was not sufficient to ensure optimal long-term medical care: adherence to statin therapy was less in CMUC patients, despite the fact that the medications could be delivered at no cost. Likewise, CMUC patients consulted...
cardiologists less often than did non-CMUC patients, a factor that may also have concurred in the lower long-term use of statins. Although it can be presumed that adherence would have been even poorer, had the medications not been completely free of charge, it appears that other measures (beyond full reimbursement of health costs) must be taken to improve medication adherence in socially deprived patients.

The impact of insurance systems on the health of socially deprived populations has been assessed in a number of studies, mostly from the United States. Overall, uninsured people have higher mortality rates and receive fewer costly procedures than privately insured patients. At the acute stage of MI, the use of invasive procedures is related to the type of payer, as shown by analyses from the National Registries of Myocardial Infarction (NRMI). An analysis based on the records of 124 599 Medicare patients hospitalized for AMI in New York City from 1988 through 2001 showed that patients who had a supplemental private insurance were significantly more likely to get revascularization procedures than patients on Medicare only or patients with supplemental public insurance.

The respective effects of socioeconomic status and type of insurance coverage on care and outcomes deserve consideration because socioeconomic status might be more important to determine access to care than type of insurance coverage. This, however, appears highly debated, with contradictory reports from the United States and Canada.

Insurance coverage may also affect mortality and clinical outcomes. In patients with AMI, analyses from the NRMI-2 showed that adjusted in-hospital mortality rate was lower in commercially insured patients, compared with Medicaid patients, uninsured patients, or younger Medicare patients. Similar findings were observed in the New York City registry: mortality in patients with supplemental private insurance was 23% lower than that of Medicare-only patients. In the CRUSADE (Can Rapid risk stratification of Unstable angina patients Suppress ADverse outcomes with Early implementation of the ACC/AHA guidelines) registry, MEDICAID patients were less likely to receive recommended medications after an acute coronary syndrome and had worse clinical outcomes than patients with Health Maintenance Organization or private insurance as the primary payer.

The impact of insurance coverage on clinical events has also been observed in clinical settings outside cardiovascular diseases. Uninsured people receive less recommended medical care and take longer to return to full health, an indicator of poorer long-term outcome.

In this context, it is noteworthy that patients on the CMUC had in-hospital death rates similar to those in non-CMUC patients: adequate insurance coverage therefore seems helpful to erase social inequalities in acute outcomes for conditions such as MI.

In chronic patients, optimal coverage of health costs also matters for the use of recommended medications. A study including Veterans from Philadelphia showed that the increase in copayment by the patient resulted in decreased adherence to lipid-lowering therapy. In Medicare patients, low-income beneficiaries are entitled to receive part D subsidies to cover extra costs for their medications; the system has allowed recipients to decrease their out-of-pocket costs for their medications and has improved adherence.

Our study has several limitations. First, because French law mandates destruction of health insurance databases after 3 years, we were unable to compare outcomes before and after the implementation of the CMUC. Also, because we used an administrative database, possible confounders such as detailed medical characteristics at the acute stage of AMI were not available for multivariate adjustments. Second, because of a limited sample size, we cannot exclude that the trends observed, in particular regarding long-term mortality, would have become statistically significant, should the population have been larger (type II error). Conversely, because of the numerous analyses made, a risk of inflated type I error cannot be excluded. Third, we analyzed the treatment and outcomes of patients who had been hospitalized. We have no way to determine whether the proportion of undiagnosed AMI differed between CMUC and non-CMUC patients. Finally, although our data are quite encouraging as regards the treatment of acute conditions such as AMI, they clearly cannot be extrapolated to the whole system of care. In particular, some French physicians affiliated with the NHI plan can ask additional honoraria on top of those reimbursed by the NHI, and a report from the French Ministry of Health recently pointed out that some of these practitioners refused to take care of CMUC patients; a recent survey in the Paris area showed that 25% of CMUC patients were refused access to care by physicians. Likewise, our findings within the French system of care may not be readily extrapolated to other countries.

In conclusion, we found that the CMUC system, which offers free full medical coverage to socially deprived people in France, may be a way to level inequalities in the acute and short-term treatment of patients with AMI. Beyond the acute stage, however, full medical coverage appears insufficient by itself to ensure optimal adherence to recommended medications. Considerable efforts therefore remain needed in terms of patient education in socially deprived populations. Beyond patient education regarding adherence to recommended medications, efforts should also be directed at lifestyle modifications in this population in which the prevalence of risk factors is particularly high.

Disclosures
Dr Danchin is the past Chairman of the Scientific Committee of the French National Health Insurance system (Caisse Nationale d’Assurance Maladie). He reports having received lecturing/consulting fees from AstraZeneca, Eli Lilly, Novo, Sanofi-Aventis, and Servier; lecture fees from Boehringer-Ingelheim, Bristol-Myers Squibb, Glaxo Smith Kline, Menarini, Merck-Serono, and MSD-Schering Plough; and grant support from Astrazeneca, Eli-Lilly, GSK, Merck-Schering-Plough, Novartis, Pfizer, Sanofi-Aventis, Servier, and The Medicines Company. Drs Neumann, Tuppin, Weill, Ricordeau, and Allemand are full-time employees of the French National Health Insurance system (Caisse Nationale d’Assurance Maladie).

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Circ Cardiovasc Qual Outcomes. published online October 4, 2011; Circulation: Cardiovascular Quality and Outcomes is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 1941-7705. Online ISSN: 1941-7713

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