Health Insurance and Mortality After Percutaneous Coronary Intervention: A Systematic Review

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Abstract

Background: Lack of health insurance may present a barrier to healthcare access for patients with acute coronary syndromes. Among interventional procedures, revascularization plays a critical role in treatment for acute coronary syndromes. A growing body of literature addresses outcome differences after percutaneous coronary intervention (PCI) between those with insurance and those without insurance. The purpose of this paper is to perform a systematic review of the literature examining how lack of health insurance is associated with mortality after percutaneous coronary intervention.

Method: An electronic database literature search was performed using the terms “medically uninsured” and “angioplasty”. Further studies were identified from bibliographies of eligible studies. Full-text articles were reviewed based on eligibility criteria. Excluded studies included those in non-U.S. settings, letters to the editor, review narratives, and those that did not explicitly report insurance status and PCI outcomes. Articles were critically appraised using the GRADE criteria.

Results: Two observational cohort studies were analyzed. Both studies showed significantly greater rates of adjusted mortality after percutaneous coronary intervention for patients without insurance. Both studies had limitations common to those of observational studies. The quality of evidence was ultimately rated as moderate using the GRADE method.

Conclusion: Assessment from two observational studies found that lack of health insurance was an independent risk factor for mortality following percutaneous coronary intervention. While no causal relationship can be drawn from this conclusion, mortality differences are likely associated with insurance-related disparities in healthcare access. Clinicians should consider patient-specific financial barriers, including lack of health insurance, when considering treatment and potential outcomes. Because so many Americans are uninsured and many are expected to remain uninsured, these types of studies have critical implications for healthcare reform.

Keywords: medically uninsured, angioplasty, percutaneous coronary intervention

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Health Insurance and Mortality After Percutaneous Coronary Intervention: A Systematic Review

A Clinical Graduate Project Submitted to the Faculty of the
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Alexis Steinberg is a native of the Mountain West, where she seeks reasons to wander.
Abstract

**Background:** Lack of health insurance may present a barrier to healthcare access for patients with acute coronary syndromes. Among interventional procedures, revascularization plays a critical role in treatment for acute coronary syndromes. A growing body of literature addresses outcome differences after percutaneous coronary intervention (PCI) between those with insurance and those without insurance. The purpose of this paper is to perform a systematic review of the literature examining how lack of health insurance is associated with mortality after percutaneous coronary intervention.

**Method:** An electronic database literature search was performed using the terms “medically uninsured” and “angioplasty”. Further studies were identified from bibliographies of eligible studies. Full-text articles were reviewed based on eligibility criteria. Excluded studies included those in non-U.S. settings, letters to the editor, review narratives, and those that did not explicitly report insurance status and PCI outcomes. Articles were critically appraised using the GRADE criteria.

**Results:** Two observational cohort studies were analyzed. Both studies showed significantly greater rates of adjusted mortality after percutaneous coronary intervention for patients without insurance. Both studies had limitations common to those of observational studies. The quality of evidence was ultimately rated as moderate using the GRADE method.

**Conclusion:** Assessment from two observational studies found that lack of health insurance was an independent risk factor for mortality following percutaneous coronary intervention. While no causal relationship can be drawn from this conclusion, mortality differences are likely associated with insurance-related disparities in healthcare access. Clinicians should consider patient-specific financial barriers, including lack of health insurance, when considering treatment and potential outcomes. Because so many Americans are uninsured and many are expected to remain uninsured, these types of studies have critical implications for healthcare reform.

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To Sean, Tanya, Shannon, H.Gregg, Clyde, and Tibbs, thank you for being amazing friends and reminding me to breathe.
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Table I: Study Characteristics and Quality Assessment

List of Abbreviations

HR..................................................................................................................Hazard Ratio
MACE.....................................................................................................Major Adverse Cardiac Event
MI.....................................................................................................myocardial infarction
OR.....................................................................................................Odds Ratio
PCI....................................................................................................percutaneous coronary intervention
STEMI.........................................................................................ST-segment elevation myocardial infarction
Health Insurance and Mortality After Percutaneous Coronary Intervention: A Systematic Review

BACKGROUND

Healthcare insurance is a growing concern among the U.S. population and national health policy now explicitly addresses the disparity between insured and uninsured groups. An estimated 49.9 million Americans are uninsured. Socioeconomic factors influence the prevalence of cardiovascular disease, complications of which cost the national healthcare system an estimated $286.6 billion per year. Cardiovascular disease is the leading cause of death among adults, and over half of cardiovascular events are associated with coronary artery disease (CAD). Uninsured patients carry the burden of this, as lack of insurance is associated with higher mortality rates in patients with CAD, and a comparatively higher proportion of ED visits for acute myocardial infarction (MI).

Previous studies suggest that lack of health insurance may present a barrier to healthcare access for patients with acute complications of CAD or acute coronary syndromes such as MI or unstable angina. Smolderen et al demonstrated that, in acute MI patients, lack of health insurance was associated with greater pre-hospital delay, which likely puts these patients at risk for poorer outcomes. Most studies, however, have focused on patient outcomes after acute coronary events based on insurance status. Many of these suggest that uninsured patients are at greater risk for increased morbidity and mortality after MI.
Effective treatment modalities to reduce mortality after acute coronary events have been developed, but lack of health insurance may also present a barrier to healthcare interventions and treatment. Among interventional procedures, percutaneous coronary intervention (PCI) plays a critical role in treatment for acute coronary syndromes. Current ACC/AHA Guidelines recommend reperfusion therapy with PCI as first-line treatment for ST-segment elevation MI (STEMI).\(^{16}\) Specifically, PCI has been shown to decrease mortality after STEMI, and is particularly beneficial for the highest risk patients.\(^{16,17}\) And while increased use of guideline-recommended PCI has resulted in significantly decreased mortality in patients with ACS, there continues to be a disparity in its use.\(^2\)

Several studies have found that the uninsured in particular, are less likely to receive invasive cardiac procedures after MI.\(^{10,12,13,15,18,19}\) Only a few studies, however, have addressed outcome differences after PCI treatment based on insurance status.\(^{20,21}\) One hypothesized advantage to these studies is that potential confounders associated with healthcare access and types of treatment received are eliminated: all patients presented for and underwent revascularization with PCI. The purpose of this paper is to perform a systematic review of the literature examining how lack of health insurance affects mortality in patients after percutaneous coronary intervention.

**METHODS**

**Literature Search and Selection**

An exhaustive literature search was performed using electronic databases and bibliographies of eligible studies. Electronic databases searched included MEDLINE, CINAHL, Evidence Based Medicine Reviews Multifile, and NCBI using the MeSH
terms “medically uninsured” and “angioplasty”. Titles and abstracts were screened for relevance and full-text articles were formally reviewed. Excluded studies were those in non-U.S. settings, letters to the editor, review narratives, and those that did not explicitly report insurance and PCI outcomes.

**Data Analysis**

Eligible articles were critically appraised using the GRADE criteria.\(^\text{22}\) Specifically, studies were evaluated for potential limitations, consistency, directness, precision, and outcome analysis. GRADE methods were applied to upgrade or downgrade the studies, where necessary, and the quality of evidence was ultimately rated.

**RESULTS**

**Systematic Review**

The literature search produced 37 articles. Titles and abstracts of these articles were screened for relevance and 7 were excluded. Thirty full-text articles were formally reviewed and two studies were found eligible for inclusion in qualitative synthesis. Both of these articles were published in 2011 and were retrospective cohort studies. The quality of evidence was ultimately rated as moderate using the GRADE method. Findings were summarized and analysis presented, as shown in Table 1: Study Characteristics and Quality Assessment.

**Study Characteristics**

**Gaglia et al** -- This retrospective cohort study\(^\text{20}\) analyzed data for 13,573 patients who underwent PCI at a single center between June 2000 and June 2009. Patients were
prospectively entered in the study and indicated for PCI based on stable or unstable angina, or acute MI. Baseline characteristics by insurance type included age, sex, race, ethnicity, clinical presentation, medical history risk factors, and specific procedural characteristics. The primary outcome measured was major adverse cardiac events (“MACE”), as measured up to 1-year post-PCI. The study defined MACE as a composite of all cause mortality, Q-wave myocardial infarction, and target vessel revascularization. A central database center managed and analyzed all clinical, procedural, follow-up, and insurance data collected from hospital charts, office visits, and phone interviews. Outcomes were recorded up to 1-year post-PCI.

Statistical adjustment for baseline characteristics was performed using multivariable Cox regression analyses. Separate analyses were performed for patients <65 years old and ≥65 years old, as uninsured patients were included only in the younger age group analysis. Of the 13 573 patients included in the study, 284 (2.1%) were uninsured. Uninsured patients were more likely to have received a glycoprotein IIb/IIIa inhibitor versus bivalirudin and a bare metal stent versus a drug-eluting stent. Analyses included univariate outcomes by insurance type, Kaplan-Meier survival probability, and adjusted hazard ratios for MACE at 1 year. Overall, this study showed significantly greater rates of mortality in-hospital and up to 1 year after PCI for patients without insurance compared to those with private insurance in the age group <65 years old (HR 2.41, 95% CI 1.36 - 4.27).

Parikh et al – This retrospective cohort study analyzed data for 13 456 patients who underwent PCI at four New York State hospitals between January 1, 2004 and December 31, 2007. Baseline characteristics by insurance type included age, sex, race,
ethnicity, clinical presentation, medical history risk factors, urgency for PCI, and specific procedural characteristics. Medicare patients were excluded. The primary outcome measured was in-hospital all cause mortality post-PCI. A central database center managed and analyzed all data collected from hospital charts. Outcomes were recorded through patient hospital stay.21

Statistical adjustment for baseline characteristics was performed using multivariable logistic regression analyses. Of the 13 456 patients included in the study, 493 (3.7%) were uninsured. Uninsured patients were more likely to have received a bare metal stent versus a drug-eluting stent. Analyses included univariate in-hospital outcomes by insurance type, adjusted odds ratios for all cause in-hospital mortality, and a subset adjusted odds ratio for patients undergoing emergent PCI. Overall, this study showed significantly greater rates of adjusted in-hospital mortality after PCI for patients without insurance (OR 3.02, 95% CI 1.10 - 8.28).21

DISCUSSION

From this systematic review, lack of health insurance was an independent risk factor for mortality following percutaneous coronary intervention. Evidence for mortality following PCI was of moderate quality according to the GRADE approach. Ultimately, findings from these observational studies agreed with findings from other studies evaluating mortality outcomes among the uninsured.

Because mortality is strongly influenced by age, these studies importantly differentiated patients >65 years old or with Medicare by separate analysis or exclusion, respectively. And while other baseline characteristics within the <65 year old group were
statistically adjusted for, their differences hold important relevance. For example, uninsured patients studied by Parikh et al\textsuperscript{21} tended to present with comparatively reduced left ventricular ejection fractions and more advanced CAD for age. Similar differences were found in baseline characteristics of the BARI2D revascularization trial\textsuperscript{23}, where uninsured patients presented with more cardiovascular risk factors and poorer baseline status of CAD. Other differences may be found at the provider-level, as demonstrated by both studies analyzed here, where uninsured patients were less likely to receive drug-eluting stents.\textsuperscript{20,21} Amin et al\textsuperscript{8} identified another potential disparity by addressing healthcare follow-up. In this study, “noncompliance” (missing follow-up appointments, failing to fill medications) post-MI was associated with increased mortality among uninsured patients. Such differences may point toward a multifactorial etiology of insurance-based disparities with regard to patient mortality. The uninsured may not be receiving ambulatory care that would potentially identify and treat risk factors contributing to CAD, and so are presenting for invasive intervention with higher disease burdens. Additionally, the uninsured may be receiving a different quality of care and/or not receiving adequate follow-up.

**Limitations**

Although these studies were large, they had the limitations of nonrandomized observational studies, including uncontrolled confounding and misclassification bias. However, due to the nature of studies investigating harm outcomes, randomized studies may not be performed. Ultimately, findings from both of these studies agreed with findings from other studies evaluating mortality outcomes among the uninsured.
Prognostically different baseline characteristics between patient groups are inherent to studies of this type. When these were controlled for, statistical analyses were still significant. Between studies, there were small differences in the baseline medical history that were controlled for. Gaglia et al\textsuperscript{20} additionally evaluated hypertension, dyslipidemia, and smoking status as risk factors; whereas Parikh et al\textsuperscript{21} evaluated prior MI and stroke characteristics. Potentially, there were unrecognized baseline characteristics between insurance groups, or medical history that was unrecognized by the patients themselves. For example, those without prior healthcare, like the uninsured, may not have had a documented history or personal knowledge about existing hypertension. There was also variability in patient treatments. In both studies, uninsured patients were more likely to receive bare metal stents versus drug-eluting stents.\textsuperscript{20,21} Gaglia et al\textsuperscript{20} further reported that uninsured patients were more likely to receive a glycoprotein IIb/IIIa inhibitor than bivalirudin.

Other potential limitations included short follow-up by the Parikh et al study,\textsuperscript{21} and potential bias due to the small number of uninsured patients within larger study populations. Results were statistically significant, as demonstrated by the hazard and odds ratios, although wide confidence intervals indicated less precision. Finally, these studies likely underestimated the mortality associated with lack of insurance because only patients who accessed the healthcare system were measured. The potential group of uninsured patients who were not admitted, died pre-hospital, or had CAD but were not treated with PCI were left unmeasured.

\textbf{Recommendations for Further Study}
Further studies are needed to address the disparities associated with healthcare outcomes and insurance status. A meta-analysis and systematic review evaluating post-MI mortality among uninsured patients may provide significant clinical and policy-making implications. Further studies are also needed to assess long-term outcomes, such as barriers to medications and follow-up, problems with pre-hospital and ambulatory access, long-term differences using specific cardiac interventions, and cause-specific mortality.

Lack of insurance is associated with morbidity and mortality, which suggests that universal health coverage could save lives. But, studies that evaluated socioeconomic status, versus insurance status alone, show that we may be underinsuring. Rahimi et al found that patients with self-reported financial barriers, 68.9% of whom were actually insured, had worse outcomes post-MI. Horne et al also demonstrated that socioeconomic status was an independent risk factor for mortality in patients with CAD. The concept of underinsurance is further supported by data that suggest that Medicaid patients are at as great a risk for mortality as the uninsured. Medicaid patients <65 years old were at comparatively increased risk for mortality following PCI in both studies evaluated here. Other studies support these findings, reporting outcome and treatment differences among Medicaid patients. Further studies that control for potential confounders associated with the Medicaid cohort, such as chronic or congenital problems, are needed.

Evidence from countries with forms of universal health coverage also suggests that socioeconomic status is associated with adverse cardiovascular outcomes. In a study from Canada, Alter et al found that socioeconomic status was associated with
increased mortality up to one year after MI. Their results even demonstrated a dose-response, where each established increase in income was associated with reduced mortality. A long-term study from Israel by Gerber et al.\textsuperscript{29} showed similar outcomes, where socioeconomic status was strongly associated with mortality up to 13 years post-MI. Such studies expose how insurance status alone may not eliminate financial barriers to healthcare access, treatment, and outcomes. These results may have implications for the quality of insurance that is developed and maintained by healthcare policy, as well as the public support provided to patients with socioeconomic barriers to healthcare.

**CONCLUSION**

Assessment from a systematic review of two observational studies found that lack of health insurance was an independent risk factor for mortality following percutaneous coronary intervention. While no causal relationship can be drawn from this conclusion, mortality differences are likely associated with insurance-related disparities in healthcare access. Clinicians should consider patient-specific financial barriers, including lack of health insurance, when considering treatment and potential outcomes. Because so many Americans are uninsured and many are expected to remain so, these types of studies have critical implications for healthcare reform.
References


Table I.

Study Characteristics and Quality Assessment

<table>
<thead>
<tr>
<th>Study</th>
<th>Total No. of patients</th>
<th>No. of uninsured patients</th>
<th>Results</th>
<th>Limitations</th>
<th>Inconsistency</th>
<th>Indirectness</th>
<th>Imprecision</th>
<th>Other</th>
<th>Quality of Evidence</th>
<th>Outcome-Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaglia et al</td>
<td>13,573</td>
<td>284 (2.1%)</td>
<td>HR 2.41 95% CI 1.36-4.27</td>
<td>no limitations</td>
<td>no inconsistency</td>
<td>no indirectness</td>
<td>no imprecision</td>
<td></td>
<td>Moderate</td>
<td>Mortality-Critical</td>
</tr>
<tr>
<td>Parikh et al</td>
<td>13,456</td>
<td>493 (3.7%)</td>
<td>OR 3.02 95% CI 1.10-8.28</td>
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<td></td>
<td></td>
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</tr>
</tbody>
</table>

2 obs. cohort studies