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Changes in Myocardial Infarction Guideline Adherence as a Function of Patient Risk

An End to Paradoxical Care?

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Objectives The goals of this analysis were to determine: 1) whether guideline-based care during hospitalization for a myocardial infarction (MI) varied as a function of patients' baseline risk; and 2) whether temporal improvements in guideline adherence occurred in all risk groups.

Background Guideline-based care of patients with MI improves outcomes, especially among those at higher risk. Previous studies suggest that this group is paradoxically less likely to receive guideline-based care (risk–treatment mismatch).

Methods A total of 112,848 patients with MI were enrolled at 279 hospitals participating in Get With The Guidelines–Coronary Artery Disease (GWTG–CAD) between August 2000 and December 2008. We developed and validated an in-hospital mortality model (C-statistic: 0.75) to stratify patients into risk tertiles: low (0% to 3%), intermediate (3% to 6.5%), and high (>6.5%). Use of guideline-based care and temporal trends were examined.

Results High-risk patients were significantly less likely to receive aspirin, beta-blockers, angiotensin-converting inhibitors/angiotensin receptor blockers, statins, diabetic treatment, smoking cessation advice, or cardiac rehabilitation referral at discharge compared with those at lower risk (all $p < 0.0001$). However, use of guideline-recommended therapies increased significantly in all risk groups per year (low-risk odds ratio: 1.33 [95% confidence interval (CI): 1.22 to 1.45]; intermediate-risk odds ratio: 1.30 [95% CI: 1.21 to 1.38]; and high-risk odds ratio: 1.30 [95% confidence interval: 1.23 to 1.37]). Also, there was a narrowing in the guideline adherence gap between low- and high-risk patients over time ($p = 0.0002$).

Conclusions Although adherence to guideline-based care remains paradoxically lower in those MI patients at higher risk of mortality and most likely to benefit from treatment, care is improving for eligible patients within all risk categories, and the gaps between low- and high-risk groups seem to be narrowing. (J Am Coll Cardiol 2011;58:1760–5) © 2011 by the American College of Cardiology Foundation

The American College of Cardiology/American Heart Association provide evidence-based guidelines to manage patients presenting with acute coronary syndromes. Guideline-based care of patients with acute coronary syndromes improves their subsequent outcomes (1). Highest-risk patients benefit most from more aggressive intervention (2). However, previous observations have revealed that higher-risk

See page 1766

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patients are less likely to receive guideline-based therapies, and this has been termed the "risk–treatment paradox" (3–5). This paradox may reflect accurate recognition of higher-risk patients but not prescribing therapy out of concern of adverse events with treatment; not prescribing due to knowledge gaps regarding guideline recommendations; or absolute contraindications being present but not documented. Alternatively, the paradox may reflect difficulties physicians face in estimating mortality risk. Although adherence to guideline-based treatment in hospitals across the United States has been improving every year (6,7), whether such improvement has occurred uniformly or is only confined to lower-risk patients has never been examined.

GWTG–CAD (Get With The Guidelines–Coronary Artery Disease) is a national performance improvement program and registry that collects information on the clinical characteristics, guideline-based therapy adherence, and outcomes across the spectrum of clinical care in the United States. Using this registry, we evaluated the following: 1) whether the application of guideline-based care among myocardial infarction (MI) patients remains suboptimal in patients at a higher baseline risk; and 2) whether there is a significant temporal change in the application of guideline-based therapies in each risk group.

Methods

Details regarding the GWTG-CAD database, selection of the study patients, development/validation of a risk stratification model, and detailed statistical analysis have been described in an online attachment (Online Appendix).

Results

Sample characteristics. The cohort included 112,848 MI patients enrolled in GWTG from 279 sites between August 15, 2000, and December 30, 2008 (Fig. 1). Using the previously described risk prediction model, patients were classified into 3 tertiles of increasing risk: 36,541 (33.3%) classified as low risk; 36,542 (33.3%) as intermediate risk; and the remaining 36,541 (33.3%) as high risk. Although high-risk patients were more likely to be older, female, and have multiple medical comorbidities, they had better initial lipid and glycemic profiles (Online Table 1). High-risk patients were hospitalized longer (median length of stay 5 days), were less likely to be discharged home, and were more likely to die during their hospitalization (Online Table 2) than lower-risk patients.

Adherence to quality and performance measures. After adjusting for various confounders, higher-risk patients were less likely to receive aspirin and beta-blockers within 24 h of presentation, were less likely to have their low-density lipoprotein (LDL) values recorded or receive lipid-lowering agents, and usually were revascularized/thrombolysed after greater delay (ST-segment elevation myocardial infarction [STEMI]/left bundle branch block patients) compared with lower-risk MI patients. At discharge, eligible higher-risk patients were also less likely to receive aspirin, angiotensin-converting inhibitors/angiotensin receptor blockers, and beta-blockers (all $p < 0.001$). Moreover, these patients were less likely to have a last recorded blood pressure ≤140/90 mm Hg (odds ratio [OR]: 0.60 [95% confidence interval (CI): 0.56 to 0.64]), were less likely to have received smoking cessation counseling (OR: 0.41 [95% CI: 0.35 to 0.47]), and were less likely to have attained 100% compliance with quality/performance measures (OR: 0.60 [95% CI: 0.55 to 0.65]) (Online Tables 3, 4, and 5).

Abbreviations and Acronyms

CI = confidence interval
LDL = low-density lipoprotein
MI = myocardial infarction
OR = odds ratio
STEMI = ST-segment elevation myocardial infarction

Temporal trends in performance/quality measures. From 2002 to 2008, a progressive increase in adherence to all quality and performance measures was observed (yearly adjusted composite performance measure increase low-risk OR: 1.33 [95% CI: 1.22 to 1.45]; intermediate-risk OR: 1.30 [95% CI: 1.21 to 1.38]; and high-risk OR: 1.30 [95% CI: 1.23 to 1.37]) (Fig. 2). The most notable improvement in quality measures was seen in smoking cessation advice given to current smokers at discharge (low-risk OR: 1.76 [95% CI: 1.53 to 2.03]; intermediate-risk OR: 1.70 [95% CI: 1.49 to 1.94]; high-risk OR: 1.62 [95% CI: 1.45 to 1.80]) and the least improvement was

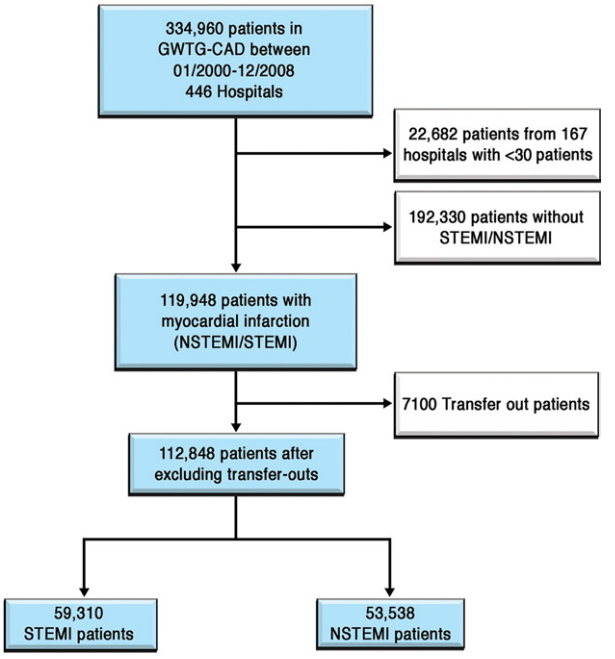

Figure 1 Study Population

The study patient selection process described in detail. GWTG–CAD = Get With The Guidelines–Coronary Artery Disease; NSTEMI = non–ST-segment elevation myocardial infarction; STEMI = ST-segment elevation myocardial infarction.

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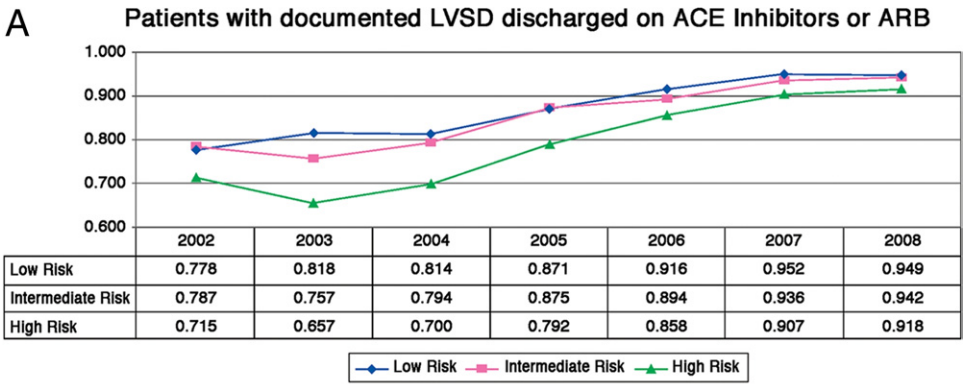
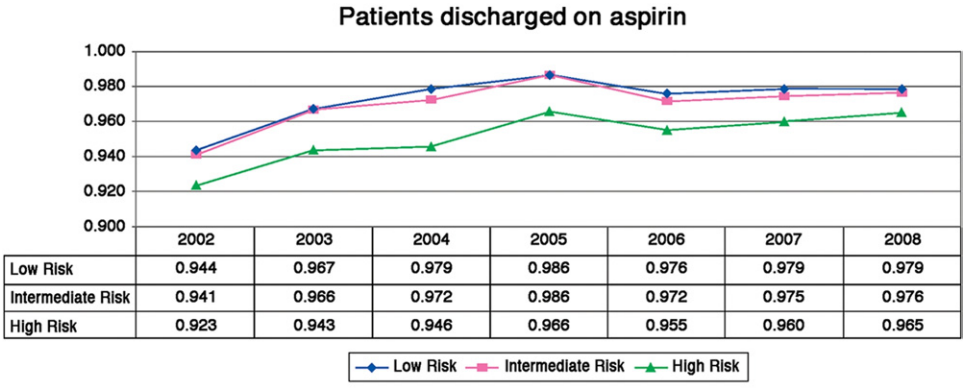
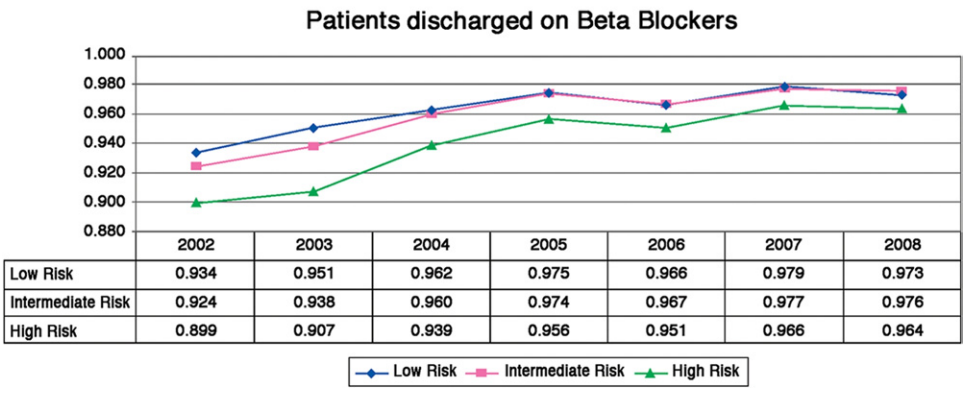


	2002	2003	2004	2005	2006	2007	2008
Low Risk	0.778	0.818	0.814	0.871	0.916	0.952	0.949
Intermediate Risk	0.787	0.757	0.794	0.875	0.894	0.936	0.942
High Risk	0.715	0.657	0.700	0.792	0.858	0.907	0.918



	2002	2003	2004	2005	2006	2007	2008
Low Risk	0.944	0.967	0.979	0.986	0.976	0.979	0.979
Intermediate Risk	0.941	0.966	0.972	0.986	0.972	0.975	0.976
High Risk	0.923	0.943	0.946	0.966	0.955	0.960	0.965



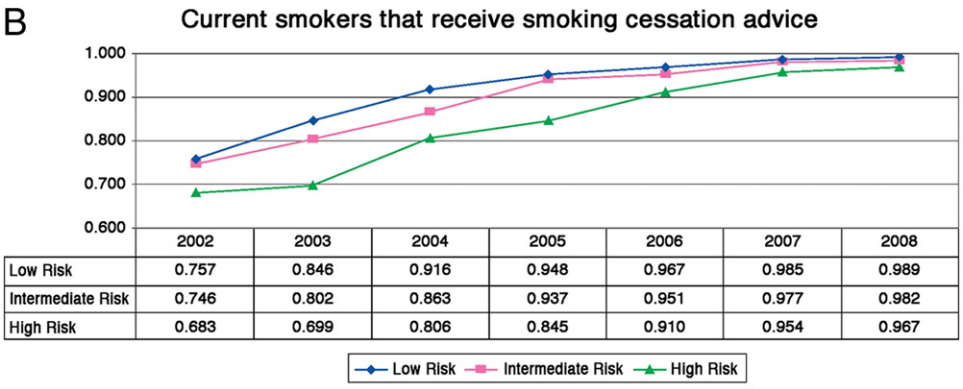
	2002	2003	2004	2005	2006	2007	2008
Low Risk	0.934	0.951	0.962	0.975	0.966	0.979	0.973
Intermediate Risk	0.924	0.938	0.960	0.974	0.967	0.977	0.976
High Risk	0.899	0.907	0.939	0.956	0.951	0.966	0.964

Figure 2 **Temporal Trends in Performance/Quality Measures**

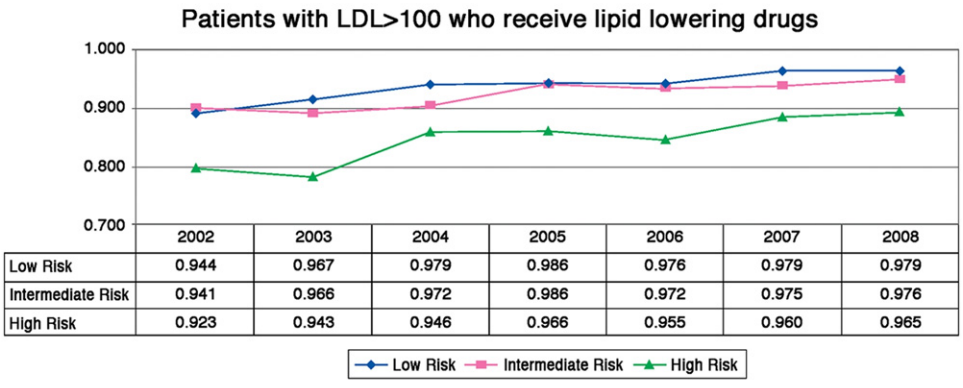
Temporal trends in adherence to quality and performance measures in patients presenting with a myocardial infarction are shown. **(A)** Discharge measures for angiotensin-converting enzyme (ACE) inhibitors, aspirin, and beta-blockers. **(B)** Acute measure for aspiring and discharge measures for smoking cessation and lipid-lowering therapy. **(C)** Composite measures. ARB = angiotensin receptor blocker; LVSD = left ventricular systolic dysfunction. *Continued on next page.*

seen in the prescription of lipid-lowering agents to patients with an LDL value >100 mg/dl (low-risk OR: 1.25 [95% CI: 1.18 to 1.32]; intermediate-risk OR: 1.18 [95% CI: 1.12 to 1.25]; high-risk OR: 1.22 [95% CI: 1.15 to 1.30]) (Online Table 5). Although the adherence to each of these measures remained significantly lower in the higher-risk MI group, the difference between the low- and high-risk groups decreased significantly with each passing year since 2003 ($p = 0.0002$). Although these trends remained similar among patients presenting with STEMIs, there were differences in patients with non-STEMIs. When analyzed separately, the temporal trends for all measures showed significant improvement among men and women. Although some of improvement in trend was due to better documentation of contraindications, temporal improvement in adherence to aspirin, angiotensin-converting enzyme inhibitors/angiotensin receptor blockers, and lipid-lowering agents at discharge persisted among eligible patients in high-risk groups (Online Table 6, Online Fig. 1).

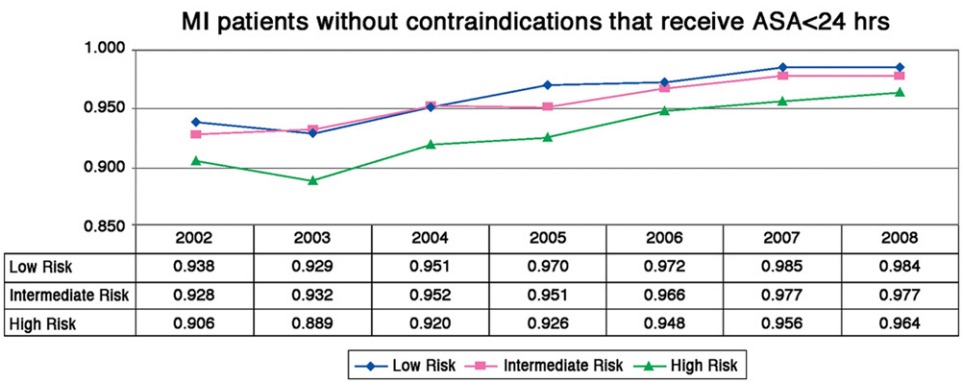
B



	2002	2003	2004	2005	2006	2007	2008
Low Risk	0.757	0.846	0.916	0.948	0.967	0.985	0.989
Intermediate Risk	0.746	0.802	0.863	0.937	0.951	0.977	0.982
High Risk	0.683	0.699	0.806	0.845	0.910	0.954	0.967



	2002	2003	2004	2005	2006	2007	2008
Low Risk	0.944	0.967	0.979	0.986	0.976	0.979	0.979
Intermediate Risk	0.941	0.966	0.972	0.986	0.972	0.975	0.976
High Risk	0.923	0.943	0.946	0.966	0.955	0.960	0.965



	2002	2003	2004	2005	2006	2007	2008
Low Risk	0.938	0.929	0.951	0.970	0.972	0.985	0.984
Intermediate Risk	0.928	0.932	0.952	0.951	0.966	0.977	0.977
High Risk	0.906	0.889	0.920	0.926	0.948	0.956	0.964

Figure 2 Continued

Discussion

The principal findings of our study are 2-fold: 1) patients with a higher baseline risk profile hospitalized with an MI remain less likely to receive guideline-based care during hospitalization; and 2) over time, there has been substantial improvement in the adherence to guideline-recommended therapies in all patients admitted with an MI within the GWTG–CAD program.

This "risk–treatment paradox" wherein higher-risk patients are less likely to receive guideline recommended therapies has been described previously (3,5,8–10). If treatment decisions were well calibrated, patients at higher risk for clinical events would be more—not less—likely to receive evidence-based therapies. We speculate that certain invasive/aggressive in-hospital therapies may have been withheld from higher-risk patients out of genuine concern of the risk of adverse effects in high-risk patients. This concern has been somewhat addressed by Eagle et al. (1), who observed no increase in treatment-related adverse effects after the implementation of the Guidelines Applied in Practice program in Michigan. This does not explain the underutilization of low-risk therapies (e.g., lipid-lowering agents, aspirin) or other performance measures without any adverse effects (e.g., measurement of LDL, counseling) during hospitalization and at discharge in our population.

McAlister et al. (4) suggest that physicians were likely to encounter confounding clinical/functional variables such as depression or poor functional capacity in their routine

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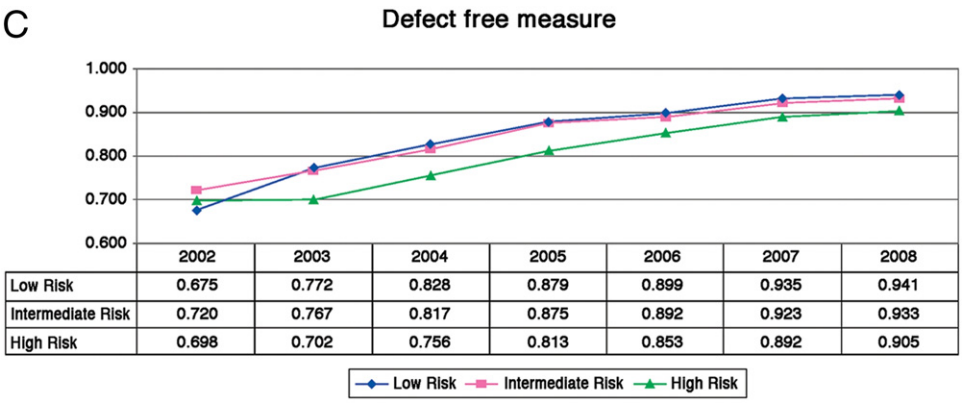
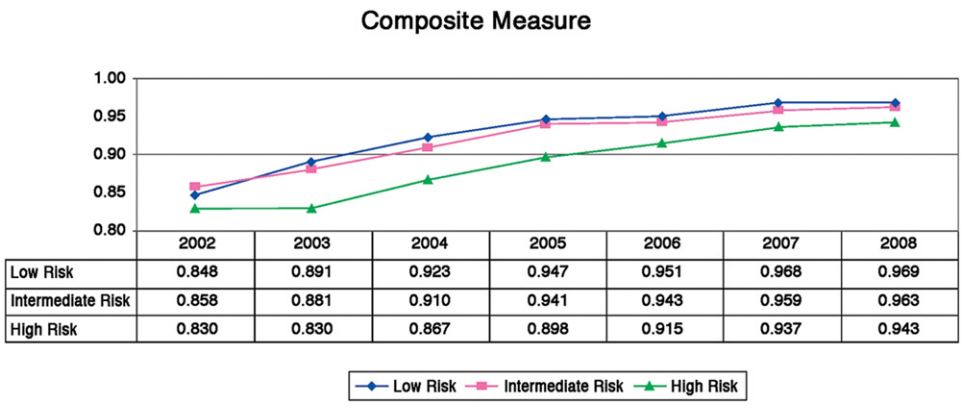


	2002	2003	2004	2005	2006	2007	2008
Low Risk	0.675	0.772	0.828	0.879	0.899	0.935	0.941
Intermediate Risk	0.720	0.767	0.817	0.875	0.892	0.923	0.933
High Risk	0.698	0.702	0.756	0.813	0.853	0.892	0.905



	2002	2003	2004	2005	2006	2007	2008
Low Risk	0.848	0.891	0.923	0.947	0.951	0.968	0.969
Intermediate Risk	0.858	0.881	0.910	0.941	0.943	0.959	0.963
High Risk	0.830	0.830	0.867	0.898	0.915	0.937	0.943

Figure 2 **Continued**

Composite performance measure: this calculation, developed by CMS, gives hospitals a sense of their overall average performance. Scores are calculated by counting the number of times patients received GWTG performance interventions and dividing the sum by the total number of interventions for which these patients were eligible. Calculations are as follows: number receiving discharge ASA + number receiving early ASA + number receiving discharge BB + number receiving discharge ACE/ARB (LVSD patients only + number receiving discharge smoking counseling + number receiving discharge lipid-lowering therapy ÷ number eligible discharge ASA + number eligible early ASA + number eligible discharge BB + number eligible discharge ACE/ARB (LVSD patients only + number eligible discharge smoking counseling + number eligible discharge lipid-lowering therapy. Defect free measure: this measure shows what percentage of patients receive all interventions for which they are eligible, i.e. the percentage of "defect-free" care.

bedside risk assessment that are not captured in a database such as ours and not assessed in suggested bedside risk scores, but suggested by the greater prevalence of higher-risk patients being discharged to a skilled nursing facility (Online Table 2). Clinicians perhaps preferentially avoided preventive therapies (such as statins) in patients who were depressed or had a poor functional status out of the fear of noncompliance/nonadherence to prescribed medications or had planned to initiate some of these in the nursing facility post-discharge. This pre-judgment by physicians of non-compliance in elderly patients with cognitive, functional, and social decline is logical. However, these same factors also seem to portend a higher risk of future events in such patients. Previous evidence suggests even higher rates of noncompliance among elderly patients with increased severity of cardiac illness (11). It has also been suggested that physicians may be concerned about applying evidence from clinical trials (which usually exclude higher-risk patients) to their everyday practice. Although such concerns are well founded, these cardiovascular preventive therapies have conferred benefits, more so in higher-risk populations excluded from trials such as those with depression or poor functional capacity (11,12). The underuse of statins and beta-blockers noted in our study in the higher-risk group may be partly explained by these factors.

Encouragingly, however, our study revealed that over time, guideline-based care has improved for all risk groups of patients presenting with an MI. The implementation of recommended guidelines continues to lag behind among the higher-risk population, but the trends are encouraging. Although similar trends have been reported earlier by the CRUSADE investigators (13), our study, to the best of our knowledge, demonstrates for the first time the gradual obliteration of this risk–treatment paradox. Perhaps this finding may be an effect of participating in the GWTG and the ability to obtain instant feedback and implementation of various quality measures over time or better documentation of contraindications to certain therapies over time (Online Table 6).

Our findings have broad implications, both to the practicing clinician taking care of these patients as well as to healthcare policy makers. As highlighted earlier, the existence of the risk–treatment paradox must be kept in mind when practitioners feel the reluctance to initiate/continue therapies to patients presenting with an MI. Whenever possible, objective data should be used to carefully weigh risks and benefits before withholding evidence-based therapies in these patients. For policymakers, it is noteworthy that hospitals participating in quality improvement projects such as the GWTG have been shown to have superior acute cardiac care and secondary prevention measures performance that is sustained over time, compared with hospitals not participating in this program (14). Perhaps one may consider participation in such programs mandatory or even linking the pay-for-performance method to participation in such programs. Moreover, although the Centers for Medicare & Medicaid Services and other federal agencies have been collecting data on similar measures, our data suggest that over time, the adherence to all of these measures has significantly improved among all risk groups. In addition, more stringent process care measures may be implemented and monitored, especially among the high-risk groups, to sustain and build on the achievements attained thus far. There are limitations to this study as noted in the Online Appendix.

These results re-enforce that programs such as GWTG, which provide solid science in the form of clearly articulated, easily actionable items that physicians at the bedside can adapt, lead to improved adherence to guideline-based care in all risk groups and could be used in managing other conditions and similar conditions in non-U.S. centers.

Conclusions

Although adherence to guideline-based care remained paradoxically lower in those MI patients at higher risk of mortality and most likely to benefit from treatment, care is improving for eligible patients within all risk categories, and the gaps between low- and high-risk groups seem to be narrowing.

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Key Words: guideline adherence ■ interventional ■ management ■ myocardial infarction ■ paradox ■ risk ■ trends.

APPENDIX

For an expanded Study Methods and Study Limitations as well as supplemental tables and figures, please see the online version of this article.