The universal definition of myocardial infarction provides criteria for the diagnosis and classification of the type of acute myocardial infarction (AMI) and recommends the measurement of cardiac troponin (cTn) for the detection of myocardial necrosis. Despite this, many institutions still use creatinine kinase-MB as part of the standard laboratory evaluation for AMI. The aim of this study was to ascertain the cost benefit of using only cTn for the diagnosis of acute coronary syndromes. A survey was done of Kansas City hospitals and the University HealthSystem Consortium list server for comparison of whether other institutions use 1 or both biomarkers. Locally, most of the responding hospitals in Kansas City and 57% of responding university hospitals surveyed use the 2 biomarkers for the diagnosis of AMI. After initiating medical staff education, the investigators’ institution’s standard order sets were changed to use only cTn for the assessment of AMI. The cost savings by eliminating creatine kinase-MB on the order sets was based on the annual volume of processed specimens. The cost of supplies, equipment, and materials was determined on a per test basis. After initiation of the new standard order sets, the creatine kinase-MB testing rate decreased to <50 per month, from 1,098, for an annualized savings of $86,786. In conclusion, as the health care system is challenged to improve care while containing cost, the use of a single biomarker (cTn) in the diagnosis of AMI fulfills this promise without sacrificing patient care.

The diagnostic value of cardiac troponin (cTn) measurement is well established. However, less well appreciated is the potential economic benefit from using a single marker instead of a panel of biomarkers that traditionally have included creatine kinase-MB (CK-MB). Expert consensus underscores using cTn determinations only for better clinical care and a reduction in cost. The elimination of multiple biomarkers, including CK-MB, in the diagnosis of acute coronary syndromes (ACS) relies on evidence-based medicine consistent with the universal definition of acute myocardial infarction (AMI). We report our experience in cost savings after developing standard order sets with cTn as the only marker on chest pain, ACS, and post-percutaneous coronary intervention orders. Our hypothesis was that a significant cost savings would be realized without compromising patient care.

Methods

Truman Medical Center is an inner-city, university-affiliated, 278-bed teaching hospital in Kansas City, Missouri. In January 2009, the Section of Cardiology within the Department of Internal Medicine elected to adopt only cTnI as the standard of measurement for AMI. The standard order sets for all chest pain, ACS, and post–percutaneous coronary intervention orders used only cTnI for the assessment of AMI, and concomitant CK-MB laboratory tests were removed. The ordering physician could add CK-MB if so desired.

The cost savings by eliminating the CK-MB on the order sets was based on the annual volume of 13,176 processed specimens. The cost of supplies, equipment, and materials was determined to be $7.05 per test, thus incurring an annual expense of $92,891. Although the activities of specimen management (processing, results reporting, and quality control) require human resources and might result in further cost, we did not factor this into our analysis.

Modification of physician practice and acceptance of the standard order sets was facilitated by lectures and informal presentations at student, resident, and staff conferences starting 6 months before the orders were changed. A survey was done of area hospitals for their use of biomarkers in the diagnosis of AMI. In addition, the University HealthSystem Consortium list server was used for comparison, and 8 of the 14 responding hospitals use both biomarkers.

Results

Locally (not including Truman Medical Centers), 75% of the responding hospitals in Kansas City use cTnI and CK-MB for the diagnosis of AMI, and 57% of the responding university hospitals in the University HealthSystem Consortium list server use the 2 markers. Figure 1 shows the acceptance of the order sets, with a rapid decrease in the number of CK-MB tests ordered per month. The number continued to decrease over the 12 months, with an average of only 46 tests per month in the last 6 months.

The year before initiating this change, there were 13,176 orders for CK-MB and 20,364 orders for cTnI (for monthly averages of 1,098 and 1,697, respectively). The cost savings on the basis of $7.05 per test results in an annualized savings of $82,894. However, because an average of only 46 tests per month was done in the last 6 months, annualized, this would result in a further reduction in cost to $3,892. The total savings would be $86,786.

Discussion

Measurement of cTnT or cTnI is a reproducible test that is readily done in clinical laboratories. This has become the preferred test for the diagnosis of AMI because of its high sensitivity and specificity. As a result, the universal def-
inition of myocardial infarction is based on the increase and decrease of cTn. Because of its superiority, cTn has been suggested as the only biomarker to be measured for the diagnosis of AMI, with a potential for cost savings.\textsuperscript{3,4} Obviously, if additional laboratory testing is needed to generate a more specific diagnosis, then cost should not be an issue. With regard to CK-MB, there is no evidence for augmented information in the diagnosis of AMI compared to cTn and therefore should not be cost effective for institutions. Our experience shows a cost savings realized for the first 12 months by eliminating CK-MB from standard order sets of $82,894, and in the last 6 months, the average number of tests for CK-MB was 46 per month, which would increase the cost savings annualized at $86,786.

There has been reluctance at some centers to adopt cTn as the only biomarker for AMI. In our area, 75\% of responding hospitals use CK-MB and cTn for the diagnosis of AMI. From a small survey of academic medical centers, nearly 60\% of these hospitals use the 2 markers as well. Data were not available for the number of CK-MB tests ordered per month at each of these institutions. However, at large-volume hospitals in the Kansas City area with large numbers of cardiac admissions annually, the presumption is that a significant cost savings would be realized with the elimination of CK-MB from standardized order sets. \textbf{Figure 1} shows the marked decrease in the frequency of CK-MB ordering for the 12 months this process was operational in our health care system. Implementation required organizational consensus, education, and changes in operational practices. Organizational communication strategies were essential to gain consensus among the care delivery teams. Presentation of the clinical evidence and revision of the standard order sets so the test panel was modified to eliminate CK-MB as an automated order were essential parts of the process to change the practice pattern at our institution.

A monthly scorecard was developed to demonstrate progress and provide targeted intervention when appropriate.

There are a number of assay-related issues that can markedly affect the performance of cTn testing in everyday practice. Yet despite such limitations, cTnI has better sensitivity and specificity compared to CK-MB for AMI and can be used at a lower cost when it is the sole laboratory marker for AMI.\textsuperscript{5} We believe we are in the midst of a paradigm shift toward reliance on cTn. Recent work has focused on novel biomarkers with increased sensitivity and specificity earlier in the time course for the diagnosis of ACS. Such work has focused on the value of myocyte injury, vascular inflammation, and hemostatic and neurohormonal markers in the early diagnosis of ACS and risk stratification of patients with ACS, and this work appears promising.\textsuperscript{6} However, in this era of health care reform with increased scrutiny of cost-effectiveness, the adoption of a single marker, cTn, can result in a large cost savings with no detrimental effect on the quality of outcomes. If this approach were applied nationally, a large cost savings could be realized.