CLINICAL INVESTIGATIONS

Impact of Technetium-99m Sestamibi Imaging on the Emergency Department Management and Costs in the Evaluation of Low-risk Chest Pain

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Abstract. **Objectives:** To assess the impact of rest sestamibi scanning on emergency physicians' (EPs') diagnostic certainty and decision making (as assessed by the hypothetical disposition of patients) for 69 consenting stable patients with suspected acute cardiac ischemia and nondiagnostic electrocardiograms. The resultant impact on costs was examined as a secondary outcome. **Methods:** Patients with suspected acute cardiac ischemia were injected with 25 mCi of sestamibi within two hours of active pain in one of three emergency department study sites. The probability of acute myocardial infarction (AMI) and unstable angina (UA), and hypothetical disposition decisions were recorded immediately before and after physicians were notified of scan results. Changes in disposition were classified as optimal or suboptimal. For the cost determinations, a cost-based decision support program was used. **Results:** For the subgroup found to be free of acute cardiac events (ACEs) ($n = 62$), the EPs' post-sestamibi scan probabilities for AMI de-

creased by 11% and UA by 18% (p < 0.001 for both conditions). In seven patients with ACEs, the post-scan probabilities of AMI and UA increased, but neither was statistically significant. Scan results led to hypothetical disposition changes in 29 patients (42%), of which 27 (93%) were optimal (nine patients were reassigned to a lower level of care, two to a higher level, and 16 additional patients to "discharge-home" status). The strategy of scanning all patients who were low to moderate risk for acute cardiac ischemia would result in an increase of direct costs of care of $222 per patient evaluated, due to added cost of sestamibi scanning. **Conclusions:** Sestamibi scanning results appropriately affected the EPs' estimates of the probability of AMI and UA and improved disposition decisions. Scanning all low-risk patients would likely be associated with increased costs at this medical center. **Key words:** sestamibi imaging; chest pain; cost evaluation; emergency department. ACADEMIC EMERGENCY MEDICINE 2001; 8:315–323

THERE are more than 5 million patient visits in the United States to emergency departments (EDs) for complaints of chest pain. Of these, approximately 2.5 million patients are admitted to

the hospital for additional evaluation of suspected acute cardiac ischemia.[1] Acute ischemia is confirmed in only 10–30% of cases of those patients admitted to the hospital with suspected disease.[2,3] The economic cost of admitted, nondiseased patients is estimated to be $10 billion to $13 billion per annum.[4,5] Various technologies and diagnostic strategies have been used to evaluate chest pain patients to improve the quality, cost, and timeliness of care.[2,6–11] Technetium-99m (Tc-99m) sestamibi has shown promise as a technology that can reliably identify patients with acute ischemia in the first few hours of care, distinguishing them from those patients who can be safely discharged home.[12–15] Cost savings would hopefully result from avoiding hospital admissions of nondiseased patients in the latter group.

In our primary study of the value of resting sestamibi for risk stratification of ED patients, we reported its value for detecting acute cardiac events

TABLE 1. Operational Definitions for Cost Analysis*

	Direct Costs†	Indirect Costs†
Variable costs	Diagnostic studies Direct nursing care Medication Technical equipment and supplies	Patient meals Housekeeping

Fixed costs	Depreciation of
	  equipment
	  (monitor)
	Administrative and
	  general costs
		Building depreciation
		Malpractice

*Total cost reflect the sum of all direct and indirect costs.
†Items listed are representative (not all-inclusive) of types of cost.

(ACEs) of death, acute myocardial infarction (AMI), revascularization, and repeat hospitalization for AMI or unstable angina (UA). Scanning with sestamibi had a sensitivity of 71% and a specificity of 92% for ACEs occurring within a 12-month follow-up period. The negative predictive value was 97% and the positive predictive value was 50%.[16]

The objectives of this follow-up study were to assess the impact of rest Tc-99m sestamibi scan results on the emergency physician's (EP's) diagnostic certainty for acute cardiac ischemia and its effect on hypothetical disposition decisions. A secondary endpoint was the resulting impact on cost of care.

METHODS

Study Design.   This prospective study used a pre- and posttest design to examine the effects of sestamibi myocardial perfusion scanning on clinical assessment and resource consumption. A study coordinator was on site during the conduct of the study and assessed physicians' pre- and posttest scanning clinical decisions regarding diagnosis and disposition just before and after receiving the sestamibi imaging test result. For the cost impact assessment, only the hospital perspective was considered because of the importance this has for hospital administration in justifying starting a program of rest sestamibi scanning. The pre- and posttest measures were the physicians' estimates, on a scale of 1 to 100, of the probabilities of AMI and UA. The physician's intended (hypothetical) disposition for the patient was recorded. Regardless of intended disposition, all patients had standard surveillance of 12 hours of observation unit care and, if needed, hospitalization, to confirm or exclude cardiac ischemia.[16] All patients were followed for a 12-month period to determine whether an ACE (defined as AMI or rehospitalization for AMI, revascularization by percutaneous translu-

minal coronary angioplasty or coronary artery bypass grafting, or death—either cardiac or unexplained) occurred. The ED and hospital costs of care (excluding professional fees) associated with these disposition decisions were calculated using the software Transition Systems Inc. (Eclipsys Corporation, Delray Beach, FL). The institutional review board approved the study protocol for the university, and written informed consent was obtained from all patients.

Study Setting and Population.   This study took place in three separate and distinct hospitals within the Detroit Medical Center: hospital A ($n = 46$) is an urban emergency hospital with an annual ED census of 75,000 and cares for adult acute trauma and medical conditions for which 16% of the ED patients are admitted to the hospital. Hospital B ($n = 13$) is a community hospital with an ED census of 27,000 of whom 23% are admitted to the hospital, and hospital C ($n = 13$) is an urban tertiary care hospital with an ED census of 24,000 (of whom 35% are admitted). Hospital A has a cardiac observation unit (COU) in the ED run by emergency medicine (EM) with routine consultation by an attending cardiologist. Hospital B has a stepdown telemetry unit and a single intensive care unit, which accommodates cardiac, medical, and trauma cases as well as a nearby observation unit. Hospital C has an adjacent observation area that was considered a COU for purposes of this study. It also has a separate stepdown telemetry unit and a cardiac care unit (CCU) for the evaluation and management of patients with suspected ischemia. The Detroit Medical Center is affiliated with Wayne State University School of Medicine and all participating hospitals are residency training sites for EM residents.

Study Protocol and Measurements.   Emergency department patients at the three sites were prospectively screened for enrollment from September 1996 to June 1997 during the hours of 7 AM to 3 PM Monday through Friday. The study protocol has been published in detail in the report of the diagnostic results.[16] Briefly, a convenience sample was chosen based on the availability of nuclear medicine personnel. Adult patients (aged ≥18 years) with nontraumatic chest pain suggestive of acute cardiac ischemia and having nondiagnostic electrocardiograms (ECGs) and without cardiac complications (defined as arrhythmias, heart failure, or shock) were included in the study. Excluded were patients whose chest pain resolved more than two hours prior to initial assessment, who were pregnant, or who had a documented history of previous myocardial infarction, current cardiac complications, or a diagnostic ECG (≥1-mm ST-seg-

ment elevation or depression or Q waves diagnostic of AMI). Demographic and current medical data were collected. The acute cardiac ischemia-time insensitive predictive instrument[17] was used to compare the objective probabilities of acute cardiac ischemia among patients in the three different hospitals.

According to protocol, patients were injected with 25 mCI of sestamibi. Myocardial perfusion image acquisition began 30 minutes to four hours after injection. Patients were returned to either the ED or the COU unless the test results dictated immediate intervention.

Prior to receiving the sestamibi test result, the EP was asked to provide a pre-sestamibi diagnostic probability of the patient's having AMI or UA based on the information available at this juncture using a questionnaire with a probability scale ranging from 0 to 100. Physicians were also asked to select one of five hypothetical dispositions (pre-sestamibi disposition) for the patient based on their own assessment: 1) CCU admission, 2) step-down telemetry admission, 3) COU, 4) admission to a medical floor, and 5) discharge from the ED.

Results of the sestamibi scans were interpreted and reported to the EP by an expert reader (a nuclear cardiologist in the urban hospitals or a radiologist credentialed to read nuclear scans in the community hospital) as positive, negative, or equivocal for a perfusion defect. For this analysis, equivocal readings were classified with positive readings. An expert nuclear cardiologist outside the study institutions who was blinded to the clinical data and the initial scan interpretation provided a second reading on a random sample of sestamibi scans. Interrater reliability was high (kappa value of 0.83, $p < 0.001$).

At this juncture, the physician was then asked to reassess, based on the sestamibi scan's interpretation, the diagnostic probability of the patient's having an AMI or UA as well as one of the five aforementioned post-sestamibi dispositions. As previously described,[16] all patients received standard surveillance for acute ischemia, including a minimum of 12 hours of observation and testing that consisted of ECGs (at times 0, 8, and 12 hours), cardiac enzymes (creatine phosphokinase-MB; 0, 8, and 12 hours), standard cardiac rhythm monitoring, and further individualized cardiac testing as indicated. Although the EP recorded a hypothetical disposition for each patient, the actual disposition decisions beyond the 12-hour surveillance period were decided jointly by the EP and the patient's primary care provider or consulting cardiologist.

Cost Impact. The actual hospital costs for the care of each patient were determined from the cost-based decision support program used by each institution, Transition Systems Inc., as used in other cost–effectiveness studies.[18] The analysis of costs was done using output for both variable direct costs and total costs (Table 1). The mean costs for each treatment disposition site and stay (CCU, telemetry, etc.) were determined for each institution. These actual mean costs were then weighted by patient enrollment and averaged across hospitals to provide a mean for each disposition site for all hospitals (average systemwide cost). These actual mean costs were then used to determine the
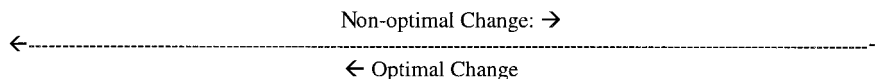
LEAST ACUTE DISPOSITION TO MOST ACUTE DISPOSITION

LEAST ACUTE   MOST ACUTE

ED Discharge   <>   Medical Floor   <>   Cardiac Observation Unit   <>   Telemetry Unit   <>   Coronary Care Unit

Non-ACUTE CARDIAC EVENT Patients:

Non-optimal Change: →

←---→

← Optimal Change

ACUTE CARDIAC EVENT Patients:

Optimal Change: →

←---→
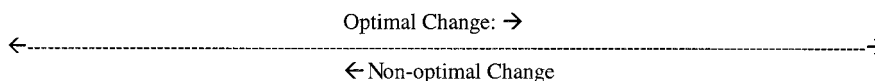
← Non-optimal Change

Figure 1. Indicated are the possible patient dispositions on a scale of least to most acute. For patients with acute cardiac events (ACEs), any disposition change going from a setting of more to less acuity would be considered optimal. A disposition going from less to more acuity would be considered suboptimal. The reverse applies for patients with an ACE. ED = emergency department.
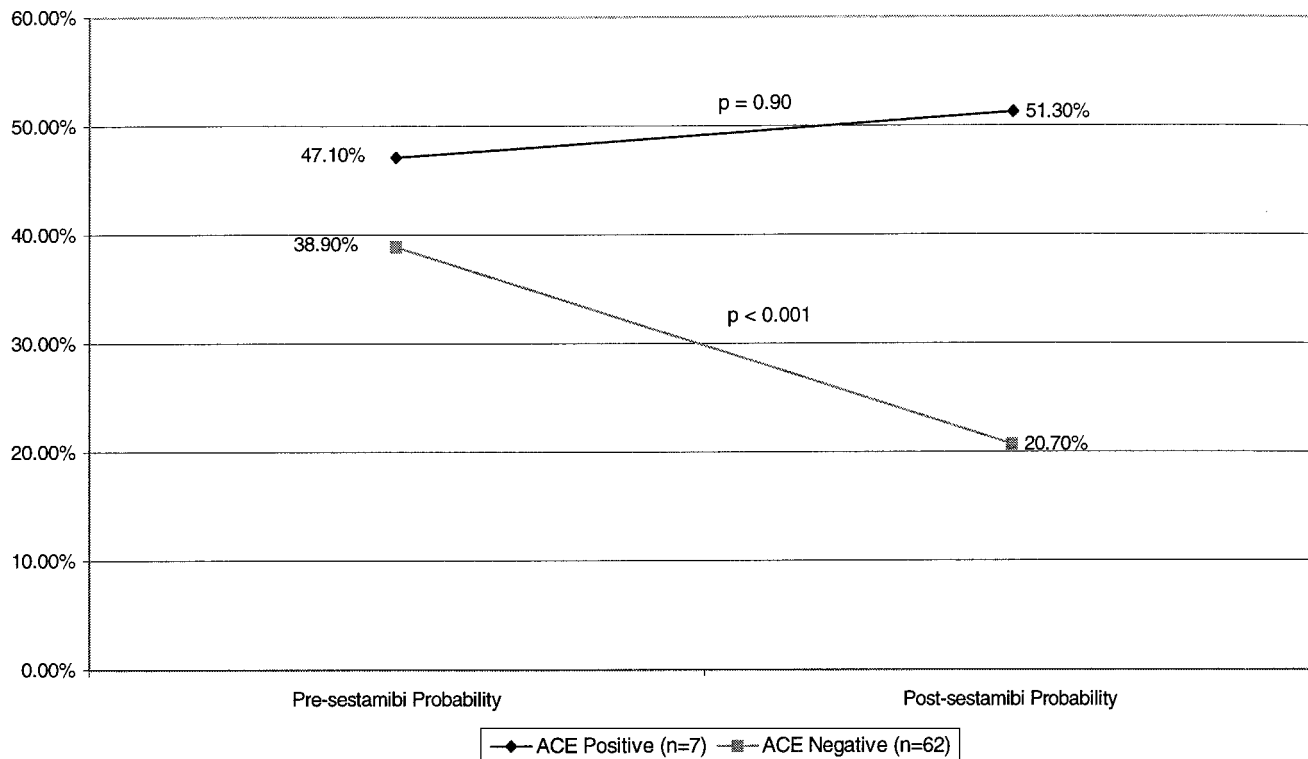
Figure 2. Indicated are the changes in probability of unstable angina (UA) before and after the emergency physician received the sestamibi scan results. In acute cardiac event positive (ACE+) patients, the pre-scan probability of UA was already high, and the scan results increased it only an average of 4.2% (p = 0.9). In contrast, in ACE− patients, although the pre-scan probability of UA was 38.9%, the scan results led, on average, to a reduction of the probability by 18% (p < 0.001).

associated costs of each hypothetical pre- and post-sestamibi disposition decisions. Since the study protocol did not permit patients to be immediately discharged, the average costs for patients discharged from the ED were determined by concurrent retrospective review of such cases for each institution. Similarly, since only one patient in the study was admitted to unmonitored floor beds, the costs for hypothetical floor dispositions were determined in the same fashion.

To assess the impact of sestamibi test results on costs of care, these (hypothetical) disposition changes were linked to the actual costs incurred by study patients by analyzing accounting data generated by the Transition Systems Inc. system. Examples of components of various types of costs are supplied in Table 1.

Data Analysis. The primary outcome was the change in pre- and posttest probabilities of AMI and UA and optimal or suboptimal changes in patient disposition status. Post-sestamibi dispositions were subsequently classified as optimal or suboptimal disposition changes, after determination of the presence or absence of ACE status (Figure 1). For patients with no ACEs, optimal disposition changes were defined as going from a more-

to a less-intensive nursing setting. Suboptimal disposition changes for patients without ACEs included changes that went from less-intense services to more-intense services. Corresponding definitions applied to patients with ACEs: optimal disposition changes included changes that went from less-acute dispositions to more-acute dispositions, whereas suboptimal changes were those that went from more-acute to less-acute dispositions. Acute myocardial infarction and UA were defined by criteria applied without reference to the sestamibi scan outcome. The intensity of nursing and patient monitoring was ranked from highest to lowest. Although this ranking is ordered, the interval differences between levels are not necessarily equal. The rank order is as follows: CCU, stepdown telemetry unit, COU, medical ward, and discharge home.

Descriptive statistics were calculated for all continuous variables, including means ± standard deviations (SDs). Frequencies were calculated for ACE status. Analysis of variance was used to determine whether the mean acute cardiac ischemia scores differed between the three hospitals.[19] Pre-sestamibi and post-sestamibi UA and AMI probabilities were obtained, and the signed-rank test was used to determine whether differences existed

between pre- and post-sestamibi probabilities of UA and AMI. Additionally, the effect of sestamibi scanning on diagnostic probability between ACE-positive and ACE-negative patients was assessed using multivariate analysis of variance (MANOVA).[19] The dependent variables included the difference in probability of UA and AMI (post-sestamibi probability minus pre-sestamibi probability).

A secondary endpoint was the difference in costs of utilizing a sestamibi scan versus no sestamibi scan strategy. Direct and total costs were calculated for pre-sestamibi and post-sestamibi dispositions. For each cost variable, the means were calculated after weighting the number of patients at each hospital by each hospital's cost. The signed-rank test was then used to determine whether these costs were significantly different. For all statistical analyses, p-values were considered significant. Analyses were performed using the SAS System, Version 8.0 (SAS Institute Inc., Cary, NC).

RESULTS

The mean age of the study population ($n = 69$) was 56 years and 43% were male; 74% were African American and 26% were white. Of these patients,

10% ($n = 7$) had ACEs and 90% ($n = 62$) were ACE-negative during the 12-month follow-up period. Of the seven patients with ACE, three were determined to have had a myocardial infarction and four required revascularization; one subsequently experienced cardiac arrest and died. The patients' mean ($\pm$SD) acute cardiac ischemia scores were not statistically significantly different between the three study sites: hospital A = 29% ($\pm$17), hospital B = 27% ($\pm$13), and hospital C = 27% ($\pm$6) (p = 0.96). As previously reported, there was no clinical difference between the groups with and without ACEs.[16]

There were significant overall differences in the pre- and post-sestamibi probabilities for UA and AMI. Among all patients ($n = 69$), the pre-sestamibi UA probability was 39.8% ($\pm$23.0), and the post-sestamibi UA probability was 23.8% ($\pm$25.6). The absolute mean difference between the post-sestamibi scan probability and the pre-sestamibi scan probability of UA was 15.9% (p < 0.001). Among all patients, the pre-sestamibi AMI probability was 17.8% ($\pm$16.3), while the post-sestamibi AMI probability was 10.7% ($\pm$21.9), resulting in an absolute mean difference of 7.1% (p < 0.01).

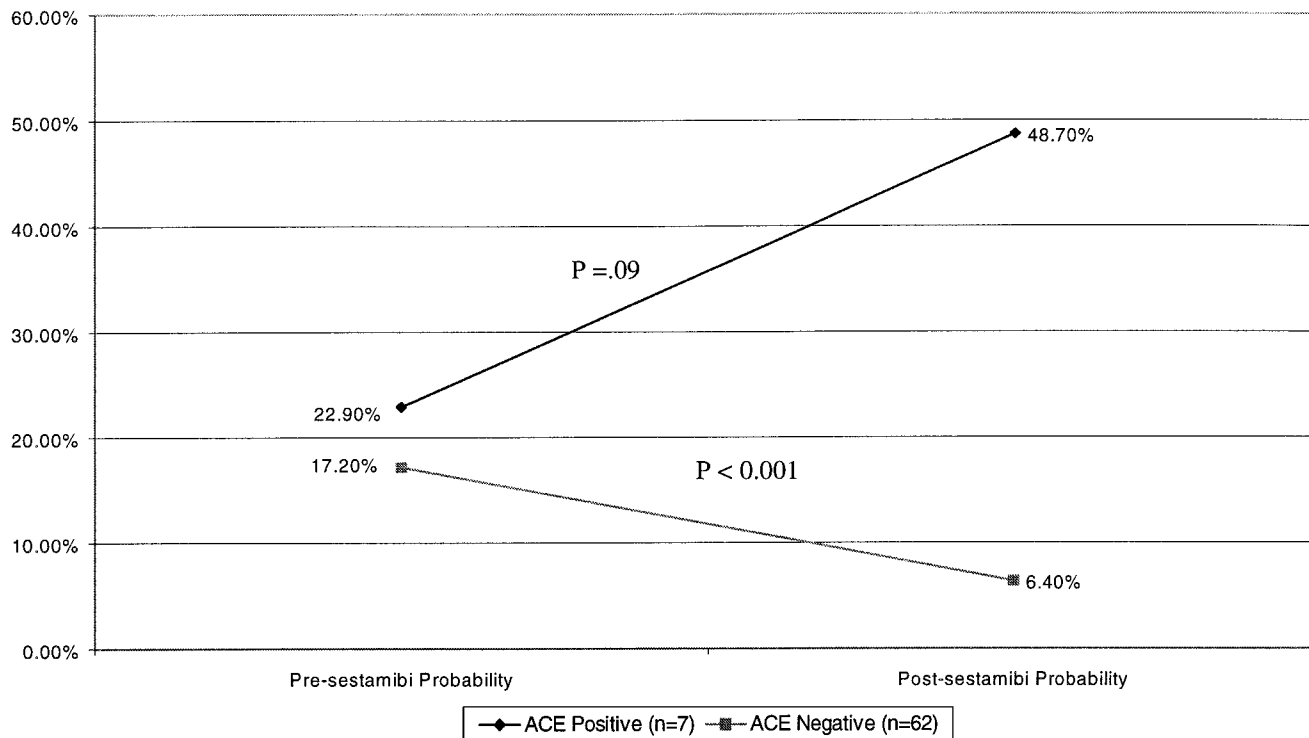The statistical modeling using MANOVA showed an overall statistically significant change

Figure 3. Indicated are the changes in probability of acute myocardial infarction (AMI) before and after the emergency physician received the sestamibi scan results. In acute cardiac event positive (ACE+) patients, the pre-scan probability of AMI was relatively low, and the scan results increased it substantially by approximately 26%. This result, however, was not statistically significant (p = 0.09), due to small sample size. In contrast, in ACE− patients, although the pre-scan probability of AMI was 17.2%, the scan results led, on average, to a reduction of the probability by 11% (p < 0.001).

in pre- and posttest probabilities in the study group (p-value of Wilks' lambda <0.001). The results of the MANOVA indicated that there was a difference between the UA and AMI probabilities (pre- vs post-sestamibi scan) among patients with ACE and without ACE. Figure 2 illustrates the change in physician UA probability before and after receiving the sestamibi scan results. Among ACE patients ($n = 7$), the physicians' pre- and post-sestamibi probabilities of UA were 47.1% (±24.3) and 51.3% (±34.9), respectively, for an absolute mean difference of 4.2%, but this difference was not statistically significant, p = 0.90. Among patients without ACE ($n = 62$), the physicians' pre- and post-sestamibi probabilities of UA were 38.9% (±22.9) and 20.7% (±22.6), respectively, for an absolute mean difference of 18.2%, p < 0.001.

Figure 3 illustrates the change in physicians' assessments of probability of AMI before and after receiving the sestamibi scan results. Among ACE-positive patients, the physicians' pre- and post-sestamibi probabilities of AMI were 22.9% (±22.2) and 48.7% (±37.2), respectively, for an absolute mean difference of 25.8%; however, this difference was not statistically significant (p = 0.09), possibly due to the small sample size ($n = 7$). Among ACE-negative patients, the physicians' pre- and postses-

tamibi probabilities of AMI were 17.2% (±15.7) and 6.4% (±14.7), respectively, for an absolute mean difference of 10.8%, p < 0.001. This study had a power of 0.75 to detect a 10% change and a power of 0.99 to detect a 20% change in the probability of AMI.

Changes in hypothetical dispositions were concordant with changes in diagnostic probability. Following the results of the sestamibi scan, 42% ($n = 29$) of all patients had a change in their planned dispositions. There were 27 optimal changes and two non-optimal changes. Among those with optimal changes, two patients went from a lower level to a higher level of care (these two patients subsequently had ACEs) and 25 patients were reassigned to a lower level of care. Among the 25 reassigned to a less-intense setting, nine went to a lower level of care and 16 were assigned to ED discharge; none of these patients experienced an ACE. Among those who were subject to non-optimal changes, two patients had negative sestamibi perfusion scans, but the scans showed that both had left ventricular dysfunction; neither patient had an ACE. Both these patients were upgraded following the sestamibi scan. It is important to note that there were no suboptimal "upgraded" dispositions due to false-positive sestamibi scans. Additionally,
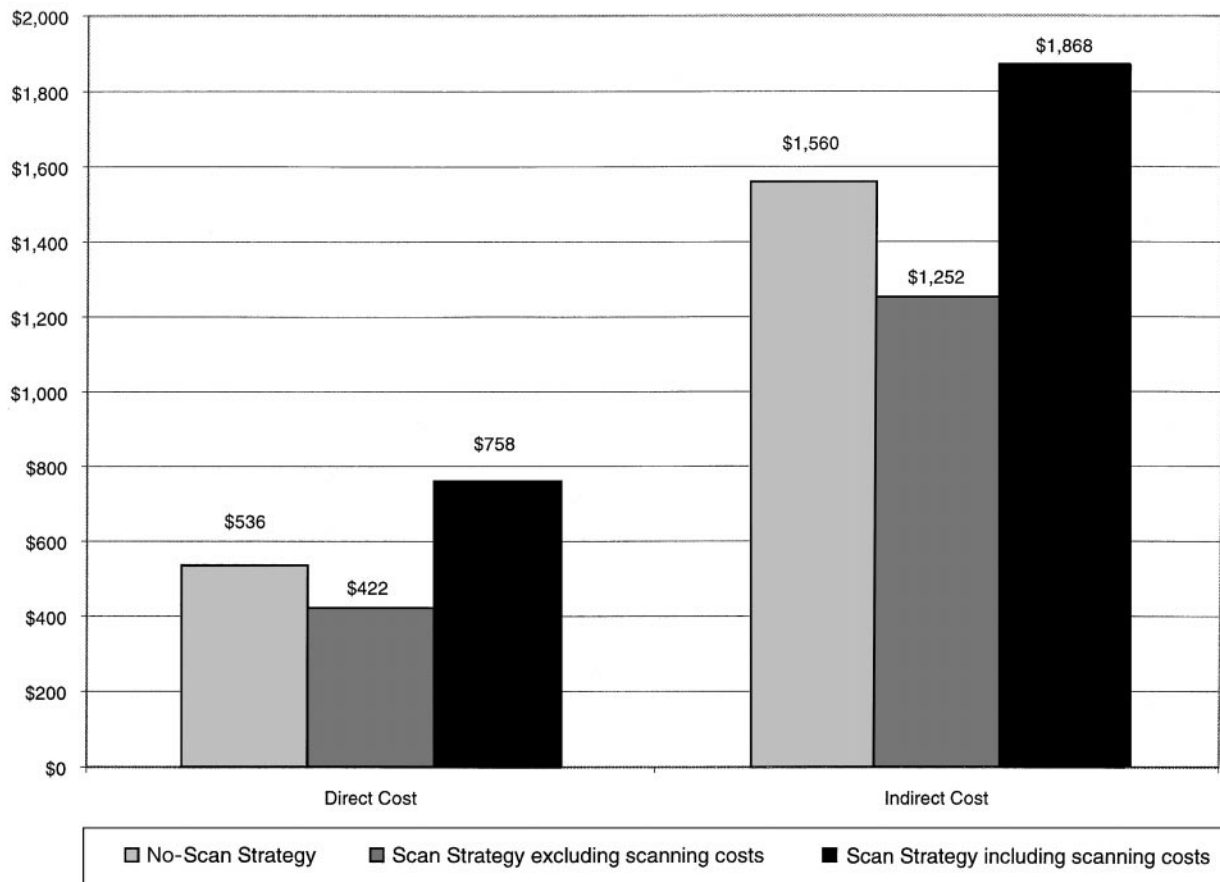

Figure 4. The cost impact of the cohort of patients tested with sestamibi.

TABLE 2. Variable Direct Costs (in Dollars) by Unit Ranging from the Least Acute Disposition (Emergency Department Discharge) to the Most Acute Disposition (Cardiac Care Unit)

	Emergency Department Discharge	Medical Floor	Cardiac Observation Unit	Telemetry Unit	Cardiac Care Unit
Hospital A*	101	337	199	824	1449
Hospital B†	135	413	439	782	693
Hospital C‡	150	338	878	866	1934

*Urban emergency department, annual census of 75,000.
†Community emergency department, annual census of 27,000.
‡Urban emergency department, annual census of 24,000.

TABLE 3. Total Costs by Unit (Dollars) Ranging from the Least Acute Disposition (Emergency Department Discharge) to the Most Acute Disposition (Cardiac Care Unit)

	Emergency Department Discharge	Medical Floor	Cardiac Observation Unit	Telemetry	Cardiac Care Unit
Hospital A*	334	950	532	2,559	4,218
Hospital B†	386	1,080	1,147	2,153	2,110
Hospital C‡	433	1,182	2,550	2,966	5,056

*Urban emergency department, annual census of 75,000.
†Community emergency department, annual census of 27,000.
‡Urban emergency department, annual census of 24,000.

there were no discharges recommended for patients who subsequently developed an ACE.

Figure 4 illustrates the financial impact of sestamibi scanning of all 69 patients—including and excluding the cost of the sestamibi scanning itself. The following results are reported in variable direct or total costs per patient (Table 1). Based on the variable direct and total costs by hospital presented in Tables 2 and 3, the variable direct and total costs for patient dispositions prior to the sestamibi scan were $536 per patient and $1,560 per patient, respectively (Fig. 4). Using the same cost data in Tables 2 and 3 and excluding the cost of the scan, the variable direct and total costs following the sestamibi scan were reduced to $422 (p < 0.01) and $1,252 (p < 0.01), respectively, due to 25 patients' being assigned to lower, less-costly levels of care. The post-scanning variable direct cost, after adding the cost of sestamibi scanning ($336 per patient), was $758 per patient. The post-scanning total cost, after adding the cost of sestamibi scanning ($616 per patient), was $1,868. The savings in variable direct costs per patient associated with the change in dispositions was $114, which was less than the cost of $336 for sestamibi scanning.

After including the direct cost of the scan ($336 per patient), the direct cost increased by $222 per patient. Similarly, the savings in total per-patient cost associated with the change in dispositions was $309 per patient. After including the total cost for the sestamibi scan ($616 per patient), the total cost increased by $307 per patient to $1868. Thus, after including the cost of the sestamibi scan itself, the use of these scans would actually increase the overall total costs for the medical center as a whole according to the model used in this study.

DISCUSSION

Diagnostic Probability and Effect on Disposition.
To the best of our knowledge, this study is the first to examine the effect of sestamibi scanning on decision making by EPs. The study evaluated both the effect on the diagnostic probabilities of AMI and UA and the changes in disposition that such quantitative changes in diagnostic probabilities might prompt. We found that sestamibi scanning was particularly helpful in augmenting diagnostic confidence in the direction of decreased probability of AMI or UA in non-ACE patients. The EP's diagnostic certainty based on sestamibi test results also changed in the appropriate direction in the subgroup with ACE, but this trend did not reach statistical significance, in part because of the smaller size of this subgroup. The use of the sestamibi scan permitted the EPs to send 42% of non-diseased patients to a lower level of care, a change that is optimal from the point of resource use matching disease status.[16]

To achieve cost savings, excellent specificity is necessary but not sufficient. A high sensitivity is also needed so that physicians will have strong confidence that negative scans are likely to be true negatives. Although the sensitivity of the scan for both early and late (12-month) cardiac events was 71%, its negative predictive value was 97%. Hilton

and colleagues have also shown that the sestamibi scanning has good to excellent specificity (95%) and moderate sensitivity (83%).[13]

In a similar fashion, Weissman and colleagues[20] reported that rest sestamibi scans improved the diagnostic certainty of cardiologists caring for chest pain patients. In their study, a scale of 1 to 5 was used to rate diagnostic certainty for cardiac versus noncardiac chest pain (1 = no confidence, 5 = very confident). The attending cardiologist's diagnostic certainty in the current working diagnosis of cardiac versus noncardiac chest pain increased from 2.92 to 4.52.[20]

Our results and those here discussed have important clinical and financial implications. For patients in whom AMI is suspected, sestamibi scanning can raise the probability of this diagnosis and identify a group that may benefit from more aggressive diagnostic and therapeutic interventions. Patients who are thought to have a low probability for ACE, and who have a negative scan, are candidates for discharge home immediately or after an ED COU stay. Stress testing may be considered prior to discharge, or can be arranged on a timely basis in the outpatient setting based on clinical risk stratification criteria. An advantage of our study over previous reports is that it included patients from three different hospital settings, which increases its generalizability.

Financial Impact of Scanning.   Unlike other studies,[20–22] the methodology used here for studying the financial impact of sestamibi scanning showed that a scan strategy resulted in a higher overall cost in our medical center. Such outcomes are clearly dependent on the alternative costs involved in not scanning versus scanning patients at low risk of disease. At EDs where the alternative to scanning is a relatively low-cost ED-based COU, the scan strategy is likely to prove more expensive. In settings where scanning leads to avoided hospital admissions, larger cost savings can accrue and the scan strategy, despite the cost of additional nuclear testing, may lead to overall cost savings. The lack of cost savings found in our study was largely due to the small savings accrued by avoiding the low- (rather than high-) cost evaluations in the COU at hospital A, where most patients were enrolled.

Weissman et al. reported that myocardial perfusion imaging with sestamibi for admitted chest pain patients is potentially cost-effective.[20] The methodology in this study was to calculate the average length of stay and cost per admission based on six-month retrospective analysis of 381 consecutive admissions for unexplained chest pain. Estimates of cost savings were based on numbers of admissions avoided, assigning a relatively high cost savings for all such patients. Radensky and colleagues reported cost savings using both Medicare-based cost data from a retrospective cohort and cost accounting data comparing the costs of traditional in-hospital chest pain evaluation on low-risk patients versus an ED evaluation strategy using Tc-99m sestamibi that allowed low-risk patients with negative scans to be discharged home for further outpatient evaluation.[21] These authors reported cost savings due primarily to avoiding unnecessary admissions. Neither of these analyses considered the lower-cost medically-equivalent alternatives for the evaluation of chest pain that exist today in ED-based COUs.

Heller et al., using Tc-99m tetrofosmin rather than Tc-99m sestamibi, in a multicenter study, employed a net cost analysis to compare the potential cost savings from reduced hospital admissions with the increased diagnostic cost of single-photon-emission computed tomography (SPECT) imaging.[22] Actual hospital charges for all patients, and the cost of performing SPECT imaging, were obtained and then analyzed according to two different strategies. One strategy called for all patients with normal scans to be discharged, and the other allowed 20% of patients with normal scans to be admitted based on clinical information. Both strategies showed cost savings on the basis of hospital days avoided, but this study was done on admitted patients and an ED-based observation unit was not used.

LIMITATIONS AND FUTURE QUESTIONS

One limitation of this study is that the hypothetical pre- and post-sestamibi disposition decisions used may differ from actual decisions that these physicians would have made, and this potential disparity could change study outcomes. The EP's actual disposition decision may be influenced by the patient's primary care provider, liability concerns, or other factors. A randomized controlled study using actual dispositions would obviate this problem.

Improved quality of care was not measured in this study. We believe that the quality of care was enhanced by the use of sestamibi,[16] but such benefits were not quantified or captured by our analysis. Anecdotal reports from clinicians showed that the scans often expedited the diagnosis of AMI or UA, with some patients going from the scan suite to the cardiac catheterization lab for an intervention. Negative scans can also be helpful. For example, in the case of a patient with an aortic dissection; a negative rest sestamibi scan expedited the consideration of the correct alternative diagnosis. If sestamibi scanning improves quality of care, then a cost–effectiveness study might dem-

onstrate its economic value. In addition, we did not measure patient satisfaction, but if evaluation time were reduced due to scanning, satisfaction might be favorably affected.

CONCLUSIONS

Sestamibi scanning in low-risk chest pain patients improves the certainty of diagnostic assessments and appropriateness of disposition decisions. Most of the changes in disposition would lead to care in less costly areas of the hospital (or hospital discharge from the ED). Scanning all low-risk patients would likely be associated with increased costs at our medical center. The degree to which lower costs of care offset the increased cost of sestamibi scanning depends on the local hospital environment and the associated costs of evaluating patients with suspected acute cardiac ischemia.

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