Critical Review Form
Clinical Decision Analysis
Sixty-four–slice Computed Tomography of the Coronary Arteries: Cost–Effectiveness Analysis of Patients Presenting to the Emergency Department with Low-risk Chest Pain, *Acad Emerg Med* 2008; 15: 623-32

Objectives: The diagnostic properties of multi-detector computed tomography of the coronary arteries (MDCTA) likely mirror those of standard observational unit stress testing among patients complaining of chest who constitute a low risk cohort. In this study, the investigators sought to develop a decision analysis tool to determine how a strategy of MDCTA compared to observation unit admission and standard coronary stress testing (conventional EKG stress test or echocardiogram stress).

Methods: This was decision analysis using TreeAge© software that compared the cost per QUALY of MDCTA versus observation unity (OU) admission and either echo or conventional stress testing. The investigators called upon actuarial and previously published studies to determine QALYs. They used results from a meta-analysis for the diagnostic properties of MDCTA. Costs were compiled also using prior published data but mostly from institutionally derived estimates of charges for ED stays. They conducted this analysis from the standpoint of the hospital.

	Guide	Comments
I.	**Are the results valid?**	
A.	**Were all important strategies and outcomes included?** *In other words, did the authors consider every potential course of action and possible outcome?*	From the standpoint of treating low risk chest pain, all important potential courses and outcomes were considered. Few would dispute the mathematical model proposed in Figure 1.
B.	**Was an explicit and sensible process used to identify, select, and combine the evidence into probabilities?** *In other words, the authors should perform as comprehensive a literature review as is required for a meta-analysis. In addition, probabilities must be assigned to each branch emanating from a chance node, and for each chance node, the sum of probabilities must add to 1.0.*	The probabilities are never explicitly stated other than by implication in the decision tree. However the authors used sensible sources of evidence of to identify the probabilities of the outcomes. They relied on meta-analyses, registry information, and well regarded published sources. Some evidence was estimated and institution specific.

C.	**Were the utilities obtained in an explicit and sensible way from credible sources?** *Utility represents the value to the patient of remaining expected life. A utility threshold of 0.92 means that your patient feels he would be willing to sacrifice 8% of his/her remaining life to avoid that limb of the decision tree (going on dialysis, taking Coumadin, etc.).* *In other words, were the quantitative measurements of the value to the decision maker of the various outcomes provided by someone who understands the outcomes and the condition being rated? Whatever the measurement method, the authors should report the source of the ratings. In a decision analysis built for an invidual patient, the most credible ratings are those measured directly from the patient.*	Utilities were based off of actuarial data from the SSA, one study from the Framingham series, and two others. The authors did not base their evidence on information they self collected. The authors point out that the utilities are those expected for a white male in his 50s.
D.	**Was the potential impact of any uncertainty in the evidence determined?** *Much of the uncertainty in clinical decision making arises from the lack of valid evidence in the literature. Even when present, published evidence is often imprecise with wide confidence intervals around estimates for important variables.* *Sensitivity analysis asks the question "Is the conclusion generated by the decision analysis affected by the uncertainties in our estimates of the likelihood of the outcomes?" Satisfy yourself that all of the clinically important variables were included.*	Heart disease is prevalent in the US. Researchers extensively study the impact of new drugs and therapies so significant evidence exists. In the ED context there is not much validated evidence regarding testing, therapies, and prognosis among individuals presenting to the ED at low risk for heart disease. To the author's credit, their analysis makes use of three presumed pre-test prevalence(s) of heart disease in their final analysis.

II.	**What are the results?**	
A.	**In the baseline analysis, does one strategy result in a clinically important gain for patients? If not, is the result a "toss-up"?** *For a clinical decision analysis that compares two clinical strategies, there are three possible results: strategy 1 is better than strategy 2, strategy 2 is better than strategy 1, or both strategies are equally good or bad. A gain in life expectancy or quality-adjusted life expectancy of 2 or more months is considered an important gain.*	This analysis becomes interesting at this point because, in terms of QALYs, there is no significant gain in one strategy over another (see Table 2). This shifts the question since, if any strategy is to dominate, then it will attributable primarily to cost. In addition the decision analysis was done from the hospital's standpoint when a more important standpoint would be that of the patient.

B.	**How strong is the evidence used in the analysis?** *Ideally, every probability estimate at every node in the tree is supported by precise estimates from primary and integrative studies of high methodological quality. The fewer the probabilities that can be precisely estimated from high quality primary studies, the weaker the overall inference one can make from the results.*	The evidence appears good. The majority of the outcomes and QALY evidence derives from meta-analyses, RCTs, or registry data. The diagnostic properties of the technology in question is derived from an extensive meta-analysis discussed during this journal club. The study's main weak point is the estimate on costs of OU care i.e. the cost of a stress test or nuc med study. This is institutional data that ends up driving the conclusions of the study. Another interesting finding involves the use of confidence intervals surrounding the final results. Since this is a decision analysis the entire matrix of the problem is theoretical. The investigators can choose how many times to 'simulate' the model. The more times the simulation runs the more precise the confidence interval
C.	**Could the uncertainty in the evidence change the result?** *For any clinical variable the decision analyst can calculate the value or "threshold" above which the results favor one strategy and below which the results favor another strategy. If the result of the analysis would change by choosing different values for one of the variables, the result is said to be "sensitive" to that variable.*	Absolutely since the costs of the observational stay and either stress test or echo stress test are variable. Plus, the assumption is that the MDCT did not consume OU time. However, as we've found out from our experts in Journal Club, a MDCTA can take up to a few hours to interpret. Granted the hours would likely still be fewer than an OU stay, however in this analysis those hours are not considered in the cost. If the analysis incorporated these costs into the model, it's not clear if the cost advantage of MDCTA would persist.
III.	**Will the results help me in caring for my patients?**	

A.	**Do the probability estimates fit my patients' clinical features?** *If the analysis was intended for patients different from yours, review the results of the sensitivity analyses. If the clinical characteristics of the intended patients are different from yours, you should discard the results. If a clinical decision analysis shows that the preferred strategy is sensitive to a given variable, you will need to gauge where your patient fits on the scale of that variable.*	The "test case" patient was a 54 year old white male. Based on prior work, the actuarial and QALY information gathered by the authors reflect probability assessments for this group of patients. However the sensitivity analysis captures information that likely encompasses the population seen at BJH. The clinical characteristics in this way are similar. However the decision analysis is most sensitive to the OU cost variable which is a limitation of this study.
B.	**Do the utilities reflect how my patients would value the outcomes of the decision?** *You must consider whether your patient's values are similar to those used in the decision analysis. If you were to ask your patient to rate the outcome states using the rating instrument in the article, you would know exactly what utility values to use.*	Again this is not exclusively addressed by the authors other than it represents the decision making of a white male. While both populations share the inner-city factor, clearly the demographics of BJH are not represented by the demographics in the test case.
C.	**Can I use the results in the management of patients in my practice?**	Not really. To begin with there is no MDCTA pathway at BJH and our OU costs may differ (for either standard of care or MDCTA). The test case likely does not reflect the QALYs of our population (which includes females) though you might suspect them to be similar. On the plus side the authors vary the probability of disease accordingly to match our population. Overall there are more misses than hits, though.

Limitations

1) **QALYs derived from cited sources that establish QALYs for white male in his 50s**

2) **There was no difference in QALYs among the three strategies leaving costs to drive the results**

3) **Costs were derived primarily from institutionally derived estimates**

4) Costs also assumed no OU stay for MDCTA when in fact the test does not result instantaneously.

Bottom Line

MDCTA appears to offer advantages in cost offsets from the vantage point of the hospital. However certain assumptions must be agreed upon that threaten the external validity of these results. Namely, that the MDCTA will provide efficient results that don't require the consumption of ED services such as OU staff or resources. Also, that QALYs among different subsets of the population will mimic those of the population chosen for this study. Lastly, the QALYs for these strategies do not differ suggesting that there will be wide variability of results highly dependent upon the costs of the local institution implementing MDCTA as a strategy in the ED.