

Decision Analysis for Evaluating Antepartum Risk Prediction of Pre-eclampsia: Minimum Test Tradeoff

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Introduction

- Pre-eclampsia (PEC) complicates 2-8% of pregnancies worldwide
- Hypertensive disorders are associated with 16% of maternal deaths in the United States
- Anesthesiologists increasingly involved in the prenatal care of obstetric patients
- Potential value in PEC screening
- Several studies have evaluated biomarkers e.g. Inhibin A, clinical factors, and other tests by using receiver-operating characteristic curve analysis and area under the curve (AUC)
- We investigated the cost of uterine artery pulsatility index (UtA PI) measurement to decide whether improvements in risk prediction of PEC are sufficient to justify data collection costs

Methods/Results

- Decision analysis to compare two models predicting risk of late-onset (>34 weeks gestation) pre-eclampsia (LO PE) in early (12-14 weeks) pregnancy
- “The test tradeoff”: decision analytic metric and a simple approximation of its minimum value
 - For a given ratio of the benefit of a true positive (TP) to the cost of a false positive, the test tradeoff is the minimum number of data collections per TP to yield a positive net benefit
- Baker’s formula applied to model comparisons to compute an approximate minimum test tradeoff (MTT) over benefit-cost ratios for an added predictor
- Formula inputs: published AUCs that used models incorporating clinical background factors plus measurements of inhibin A with (AUC 0.824) or without (AUC 0.815) the addition of UtA PI
- Formula includes probability of developing LO PE
- Compared MTT for the general US population (5% prevalence) with the MTT for a high-risk group of subjects with a history of PEC (40% prevalence)

$$MTT = \frac{1}{\{h(AUC_2)-h(AUC_1)\} \times P}$$

$$h(AUC) = AUC - \sqrt{\frac{1-AUC}{2}}$$

MTT = minimum test tradeoff
AUC₁ = AUC for Model 1
(clinical risk factors with inhibin A)
AUC₂ = AUC for Model 2
(clinical risk factors with inhibin A and UtA PI)
P = probability of developing LO PE in the population

Biomarker	CPT Code	Cost
Inhibin A	86336	\$53
UtA PI	93976	\$1395

US Population	MTT
Low Risk	1250
High Risk	156

Conclusion

- For a positive net benefit, we would need to trade 1250 UtA PI measurements for every true positive prediction of LO PE in the general US obstetrical population
- This number is significantly lower (156) in women with PEC in the past
- Data collection costs are low for the model that incorporates baseline clinical data with Inhibin-A levels
- Based on MTT, costs of adding UtA PI are relatively high compared to the anticipated benefit of a true positive that prompts intervention, especially in the general US group
- Implications of a true positive include prophylactic administration of aspirin and frequent monitoring of maternal blood pressure and fetal condition
- MTT can assist with medical decision-making when risk prediction alters clinical management

References

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