Screening for Gestational Diabetes Mellitus

A decision and cost-effectiveness analysis of four screening strategies

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**G**estational diabetes mellitus (GDM), defined as carbohydrate intolerance of variable degree with onset or first recognition during pregnancy, is the most common medical condition of pregnancy. GDM affects \(\sim 190,000\) \((4-5\%)\) of the \(>4\) million births occurring annually in the U.S. and is associated with several maternal and infant complications\(^1\). Worldwide, the three primary screening strategies for GDM are the sequential strategy (initial 50-g glucose challenge test followed by, in those who test positive, a 100-g glucose tolerance test [GTT]), the 75-g GTT strategy, and the 100-g GTT strategy\(^2\). The efficacy of these strategies, however, is debated. There are few randomized trials on the effectiveness of GDM screening\(^3\). Yet, the majority of U.S. obstetricians provide universal screening for GDM\(^4\).

We conducted a cost-effectiveness analysis to compare four screening strategies for universal screening of GDM, including the sequential strategy, the 75- and 100-g GTT, and a no-screening strategy. We assessed the relative cost and effectiveness (quality-adjusted life-years [QALYs]) of each strategy relative to the sequential strategy using a decision model.

**METHODS**

— We performed a decision and cost-effectiveness analysis from a societal perspective that incorporates all health effects and medical resources consumed regardless of who pays\(^5\). Separate cost-effectiveness ratios were estimated for mothers and infants. Maternal outcomes were hypertensive disease, polyhydramnios, cesarean or vaginal delivery, and the potential complications of cesarean and vaginal delivery. Complications included operative injury, endometritis, deep vein thrombosis, severe hemorrhage requiring blood transfusion, and hysterectomy. Neonatal outcomes were mild hypoglycemia (\(\leq 50 \text{ mg/dl}\) requiring intravenous fluid and observation), macrosomia (birth weight >4,500 g), respiratory distress syndrome, shoulder dystocia, none/mild morbidity, moderate morbidity, and severe morbidity/infant death. Test effectiveness (sensitivity, specificity), GDM prevalence, clinical probabilities, and quality of life measures were obtained from the literature. We used the standard cutoff value of 140 mg/dl for the 50-g glucose challenge test (sensitivity 80%, specificity 86%)\(^6\) and the World Health Organization 2-h threshold value (\(\geq 140\) mg/dl) for the 75-g GTT\(^7\). Because of limited data on the efficacy of the 75-g GTT in pregnancy, we used a baseline sensitivity and specificity of 80 and 86%, respectively, but varied sensitivity and specificity to 100%\(^8\). Modified threshold levels were used for the 100-g GTT (fasting <95 mg/dl, 1 h 180 mg/dl, 2 h 155 mg/dl, 3 h 145 mg/dl), and a sensitivity and specificity of 100% was assumed\(^9\).

Costs for maternal and infant care were estimated using the 2003 Medicare resource-based relative value units\(^10\) and the 1997–2001 Maryland Health Care Commission Database\(^11\). This database contains clinical and cost information on hospital discharges for maternity care within the state. Hospital charges were converted to costs using cost-to-charge ratios\(^12\). Physician and hospital costs were adjusted to 2003 dollars based on the annual medical care component of the Consumer Price Index\(^13\).

The model incorporates three maternal health states: perfect health (utility: 1.0), perfect health following hysterectomy (0.9), and maternal death (0). There were three neonatal health states: none/mild morbidity (utility: 1), moderate morbidity (0.7), and severe morbidity/neonatal death (0)\(^14\). QALYs for both mothers and infants were then calculated by combining the utility estimates with the 2003 life table data from the National Center for Health Statistics. Costs and utilities were discounted 3% per year\(^5\). Indirect costs, including lost productivity and wages for an average U.S. female worker, were estimated using the Bureau of Labor Statistics\(^15\).

In the base-case analysis, the cost-effectiveness of screening a 30-year-old pregnant woman between 24 and 28 weeks gestation was estimated with the incremental cost-effectiveness ratio, expressed as QALYs gained. A strategy was considered “dominated” if it was both...
more costly and less effective than its comparative strategy. One-way sensitivity analyses were performed in which model parameters (e.g., GDM prevalence, probabilities, utilities, costs) were changed individually to bias them in favor or against screening with the sequential strategy. Cost-effectiveness ratios of $<50,000/QALY were considered highly favorable toward a particular screening strategy (5).

**RESULTS** — With a GDM prevalence of 4%, the sequential strategy (reference strategy) was the least costly strategy for mothers and infants (Table 1). Absolute cost and effectiveness of the sequential strategy was $2,836.00 and 25.9219 QALYs for maternal and $77.00 and 29.9177 QALYs for infant outcomes. The no-screening strategy followed by the 100-g GTT strategy was more costly and less effective (dominated) compared with the sequential strategy. The 75-g GTT strategy has both higher cost (maternal outcomes $2,895 vs. $2,836; infant outcomes $59 vs. $77) and less effectiveness (maternal outcomes $25,9157 vs. 25,9219; infant outcomes 29,9108 vs. 29,9177) than the sequential strategy. +, QALYs gained; –, QALYs lost. GTT, glucose challenge test.

There are limitations to this study, most notably the lack of well-established test parameters for the 75-g GTT in pregnancy and the paucity of data on newborn health utilities. However, the cost-effectiveness ratios for screening strategies were not highly influenced at the extremes of our estimates in sensitivity analyses. We recognize that the probability of maternal or neonatal outcomes is dependent on the severity of glucose intolerance (16). Pregnancies with mild GDM controlled by diet alone or false-negative cases with mild glucose intolerance may have outcomes similar to normal pregnancy. Finally, the analysis does not include potential effects of the intrauterine environment on the long-term health of the offspring.

We conclude that conventional use of the sequential strategy is the preferred strategy followed by the 100-g GTT. The 75-g GTT and the no-screening strategy are not currently viable screening methods.

**CONCLUSIONS** — The sequential screening method was the most cost-effective strategy. Because the 100-g strategy had a highly favorable cost-effectiveness ratio, it may be useful in populations where GDM is more prevalent (e.g., Hispanics) to avoid the need for subsequent confirmatory testing. Future screening guidelines might incorporate the prevalence of GDM in different racial groups. While the no-screening strategy has no upfront screening costs, the initial cost savings is not sufficient to overcome the cost and disutility of potential obstetrical complications.

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**References**

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