

Financial Implications of Implementing Standards of Care for Diabetes and Pregnancy

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This article examines the financial implications of implementing standards of care for pregnancy among women with diabetes, including both the costs of enhanced treatment and the savings of avoided adverse outcomes. Numerous studies have demonstrated the harmful effects of poor blood glucose control for both mother and fetus. Standards set forth by the American Diabetes Association aim to reduce maternal complications and fetal adverse outcomes, such as congenital malformations. Because the precise configuration of resources required to meet these standards was not outlined in the American Diabetes Association statement, a panel of physicians (all specialists in pregnancy care for women with diabetes) was convened to develop a model program. Implementing such a program during the preconception and prenatal periods will represent an intensification of resource use in the outpatient setting. However, through these preventive measures, medical care costs for maternal and fetal complications can be avoided.

In the past, decisions about the use of health-care interventions were based primarily on their demonstrated clinical efficacy and safety. Upwardly spiraling medical costs have sensitized health-care decision makers, such as third-party payors, to the problem of scarce resources and the need to allocate health-care dollars efficiently. In efforts to constrain health-care costs, decision makers are evaluating the economic costs and consequences of health care interventions (1).

This article examines the financial implications of implementing standards of care for pregnancy among women with diabetes. The economic ramifications of heightened monitoring and intervention prior to and during pregnancy fall into two main categories: 1) the costs of preconception and prenatal care for diabetic women and 2) the savings resulting from reductions in fetal and maternal complications associated with poor diabetic control during pregnancy. By comparing these economic inputs and outcomes, advocates for intensive preconception and prenatal care for women with diabetes can establish the economic and health benefits of improved standards of care.

STANDARDS OF CARE FOR DIABETES AND PREGNANCY —

The American Diabetes Association (ADA) has promulgated a statement on the standards of care for pregnancy among women with diabetes:

To reduce the risk of fetal malformations and maternal and fetal complications, pregnant women and women planning pregnancy require excellent blood glucose control. These women need to be seen by a physician frequently, must be trained in self-monitoring of blood glucose, and may require specialized laboratory and diagnostic tests. Consultation with an obstetrician and medical specialist in diabetes is indicated before pregnancy (2).

Goals of the standards

The first goal of the ADA standards is to reduce fetal complications and mal-

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THIS PAPER WAS PRESENTED AT THE SECOND NATIONAL CONFERENCE ON FINANCING THE CARE OF DIABETES MELLITUS IN THE 1990s IN WASHINGTON, DC, 3–5 DECEMBER 1989 AND PARTIALLY SPONSORED BY THE UPJOHN COMPANY AND ELI LILLY AND COMPANY.

formations. It has been demonstrated that poor blood glucose control very early in pregnancy is associated with increased risk of spontaneous abortion (3–7). Blood glucose control during the first trimester of pregnancy, specifically the first 8 wk of gestation (8–15), is a critical determinant of congenital malformations. Infants of mothers with diabetes are at particular risk for multiple types of major malformations that can cause death or require major surgery (16,17). Reduction of these risks requires intensive preconception care of diabetes (8,11,18,19). Other fetal complications associated with poor blood glucose control during pregnancy include stillbirth (15,20,21), macrosomia and hypertrophic cardiomyopathy (21–25), neonatal respiratory distress (20, 22–24), and hypoglycemia (25–28). A number of other complications, including neonatal asphyxia and hypoxic ischemic encephalopathy, polycythemia, hypocalcemia, hypomagnesemia, hyperbilirubinemia, and poor feeding are more frequent among infants of women with diabetes (29,30); however, the relationship to blood glucose control has not been as well established.

A second goal of these standards is to reduce maternal complications. Polyhydramnios is associated with poor blood glucose control and may increase the risk of preterm delivery (29). Pregnancy also increases the likelihood of maternal hypoglycemia and coma, unless rigorous attention is given to timing of meals and snacks (31). Maternal ketoacidosis poses substantial risk for both mother and fetus, and is associated with high rates of fetal demise (32–33). More rapid progression of diabetic retinopathy has been observed during pregnancy (34–37). Pooled data from several studies suggest that women with no retinopathy may develop mild nonproliferative retinopathy during pregnancy. These changes often regress after delivery, and the risk to vision is low. Women with advanced nonproliferative retinopathy or prolifer-

ative retinopathy may have rapid progression of disease during pregnancy, which can result in hemorrhage and vision loss. Treatment of proliferative retinopathy appears to be more effective when performed prior to pregnancy than during pregnancy (31). Although decline in renal function has been observed during pregnancy, it is unlikely that pregnancy accelerates nephropathy over and above the natural progression of disease (38–40). Other adverse outcomes associated with maternal diabetes include excessive rates of cesarean section and pyelonephritis (29).

RESOURCE REQUIREMENTS OF THE STANDARDS

The ADA statement does not specify the precise components of prepregnancy and prenatal care for the woman with diabetes; however, a number of programs and studies provide insight into the specific requirements for care aimed at reducing fetal and maternal complications. These programs are characterized by their focus on attaining optimal diabetic control before conception and maintaining that control throughout the prenatal period, and identifying and treating maternal complications before conception. To provide more precise guidelines for preconception and prenatal care, a panel of physicians specializing in the care of pregnant women with established diabetes developed a consensus program of care for the woman with diabetes who is currently considering pregnancy. Through a series of questionnaires and meetings, in which consensus development techniques were used, the panel outlined specific recommendations that addressed the four main components of the ADA standards of care: preconception care, blood glucose control, frequent visits, and specialized laboratory and diagnostic tests.

Preconception care

The goals of preconception care are to integrate the patient into the management of her condition; to postpone

pregnancy until excellent blood glucose control is achieved (to prevent spontaneous abortion and congenital anomalies); and to identify, evaluate, and treat hypertension, nephropathy, and proliferative retinopathy. Preconception care should include meeting with appropriate specialists to obtain metabolic and gynecological care, prescription of birth control methods until conception is deemed safe, extensive counseling to inform the woman about the risks of pregnancy complicated by diabetes and how the risks may be decreased, education in glucose control and monitoring, nutrition and diet instruction, and suitable social work and counseling interventions. In addition, all patients should see an ophthalmologist to be screened for retinopathy and, if necessary, to receive laser photocoagulation to prevent progression of proliferative retinopathy.

The cornerstone of preconception care, as well as prenatal care, is close interaction between the patient and the health-care team. Figure 1 illustrates this relationship. Although physician care is generally reimbursed, preventive interventions and counseling provided by nurse educators, dietitians, and social workers are less likely to be covered by third-party payors. *If services provided by specific members of the health-care team are not reimbursed, these services may not be provided to patients.*

Excellent blood glucose control

A second component of the ADA standards is excellent blood glucose control. Two principles in blood glucose control can guide general practice. First, to avert spontaneous abortions and congenital anomalies, it is vital to prevent marked hyperglycemia at the beginning of pregnancy. This is achieved by maintaining glycohemoglobin levels within 4 SD of the mean or keeping postprandial capillary blood glucose levels <10 mM (11). Second, to prevent macrosomia, birth trauma,

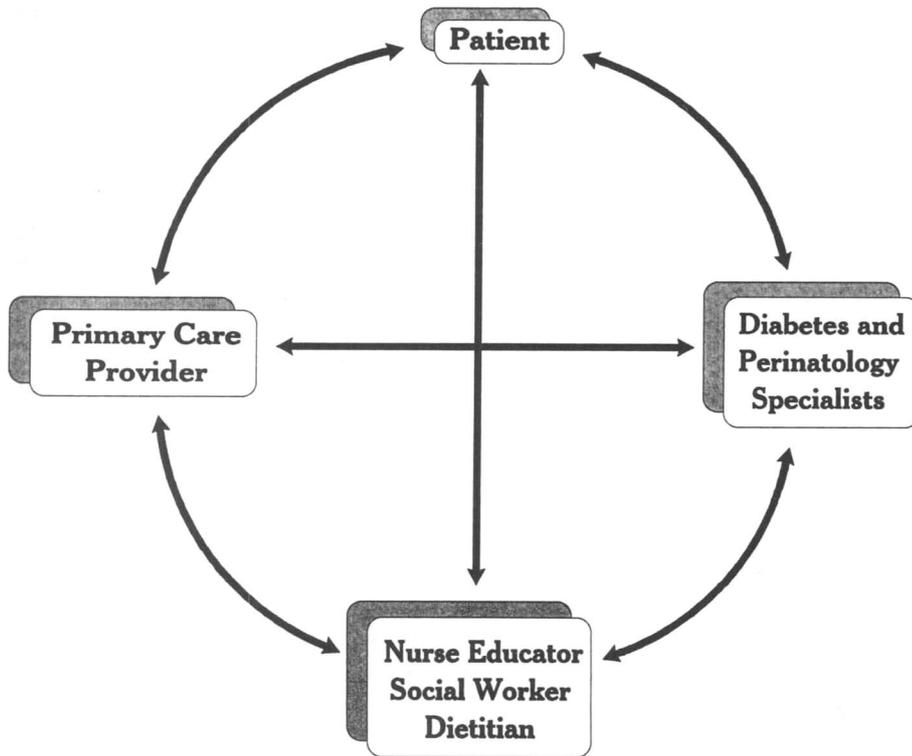


Figure 1—Participants in preconception care.

and neonatal respiratory distress and hypoglycemia, it is necessary to attain normoglycemia during pregnancy, defined as an average premeal capillary blood glucose of <5.1 mM and a peak postprandial blood glucose of <7.2 mM (25,27,41).

Achieving these objectives requires a multidimensional approach, including behavior change, patient education, dietary instruction, self-monitoring, frequent interaction with health practitioners, and laboratory testing. Excellent blood glucose control requires that patients:

1. Follow an eating plan developed with a dietitian and use food records that are reviewed regularly by the dietitian.
2. Learn to monitor their own urine ketone levels (e.g., 3 times/wk) and blood glucose levels (e.g.,

with a reflectance meter 4 times/day; once fasting and after each meal or before meals and the bedtime snack).

3. Learn to self-adjust insulin dosages in varied individualized regimens.
4. Meet regularly with members of the health-care team to “tune-up” blood glucose control and diet.
5. Identify and manage sources of stress that interfere with adherence to the treatment plan.

These components of blood glucose control hinge on active involvement of every member of the health-care team: patient, primary care practitioner, diabetes specialist, perinatologist, nurse educator, dietitian, and social worker. The intensity of involvement of each

health-care provider will vary by patient; however, each provider should have at least initial contact with the patient to evaluate her medical, psychological, and social needs, and to devise a treatment plan aimed at achieving the lowest risk to the mother and fetus.

Frequent visits

Throughout the preconception and prenatal periods, continued close contact between patient and health-care providers is essential to maintain glucose control and to allow close monitoring for the development of complications. Before conception, visits should be quite frequent (e.g., weekly) until blood glucose is controlled, and then may be less frequent (e.g., monthly). Telephone contact is an essential component of care at many centers, particularly when the patient catchment area is large.

During pregnancy, visit frequency should again be guided by the level of glucose control. For normoglycemic patients, visits may be scheduled less frequently (e.g., every 2 wk until about 28 wk gestational age and weekly thereafter). More frequent visits and even hospitalization may be required for patients whose blood glucose levels remain high. As in the preconception period, one or more visits with an ophthalmologist should be scheduled to monitor the development or progression of retinopathy, and laser photocoagulation should be performed if indicated.

Specialized laboratory and diagnostic tests

Glycosylated hemoglobin levels should be obtained regularly (e.g., every 4–12 wk) to ascertain the degree of glucose control during the preconception and prenatal periods. Other diagnostic testing should include rubella antibody testing, complete blood count, blood urea nitrogen, serum creatinine, urinalysis, urine culture, and 24-h urine for creatinine clearance and protein. In addition, patients should be screened for

thyroid disease, hypertension, and, if indicated, ischemic heart disease.

All pregnant patients should have maternal serum α -fetoprotein measured at about 16 wk gestation to screen for neural tube defects and other problems. Approximately four ultrasounds should be performed during pregnancy: one for dating (during the 1st trimester), one for an anatomic survey (at ~20 wk), one for growth and amniotic fluid volume, and one just prior to delivery for estimated fetal weight. Nonstress tests and/or biophysical profiles are indicated at regular intervals during the third trimester to identify fetal compromise.

The costs of implementing the standards

These recommendations for care in the preconception period and during pregnancy will represent an intensification of resource use for the majority of patients with preexisting diabetes who are contemplating pregnancy or are pregnant. More health-care providers are involved in patient care over a longer period of time at a more intensive level. More laboratory and diagnostic tests are conducted. The appropriate monitoring tools, such as reflectance meters and glucose testing strips, must be provided to the patient to enable her to reach the goal of excellent blood glucose control. In short, adherence to these standards may represent additional costs to patients or third-party payors.

Although physician services are generally reimbursed among insured patients, few third-party payors cover several key components of preconception care, e.g., outpatient health education is not commonly reimbursed. In addition, insurance coverage is generally lacking for preventive services provided by social workers and for intensive dietitian interventions on an outpatient basis. It is vital that health behaviors be periodically reinforced to maintain adherence to therapeutic regimens, especially for comprehensive reg-

imens, such as those prescribed for pregnant women with diabetes. Without insurance coverage for health-care providers who are instrumental in teaching and reinforcement, it is unlikely that these standards can be implemented on a widespread basis.

ECONOMIC BENEFITS OF IMPLEMENTING THE STANDARDS

—The economic benefits of implementing the ADA Standards of Pregnancy Care for women with diabetes are the savings that result from avoiding maternal and fetal complications. The complications associated with inadequate care for the pregnant woman with diabetes represent serious morbidity and mortality, and are reflected in personal loss, reductions in quality of life, and significant economic burden. The economic consequences of these adverse outcomes of pregnancy are most readily observed in the costs associated with treatment, such as hospitalization of the expectant mother, other interventions to prevent further harm to mother or fetus, and hospitalization of the infant.

There are enormous costs associated with medical treatment of the complications of poorly managed diabetes in pregnancy. One of the most costly consequences of poor glucose control is congenital malformation. Open heart surgery for the infant with malformations, such as ventricular septal defect, pulmonic stenosis, or transposition of the great vessels, has been estimated to cost \$154,000 per survivor (42). (All figures have been updated to 1989 using the medical care component of the consumer price index for medical costs and the general consumer price index for all other costs.) Direct medical costs for the first 10 yr of life for the child born with open spina bifida have been estimated to be approximately \$84,600 (43), whereas lifetime medical costs average \$103,500 (44). The estimated lifetime costs of caring for an individual with severe spina bifida is \$330,000 (including both direct

and indirect costs) (45). (Direct costs include all medical expenses incurred in treating a condition, whereas indirect costs are the value of wages that are lost as result of morbidity and mortality associated with the condition.) Other fetal complications, such as preterm labor, fetal compromise, and respiratory distress, are also associated with significant hospitalization costs. For the normal birthweight infant with respiratory distress who receives assisted ventilation, hospital costs average approximately \$40,800 (46).

In addition to avoiding the costs of poor fetal outcomes, intensive preconception and prenatal care can help to avoid hospitalizations for maternal complications. For example, hospitalization costs for a single episode of ketoacidosis average approximately \$4500 (47). Other maternal complications that can be reduced through careful monitoring and excellent glucose control are hypertension, preeclampsia, and pyelonephritis. Furthermore, establishing good glucose control during the preconception period may serve to avert hospitalization aimed at attaining rapid glucose control early in pregnancy. By avoiding macrosomia, cesarean section can be avoided, as well as the birth trauma associated with large-for-gestational-age infants. Additional costs that are potentially averted by reducing maternal and fetal complications are the costs associated with legal action taken by patients against health-care providers in malpractice suits.

This discussion of the economic consequences of the complications of diabetes and pregnancy has thus far been limited to the costs of medical care. Some complications, such as spontaneous abortion or onset of blindness, are more difficult to quantify in monetary terms. Although such costs are significant both economically and personally, placing a monetary value on health outcomes remains controversial. In the medical literature, the most common method of monetizing morbidity and mortality (i.e.,

computing indirect costs) is the human capital approach that uses lifetime wages as a proxy of the monetary value of indirect costs (48). In this approach, indirect costs would include the loss of productivity associated with blindness or with loss of an infant at the net present value of that individual's lifetime wages lost as a result of the condition or premature death.

Cost-effectiveness and cost-benefit analyses (49) can aid in illustrating the socioeconomic implications of preconception care for women with diabetes. A pilot study of California's Diabetes and Pregnancy Program (R. Scheffler, L. Feuchtbaum, unpublished observations) suggested that preconception care can actually result in cost savings by reducing the need for hospitalization during pregnancy and by reducing fetal complications. A Centers for Disease Control-sponsored study has demonstrated cost savings of preconception plus prenatal care over prenatal care only. Despite a potential overestimate of the costs of preconception care and underestimate of its benefits, preconception care had a benefit cost-ratio of nearly 2 to 1 and cost savings of approximately \$1,700 per delivery (A.E., J.M.W., H.W.B., D.R.C., S.G.G., W.H.H., J.L.K., J.M., E. Ogata, S.S., unpublished observations). These cost savings remained across a wide range of assumptions regarding the incidence of adverse outcomes and program costs.

CONCLUSIONS—Numerous studies have demonstrated the importance of tight blood glucose control before and during pregnancy in avoiding a wide array of maternal and fetal complications. General guidelines for the care of pregnant women with diabetes have been provided by the ADA. Following these guidelines will require intensive monitoring of patients, development of a team approach to diabetes care in pregnancy, and integration of the patient into the health-care management team.

The preventive services provided during preconception care can reduce the occurrence of potentially costly complications, particularly congenital malformations. Physicians, diabetes educators, dietitians, and social workers must work together to provide state-of-the-art preventive interventions aimed at reducing adverse outcomes associated with pregnancy complicated by diabetes. Two separate studies have demonstrated that the savings that result from avoided adverse outcomes outweigh the added costs of preconception care. The role of reimbursement of comprehensive diabetes and pregnancy care by third-party payors is critical in ensuring that women with diabetes have access to the level of care required to prevent adverse outcomes for themselves and their infants. Comprehensive diabetes and pregnancy care of this scope is currently beyond that supported by most third-party payors, yet even services of this intensity would be cost-saving for insurers.

Acknowledgments—This study was funded in part through Contract 200-88-0644 from the Centers of Disease Control to Battelle Human Affairs Research Center, Medical Technology and Policy Assessment Research Center, Washington, DC.

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