14. PRENATAL CARE

Deidre Gifford, M.D., Paul Murata, M.D., and Elizabeth A. McGlynn, Ph.D.

This review is based primarily on a review of the processes and outcomes of prenatal care that was done for a previous RAND study (Murata et al., 1992). In addition, we sought to update the literature by conducting a targeted MEDLINE search on specific topics. We conducted a MEDLINE search covering the years 1980 to 1990 to identify articles related to process and outcomes of prenatal care. We supplemented these articles by examining some reference lists in the recent literature and major obstetrical textbooks; articles published before 1980 were included in this step if they represented important research findings. Articles not published in English were excluded. Since this report focuses on prenatal care, intrapartum and postpartum processes and outcomes are addressed only to the extent that they directly relate to prenatal care.

We also reviewed recommendations made by a number of organizations regarding the content of prenatal care. The American College of Obstetricians and Gynecologists (ACOG) periodically publishes Technical Reports on various topics and, in conjunction with the American Academy of Pediatrics (AAP), has published Guidelines for Perinatal Care (Frigoletto and Little, 1988). The United States Preventive Services Task Force (USPSTF) has published a review of preventive health services in the United States, some of which pertain to prenatal care (USPSTF, 1989). The United States Public Health Service (USPHS) also convened an expert panel that completed a review of the content of prenatal care (USPHS, 1989; Merkatz and Thompson, 1990). These recommendations differ from each other as to the importance placed on various prenatal care processes. Because these reviews were conducted at nearly the same time and therefore would have made their recommendations based on much of the same information, the differences between them probably reflect varying value judgments used in weighing the information (Eddy et al., 1988).
IMPORTANCE

In this section, we will review the evidence for including various processes in prenatal care. Most of these processes have been discussed in the United States Preventive Services Task Force and the United States Public Health Service Prenatal Care Panel reports (USPSTF, 1989; USPHS, 1989). This report differs in that the processes emphasized are those for which objective quality of care measures can be developed using information from a medical records chart audit. Several processes that are commonly performed during prenatal care because of the opportunity to screen the mother for certain health problems not related to the pregnancy (e.g., cervical cancer) will not be discussed.

We will first consider the timing and frequency of prenatal care visits and the processes that should be routinely performed during these visits. Separate sections will discuss the problem of substance abuse during pregnancy, screening and treatment of infections during pregnancy including sexually-transmitted diseases, screening for congenital abnormalities, and screening and management of common prenatal obstetrical complications. These conditions and their prevalence during pregnancy are summarized in Table 14.1.
### Table 14.1

**Prevalence of Conditions Affected by Prenatal Care**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Prevalence</th>
<th>Major Risk Factors</th>
<th>Literature</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Routine Prenatal Care</strong></td>
<td></td>
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<tr>
<td>Anemia</td>
<td>9-10%</td>
<td>Race, SES, parity, nutritional status</td>
<td>USPSTF, 1989; Horn, 1988; Merkatz et al., 1980</td>
</tr>
<tr>
<td><strong>Substance Abuse</strong></td>
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<tr>
<td>Smoking</td>
<td>30-40%</td>
<td>Race, education level</td>
<td>Stewart and Dunkley, 1985; Kleinman and Kopstein, 1987; Kleinman et al., 1988; Williamson et al., 1989; Fingerhut et al., 1990; Osterloh and Lee, 1989</td>
</tr>
<tr>
<td>Alcohol</td>
<td>3% of women average more than 1 drink/day</td>
<td></td>
<td>Strehler et al., 1989; Olsen et al., 1991; Ernhart et al., 1988; Morrow-Tlucak et al., 1989; Waterson and Murray-Lyon, 1989; Rosett and Weiner, 1981</td>
</tr>
<tr>
<td><strong>Drug Abuse</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cocaine</td>
<td>3.4-18.0%</td>
<td></td>
<td>Zuckerman et al., 1989; Osterloh and Lee, 1989; Main and Gabbe, 1987</td>
</tr>
<tr>
<td>Marijuana</td>
<td>11.9-27.0%</td>
<td></td>
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<tr>
<td>Opiates</td>
<td>0.3%</td>
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<td></td>
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<tr>
<td><strong>Infections and Sexually-Transmitted Diseases</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rubella Nonimmune</td>
<td>10-20%</td>
<td></td>
<td>Williamson et al., 1989</td>
</tr>
<tr>
<td>Asymptomatic Bacteriuria</td>
<td>3-10%</td>
<td>Black race, multiparity</td>
<td>Stenqvist et al., 1989; Romero et al., 1989; Campbell-Brown et al., 1987</td>
</tr>
<tr>
<td>Group B Streptococcus</td>
<td>8-31%</td>
<td></td>
<td>Daugaard et al., 1988; Siegel et al., 1980</td>
</tr>
<tr>
<td>Hepatitis B Carrier</td>
<td>0.1-0.5%</td>
<td>IV drug use, homosexual males, hemodialysis patients, clients and staff in mental institutions, Asians, household contacts of carriers, and health care workers</td>
<td>Malecki et al., 1986; Summers et al., 1987; Kumar et al., 1987; Cruz et al., 1987; Alexander, 1988; Rothenberg, 1979; Friedman et al., 1988; Greenspoon et al., 1989; Christian and Duff, 1989; Arevalo and Arevalo, 1989; Immunization Practices Advisory Committee, 1985; Immunization Practices Advisory Committee, 1988</td>
</tr>
<tr>
<td>Syphilis</td>
<td>0.02%</td>
<td></td>
<td>CDC, 1988a</td>
</tr>
</tbody>
</table>
### Condition Prevalence Major Risk Factors Literature

<table>
<thead>
<tr>
<th>Condition</th>
<th>Prevalence</th>
<th>Major Risk Factors</th>
<th>Literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gonorrhea</td>
<td>1-4%</td>
<td>Alexander, 1988; Investigators of the Johns Hopkins Study of Cervicitis and Adverse Pregnancy Outcome, 1989</td>
<td></td>
</tr>
<tr>
<td>Chlamydia</td>
<td>5-15%</td>
<td>Adolescents, unmarried, history of STD</td>
<td>Harrison et al., 1983; Martin et al., 1982; Investigators of the Johns Hopkins Study of Cervicitis and Adverse Pregnancy Outcome, 1989; Schachter et al., 1986a; McMillan et al., 1985; Schachter et al., 1986b</td>
</tr>
<tr>
<td>Herpes Simplex</td>
<td>0.2%</td>
<td>Previous episode of genital herpes (1.4%)</td>
<td>Arvin et al., 1986; Prober et al., 1988; Gibbs et al., 1988</td>
</tr>
<tr>
<td>Human Immunodeficiency Virus</td>
<td>0.1-0.8%</td>
<td>IV drug use, transfusion recipient, sex partner of IV drug user or bisexual male, multiple sex partners, or emigrant from endemic area</td>
<td>Hoff et al., 1988; Lindsay et al., 1989; Barton et al., 1989</td>
</tr>
<tr>
<td>Inherited Disorders</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Down Syndrome</td>
<td>0.3% @35y</td>
<td>Age, family history of Down syndrome</td>
<td>USPSTF, 1989</td>
</tr>
<tr>
<td></td>
<td>3% @45y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neural Tube Defects</td>
<td>0.1%</td>
<td>Previous or family history of NTD</td>
<td>U.K. Collaborative Study, 1977; Ward et al., 1981; Macri and Weiss, 1982; Burton et al., 1983; Hooker et al., 1984; Milunsky and Alpert, 1984; Robinson et al., 1989; Milunsky, 1989a, Milunsky, 1989b</td>
</tr>
<tr>
<td>Rh Negative</td>
<td>9-10%</td>
<td>White race</td>
<td>USPSTF, 1989</td>
</tr>
<tr>
<td>Sickle Cell Carrier</td>
<td>8%</td>
<td>Black race, family history</td>
<td>USPSTF, 1989; BCSH General Haematology Task Force, 1988</td>
</tr>
<tr>
<td>Common Pregnancy Complications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intrauterine Growth Retardation</td>
<td>3-10%</td>
<td>Multiple gestation, hypertension, diabetes, chronic disease</td>
<td>Goldenberg et al., 1989a, Goldenberg et al., 1989b</td>
</tr>
<tr>
<td>Post-term Pregnancy</td>
<td>4-12%</td>
<td>Nulliparity, black race, chronic hypertension</td>
<td>Goldenberg et al., 1989a; McClure-Brown, 1963; Vorherr, 1975</td>
</tr>
<tr>
<td>Pregnancy-Induced Hypertension</td>
<td>5-10%</td>
<td>Nulliparity, black race, chronic hypertension</td>
<td>Lindheimer and Katz, 1985</td>
</tr>
<tr>
<td>Gestational Diabetes Mellitus</td>
<td>2-3%</td>
<td>Age, previous macrosomic infant or GDM, obesity, family history</td>
<td>CDC, 1989; O'Sullivan et al., 1973; Merkatz et al., 1980</td>
</tr>
</tbody>
</table>

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EFFICACY AND/OR EFFECTIVENESS OF INTERVENTIONS

Timing and Frequency of Visits

The most commonly used standard for prenatal care is an index described by Kessner which prescribes prenatal care for normal pregnancies in terms of timing and frequency of visits and includes the type of hospital delivery service, private or general (Kessner et al., 1973). After adjusting for differences in gestational length, prenatal care is classified into three levels: adequate, intermediate, or inadequate. Adequate care at 36 weeks is defined as nine visits with the first visit occurring in the first trimester. Many studies using minor modifications of this index have shown pregnancy outcomes are related to the three levels of care (Institute of Medicine, 1985; Showstack et al., 1984; Gorsky and Colby, 1989).

Although studies have consistently shown that some prenatal care is better than no prenatal care, the number of visits considered to be sufficient is still subject to debate. The USPHS panel supported reducing the recommended number of prenatal visits for normal-risk pregnancies (USPHS, 1989). In contrast to the Kessner Index, they recommended that more prenatal care visits occur early in the pregnancy—including a preconceptual visit—to perform better risk assessment and to target high-risk pregnancies for more frequent follow-up. Fewer visits were recommended for the second trimester and overall. By 36 weeks, for uncomplicated nulliparous pregnancies, they recommended only seven visits compared to nine using the Kessner Index. For multiparous women, the USPHS panel recommended six visits; the Kessner Index does not differ based on parity.

Past recommendations have emphasized that prenatal care should begin in the first trimester. In the USPHS Panel Report, however, a preconceptual visit was proposed (USPHS, 1989). This visit would provide the opportunity to treat specific preexisting conditions such as diabetes or hypertension (Hollingsworth et al., 1984) and provide anticipatory guidance such as genetic counseling. For example, better glucose control of diabetes in the periconceptual period may prevent
some congenital malformations (Miller et al., 1981; Steel et al., 1990). Similarly, evidence suggests that folate supplementation in the first six weeks of gestation may prevent neural tube defects (Milunsky et al., 1989a and 1989b).

Evidence supporting the role of the preconceptual visit, however, is still lacking. The extent to which preconceptual risk assessment and counseling are cost-effective in addressing problems, such as appropriate interpregnancy intervals, maternal weight, anemia, substance abuse and environmental teratogens, remains to be determined. The USPHS report, while recommending the preconceptual visit, acknowledged that further research is needed to substantiate its benefits. It is probably premature to use a preconceptual visit as an indicator of prenatal care quality. An initial visit during the first trimester would be a more reasonable standard for which there is some evidence supporting a relationship to pregnancy outcomes (Sokol et al., 1980).

**Gestational Age Determination**

An accurate determination of the gestational age is a very important process because it ensures that key prenatal care interventions are properly timed and that pregnancy complications can be appropriately identified and managed. Accurate dating of a pregnancy maximizes the likelihood that an infant will be delivered as close to term as possible, thus avoiding the multitude of complications related to either premature or postterm births. For a number of problems such as premature rupture of membranes, multiple gestations, intrauterine growth retardation and pregnancy-induced hypertension, the risk of potential complications must be weighed against the complications of premature delivery in deciding upon the appropriate time to effect delivery; this is best done when the gestational age of the infant is known precisely.

In pregnancies with an accurate last menstrual period (LMP), the day of delivery can be predicted within fourteen days in over 85 percent of pregnancies. Other clinical parameters such as early uterine sizing, fundal height, auscultated fetal heart tones, and quickening are useful adjuncts to confirm the accuracy of the gestational age determination.
based on the LMP (Andersen et al., 1981). The addition of ultrasound
dating can further improve the accuracy of the delivery date prediction,
but only modestly (Campbell et al., 1985). One study found that even
with an accurate LMP, ultrasounds were more likely to result in a
revision of the estimated date delivery in those pregnancies where
precise dating is the most important--i.e., in preterm and postterm
gestations (Kramer et al., 1988). Although the routine use of
ultrasonography in early pregnancy to establish an accurate gestational
age might identify a higher proportion of preterm and postterm
pregnancies, this has not been recommended because of the added costs to
prenatal care, the limited overall benefit, and the problems with
incorrectly predicting normal gestations as preterm or postterm (USPHS,
1989; Goldenberg et al., 1989a; Consensus Conference, 1984).

In contrast, in pregnancies with uncertain LMP dates or with early
physical examinations not consistent with the LMP, ultrasound
examinations are essential in more accurately predicting the delivery
date. Ultrasounds performed in the first trimester are accurate to
within five days. From the second trimester through 26 weeks, the
estimates are accurate to within ten days, but after 26 weeks the
accuracy declines to within two to three weeks (Cunningham et al.,
1989).

**Nutrition and Anemia**

The importance of nutrition for adequate fetal growth during
pregnancy was first shown in studies from the Dutch famine during World
War II. Extreme nutritional deprivation reduced infant birthweights by
300 to 400 grams. Excess premature births and perinatal mortality also
occurred. Under conditions of moderate malnutrition seen in developing
countries, nutritional supplementation appears to improve birthweights
by 60 grams. However, under the less extreme conditions seen in most
developed countries, improved infant birthweights and perinatal
mortality from better maternal nutrition have been more difficult to
show (Rush et al., 1980; Susser, 1981; Sweeney et al., 1985; Orstead et
al., 1985; Ershoff et al., 1983).
Studies in the United States have shown an association between low maternal weight gain during pregnancy and adverse pregnancy outcomes including low birthweight and perinatal mortality among women beginning the pregnancy underweight (Brown et al., 1981; Naeye, 1979). The Special Supplemental Food Program for Women, Infants and Children (WIC) has been implemented to improve pregnancy outcomes in high-risk populations through better maternal nutrition. Women enrolled in WIC have lower rates of low birthweight and premature births compared to similar women not enrolled; its greatest benefit occurs among women at highest nutritional risk. It is unclear, however, whether the benefits from the WIC program are the result of better nutritional status, self-selection by participants, or better prenatal care, a secondary benefit of the program (Stockbauer, 1987; Kotelchuck et al., 1984; Kennedy and Kotelchuck, 1984; Rush et al., 1988; Collins et al., 1985; Rush, 1981). One prospective, randomized controlled trial in a high-risk population has shown that WIC supplementation increased birthweights by 91 grams, after adjusting for the adequacy of prenatal care (Metcoff et al., 1985). For women who are not at high nutritional risk, adequate nutrition is prudent but routine nutritional counseling has not been shown to be beneficial (Robitaille and Kramer, 1985). Factors such as maternal height, pre-pregnancy weight, and smoking history can be used to identify women who are at high nutritional risk and for whom nutritional counseling might be recommended. Monitoring maternal weight gain during pregnancy may be helpful, but may also produce unnecessary anxiety without improving pregnancy outcomes (Dawes and Grudzinskas, 1991; Committee on Nutritional Status During Pregnancy and Lactation, 1990; Worthington-Roberts and Klerman, 1990).

Vitamin and mineral supplementation during pregnancy has become a routine obstetrical practice. In the 1980 National Natality Survey, 97 percent of married pregnant women took a vitamin-mineral supplement, usually on the advice of their physician (Hemminki, 1988). A review in 1978 identified seventeen controlled trials of vitamin and/or mineral supplementation (Hemminki and Starfield, 1978). Few showed any utility in their routine use. One study showed vitamin and mineral supplements decreased rates of preeclampsia, low birthweight and deliveries before
39 weeks; another showed decreased preeclampsia only. A third study showed that women had decreased rates of dental caries. The remaining studies all failed to show any differences in birthweight, preterm delivery, infant or maternal morbidity and mortality with routine vitamin or mineral supplementation. Many of these studies had design problems, the most apparent being insufficient power to conclude a lack of effect. A more recent case-control study in Finland failed to show an association between limb anomalies and vitamin intake during early pregnancy (Aro et al., 1984). A recent well-designed study was able to show that folate supplementation decreased the incidence of neural tube defects. A large sample size and a careful dietary history were important in showing this benefit (Milunsky et al., 1989b). Another large study of neural tube defects, however, failed to show benefit from vitamin supplementation (Mills et al., 1989).

Another very common obstetrical practice has been to screen for anemia because women of child-bearing age are at greater risk. Anemia (defined as hematocrit < 34 percent or hemoglobin < 10.4 g/dl) has been associated with adverse outcomes such as preterm delivery and perinatal mortality (Lieberman et al., 1988; Murphy et al., 1986). Higher hemoglobin levels may be important in maximizing fetal growth potential and in providing pregnant women with adequate reserve in the event of excess blood loss during delivery. Anemia, however, may be only indirectly related to poor outcomes. Women with anemia are likely to have other risk factors such as inadequate prenatal care and low socioeconomic status explaining their greater risk of preterm delivery and perinatal mortality. One study that corrected for some of these other factors showed that anemia during the third trimester is only weakly associated, if at all, with preterm delivery (Klebanoff et al., 1989). Iron supplementation during pregnancy, while improving hemoglobin levels, has not been shown to improve perinatal outcomes (Hemminki and Starfield, 1978; Reece et al., 1987).

Currently, there is insufficient evidence to conclude that routine vitamin or mineral supplements during pregnancy are necessary (Hibbard, 1988; Horn, 1988). The one exception may be the use of folate in the first six weeks of pregnancy (Milunsky et al., 1989). For the purposes
of assessing prenatal quality of care, measuring the use of supplements is not likely to be helpful, given that most women already take vitamin or mineral supplements (Hemminki, 1988). The USPSTF, USPHS Panel, the Canadian Task Force and ACOG have all recommended screening for anemia during pregnancy, despite little evidence showing clear benefits. Even if early detection of anemia were beneficial, the benefits from screening would be diminished since most women already routinely take iron supplements.

**Substance Abuse**

Three main categories of substance abuse have an important impact upon pregnancy outcomes: smoking, alcohol use, and illicit drug use. In recent years, substance abuse in pregnancy has been recognized as an important cause of perinatal morbidity and mortality. Physicians may have difficulty identifying individuals with a substance abuse problem because women may not accurately report their behavior. Many women will have problems with multiple substances.

**Smoking**

The most commonly used substance in pregnancy is tobacco. About 30 to 40 percent of women in their child-bearing years smoke (Stewart and Dunkley, 1985; Kleinman and Kopstein, 1987; Kleinman et al, 1988; Williamson et al., 1989; Fingerhut et al., 1990). Pregnant smokers have a 25 to 56 percent greater chance of perinatal mortality compared to nonsmokers, after controlling for other maternal risk factors. Perinatal mortality rates could be lowered by an estimated 7 to 10 percent if all women stopped smoking during pregnancy (Kleinman et al, 1988; McIntosh and Chir, 1984; Cnattingius et al., 1988).

Infants whose mothers smoke also have significantly lower birthweights (150 to 300 grams less on average) (Wainright, 1983). Birthweights appear to be correlated with the duration of smoking during pregnancy. Compared to nonsmokers, pregnant women who smoked but quit had a 1.3 relative risk of delivering a low birthweight infant; women who smoked throughout pregnancy had a relative risk of 3.1 (Petitti and Coleman, 1990). The risk of low birthweight is partly due to increased rates of preterm birth, particularly births prior to 33 weeks (Shiono et
al., 1986). Congenital anomalies have not been consistently associated with smoking (Khoury et al., 1987; Malloy et al., 1989).

Self-report of cigarette smoking in the general population appears to be generally valid (Strecher et al., 1989). Identifying pregnant smokers is a much easier task than identifying pregnant alcohol and drug users. Many women will stop smoking once they learn that they are pregnant (Ershoff et al., 1983; Fingerhut et al., 1990). For others, smoking cessation interventions have been shown to be effective in a variety of patient populations once the smoking problem has been identified. Pregnant smokers in a WIC clinic were entered into a randomized, controlled trial of a multiple component intervention, which included twenty-minute individual counseling sessions and printed materials. By the ninth month of pregnancy, 11.1 percent of women receiving the intervention had quit smoking, compared to 2.6 percent in the control group (Mayer et al., 1990). In an HMO setting, pregnant smokers were randomized to receive a series of mailings containing printed smoking cessation materials; 22.2 percent of the treatment group quit smoking compared to 8.6 percent of controls (Ershoff et al., 1989). The most impressive results were shown in a group of women who smoked ten or more cigarettes per day who were seen by private or university hospital obstetricians. These women were randomly assigned to receive an intensive personalized intervention with individual counseling sessions and multiple mail and phone follow-up contacts. Forty-three percent of women in the treatment group quit smoking by the eighth month of their pregnancy compared to 20 percent of controls. Infants born to women in the treatment group weighed an average of 92 grams more than control infants. Improvements in average gestational age at birth and very low birthweight rates, however, were not seen (Sexton and Hebel, 1984; Hebel et al., 1985).

Effective smoking cessation interventions are available and can improve pregnancy outcomes, but most of the available methods rely largely on time-consuming counseling (Ershoff et al., 1983). Physicians generally recommend that pregnant women cease smoking, but most physicians are not trained or do not have the time to directly provide smoking cessation services using the best available approaches (Hickner
et al., 1990). Other types of interventions such as nicotine gum and clonidine are contraindicated during pregnancy. Smoking cessation has been widely recommended for all persons regardless of whether they are pregnant. The USPSTF and the USPHS panel have specifically recommended routine prenatal assessment of cigarette smoking with appropriate intervention.

**Alcohol Use**

Jones and Smith (1973) first recognized that heavy alcohol consumption during pregnancy could cause problems in fetal development. They described the fetal alcohol syndrome, the main features of which are growth retardation, mild to moderate mental retardation, and congenital anomalies, usually craniofacial (Jones and Smith, 1973). FAS is the leading known cause of congenital mental retardation, ahead of Down syndrome and spina bifida, affecting 1 to 3 infants per 1,000 live births (Abel and Sokol, 1986).

Alcohol intake during pregnancy can cause perinatal morbidity in addition to the complete fetal alcohol syndrome (FAS). Several congenital anomalies of the extremities and cardiovascular system have been associated with alcohol intake (Ouellette et al., 1977). One study found that one drink per day was associated with an average decrease in birthweight of 91 grams (Little, 1977). A prospective study showed a clear linear relationship between maternal alcohol intake and the proportion of infants born who were small-for-gestational-age. Among infants whose mothers were non-drinkers, 5.8 percent had birthweights below the 10th percentile. This percentage increased linearly to 17.7 percent for infants whose mothers had six or more drinks per day; their adjusted odds ratio of delivering a small-for-gestational-age infant compared to non-drinkers was 2.3 (Mills et al., 1984). In another prospective study, alcohol consumption was related to increased still birth rates and lower birth weights (Kaminski, 1978). There is also evidence to suggest that alcohol consumption interacts adversely with smoking in further reducing birthweights (Olsen et al., 1991). It does not appear that occasional alcohol intake (fewer than two drinks weekly) affects infant birthweights (Mills et al., 1984; Halmesmaki et al., 1987; Ernhart et al., 1989), but the precise level at which problems
begin to occur is not known. Results have varied as to whether alcohol consumption increases the risk of preterm birth (Shiono et al., 1986; Halmesmaki et al., 1987). Women who drink or use drugs have also been shown to be at greater risk for being victims of violence (Amaro et al., 1990).

Decreasing alcohol consumption during pregnancy depends on identifying women with alcohol problems. Self-report of alcohol intake in nonpregnant and pregnant patients often underestimates actual consumption (Strecher et al., 1989; Ernhart et al., 1988; Morrow-Tlucak et al., 1989). Because many women know that alcohol consumption during pregnancy is not good, there may be greater bias in self-report among pregnant women because of social desirability. Standard alcoholism screening surveys used in the general population also may not be sensitive enough for use in pregnant patients because accurate measurement of lower levels of consumption may be required. Better measures of alcohol intake applicable to prenatal patients are needed (Waterson and Murray-Lyon, 1989; Rosett and Weiner, 1981).

Many women spontaneously decrease their alcohol consumption once they learn that they are pregnant out of concern for the infant's health (Kruse et al., 1986; Waterson and Murray-Lyon, 1989; Allen and Ries, 1985). For those who continue to drink, the usual interventions used for nonpregnant problem drinkers often cannot be used during pregnancy. Medications used to treat withdrawal symptoms, such as benzodiazepines and anticonvulsants, have potential risks for the fetus. Disulfiram for abstinence maintenance therapy has also been identified as a potential teratogen. Most treatment programs during pregnancy have relied upon individualized counseling and close follow-up. Although these methods may help to reduce alcohol consumption (Rosett et al., 1983; Halmesmaki, 1988), better strategies tested in studies with randomized designs are needed. Among women decreasing their intake, improved pregnancy outcomes are seen (Rosett and Weiner, 1981; Rosett et al., 1983; Halmesmaki, 1988).

Alcohol consumption during pregnancy has a significant impact on infant morbidity, specifically mental retardation. There are problems in identifying pregnant women with drinking problems and better alcohol
cessation techniques are needed. As the USPHS Panel, USPSTF, and ACOG have all concluded, there is sufficient evidence to recommend that pregnant women should be counseled to decrease and preferably avoid alcohol during pregnancy.

Drugs

Use of illicit drugs during pregnancy has been associated with a wide range of adverse pregnancy outcomes including low birthweight, preterm delivery and perinatal mortality (O'Conner, 1987; Joyce, 1990). Opiates have been associated with premature delivery, intrauterine growth retardation, premature rupture of membranes, and other complications (Kaye et al., 1989; Doberczak et al., 1987). Methamphetamine and marijuana use have been associated with similar complications (Oro and Dixon, 1987; Little et al., 1988; Zuckerman et al., 1989).

In recent years, problems related to cocaine use have increased. A review of toxicological screening in a public teaching hospital showed cocaine to be the most common drug detected (Osterloh and Lee, 1989). Cocaine use in pregnancy is associated with an average 93 gram decrease in birthweight (Zuckerman et al., 1989). Use throughout pregnancy is associated with a four-fold increased risk of delivering a low birthweight infant. Petitti et al. estimated that 10 percent of the low birthweight deliveries in their county were due to cocaine use (Petitti and Coleman, 1990). Cocaine use has also been associated with preterm labor, premature rupture of membranes, intrauterine growth retardation (Chasnoff et al., 1989; Cherukuri et al., 1988; Chouteau et al., 1988; Keith et al., 1989; Chasnoff et al., 1987), maternal and infant cerebral hemorrhage (Mercado et al., 1989), neurobehavioral abnormalities in newborn infants (Chasnoff et al., 1989), and congenital syphilis (Worthington-Roberts and Klerman, 1990; Nanda et al., 1990).

A major problem in treating drug use during pregnancy is that many drug users are not seen for prenatal care (Cherukuri et al., 1988). Even when seen, self-report greatly underestimates actual drug use. Despite consenting to drug testing, 26 percent of women who tested positive for marijuana denied using it. Forty-five percent of women testing positive for cocaine denied its use (Zuckerman et al., 1989).
Few prospective studies have been conducted to demonstrate whether drug treatment programs during pregnancy can decrease drug use and improve pregnancy outcomes. Methadone can be used to treat mothers addicted to heroin, decreasing obstetrical problems related to acute narcotic withdrawal and the drug-seeking life style (O'Connor, 1987). No similar maintenance substitute is available for cocaine or other drugs. Providing comprehensive prenatal care and psychosocial services are thought to be important in encouraging decreased drug use (Chavkin, 1990). Uncontrolled studies have reported mixed results. One study enrolled 109 cocaine users before their twelfth week of pregnancy. Although these women averaged fourteen visits throughout their pregnancies, 21 percent successfully discontinued their cocaine use, while 48 percent used cocaine throughout the pregnancy and the remainder used cocaine sporadically (Chasnoff et al., 1989). Another intervention study of 58 pregnant opiate addicts reported achieving normal distributions of newborn weight, length and head circumference, and no perinatal deaths. Their low birthweight rate was 17.7 percent and very low birthweight rate was 1.6 percent (Rosner et al., 1982). Interpreting these two rates, however, is difficult without an adequate control group; the rates are high relative to the general population, but may be comparable to women of similar socioeconomic status who are not drug users.

Circumstantial evidence for benefit with drug treatment comes from other studies which show a relationship between duration of drug use during pregnancy and outcomes. Women who continued to use drugs throughout their pregnancy had the greatest risk of poor outcomes, those who discontinued use for part of the pregnancy were at intermediate risk, and those who completely stopped using drugs from the first trimester were at lowest risk (Petitti and Coleman, 1990; Zuckerman et al., 1989).

For the purposes of developing process measures of prenatal care, the literature on drug use during pregnancy is lacking in several areas. Drug use is clearly a major preventable cause of adverse pregnancy outcomes. As the USPHS panel and the USPSTF have recommended, routine inquiries into drug use as part of the prenatal assessment is important,
but it is probably unreliable. Better means of identifying pregnant drug users are greatly needed (Chasnoff, 1989). In some settings, implementing routine or random urine screening for drug use has increased the numbers of pregnant women identified who are using drugs (Chasnoff, 1989; Chasnoff et al., 1990). Given the profound impact of drug use on the fetus, broader use of prenatal drug screening may need to be considered (Graham et al., 1989). Once drug use has been identified as a problem, these women need to receive adequate prenatal care and appropriate social services. It is not clear what constitutes an effective prenatal drug treatment program. Access to existing programs is limited (Chavkin, 1990). Programs for nonpregnant patients which have longer term goals may need significant modifications to meet the more immediate needs of the pregnant patient. Although it is likely that pregnancy outcomes will improve once successful prenatal drug use cessation programs have been developed, this has not yet been demonstrated conclusively.

**Infections and Sexually Transmitted Diseases**

**Asymptomatic Bacteriuria**

Asymptomatic bacteriuria occurs in 3 to 10 percent of pregnancies (Stenqvist et al., 1989). Of these pregnancies, 20 to 40 percent will later develop symptomatic urinary tract infections which are associated with an increased risk of pyelonephritis and preterm labor (Kincaid-Smith and Bullen, 1965; Patterson and Andriole, 1987). A meta-analysis of seventeen cohort studies found that women treated for asymptomatic bacteriuria had a lower relative risk of LBW (0.65) and lower relative risk of preterm delivery (0.50) compared to untreated women (Romero et al., 1989).

Screening for bacteriuria can be done with urinalyses and screening dipstick tests, but in comparison to the urine culture, they are less sensitive and specific. The nitrite dipstick test has a sensitivity ranging from 35 to 85 percent and a specificity of 92 to 100 percent. The leukocyte esterase test has better sensitivity ranging from 72 to 97 percent, but with poorer specificity, 64 to 82 percent (Pels et al., 1989). In one screening program, 5.1 percent of 4,470 pregnant women
had positive dipslide tests; only 2.6 percent of the total were
confirmed positive on urine culture (Campbell-Brown et al., 1987).

Women identified as having asymptomatic bacteriuria can benefit
from treatment. Most of the randomized controlled trials of treatment
for asymptomatic bacteriuria have shown decreases in low birthweight
rates. A meta-analysis of eight trials found that treated patients had
a 0.56 relative risk of LBW birth compared to untreated patients (Romero
et al., 1989).

There is good consensus that pregnant women should be screened for
asymptomatic bacteriuria. The USPSTF, the USPHS panel, and the Canadian
Task Force recommend using urine cultures, whereas ACOG accepts
urinalyses as the initial screening method.

**Rubella**

Congenital rubella infection can cause considerable morbidity
including fetal wastage, cataracts, deafness, microcephaly, congenital
heart defects, mental retardation and thrombocytopenia. About 80
percent of infants whose mothers are infected in early pregnancy develop
manifestations. Second trimester infections are less likely to cause
abnormalities (Hardy et al., 1969). Ten to twenty percent of women of
child-bearing age lack evidence of immunity to rubella (Centers for
Disease Control, 1989). Congenital rubella in the children of these
women can be prevented by screening and vaccinating the women before
they become pregnant (Griffiths and Baboonian, 1982). The serologic
tests to screen for rubella immunity are 95 to 99 percent sensitive and
specific (USPSTF, 1989). Effective live-attenuated vaccines are
available which have been shown to cause successful seroconversion in 98
percent of women when given in the postpartum period (Black et al.,
1983). Inadvertent administration of the vaccine to pregnant women has
not been shown to cause congenital rubella syndrome (Centers for Disease
Control, 1989). Postpartum vaccination generally avoids this risk.

Optimally, susceptible women should be immunized more than three
months before becoming pregnant. Postpartum vaccination misses the
opportunity to prevent congenital rubella in the current pregnancy, but
one-third to one-half of congenital rubella cases occur in pregnancies
subsequent to the first (CDC, 1987; CDC, 1986b). Rubella screening of
pregnant women with postpartum vaccination has been supported by the USPHS panel, the USPSTF, the AAP and ACOG (ACOG, 1992).

**Group B Streptococcus**

Group B streptococcus (GBS) is associated with severe perinatal morbidity and mortality. Women infected with GBS have increased rates of preterm delivery and fetal deaths (Regan et al., 1981; Boyer and Gotoff, 1988). One to three per 1,000 live births will be affected by early-onset GBS infections; these carry a case fatality rate of 25 to 80 percent (Daugaard et al., 1988).

Prenatal screening and prophylaxis have proven to be impractical. GBS can be found in the urogenital tract of 20 percent of pregnant women. Antibiotic therapy has little effect on GBS carriage. Many of the women reacquire the infection later in pregnancy, even with treatment of their sex partner. An alternative strategy of treating women near term reduces maternal carriage but does not reduce newborn colonization. Waiting until near term also has the disadvantage of missing the pregnancies with the greatest neonatal morbidity and mortality due to GBS, those delivering before 38 weeks (Boyer and Gotoff, 1988).

Several strategies for preventing GBS infections in newborns may become available. Developing a vaccine against GBS for pregnant women could help prevent GBS disease (Baker et al., 1988). Rapid methods of diagnosing maternal GBS infections during the intrapartum period may permit the early use of antibiotics to reduce neonatal colonization and early-onset group B streptococcal disease (Boyer and Gotoff, 1986). However, in studies of antenatal screening for GBS, early treatment of neonates at risk has not been shown to prevent early-onset streptococcal disease nor reduce excess mortality (Pyati et al., 1983; Siegel et al., 1980). In certain high-risk pregnancies--e.g., preterm labor or premature rupture of membranes--intrapartum screening and treatment of GBS infections may be beneficial. Currently, no organization recommends routine antepartum screening for GBS.

**Hepatitis B**

Pregnant women carrying the hepatitis B virus (HBV) are at risk for transmitting the virus to their baby at birth. Forty to forty-five
percent of infants born to chronic hepatitis B carriers become infected; this risk increases to 65 to 90 percent if the mother also carries the hepatitis B virus e antigen (HBeAg) (Stevens et al., 1975; Xu et al., 1985). Although these perinatal infections infrequently cause acute hepatitis in the neonate, they often result in the development of a chronic HBV carrier state. Among perinatally-infected infants, 85 to 90 percent develop chronic HBV infections (Xu et al., 1985; Stevens et al., 1985). The long-term consequences of these infections include chronic active hepatitis, cirrhosis, and primary hepatocellular carcinoma (PHC). In a prospective study, chronic HBV carriers had a 390-fold greater risk of developing primary hepatocellular carcinoma (Beasley, 1982). Ultimately, 40 to 50 percent of chronic carriers have been estimated to die from either PHC or liver cirrhosis (Beasley and Hwang, 1984).

Hepatitis B vaccines with hepatitis B immune globulin given to neonates can prevent 85 to 95 percent of perinatal HBV infections and provide long-term protection (Xu et al., 1985; Stevens et al., 1985; Beasley et al., 1983; Schalm et al., 1989). Even among infants at the highest risk of becoming infected, those whose mothers carried the e antigen, the risk of infection can be decreased from 65 to 90 percent to between 7 and 30 percent (Poovorawan et al., 1989). Initial efforts to identify at-risk infants for vaccination focused on selective screening for HBV carriers among high-risk pregnant women (Table 15.1) (CDC, 1985). Several reports, however, have shown that selective screening may miss 50 to 67 percent of pregnant HBV carriers (Malecki et al., 1986; Summers et al., 1987; Kumar et al., 1987; Cruz et al., 1987; Jonas et al., 1987; McQuillan et al., 1987; Friedman et al., 1988; Greenspoon et al., 1989). Their prenatal care provider may not be adequately determining their risk status or carriers may be reluctant to report their high-risk behaviors. Some HBV carriers also do not belong to any of the high-risk groups.

Consequently, routine screening of all prenatal patients has been recommended in an effort to more effectively prevent perinatal HBV transmission. There has been some criticism of this approach because the studies showing the high proportion of missed carriers with selective screening were conducted in inner-city public hospitals with
low socioeconomic status populations, likely to have higher carrier rates than the general population. Two more recent studies conducted in lower-risk populations suggest that selective screening may be sufficient. One study screened all enlisted military personnel and their dependents seen for prenatal care. No cases of chronic HBV would have been missed using the CDC risk factors (Table 15.1); all of the HBV carriers were of Asian descent (Christian and Duff, 1989). A smaller study of 430 prenatal patients seen in a family practice clinic identified 38 women as being chronic carriers. All but two of these would have been detected using a single high-risk factor, Asian descent (Table 15.1) (Arevalo and Arevalo, 1989).

Long-term morbidity and mortality due to perinatal transmission of HBV infections can be effectively prevented through the use of HBV vaccines in the peripartum period. Mothers at high risk for being HBV carriers should be screened to determine whether their child needs neonatal vaccination. Additional studies in low-risk populations are needed to resolve conclusively whether all prenatal patients should be screened routinely. However, the USPHS Panel, the USPSTF, ACOG, AAP, CDC, and the Canadian Task Force recommend that all pregnant women be screened routinely for HBV.

**Syphilis**

In recent years, there has been a resurgence in the incidence of syphilis in the general population. As a result, there has also been a rise in the rate of congenital syphilis. In the second half of 1987, the congenital syphilis rate increased 21 percent to 10.5 cases per 100,000 live births. Sixty-seven percent of these cases occurred in the three states (Florida, California, and New York) with the highest syphilis rates for the general population (CDC, 1988a). Untreated congenital syphilis causes perinatal deaths in about 40 percent of affected pregnancies (Schulz et al., 1987), although it is not known how many fetal deaths are currently caused by syphilis infections. Infants born with congenital syphilis can have a variety of manifestations including osteochondritis, gummas, hepatosplenomegaly, and neurosyphilis (CDC, 1988b).
Screening for syphilis in mothers is very effective. Non-treponemal screening tests vary in sensitivity depending on the stage at presentation. In secondary syphilis, sensitivity approaches 100 percent; lower sensitivities are seen in other stages. When combined with treponemal syphilis tests, specificity of these tests approaches 100 percent. Diagnosis and proper treatment of syphilis in early pregnancy can effectively prevent many of the manifestations of congenital syphilis (CDC, 1988a).

The USPHS Panel, the USPSTF, the Canadian Task Force, CDC, and ACOG all recommend routine screening for syphilis at the first prenatal visit (CDC, 1988a). For high-risk women, a second test at the beginning of the third trimester is also recommended.

**Gonorrhea**

Routine screening for gonorrhea has been commonly performed in pregnancy. Its main benefit is preventing ophthalmia neonatorum with its associated risk of blindness. Untreated gonorrhea during pregnancy can also develop into an acute pelvic infection with its associated morbidity. Septic abortions, chorioamnionitis, and premature rupture of membranes with premature delivery are associated with gonorrhea infections during pregnancy (Schulz et al., 1987; Hook and Holmes, 1985; Alexander, 1988).

Successful screening and treatment of gonorrhea have made its complications during pregnancy relatively rare events (Rothenberg, 1979). The efficacy of prenatal screening has not been studied. Ethical considerations make it difficult to study issues such as whether neonatal conjunctivitis prophylaxis is sufficient or if maternal screening and treatment is also important. Routine screening for gonorrhea in pregnancy continues to receive wide support from most organizations including the USPHS Panel, the USPSTF, the CDC, ACOG, and the Canadian Task Force.

**Chlamydia**

*Chlamydia trachomatis* infections are estimated to occur in 8 to 12 percent of pregnancies. Women who are adolescent, unmarried or low socioeconomic status are at greater risk (Harrison et al., 1983; Martin et al., 1982). *Chlamydia trachomatis* infections may cause a number of
adverse outcomes in pregnancy. In one prospective study, stillbirths or neonatal death occurred in 33 percent of pregnancies complicated by *C. trachomatis* infections compared to 3 percent of uninfected women (relative risk = 9.9); premature delivery occurred in 28 percent of infected women compared to 6 percent of uninfected women (relative risk = 4.4) (Martin et al., 1982). Another prospective study found an increased risk of IUGR (OR = 2.4) and preterm delivery (OR = 1.6) with chlamydial infections (Investigators of the Johns Hopkins Study of Cervicitis and Adverse Pregnancy Outcome, 1989). Harrison et al. found an increased risk of prematurity and perinatal death, but only among IgM-seropositive women, indicating those with more recent infection (Harrison et al., 1983). Premature rupture of membranes, preterm labor, postpartum endometritis and fever have been linked in other studies to *C. trachomatis* infections (Sweet et al., 1987).

Chlamydia can be transmitted from the mother to the infant in the peripartum period. Infants born to mothers carrying *C. trachomatis* have an 18 percent chance of developing chlamydial conjunctivitis and a 16 percent chance of developing chlamydial pneumonia (Schachter et al., 1986a). Pregnant women can be screened for chlamydia and treated with erythromycin to prevent antepartum complications and perinatal acquisition of chlamydia by the newborn infant (McMillan et al., 1985; Schachter et al., 1986b; Cohen et al., 1990). However, chlamydial infections not detected by screening usually can be treated with antibiotics in the neonatal period without adverse outcomes (Schachter et al., 1986a).

Chlamydia screening in pregnancy is recommended for high-risk groups including adolescents, unmarried women, and those reporting multiple sex partners or a history of other sexually-transmitted disease (CDC, 1985). Groups supporting this recommendation include the USPHS Panel, the USPSTF, the CDC, ACOG, and the Canadian Task Force.

**Human Immunodeficiency Virus (HIV)**

A woman carrying the HIV virus has an estimated 30 percent chance of transmitting it to her fetus (AAP Task Force on Pediatric AIDS, 1988). Congenital HIV infections have very poor prognoses and are increasing in frequency (Scott et al., 1989). Until recently, the value
of screening for HIV infection in pregnant women derived mostly from providing women with information to inform choices about the continuation of pregnancy. However, recent data have provided an additional reason for identifying women at risk of transferring HIV infection to their fetuses.

One study demonstrated that HIV-infected women who were treated with the anti-retroviral drug zidovudine during pregnancy had a significantly lower risk of transmitting the infection to their newborns (Connor et al., 1994). In this randomized, double-blind, placebo-controlled trial of HIV-infected pregnant women with CD4+ counts about 200, women treated with zidovudine transmitted the infection to 8.3 percent of their infants, whereas women treated with placebo transmitted the infection to 25.5 percent of their infants. This 67.5 percent reduction in perinatal transmission is statistically significant (P<0.01). Further, minimal short term toxic effects were observed in either mothers or infants treated with zidovudine.

These data on the effectiveness of zidovudine in preventing perinatal HIV transmission provide a compelling rationale for identifying HIV-infected pregnant women. The USPHS (1989) has recommended offering HIV testing to all pregnant women. All pregnant women should receive counseling about their individual risk of HIV infection, and should be offered testing so that antiretroviral therapy can be instituted in women found to be positive.

**Congenital Fetal Disorders**

**Down Syndrome**

Antenatal screening for Down syndrome in women over 35 years of age has long been an accepted prenatal care process. The risk of a Down syndrome infant increases exponentially when the mother is 35 years or older; the rate is 1 in 375 births at age 35 and 1 in 30 births at age 45. Karyotyping of the fetus, from amniocentesis and more recently chorionic villus sampling, is a sensitive and specific means of prenatal detection. The main disadvantage to antenatal detection is the risk of inducing abortions in normal pregnancies. This occurs following about 0.5 percent of amniocenteses. Amniocentesis may also rarely cause
orthopedic deformities and respiratory distress syndrome in the fetus (Campbell, 1987). Alternatively, chorionic villus sampling can be performed earlier in the pregnancy with equal or slightly higher abortion rates (American Medical Association, 1987). For women aged 35 years, this means one normal fetus is aborted for every one or two Down syndrome infant(s) detected.

Offering amniocentesis to women over 35 years old has been recommended by the USPSTF, the USPHS panel, ACOG, and AAP. Newer, less invasive, methods of screening for Down syndrome are being investigated such as maternal serum AFP screening and ultrasound, but none have yet been proven to be accurate enough to replace amniocentesis.

**Neural Tube Defects**

Neural tube defects (NTDs) are among the most common congenital anomalies, occurring in approximately 1 in every 1000 pregnancies in the United States. Some women are at higher risk of having an infant with a NTD, but 90 percent of NTDs occur in low-risk groups. About half of the NTDs are anencephalic and do not survive. The remainder are mostly spina bifidas and myelomeningoceles which can cause significant neurologic impairment including paraplegia and bowel and bladder incontinence (USPSTF, 1989; Campbell, 1987).

Measuring maternal serum alpha-fetoprotein (AFP) can be used to detect NTDs in early pregnancy. Screening using serum AFP determinations is performed by first measuring the maternal level usually between 16 and 18 weeks gestation. Based on this initial screen, 2.5 to 7.0 percent of serum AFP samples, depending on the criteria used, will be abnormally high. Abnormal screening AFP levels are then evaluated by either repeating the AFP determination to confirm or performing an ultrasound to identify a NTD or to exclude incorrect gestational age and multiple gestations as a cause for the abnormality (Nadel et al., 1990). For elevated AFPS not explained by the ultrasound, amniocentesis may be performed to measure amniotic fluid AFP and acetylcholinesterase levels. About 1.5 percent of all pregnancies receiving an AFP screen are subsequently offered amniocentesis. For women who complete this evaluation, the sensitivity of AFP screening for anencephaly has been 83 to 100 percent and 50 to 100 percent for open
spina bifida (see Table 15.2). The specificity of AFP screening is nearly 100 percent. Almost no normal pregnancies have been terminated based on abnormal results from an amniocentesis or ultrasound evaluation—although the risk of inducing an abortion in performing amniocentesis is estimated to be 0.5 percent (Campbell, 1987). The feasibility of AFP screening has been demonstrated in numerous large-scale trials initially in the United Kingdom and later in the United States (Table 14.2). Reports have been published on over 100,000 pregnancies screened (UK Collaborative Study, 1977; Ward et al., 1981; Macri and Weiss, 1982; Burton et al., 1983; Hooker et al., 1984; Milunsky and Alpert, 1984; Milunsky et al., 1989a).
### Table 14.2
Summary of Serum Alpha-Fetoprotein Screening for Neural Tube Defects in Pregnancy

<table>
<thead>
<tr>
<th>Author</th>
<th>Study Setting</th>
<th>Number of Patients</th>
<th>NTD Rate (per 1,000)</th>
<th>Elevated AFPs No. (%) [Criteria]</th>
<th>Offered Amniocentesis No. (%)</th>
<th>Proportion of Anencephaly Detected</th>
<th>Proportion of Open Spina Bifida Detected*</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.K. Collaborative Study, 1977</td>
<td>19 U.K. centers</td>
<td>19,148</td>
<td>1.6</td>
<td>N.R. (3.3%) [2.5x median]</td>
<td>N.R.</td>
<td>88%</td>
<td>79%</td>
</tr>
<tr>
<td>Ward, 1981</td>
<td>1 U.K. center</td>
<td>5,668</td>
<td>1.9</td>
<td>129 (2.3%) [Varied]</td>
<td>19 (0.3%)</td>
<td>100%</td>
<td>50%</td>
</tr>
<tr>
<td>Macri, 1982</td>
<td>Long Island, NY screening program</td>
<td>17,703</td>
<td>1.2</td>
<td>692 (3.9%) [2x median]</td>
<td>365 (2.1%)</td>
<td>83.3%</td>
<td>100%</td>
</tr>
<tr>
<td>Burton, 1983</td>
<td>No. Carolina screening prgm.</td>
<td>12,084</td>
<td>1.5</td>
<td>452 (3.7%) [2.5x median]</td>
<td>148 (1.2%)</td>
<td>80%</td>
<td>85%</td>
</tr>
<tr>
<td>Hooker, 1984</td>
<td>1 U.K. center</td>
<td>6,344</td>
<td>1.3</td>
<td>88 (1.4%) [2.5x median]</td>
<td>45 (0.7%)</td>
<td>None occurred</td>
<td>100%</td>
</tr>
<tr>
<td>Milunsky, 1984</td>
<td>New England private practices</td>
<td>21,442</td>
<td>1.2</td>
<td>249 (1.2%) [2.5x median]</td>
<td>56 (0.3%)</td>
<td>86%</td>
<td>63%</td>
</tr>
<tr>
<td>Robinson, 1989</td>
<td>California AFP program</td>
<td>35,787</td>
<td>0.9</td>
<td>560 (1.6%) [2.5x median]</td>
<td>413 (1.2%)</td>
<td>N.R.</td>
<td>N.R.</td>
</tr>
<tr>
<td>Milunsky, 1989</td>
<td>New England private practices</td>
<td>13,486</td>
<td>1.6</td>
<td>530 (3.9%) [2.0x median]</td>
<td>N.R.</td>
<td>100%</td>
<td>91%</td>
</tr>
</tbody>
</table>

* Excludes closed neural tube defects
N.R. = not reported
Maternal serum AFP screening has other advantages besides detecting NTDs. About 40 percent of patients with elevated AFPs are determined by ultrasound to have incorrect dates or twin gestations. Whether having this information improves pregnancy management and outcome has not been determined. Patients with elevated AFP levels with subsequent normal amniotic AFP levels have also been identified as having a greater risk of perinatal loss (Robinson, 1989). Finally, pregnancies with abnormally low AFP levels are at greater risk for chromosome abnormalities, including Down syndrome (Milunsky et al., 1989; DiMaio et al., 1987). Amniocentesis for genetic analysis has been recommended to evaluate low serum AFP levels, although the value of this approach is still considered investigational (American Medical Association, 1988).

ACOG, USPHS panel, the USPSTF and an international consensus meeting (Boppart et al., 1985) have all supported well-coordinated AFP programs which provide mothers with appropriate counseling services if any abnormalities are detected. Antenatal detection of NTDs enables pregnant women to make more informed choices about their pregnancy and to receive appropriate counseling. Concerns about the value of AFP screening have been raised because half of the anomalies detected are anencephaly, for which early detection does not alter the ultimate outcome (fetal or early neonatal death), although considerable emotional trauma from the unexpected delivery of a severely deformed fetus may be avoided. Also, AFP screening can result in the termination of normal pregnancies, the greatest risk being related to the performance of amniocentesis. For cases of spina bifida detected, the parents are faced with what can be a difficult ethical decision regarding pregnancy termination since these pregnancies can result in a mentally intact, but chronically disabled, infant. AFP screening programs must take into consideration individual perspectives about how to value life and the burden of suffering imposed on an afflicted infant.

**Sickle Cell Disease**

Sickle cell disease and its variants are genetic abnormalities transmitted in an autosomal recessive pattern; both parents must carry an abnormal gene for the disease to be fully manifest. The disease causes severe hemolytic anemia, painful vasoocclusive crises,
cholelithiasis, renal dysfunction, cerebral thromboses, and decreased life expectancy. It afflicts about 0.15 percent of blacks. About 8 percent of blacks are asymptomatic heterozygous carriers. This places one in 150 black couples at risk for giving birth to a child with sickle cell disease.

Parents can be screened to determine whether they carry the trait. If both members of a couple carry the trait, antenatal testing of the fetus for sickle cell disease can be performed either using amniocentesis (Boehm et al., 1983; Driscoll et al., 1987; Embury et al., 1987) or chorionic villus sampling (Goossens et al., 1983). The sensitivity and specificity of these tests appear to be very good although no large scale studies have yet been reported (USPSTF, 1989).

As with other genetic abnormalities, antenatal diagnosis of sickle cell disease allows the family to make informed decisions about whether to carry the pregnancy to term (Anionwu et al., 1988). Patients should be counseled about their options including termination of the pregnancy. The USPSTF supports routine screening of pregnant women at risk. ACOG and the British Society for Haematology (BCSH General Haematology Task Force, 1988) recommend that pregnant women with abnormal red cell indices be screened for sickle cell and other hemoglobinopathies.

**Rh Isoimmunization**

The incidence of Rh isoimmunization, which causes such fetal complications as hemolytic anemia, hyperbilirubinemia, hydrops fetalis and fetal death, has declined dramatically since the introduction of Rh(D) immune globulin (Rhogam) prophylaxis. About 9 to 10 percent of women are Rh-negative. Of these women, 8 to 15 percent would become isoimmunized in the postpartum period without prophylaxis. Rhogam has been used so successfully that only 14.3 of every 100,000 pregnancies are now affected (USPSTF, 1989).

With postpartum prophylaxis reducing the number of women isoimmunized in the postpartum period, isoimmunization occurring in the antepartum period has increased in relative importance (Tovey and Taverner, 1981). From 0.7 to 1.8 percent of Rh-negative women are isoimmunized if they do not receive Rhogam antenatally. Studies of
Antepartum administration of the Rh immune globulin have found it to be effective in preventing antepartum isoimmunization (Hensleigh, 1983).

Screening for Rh-negative women and Rh immune globulin prophylaxis, both antenatally and postpartum, are unanimously recommended by the USPSTF, the USPHS panel, ACOG, AAP, and the Canadian College of Obstetricians and Gynecologists. Performing an indirect Coombs test to detect other less common types of isoimmunizations has also been recommended.

**Common Pregnancy Complications**

**Intrauterine Growth Retardation**

Intrauterine growth retardation (IUGR) complicates about 5 percent of pregnancies. These infants are at greater risk for obstetrical complications including fetal distress during labor, meconium aspiration, hypoglycemia and hypothermia, and perinatal mortality. Growth-retarded infants accounted for 18 percent of total perinatal mortality and 31 percent of fetal loss (Tejani and Mann, 1977).

The simplest means of screening for IUGR is serial measurements of symphysis-fundal height (SFH). SFH measurements are safe and inexpensive, but are subject to several problems. One problem is its relatively poor reliability. Repeated SFH measurements for a given patient can vary between observers by as much as 4 cm (S.D. = 1 cm) (USPSTF, 1989; Rogers and Needham, 1985). Another difficult problem is deciding upon the specific SFH-gestational age discrepancy to define abnormal since this greatly influences the sensitivity and specificity of this method. A three- or four-centimeter discrepancy between the SFH and that expected for a given gestational age is the criterion generally recommended with reported sensitivities ranging from 65 to 85 percent and specificities from 80 to 93 percent (USPSTF, 1989; Cunningham et al., 1989; Goldenberg et al., 1990). A lower criterion could be used to increase the sensitivity of the test but this would also decrease the test's specificity and positive predictive value. Finally, the utility of the test will vary with the prevalence of IUGR in the population. Assuming a sensitivity of 75 percent and specificity of 90 percent, the positive predictive value in a population with a prevalence of 5 percent
would be about 28 percent. Using the same sensitivities and specificities in a higher-risk population with a prevalence of 10 percent, the positive predictive value increases to 45 percent.

The relatively low sensitivity of SFH measurements (as many as 35 percent of IUGR will not be detected) has led to the consideration of an alternative means of screening for IUGR, obstetrical ultrasound. Its sensitivity compares favorably to physical examination, with sensitivities of 80 to 96 percent and specificities of 80 to 90 percent (USPSTF, 1989; Seeds, 1984). Again, the low prevalence of IUGR in the general population limits its positive predictive value. Even assuming a sensitivity of 95 percent and specificity of 90 percent, the positive predictive value is improved to only 33 percent. In pregnancies with complicating maternal or fetal conditions that increase the risk of IUGR, the improved positive predictive value may warrant ultrasound screening. Of note, a single ultrasound examination is often not sufficient to diagnose IUGR. Many pregnancies will require two or more ultrasound examinations to evaluate problems adding considerably to the cost of prenatal care. For example, women in Norway where routine ultrasonography is widely accepted have an average of 2.45 examinations per pregnancy (Nesheim et al., 1987). Studies of the safety and long-term effects of obstetrical ultrasounds so far have not shown any harmful consequences, but many authors warn of possible unobserved effects (Kremkau, 1984).

Arguments for the routine use of ultrasound to screen for IUGR are supported by its benefit in detecting other obstetrical problems such as: incorrect gestational age based on LMP, congenital anomalies, multiple gestations, placenta previa, and abnormal fetal presentation. By screening for these problems and IUGR, earlier interventions could be implemented to improve pregnancy outcomes. A number of controlled clinical trials have tested the overall benefit of routine obstetrical ultrasounds (Campbell et al., 1985; Goldenberg et al., 1989a; Bennett et al., 1982; Cochlin, 1984; Neilson et al., 1984; Eik-Nes et al., 1984; Bakketeig et al., 1984; Waldenstrom et al., 1988; Reading and Cox, 1982; Field et al., 1985; Ewigman et al., 1990). Some benefits were noted such as fewer inductions of postterm pregnancies, earlier detection of
multiple gestations and placenta previas. Only limited benefits in terms of perinatal outcomes, however, were noted. Eik-Nes found nonsignificantly higher birthweights for twin gestations and lower perinatal mortality rates among women receiving routine ultrasounds (Eik-Nes et al., 1984). Bakketeig found a nonsignificant improvement in birthweights for twin gestations (Bakketeig et al., 1984). Waldenstrom et al. (1988) found slightly fewer infants with low birthweight. These studies are limited by their sample sizes in their ability to show statistically significant differences with routine ultrasound. Pooled analysis was still inconclusive showing nonsignificant improvements in both perinatal death rate and Apgar scores (Thacker, 1985).

Other methods of detecting IUGR are being tested. Doppler ultrasound of umbilical artery flow has been used to evaluate uteroplacental perfusion. Fetuses with abnormal Doppler studies are at greater risk of poor pregnancy outcomes. Its present role, however, is in confirming abnormal growth patterns suggesting IUGR, and not as a screening test (Reuwer et al., 1987).

In the United States, serial physical examinations continue to be the primary method of screening for IUGR. Although obstetrical ultrasounds are used for medical indications, their use for routine screening has not been advocated by any major organizations in the United States. The USPSTF recommends ultrasound examinations be performed routinely for women at increased risk of delivering a growth-retarded infant. They should also be considered for pregnancies with uncertain menstrual dates. A National Institutes of Health consensus development conference (Consensus Conference, 1984) and ACOG have made similar recommendations for the use of ultrasound. The Canadian Task Force also does not recommend routine serial ultrasounds in normal pregnancies. Even in Norway where 94 percent of women receive ultrasound examinations, a consensus group could not recommend implementing ultrasound screening citing concerns about overutilization, uncertain quality, and unknown risks (Nesheim et al., 1987). The only organization currently recommending routine ultrasound examinations is the Royal College of Obstetricians and Gynaecologists in Britain.
Management of IUGR relies mostly upon treating the underlying cause, such as cigarette smoking. A precise cause for the IUGR, however, is often not known. Patients are advised to limit their strenuous activities and optimize their nutritional intake. Fetuses with IUGR are at greater risk for fetal distress; signs of fetal distress on serial fetal monitoring would be an indication to effect delivery. Depending upon the severity of the IUGR and fetal maturity, early delivery should be considered (Seeds, 1984).

**Postterm Pregnancy**

From 4 to 12 percent of pregnancies continue beyond 42 weeks after the last menstrual period (McClure Browne, 1963; Vorherr, 1975). The process by which labor is initiated remains unknown, but many of these postterm pregnancies are likely due to inaccurate recall of the last menstrual period or to delayed ovulation (Saito et al., 1972). True postterm pregnancies, however, are at increased risk of perinatal morbidity and mortality. Rates of perinatal mortality increase at 41 weeks, double by 42 weeks and quadruple by 44 weeks. Postterm infants are at greater risk for cesarean delivery due to fetal distress and failed progress in labor related to higher birthweights (McClure Browne, 1963; Arias, 1987).

Studies have shown that appropriate management of postterm pregnancies can prevent much of the perinatal mortality (Yeh and Read, 1982; Eden et al., 1982; Shime et al., 1984; Dyson et al., 1987; Johnson et al., 1986; Bochner et al., 1987; Khouzami et al., 1983; ). These studies vary somewhat in their obstetrical management and few comparisons of approaches have been made to identify the optimal strategy. Much of the management of postterm pregnancy depends on the accuracy of the fetal gestational age.

For patients with good dates, labor can be routinely induced at 42 weeks, particularly if the cervix is favorable (Witter and Weitz, 1987). If not induced, fetal monitoring should be performed regularly beginning no later than 42 weeks (Benedetti and Easterling, 1988). Some authors recommend beginning fetal monitoring at 41 weeks because some fetal deaths occur between 41 and 42 weeks (Bochner et al., 1988). A variety of different antepartum fetal monitoring methods are used including
nonstress test, contraction stress test, biophysical profiles, serum estriols, and ultrasound. When the cervix is not favorable, the decision to deliver is based on repeated fetal monitoring and estimated fetal weight; fetal distress or oligohydramnios are indications for induction of labor, or possibly primary cesarean section (see Chapter 6). Pregnancies with good dates should rarely continue beyond 43 weeks (Dyson, 1988; ACOG, 1989).

For patients with poor dates, management is more difficult. Inducing labor in a pregnancy with inaccurate determination of gestational age could result in the delivery of a premature infant. A more conservative approach is used to manage these pregnancies. Antepartum fetal monitoring is used to assess the status of the fetus while awaiting spontaneous labor. Once the pregnancy reaches a stage at which fetal maturity can be assured based on clinical information or fetal distress is noted, induction may occur (Dyson, 1988).

**Pregnancy-Induced Hypertension**

Pregnancy-induced hypertension (PIH) is one of the more common medical complications during pregnancy. It occurs in about 5 to 10 percent of pregnancies with manifestations ranging from isolated mild elevations in blood pressure to eclamptic seizures, disseminated intravascular coagulopathy, and maternal or fetal death. Most cases occur among primiparous women or those with preexisting hypertension.

Several studies have suggested primary prevention of PIH may be possible, but further studies are needed (Klonoff-Cohen et al., 1989; Benigni et al., 1989; Schiff et al., 1989). Prenatal care currently plays an important role in the secondary and tertiary prevention of complications due to PIH. Failure to diagnose and treat preeclampsia appropriately is an important factor in maternal mortality from PIH and eclampsia (Evans et al., 1983).

Screening for PIH is based primarily on noting an increase in blood pressure, preferably before the second trimester of pregnancy. The most commonly used criteria are systolic blood pressure above 140 mm Hg and diastolic above 90 mm Hg, or increases in blood pressure during pregnancy of more than 30 mm Hg systolic or 15 mm Hg diastolic. Elevated blood pressure alone, however, does not reliably predict which
women will develop complications. Many women with even moderately elevated blood pressures will have no other manifestations of PIH; women who develop eclamptic seizures, however, will sometimes have only mild elevations of blood pressure. The presence of proteinuria or peripheral edema with elevated blood pressures helps to confirm the diagnosis of preeclampsia. Neither proteinuria nor peripheral edema alone or combined have sufficient sensitivity and specificity (Chesley, 1985). Other methods have been suggested to refine the screening for PIH such as mean arterial blood pressure, uric acid levels, and platelet counts. Preeclampsia still remains a clinical diagnosis based primarily on blood pressure criteria, but taking into consideration other clinical information such as proteinuria and edema (Sibai, 1988; Redman and Jefferyes, 1988; Fay et al., 1985).

Early detection and appropriate treatment of preeclampsia almost certainly helps to avert many of its complications (ACOG, 1986). However, the weight of scientific evidence and expert consensus ethically precludes such a trial from being conducted. Management of PIH depends on its severity and when during pregnancy it is diagnosed. When the pregnancy is near term, efforts are usually made to deliver the fetus. When the pregnancy is remote from term, however, management of PIH may vary. Disease severity can be assessed by physical examination, and laboratory tests including complete blood counts, coagulation tests, liver function tests and renal function tests (Thiagarajah et al., 1984). For milder cases, bedrest can usually be prescribed, but it is not clear at what point hospitalization becomes necessary (Sibai, 1988). In more severe cases, immediate delivery should be considered when fetal maturity can be demonstrated, conservative management fails, signs of fetal distress or growth retardation develop, or gestational age exceeds 32 to 34 weeks (Thiagarajah et al., 1984; Lindheimer and Katz, 1985; Cunningham and Pritchard, 1984; Sibai et al., 1985). Magnesium sulfate or other anti-seizure measures should be implemented to prevent eclampsia (Cunningham and Pritchard, 1984; Sibai et al., 1984; Slater et al., 1987). Antihypertensive medications can be used to treat severe hypertension (diastolic blood pressure over 110 mm Hg) (Cunningham and Pritchard, 1984). Antihypertensive medications do not appear to
influence outcomes in milder preeclampsia (Sibai et al., 1987).
Disseminated intravascular coagulation should be appropriately diagnosed
and treated (Thiagarajah et al., 1984).

Screening for preeclampsia with periodic blood pressure
measurements during pregnancy has been supported by the USPSTF, USPHS,
ACOG and the Canadian Task Force. Although most groups recommend that
blood pressure be taken at every visit, the optimal frequency of
measurement recommended varies among the different groups because they
differ in their recommended number and frequency of prenatal visits.
The USPSTF leaves the recommended frequency to clinical discretion
noting that the optimal frequency has not been determined.

**Gestational Diabetes Mellitus**

Gestational diabetes is a relatively common problem, developing in
2 to 3 percent of pregnancies, usually in the second or third trimester
(O'Sullivan et al., 1973; Merkatz et al., 1980; CDC, 1986). By
comparison, only 0.3 percent of pregnant women have a previous diagnosis
of diabetes. Gestational diabetes is associated with increased risk of
perinatal mortality, fetal macrosomia and associated delivery
complications, and neonatal morbidity including hypoglycemia,
hypocalcemia, polycythemia and hyperbilirubinemia (O'Sullivan et al.,
1966; American Diabetes Association, 1986).

In order to identify women with gestational diabetes, risk factors
such as age, obesity, family history, and previous delivery of a
macrosomic or congenitally malformed infant can be used to select women
for screening. Most women with gestational diabetes, however, will not
have any risk factors (O'Sullivan et al., 1973). For selective or
routine screening for gestational diabetes, a 50 gram glucose challenge
test is generally given at 24 to 28 weeks gestation. Plasma glucose
levels drawn one hour after ingestion are abnormal if greater than 140
mg/dl. Abnormal screening tests are confirmed with a three-hour glucose
tolerance test. This method is about 80 to 85 percent sensitive and
specific. Other diabetes screening methods such as urine dipsticks for
glucose and glycosylated hemoglobins are not sensitive enough for
screening (USPSTF, 1989; CDC, 1988b; ACOG, 1994).
Treatment of gestational diabetes usually includes diabetes education, diet, and exercise (CDC, 1986; ACOG, 1994). Although routine use of insulin helps prevent macrosomia and related complications of delivery (Coustan and Lewis, 1978; Coustan and Imarah, 1984), there may not be any advantage over treating with diet initially and reserving insulin therapy for women whose fasting or postprandial glucoses are not well-controlled (e.g., fasting plasma glucose > 65 ml/dl or two-hour postprandial glucose > 120 mg/dl) (ACOG, 1994; Persson et al., 1985). Oral hypoglycemic medications are generally not used during pregnancy. Because of the complications associated with gestational diabetes, fetal monitoring is generally initiated at term and delivery is usually effected close to term (CDC, 1988b; ACOG, 1994; Langer, 1990).

The improvement in outcomes from screening and treating gestational diabetes are relatively limited. Two experimental controlled trials and a number of observational studies have shown that treatment of gestational diabetes can significantly reduce the incidence of fetal macrosomia. In the experimental trials, however, decreased macrosomia was not associated with improvements in perinatal mortality and birth trauma rates (O'Sullivan et al., 1966; Coustan and Lewis, 1978; Singer et al., 1988). Thus, the benefits from screening for gestational diabetes are limited to avoiding some short-term morbidity related to the delivery of a macrosomic infant and do not appear to include improved long-term morbidity nor perinatal mortality.

The USPHS panel, the USPSTF, the American Diabetes Association, the CDC, and the Second International Workshop-Conference on Gestational Diabetes Mellitus support routine screening for diabetes in pregnancy. ACOG, however, does not recommend routine screening; rather, screening is recommended only for women over age 30 or for those who have specific risk factors which include glucosuria, hypertension, family history of diabetes, previous delivery of a macrosomic, malformed, or stillborn infant, or obesity (ACOG, 1994).
## RECOMMENDED QUALITY INDICATORS FOR PRENATAL CARE

### Screening

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<tr>
<th>Indicator</th>
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<th>Literature</th>
<th>Benefits</th>
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<td><strong>Routine Prenatal Care</strong></td>
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<tr>
<td>1. The first prenatal visit should occur in the first trimester.</td>
<td>II-1</td>
<td>USPHS, 1989</td>
<td>Prevent morbidity/mortality associated with complications in pregnancy.</td>
<td>An early first prenatal visit has been associated with decreased low birth weight. First trimester blood pressure assessment allows more accurate diagnosis of pre-eclampsia later in pregnancy. High-risk factors for which intervention is available can be identified (e.g., smoking, substance abuse, chronic hypertension, diabetes).</td>
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<tr>
<td>2. The physician should make an accurate determination of gestational age using: a. An ultrasound in the 1st or 2nd trimester, or b. Reliable LMP and size within 2 wks indicated by dates in the 1st trimester, or c. No 1st trimester exam, but reliable LMP &amp; 2 of the following: 1) size w/in 2 wks. of dates in 2d trimester; 2) quickening by 20 wks.; 3) fetal heart tones by fetoscope before 20 weeks, or d. If unreliable LMP, then an ultrasound is required.</td>
<td>III</td>
<td>USPHS, 1989; Cunningham et al., 1989; Campbell et al., 1985; Andersen et al., 1981; Kramer et al., 1988; Goldenberg et al., 1989a; NIH Consensus Conference, 1984</td>
<td>Prevent or identify complications of pregnancy such as post-datism and intrauterine growth retardation. Prevent iatrogenic prematurity. Prevent unnecessary induction of labor.</td>
<td>Diagnosis of inappropriate fetal growth and post-dates require accurate knowledge of gestational age. The timing of induction of labor for post-dates is dependent on accurate gestational age information. Scheduled cesarean deliveries prior to term can be avoided if accurate dating is available.</td>
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<td>3. Pregnant women should be screened for anemia at the first prenatal visit.</td>
<td>III</td>
<td>USPSTF, 1989; USPHS, 1989; Hemminki and Starfield, 1978; Lieberman et al., 1988; Murphy et al., 1986; Klebanoff et al., 1989; Reece et al., 1987; Hibbard, 1988; Horn, 1988; Shapiro and Lyons, 1989</td>
<td>Prevent low and very low birthweight births.</td>
<td>Early identification of anemia allows for treatment during pregnancy. Severe anemia has been associated with low birthweight. The risk of untreated mild anemia is not well defined, but screening and iron supplementation have become routine.</td>
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<td>4.</td>
<td>Pregnant women should be rescreened for anemia after 24 weeks.</td>
<td>III</td>
<td>Lieberman et al., 1988; Murphy et al., 1986</td>
<td>Prevent low and very low birthweight births.</td>
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<td><strong>Substance Abuse</strong></td>
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<td>5.</td>
<td>A smoking history should be obtained at the first prenatal visit.</td>
<td>I+</td>
<td>Mayer et al., 1990; Ershoff et al., 1989; Sexton and Hebel, 1984; Hebel et al., 1985</td>
<td>Reduce incidence of low birthweight.</td>
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<td><strong>Infections and STDs</strong></td>
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<td><strong>Asymptomatic Bacteriuria</strong></td>
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<td>8.</td>
<td>Pregnant women should receive a urine culture at the first prenatal visit.</td>
<td>I+</td>
<td>Romero et al., 1989; Pols et al., 1989; Campbell-Brown et al., 1987; Wadland and Plante, 1989</td>
<td>Prevent pyelonephritis and its complications (e.g., preterm delivery, hospitalization).</td>
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<td><strong>Hepatitis B Carriers</strong></td>
<td>II-2</td>
<td>Xu et al., 1985; Stevens et al., 1985; Beasley et al., 1983; Schalm et al., 1989; Poovorawan and Sanpavat, 1989; CDC, 1985; Arevalo and Washington, 1988</td>
<td>Decrease incidence of hepatitis infection in newborns.</td>
<td>Many HBsAg carriers can be detected using risk factor screening, but in practice this has not been effective. Routine screening allows for early vaccination of newborns, as well as Ig prophylaxis, which can effectively prevent vertical transmission.</td>
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<td><strong>Syphilis</strong></td>
<td>II-3+</td>
<td>CDC, 1988b; Stray-Pedersen, 1983; Williams, 1985</td>
<td>Prevent congenital syphilis</td>
<td>Screening only high risk women has not proven effective.</td>
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<tr>
<td><strong>Chlamydia</strong></td>
<td>III</td>
<td>CDC, 1985</td>
<td>Reduce neonatal chlamydial infection.</td>
<td>Chlamydial infections in newborns include pneumonia and conjunctivitis.</td>
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<td><strong>Human Immunodeficiency Virus</strong></td>
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<td>Minkoff and Landesman, 1988</td>
<td>Reduce perinatal transmission of HIV.</td>
<td>In order to inform their decision to accept or reject HIV testing, women need to know if they fall into a high-risk category.</td>
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<td></td>
<td>Inherited Disorders</td>
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<td>15.</td>
<td>Pregnant women should be offered HIV testing at the first prenatal visit.</td>
<td>I/III</td>
<td>Connor, 1994; USPHS, 1989</td>
<td>Reduce perinatal transmission of HIV. Based on data that show that zidovudine therapy can effectively reduce perinatal transmission. Also allows for PCP prophylaxis or early treatment of those pregnant women infected with HIV.</td>
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<td>16.</td>
<td>Pregnant women age 35 and over, or who have had a previous Down syndrome infant, should receive amniocentesis or chorionic villus sampling (CVS), or should explicitly decline such a test after genetic counseling.</td>
<td>II-2+</td>
<td>USPSTF, 1989; Sadovnick and Baird, 1982</td>
<td>Facilitate patient-informed choice. Allows women who would consider terminating their pregnancy early access to information about chromosomal abnormalities. The age cutoff is designed to balance the risk of a spontaneous abortion with a chosen abortion and the chance of an affected child.</td>
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<tr>
<td>17.</td>
<td>Pregnant women under age 35 should be offered serum AFP; this should be performed between 15 and 20 weeks.</td>
<td>II-2+</td>
<td>USPSTF, 1989; USPHS, 1989; Campbell, 1987; Nadel et al., 1990; American Medical Association, 1988; Boppart et al., 1985; Sadovnick and Baird, 1983; Sadovnick and Baird, 1982; Layde et al., 1979</td>
<td>Allows parents who would consider termination of pregnancy to do so. Prepares parents and health care team for birth of affected infant. See Table 14.1. Early detection of fetuses with open neural tube defects. Serum AFP can also detect Down Syndrome, twins, and incorrect dating.</td>
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<tr>
<td>18.</td>
<td>Pregnant women who have had a previous NTD infant should receive amniocentesis or should explicitly decline such a test after genetic counseling.</td>
<td>II-2+</td>
<td>Boppart et al., 1985</td>
<td>Identify fetuses with NTD early. Allow parents who would consider termination to do so. Prepares parents and health care team for birth of affected infant. These women are at increased risk of having fetuses affected with neural tube defects.</td>
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<td><strong>Sickle Cell Disease</strong></td>
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<td>19. Pregnant women who are African American or have a family history of sickle cell disease should be screened at the first prenatal visit.</td>
<td>II-2+</td>
<td>Identify fetuses at risk for sickle cell disease and allow for diagnosis and termination of pregnancy, if desired.</td>
<td>If a woman is a sickle cell carrier, testing of the partner and appropriate counseling can take place.</td>
<td>Bohem et al., 1983; Driscoll et al., 1987; Embury et al., 1987; Goossens et al., 1983; Anionwu et al., 1988; BCSH General Haematology Task Force, 1988</td>
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</table>

**Rh Isoimmunization**

| 20. For pregnant women with the sickle cell trait, the baby's father should be screened. | II-2+ | Identify fetuses at risk for sickle cell disease and allow for diagnosis and termination of pregnancy, if desired. | Allows for the quantification of the risk of sickle cell disease in the fetus. | See above. |

**Common Pregnancy Complications**

**Intrauterine Growth Retardation**

| 21. Pregnant women should receive an Rh factor and antibody screen at the first prenatal visit. | II-2+ | Prevent isoimmunization. Prevent complications (e.g., hydrops fetalis, fetal death) in women previously isoimmunized. | Unsensitized women can be administered anti-D immunoglobulin at the appropriate interval. Sensitized women can be monitored with antibody titers and amniocentesis. | Tovey and Taverner, 1981; Hensleigh, 1983; Torrance and Zipursky, 1984; Adams et al., 1984; |

**Post-term Pregnancy**

| 22. Measurements of the symphysis-fundal height should be made at each visit from 20-32 weeks. | III+ | Prevent intrauterine fetal death. | Although not a highly-specific test, this measurement can identify a subset of infants at risk for intrauterine growth retardation, who can be followed and diagnosed with ultrasound. Without intervention, a growth-retarded fetus is at risk for intrauterine death. | Wennergren and Karlsson, 1982; Rogers and Needham, 1985 |

**Pregnancy-Induced Hypertension (PIH)**

| 23. Weekly fetal monitoring should begin at 41.5 weeks and continue until labor (spontaneous or induced) begins. | II-I+ | Reduce risk of intrauterine fetal death. | Risk of intrauterine fetal death at greater than 41 weeks is increased and can be lowered to the risk at 40 weeks with testing and an induction protocol. | Arias, 1987; Dyson et al., 1987; Bochner et al., 1988; Dyson, 1988 |

| 24. Blood pressure measurements should be taken at each visit. | II-2+ | Prevent complications of pre eclampsia (e.g., seizure, abruptio placenta, fetal and maternal death). | Early identification of PIH may result in better outcomes. | Sibai, 1988; ACOG, 1986 |
### Gestational Diabetes Mellitus

| 25. | A one-hour, 50g glucose challenge test should be performed on pregnant women with risk factors at 24-28 weeks. | I+ | CDC, 1986; ADA, 1986; ACOG, 1994; Persson et al., 1985 | Decrease fetal macrosomia. | ACOG recommends screening high risk only. Screening and treatment of gestational diabetes decreases morbidity from macrosomia but no mortality benefit. ACOG risk factors include: age > 30; glucosuria; hypertension; family history of diabetes; previous delivery of a macroscopic, malformed, or stillborn infant; or obesity. |

### Diagnosis

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<tr>
<td>Hepatitis B Carriers</td>
<td>I+</td>
<td>Xu et al., 1985; Stevens et al., 1985</td>
<td>Decrease incidence of hepatitis B infection in newborns.</td>
<td>Newborn can be vaccinated at birth and given Hb immunoglobulin if maternal carrier status is known.</td>
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<td>26.</td>
<td>For pregnant women carrying HBsAg, carrier status should be documented in delivery record.</td>
<td>I+</td>
<td>Xu et al., 1985; Stevens et al., 1985</td>
<td>Decrease incidence of hepatitis B infection in newborns.</td>
</tr>
<tr>
<td>Syphilis</td>
<td>II-3+</td>
<td>CDC, 1988</td>
<td>Reduce risk of side effects from unnecessary syphilis medications.</td>
<td>Pregnancy and other conditions can result in a false positive test. This confirmatory test avoids unnecessary treatment.</td>
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<tr>
<td>27.</td>
<td>Pregnant women whose non-treponemal tests are weakly reactive or reactive should receive a treponemal test to confirm presence of syphilis.</td>
<td>II-3+</td>
<td>CDC, 1988</td>
<td>Reduce risk of side effects from unnecessary syphilis medications.</td>
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<td><strong>Inherited Disorders</strong></td>
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<td>Neural Tube Defects (NTDs)</td>
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<td>28.</td>
<td>Pregnant women with an abnormal serum AFP should receive an ultrasound to evaluate gestational age and possible multiple gestation.</td>
<td>II-2+</td>
<td>Nadel et al., 1990</td>
<td>Avoid erroneous diagnosis of neural tube defect.</td>
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<td>Sickle Cell Disease</td>
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<td>29.</td>
<td>Pregnant women with the sickle cell trait should receive either amniocentesis or chorionic villus sampling, unless the baby’s father is known to be negative for the sickle trait.</td>
<td>II-2+</td>
<td>Driscoll et al., 1987; Embury et al., 1987; Goosens et al., 1983</td>
<td>Identify affected fetuses. Allow termination of pregnancy if desired.</td>
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<td><strong>Common Pregnancy Complications</strong></td>
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<td>Intrauterine Growth Retardation</td>
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<td>30.</td>
<td>Pregnant women whose symphysis-fundal height is 4cm less than indicated by their gestational age between 20-32 weeks should have an ultrasound.</td>
<td>III+</td>
<td>USPSTF, 1989; Seeds, 1984</td>
<td>Decrease the risk of intrauterine fetal death.</td>
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<td><strong>Pregnancy-induced Hypertension (PIH)</strong></td>
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<td>31. For elevated BPs (systolic &gt; 140 mm Hg, or diastolic &gt; 90 mm Hg, OR systolic rise &gt; 30 mm Hg or diastolic rise &gt; 15 mm Hg), proteinuria and peripheral edema should be assessed.</td>
<td>II-2+</td>
<td>Sibai, 1988; Redman and Jeffries, 1988; Fay et al., 1985</td>
<td>Prevent complications of pre-eclampsia (e.g., seizure, placental abruption, or fetal or maternal death).</td>
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<td>32. For pregnant women with elevated BP and either proteinuria (1+ or more) or edema (&gt; trace), PIH diagnosis should be made.</td>
<td>II-2+</td>
<td>Sibai, 1988; Redman and Jeffries, 1988; Fay et al., 1985</td>
<td>Prevent complications of pre-eclampsia (e.g., seizure, placental abruption, or fetal or maternal death).</td>
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<td><strong>Gestational Diabetes Mellitus</strong></td>
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<tr>
<td>33. Pregnant women with abnormal glucose challenge tests (≥ 140 mg/dL or 7.8 mmol/L) should have a 3-hour plasma glucose tolerance test performed.</td>
<td>I+</td>
<td>ACOG, 1994</td>
<td>Decrease macrosomia.</td>
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### Treatment

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<tr>
<th>Indicator</th>
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<tr>
<td><strong>Substance Abuse</strong></td>
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<tr>
<td>34. Pregnant women identified as smokers should receive counseling to stop smoking from their physician.</td>
<td>I+</td>
<td>Kleinman et al., 1988; McIntosh and Chir, 1984</td>
<td>Decrease low birthweight births.</td>
<td>Counseling will help increase the percentage of women who quit and consequently decrease the associated risks (e.g., low birth weight).</td>
</tr>
<tr>
<td>35. Pregnant women identified as smokers should be referred to a smoking cessation clinic, group, or counselor.</td>
<td>I+</td>
<td>Kleinman et al., 1988; McIntosh and Chir, 1984</td>
<td>Decrease low birthweight births.</td>
<td>Intervention will help increase the percentage of women who quit and consequently decrease the associated risks (e.g., low birth weight).</td>
</tr>
<tr>
<td>36. Pregnant women who indicate they use any amount of alcohol should be counseled to eliminate alcohol consumption during pregnancy.</td>
<td>II</td>
<td>Little, 1977; Halmesmaki, 1988</td>
<td>Prevent fetal alcohol syndrome.</td>
<td>No threshold level has been identified and therefore the risk of fetal alcohol syndrome may exist at any level of consumption.</td>
</tr>
<tr>
<td>37. Pregnant women who indicate they use cocaine or heroin should be counseled by their physician to cease use during pregnancy.</td>
<td>II</td>
<td>Zuckerman et al., 1989</td>
<td>Decrease abruptions and preterm labor (cocaine). Decrease the chance of fetal death (heroin).</td>
<td>Counseling may increase rate of cessation of drug use.</td>
</tr>
<tr>
<td>38. Pregnant women who indicate they use drugs should be referred to a drug treatment clinic, group, or counselor.</td>
<td>II</td>
<td>Keith et al., 1989; Pettiti and Coleman, 1990</td>
<td>Decrease abruptions and preterm labor (cocaine). Decrease the chance of fetal death (heroin).</td>
<td>Specialized facilities are better equipped to counsel patients.</td>
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<tr>
<td><strong>Infections and Sexually Transmitted Diseases</strong></td>
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<tr>
<td><strong>Asymptomatic Bacteriuria</strong></td>
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<td>39. Pregnant women with positive cultures (&gt;100,000 bacteria/cc) should receive an appropriate antibiotic.</td>
<td>I+</td>
<td>Romero et al., 1989</td>
<td>Prevent pyelonephritis and its complications (e.g., preterm delivery, hospitalization).</td>
<td>Untreated bacteriuria has been associated with these adverse outcomes.</td>
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<td><strong>Rubella</strong></td>
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<td><strong>Syphilis</strong></td>
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<td>41. Pregnant women with confirmed positive serology should be treated with penicillin appropriate for the stage of disease; tetracycline and doxycycline are contraindicated.</td>
<td>II-3+</td>
<td>CDC, 1988</td>
<td>Prevent congenital syphilis.</td>
<td>Tetracycline and doxycycline are teratogens.</td>
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<tr>
<td><strong>Gonorrhea</strong></td>
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<td>42. Pregnant women with positive cultures should be treated as recommended by the PHS Guidelines on STD (250 mg IM once of ceftriaxone and erythromycin base 500 mg orally 4x/day for 7 days).</td>
<td>III+</td>
<td>CDC, 1988</td>
<td>Prevent ophthalmia neonatorum, septic abortions, chorioamnionitis, premature rupture of membranes and premature delivery.</td>
<td>Untreated gonorrhea has been associated with each of these complications.</td>
</tr>
<tr>
<td><strong>Antepartum Care</strong></td>
<td><strong>Inherited Disorders</strong></td>
<td><strong>Rh Isoimmunization</strong></td>
<td><strong>Common Pregnancy Complications</strong></td>
<td><strong>Post-Term Pregnancy</strong></td>
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<td>43. <strong>Human Immunodeficiency Virus</strong></td>
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<tr>
<td>Pregnant women known to be HIV positive with CD4+ counts of 200 or greater should be treated with zidovudine during pregnancy and intrapartum</td>
<td>I</td>
<td>Connor, 1994</td>
<td>Reduce perinatal transmission of HIV.</td>
<td>Based on data that show that zidovudine therapy can effectively reduce perinatal transmission.</td>
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<td>44. <strong>Inherited Disorders</strong></td>
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<tr>
<td>Down Syndrome</td>
<td>II-2+</td>
<td>USPSTF, 1989; USPHS, 1989</td>
<td>Allows women to chose the most appropriate option given current information about their test results and risks.</td>
<td>Genetic counseling is considered a necessary way of helping patients understand their options.</td>
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<td>45. <strong>Neural Tube Defects (NTDs)</strong></td>
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<td>Pregnant women whose amniocentesis shows infant with abnormal karyotype should receive additional genetic counseling.</td>
<td>II-2+</td>
<td>Boppart et al., 1985</td>
<td>Enhance patient-informed choice.</td>
<td>Genetic counseling can facilitate informed choice.</td>
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<td>46. <strong>Sickle Cell Disease</strong></td>
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<tr>
<td>Pregnant women whose amniocentesis shows an infant with sickle cell disease should be offered genetic counseling.</td>
<td>II-2+</td>
<td>Anionwu et al., 1988</td>
<td>Enhance patient-informed choice.</td>
<td>Genetic counseling can facilitate informed choice.</td>
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<tr>
<td>47. <strong>Rh Isoimmunization</strong></td>
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<tr>
<td>Pregnant women who are Rh negative should receive RhoGAM between 26 and 30 weeks antenatally and postpartum.</td>
<td>II-2+</td>
<td>Hensleigh, 1983</td>
<td>Prevents isoimmunization.</td>
<td>Avoiding isoimmunization will prevent possible hydrops fetalis in future pregnancies.</td>
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<td>48. <strong>Common Pregnancy Complications</strong></td>
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<tr>
<td>Post-Term Pregnancy</td>
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<tr>
<td>49. Labor should be induced when fetus shows signs of distress or oligohydramnios.</td>
<td>II-I+</td>
<td>Dyson, 1988</td>
<td>Prevent fetal death.</td>
<td>A post-term fetus with signs of distress or oligohydramnios is at high risk for intrauterine fetal death.</td>
</tr>
<tr>
<td>50. Pregnancies with reliable dates should not extend beyond 44 weeks.</td>
<td>II-I+</td>
<td>Shime et al., 1984; Dyson et al., 1987; Witter and Weitz, 1987; Dyson, 1988</td>
<td>Prevent fetal death.</td>
<td>Risk of fetal death increased in pregnancies greater than 44 weeks.</td>
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<td>51. <strong>Pregnancy-Induced Hypertension (PIH)</strong></td>
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<tr>
<td>If PIH diagnosed and patient is not admitted, bedrest should be recommended &amp; a return visit should occur w/in 1 week.</td>
<td>II-2+</td>
<td>Sibai, 1988</td>
<td>Prevent complications of PIH (e.g., seizure, placental abruption, or fetal or maternal death).</td>
<td>May allow delay of delivery until maturity.</td>
</tr>
<tr>
<td>52. If PIH diagnosed and pregnancy is at term (&gt;37 weeks), either labor should be induced or delivery by cesarean section should take place.</td>
<td>II-2+</td>
<td>Thiagarajah et al., 1984; Cunningham and Pritchard, 1984</td>
<td>Reduce risk of seizure, placental abruption, and death.</td>
<td>Increased risk of induction and cesarean delivery when compared to spontaneous vaginal delivery. Risk probably offset by reducing PIH complications.</td>
</tr>
<tr>
<td>53. If severe PIH is diagnosed by any of the following: (systolic &gt;160 mm Hg, diastolic &gt;110 mm Hg, 3-4+ proteinuria, pulmonary edema, oliguria, RUQ pain or seizures), patient should be admitted to induce labor or deliver by cesarean section.</td>
<td>II-2+</td>
<td>ACOG, 1986; Lindheimer and Katz, 1985</td>
<td>Decreases risk of PIH complications (see above).</td>
<td>Should consider transferring cases to a tertiary care center.</td>
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</table>

**Gestational Diabetes Mellitus**

<table>
<thead>
<tr>
<th>54. Pregnant women with abnormal 3-hour glucose tolerance tests should receive dietary counseling from a dietician.</th>
<th>I+</th>
<th>CDC, 1986; ACOG, 1994</th>
<th>Reduce blood glucose levels and eliminate the need for insulin therapy.</th>
<th>Gestational diabetes can often be managed with diet alone.</th>
</tr>
</thead>
<tbody>
<tr>
<td>55. Pregnant women on dietary therapy with 2 or more consecutive abnormal fasting (&gt;105 mg/dL) or postprandial (&gt;120 mg/dL one-hour post) plasma glucose tests should be placed on insulin therapy.</td>
<td>I+</td>
<td>ADA, 1986; ACOG, 1994</td>
<td>Reduce risk of macrosomia and neonatal complications (e.g., hypoglycemia, hypocalcemia).</td>
<td>If hyperglycemia persists on dietary therapy, insulin is indicated.</td>
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<td>Indicator</td>
<td>Quality of evidence</td>
<td>Literature</td>
<td>Benefits</td>
<td>Comments</td>
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<td>57. Pregnant women treated for positive cultures should receive a post-treatment follow-up culture within one month of completing treatment.</td>
<td>I+</td>
<td>Patterson and Andriole, 1987</td>
<td>Prevent pyelonephritis and its complications (e.g., preterm birth, hospitalization).</td>
<td>Testing for failure of initial treatment.</td>
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<tr>
<td><strong>Syphilis</strong></td>
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<td>58. Pregnant women diagnosed with syphilis in pregnancy should be followed up with monthly serology and retreated if necessary.</td>
<td>II-3+</td>
<td>CDC, 1988</td>
<td>Prevent congenital syphilis.</td>
<td>Assures adequate treatment.</td>
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<tr>
<td><strong>Gonorrhea</strong></td>
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<td>59. Pregnant women with positive cultures should receive a post-treatment follow-up culture 4-7 days after treatment is completed.</td>
<td>III+</td>
<td>Hook and Holmes, 1985</td>
<td>Prevent spread of disease to infant and other sexual partners.</td>
<td>Testing for failure of initial treatment.</td>
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<td><strong>Chlamydia</strong></td>
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<tr>
<td>60. Pregnant women with positive cultures should receive a post-treatment follow-up negative culture 4-7 days after treatment is completed.</td>
<td>III</td>
<td>CDC, 1993</td>
<td>Prevent spread of disease to infant and other sexual partners.</td>
<td>Allows identification of treatment failures and further follow-up.</td>
</tr>
<tr>
<td><strong>Common Pregnancy Complications</strong></td>
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<td><strong>Gestational Diabetes Mellitus</strong></td>
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<tr>
<td>61. Pregnant women with abnormal 3-hour plasma glucose tolerance tests who are on dietary therapy should have biweekly fasting or postprandial glucose tests.</td>
<td>I+</td>
<td>ACOG, 1994</td>
<td>Prevent fetal macrosomia.</td>
<td>Identify those women at increased risk for macrosomia and treat with insulin. Biweekly glucose testing will indicate whether or not dietary treatment requires modification.</td>
</tr>
</tbody>
</table>

**Quality of Evidence Codes:**

I: RCT  
II-1: Nonrandomized controlled trials  
II-2: Cohort or case analysis  
II-3: Multiple time series  
III: Opinions or descriptive studies  
+: Individual process studied only as part of an overall intervention
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