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Abstract

While many people know smoking causes cancer, heart disease and other major health problems, smoking during pregnancy causes additional fetal health complications including birth defects, premature birth and infant death. Cigarettes contain carbon monoxide and nicotine, both of which can cause a decrease in oxygen delivery to the fetus' developing tissues causing organs like the brain, lungs, kidneys and ears not to develop properly. If children are exposed to these toxins through secondhand smoke after birth, they are more likely to experience severe health problems such as ear infections, cataracts, lung cancer and heart disease. It is also known that nicotine is found in high concentrations in breast milk which allows it to be transferred to infants as they breastfeed. Approximately 15 to 20 percent of pregnant women smoke tobacco during pregnancy despite the strong public-health campaign over the last few decades. Because of the risks and potential negative pregnancy outcomes, pharmacists have the duty to assess the patient's willingness to quit smoking (during and after pregnancy) and, if receptive, offer counseling and create a plan for cessation. Nonpharmacologic treatment is the best option for smoking cessation for women who are pregnant as it does not expose the fetus to any additional medications. The "5 R's" are often used to influence any patient, including pregnant women, to consider quitting smoking and to provide them with the right direction to successfully quit. Nonpharmacologic options are the most important for pregnant patients as pharmacologic treatments have not been studied sufficiently to determine safety for the fetus.

Key Terms

Breast Feeding; Carbon Monoxide; Fetus; Heart Disease; Nicotine; Parturition; Pharmacists; Pregnant Women; Premature Birth; Smoking; Smoking Cessation; Tobacco

Introduction

The contribution of the pharmacist is key in facilitating smoking cessation interventions in the community setting. Conveniently located in a retail setting, pharmacists are easily accessible to patients who seek counseling and follow-up consultation during smoking cessation. Pharmacists have a unique opportunity to counsel patients who are pregnant or are considering becoming pregnant on the risks of smoking during pregnancy as well as various treatment options for smoking cessation. Smoking during pregnancy can cause various health problems and risks for both the mother and the fetus including gestational bleeding, placental abruption, placenta previa miscarriage and preterm birth.[1,2] Additionally, tobacco smoke contains many chemicals that are potentially toxic to fetal development. The most toxic include nicotine and carbon monoxide. Nonpharmacologic treatment using the "5 A's" counseling technique is considered first-line in order to prevent pregnancy complications and potential birth defects.[3]

Health Risks of Smoking During Pregnancy

Numerous health risks of smoking during pregnancy exist. Many are linked to nicotine and carbon monoxide.[1] Pharmacists can educate patients on the specific health risks linked to these chemicals. Specifically, nicotine has been shown to cross the placenta and enter fetal circulation in both active and passive smoking mothers resulting in an accumulation of nicotine in the fetal compartments as early as seven weeks gestation. The concentrations of nicotine in fetuses are known to be higher with longer lasting effects than the nicotine concentrations in the mothers. Evidence has shown nicotine concentrations are 15 percent higher in fetal circulation compared to the mother's, while the amniotic fluid contains nicotine concentrations that are 88 percent higher than those in the mother's plasma. These elevated concentrations of nicotine can cause vasoconstriction of the uteroplacental vasculature causing a decrease in the nutrients and oxygen reaching the fetus.[2] Nicotine also causes alterations in cellular growth in the peripheral and central nervous systems of the fetus. Additionally, nicotine has been shown to suppress appetite which results in less maternal food intake and potential nutritional deprivation of the fetus. Ultimately, this causes a reduction in the energy supplied to the fetus which may deter its growth and development.

Similarly, carbon monoxide has been shown to cross the placenta and bind to the hemoglobin in fetal circulation, displacing oxygen, which limits the delivery of oxygen to the tissues and organs of the fetus resulting in hypoxic ischemia.[1,2] The growth of the fetus during pregnancy depends on the oxygen and nutrition supply to help the tissues to continue to develop. Normally when fetal oxygen levels are low, a protective mechanism helps keep the brain supplied with oxygen. The chemicals from the cigarette can cause this protection mechanism to work incorrectly, reducing the exposure of the brain to oxygen, thus negatively impacting its growth and development. Specifically, the proposed mechanism is that nicotine increases the apoptosis of various structures in the brain including progenitor cells and postmitotic neurons. Considering the health concerns of carbon monoxide on fetal growth and development, research suggests that maternal smoking cessation early in pregnancy may support normal fetal head and brain and the prevention of volumetric changes associated with the brain including thinning of the frontal, parietal and temporal lobe which may take until adolescence to be manifested.[1] Changes and abnormalities in brain structure

can cause long-term effects on behavior including an increased risk of Attention Deficient Hyperactivity Disorder (ADHD).[1,2] The fetuses of smoking mothers have an additionally increased risk of being born at a low birth weight, developing Sudden Infant Death Syndrome (SIDS) and being born with other respiratory diseases because nicotine exposure causes decreased airway size, resulting in a reduction in the overall growth of the lungs.[2]

The chemicals found in cigarettes may reduce kidney size leading to kidney malfunction later in life for the child.[2] Newborns were shown to be four times more responsive to sound stimuli than their nonexposed counterparts resulting in potential dysfunction in their ability to process auditory information and potentially leading to both impaired reading and language skills as they grow up.[1] Even though children exposed to cigarette smoking are initially smaller than those not exposed to prenatal smoking, they are at a higher risk for developing obesity later in life which puts them at risk for comorbid conditions like cardiovascular disease or diabetes.[2]

Additional Health Risks: Secondhand Smoke and Smoking During Breastfeeding

Following pregnancy, some women choose to breastfeed their infant. However those who smoke tend to have a smaller milk supply and usually stop breastfeeding their infants sooner than those who do not smoke.[4] It is known that nicotine can easily be transferred into the breast milk in high levels, and the amount of nicotine transferred to the breast milk is 2.9 times the amount present in the mother's blood plasma causing the infants to be exposed to nicotine every time they feed. This exposure to nicotine when feeding can cause shorter sleep times and altered sleep patterns especially if mothers smoke just prior to feeding their child.[4,5] A study by Primo and colleagues demonstrated that when mothers smoked before breastfeeding their children only slept for 53.4 minutes whereas children whose mothers did not smoke before breastfeeding slept on average 84.5 minutes.[5] The infants who were exposed to nicotine when they breastfed experienced sleeping disorders. Additionally, the study showed if the mother smoked during pregnancy and lactation, the child had permanent destruction of the pancreatic β cells which caused them to have an impaired glucose tolerance. Based on the findings of these studies, it important that smoking mothers be counseled on all the harmful chemicals in tobacco smoke and their potential detrimental effects on pediatric health. While limited research is currently available on the impact of e-cigarettes, it is thought that e-cigarettes have similar risks to regular cigarettes because e-cigarettes still deliver the same level of nicotine to the mother. Furthermore, the nicotine is passed to the infant in the same way as from regular cigarettes.

Pharmacists can also educate patients on the additional fetal health risks of exposure to secondhand smoke and smoking during breastfeeding. Secondhand smoke is defined as smoke from a cigarette, pipe or a cigar that is inhaled by people in close proximity to the person smoking.[6] Secondhand smoke is known to be dangerous and can cause mild symptoms in children like a stuffy nose, headache, sore throat, eye irritation, tooth decay and hoarseness.[7] These children can also experience more serious health problems like lung cancer, heart disease, cataracts, wheezing, coughing and ear infections. Studies show children who are exposed to secondhand smoke are more likely to become sick with diseases like the common cold, pneumonia or bronchitis and tend to be sick longer than normal which causes them to miss more school than children from nonsmoking families. If a child has preexisting asthma, secondhand smoke can trigger asthma attacks which may occur more frequently with an increased severity. If the asthma attack is severe enough, it could require hospitalization and may be life threatening for the child.[7,8] Children who grow up in smoking households are also more likely to become smokers themselves.[7]

Smoking During Pregnancy: Patient Perceptions and Demographics

Considering the known fetal and maternal health risks from smoking and secondhand smoke during pregnancy, understanding patient perceptions about smoking during pregnancy is of utmost importance for the pharmacist to initiate interventions for smoking cessation.[9] Furthermore, understanding the demographics of pregnant patients who smoke can help better identify target populations for smoking cessation interventions. According to the American College of Nurse-Midwives, some potential misconceptions for smoking during pregnancy include:[10]

- Smoking hasn't seemed to have any impact on my health. I got pregnant without any difficulty.
- I smoked during my last pregnancy and had a healthy baby, so this baby will be healthy, too.
- There is nothing wrong with a small baby.
- I am three months pregnant. There is no point in stopping smoking now. The damage is done.
- Smoking relaxes me, and being relaxed is better for my baby.
- Quitting smoking during pregnancy will be too stressful on my baby.
- Smoking fewer cigarettes during pregnancy is good enough.
- If I stop smoking, I'll gain too much weight.
- The only way to quit smoking is cold turkey.
- I smoke, so I should not breastfeed my baby.

Approximately 15 to 20 percent of pregnant women smoke tobacco during pregnancy despite a strong public-health campaign over the last few decades.[2] About 20 percent of pregnant smokers quit before their initial prenatal visit. Of women who smoke before pregnancy, 55 percent quit during their pregnancy, 40 percent of which relapse within six months after giving birth.[11] It was reported that the number of pregnant smokers decreased in half from 1989 to 2000. The federal government initiative "Healthy People 2020" has a goal to continue to decrease the number of pregnant smokers to nearly 2 percent.[12] The 2011 Pregnancy Risk Assessment and Monitoring System (PRAMS) provided data from

24 states in regard to various demographics and the percent of births to smoking mothers. This data can be found in Table 1.[12]

Quitting smoking within the first three to four months of pregnancy can yield many benefits including a reduction in risk of low birth weight, premature birth and stillbirth.[13] Considering the extensive need for smoking cessation interventions in pregnant patients among a variety of demographics, there exists considerable opportunity for pharmacists to initiate smoking cessation with patients particularly in the community setting. Behavioral and psychological therapy should be offered to smoking patients who are pregnant before a pharmacotherapy option is considered. Nonpharmacologic behavioral strategies are used to help the patient identify the triggers that cause patients to smoke and how to control impulses.[14] Pharmacists should offer coping strategies to help patients overcome barriers to smoking cessation. The American College of Obstetricians and Gynecologists (ACOG) guidelines suggest strategies to overcoming common barriers in smoking cessation which pharmacists can use to initiate smoking cessation interventions (Table 2).[15]

Approaches to Smoking Cessation: Pharmacologic and Nonpharmacologic

Among the available interventions pharmacists can recommend in initiating smoking cessation, the 5 A's approach (Table 3) is a preferred nonpharmacologic intervention.[3,15] Given the lack of evidence regarding safety and efficacy of pharmacologic options for smoking cessation during pregnancy, use of the 5 A's as a first-line measure to assess the pregnant patient's willingness to quit is recommended. This

Table 1. The 2011 Pregnancy Risk Assessment and Monitoring System (PRAMS) Data for Pregnant Smokers' Demographics.[12]

Demographic	Percent of births to smoking mothers
Race	
American Indian or Alaska Native mothers	18.0%
Non-Hispanic white mothers	12.4%
African American mothers	7.0%
Asian or Pacific Islander mothers	1.2%
Hispanic mothers	2.0%
Age (years)	
<15	2.5%
15-19	10.6%
20-24	13.3%
25+	<10.0%
Mother's Education	
Bachelor's degree or more	1.0%
Some college or associate's degree	9.0%
High school diploma	13.8%
9-12 grade education	16.7%
8th grade or less	4.4%

Adapted from: Child Trends Data Bank. Bethesda (MD): Child Trends. Mothers who smoke while pregnant.

Table 2. Barriers and Coping Strategies for Smoking Cessation.[15]

Barrier	Coping Strategy
Negative mood	Participate in physical activity, talking to a friend, journaling, taking 10 deep breaths.
Being around other smokers	Spend more time with nonsmokers, walk away from smokers when you feel like smoking, ask others around you not to smoke, create a smoke free area in your house.
Triggers	Identify situations that trigger a craving, change your routine after meals such as brushing your teeth instead of smoking.
Time pressures	Change lifestyle to reduce stress, participate in physical activity.

Adapted from: Phelan S, Albrecht S, Melvin C, Rohweder C, Laping J, Chapin J, Mahoney J. The American College of Obstetricians and Gynecologists. Smoking cessation during pregnancy: a clinician's guide to helping pregnant women quit smoking.

Table 3. The 5 A's Approach to Smoking Cessation: Applied to Pregnant Patients.[3,15]

Ask	Ask patient at every health care visit about her tobacco use. Document answer as a vital sign. Avoid asking in the form of a yes or no question. • For example, include a multiple-choice question about tobacco use in the personal patient information that the patient files upon the first visit, and updates at every subsequent visit.
Advise	Strongly advise every patient to quit using tobacco in a way that is personalized to the patient's situation. • Focus on the benefits of quitting for her and the fetus, instead of focusing on negative outcomes for greatest efficacy. Some patients may know other women who have smoked during pregnancy and delivered healthy babies. • Provide educational materials about benefits and risks of tobacco use, Advise any patients that have quit smoking in the past of the importance to remain abstinent.
Assess	Assess willingness to quit within the next 30 days. • If the patient is willing, move on to the Assist phase. • If not, discuss the 5 R's (Table 4) with the patient to motivate them.[15] The 5 R's discussion is directed by the patient and is meant to have the patient generate their own ideas. This discussion can be spread out over multiple visits if necessary.
Assist	Assist in quitting by offering counseling and treatment options. • Form a "quit contract" that states "I agree to stop smoking on (date). I understand that quitting smoking is the best thing I can do to protect my health and the health of my baby." Include signatures of the patient and the physician.[15] • Utilize the STAR approach (Table 5) to plan ahead for challenges in the quitting process. • Provide self-help materials and ways to get help: ° 1-800-QUIT NOW ° www.smokefree.gov • Identify people close to the patient that can help in the quitting process.
Arrange	Arrange a follow-up date, either to follow up on the phone or in person. • Provide encouragement and positive reinforcement. • Encourage the patient to talk about successes and challenges. • Express empathy and acknowledge that quitting is difficult and setbacks may occur.

Adapted from: Fiore MC, Jaén CR, Baker TB, et al. Treating tobacco use and dependence: 2008 update. Rockville (MD): U.S. Department of Health and Human Services; 2008 May. Phelan S, Albrecht S, Melvin C, Rohweder C, Laping J, Chapin J, Mahoney J. The American College of Obstetricians and Gynecologists. Smoking cessation during pregnancy: a clinician's guide to helping pregnant women quit smoking.

approach has had the most success in helping pregnant patients to quit and is considered noninferior to pharmacologic therapy.[15] According to ACOG, if a pregnant patient is unwilling to quit after evaluation using the 5 A's strategy, the patient should be asked to think about quitting between doctor/pharmacy visits. The 5 R's (Table 4) is a motivational strategy that may help encourage patients who do not want to quit. The 5 R's can easily be implemented at the close of conversation. For patients who have decided to quit, the STAR approach (Table 5) is useful in planning an official quit date and accounting for challenges the patient may encounter throughout the process.[3] Pharmacists should be mindful of utilizing these approaches in patient encounters.

Nonpharmacologic therapy is the preferred method for smoking cessation in pregnancy. However, it can be difficult to implement, and many patients are unsuccessful. Pharmacologic options are available but, generally, pregnant women are excluded from randomized controlled trials and thus little information exists on the safety and efficacy of the available pharmacologic interventions.[3] Evidence is also lacking that pharmacologic treatment is superior in efficacy to nonpharmacologic treatment.[15] In pregnant patients that have been unable to quit using counseling techniques, pharmacists should counsel on the risks and benefits of drug treatment for the patient and the fetus. The maternal benefit of quitting smoking using drug treatment is likely greater than the risk to the fetus and, if the mother and physician ultimately decide that pharmacologic treatment is the next best option to try, close monitoring is required to maximize the safety of the patient and fetus.[13]

Table 4. The 5 R's: A Motivational Intervention for Patients That Do Not Want to Quit.[15]

Relevance	Discuss why quitting might be relevant to the patient personally and to her unborn child. The goal is to encourage the patient to quit for personal reasons.
Risk	Ensure the patient understands the negative health risks of smoking for her and her baby.
Reward	Ensure the patient understands the benefits to herself and her family if she quits smoking. Setting a good example is an important part of parenting and prevention of smoking habits in the patient's children.
Roadblocks	Reassure the patient that there are strategies for overcoming roadblocks and help is available any time she decides she is ready to make the steps to quit smoking.
Repetition	Follow up at every visit and reassess the patient's willingness to quit. Continue to repeat the 5 A's and the 5 R's until the patient is ready to quit.

Adapted from: Phelan S, Albrecht S, Melvin C, Rohweder C, Laping J, Chapin J, Mahoney J. The American College of Obstetricians and Gynecologists [Internet]. Smoking cessation during pregnancy: a clinician's guide to helping pregnant women quit smoking.

Table 5. STAR Approach to Planning for Quit Date.[3]

Set	Set a definite quit date.
Tell	Tell family and friends about quitting so they may facilitate the process.
Anticipate	Anticipate challenges and identify barriers that will or have in the past inhibited the patient from successfully quitting.
Remove	Remove tobacco products and related items from the patient's immediate environment, and have the patient try to avoid items and places that will trigger thoughts of tobacco usage.

Adapted from: Fiore MC, Jaén CR, Baker TB, et al. Treating tobacco use and dependence: 2008 update. Rockville (MD): U.S. Department of Health and Human Services; 2008 May.

There are seven FDA-approved pharmacologic treatment options that are first-line in nonpregnant patients. The options include varenicline (Chantix®), bupropion SR Zyban®), and a variety of nicotine replacement therapies (NRT).[16] Table 6 outlines the FDA-approved dosing and pregnancy risk levels for each drug.[17] Even though the dosages are FDA -pproved, the data assessing safety and efficacy in pregnancy is limited with risk categories of C and D for the options available.[18] Pregnancy risk category C implies inadequate studies completed to assess safety, or adverse effects occurred in animal populations, but human data is unavailable. Category D medications have evidence of fetal risk in humans and appropriateness of use depends upon the risks and benefits for the patient.

Conclusion

Women who smoke and are pregnant or planning to become pregnant may be unaware of the dangers smoking poses to the fetus and the developing child. Pharmacists, as health care professionals who are widely available and accessible, are in an ideal position to positively influence patients, and particularly pregnant women, to quit smoking. By assessing willingness to quit smoking and offering extensive counseling, pharmacists can help decrease the number of patients who smoke and encourage them with successfully achieving smoking cessation.

Table 6. Pharmacologic Treatment Options for Smoking Cessation.[17]

Drug Name	Pregnancy Risk Category	Dose	Other Notes
Varenicline (Chantix®)	C	• Day 1-3: take 0.5 mg by mouth in the morning. • Day 4-7: take 0.5 mg by mouth twice daily. • Weeks 2 - 12: take 1 mg by mouth twice daily.	• Begin treatment 1 week before quit date. • Take dose after eating with a large glass of water. • Typical duration: 12 weeks, but may be continued another 12 weeks in select patients.
Bupropion SR (Zyban®)	C	• Day 1-3: take 150 mg tablet by mouth in the morning. • Day 4 and beyond: take 150 mg by mouth twice daily. • Do not exceed 300 mg per day.	• Begin treatment 1- 2 weeks before quit date. • Separate doses by at least 8 hours. • Do not take before bed in order to minimize insomnia. • Typical duration: 7 to 12 weeks, but may be continued for up to 6 months in select patients.
Nicotine Replacement Therapy:	D		• Ensure the patient is aware that if they continue to smoke while using NRT, the risk to the fetus is greater than either alone.[13]
Gum		If first cigarette is used within 30 minutes of waking, use 4 mg gum. If first cigarette is used after 30 minutes of waking, use 2 mg. • Week 1-6: chew one piece every 1-2 hours. • Week 7-9: chew one piece every 2-4 hours. • Week 10-12: chew one piece every 4-8 hours.	• Maximum: 24 pieces per day. • Chew gum slowly and "park" on inside of cheek when the tingling sensation appears. • When the sensation disappears, chew again. • Park in different areas of the mouth each time. • Continue chewing and parking; cycle for about 30 minutes until effect stops. • Do not eat or drink 15 minutes before or while using gum. • Treatment duration: up to 12 weeks.
Lozenge		See gum dosing.	• Maximum: 20 lozenges per day. • Do not chew, bite or swallow the lozenge. • Let lozenge dissolve slowly. • Rotate the lozenge around the mouth. • Do not eat or drink 15 minutes before or while using lozenges. • Treatment duration: up to 12 weeks.
Patch		If more than 10 cigarettes are used in one day: • Week 1-6: apply 21 mg patch once daily • Week 7-8: apply 14 mg patch once daily • Week 9-10: apply 7 mg patch once daily. If less than 10 cigarettes are used in one day: • Week 1-6: apply 14 mg patch once daily • Week 7-8: apply 7 mg patch once daily.	• Apply the patch to dry, hairless, clean skin. • Rotate the patch site with each application. • Patch may be worn up to 16 hours, and it may be removed at bedtime if the patient has trouble sleeping or has bothersome vivid dreams. • Treatment duration: 8-10 weeks.
Nasal Spray (prescription only)		Spray once in each nostril once or twice per hour (0.5 mg per spray).	• Maximum: 5 doses per hour or 40 doses per day. • Initial use of 8 doses per day is recommended. • Do not sniff, inhale or swallow when spraying. • Treatment duration: 3-6 months.
Oral Inhaler (prescription only)		Initially use one cartridge every 1-2 hours, or 6 cartridges per day.	• Maximum:16 cartridges per day. • Continuously puff for 20 minutes for greatest efficacy. • Inhale in short breaths toward the back of the throat, and not the lungs. • Do not eat or drink 15 minutes prior to or during inhalation treatment. • Treatment duration: 3-6 months.

Adapted from: Pharmacologic product guide: FDA-approved medications for smoking cessation. Regents of the University of California; 1999.

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