



Strengthen the Evidence Base for Maternal and Child Health Programs

Smoking in Pregnancy

Smoking is one of 15 Maternal and Child Health (MCH) National Performance Measures (NPMs) for the State Title V MCH Services Block Grant program. The goal of **NPM 14.1: Smoking—Pregnancy** is to decrease the percent of women who smoke during pregnancy. The purpose of this evidence analysis review is to identify evidence-based and evidence-informed strategies that MCH Block Grant programs can implement to support smoking cessation in pregnancy. Interventions that impact smoking during pregnancy range from psychosocial interventions, such as counseling, incentives, and feedback, to pharmacotherapy, such as nicotine replacement therapy (NRT), as well as policy-related interventions, such as smoke-free legislation, tobacco taxation, and media campaigns.

The full report and supplemental implementation resources can be found at: www.mchevidence.org/documents/reviews/npm-14.1-smoking-pregnancy.pdf, and www.mchevidence.org/tools/npm/14-smoking.php. This review was conducted as part of Strengthen the Evidence Base for MCH Programs, a Health Resources and Services Administration (HRSA)-funded initiative that aims to support states in their development of strategies to promote the health and well-being of MCH populations.

Background

Smoking is one of the most important modifiable causes of poor pregnancy outcomes in the United States (U.S.) and is associated with maternal, fetal, and infant morbidity and mortality (American College of Obstetricians

and Gynecologists (ACOG), 2017). Smoking during pregnancy increases the risk of health problems for both mothers and babies, such as pregnancy complications, premature birth, low birth weight, stillbirth, infant death, and birth defects of the mouth and lip, as well as possible cognitive effects associated with learning disabilities and conduct disorders (DiFranza & Lew, 1995; Drews et al., 1996; Fiore et al., 2008; Makin, 1991; USDHHS, 2004; Wakschlag, 1997). An estimated 5-8% of preterm deliveries, 13-19% of term deliveries of infants with low birth weight, 23-34% of cases of sudden infant death syndrome (SIDS), and 5-7% of preterm-related deaths can be attributed to prenatal maternal smoking (Dietz et al., 2010). Women who quit smoking before or during pregnancy reduce the risk for adverse reproductive outcomes.

National survey data. The National Vital Statistics System enables the Center for Disease Control and Prevention's (CDC) National Center for Health Statistics to collect and disseminate the nation's official vital statistics.¹ The 2003 revision of the U.S. Standard Certificate of Live Birth included new and modified items on maternal cigarette smoking before and during pregnancy. The 2016 natality data file is the first for which this self-report information is available for all states and the District of Columbia.² The 2016 data revealed that 7.2% of women who gave birth that year smoked cigarettes during pregnancy.³ This translates to 1 in 14 women smoking while pregnant.⁴ Maternal smoking during pregnancy was most common among women aged 20-24, non-Hispanic American Indian

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¹ <https://www.cdc.gov/nchs/nvss/index.htm>

² <https://www.cdc.gov/nchs/products/databriefs/db305.htm>

³ <https://www.cdc.gov/nchs/products/databriefs/db305.htm>

⁴ <https://www.cdc.gov/nchs/products/databriefs/db305.htm>

or Alaska Native mothers, and women with a high school education or less.⁵

Systematic reviews. Two recent systematic reviews provided the foundation for this evidence review. The objective of the Chamberlain et al. (2017) review was to assess the effects of smoking cessation interventions during pregnancy on smoking behavior and perinatal health outcomes. Selected studies were categorized into seven main intervention strategies: Counseling, health education, feedback, incentives, social support, exercise, and other. The provision of health education and risk advice alone was not sufficient; any psychosocial support should include additional intervention components. Counseling, financial incentives, and feedback appeared to be effective in reducing the number of women who smoke late in pregnancy. The effect of health education, social support, and support for physical activity was less clear.

ONLINE TOOLS

The report is supplemented by implementation resources for Title V programs that can be found in the MCH Evidence website's NPM 14 Toolkit at <https://www.mchevidence.org/tools/npm/14-smoking.php>. These resources include links to introductory information, a summary of the evidence, examples of promising practices, sample evidence-based or informed strategy measures (ESMs), links to current, related ESMs in process across the country, learning opportunities, and resources from the leading proponents of reducing smoking during pregnancy.



⁵ <https://www.cdc.gov/nchs/data/databriefs/db305.pdf>

⁶ Title V Maternal and Child Health Services Block Grant to the States Program: Guidance and Forms for the Title V Application/Annual Report (OMB No. 0915-0172; Expires 12/31/2020).

⁷ The conceptual framework for the services of the State Title V MCH Block Grant is envisioned as a pyramid with three tiers of services and levels of funding that provide comprehensive services. A goal is to “move on down” the pyramid with more states and jurisdictions engaging in public health services and systems. See <https://mchb.tvisdata.hrsa.gov/Glossary/Glossary> for a graphical representation of the pyramid.

The objective of the Coleman et al. (2015) review was to determine the efficacy and safety of smoking cessation pharmacotherapies, including NRT, varenicline, and bupropion, and other medications, or electronic nicotine delivery systems (ENDS) or e-cigarettes, when used for smoking in pregnancy. When used by non-pregnant smokers, pharmacotherapies are effective for smoking cessation; however, their efficacy and safety in pregnancy remains unknown. There is no evidence that NRT had either a positive or negative impact on pregnancy and infant outcomes. Excluding non-placebo NRT trials from a pooled analysis revealed that improvement over placebo was not statistically significant. The authors rated the evidence that NRT could be effective for smoking cessation during pregnancy as weak and recommended further research.

Smoking in pregnancy Evidence-based or informed Strategy Measures (ESMs).

Across the states and jurisdictions that chose smoking in pregnancy as one of the NPMs, there are 38 ESMs that have been chosen by Title V agencies to monitor progress in advancing NPM 14.1. These ESMs fall into three categories:

- 8 represent activities directed to professionals (e.g., training activities, technical assistance),
- 24 are directed to families and their children (e.g., outreach materials to families, family-to-family support, development of care coordination plans), and
- 6 represent activities related to systems-building (e.g., engagement of stakeholder groups, quality improvement initiatives, collaboration between systems of care).

Findings from this report—specifically the evidence-based and evidence-informed interventions identified—can be used by Title V programs as models to strengthen current ESMs or develop new measures to effect change for each of these categories.

Against a matrix of the “MCH Pyramid,”⁶ the conceptual framework for services of the Title V MCH Block Grant program, of the 38 ESMs that focus on NPM 14.1:⁷

- 24 measure activities related to public health services and systems (foundational level of the pyramid),
- 9 measure strategies related to enabling services (middle level of the pyramid), and
- 5 Title V programs are currently funding strategies related to direct services in regards to reducing smoking in pregnancy (gap-filling level of the pyramid).

The MCH Evidence Center uses Results-Based Accountability (RBA)⁸ as a conceptual framework to track how ESMs are measured. This framework consists of increasing levels of measurement across four quadrants (Quadrant 1 being the simplest measurement and Quadrant 4 being the most complex). States and jurisdictions should focus efforts in expanding how they measure programs by moving up the RBA quadrant scale.^{9,10}

- 32 current smoking in pregnancy ESMs measure effort:
 - 19 ESMs fall within Quadrant 1 (measuring the quantity of agency effort) and answer the question “what did we do?” (e.g., counts and “yes/no” activities).
 - 13 ESMs fall within Quadrant 2 (measuring the quality of effort) and answer the question “how well did we do it?” (e.g., reach, quality of materials, satisfaction of intervention).
- 6 current smoking in pregnancy ESMs measure effect (e.g., increases in skills/knowledge, change in behavior or circumstance):

- 5 ESMs fall within Quadrant 3 (measuring the quantity of the effect) to answer the question “is anyone better off?” (e.g., numbers of providers with increased knowledge).
- 1 ESM falls within Quadrant 4 (measuring the quality of the effect) and answer “how are they better off?” (e.g., percentages of families whose self-efficacy improved).

Methods and Results

Peer-reviewed studies were identified by searching four online databases. Forty-two studies met the inclusion criteria for this evidence review.¹¹ These studies examined the effectiveness of interventions aimed at reducing the number of women who smoke during pregnancy. These studies were categorized into psychosocial and pharmacological interventions in clinic-based, electronic, and community-based settings and also included population-based, policy interventions.¹² The target audience for the interventions was pregnant women with one exception—the health care provider training focused on health care practitioners.

Summary of Evidence-Based and Evidence-Informed Strategies to Decrease the Number of Women Who Smoke During Pregnancy

SETTING	INTERVENTION TYPE	STRATEGY	EVIDENCE RATING
Clinic-based	Incentive	Financial incentives and vouchers to enhance smoking abstinence in a multicomponent standard smoking cessation package for pregnant women (n=7) (Lopez, 2015a; Lopez, 2015b; Olson, 2019; Passey, 2018; Tappin, 2015; Wen, 2019; Zvorsky, 2015)	Moderate evidence
	Counseling	Enhanced adult smoking cessation program with motivational interviewing targeting pregnant women (n=6) (Bailey 2015; Fallin-Bennet, 2019; Lee, 2015; Naughton, 2017; Patten, 2019; Reynolds, 2019)	Moderate evidence
	Multicomponent psychosocial	Multicomponent standard smoking cessation package for pregnant women embedded into Women, Infants, and Children (WIC) prenatal care clinic services (n=1) (Olaiya, 2015)	Moderate evidence
	Pharmacotherapy	NRT + multicomponent standard smoking cessation package for pregnant women (n=1) (Berlin 2014)	Moderate evidence
	Health care provider training	Health care provider training including maternity staff, administrators and smoking cessation counselors; or midwives (n=2) (Bell 2018; Chertok, 2015)	Moderate/Emerging evidence
	Automatic initiation of smoking cessation program	Biochemical verification or electronic health records used to automatically opt in pregnant smokers to smoking cessation program (n=3) (Bailey 2017; Buchanan, 2017; Campbell, 2017)	Emerging evidence
	Feedback	Indoor air quality measurement feedback + multicomponent standard smoking cessation package for pregnant women (n=1) (Morgan, 2016)	Emerging evidence
	Exercise	Exercise + multicomponent standard smoking cessation package for pregnant women (n=3) (Jin, 2018; Ussher, 2015a; Ussher, 2015b)	Evidence against

⁸ RBA is described in the RBA Implementation Guide <http://raguide.org/index-of-questions/>

⁹ ESM Review & Resources: National Summary <https://www.mchevidence.org/documents/ESM-Review-National-Summary.pdf>

¹⁰ To search the MCH Library to find state ESMs, visit: <https://www.mchlibrary.org/evidence/state-esms.php>

¹¹ Refer to the full report for the inclusion criteria and list of included studies.

¹² The strategies are arranged in the table by setting and the strength of the evidence ratings from most to least favorable.

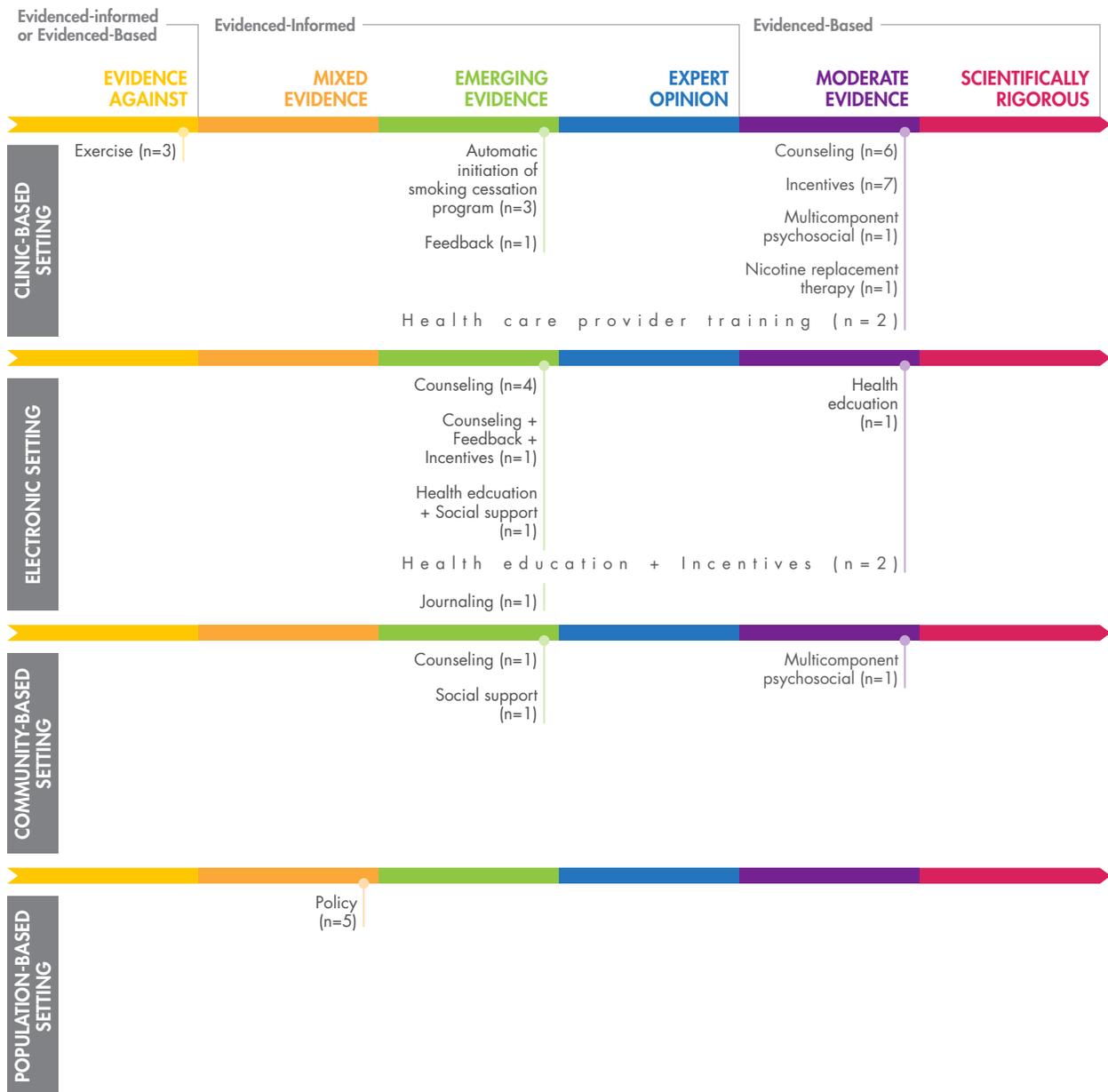
Summary of Evidence-Based and Evidence-Informed Strategies to Decrease the Number of Women Who Smoke During Pregnancy			
SETTING	INTERVENTION TYPE	STRATEGY	EVIDENCE RATING
Electronic	Health education	Standard motivational text messages added to support standard multicomponent smoking cessation program for pregnant women (n=1) (Forinash, 2018)	Moderate evidence
	Health education + Incentives	Standard smoking cessation text messages specific to pregnant women + monetary incentives/gift vouchers to complete follow up at 1, 3 and 6 months (n=2) (Abroms 2017a; Abroms 2017b)	Moderate/Emerging evidence
	Health education + Social support	Standard smoking cessation text messages with limited interaction for support to pregnant women + social support for quitting via a "quitpal" (n=1) (Abroms 2015)	Emerging evidence
	Counseling	Telephone, internet platform or text application to deliver individual counseling support for smoking cessation (n=4) (Coleman-Cowger, 2018; Cummins, 2016; Sloan 2017; Stiegler, 2016)	Emerging evidence
	Counseling + Incentives + Feedback	Web-based, incentive-based contingency management program + phone-delivered cessation counseling + feedback based on breath CO results (n=1) (Harris, 2015)	Emerging evidence
	Journaling	Online journaling platform to support smoking cessation for pregnant women (n=1) (Minian, 2016)	Emerging evidence
Community-based	Multicomponent psychosocial	Home visitors use smoking cessation strategies (education, motivational interviewing, referral to smoking cessation resources) during home visiting program visits (n=1) (Griffis, 2016)	Moderate evidence
	Counseling	Trained midwives to provide smoking cessation counseling with standard smoking cessation package to pregnant women and household members in home-based care (n=1) (Eddy, 2015)	Emerging evidence
	Social support	Using voluntary community members as community support workers to deliver in-person, culturally appropriate multicomponent smoking cessation package to pregnant women (n=1) (Glover, 2016)	Emerging evidence
Population-based	Policy	National, state or local anti-smoking campaigns or regulations to increase smoke-free environments (n=5) (Bartholomew 2016; Brown, 2016; England, 2017; Hankins, 2016; Havard, 2018)	Mixed evidence

Evidence continuum. Each study received a rating of effectiveness based on its own merit and each intervention type was rated for its overall level of evidence to speak to the public health impact. The intervention strategies were then placed along a continuum from *evidence against* (least favorable) to *scientifically rigorous* (most favorable) by setting.

Key Findings. Overall, 6 key findings emerged from the analysis:

1. In terms of setting, of the 42 studies:
 - a. 24 studies (57%) were clinic-based interventions (e.g., obstetrical/prenatal/primary care clinics, community health centers, hospital delivery units),
 - b. 3 studies (7%) were community-based interventions (e.g., home/residential health care, community-based home visiting organizations),
 - c. 10 (24%) of the studies were conducted electronically (e.g., phone applications, telephone, online), and
 - d. 5 (12%) were policy interventions to increase smoke-free environments.
2. Psychosocial interventions tested are predominately focused on enhancing standard multicomponent smoking cessation programs for pregnant women.
 - a. The standard package generally consisted of the 5 A's of smoking cessation (Ask, Advise, Assess, Assist, and Arrange) or a variation of this approach under the guidance of trained practitioners to help women quit smoking or maintain smoking cessation during and after pregnancy.
 - b. This clinic-based (or office-based) intervention that systematically identifies pregnant women who smoke and offers treatment or referral has been proven to increase quit rates.

EVIDENCE CONTINUUM



- c. Studies primarily used clinical settings to build in additional intervention components to support smoking cessation for pregnant women.
3. Psychosocial interventions that encourage behavior change and support smoking cessation consist of counseling, incentives, health education, exercise, feedback, and social support. Psychosocial interventions were delivered in clinic-based, electronic, and community-based settings.
 - a. Counseling and incentives were the most frequently used and effective standalone interventions. There is *moderate evidence* for both of these intervention types. Chamberlain et al. (2017) found that counseling, incentives, and feedback appeared to be effective in reducing the number of women who smoke late in pregnancy; the provision of health education and risk advice alone is not sufficient.

- b. Different combinations of intervention components are used to enhance the effectiveness of smoking cessation for pregnant women. Intervention components were most often combined when programs were delivered electronically. There is primarily *emerging evidence* for the different configurations of intervention components (e.g., counseling + health education; counseling + feedback + incentives; health education + incentives; health education + social support). Given the limited number of studies on these combinations of components, further research is needed to determine effectiveness.
 - c. Embedding multicomponent psychosocial programs into community-based programs, such as home visiting, or social service programs, such as WIC, have *moderate evidence* of effectiveness to increase smoking cessation in the pregnant women they serve.
4. Researchers are attempting to use novel ways of delivering psychosocial interventions to increase the reach and effectiveness of smoking cessation programs in pregnancy, such as technology or culturally acceptable practices.
 - a. Both general and individualized mobile phone applications have been attempted with some positive trends.
 - b. Individualized phone counseling is used to support behavior change and smoking cessation.
 - c. Internet-based/website education, incentives, and feedback and support are being increasingly utilized for smoking cessation during pregnancy.
 - d. Community health workers or a culturally acceptable equivalent is being used to reach indigenous or isolated communities of pregnant women with high smoking rates.
 5. Pharmacological interventions for smoking in pregnancy can include NRT, varenicline, bupropion, and ENDS. However, their efficacy and safety in pregnancy remains unknown.
 - a. Pharmacotherapies were oftentimes included as part of tailored interventions where pregnant women were offered higher levels of psychosocial support, referrals, and a menu of cessation aids.
 - b. There was 1 pharmacotherapy study included in this review on the use of NRT that was rated as *moderate evidence*. Results from Coleman et al. (2015) indicate that NRT used for smoking cessation increased rates measured in late pregnancy by approximately 40%. However, there is evidence suggesting that when potentially-biased, non-placebo trials are excluded from the analyses, NRT is no more effective than placebo.
 6. Population-based interventions consist of non-clinical, public policy-related efforts, such as smoke-free legislation or smoking bans, tobacco taxation, product regulation, advertising/marketing restrictions, and media campaigns. For the 5 studies in this evidence review that focused on population-based messaging, campaigns, smoke-free policies, and access to health coverage, there was *mixed evidence* of effectiveness in specifically supporting pregnant women to become smoke-free.

Implications. The research being conducted to decrease the number of women who smoke during pregnancy provides valuable insights that can inform current Title V program initiatives and partnerships to improve the health and well-being of mothers and children.

- Research findings indicate that chronic stressors, symptoms of depression, and the quality of intimate relationships play an important role on the pathway to smoking cessation (Yang et al., 2017). Other factors associated with smoking during pregnancy include social support, neighborhood risk, access to prenatal care, alcohol or illicit drug abuse, secondhand smoke exposure, and abuse/trauma (Yang & Hall, 2019).
- Pregnant women from socioeconomically-disadvantaged backgrounds are likely to benefit from targeted cessation interventions delivered by trained health care providers (Siddiqui et al., 2017).
- Given the high co-morbidity with psychological symptoms and the potential to improve mental well-being, interventions that include mental health support for women with symptoms should be considered (Chamberlain et al., 2017).
- Depression-prone pregnant women and newly postpartum women have responded well to incentive-based smoking cessation interventions, where participants not only achieved abstinence, but also reported a reduction in the severity of their depression.
- To date, few trials on smoking cessation interventions for indigenous women have been completed, and those involving biomarker feedback (Patten et al., 2019) or intense counseling combined with NRT were inconclusive (Patten et al., 2019). However, there is a growing body of evidence indicating that contingency-based incentives

that reward biochemically-confirmed smoking cessation—combined with standard care that includes counseling—can be very effective (Notley et al., 2019).

- Although research indicates that smoking cessation interventions are most effective when delivered by trained health care staff, many health practitioners do not receive training in how to deliver the 5 A's or other evidence-based smoking cessation interventions. “What works” is likely to be a multi-faceted approach that considers the role that health care providers at all levels might play in reducing the number of pregnant women who smoke.
- The “timing” of smoking cessation during pregnancy is important to the developing fetus, with possible smoking-influenced epigenetic processes taking place as early as the embryonic stage of development and lasting through the second month of pregnancy. There is also evidence that the increased risk of smoking-influenced low birth weight dissipates when expectant mothers quit smoking by the fifth month (Alshaarawy & Anthony, 2015). Cessation during *any* stage of pregnancy, however, is likely to improve health outcomes for both mother and child.
- Policies that call for the routine testing of all pregnant women could unintentionally do more harm than good, since it can send the message that pregnant women cannot be trusted and may not make decisions in the best interests of themselves and their unborn offspring. If the goal is to improve maternal and child health outcomes, the evidence leans towards encouraging, supporting, and empowering pregnant women to “opt in” to effective interventions (Bowden, 2019).
- Smoking cessation interventions that use digital forms of communication, whether it be social media, text messaging, web interfacing, or smart phone applications, have the potential to reach large numbers of women of reproductive age. While digital technology offers the potential to influence vast numbers of pregnant women who smoke, it is ultimately just a highway—an alternative delivery method—rather than a separate intervention type. And despite the prevalence of cell phone owners in the U.S., a digital divide persists between rich and poor, rural and urban/suburban.
- While further research is needed to guide safety and treatment recommendations, and to validate the effectiveness of alternative and complementary interventions for pregnant women, emerging evidence suggests that interventions such as massage therapy and journaling have the potential to help reduce stress and tobacco use among pregnant women (Minian, 2016; O’Hair et al., 2018).
- The use of e-cigarettes, vaping, and other forms of ENDS have increased significantly in recent years, but there is little data regarding the health effects of these agents on pregnant women.¹³ According to ACOG, there is the perception that these products represent a safer alternative to tobacco smoking, since combustion products are not present; however, nicotine in any form can pose considerable health risks to the developing fetus. ENDS are being used by both pregnant and non-pregnant smokers in the belief that it will help them quit or cut back on smoking. The evidence though does not support this widespread belief.
- Accumulating evidence indicates that tobacco control policies have a substantial impact on maternal and child-health outcomes (Levy et al., 2016), although few studies have specifically assessed the impact that government policies and interventions have on pregnant women. Since pregnant women are often excluded from research studies due to safety and health-risk factors, much of the “evidence” is based on survey results, vital records, or simulations, where pregnant women are asked how they *think* they would respond to a specific intervention. Innovative research approaches are being used in an ongoing effort to implement effective interventions that reduce the number of pregnant women who smoke.
- Partnership is essential to effective implementation of smoking cessation interventions for pregnant women. National experts, such as the CDC’s Office of Smoking and Health, ACOG, the U.S. Preventive Services Task Force, and the Robert Wood Johnson Foundation, are leading efforts to further reduce smoking during pregnancy. Title V programs are well positioned to coordinate and partner with these and other public and private agencies and organizations, especially state and territorial health agencies, state-funded quit lines, WIC, and state or local authorities responsible for the implementation and enforcement of tobacco control laws (e.g., state departments of health, county health departments, local health departments)¹⁴ to promote and provide widespread support for smoking cessation during pregnancy.

¹³ <https://www.acog.org/-/media/Committee-Opinions/Committee-on-Obstetric-Practice/co721.pdf>

¹⁴ https://www.rand.org/content/dam/rand/pubs/monograph_reports/2006/MR841.pdf

From Evidence to Action

This review is part of a series of scholarly works focused on each NPM to identify and describe evidence-based and informed strategies from peer-reviewed and grey literature. The 42 studies analyzed in this review provide an overview of the scientific literature that can inform Title V program design, implementation, and measurement to reduce the number of women who smoke during pregnancy. If you are looking to build or strengthen smoking cessation efforts in your state or jurisdiction, moving “from evidence to action” can seem daunting. The MCH Evidence Center has developed a framework, tips, and resources to help you through the process. An NPM 14: Smoking Toolkit is also available at <https://www.mchevidence.org/tools/npm/14-smoking.php>. Email us with questions, comments, and requests for technical assistance at mchevidence@ncemch.org.

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