ANESTHESIOLOGY

Anesthesiologists and the Other Pandemic: Tobacco Use

David O. Warner, M.D.

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ABSTRACT

Tobacco use will kill a projected 1 billion people in the 21st century in one of the deadliest pandemics in history. Tobacco use disorder is a disease with a natural history, pathophysiology, and effective treatment options. Anesthesiologists can play a unique role in fighting this pandemic, providing both immediate (reduction in perioperative risk) and long-term (reduction in tobacco-related diseases) benefits to their patients who are its victims. Receiving surgery is one of the most powerful stimuli to quit tobacco. Tobacco treatments that combine counseling and pharmacotherapy (*e.g.*, nicotine replacement therapy) can further increase quit rates and reduce risk of morbidity such as pulmonary and wound-related complications. The perioperative setting provides a great opportunity to implement multimodal perianesthesia tobacco treatment, which combines multiple evidence-based tactics to implement the four core components of consistent ascertainment and documentation of tobacco use, advice to quit, access to pharmacotherapy, and referral to counseling resources.

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During 2020 and 2021, the COVD-19 pandemic caused more than 845,000 deaths in the United States[1] and up to 18 million deaths worldwide,[2] accompanied by widespread social and economic disruption. However, another deadly pandemic has been ongoing for more than a century—the tobacco pandemic.[3–6] This pandemic originated in the United States in the early 20th century and then spread throughout the world. Globally, tobacco use kills more than 8 million people each year, including bystanders exposed to secondhand smoke.[7] It is the leading cause of preventable death in many countries, including the United States, where it accounts for approximately 1 in 5 deaths (480,000 annually).[8] If current trends continue, approximately 1 billion people will die of tobacco use in the 21st century.[4] The tobacco pandemic continues to evolve, as new products that spread the disease of tobacco use disorder, such as electronic cigarettes, are developed and marketed, perhaps analogous to coronavirus variants.

Pandemic control requires a mix of public policy and medical measures. The response to the COVID-19 pandemic was complex and multilayered, including a variety of government policies, such as lockdowns and masking, and medical innovations such as vaccines and monoclonal antibody treatment. Anesthesiologists played an important role in this response by providing outstanding surgical and intensive care to these patients, often at considerable personal risk. The response to the tobacco pandemic has been similarly multifaceted, including government policies such as increased tobacco taxation and bans on smoking in public places, and treatment innovations such as nicotine replacement therapy.[5,6] As with COVID-19, anesthesiologists can also play an important role in the response to tobacco pandemic—but many do not know how. In addition to improving public health, a collateral benefit of anesthesiologists' efforts is an immediate impact on perioperative risk and the long-term health of each individual tobacco user.

This narrative review is a primer for anesthesiologists who want to help their patients who are victims of the tobacco pandemic. An effective pandemic response requires first an understanding of the origins, natural history, pathophysiology, and treatment of the underlying disease. With this as a foundation, this review will then present the compelling rationale to address tobacco use in perianesthesia practices, putative barriers to anesthesiologist involvement, and practical strategies to take advantage of the unique opportunities available for anesthesiologists to help their patients. The focus will be on two popular tobacco products, conventional cigarettes that burn tobacco and electronic cigarettes, recognizing that there are numerous other forms of tobacco that can also cause harm.

Pandemic Origins and Evolution

Given the ubiquity of tobacco products in the modern world, it is easy to think that tobacco use has always been widespread in human societies. Indeed, tobacco has an important long-standing ceremonial role in some cultures.[9] However, until the beginning of the 20th century, only a small fraction of the world's population used tobacco, mostly in the form of chewing tobacco, snuff, and pipe tobacco.[4–6] Three factors combined to dramatically increase the prevalence of commercial tobacco use during the 20th century, first in the United States, then in the rest of the world: technological advances in tobacco product design and manufacture, sophisticated marketing campaigns by tobacco companies, and the high addiction potential

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David O. Warner, M.D.: Department of Anesthesiology and Perioperative Medicine, Mayo Clinic, Rochester, Minnesota.

of nicotine. Regarding technology, the invention in the United States of (1) flue-curing, a new method to process tobacco leaves that made tobacco smoke easier to inhale, (2) the safety match, and (3) machines that made cigarettes in large quantities enabled mass cigarette production and consumption.[5,6] Regarding marketing, the tobacco industry pioneered sophisticated marketing campaigns employing techniques that are still widely utilized today by many industries. Tobacco products remain one of the most heavily marketed products in the world.[4] Regarding addiction, cigarettes function primarily as devices to rapidly deliver to the brain high levels of nicotine, one of the most addictive substances known.[10] These factors combined to produce a dramatic increase in the prevalence of tobacco use; at the U.S. pandemic peak in the 1960s, more than 40% of the adult population smoked cigarettes (fig. 1).[3,8,11]

The health consequences of this pandemic became evident in the early 1950s, thanks to a series of classic observational studies linking smoking to lung cancer,[12,13] followed by other studies demonstrating similar links to cardiovascular and pulmonary disease.[14] In response, the tobacco industry launched a sustained disinformation campaign designed to refute these studies, cast doubt on any relationship between smoking and disease, and deny that cigarettes were addictive, with smoking presented rather as a personal choice.[4,5] It later became apparent from their own internal documents that the industry in fact had known for decades that smoking caused disease and was highly addictive; indeed, the industry continues to actively manipulate nicotine delivery by cigarettes to maximize addiction and sales.[5,15] In a landmark case, in 2006 the tobacco industry was found guilty under racketeering laws, demonstrating that criminal behavior contributed to the pandemic.[5,6,16]

The 1964 release of the U.S. Surgeon General's report *Smoking and Health*[14] summarized the conclusive evidence that smoking caused a host of serious diseases including chronic lung disease, cardiovascular disease, and cancer, and sparked the implementation of various policy measures that proved highly effective in reducing the prevalence of tobacco use.[4] For example, appreciation of the dangers of secondhand smoke (*i.e.*, breathing in smoke exhaled by others) led to policies banning smoking in public places,[17] and increased tobacco excise taxes significantly reduced sales.[18] These and other measures dramatically reduced smoking

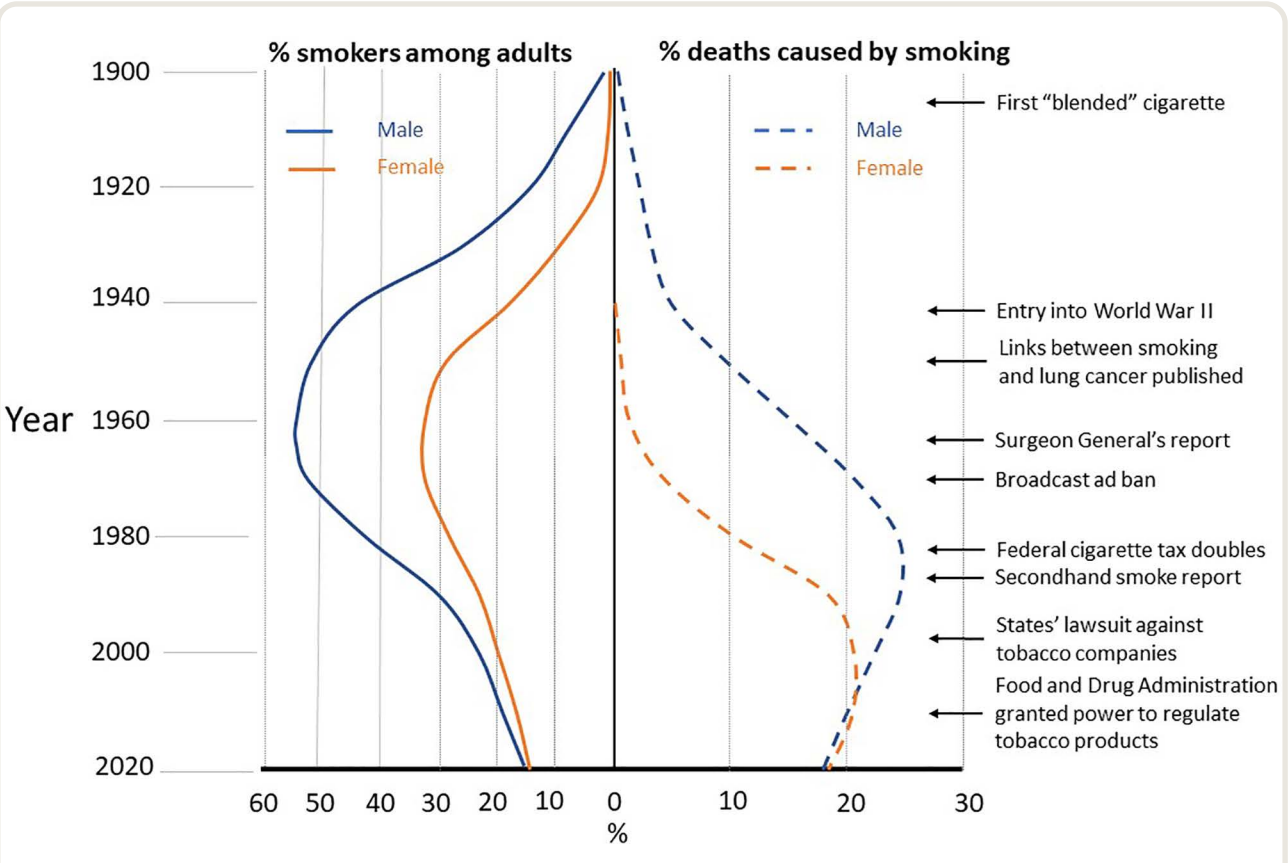

Fig. 1. Estimates of the proportion of adults who smoked cigarettes (*left*) and the proportion of adult deaths caused by smoking (*right*) in the United States from 1900 to 2020 for males and females. Also shown are the timing of major events related to tobacco control in the United States. "Blended" cigarettes include a mixture of flue-cured and other tobaccos that produce smoke that is sweeter and better tolerated. Data from Thun *et al.*[11]

prevalence in the United States and many other high-income countries (fig. 1). Nonetheless, nearly one in five U.S. adults still uses a tobacco product,[19] and smoking-related illnesses cost the United States more than $300B annually.[8] At this stage in the U.S. pandemic, compared with nonsmokers, smokers have lower educational attainment, have lower household income, and are more likely to have mental health conditions, including other substance use disorders.[19–21] Tobacco use thus contributes to widespread health disparities in the U.S. population.

In response to declines in tobacco sales in the United States, the tobacco industry took advantage of trade liberalization policies in the late 20th century and dramatically increased its international marketing efforts.[5,22] These efforts were highly successful—many low- and middle-income countries still have a high prevalence of tobacco use (*i.e.*, are in the earlier stages of the pandemic)—a disparity that mirrors (and contributes to) other disparities in health and health care among nations.[23]

Pathophysiology and Natural History of Tobacco Use

Most tobacco use can be conceptualized as a behavioral disorder, as recognized by the most recent *Diagnostic and Statistical Manual of Mental Disorders*, 5th edition.[24] The majority of those who smoke cigarettes meet criteria for tobacco use disorder (table 1); however, not all people who use nicotine develop this disorder, for reasons that are unknown. Earlier editions of this manual employed the diagnostic term "nicotine dependence," which is still utilized. Most who suffer from tobacco use disorder begin using tobacco before age 18 yr. In 2021, 34% of U.S. high school students had tried a tobacco product, and 13% were current users.[25] Of these, almost a third already showed signs of nicotine dependence (*e.g.*, experienced cravings). The tobacco industry has recognized the importance of youth tobacco use in creating and sustaining a market for their products and has engaged in a variety of activities to promote such use.[6,26,27]

Pathophysiology

Although cigarette smoke contains literally thousands of pharmacologically active compounds, many of which cause disease, nicotine is the active ingredient responsible for reward and addiction.[10] Like other drugs of abuse, nicotine activates the mesolimbic dopamine system, a central mediator of drug reward and reinforcement,[28] such that smoking has pleasurable effects including stress reduction and enhanced mood (fig. 2). The rapid rise in brain nicotine levels produced by cigarette smoke contributes to this pleasure.[29] The pharmacology of the nicotinic acetylcholine receptor that mediates nicotine's actions is complex and beyond the scope of this review, but some characteristics explain the features of tobacco use disorder.[10,30,31] Although initial exposure to nicotine is usually unpleasant (*e.g.*, causes nausea), continued exposure to nicotine causes rapid desensitization of several nicotine subtypes, leading to the rapid development of tolerance, such that more tobacco is needed to achieve the desired effects.[32] Desensitization can also contribute to symptoms of craving and nicotine withdrawal, the latter characterized by irritability, anger, difficulty concentrating, increased appetite, restlessness, depressed mood, and insomnia, which can persist for at least several days after discontinuation of nicotine.[33,34] Daily smokers typically maintain saturation of nicotinic receptors, which prevents craving and withdrawal symptoms; *i.e.*, they self-medicate to prevent unpleasant withdrawal symptoms and regulate

Table 1. Criteria for Tobacco Use Disorder

A problematic pattern of tobacco use leading to clinically significant impairment or distress, as manifested by at least two of the following, occurring within a 12-month period

1. Tobacco taken in larger amounts or over a longer period than intended
2. Persistent desire or unsuccessful efforts to cut down or control tobacco use
3. A great deal of time is spent in activities necessary to obtain or use tobacco
4. Craving, or a strong desire or urge to use tobacco
5. Recurrent tobacco use resulting in a failure to fulfill major role obligations at work, school, or home (*e.g.*, interference with work)
6. Continued tobacco use despite having persistent or recurrent social or interpersonal problems caused or exacerbated by the effects of tobacco (*e.g.*, arguments with others about tobacco use)
7. Important social, occupational, or recreational activities given up or reduced because of tobacco use
8. Recurrent tobacco use in situations in which it is physically hazardous (*e.g.*, smoking in bed)
9. Tobacco use continued despite knowledge of having a persistent or recurrent physical or psychologic problem that is likely to have been caused or exacerbated by tobacco
10. Tolerance, as defined by either of the following:
    a. Need for markedly increased amounts of tobacco to achieve the desired effect
    b. Markedly diminished effect with continued use of the same amount of tobacco
11. Withdrawal, as manifested by either of the following:
    a. The characteristic withdrawal syndrome for tobacco
    b. Tobacco (or a closely related substance, such as nicotine) taken to relieve or avoid withdrawal symptoms

Classified as mild (2 to 3), moderate (4 to 5), or severe (6 or more). Adapted from the *Diagnostic and Statistical Manual of Mental Disorders*, 5th edition.[24]

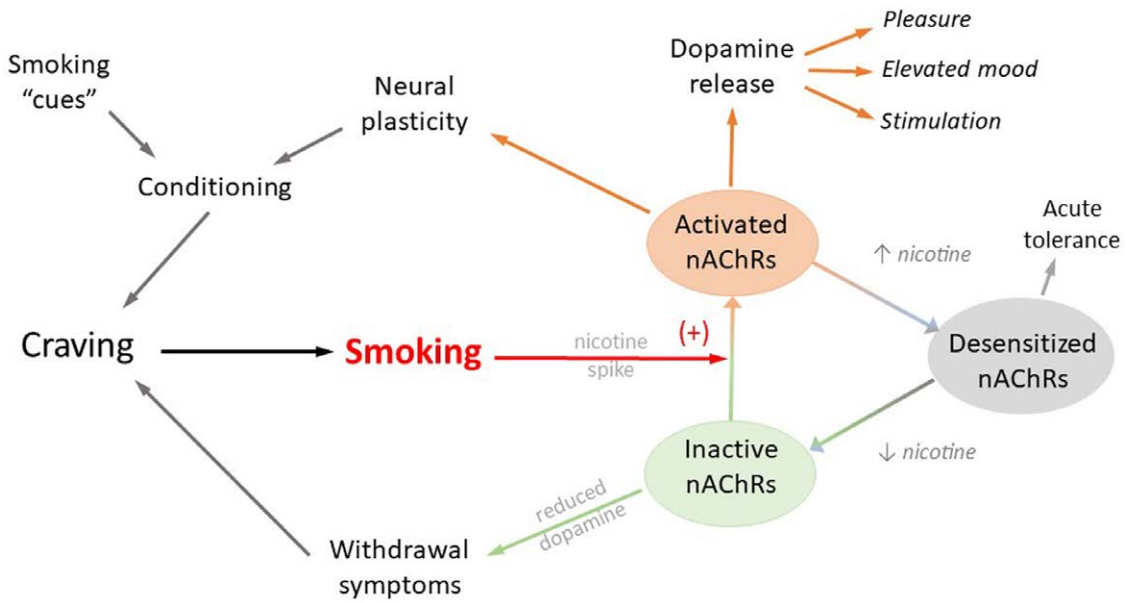

Fig. 2. Schematic of how smoking produces pleasure and how abstinence causes withdrawal symptoms. Smoking a cigarette produces a rapid increase in brain nicotine levels, activating brain nicotine acetylcholine receptors (nAChRs) that produce dopamine release in the "pleasure centers" of the brain. Nicotine acetylcholine receptors become desensitized soon after activation, which produces acute tolerance to nicotine. As nicotine levels fall, nicotine acetylcholine receptors become inactive (*i.e.,* not bound to nicotine), reducing brain dopamine levels and triggering nicotine withdrawal symptoms, which also increases cravings for cigarettes. Repeated activation also causes neural plasticity that, among other actions, results in a conditioned response to smoking "cues" (*i.e.,* smoking after meals), such that these cues trigger craving for cigarettes. Thus, smokers are rewarded for continued nicotine consumption to maintain nicotine acetylcholine receptors activation. Figure modified from Benowitz.[10]

their cigarette consumption to this end.[10] Exposure also causes long-term plastic changes in brain function, changes that are particularly pronounced in the adolescent brain.[35] For example, exposure of adolescents to nicotine causes increased rewarding effects of other abused drugs, and there is a strong association between tobacco use and later anxiety, depression, and other disorders of emotional regulation. Finally, conditioning, another consequence of neural plasticity caused by nicotine exposure, is an important component of addiction.[36,37] With conditioning, smokers associate particular moods or situations (*e.g.*, smoking after meals) with the pleasurable effects of nicotine, such that these smoking-related "cues" trigger the desire to smoke—even in those who have quit smoking for some period of time and no longer suffer from acute nicotine withdrawal symptoms.[10] Patients with tobacco use disorder thus continue to smoke for several reasons, including pleasurable effects, avoidance of the unpleasant effects of nicotine withdrawal, and conditioning—their brains are literally "rewired" in complex ways to seek nicotine.

Natural History of Quitting

The profound effects of sustained nicotine exposure on the brain can make it very difficult for patients with tobacco use disorder to quit using tobacco, even though the majority want to do so.[38,39] Each year, approximately half of smokers in the United States make at least one quit attempt, most without assistance.[40,41] Although the majority eventually succeed,[39] only about 1 in 20 unassisted attempts results in long-term abstinence, such that almost all smokers require multiple attempts—hence the frequent characterization of tobacco use disorder as a chronic relapsing disease.[42,43] Given the importance of quitting to health, surprisingly little is understood about the quitting process. Various theories of behavior have been proposed. For example, the transtheoretical model postulates that health behavior change such as quitting smoking involves progress through distinct stages including contemplation, preparation, action (*i.e.*, quitting), and maintenance.[44] However, this and other theories have proven largely unsatisfactory.[45] Most quit attempts appear to be in fact unplanned and spontaneous,[41,46–48] and those who make an unplanned attempt may indeed be more likely to succeed.[49] The only factors shown in the general populations to consistently predict quit attempts are the number of previous attempts and motivation to quit.[50] Thus, life events that increase such motivation can play an important role in the process—and as will be discussed in a subsequent section, surgery is one such event that has a powerful effect.

Electronic Cigarettes: A New Pandemic Vehicle

Since their introduction in 2003, a new vehicle for the widespread administration of the pathogen responsible for the addictive properties of tobacco has emerged—electronic cigarettes, also known by a variety of other names such as electronic nicotine delivery devices.[51] Although there are many different designs, all utilize a battery-powered atomizing device to heat and vaporize a liquid solution, which is then inhaled ("vaped"; fig. 3).[52] Solutions usually contain humectants such as propylene glycol and various flavors in addition to nicotine. It is also possible to vape other drugs such as opioids or cannabinoids. Although vapor does not contain the combustion products present in cigarette smoke, heat applied in the vaporization process creates a wide range of chemical compounds (such as formaldehyde) that can be pharmacologically active. As these devices have only recently come under regulation by the U.S. Food and Drug Administration (Silver Spring, Maryland) and regulatory authorities in other countries, the actual composition of solution is often unknown. In addition to electronic cigarettes, products have also been developed that heat, rather than burn, tobacco to produce a nicotine aerosol that can be inhaled (known as "heat-not-burn" products). Two of these products are currently available in the United States, but they have not yet achieved popularity, and nothing is known regarding their potential effects in the perioperative period.[53]

Electronic Cigarettes as a Vehicle for Nicotine

Electronic cigarettes now play a significant role in initiating and sustaining nicotine use. In 2019, approximately 5% of U.S. adults used these devices, especially young adults.[19] Alarmingly, in 2021, 11% of high school students and 3% of middle school students used electronic cigarettes.[25] This relatively high utilization has raised considerable concerns that these devices not only expose the developing brain to the deleterious effect of nicotine and promote addiction but also

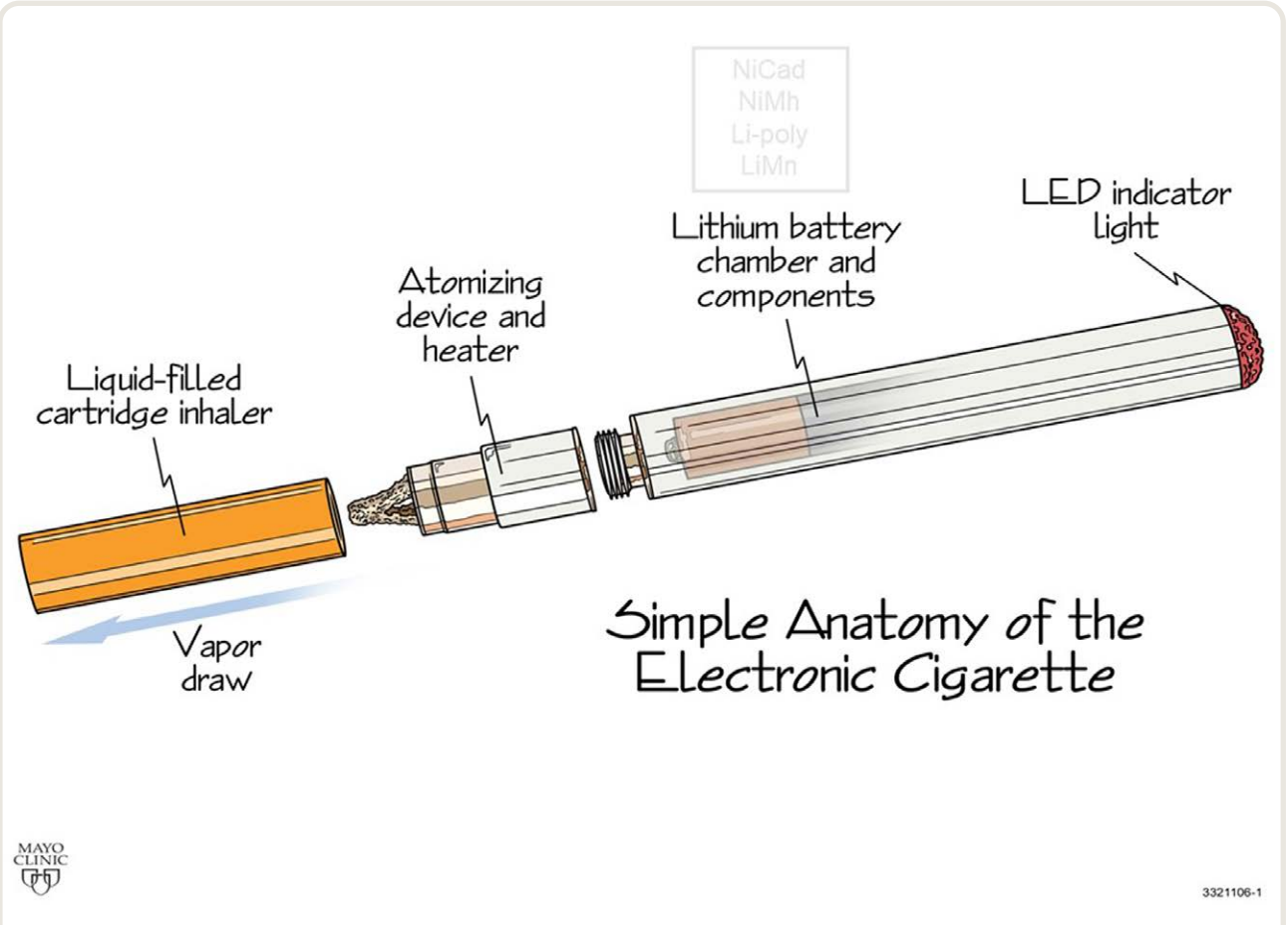

Fig. 3. Typical components of electronic cigarettes. All utilize a reservoir for liquid containing the substance to be vaporized (*e.g.*, nicotine), a device to atomize this liquid to produce a vapor that is inhaled, and a battery with electronic control components. These devices have multiple names and configurations. For example, in some devices, the liquid comes in prepackaged cartridges (as shown in this example), whereas others utilize reservoirs ("tanks") that can be filled with any solution the user desires ("juice"). Used with permission of Mayo Foundation for Medical Education and Research, all rights reserved.[52]

serve as a "gateway" facilitating a transition to smoking conventional cigarettes,[54] a pattern noted in recent observational studies.[55–57] Evidence suggests that despite protestations to the contrary, companies producing electronic cigarettes actively promote youth use through strategies such as flavors and the renormalization of nicotine use (*i.e.*, vaping as glamorous) to generate lifelong users of their products.[26,58] From this standpoint, these devices may threaten the progress made in fighting the tobacco pandemic.

Electronic Cigarettes as Nicotine Replacement

On the other hand, if cigarette smokers could switch to electronic cigarettes as their means to consume nicotine, it could reduce risk—to the extent that vapor may be less harmful than cigarette smoke.[59] In addition, these devices could function as a form of nicotine replacement therapy to facilitate attempts to quit tobacco use. When used as pharmacotherapy in randomized clinical trials of patients in tobacco treatment programs, electronic cigarettes promote quitting.[60] Feasibility studies, including surveys and distribution of electronic cigarettes in a preoperative clinic, have also explored the potential for using electronic cigarettes specifically to help surgical patients quit.[61,62] In contrast, observational studies that reflect use outside of randomized clinical trials generally do not support the hypothesis that cigarette smokers who use electronic cigarettes are more likely to quit smoking (with some exceptions); many continue to use both (dual use).[63–65] However, the quality of evidence is low, the analyses are complex, and controversy remains.[59,63,66–68] Thus, although some smokers have successfully used electronic cigarettes to quit, there is not yet good evidence that these devices are effective for this purpose across populations. In addition, similar to conventional cigarettes, most users of electronic cigarettes want to quit, but may find it difficult to do so as they experience symptoms of nicotine withdrawal and cravings.[25,69] Methods to treat electronic cigarette use are not yet well-established.[70]

"Safety" of Vapor

The potential benefits of trading one nicotine source (cigarette smoke) for another (vapor from electronic cigarettes) depend on whether vapor is "safer" than cigarette smoke. Unfortunately, evidence continues to accumulate that inhaled vapor can have adverse physiologic effects. Vapor exposure is cytotoxic to pulmonary cells *in vitro* and causes lung inflammation *in vivo*.[71,72] Use is associated with an increased incidence of respiratory diseases such as emphysema and asthma[73] and can cause severe acute lung injury (e-cigarette or vaping product use associated lung injury).[74,75] Vapor exposure causes acute increases in blood pressure and heart rate and chronic changes in measures of arterial stiffness consistent with increased cardiovascular risk, and detrimental changes in cardiovascular health in animal models.[76,77] Accordingly, use of electronic cigarettes may be a risk factor for myocardial infarction, independent of any concurrent cigarette use,[78] although such observational data have multiple limitations, and other studies have failed to find such associations.[79] Switching from conventional to electronic cigarettes may improve some measures of cardiovascular health such as flow-mediated vasodilation.[80] The risk of cancer is unknown, although switching to electronic cigarettes reduces exposure to carcinogens.[81] Vaping may affect surgical wound healing. Two animal studies found that both cigarette smoke and vapor decrease survival of surgical free flaps in animal models by a similar degree.[82,83] There are no data in patients save two case reports of problems with flaps in vapers that do not provide a convincing link.[84–86] Thus, even if vapor may prove "safer" than cigarette smoke in some respects, it is not "safe."[54]

Effect of Surgery on Tobacco Use

The term "teachable moment" refers to health events that motivate individuals to spontaneously (*i.e.*, without treatment) adopt risk-reducing health behaviors such as quitting tobacco use.[87–89] Teachable moment events for smoking cessation include disease diagnosis (especially those related to tobacco use such as lung cancer), office visits, abnormal test results, pregnancy—and surgery.[90–92] Numerous studies consistently show that receiving a surgical procedure increases long-term quit rates, even if patients are not treated for their tobacco use.[93–95] Quit rates are highest after major inpatient procedures necessitated by smoking-caused disease, such as lung resection for cancer and coronary artery bypass grafting. However, less invasive procedures can also motivate abstinence. An analysis of longitudinal data from a nationally representative survey of adults older than 50 yr found that smokers undergoing major inpatient surgery (heart, cancer, or joint replacement surgeries) were up to twice as likely to quit compared with those who did not have surgery, controlling for other factors including age, sex, and a new medical diagnosis.[96] Even those undergoing more minor outpatient surgery were approximately 30% more likely to quit. Approximately 1 in 12 quit events in older Americans could be attributed to their undergoing one of these four types of surgical procedures, representing a powerful effect on population health.

Despite the dramatic effect of surgery on this hard-to-change behavior, it is perhaps surprising that the mechanism is not understood. Factors associated with quitting include surgical acuity, perioperative intent to quit, and self-efficacy (*i.e.*, belief that quit attempts will succeed),[97,98] but none of these factors explain the underlying psychologic processes. A population-based analysis of longitudinal data examined the effect of children undergoing surgical procedures on their parents' smoking.[99] These parents were more than twice as likely to make a quit attempt compared with those whose children did not have surgery but were not more likely to succeed in actually quitting. Thus, whatever factors are operative, they are sufficient to

motivate a quit attempt in this situation, but insufficient to produce sustained quitting. It is not known whether treatment for tobacco use disorder may be more effective during "teachable moments" such a surgery, but the fact that these parents were motivated to make a quit attempt suggests that they may be receptive to treatment; clearly such treatment is necessary for success in this instance. Other work suggests that patients with some medical comorbidities are more likely to make quit attempts, but may not be more likely to succeed[100]—again suggesting that the "teachable moment" effect may be enhanced by effective treatment.

Treatment of Tobacco Use

Although most tobacco users quit without assistance, treatment can more than double the odds that a quit attempt will succeed.[101] Even so, only approximately one of four individual quit attempts by patients participating in good tobacco treatment programs succeed,[102,103] and most users require multiple attempts to maintain long-term abstinence, reinforcing the concept of tobacco use disorder as a chronic disease.[42,43] Like other chronic diseases such as hypertension or diabetes, tobacco use disorder may not be "cured" by a single treatment. However, the odds of success increase with the number of attempts and treatments—so it is important to make the most of every opportunity to motivate a quit attempt and provide treatment.[101] Even if treatment does not result in quitting immediately, the fact that smokers made an attempt increases the likelihood that a subsequent attempt will succeed.[50]

Treatment Components

Optimal treatment includes two components: counseling and pharmacotherapy.[104]

Counseling can range from brief discussions with physicians[105] to multiple sessions provided by trained tobacco treatment specialists.[103,106,107] These healthcare professionals are specifically trained to provide counseling services and to manage pharmacotherapy. A variety of counseling techniques are employed, with many grounded in principles of cognitive behavioral therapy. Techniques such as motivational interviewing are used for patients not yet ready to make a quit attempt, although it is not clear that these are effective.[108] As with other areas of healthcare, the COVID-19 pandemic prompted the expansion of telephone and video-based counseling services, which are effective.[109] For example, in the United States, the National Cancer Institute (Bethesda, Maryland) sponsors a single toll-free number (1-800-QUITNOW) that provides access to free state-sponsored "quitline" telephone counseling services. Other methods such as text messaging and web-based programs also show promise.[110–112] For all types of counseling, efficacy increases with intensity, although even just brief advice to quit by physicians increases quit rates by approximately 30%.[101,105] Effectiveness increases with the total patient contact time and the number of counseling sessions.[101]

Several medications increase quit rates.[113] Nicotine replacement therapy was the first approved class and remains a mainstay of therapy, as many forms are available in the United States and other countries without a prescription.[114,115] Nicotine replacement therapy can alleviate both nicotine withdrawal symptoms and cravings for cigarettes. Various formulations are available in different countries; in the United States, skin patches, chewing gum, and lozenges are available without prescription, and nasal spray and oral inhalers are available with a prescription. Formulations can be combined according to need. For example, patches provide extended release useful to prevent withdrawal, while gum is more rapid-acting and can be useful for cravings. Overall, nicotine replacement therapy increases quit rates by approximately 60%.[114,115] The overall safety profile of nicotine replacement therapy is excellent, even in patients with significant comorbidity such as cardiovascular disease.[116,117] Approved first-line non-nicotine medications include bupropion and varenicline.[115] Bupropion is an atypical antidepressant that blocks norepinephrine and dopamine reuptake in the mesolimbic system and may also act as an antagonist of nicotinic receptors. It also has an excellent safety profile and has efficacy similar to that of nicotine replacement therapy.[118] Varenicline is a partial agonist of the $\alpha_4\beta_2$ nicotinic receptor subtype that helps sustain mesolimbic dopamine concentration and alleviate nicotine withdrawal symptoms while blocking nicotine-induced dopaminergic activation and thus the rewarding effect of smoking. Varenicline is the most efficacious of available medications, more than doubling quit rates.[119] Nausea is the most common side effect. There were initial concerns regarding whether varenicline increased risk of depression and self-harm, but subsequent studies have not supported this link.[120] Both bupropion and varenicline should be started 1 week before a quit attempt to achieve therapeutic levels.

Approach to Treatment in Healthcare Settings

Evidence-based Guidelines

Given that tobacco use causes diseases, the relatively frequent contact that users have with the healthcare system provides opportunities to deliver tobacco treatment. A U.S. Public Health Service (North Bethesda, Maryland)–sponsored Clinical Practice Guideline provides recommendations for the implementation of tobacco treatment in healthcare settings, stating that "it is essential that clinician and health care delivery systems consistently identify and document tobacco use status and treat every tobacco user seen in a health care setting."[101] The guideline recommends the "5As" approach: *ask* every patient if they use tobacco, *advise* them to quit, *assess* willingness to make a quit attempt,

assist those willing to quit by offering medication and providing or referring for counseling, and *arrange* for follow-up contact to prevent relapse. Each of these steps is supported by compelling evidence for efficacy. Other countries have issued similar guidelines.[121,122] Unfortunately, these guidelines have proved challenging to implement into routine clinical practice. Although most healthcare systems in the United States attempt to ascertain tobacco use status (with varying degrees of effectiveness), a minority of patients receive even advice to quit on a consistent basis, much less assistance or follow-up.[123–130] Similar results have been found specifically in surgical patients. A national survey of anesthesiologists found that although most asked their patients about tobacco use, only 30% reported advising them to quit, and 5% provided any assistance.[131] Indeed, only 5% felt that it was part of their responsibility to provide assistance. Other surveys of anesthesiologists and surgeons have found similar results.[132–138]

Implementation of Recommendations in Clinical Practices

Many have attempted to increase the provision of tobacco treatment in clinical practices. In general, although such efforts can succeed in the context of clinical studies, it has proven much more difficult to embed them into routine clinical practice.[139,140] The most successful sustained efforts have targeted hospitalized patients. Intensive practice support efforts such as embedded outreach facilitators, decision-support tools within electronic medical records, extensive clinician training, and ongoing audits can increase the provision of tobacco treatment to hospitalized patients and produce measurable improvements in clinical outcomes.[141–144] However, these efforts are resource-intensive, and even so, many patients do not receive treatment. In the absence of this intensive approach, results are less favorable. A meta-analysis of studies examining efforts to increase clinician delivery of tobacco treatment to hospitalized patients found that such efforts increased the provision of assistance, but did not affect asking about tobacco use, advising to quit, or the provision of pharmacotherapy.[145] A consortium of nine research groups used a variety of locally tailored strategies and pragmatic approaches to provide tobacco treatment to hospitalized patients, but only two found that their strategies were effective in increasing postdischarge quit rates.[146] Attempts to increase the provision of tobacco treatment in outpatient settings have had mixed results in terms of how frequently treatment elements are provided.[147–156] There is little information regarding effects on actual quit rates and no information about whether efforts can be sustained in clinical practice.

Other Approaches

Given the very real challenges to implementing clinician-delivered tobacco treatment,[140] two other approaches have been proposed to consistently deliver tobacco treatment in clinical settings. The first is a modification of the "5As" approach, recognizing that most clinicians (and perhaps especially anesthesiologists) do not have the time or training to provide assistance (counseling and pharmacotherapy) or arrange for follow-up. Rather, clinicians should *ask* their patients about tobacco use, *advise* them to quit, and *refer* them to other resources that could provide assistance and follow-up—Ask-Advise-Refer.[149,157,158] Efforts to implement the Ask-Advise-Refer approach have focused on systems to facilitate referral and access to appropriate resources. Its feasibility in practice is now well-established, as well as its ability in study settings to increase referral to treatment resources.[149–151,159,160] However, its sustainability in routine practice and its ability to actually increase quit rates remain to be determined.[151]

The second approach challenges the utility of the third component of the "5As"—*assess* willingness to make a quit attempt. In the "5As" paradigm, the offer of treatment depends on the willingness of patients to make a quit attempt.[101] Thus, the default option for smoking cessation is "no treatment," as treatment is only offered if patients are willing to quit now. Richter and Ellerbeck[161] recently made a persuasive argument that this approach significantly limits the reach of tobacco treatment as only a minority of patients state a willingness to make a quit attempt. They proposed rather than the current "opt-in" approach to treatment, an "opt-out" approach to tobacco treatment should be adopted in clinical encounters. In this framework, analogous to the approach to other chronic conditions, the focus of the discussion would be on treatment options and mechanisms to access these options rather than first assessing readiness to quit. In other words, the default would be treatment; patients could choose not to accept treatment. In support of this concept, they note that changing defaults has changed choice and outcomes for numerous health behaviors, that most tobacco users want to quit, and that there is little evidence of the utility of "assessment" of readiness to quit. Contrary to some prevailing theories of behavior change, there is little evidence that tailoring interventions based on intent (as assessed by the stage of change) affects the efficacy of interventions.[45] Also, there is now evidence in healthcare settings that offering treatment to all, not just those motivated to quit immediately, is efficacious,[22,142] and that pharmacotherapy can be efficacious even when applied to those not ready to quit immediately.[162] This "opt-out" proposal has generated controversy but satisfies accepted principles of medical ethics.[163] Initial studies exploring this approach in cancer and hospitalized patients have produced encouraging results, but more work is needed to compare its effectiveness with the "opt-in" strategy.[164–166]

Benefits of Treating Surgical Patients

Risk of Tobacco Use

The perioperative period involves several clinical encounters that provide multiple opportunities to provide tobacco

treatment. We have already reviewed how surgery can serve as a powerful "teachable moment" to quit, with long-term benefit to health. In addition, treating perioperative tobacco use can improve perioperative outcomes, because tobacco use increases perioperative risk,[167] as has been recognized for more than 75 yr.[168] Mechanisms contributing to risk include tobacco-induced disease (*e.g.*, chronic obstructive pulmonary disease and coronary artery disease) and the acute effects of tobacco constituents (such as carbon monoxide in cigarette smoke).[30] A recent meta-analysis of 107 available studies found increased risk of pulmonary complications (relative risk, 1.73; 95% CI, 1.35 to 2.23), wound-related complications (relative risk, 2.15; 95% CI, 1.87 to 2.49), and neurologic complications (relative risk, 1.38; 95% CI, 1.01 to 1.88) for current smokers compared with nonsmokers.[169] Although smoking can increase the risk of intraoperative myocardial ischemia,[170] current smoking was not associated with major cardiovascular complications (relative risk, 1.07; 95% CI, 0.78 to 1.45). Smoking is also associated with delayed healing of bony fusions and fractures,[171–177] and adverse outcomes after joint and fracture surgeries.[174,178–186] Recent evidence suggests that smoking is also associated with an increased risk of surgical bleeding, perhaps reflecting vascular endothelial damage and inflammation caused by smoke constituents.[187–189] Some studies suggest that requirements for postoperative analgesics are higher in current smokers,[190–192] although as reviewed elsewhere,[193] it is difficult to control for other confounding variables in these observational studies. This same critique can be applied to the observational studies that support the link between smoking and the other complications, although the evidence from randomized trials of tobacco treatments reviewed in the next section supports the causal role of smoking.

Secondhand smoke from others' smoking also poses risks.[194] Approximately one in seven children undergoing surgery in the United States are chronically exposed to secondhand smoke,[99] which increases their risks of perianesthetic respiratory events such as laryngospasm and bronchospasm (relative risk, 2.52; 95% CI, 1.68 to 3.77 in a meta-analysis of 15 studies).[195] These risks of respiratory complications may extend also to adults.[196–198] Effects specifically on wound-related complications are unknown; one cohort study found an association between secondhand smoke exposure and a composite outcome of postoperative morbidity (which included wound-related complications).[199]

Benefits of Quitting

Quitting smoking reduces perioperative risk. A recent systematic review of 13 randomized trials concluded that both intensive (defined as multisession in-person counseling initiated at least 4 weeks before surgery) and brief interventions produced cessation at the time of surgery (pooled risk ratios of 10.8 [95% CI, 4.5 to 25.5] and 1.3 [95% CI, 1.2 to 1.5] for intensive and brief interventions, respectively).[200] Four trials examined whether smokers were abstinent 1 yr after surgery; only intensive (not brief) interventions were efficacious (risk ratio, 2.96; 95% CI, 1.57 to 5.55). More intensive interventions reduced the incidence of a composite outcome of any complication (wound-related, cardiovascular, or other complication requiring treatment; risk ratio, 0.42; 95% CI, 0.27 to 0.65) and the incidence of wound-related complications (risk ratio, 0.31; 95% CI, 0.16 to 0.62); brief interventions did not. Trials and meta-analyses subsequent to this systematic review are consistent with these findings.[201–204]

The duration of preoperative abstinence necessary for benefit has not been studied in randomized trials and likely depends on the complication. Most of the randomized trials showing benefit began treatment at least 4 weeks before surgery. Data from observational trials suggest that it may require several weeks of abstinence before the rate of pulmonary complications decreases.[205–211] Given the relatively short half-life of active cigarette smoke constituents such as nicotine (approximately 1 h) and carbon monoxide (approximately 4 h), even brief abstinence may be beneficial.[30] Randomized trials are not available, but one observational study found that among current smokers, smokers who smoked the morning of surgery were 75% more likely to develop a surgical site infection compared with smokers who did not.[212] Higher intraoperative exhaled carbon monoxide values, indicative of more recent preoperative smoking, are associated with an increased risk of myocardial ischemia.[170] These findings support the practice of advising smokers to at least not smoke on the morning of surgery—just like they "fast" from food, they should also "fast" from cigarettes. A randomized trial of tobacco treatment applied postoperatively in patients who had received acute surgical repair of fractures found that treatment reduced postoperative complications[213]; *i.e.*, even just postoperative abstinence was beneficial.

A reduction in complications with quitting may translate to a reduction in healthcare costs, although only observational studies comparing costs according to smoking status are available. Evidence that current smokers have higher costs for inpatient surgical care during admission compared with never-smokers is mixed,[214,215] but postoperative costs are increased.[215] Modeling studies suggest that, as in other settings, providing tobacco treatment to smokers undergoing surgery is cost-effective.[216–220]

Putative Barriers to Treating Surgical Patients

As noted, it has proved challenging to implement tobacco treatment in clinical practice. There are several additional potential barriers particular to the surgical setting which have been addressed in recent work.

Safety of Nicotine Replacement Therapy

Concerns have been raised regarding the safety of nicotine replacement therapy in surgical patients, primarily regarding the potential for nicotine to cause vasoconstriction that

could impair the healing of surgical wounds.[131] As outlined in recent reviews,[221–223] evidence supporting the safety of nicotine replacement therapy in the surgical setting includes the following: (1) most of the studies showing the efficacy of tobacco treatment to reduce perioperative complications (including wound-related complications) include nicotine replacement therapy in the treatment arm; (2) animal studies suggesting deleterious effects of nicotine on wound healing utilize nicotine doses that exceed those provided by nicotine replacement therapy; (3) randomized studies in an experimental human models show that nicotine replacement therapy does not affect the beneficial effects of abstinence from smoking on wound healing; and (4) a large observational study (including more than 25,000 patients undergoing major surgical procedures who received nicotine replacement therapy) showed no association between nicotine replacement therapy and adverse outcomes, including wound-related complications.[224] Thus, available evidence strongly supports the use of nicotine replacement therapy to treat tobacco use in surgical patients.[222,223]

Safety of Quitting Immediately before Surgery

Concerns have been raised regarding whether quitting smoking shortly before surgery increases the risk of pulmonary complications due to an increase in cough and sputum production. This concern arose from a misinterpretation of experimental data[225] and has persisted despite the facts that (1) smoking cessation is not associated with increased cough[226] and (2) multiple studies, summarized in two meta-analyses,[207,209] show that although several weeks of abstinence may be necessary to reduce risk, quitting shortly before surgery does not increase the risk of pulmonary complications. Thus, although prolonged preoperative abstinence likely has the greatest benefit, patients should not be discouraged from quitting at any time before (or after) surgery.

Increased Psychologic Stress and Nicotine Withdrawal Caused by Perioperative Abstinence

Smoking acutely reduces psychologic stress,[227] and abstinence could add to the already considerable stresses posed by surgery. However, studies show (1) no differences in changes in measures of psychologic stress over the perioperative period between smokers and nonsmokers[97]; (2) no effect of nicotine replacement therapy on perioperative stress or withdrawal symptoms in smokers[98]; and (3) surprisingly little reported craving for cigarettes.[97] Thus, perioperative abstinence can be urged without fear of adding to patient psychologic distress.

Patient Acceptance

Physicians may perceive that smokers already feel overwhelmed around the time of surgery and do not want physicians to address their smoking behavior.[131] Evidence shows that most patients have favorable attitudes toward attempting abstinence in the perioperative period,[97,98,228–230] but are not well-informed about the acute perioperative risks of smoking and the potential benefits of even temporary abstinence.[228,231–234] Most feel that their physicians are credible and should talk to them about how their smoking affects their risk.[135,228,235,236] Thus, anesthesiologists should not hesitate to do so.

Practical Methods to Treat Surgical Patients

Research studies find that treating surgical patients for their tobacco use can reduce both tobacco use and perioperative complications. As with so many other research findings, the challenge is to implement these results into routine clinical practice.[140] Fortunately, recent reports detail the results of implementing practical approaches into clinical practices and can provide guidance (table 2). Several themes are apparent.

Multimodal Treatment Maximizes Efficacy

Most successful programs incorporate four core components: consistent ascertainment and documentation of tobacco use (*i.e.*, "asking"), advice to quit, access to nicotine replacement therapy or other pharmacotherapy, and referral to counseling resources (fig. 4). This approach can be conceptualized as multimodal perianesthesia tobacco treatment, analogous to multimodal analgesia—the combination of multiple modalities that in isolation may be insufficient to provide adequate analgesia but are more effective when combined. In the same way, applying single components of tobacco treatment in isolation may not be effective. For example, telephone counseling services ("quitlines") are a primary referral resource in several studies. Treatments that incorporate quitlines are successful in many of these studies,[201,202,250] but it is not possible to determine how the quitlines may have contributed to this success. Observational studies show a positive association between quitline utilization and the odds of quitting postoperatively.[239,240,242] However, randomized trials in other settings show that quitline utilization may be simply a marker for those who would have quit in any event.[257] The only study isolating quitline use as an experimental factor (*i.e.*, included no other component of treatment) found only a nonsignificant trend toward greater quitting at 30 days after surgery.[254] Thus, quitline services alone may not be sufficient, and need to be combined with other treatment elements for efficacy. There are similar findings for applying nicotine replacement therapy alone in the perioperative setting without advice or counseling.[98]

Implementation of Multimodal Perianesthesia Tobacco Treatment into Clinical Practice Is Feasible and Effective

Initial implementation of multiple treatment components across practice sites is feasible and can be accomplished using existing clinical personnel.[233,239,242,244,258] Two reports provide

Table 2. Studies of Tobacco Treatment Delivered by Clinical Personnel in Surgical Settings

Study	Setting	Number of Smokers	Interventions*	Outcomes	Highlights of Findings
Implementation case series					
Akhavan *et al.*, 2017[237]	Total joint arthroplasty clinic	30	Brief advice, brochure with quitline number	Preoperative quitting, resource use	70% preoperative quitting, 5% used quitline, 24% used nicotine replacement therapy.
Hart *et al.*, 2019[238]	Total joint arthroplasty clinic	2,109	Brief advice, preoperative cotinine testing	Preoperative quitting	28% preoperative quitting with cotinine testing (n = 71), 16% without testing.
Howard *et al.*, 2022[239]	35 Michigan hospitals, vascular surgery	5,158	Brief advice, proactive quitline referral, nicotine replacement therapy prescription	Resource use, postoperative quitting at 30 days and 1 yr	44% received at least one intervention; 15% referred to quitline, 19% received nicotine replacement therapy. Overall, 35% quit at 30 days; quit associated with receiving multiple interventions (odds ratio, 1.29).
Mustoe *et al.*, 2020[240]	Thoracic surgery clinic	111; 58 received surgery	Brief advice, quitline referral	Preoperative quitting, postoperative quitting, quitline enrollment	50% used quitline. Having surgery increased preoperative quitting (odds ratio, 2.4). Using quitline associated with increased postoperative quitting at 6 months (odds ratio, 3.6) but not preoperative quitting.
Nolan *et al.*, 2016[61]	Preoperative anesthesia clinic	105	Brief advice, free supply of electronic cigarettes	Resource use, postoperative quitting	87% used electronic cigarettes in the perioperative period; reduction in conventional cigarette consumption at 30 days (statistically significant); 17% quit at 30 days.
Nolan *et al.*, 2019[241]	Preoperative anesthesia clinic	100	Text message cessation program	Resource use, postoperative quitting	80% of participants expressed satisfaction with the program; 31% quit at 30 days.
Saxony *et al.*, 2017[242]	Preoperative surgery clinic	2,867	Brief advice, referral to tobacco treatment specialist counseling with discounted nicotine replacement therapy	Resource use, postoperative quitting	18% of smokers referred to tobacco treatment specialist; 58% of those referred received treatment, and 56% of these (n = 123, 4% of all smokers) set a quit date. 49% of these quit at 12 months.
Warner *et al.*, 2009[230]	14 anesthesiology practices	—	Academic detailing (*i.e.*, clinician education) to promote ask-advise-refer	Clinician attitudes and practices	80% of those surveyed (74% response rate) agreed that it was part of their responsibility to help smokers quit, and 75% planned to incorporate ask-advise-refer into their practices.
Pre–post implementation studies					
Bottorff *et al.*, 2016[236]	2 Canadian practices	240	Patient promotional materials and encouragement of 5As	Rate of brief advice, preoperative quitting, patient knowledge	No effect on preoperative quitting (6% *vs.* 8%, not statistically significant). Increased rate of brief advice (55% *vs.* 70%, statistically significant). Correlation between brief advice and (1) preoperative quitting and (2) awareness of smoking-related complications.
Coffman *et al.*, 2019[243]	Preoperative clinic	133	Brief 5As, brochure, referral to unspecified resources	Preoperative quitting	Preoperative quitting went from 40 to 46% (not statistically significant); concluded feasibility
Stonesifer *et al.*, 2021[244]	Veterans Administration vascular and plastic surgery clinics	943	Electronic decision support tool for referral to tobacco treatment specialist	Tobacco treatment specialist treatment	No treatment before implementation; 20% of eligible patients treated after implementation (statistically significant).
Young-Wolff *et al.*, 2019[245]	Practices of 34 surgeons in integrated healthcare system	276	Brief counseling, decision aid, referral to tobacco treatment specialist, pharmacotherapy	Resource use, preoperative quitting, postoperative quitting	Referrals increased from 3 to 28% (statistically significant), no change in pharmacotherapy, counseling increased from 5 to 12% (statistically significant). Preoperative quitting changed from 21 to 29% (not statistically significant). 30-day continuous postoperative quitting increased from 18 to 39% (statistically significant).

(*Continued*)

Table 2. (Continued)

Study	Setting	Number of Smokers	Interventions*	Outcomes	Highlights of Findings
Webb *et al.*, 2014[246]	Preoperative anesthesia clinic	347	Mailed brochure and quitline referral form	Preoperative quitting	Increased preoperative quitting for > 4 weeks by 9% (statistically significant)
Webb *et al.*, 2017[247]	Preoperative anesthesia clinic	999	Standardized documentation of brief advice and referral	Documentation in medical record	Increased documentation of advice given (2 to 19%, statistically significant) and referral (1 to 6%, statistically significant)
Randomized trials					
Andrews *et al.*, 2006[248]	Preoperative clinic	102	Mailed advice letter from surgeon	Preoperative quitting	Letter increased preoperative quitting from 8 to 18% (statistically significant)
Goodney *et al.*, 2017[249]	8 vascular surgery practices, cluster randomized	156	Brief advice by surgeon, proactive quitline, nicotine replacement therapy	Resource use, postoperative quitting	75% of patients in intervention arm received all three elements (no information about actual quitline or nicotine replacement therapy utilization). Postoperative quitting at 3 months 40% *vs.* 31% active and control, respectively (not statistically significant). Brief counseling and nicotine replacement therapy, not quitline referral, associated with postoperative quitting.
Lee *et al.*, 2013, 2015[250,251]	Preoperative anesthesia clinic	168	Brief counseling by nurse (< 5 min), brochure, proactive quitline referral, nicotine replacement therapy	Resource use, preoperative quitting, postoperative quitting	52% intervention group contacted quitline. Preoperative quitting 4% *vs.* 14% (statistically significant), postoperative quitting 11% *vs.* 29% at 30 days (statistically significant), 8% *vs.* 25% at 1 yr (statistically significant).
Lee *et al.*, 2018[62]	Preoperative anesthesia clinic	30	Brief advice, proactive quitline referral, nicotine replacement therapy *via* patches *vs.* electronic cigarettes	Preoperative quitting, postoperative quitting	No differences in preoperative quitting or postoperative quitting (not statistically significant). Utilization of patches and electronic cigarettes similar.
Newhall *et al.*, 2017[233]	8 Vascular surgery practices, cluster randomized	156	Brief advice by surgeon, proactive quitline, nicotine replacement therapy	Survey of patient experiences and attitudes	Increased provision of brief advice by surgeons (77% *vs.* 99%, statistically significant), increased awareness of risks and interest in quitting.
Shi *et al.*, 2013[252]	Preoperative anesthesia clinic	183	Brief advice ± message that CO would be tested morning of surgery	Preoperative quitting assessed *via* CO on morning of surgery	No difference in CO levels the morning of surgery. CO levels significantly higher in patients receiving usual care who did not receive brief advice (indicating decreased preoperative quitting).
Sørensen *et al.*, 2007[253]	Preoperative anesthesia clinic	215	Brief advice ± reminder before surgery	Preoperative quitting, postoperative quitting	Brief advice increased preoperative quitting (2% *vs.* 19%, statistically significant), postoperative quitting at day 7 (2% *vs.* 18%, statistically significant), but not day 30. No effect of reminder.
Warner *et al.*, 2005[98]	Preoperative anesthesia clinic	121	Active *vs.* placebo nicotine replacement therapy patch; no advice to quit	Perceived stress scale, withdrawal, postoperative quitting	No effect on stress or withdrawal; delayed relapse to smoking in the first 30 days postoperatively only for outpatient surgery, not inpatient surgery. No effect on postoperative quitting at 30 days (30% *vs.* 39% placebo *vs.* active, not statistically significant).
Warner *et al.*, 2011[254]	Preoperative anesthesia clinic	300	Brief counseling by anesthesiologists to encourage quitline use, including faxed referral and free nicotine replacement therapy per quitline	Quitline utilization (completing ≥1 session), preoperative quitting, postoperative quitting	0% *vs.* 20% quitline utilization in controls and intervention (statistically significant), median of four sessions. No difference in preoperative quitting, postoperative quitting (37% *vs.* 45% abstinent at day 30 in control and intervention, not statistically significant).

Table 2. (Continued)

Study	Setting	Number of Smokers	Interventions*	Outcomes	Highlights of Findings
Warner *et al.*, 2015[255]	Preoperative anesthesia clinic	130	Decision aid for perioperative smoking	Decisional quality, patient involvement, postoperative quitting	Increased measures of decisional quality and patient involvement, no effect on postoperative quitting.
Webb *et al.*, 2020[256]	Preoperative anesthesia clinic	600	Brochure (all), offer of free mailed nicotine replacement therapy preoperatively.	Use of free nicotine replacement therapy, preoperative quitting	39% in intervention group accepted nicotine replacement therapy, 13% used for ≥ 4 weeks. 6% *vs.* 9% preoperative quitting for > 4 weeks (not statistically significant), 11% *vs.* 16% preoperative quitting for 24 h preoperatively (not statistically significant).
Webb *et al.*, 2022[202]	Preoperative anesthesia clinic	748	Brochure, offer of free mailed nicotine replacement therapy, proactive quitline referral	Resource use, preoperative quitting, postoperative quitting for those who quit preoperatively	Nicotine replacement therapy and quitline referral accepted by 32% of intervention group; 16% actually contacted quitline. Preoperative quitting greater for intervention (10% *vs.* 21%, statistically significant), postoperative quitting at 3 months for those who had preoperative quitting not different.
Wong *et al.*, 2017[201]	Preoperative anesthesia clinic	296	Brief counseling (10–15 min), varenicline, brochure, proactive quitline referral	Postoperative quitting	Treatment increased postoperative quitting (26% *vs.* 42% treatment *vs.* control, statistically significant). Postoperative quitting associated with quitline utilization,

Studies include those utilizing interventions provided by clinical personnel (including referral to quitlines). Studies that utilized trained study personnel to deliver interventions are not included.
*For randomized trials, active treatment arm is described, with usual care as control condition, unless otherwise specified.
CO, carbon monoxide.

successful examples of this approach. Lee *et al.* designed and evaluated a treatment program for their preoperative clinic that included a brief (less than 5 min) counseling session by a preadmission nurse who had received a 1-h training session, an informational brochure, a faxed referral to a quitline, and a 6-week supply of nicotine patches.[250,251] Quit rates at 1 yr after surgery were significantly higher in patients randomized to this program compared with a control condition of usual practice (25% *vs.* 8%, respectively; $P = 0.018$). Young-Wolff *et al.* established a screening system to consistently ascertain tobacco use, trained surgeons to provide brief counseling (facilitated by a decision aid), and referral to counseling services in the practice.[245] This intervention required less than 5 min. In a pilot study employing a pre–post implementation design, referral rates to counseling increased from 3 to 28% ($P < 0.001$), and the rate of counseling went from 5 to 12% ($P = 0.06$). Continuous abstinence at 30 days postoperatively increased from 18 to 39% ($P = 0.005$).

Advice to Quit Is Foundational

Multiple studies highlight the importance of even brief advice to quit before surgery. Although the number of patients included in some studies was insufficient for statistical significance, advice itself (delivered in person or with mailed materials) is associated with preoperative quitting.[236,237,243,246,248,252,253,256] The effect of advice on postoperative abstinence is not known, but it is included as a component of other interventions efficacious for this purpose. Advice may include the requirement for preoperative quitting for surgery to proceed,[93,238,259,260] which is cited as a powerful motivating factor by patients.[235] The ethics of this requirement have been questioned for nonelective procedures,[261] and it has not been reported outside of elective orthopedic and plastic surgery, where concerns for wound- or bone-related complications are especially acute. Biochemical verification of preoperative smoking status can be readily performed using exhaled carbon monoxide or urinary cotinine (a metabolite of nicotine)[262–264]; evidence is mixed as to whether verification itself increases the likelihood of quitting.[238,252]

Other Simple Tactics Can Facilitate Treatment

Several practical tactics can increase the provision of treatment to surgical patients. Decision support tools such as electronic reminders increase documentation and referrals.[244,247,258] Educational programs directed toward clinicians can increase the rate of brief advice and referrals.[230,233,234,236,239,249,254] Decision aids can effectively facilitate conversations between clinicians and their patients about smoking.[255] Mailed materials such as a letter from the surgeon or brochures can be efficacious.[246,248] Such tactics can be used to implement and optimize the core treatment components of asking, advising, and providing access

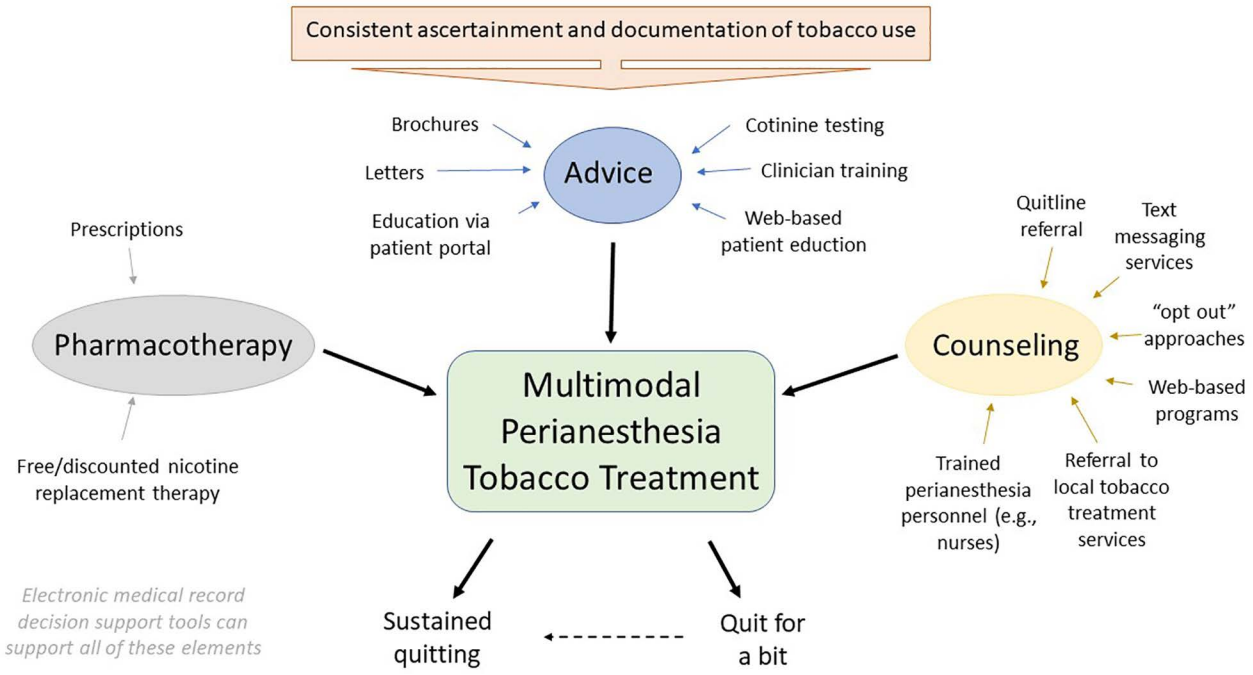

Fig. 4. Schematic of multimodal perianesthesia tobacco treatment, with four main components of consistent ascertainment and documentation of tobacco use, advice to quit by anesthesiologists and other clinicians, pharmacotherapy, and counseling. Goals of treatment can include both sustained quitting and "quit for a bit" (from at least the morning of surgery to at least 1 week after surgery), which may be attractive to some patients, and which may lead to sustained quitting. Also shown are representative evidence-based tactics that can be used to accomplish each element.

to pharmacotherapy and counseling, depending on the opportunities available in specific practice settings (fig. 4). Investigators are exploring other strategies to increase the feasibility of treatment, including additional methods of providing support such as text messaging services specifically designed for surgical patients,[241] and "opt-out" approaches that simplify and facilitate referral to treatment.[165,166,265]

Sustainability in Practice Is Key

Although recent progress is encouraging, considerable work remains to ensure that all surgical patients who smoke receive treatment, as there are not yet reports describing large-scale, sustained treatment efforts embedded into practices. We do not lack a menu of proven tactics that can be applied to perioperative patients (fig. 4), and many guidelines and recommendations for providing tobacco treatment to surgical patients are available.[121,157,266–274] Achieving the goal of incorporating these tactics into the routine care of surgical patients (*i.e.*, sustainability) requires an integrated systems approach adapted to the particular needs of individual practices—one size does not fit all. For example, some practices have ready access to in-person counseling services that can provide multiple sessions, whereas others may only have access to general quitline services. Fortunately, considerable recent progress has been made in understanding how changes in clinical practice occur through the new discipline of implementation science[275]; understanding these processes can guide efforts to make such changes. A recent review presents the principles of implementation science and how they can be applied to facilitate treatment of surgical patients who use tobacco.[140]

Getting Started

For those interested in how they can contribute to the fight against the pandemic by helping their patients who use tobacco, the task can seem daunting. However, there are simple evidence-based steps everyone can take.

Ask every patient if they use tobacco (*e.g.*, "Do you currently smoke or vape?"), even if you already know the answer. This communicates that you as an anesthesiologist view this as an important topic. For example, anesthesiologists routinely confirm *nil per os* status, even when others have already done so, because they think this is important. Once ascertained, ensure that tobacco use status is accurately documented in the medical record.

Advise all patients who use tobacco to quit for as long as they can before and after surgery. Many smokers who are not yet ready to quit for good are willing to "quit

for a bit" (*e.g.*, from at least the morning of surgery until at least 1 week after surgery) if informed that it will reduce perioperative risk.[255] Emphasize that it is especially important for them to not use tobacco the morning of surgery—just like they are not to eat the morning of surgery, they should also not use tobacco. Advice to those who use electronic cigarettes may need to be more nuanced if they are using these devices to quit conventional cigarettes, although there is not yet evidence that vaping is safer than smoking in the perioperative period. Given this state of knowledge, most patients should be advised to quit vaping as well.

These two actions alone are effective. To *go further*, explore what counseling services may be available in your healthcare system. These services are typically housed within departments of pulmonary or cardiovascular medicine but may also be found in cancer centers and departments of respiratory therapy or nursing. If your system does not have these services, everyone has access to telephone counseling services in through a single toll-free number, 1-800-QUITNOW. Similar resources are also available in many other countries. Consider mechanisms in your practice that can facilitate referral to these services. Such mechanisms can range from distributing cards and brochures with quitline information to electronic decision support tools that automatically refer all tobacco users to treatment (fig. 4).[166]

Ultimately, widespread implementation of consistent multimodal perianesthesia tobacco treatment in practices requires an implementation "champion."[276] The primary requirement of a champion is commitment; other elements of the role can be learned. My own experiences in tobacco research may be instructive. I was trained as a respiratory physiologist during my anesthesiology residency, and my interests in the tobacco pandemic originally came from a desire to improve perioperative lung health. However, I was a laboratory-based scientist at the time, with no training or experience in public health or tobacco control. Thanks to the supportive environment of the Mayo Clinic Nicotine Dependence Center and a passion to make a difference, I was able to change research direction and build a program to generate and disseminate evidence supporting perioperative tobacco treatment. Change is not always comfortable or smooth, but as is the case with patients who struggle yet succeed in changing their smoking behavior, ultimately can be rewarding.

Based on the research of many investigators, professional societies and others have issued several guidelines that are valuable sources of information.[121,157,266–274] Many online materials (which can be accessed at www.quitforsurgery.com) are freely available, including education for both clinicians and patients and useful implementation information such as how tobacco treatment can be reimbursed in the United States (separate from anesthesia services) and how outcomes of tobacco treatment can serve as anesthesiology-specific quality measures in the U.S. Merit-based Incentive Payment System.

Anesthesiologists Can Make a Difference

Of all the pandemics that have afflicted humanity, the tobacco pandemic is among the most tragic because it is sustained by human greed and could be largely eliminated—if societies can muster the political will to do so. As observed by Robert Proctor in his book *Golden Holocaust*,[6] "…the cigarette is the deadliest artifact in human history…and is still, apparently, the only consumer product that kills when used as directed. Half its users, in fact." Anesthesiologists can play a unique role in the fight against this pandemic, providing both immediate (reduction in perioperative risk) and long-term (reduction in tobacco-related diseases) benefits to their patients' health—if we choose to do so.

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Competing Interests

The author declares no competing interests.

Correspondence

Address correspondence to Dr. Warner: Department of Anesthesiology and Perioperative Medicine, Mayo Clinic, 200 1st St. SW, Rochester, Minnesota 55905. warner.david@mayo.edu.

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