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Behavioral Outcomes of Nicotine Reduction in Current Adult Smokers

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The United States is currently considering a policy which would reduce the level of nicotine in cigarettes and potentially other combustible tobacco products (ie, roll-your-own tobacco, small cigars, cigarillos, and pipe tobacco) to a minimally addictive or nonaddictive level. If such a policy is implemented, it is likely that the prevalence of smoking will drop drastically. The greatest public health gains associated with such a policy are likely to come from a lower rate of smoking initiation. According to one recent estimate, by the year 2100, 33.1 million individuals will have not initiated smoking due to a nicotine reduction policy.[1] Current data supporting a reduction in youth initiation come from both preclinical and clinical sources, and are discussed in depth in a separate commentary devoted to this topic within this same issue. Among current smokers, a variety of behavioral outcomes are possible: current smokers may choose to (1) continue to smoke very low nicotine content (VLNC) cigarettes; (2) switch to use other nicotine and tobacco products, either alone or concurrently with VLNC cigarettes; (3) may stop using all tobacco; (4) and/or may seek out illicit normal nicotine content (NNC) cigarettes. Below, we comment on the likelihood of each of these outcomes based on VLNC studies conducted to date. In particular, we note that the degree to which any of these outcomes may occur will largely depend on the availability, cost, and appeal of alternative nicotine and tobacco products, along with the costs and acceptability of VLNC cigarettes

First, if a very low nicotine standard is adopted for cigarettes, most smokers will try VLNC cigarettes, and many will reduce their cigarette consumption. Although commercially available VLNC cigarettes have not achieved high market share in the past, smokers have been willing to try them. In clinical trials with VLNC cigarettes, participants generally use the VLNC cigarettes, at least at some level, for the duration of the trial.[2–4] In short term (<2 weeks) in-patient studies where participants are provided with VLNC cigarettes and restricted from accessing NNC cigarettes or other tobacco products, all participants continue using VLNC cigarettes.[5] These preliminary data suggest that if NNC cigarettes were unavailable, most smokers would likely switch to and continue smoking VLNC cigarettes over the short-term.

Even though some smokers may continue to smoke VLNC cigarettes, the number of cigarettes smoked per day would likely decrease. In nicotine reduction clinical trials, smokers generally reduce the number of cigarettes they smoke per day by about five cigarettes per day, with most having reduced smoke exposure.[2,3,6] Furthermore, the magnitude of the effect of nicotine reduction on smoking in these trials is likely underestimated because cigarettes are provided for free. If a nicotine reduction policy is implemented, cigarette consumption is likely to be reduced to a larger degree than seen in clinical trials since smokers will be required to pay for their cigarettes. In one recent clinical trial, participants who were assigned to VLNC cigarettes estimated that if the price of VLNC cigarettes were $6.00/pack, they would reduce their smoking by half compared with rates of smoking usual brand cigarettes at baseline.[2]

Second, many smokers are likely to increase their use of and/or switch partially or completely to alternative noncigarette nicotine delivery products. In a recent clinical trial, the prevalence of any nonstudy NNC cigarette use among nontreatment-seeking smokers who were asked to switch to VLNC cigarettes was ~75%,[7] suggesting that most smokers who are not trying to quit are likely to seek out an alternative source of nicotine. Indeed, in the only clinical trial designed to directly investigate the impact of nicotine reduction on alternative product use, the percentage of smokers who purchased noncigarette tobacco products was higher among smokers assigned to VLNC cigarettes than in smokers assigned to NNC cigarettes.[8] A recent report modeled the impact of nicotine reduction and found that dual use of cigarettes and noncombusted tobacco products is likely to increase in the short term but begin decreasing within a year, because smokers are likely to find the VLNC cigarettes less satisfying relative to alternative nicotine products.[1] According to the same model, use of noncombusted products is likely to increase and stay elevated over the long term following a nicotine reduction policy.[1]

Information about which products are most likely to be substituted under a nicotine reduction policy for cigarettes comes from several sources. First, data from studies in which the cost/price of NNC cigarettes is increased while the price of other tobacco products is held constant can provide information about which products are likely to substitute for NNC cigarettes when nicotine is reduced. In these models, VLNC cigarettes, nicotine replacement products, other combustible products, and e-cigarettes have all been found to substitute for NNC cigarettes.[9–12] One trial suggested that noncigarette combustible products were likely to be the most preferred substitute, but when these products were unavailable, e-cigarettes were the most commonly chosen substitute.[11] Second, clinical trials where smokers are given the choice between VLNC cigarettes and noncigarette tobacco products provide direct information about the likelihood of use for each of these products. Although several of these trials are ongoing, only one trial is published to date.[8] In this trial, the most commonly purchased noncigarette product was e-cigarettes, with ~25%–30% of participants using e-cigarettes during the sixth week of the trial.[8] The next most commonly chosen product category was normal nicotine content noncigarette combustibles (ie, little cigars and cigarillos), followed by nicotine replacement therapy. There was very little interest in smokeless tobacco (<5%). These results are consistent with data from self-report studies.[13,14] Together, these data suggest that noncigarette combustible products and e-cigarettes are likely to be the most commonly substituted products following implementation of a nicotine reduction policy. As combustible products carry substantially greater health risks compared to noncombustible products, it is critical that the FDA take steps to limit the appeal of noncigarette combustible products (see below).

Third, nicotine reduction will increase the percentage of smokers who try to quit smoking and who are successful at quitting. Currently, 53% of smokers try to quit smoking every year, but less than 7% of smokers quit successfully.[15] The very low nicotine standard is likely to have a major impact on both the rate at which smokers try to quit and the rate at which smokers succeed in remaining abstinent from all tobacco products. Randomized assignment to VLNC cigarettes has been shown to increase the number of days that smokers abstain from smoking,[3] and to more than double the likelihood of making a quit attempt[2] among smokers who had not been interested in quitting at baseline. Among smokers who are interested in quitting, clinical trials have shown that VLNC use doubles the rate of biochemically confirmed tobacco cessation.[6] These data are consistent with self-report studies showing that when smokers who have not tried VLNC cigarettes are asked how they would respond to a nicotine reduction policy, a substantial portion report they would quit smoking (13%–22%).[14,16] However, self-report data from trials where participants have experience with VLNC cigarettes suggest the impact on cessation could be even larger (>50%).[17] A recent modeling article estimated that a mandated nicotine reduction policy would produce 5 million additional quitters within a year of implementation and 13 million within 5 years.[1]

Fourth, the size of the illicit trade market is likely to depend on the availability of appealing illicit tobacco product options. The outcome that is most difficult to predict is the likelihood of illicit cigarette use. This topic has been written about more extensively in an FDA report.[18] In a large clinical trial among nontreatment-seeking smokers who were willing to switch to research cigarettes for 6 weeks, 75% of participants used at least some nonstudy cigarettes during the trial.[7] These data may suggest that if a nicotine reduction policy is implemented, some portion of smokers would be interested in using NNC cigarettes obtained from illicit sources if they are readily available and come at a low cost and with little risk. However, while a majority of smokers use nonstudy NNC cigarettes during nicotine reduction clinical trials, the rate of nonstudy cigarette use appears to be low (2–3 CPD[2,3]). Thus, substitution is not complete and reductions in smoke and toxicant exposure are still observed.[2,3] These data suggest that even if illicit NNC cigarette use is widespread following implementation of a nicotine reduction policy, the benefits of a nicotine reduction policy may be diminished but are unlikely to be removed entirely.

However, there are several reasons to be confident that illicit cigarette use of NNC cigarettes is not likely to be widespread following implementation of a nicotine reduction policy. First, under a reduced-nicotine policy, illicit cigarettes will likely be more difficult to purchase than NNC cigarettes were in clinical trials, whereas other sources of nicotine (e-cigarettes, nicotine replacement) are readily available. Thus, the appeal of illicit options is likely to depend, in part, on the availability of appealing legal alternatives. Second, the cost of manufacturing and distributing illicit cigarettes may drive up the cost of these products relative to legally available VLNC cigarettes, decreasing demand for the illicit NNC cigarettes.[18] However, if illicit cigarettes are diverted from established manufacturing sites, prices may be lower because federal and state taxes would be avoided.[18] The cost differential between illicit cigarettes and VLNC cigarettes will be an important factor because the reinforcement value for NNC cigarettes has been found to be approximately two times higher than for VLNC cigarettes.[19] Third, the demand for illicit NNC cigarettes is unlikely to be high. In one self-report study, interest in illicit NNC cigarettes was only 10%.[16] This percentage may conservatively represent the level of interest in illicit cigarette purchasing that would exist following implementation of a cigarette nicotine reduction policy.

Discussion

If a very low nicotine standard for cigarettes were implemented, the health impact of any substituted product use will be a joint function of the rates of use and the direct health effects of each product.[1] The data presented above suggest the most commonly chosen products are likely to be noncigarette combustible products and e-cigarettes. Thus, policy makers could maximize the beneficial effects of a reduced-nicotine policy by taking steps to increase the likelihood that smokers will choose less harmful noncombustible alternative nicotine products, like oral tobacco and e-cigarettes, and decrease the likelihood that smokers will choose more harmful combustible products, like little filtered cigars, cigarillos, and illicit NNC cigarettes. First, policy makers considering a nicotine standard should expand the scope of this standard to include other combusted products that are smoked like cigarettes, which are likely to carry health risks similar to the health risks of cigarettes. If the scope of the regulation is not extended to these other combustible products, consumers are likely to substitute these products for cigarettes,[20] diminishing gains in public health. Second, policy makers might consider regulatory frameworks that favor the availability of less harmful noncombustible tobacco products, such as less stringent marketing regulations (ie, allow broadcast advertising, product sampling), accurate labeling about the relative risks of different tobacco products, and a speedier, less costly way to get less harmful noncombustible tobacco products into the marketplace. These actions would

incentivize manufacturers to develop such products and decrease demand for illicit NNC cigarettes. Third, smokers who are interested in using noncigarette products may seek out information about the relative risk of these products, and policy makers should provide information about which choices are likely to be the least harmful. Product packaging/advertisement could also include relative risk information in a way that is easily understood by consumers. For example, the stoplight approach (eg, green, yellow, red) has been effective for other health domains (healthy eating), and can be used to clearly communicate potential tobacco product harm. Together, these strategies will maximize the public health gains associated with a nicotine reduction policy.

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Declaration of Interests

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