

## En Route for Better From Bad (?): Introducing Reduced Nicotine Cigarettes

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### Abstract

Smoking is one of the major modifiable etiological factors of multiple morbidities. Convincing evidences are available to establish the causal influence of smoking on cancers, cardiovascular diseases, respiratory morbidities and reproductive dysfunctions. The main culprit responsible for smoking-associated morbidities and mortality is nicotine. Youngsters accidentally experiment smoking, get addicted to smoking which pushes the into the dark era of associated morbidities. With a view of reducing exposure to toxicants in cigarettes, reduced-nicotine cigarettes (RNCs) were introduced with a belief that they would reduce the incidence of addiction and thus the incidence of associated morbidities. These RNCs were introduced as a result of nicotine reduction policy implemented by the US government. Recent evidences have demonstrated that RNCs are safer than conventional cigarettes in many aspects. This article describes the challenges involved in effective functioning of nicotine reduction policy and adds a note on future prospects to enhance the outcomes.

**Keywords:** Smoking; Smoking associated morbidity and mortality; Conventional cigarettes; Reduced nicotine cigarettes; Nicotine reduction policy

### Cigarettes, Smoking and Health

Smoking is one of the major modifiable etiological factors of multiple morbidities. Convincing evidences are available to establish the causal influence of smoking on cancers, cardiovascular diseases, respiratory morbidities and reproductive dysfunctions. Major constituent of cigarette is tobacco which is culprit, responsible for all causes of morbidity and mortality associated with smoking. Cigarette smoke is said to contain more than 60 carcinogens [1] like Polycyclic aromatic hydrocarbons (PAHs), nitrosoamines, aromatic amines, oxidants and free radicals which covalently bind to the DNA causing somatic mutations and thus induce carcinogenesis. Smoking has been implicated as a causal factor in cancers of lung, larynx, oropharynx, esophagus, pancreas, bladder, kidney, cervix, stomach and acute myeloid leukemia. Cigarette smoke contains aerosols and gases of a multiple

chemical compounds [2] such as acrolein, formaldehyde, nitrogen oxides, cadmium, hydrogen cyanide, etc which have been proven beyond doubt to possess cilia toxic and oxidant effect. Due to the effect of these chemicals on the respiratory mucosa and alveoli [3], smoking has a direct causal effect on COPD, emphysema, chronic bronchitis and asthma which are serious morbid conditions known to reduce the quality of life commonly encountered by a practicing physician. Studies have also demonstrated the relation between tobacco smoke and cardiovascular diseases such as coronary artery disease and stroke owing to its effect on cardiometabolic parameters [4] such as impairing glucose tolerance, thrombogenic effect [5] and reducing HDL cholesterol levels. Presence of nicotine, carbon monoxide and many metals [6, 7] in the tobacco smoke also impair the reproductive functions especially in females [8]. Among all these effects on health, respiratory morbidities and cancers comprise the major component of smoking-associated morbidity and mortality.

### Tracing Back

In 1976, Michael Russell, a scientist known for his extensive work on tobacco and its effect on health, made a remarkable commentary that 'people smoke for nicotine but die of tar [9] which marked the initiation of various efforts to reduce the ill effects associated with smoking. In 1988, a cigarette-like product called Premier was introduced which delivered more carbon monoxide but less toxicant when compared with conventional cigarettes [10]. Other such products like eclipse [11] and accord [12] were introduced later but were a failure. With a motive of reducing smoking-associated morbidity, in 1970s, light cigarettes were introduced and marketed. These cigarettes had a filter that reduces the yield of nicotine by increasing ventilation [13]. In 1994, Benowitz and his colleagues with a basic objective of weaning the addicted Americans off cigarettes hypothesized that cigarettes can be rendered non-addictive if its nicotine content is reduced to 0.5 mg per cigarette [14-16]. Recently, the significance of Benowitz's hypothesis on nicotine reduction has been accepted worldwide and a plenty of efforts have been initiated on a myriad of modalities for its implementation and evaluation of such modalities. In the past decade, nicotine reduction policy has attained universal attention especially in the WHO [17], Institute of Medicine [18], office of US Surgeon General [19] and many other international legislative bodies working on health care sector. It was in 2009, Mr. Barack

Obama, the president of USA signed legislation that authorized FDA to guide national policies in nicotine reduction and thus Tobacco control act was framed. Though this act allowed FDA to reduce the levels of nicotine yield, it prohibits FDA from completely eliminating nicotine yield [20]. As a result of this act, Reduced Nicotine Cigarettes (RNCs) are under evaluation to be introduced in commercial trade markets.

## The Principle

Youngsters in the current scenario are possessed by the spirit of adventure which tempts them to experiment smoking following which they get addicted and later develop smoking-associated morbidities. Nicotine is the culprit component present in the cigarette smoke that is solely responsible for addiction. The basis of framing nicotine reduction policy lies in the fact that reduction in the quantity of nicotine, the addictive agent will reduce the incidence of addiction which in turn reduces the term of exposure to carcinogens and toxicants and thus reducing smoking-associated morbidity and mortality. Conventional cigarettes contain 15.8 mg of nicotine per g of tobacco while RNCs contain only 0.4 mg nicotine per g of tobacco [21]. These RNCs differ from light cigarettes by containing tobacco which has reduced nicotine content. Many minor studies across the globe have shown that RNCs are associated with reduction in smoking, nicotine exposure, dependence, toxicant exposure and increased withdrawal from smoking in comparison with standard cigarettes [22-25]. Reliable evidence was generated recently through a large scale clinical trial conducted by Donny et al. [21] which evaluated the effects of stratified levels of nicotine and confirmed the above listed outcomes.

## Challenges and Outcomes

Worldwide implementation of nicotine reduction policy is not a simple task. It goes with numerous challenges, a few of which will be discussed here. Replacing standard cigarettes with RNCs will cause a greater reduction in the yield of nicotine, causing withdrawal manifestations that might discourage the user to switch back to conventional cigarettes. This requires gradual withdrawal of cigarettes which can be done by introducing cigarettes with stratified levels of nicotine. But recent evidences oppose this recommendation. An experienced long-term smoker does it simple to recognize any modulation in the quantity of nicotine he acquires using his subjective judgment skills and his response in this regard is unpredictable. After recognizing the reduction in the routine quantity of nicotine he acquires, he can start using other forms of combustible tobacco which will make no much difference in the existing scenario. A person who is already addicted to smoking might compensate the reduction in nicotine gain due to RNCs might compensate it by increasing the frequency of smoking [26] that drags his health into a still more deleterious state owing to increased exposure to harmful toxicants and carcinogens. As a compensatory measure, smokers might changeover or supplement other forms of commercially available nicotine-containing products such as e-pipes, e-cigars, etc. This can be considered much harmless when

compared to combustible tobacco products though the risk of development of tolerance is still in place. Moreover, no evidence is available regarding the influence of using both RNCs and electronic nicotine delivery systems (ENDS) on the health of a smoker. Illegal issues comprising illegal alterations in the quantity of nicotine incorporated in RNCs by manufacturers and illegal trade of high nicotine cigarettes in black markets will pose serious threat to the integrity of nicotine reduction policy.

## Foresight

Nicotine reduction policy is still rudimentary and requires further evidence-based amendments, rules and efforts for achieving the desired outcome. Efforts initiated upon the following strategies can be expected to be fruitful on the long run.

Gradual withdrawal of smoking requires introduction of cigarettes containing stratified amount of nicotine. Scientific councils and bodies should invest efforts in describing and evaluating the dosage of nicotine to be incorporated in stratified cigarettes to ensure tapering of smoking.

Care should be taken that any nicotine reduction policy should incorporate all forms of combustible tobacco. This will avoid compensatory harming of smokers' health by using other forms of combustible tobacco.

Efforts aimed at characterizing the effect of dual usage i.e., usage of RNCs with ENDS and usage of RNCs with non-combustible tobacco products should be promoted. These efforts may aid in modifying existing principles or formulating new principles on promotion or withdrawal of the supplement.

Development of microcomponents that can be coupled with nicotine using innovative chemical compounding or nanosciences which ensure safe nicotine delivery to the pulmonary air sacs for absorption into the complex pulmonary vascular system. Introduction of such compounds will further reduce the use of combustible tobacco products.

Adaptation, formulation and legislation of nicotine reduction policy by all nations especially by nations which report higher incidence of smoking-associated morbidities should be emphasized by the national scientific councils and advisory boards. This can be achieved by providing policy makers with convincing evidences on the health benefits of nicotine reduction.

Integration of health education services regarding nicotine reduction policy and introduction of RNCs with existing community-based health care interventions and involvement of private sectors like active NGOs in promotion of such facilities can accelerate the desired outcome.

Gradual withdrawal of conventional cigarettes and other forms of combustible tobacco products from the market can make a big difference on the long run.

Strict surveillance either by forming new legislative bodies or incorporating it under the responsibility of existing bodies

that work on promotion of health can yield fruitful outcomes when projected in time.

## Conclusion

Effective functioning of nicotine reduction policy calls for a greater degree of co-operation among scientific councils, legislative bodies, cigarette industries, community-level health workers, family of the smokers and smokers indeed. Being rudimentary, nicotine reduction policy needs new reforms amendments to accelerate the progression towards desired objectives. However, a well-built spirit of co-ordination among all the above sectors can make it possible.

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