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Leveraging Adjuvants for Improved Nicotine Vaccines

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Tobacco dependence is the most common form of drug abuse with an estimated seventy million adult cigarette smokers. Smoking is associated with over half a million deaths per year in the United States alone. Indeed, cigarette smoking remains the leading preventable cause of death in the United States. Additionally, approximately 38,000 deaths each year are caused by exposure to secondhand smoke. Lung cancer is the leading cause of cancer death among both men and women in the United States, with 90 percent of lung cancer deaths among men and approximately 80 percent of lung cancer deaths among women attributed to smoking. Smoking also increases the risk of many other types of cancer, including cancers of the throat, mouth, pancreas, kidney, bladder, and cervix. People who smoke are up to six times more likely to suffer a heart attack than nonsmokers, and the risk increases with the number of cigarettes smoked. Smoking also causes most cases of chronic obstructive lung disease, which includes bronchitis and emphysema. In 2007, approximately 19.8 percent of U.S. adults were cigarette smokers. Twenty-three percent of high school students and 8 percent of middle school students in this country are current cigarette smokers. Thus, the treatment of tobacco dependence continues to be a major public health priority.

What are some of the challenges associated with quitting smoking? Quitting smoking may cause short-term problems, especially for those who have smoked a large number of cigarettes for a long period of time. People who quit smoking are likely to feel depressed, anxious, irritable, and restless, and may have difficulty sleeping or concentrating. Furthermore, increased appetite is a common problem after quitting smoking, and studies show that people who quit smoking increase their food intake. Although most smokers gain less than 10 pounds, for some people the weight gain can be troublesome. Many people find that nicotine replacement products and other medicines may relieve these problems. However, these replacement products have been shown to be less than successful. We believe new therapeutics must be investigated if we are to win the war on smoking. Nicotine is considered the main chemical component in tobacco that is key for engendering cigarette use and dependence. Although it is clear that other components in cigarettes can play a role in the tobacco dependence, the primary role of nicotine has broad empirical support providing a strong rationale for targeting its effects in the development of tobacco dependence. When a smoker takes a "puff" from a cigarette, nicotine reaches the brain in about 10 to 20 seconds. This then causes a chemical, dopamine, to be released in the brain. Dopamine provides a feeling of pleasure. An alternative for assistance in smoking cessation is presented in our research proposal. An approach for the treatment of drug addiction that we pioneered in the early 1990's was the enlistment of a vaccine, and thus the immune system, to treat cocaine addiction. The simplicity of this tactic was founded on the premise that brain physiology would not be directly perturbed by additional chemical substances and that we would take advantage of the principle means by which the body uses to defend against foreign invaders. We termed this approach immunopharmacotherapy. The goals of our work are succinct and focused to the following: we will prepare nicotine vaccines that can block the effects imposed by cigarette smoking; in essence with the "drug" nicotine unable to reach the pleasure centers of the brain we will make inroads to assist people to quit smoking.