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Nicotine Addiction Treatment Summary

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ABSTRACT

Nicotine addiction is a leading cause of preventable illness and death worldwide. This review summarizes current treatment options, focusing on both behavioral and pharmacological methods used in Poland and internationally. Effective strategies include nicotine replacement therapy (NRT), medications like cytisine, varenicline, and bupropion, as well as structured psychotherapy. Combining medical and psychological approaches significantly improves cessation outcomes and reduces the global burden of tobacco use.

Introduction

Tobacco use remains a major global health issue, contributing to millions of deaths annually. Nicotine's addictive properties make quitting challenging despite widespread awareness of its risks. Effective treatment requires a comprehensive approach, combining behavioral support and pharmacotherapy. This paper reviews current methods of nicotine addiction treatment, with an emphasis on practices in Poland and globally.

Aim of the Study

This study aims to present a clear overview of evidence-based nicotine addiction treatments, with a focus on therapies available in Poland. It evaluates the effectiveness of both behavioral and pharmacological interventions to support healthcare professionals in smoking cessation efforts.

Materials and Methods

A literature review was conducted using PubMed and Google Scholar. The study includes international and Polish guidelines, scientific articles, and clinical data related to nicotine addiction therapy. Sources span behavioral interventions, NRT, and pharmacological treatments like cytisine, varenicline, and bupropion.

Conclusion

Nicotine dependence is treatable through a combination of behavioral and pharmacological methods. In Poland, comprehensive treatment programs and modern pharmacotherapy are available and effective. Increasing access to these resources is essential to reducing smoking rates and improving public health.

Keywords

Nicotine addiction, smoking cessation, NRT, behavioral therapy, cytisine, varenicline, bupropion, pharmacotherapy, Poland.

The tobacco epidemic is without a doubt one of the biggest public health threats - according to WHO it is a cause of over 8 million diseases a year around the world [1] and kills up to half of its users who don't quit [2]. Nicotine contained in tobacco is a significant risk factor for respiratory and cardiovascular disorders, moreover contributes to the development of over 20 types of cancers [3]. It is estimated that as of today there are 1,3 billion tobacco users globally, but more than 60% of them want to quit [4].

In Poland, access to nicotine addiction treatment is integrated into the healthcare system. Services are available through primary healthcare clinics, psychiatric practices within addiction treatment centers, and specialized anti-smoking facilities. These include support through the national Tobacco-Related Disease Prevention Program, in place since 2005, which offers medical consultations, psychological interventions, and telephone-based cessation support via the Smoking Cessation Helpline [5].

A key milestone in treatment standardization occurred on May 31, 2022, when the Polish Lipidological Society, in collaboration with WHO Poland, issued the Guidelines for Nicotine Addiction Treatment. These guidelines outline evidence-based approaches to managing tobacco dependence, combining international standards with national public health priorities [6]. Current treatment modalities employed in Poland and globally encompass behavioral therapy, patient self-regulation techniques, group therapy, nicotine replacement therapies (e.g., gums, tablets, patches), and non-nicotine pharmacological agents. Importantly, these interventions address both the physiological and psychological dimensions of addiction. Their effectiveness is particularly notable in oncology—for instance, in patients with laryngeal cancer, combining cessation with radical treatment can result in cure rates as high as 95% [7].

Psychotherapy

Psychotherapy serves as a cornerstone in non-pharmacological smoking cessation strategies, encompassing both individual and group behavioral therapies administered by qualified professionals specializing in tobacco addiction treatment. These interventions aim to modify maladaptive behaviors, address psychological triggers, and equip individuals with coping mechanisms to manage withdrawal symptoms and prevent relapse.

Group therapy, in particular, fosters a structured, empathetic environment in which participants can exchange experiences, build solidarity, and collaboratively develop techniques for navigating daily challenges without resorting to tobacco use. Core behavioral modalities include positive reinforcement and aversive conditioning, wherein negative associations are deliberately formed. The latter may involve rapid smoking to elicit nausea or

the use of silver nitrate preparations to induce an unpleasant taste when smoking, thereby reducing the appeal of tobacco consumption [8].

The role of behavioral support is especially salient in the context of oncology care. Structured psychotherapeutic modalities such as cognitive-behavioral therapy (CBT) have demonstrated efficacy in addressing both emotional distress and nicotine dependence. In such cases, the therapeutic alliance is paramount: healthcare providers must adopt a compassionate, non-judgmental stance, foregrounding not only the risks of continued smoking but also the psychosocial and physiological benefits of cessation. Empowering patients through empathetic dialogue fosters agency and resilience during the course of treatment.

In Poland, a significant advancement in addiction treatment was marked by the Ministry of Health's regulation on March 30, 2022, which introduced addiction psychotherapy as a recognized healthcare specialization. This regulation established a structured training program that includes modules on harm reduction therapy for nicotine addiction, thereby enhancing the professional framework for addressing tobacco dependence [9].

Pharmacotherapy – Nicotine Replacement Therapy (NRT)

Nicotine exerts its pharmacological effects by binding to nicotinic acetylcholine receptors in the central and peripheral nervous systems, leading to receptor desensitization and upregulation, which collectively contribute to the development and reinforcement of nicotine dependence. Current pharmacotherapeutic strategies for nicotine addiction center on two primary mechanisms: first, the administration of purified nicotine to alleviate withdrawal symptoms and reduce exposure to the harmful constituents of tobacco smoke; and second, the blockade of nicotinic receptors to prevent nicotine from exerting its reinforcing effects.

Nicotine Replacement Therapy (NRT) aims to sustain a low yet pharmacologically active level of nicotine in the body, thereby partially stimulating nicotinic receptors to diminish withdrawal symptoms and cravings. NRT constitutes a first-line intervention in smoking cessation programs and is available in multiple formulations, all of which have demonstrated efficacy in promoting abstinence from tobacco use.

Nicotine Transdermal Systems

Nicotine transdermal systems (NTS), commonly known as nicotine patches, are a widely used form of nicotine replacement therapy (NRT). These patches provide a controlled release of nicotine through the skin, helping to reduce withdrawal symptoms and cravings associated with smoking cessation. By delivering nicotine steadily throughout the day, transdermal systems help maintain stable nicotine levels in the bloodstream, reducing the urge to smoke. This steady absorption mimics the background nicotine levels typically experienced by smokers, without the harmful toxins found in cigarettes. Patches are available in different

strengths, allowing for gradual dose reduction over time to wean individuals off nicotine dependence.

Are the NTS an effective therapy? Clinical studies have demonstrated that nicotine patches significantly increase the chances of quitting smoking compared to placebo.[10] When combined with behavioral support or other pharmacological treatments, such as nicotine gum or lozenges, their effectiveness further improves. The success rates of NTS depend on factors such as adherence to the recommended regimen, the level of nicotine dependence, and the use of additional support mechanisms.

Patches are typically applied once daily to clean, dry, and hairless skin, often on the upper torso or arm. Treatment generally commences with a higher-dose patch, followed by stepwise reduction over 8 to 12 weeks, depending on the user's degree of dependence and clinical response. While generally well tolerated, nicotine patches may elicit local dermal reactions, sleep disturbances, dizziness, or vivid dreams. These adverse effects can often be mitigated through site rotation, dose adjustment, or removal of the patch prior to sleep. Adherence to usage instructions and individualized consultation with healthcare professionals are essential to optimize therapeutic success.

Nicotine Gum

Nicotine gum is one of the most widely used forms of NRT, offering a convenient and effective way to help individuals quit smoking. It is designed to provide controlled doses of nicotine to reduce withdrawal symptoms and cravings associated with smoking cessation. Available in various strengths, typically 2 mg and 4 mg, nicotine gum is an over-the-counter medication in many countries, including Poland and the United States.The gum delivers nicotine via the oral mucosa, leading to a slower and more controlled systemic absorption compared to inhaled tobacco, thereby reducing the acute nicotine peaks associated with cigarette smoking.

When used correctly and combined with behavioral therapy, nicotine gum has been found to double the success rate of long-term smoking cessation. The effectiveness of nicotine gum depends on adherence to recommended usage guidelines, including proper dosing and duration of therapy, which typically lasts up to 12 weeks with gradual dose reduction. [11]

While nicotine gum is generally safe, it can cause mild side effects such as hiccups, mouth irritation, jaw discomfort, and nausea. Improper use or overconsumption may result in symptoms of nicotine overdose, including dizziness and tachycardia. Individuals with cardiovascular comorbidities, particularly uncontrolled hypertension or ischemic heart disease, should use nicotine gum under medical supervision [12].

Nicotine Lozenges

Nicotine lozenges represent another effective and discreet NRT option that delivers nicotine through the oral mucosa. As the lozenge dissolves slowly in the mouth, nicotine is absorbed

gradually, mimicking the effects of nicotine gum while avoiding the need for chewing. Available in 2 mg and 4 mg strengths, lozenge selection is generally based on the time to first cigarette: individuals who smoke within 30 minutes of waking are advised to begin with 4 mg, while those who wait longer may use the 2 mg form.

Lozenges should be allowed to dissolve fully in the mouth and not chewed or swallowed, to ensure optimal absorption. The standard protocol involves using the lozenges regularly and gradually reducing usage over a 12-week period [11]. Clinical studies confirm the efficacy of nicotine lozenges in enhancing smoking cessation rates compared to placebo [13]. Their discrete use and portability make them especially advantageous in environments where smoking or vaping is prohibited.

While effective, lozenges may cause localized adverse effects such as mouth and throat irritation, hiccups, nausea, and gastroesophageal discomfort [12]. Nonetheless, their safety profile and ease of use make them a valuable component of multi-modal cessation strategies, particularly when combined with behavioral interventions [12].

Sublingual Nicotine Tablets

Sublingual nicotine tablets contain either 2 mg or 4 mg of nicotine, which is absorbed through the oral mucosa. These small tablets offer a discreet method to alleviate withdrawal symptoms associated with smoking cessation. When placed under the tongue, the tablet dissolves over approximately 20–30 minutes, during which eating or drinking should be avoided [14]. The recommended dosage ranges from 8 to 12 tablets per day. Individuals who do not experience smoking cessation with the 2 mg tablet should transition to the 4 mg dose. Treatment typically lasts for at least 12 weeks after quitting smoking. Initially, users should take one tablet every 1–2 hours, with a gradual reduction in frequency until reaching a maintenance dose of 1–2 tablets per day. If complete smoking cessation is not achieved, tablets may be used to reduce cigarette consumption as part of a harm reduction approach [14]. Common side effects include oral and throat irritation, headaches, dizziness, nausea, heartburn, dry mouth, and a sensation of warmth in the mouth. Less commonly, patients may experience palpitations or transient atrial fibrillation. Careful monitoring is advised in patients with cardiovascular conditions or a history of arrhythmias [15].

Nicotine Inhalers

Nicotine inhalers are designed to resemble cigarettes in both size and shape. Each inhaler consists of a plastic mouthpiece and a replaceable nicotine cartridge. This design is particularly beneficial for individuals who are behaviorally dependent on smoking, as it mimics the ritualistic aspect of smoking [16]. Unlike conventional smoking, where nicotine is absorbed through the lungs, nicotine inhalers deliver nicotine through oral mucosal absorption. This method provides a similar hand-to-mouth experience without the harmful toxins

associated with cigarette smoke. Each cartridge releases approximately 10 mg of nicotine, of which about 4 mg is absorbed systemically, comparable to a 2 mg nicotine gum [17].

Nicotine inhaler use should be tailored to individual needs, with an initial dosage that reflects smoking habits and nicotine dependence. The typical recommendation is to use at least six cartridges per day, up to a maximum of 16 cartridges per day in the first 6–12 weeks. Gradual tapering is advised after this period to facilitate cessation [17]. Unlike traditional smoking, nicotine from inhalers is absorbed through the oral mucosa rather than the pulmonary system, avoiding exposure to combustion-related toxins. The recommended regimen typically includes six to sixteen cartridges per day for the initial 6–12 weeks, followed by a gradual tapering. Dosage can be adjusted based on individual smoking patterns [17]. For example, a person smoking 1–10 cigarettes per day may use 6 cartridges, while those smoking more than 30 may require up to 16 [18].

Each cartridge supports approximately 20 minutes of active use and remains viable for up to 24 hours after opening. Users may choose between shallow (pipe-like) or deep (cigarette-like) inhalation techniques, with both methods offering comparable nicotine absorption provided that inhaled air volume remains constant [18]. Environmental factors, such as temperature, may influence nicotine release and inhalation duration. Contraindications include hypersensitivity to menthol, nicotine allergy, recent myocardial infarction, unstable angina, severe arrhythmias, and acute cerebrovascular events. Mild irritation of the throat or cough may occur but often diminishes with continued use [19].

Electronic Cigarettes

Electronic cigarettes (e-cigarettes), also referred to as electronic nicotine delivery systems (ENDS), are not classified as nicotine replacement therapy (NRT). However, they represent a novel method for nicotine inhalation. The primary distinctions between e-cigarettes and traditional nicotine inhalers are the heating mechanism and the composition of the inhaled substance. Unlike medically approved nicotine inhalers, e-cigarettes are not regulated as pharmaceutical or medical devices, and their production varies by region [20].

E-cigarettes are similar in shape and size to conventional cigarettes. The mouthpiece contains a replaceable cartridge filled with a liquid that typically includes nicotine (0.4% to 3.6%), propylene glycol, glycerin, and, in some cases, flavoring agents. When a user inhales, an internal microprocessor detects airflow and activates an atomizer, which heats the liquid to 150–180°C, generating an aerosol that is then inhaled. Propylene glycol enables the liquid to form a vapor resembling cigarette smoke, while glycerin enhances this effect. Some models feature an LED light at the tip that simulates the glowing ember of a cigarette [20].

Research conducted by Bullen et al. at the Clinical Trials Research Unit and Auckland Tobacco Control Research Centre (University of Auckland, New Zealand) found that e-

cigarettes are well tolerated and elicit fewer negative sensations compared to traditional nicotine inhalers. Additionally, e-cigarettes deliver nicotine more rapidly (19.4 minutes) than inhalers (30 minutes), although still more slowly than conventional cigarettes (14.3 minutes) [21].

Further research is needed to determine the long-term effects of e-cigarette use as a smoking cessation aid. While some studies suggest that e-cigarettes may help reduce cigarette consumption, concerns remain about their potential to reinforce nicotine addiction and their impact on respiratory health. Regulatory bodies such as the FDA and WHO continue to assess the safety and effectiveness of e-cigarettes compared to traditional NRT options [22].

Nicotine-Free Pharmacotherapy

In cases where psychotherapy and nicotine replacement therapy (NRT) do not yield the expected results in the treatment of nicotine addiction, medications that affect the central nervous system and alleviate withdrawal symptoms are introduced. These medications may work by stimulating receptors, blocking receptors, or simultaneously stimulating and blocking receptors, which helps alleviate withdrawal symptoms and reduce the rewarding effects associated with smoking. In the treatment of nicotine addiction, antidepressants are used to increase dopamine levels in the brain, and substances that inhibit the activity of neurons responsible for withdrawal symptoms. All medications with the aforementioned mechanisms should only be used under medical supervision and after prior consultation.

Cytisine

Cytisine is an alkaloid found naturally in the seeds of *Cytisus laburnum*. Cytisine acts by affecting nicotine receptors (N-cholinergic receptors), leading to their stimulation and subsequent paralysis of the ganglia of the autonomic nervous system. Like lobeline, cytisine stimulates respiratory function and promotes the release of adrenaline from the adrenal medulla, leading to increased blood pressure. Due to competition with nicotine for N-cholinergic receptors, cytisine may assist in gradually reducing the body's dependence on nicotine and in the process of quitting smoking, minimizing withdrawal symptoms. However, caution is required when using cytisine-containing products, as overdose can lead to nausea, vomiting, tachycardia, elevated blood pressure, and respiratory disturbances. In such cases, management should follow the procedures used for nicotine poisoning, such as gastric lavage and the administration of sedatives or blood pressure-lowering agents. The cytisine treatment protocol involves gradually reducing the number of cigarettes smoked and taking one tablet every 2 hours (up to 6 tablets per day) for the first three days. Then, the number of tablets is reduced every few days until smoking cessation is achieved on the fifth day of treatment.

From days 21 to 25, one to two tablets should be taken daily. The treatment can be repeated after 4-5 months. Patients with peptic ulcer disease should exercise caution, and absolute contraindications to cytisine therapy include atherosclerosis, pheochromocytoma, severe cardiovascular insufficiency, and advanced hypertension. During the therapy, alcohol consumption and the use of anti-tuberculosis drugs should be avoided, [23], [24].

Varenicline

Varenicline is a partial agonist-antagonist of nicotine receptors. Its action involves stimulating receptors, which alleviates withdrawal symptoms, and blocking the same receptors, which prevents the rewarding effects associated with dopamine release. Varenicline binds to α4β2-type N-acetylcholine receptors. Although this drug is relatively new, there is still insufficient clinical experience regarding its use in patients with various diseases, so caution is necessary. The most common side effects include insomnia, headaches, nausea, vomiting, constipation, diarrhea, taste disturbances, and indigestion. Monitoring for interactions with theophylline, warfarin, and avoiding the concurrent use of cimetidine in patients with severe renal dysfunction is also essential. Varenicline therapy should begin 1-2 weeks before the planned smoking cessation date and last for 12 weeks. If smoking cessation is achieved within this period, a further 12-week treatment may be considered at a dose of 1 mg twice daily. If side effects are intolerable, the dose can be reduced to 0.5 mg twice daily [25], [26].

Bupropion

Bupropion is considered to be one of the first non-nicotine based drug for smoking cessation and belonging to the class of selective neuronal reuptake inhibitors of catecholamines (norepinephrine and dopamine). Inhibiting of the dopamine reuptake, is considered the key action of this drug in supporting the treatment of addiction [27]. It has only a minor effect on serotonin reuptake. The mechanism of action in the treatment of nicotine dependence is related to the stimulation of neuronal pathways (noradrenergic and dopaminergic mechanisms) [27]. Bupropion is also a broad-spectrum antagonist of nicotinic acetylcholine receptors (nAChRs) causing attenuation of effects of nicotine on these receptors [27]. In addition, blocking the pharmacological effects of nicotine, has been shown to inhibit nicotine-induced vesicular release of dopamine [27]. The relevant effects of this drug are demonstrated by the active metabolites of bupropion such as hydroxybupropion, threohydrobupropion and erythrobupropion [27]. Bupropion has shown efficacy in smoking cessation in a number of clinical trials, and is estimated to have helped about one in five smokers quit [27]. Bupropion is absorbed through the intestines, and its metabolism takes place mainly in the liver and it is excreted through the kidneys. Its half-life is about 21 hours [27]. The effect of bupropion is manifested by a reduction in withdrawal symptoms after quitting smoking [28]. Treatment should be started during the period of active smoking, two weeks before quitting [28, 29]. The starting dose is 150 mg per day in the morning for 3 consecutive days, with 150 mg in the morning and 150 mg in the afternoon (with at least an 8-hour break between doses) starting

on day 4. The maximum single dose is 150 mg, and the maximum daily dose is 300 mg [28, 29]. Unfortunately, bupropion has many side effects [27]. Up to half of patients taking bupropion experience side effects, mainly insomnia and dry mouth, which are closely associated with nicotine withdrawal syndrome [27]. Bupropion is rarely associated with seizures, but caution should be exercised when prescribing concomitant medications that may lower the seizure threshold. In addition, bupropion is a potent enzyme inhibitor and may increase plasma concentrations of certain drugs, including antidepressants and antiarrhythmics [27]. In addition, the following may occur: tremor, gastrointestinal disturbance, impaired concentration, depression, chest pain, asthenia, tachycardia, hypertension, flushing, confusion, anorexia, tinnitus, visual disturbance, palpitations, hallucinations, abnormal dreams, parasthaesia, irritability, incoordination, urinary retention, urinary frequency, Stevens Johnson syndrome, blood glucose disturbance, and exacerbation of psoriasis [27]. Unfortunately, to date, it has not been proven whether this drug has any long-term effect in preventing relapse into addiction after treatment is stopped [27]. The amount of research on bupropion continues to increase, but clinically proven information such as the optimal duration of treatment with this drug, the potential role of combination therapy with NRT and psychological interventions, and establishing its efficacy in smokers with other psychiatric disorders is still needed [28].

Clonidine

Clonidine is a second-line treatment for nicotinism. It affects α2 autoreceptors and reduces the activity of noradrenergic neurons associated with nicotine dependence symptoms [30]. The drug is particularly effective in female smokers and in patients with hypertension, as it also uses its hypotensive effects [30]. However, clonidine is recommended as a second-line therapy due to its significant side effects and the required physician monitoring [30]. While taking clonidine, patients may experience sedation, drowsiness, fatigue and dry mouth [31]. In addition, it has been shown that this drug can also cause postural hypotension, which may cause light headedness or dizziness [31]. NRT is thought to be better for general use because, unlike clonidine, they rarely cause adverse side effects that interfere with normal daily life [30]. Moreover, although the use of bupropion can be associated with serious side effects such as seizures, it is generally better tolerated than clonidine [30]. To avoid compensatory receptor changes, treatment should be gradually increased and the drug slowly discontinued [30]. Typically, treatment lasts from 3 to 10 weeks or until nicotine abstinence symptoms have disappeared [30]. Clonidine in the treatment of nicotinism definitely needs more research to confirm its efficacy, also taking into account comorbidities. There are studies reporting that major depression recurrent type comorbidity with nicotinism significantly reduces the effectiveness of clonidine treatment [32].

Additional Considerations and Recommendations

Recent evidence underscores the need for an integrated approach to nicotine addiction treatment. Without intervention, long-term cessation rates remain low—only around 5–10%

of smokers are able to quit unassisted [12]. However, interventions such as nicotine e-cigarettes, varenicline, and cytisine have demonstrated increased success rates of approximately 14%, while combination nicotine replacement therapy (NRT) can reach up to 12%, outperforming single NRT products or bupropion, which yield quit rates closer to 7–9% [16][19][21]. For instance, the EAGLES trial reported 6-month abstinence rates of 22% for varenicline, 16% for bupropion, and 9% for placebo [16].

Despite these promising outcomes, relapse remains a significant challenge, particularly within the first three months after cessation [12]. On average, six serious quit attempts are required to achieve lasting abstinence, and long-term follow-up is crucial to reducing relapse rates [12]. Accordingly, treatment guidelines recommend sustained support beyond the initial quitting phase.

Cost-effectiveness is another essential factor. A standard 12-week course of varenicline has been shown to cost approximately $4,600 per quality-adjusted life year (QALY)—well below widely accepted health economic thresholds [17]. Cytisine, used widely in Central and Eastern Europe, offers comparable efficacy to varenicline at a fraction of the cost, making it particularly valuable in lower-resource settings [24].

Complementary to clinical treatment are evidence-based prevention strategies. The WHO's MPOWER framework advocates for a multi-faceted public health approach, including increased tobacco taxes, smoke-free laws, public education, advertising bans, and accessible cessation services [20][22]. Countries that fully implement these measures have shown marked declines in smoking prevalence, reinforcing the importance of policy-driven intervention alongside individual treatment.

Ultimately, the most effective strategy to reduce tobacco use combines evidence-based medical treatment, long-term patient follow-up, and robust public health infrastructure.

Summary of Smoking Cessation Treatments

The table below summarizes key smoking cessation methods, comparing quit rates, cost-effectiveness, and notable considerations based on recent evidence.

Treatment Method	6–12 Month Quit Rate	Cost-effectiveness	Notes
No aid / cold turkey	5–7%	Very low	High relapse rate
NRT (single)	~9%	High	First-line treatment
NRT (combination)	~12%	High	More effective than single

Cytisine	~13–14%	Very high	Low cost, limited global access
Varenicline	~14–22%	High	Very effective, recent recalls in some regions
Bupropion	~7–9%	Moderate	Useful for dual addiction (e.g. depression)
E-cigarettes (nicotine)	~14%	Variable	Long-term safety under study

Table 1. Summary of evidence-based smoking cessation methods, including estimated 6–12 month quit rates, cost-effectiveness, and key considerations. Data compiled from systematic reviews, clinical trials, and WHO reports [12, 16, 17, 19, 20, 21, 22, 24].

1. Patient consent:

Not applicable

2. Data were obtained from

PubMed and Google Scholar.

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