trials, although supporting the efficacy of nicotine polacrilex gum, were flawed by statistical problems, inadequate nicotine delivery, concurrent smoking and use of gum by subjects, and lack of validation or inappropriate controls (Malcolm et al. 1980; Puska, Bjorkqvist, Koskela 1979; Raw et al. 1980). In the placebo-controlled clinical trials, nicotine polacrilex gum significantly increased success rates for as long as 6 months in some studies (Fagerström 1982a; Schneider et al. 1983) and 1 year in others (Hjalmarson 1984; Jarvis et al. 1982; Table 1). It should be noted, however, that in most of these studies, other treatment procedures (e.g., group therapy) were applied in addition to either nicotine polacrilex gum or placebo.

Subsequent efficacy trials proceeded without regard to control of dose or scheduled use of nicotine polacrilex gum. The trials may be divided into those conducted in clinic settings versus physician or dispensary trials. Different trials compared active gum with a placebo, active gum with no-gum conditions, or gum with other treatments (Fagerström 1988).

Hall and coworkers (1985) assessed nicotine polacrilex gum plus an intensive contact behavioral treatment (14 sessions over an 8-week period), nicotine polacrilex gum plus low-contact behavioral treatment (4 sessions over a 3-week period), and the intensive behavioral treatment alone. The combination of intensive behavioral treatment and nicotine polacrilex gum was significantly superior to the other interventions through 6-month followup. Differences were no longer significant at 1 year, however. In a subsequent study, Hall and colleagues (1987) assigned subjects to intensive behavioral or to low-contact smoking treatment and to 2-mg-nicotine gum or to placebo gum in a 2-by-2 factorial design. Results at 1-year followup indicated significant effects only for nicotine polacrilex gum. No differences were found between low-contact treatment and intensive behavioral intervention. In a study by Killen and colleagues (1984), the success rate of nicotine polacrilex gum combined with behavioral treatment at a 10.5-month followup was 50 percent as opposed to 23 percent for gum and 30 percent for behavioral treatment alone. However, these differences between treatment conditions were not significant.

Physician trials have resulted in lower overall success rates for all groups and some equivocal findings. These lower success rates may be attributable, at least in part, to a selection bias. Clinics may attract only a small proportion of smokers who are interested specifically in treatment. Physician trials sometimes have included all smoking patients regardless of their level of interest in quitting. The British Thoracic Society (1983) reported no differences among four conditions involving active nicotine polacrilex or placebo gum. However, this study included patients who were not actively seeking treatment and failed to instruct patients in the use of the preparation. Jamrozic and coworkers (1984), using patients who were

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motivated to quit, reported no differences between patients given nicotine polacrilex or placebo gum. In that study, only 70 percent of the subjects even tried the active nicotine polacrilex gum, and only one-half of the subjects used it regularly. In a dispensary study with nicotine polacrilex versus placebo gum, all individuals started gum but most stopped use within 3 to 5 days and failed (Schneider et al. 1983).

Differences in outcome comparing the clinic setting versus physician offices have been interpreted as indicating the requirement for support treatment with nicotine polacrilex gum. However, it is not clear whether support treatment per se is necessary or whether it serves to encourage sufficient use of the preparation. In fact, compliance with gum use instructions is often unsatisfactory in both clinic and physician office settings. In a large physician trial, Russell, Merriman, and colleagues (1983) reported that 47 percent of subjects given active nicotine polacrilex gum did not use it. However, use of nicotine polacrilex gum resulted in significantly higher success rates (8.8 percent) compared with no gum (4.0 percent) at 1 year, and when patients used a total of at least three boxes of nicotine polacrilex gum, success rates tripled to 24 percent without further intervention. It is unclear whether these substantially increased success rates are a function of gum use per se or simply a reflection of a greater overall commitment to treatment.

Followup may also prove to be important for a good outcome. Fagerström (1984) assigned subjects to either short or long followup and to either nicotine polacrilex gum or no-gum conditions. Short followup consisted of one physician appointment approximately 14 days after cessation. Long followup included two physician appointments (approximately 14 and 30 days after cessation), a telephone call (after about 7 days), and a personal letter inquiring about patients' smoking status (3 months after cessation). Results at 1-year followup indicated significant differences in favor of nicotine polacrilex gum over no gum. Initial effects were also found for long over short followup. However, these effects were no longer significant at 1-year followup. At this point 27 percent of the subjects assigned long followup and nicotine polacrilex gum were abstinent, compared with 22 percent of those receiving short followup and nicotine gum, 15 percent of those assigned long followup and no gum, and 3 percent of those receiving short followup and no gum. In a recent physician trial by Hughes and associates (1988), with minimal intervention and a followup visit, significant differences in favor of active gum over placebo gum were observed at 1 and 6 months, although the differences were no longer evident at 1 year.

The high long-term relapse rate observed in their own and other published reports led Hughes and coworkers (1988) to conclude that nicotine polacrilex gum in the physician setting is not more effective

than placebo. However, the issue may be a different one. In several studies, early significant effects reported at 1 month (Fee and Stewart 1982) and 6 months (Fagerström 1982a; Hall et al. 1985; Schneider et al. 1983) disappeared at 1 year although the trends continued to favor active nicotine polacrilex gum. Rather than being interpreted as a failure for nicotine polacrilex gum versus a placebo, this may mean that what is effective treatment for initial quitting (e.g., relief of withdrawal symptoms) is different from effective long-term relapse prevention.

Another variable which may affect outcome is duration of nicotine polacrilex gum use. It has been suggested that longer use will be more effective (Russell, Raw, Jarvis 1980; Wilhelmsen and Hjalmarson 1980), yet duration of use remains an untested and unresolved issue. The one prospective trial comparing 1- with 6-month use of nicotine polacrilex gum (Fagerström and Melin 1985) was flawed by differential clinical intervention for the 1-month group. Duration of use is also an issue in evaluating followup results. Followup is virtually never calculated as time since discontinuation of nicotine polacrilex gum. One-year followup results might be considerably shorter if the end of treatment were defined as the point at which nicotine polacrilex gum is no longer consumed. In fact, a significant proportion of subjects appear to persist in their use of this gum for at least 6 months to 1 year (Hughes 1988).

Dose and patient relationship. A few trials have used both 2- and 4-mg doses of nicotine polacrilex gum (Kornitzer et al. 1987; Toennesen et al., in press; Toennesen 1986). These studies have not found a direct effect of dose but report that dose interacts significantly with degree of nicotine dependence in the smokers tested. Four-milligram nicotine polacrilex gum improved success rates for more highly dependent smokers, whereas 2-mg nicotine polacrilex gum was superior in less-dependent smokers. The problem, once again, is that ad libitum dosing (thus uncontrolled dose-response testing) reduces the interpretability of the observed effects. Otherwise, the logic is reasonable: smokers who have a greater degree of dependence on nicotine may require treatment with higher doses than those required by less-dependent smokers.

With respect to the selection of subjects for treatment with nicotine polacrilex gum, Hall and colleagues (1985) reported a significant positive correlation between smokers with high pre-quit cotinine levels and abstinence with nicotine polacrilex gum. Jarvik and Schneider (1984) reported that individuals scoring high on the Fagerström Tolerance Scale had greater success with replacement. Other selection issues may be equally important. For example, Toennesen and coworkers (in press) reported a substantial difference in outcome at 1 year between healthy subjects (45 percent success) and those with chronic bronchitis (16.2 percent). Patient selection

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and variations in severity of nicotine dependence are expected to interact with success rates for any replacement therapy (Chapter IV).

Nasal Nicotine Solution

Russell, Jarvis, and colleagues (1983) have investigated nicotine replacement in the form of an NNS. NNS is a gel-like droplet of nicotine squeezed into the nose from a small vial. NNS was formulated to provide more rapid and efficient absorption of nicotine than is possible with use of nicotine in polacrilex gum (Russell 1986; Jarvis 1986).

Russell, Jarvis, and colleagues (1983) reported average peak plasma nicotine levels of 25.7 ng/mL in three male smokers for a single cigarette (1.4-mg machine-determined nicotine yield), 8.5 ng/mL for one piece of 2-mg gum, and 14.1 ng/mL for NNS (0.1 mL of a 2 percent aqueous solution of nicotine, 2 mg, at pH 5.0 without added buffer). Higher levels with hourly dosing of NNS versus nicotine polacrilex gum were also documented (West, Jarvis, Russell, Feyerabend 1984).

Only very preliminary data are available with respect to the clinical efficacy of NNS. Jarvis (1986) reported decreased craving and encouraging abstinence outcomes in a sample of 26 consecutive new attenders at the Maudsley Smokers Clinic (approximately two-thirds of the subjects achieved initial abstinence and one-third remained abstinent at 1-year followup). The faster absorption and higher plasma nicotine levels attained with NNS as opposed to nicotine polacrilex gum suggest that NNS may be more effective and better accepted by smokers as a replacement for cigarettes. However, subjects in the Jarvis study reported NNS to be somewhat embarrassing to use in the company of others.

Nicotine Transdermal Patch

Rose, Jarvik, and Rose (1984) initially suggested that a transdermal nicotine delivery system might be an effective route of administration. In a short-term (hours) laboratory trial, Rose and colleagues (1985) reported a decrease in craving and nicotine preference in subjects using a nicotine patch versus a placebo patch.

A transdermal delivery system could eliminate some of the compliance and chewing problems associated with nicotine polacrilex gum. Steady-state administration expected from such a system may be more effective in preventing withdrawal symptoms. While the patch does not allow for self-dosing in response to smoking urges, it could potentially be used in combination with the other rapidly absorbed forms of nicotine replacement. Transdermal delivery

systems have not yet been tested in clinical trials or in nonlaboratory settings.

Nicotine Aerosols

Devices have been marketed that provide for inhalation of nicotine without other components of tobacco. One such product was on the commercial market for approximately 18 months, but was removed by the FDA (Chapter IV). Because the nicotine vapor inhaler was devoid of tobacco (other than the tobacco constituent nicotine), it was deemed by the FDA to be a nicotine delivery system. Because nicotine is regarded as a drug with clinical application (namely to treat nicotine dependence), the FDA ruled that it could not be sold until it had been shown to be safe and effective in appropriate clinical trials.

Technical engineering problems have also been encountered. The shelf life of the unrefrigerated vapor inhaler was apparently limited to approximately 1 month. In addition, this device delivers little nicotine unless there is extraordinary effort on the part of the user (Sepkovic et al. 1986). Russell and associates (1987) reported negligible plasma nicotine levels when vapor inhalers were puffed at a regular rate for 10 min. When the nicotine vapor inhalers were puffed at the rate of 10 puffs/min and 4 of these inhalers were used in a 20-min period, plasma nicotine levels increased to 17.3 ng/mL, levels similar to those seen after cigarette smoking.

If nicotine aerosols can be improved, they may be of value to smokers for whom slow-release nicotine replacement preparations are inadequate to produce the desired effects of nicotine. Such aerosols would allow nicotine replacement with some replacement also of the oral, handling, and sensory reinforcements (Rose 1986) for individuals who need to be weaned more slowly. Whether these aerosols will be effective in smoking cessation treatment is unknown.

Comparisons of Preparations

All nicotine replacement products produce side effects. Nicotine polacrilex gum may produce mouth sores, gastric upset, and hiccups. NNS produces runny nose and irritation, whereas transdermal devices can result in skin irritation. Transdermal devices have the advantages of better patient compliance with treatment and steady-state drug levels, whereas NNS and nicotine polacrilex gum have the advantage of ad libitum access to replacement. Because triggers to smoke can appear at any time, the flexibility offered by the latter may be essential. Ultimately, a combination of preparations may be most useful to control symptoms as well as to allow instant responses to smoking urges. At this point, the replacement therapies in development must undergo testing for bioavailability, safety, and

toxicity as well as testing for dose-response effectiveness in relief of withdrawal and efficacy in treatment.

Dependence on Nicotine Replacement

West and Russell (1985) and Hughes and coworkers (1986) reported the appearance of withdrawal symptoms upon abrupt cessation of nicotine polacrilex gum. However, the authors have different interpretations of these findings. Hughes and coworkers (1986) consider this phenomenon as an indication that nicotine polacrilex gum produces physical dependence. West and Russell (1986) point out that any dependence on this gum is part of the continued dependence on nicotine that originated with smoking and is bound to transfer during weaning (Chapter IV).

A more complicated issue is that of continued compulsive long-term use. The definition of excessive long-term use cannot be resolved without studies to determine the length of treatment necessary and sufficient for successful intervention. No such studies are available in the current published literature. Hughes (1988) reports that many abstinent smokers are unable to discontinue nicotine polacrilex gum use (35 to 90 percent of abstinent smokers at 6 months and 13 to 38 percent at 1 year continued to use nicotine polacrilex gum despite advice to stop).

An important additional issue is whether it is possible to initiate and maintain physical dependence on nicotine with replacement products alone. Nicotine polacrilex has been used widely with no reported cases of such development. This would suggest that nicotine polacrilex gum, through a combination of regulatory, packaging, marketing, and physical characteristics, does not readily lend itself to such abuse. Systematic investigation of the dependence-producing potential of other replacement products is needed.

Other Pharmacologic Approaches

Nonspecific Pharmacotherapy—Symptomatic Treatment

As reviewed in Chapters III and IV, administration and withdrawal from nicotine produce a number of neurohormonal and other physiological effects. These effects, as well as those on receptors in the central nervous system, mediate the various actions of tobacco (Chapters IV and VI). Because several such effects are functional in the maintenance of cigarette smoking and in relapse, it is generally assumed that addressing such factors would enhance treatment programs (Pomerleau and Pomerleau 1984; Shumaker and Grunberg 1986). Such strategies are also an integral part of many interventions for drug addiction in general, as described in Chapter V.

Prevention of relapse to tobacco may be aided by specific intervention (pharmacologic or behavioral) for needs met by the use of

tobacco. The present summary will mainly address pharmacologic methods, excluding nicotine replacement, that have been either used or suggested as means to alleviate the effects of tobacco abstinence that are considered adverse by patients themselves. The categories of such adverse effects for which pharmacologic treatment intervention appears viable are derived from the effects of tobacco in the regulation of mood, weight, performance, and the prevention of specific withdrawal-related discomfort. In addition, the results of studies involving pharmacologic approaches to directly alter cigarette consumption will be summarized.

The emphasis in this Section is upon recent research. It should be noted that there is a long history of generally unsuccessful pharmacologic treatment of smokers (Gritz and Jarvik 1977; Jarvik and Gritz 1977). Experimentation with lobeline sulfate as a smoking substitute dates back to the early 1900s (Edmunds 1904). Lobeline appears to be no more effective than a placebo in facilitating abstinence (Schwartz 1987). Medications intended to reduce withdrawal symptoms (sedatives, tranquilizers, anticholinergics, sympathomimetics, and anticonvulsants) also have failed to improve outcome relative to placebos (Gritz and Jarvik 1977).

Treatment of Discomfort Associated with Tobacco Withdrawal

The signs and symptoms of tobacco withdrawal vary to some degree in nature and severity among individuals, as shown in Chapter IV (also Hughes and Hatsukami 1985). Because symptoms can be treated independently of their origin, symptomatic therapy approaches might be useful in alleviation of tobacco abstinence-associated discomfort. This approach was used in a study by Glassman and his colleagues (1984). In this study, alprazolam (1 mg orally) and clonidine (0.2 mg orally) were compared with a placebo for heavy cigarette smokers on days when they abstained from tobacco. The subjects were exposed to one of the medication conditions on each of 3 smoking abstinence study days, which were separated by at least 3 days of normal smoking. Alprazolam, a benzodiazepine tranquilizer, was included as a control because of the known sedative effects of clonidine. Both clonidine and alprazolam were more effective than the placebo in reducing anxiety, irritability, restlessness, and tension. Only clonidine, however, successfully reduced the craving for a cigarette. Because craving tended to increase during the day, the difference between clonidine and the other two conditions became more evident as the day progressed.

Glassman and colleagues (1988) reported a clinical intervention study with clonidine in a sample of 71 smokers who consumed at least 1 pack/day and who had made at least one previous unsuccessful quit attempt. Each smoker began taking one 50-μg tablet of clonidine (N = 33) or a matched placebo (N = 38) at least 3 days before

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a designated quit date. Dosage was increased by one tablet every day (or as tolerated) until subjects were taking four tablets by the quit date. Subjects were seen weekly for the next 4 weeks. After 4 weeks of treatment, clonidine was gradually withdrawn (50 µg every 3 days over an average of 12 days). Success rates both at the end of 4 weeks on clonidine or placebo and at followup 6 months after discontinuance of medication favored clonidine. At 6-month followup, 27 percent of the subjects receiving clonidine and 5 percent of those on placebos reported abstinence. An unexpected finding, however, was that clonidine appeared to be effective only for women; among male subjects, drug treatment did not significantly affect outcome.

Before any recommendation of clonidine as an adjunct to smoking cessation, potentially hazardous side effects must be weighed carefully. Clonidine has been extensively used in the treatment of hypertension. Abrupt cessation has sometimes led to severe hypertension and in rare instances to hypertensive encephalopathy and even death. Far more common is sedation, which could be dangerous if individuals use this drug while driving or operating dangerous machinery.

It is interesting to compare the utility of clonidine in the treatment of tobacco withdrawal with its utility in the treatment of opioid withdrawal (Chapter V). When assessed in a paradigm analogous to that described for tobacco abstinence, clonidine was as effective as morphine in reducing certain physiological signs of opioid withdrawal (Jasinski, Johnson, Kocher 1985). However, in the study by Jasinski and colleagues, clonidine did not reduce the self-reported "discomfort" as effectively as did morphine (measures of "desire to use narcotics" or narcotic-seeking behavior were not collected).

Treatment of Abstinence-Associated Mood Changes

As discussed in Chapter VI, nicotine may serve as a regulator of mood. This observation suggests that for certain persons, selective use of minor tranquilizers, antidepressants, or even psychomotor stimulants may be beneficial in preventing relapse. Again, issues of possible side effects and drug dependence must be considered before such an approach would be recommended in clinical practice.

Laboratory studies with human subjects have shown that stressful situations lead to increased smoking and that smoking may reduce smoker distress responses to stressful stimuli and enhance reported mood (Gilbert 1979; Golding and Mangan 1982; Rose, Ananda, Jarvik 1983). Also, relapse to cigarette smoking often occurs in response to stressful situations (Gunn 1983a; Ockene et al. 1982; Shiffman 1982; Marlatt and Gordon 1980; Lichtenstein, Glasgow, Abrams 1986). There have been no clinical trials in which the targeted use of more specific anxiolytics (e.g., benzodiazepines) has been evaluated in the maintenance of tobacco abstinence. The only study involving a

benzodiazepine was that of Glassman and associates (1984), who compared alprazolam with clonidine during a brief abstinence.

Nicotine Blockade Therapy

Whereas the goal of both replacement therapies and symptomatic treatments is to relieve withdrawal by mimicking critical effects of the drug from which the person is attempting to abstain, blockade therapy provides no such potentially rewarding or therapeutic effect. Rather, the goal of blockade therapy is to reduce or eliminate any rewarding pharmacologic effects should the person attempt to resume drug use. The prototypical blockade therapy is that used in the treatment of opioid dependence (Jaffe 1985). The long-acting opiate antagonist naltrexone can be given on a daily basis to opioid abusers to prevent them from experiencing the reinforcing effects of opioid agonists. Unfortunately, only about 5 percent of opioid-abusing patients are willing to comply with such a therapeutic regimen. Success in naltrexone treatment is correlated with the following characteristics: the patient is highly motivated, well adjusted in society, and has a steady job (Greenstein et al. 1983).

Relapse to former levels of cigarette smoking begins with the first few cigarettes which are smoked. If smoking levels do not progress beyond these few cigarettes, the incident is generally referred to as a "slip" (Shumaker and Grunberg 1986). Slips can lead to relapse because they provide the stimuli which were important in maintenance of the smoking behavior in the first place. Because nicotine itself is the source of many of the effects which are sought by cigarette smokers (Chapters II, IV, and VI), blocking the effects of nicotine should assist in the prevention of relapse. As described in Chapter V, such an approach is effective in preventing relapse to opioid use if the morphine-blocking drug (opioid antagonist) is taken (see also Greenstein et al. 1983).

Pharmacologic antagonists of nicotine, the administration of which could diminish a variety of responses to nicotine, have been known for several decades (Domino 1979). Those antagonists which act both centrally and peripherally (mecamylamine), but not those which only act peripherally (e.g., pentolinium and hexamethonium), appear to have functional effects on patterns of cigarette smoking in humans. Central antagonists also alter the behavioral effects of nicotine (including self-administration) in animals (Henningfield 1984; Stolerman 1986).

Preliminary data suggest the possibility that mecamylamine could be used as an antagonist to block the nicotine-mediated reinforcing consequences of cigarette smoking. The following findings are of particular relevance: (1) Mecamylamine pretreatment produces a dose-related blockade of the ability of animals and humans to discriminate nicotine from a placebo (mecamylamine is injected in

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animals and administered orally to humans) (Rosecrans and Meltzer 1981; Stolerman 1986; Henningfield et al. 1982), (2) mecamylamine pretreatment diminishes the reinforcing efficacy of intravenous nicotine administration in animals (Goldberg et al. 1983) and possibly in humans (Henningfield and Goldberg 1983), (3) mecamylamine pretreatment increases the preference for high-nicotine-delivering cigarette smoke (apparently by reducing its nicotinic effects) when subjects are tested with a device which blends smoke from high- and low-nicotine-delivering cigarettes (Rose, Sampson, Henningfield 1985), and (4) mecamylamine pretreatment increases various measures of cigarette smoking behavior and tobacco smoke intake when subjects are allowed to freely smoke (Stolerman et al. 1973; Nemeth-Coslett et al. 1986; Pomerleau, Pomerleau, Majchrzak 1987). Results from the study by Pomerleau and colleagues also suggested that the toxicity of nicotine exposure was reduced substantially by mecamylamine pretreatment.

In one clinical trial, Tennant, Tarver, and Rawson (1984) attempted to determine if mecamylamine could be used safely and efficaciously to treat cigarette smoking. Mecamylamine was given to heavy cigarette smokers in conjunction with counseling to quit smoking. Mecamylamine reduced tobacco craving in 13 of 14 subjects, and half of the subjects quit smoking within 2 weeks of initiation of mecamylamine treatment. The mean dose of mecamylamine at the time of quitting was 26.7 mg/day. Mecamylamine was not used to maintain abstinence as naltrexone is used for opioid dependence. Rather, it was used as an aid to initial quitting. In theory, because mecamylamine blocks the effects of nicotine, it should precipitate withdrawal and, therefore, would not be indicated for acute cessation. Despite this theoretical problem and the lack of placebo controls in the trial, these data suggest that nicotine blockade warrants further exploration.

The main obstacles to this treatment approach are the ganglionic blocking and antihypertensive effects of mecamylamine, the strong likelihood of considerable difficulty in obtaining adequate therapeutic compliance, and conditioned and non-nicotine-mediated reinforcers of tobacco use which may be powerful enough to sustain urges to smoke even when they are no longer associated with the pharmacologic effects of nicotine.

Deterrent Therapy

Deterrent therapy is based on the premise that pretreatment with an agent may transform smoking from a rewarding to an aversive behavior. Disulfiram treatment of alcoholism provides the pharmacologic analogy for this form of treatment (Chapter V).

With regard to cigarette smoking, the main analog to disulfiram treatment is the administration of silver acetate. Variants on this

method have been marketed for over-the-counter purchase for a number of years. The physiological basis of the approach is that sulfide salts are produced when silver acetate contacts the sulfides in tobacco smoke. The resulting silver sulfides are extremely distasteful for most people. The approach is not specific to nicotine intake, but rather to sulfide-containing smoke. Most recently, a gum preparation of silver acetate has been tested as a means to maintain abstinence from tobacco smoking (Malcolm, Currey, Mitchell, Keil 1986). The gum must be chewed upon awakening and then repeatedly during the day to assist in abstinence, because a single piece of gum is apparently only effective for a few hours. Although many over-the-counter silver acetate smoking remedies are available, their efficacy never has been validated scientifically.

Conclusions

In evaluating experimental and clinical trials involving nicotine polacrilex gum, it should be noted that actual nicotine intake may have been significantly less than had been intended or reported if there were not systematic procedures to standardize administration (Benowitz et al. 1986; Nemeth-Coslett et al. 1987; Chapters II and IV). Criteria for the determination of successful outcome in nicotine replacement studies are ambiguous. It is unclear how to interpret results in which nicotine replacement is significantly more effective than a placebo at 6 months, but not at 1 year (Fagerström 1982a; Schneider et al. 1983). Nicotine replacement may be effective in facilitating cessation and in developing early resistance to relapse (withdrawal symptoms, reported cravings for tobacco; Harackiewicz et al. 1987; Hjalmarson 1984; Hughes et al. 1984; West et al. 1984a), but may not have residual effects that prevent relapse (Chapter IV).

Overall, the outcomes of experimental and clinical trials of nicotine polacrilex gum are modestly encouraging, at least for short-term results. In the vast majority of these trials, however, nicotine polacrilex gum has been combined with additional treatment components.

The combination of low doses (with the 2-mg gum), poorly defined criteria for self-administration, compliance problems, and variable absorption of nicotine from polacrilex gum is part of the rationale for the development of alternative replacement strategies (Pomerleau et al. 1988). At the same time, additional work with nicotine polacrilex gum is continuing to address compliance and dosage problems. Availability of a 4-mg preparation might be useful for highly tobacco-dependent individuals. Little clinical application of other replacement strategies has been reported to date. Alternative forms of nicotine replacement should help to determine the relative roles of nicotine and sensory/ritual phenomena in compulsive tobacco use

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and improve the therapeutic effectiveness of nicotine replacement strategies.

The precedent for the use of pharmacologically based therapies to help establish and maintain abstinence from tobacco products is the use of similar kinds of techniques to treat other substance-use disorders. It should be noted, however, that some variant on each of the pharmacologic treatment approaches described in this review has been applied to other forms of substance abuse, but with limited success. Individual differences are very important. Some smokers appear to be much more dependent upon the pharmacologic properties of nicotine (both withdrawal relief and positive mood enhancement) than are others (Chapters IV and VI). The efficacy of pharmacologic intervention may be limited by the extent to which the substance-seeking behavior and the desired effects have become functionally autonomous from the drug itself. This problem is not unique to tobacco (Henningfield and Brown 1987). It is known that treating opiate users involves considerably more than blocking physiological withdrawal; an entire lifestyle may require change (Grabowski and Hall 1985; Bigelow, Stitzer, Liebson 1986).

Behavioral Treatment Strategies

Pharmacologic strategies may have a useful role in alleviating withdrawal symptoms or in blocking gratification typically derived from smoking, but these agents do not address conditioned cues and reinforcers or the social context of tobacco use. Effective treatment of the dependent smoker requires behavioral intervention in addition to any pharmacologic agents that might be administered. Research generally indicates that pharmacologic intervention is most effective when applied in a context that includes social support and skills training (Fagerström 1988; Hall, Ginsberg, Jones 1986). Furthermore, behavioral intervention may also be useful in increasing adherence to pharmacologic treatment procedures (Epstein and Cluss 1982).

Behavioral interventions have been applied in treating dependent smokers for many years. This Section will provide an overview of that research, with an emphasis upon current approaches. The review of the literature is necessarily both selective and limited. A major review in a previous Report of the Surgeon General (US DHEW 1979) listed 452 references. Schwartz (1987) prepared a comprehensive monograph reviewing smoking cessation in the United States and Canada. Although he focused upon the period 1978–85, he included 883 references. As noted above, some topics are deliberately either excluded or minimized because they have received extensive coverage in recent Reports. These topics include physician intervention, community trials, and worksite smoking programs. Excellent reviews of other approaches such as self-help

and use of the mass media are available elsewhere (Flay 1985a; Schwartz 1987). These methods are not considered in the current Report. It is recognized, however, that self-help, mass media, physician, worksite, and community interventions can have critical impact in overall public health initiatives designed to address the smoking problem. The vast majority of smokers who have quit to date have done so in the absence of formal treatment.

Schwartz (1987) compiled a summary table listing quit rates of 416 smoking cessation trials by method. This Table is reprinted here as Table 2. The Table provides overall outcomes for a number of different intervention techniques. As discussed by Schwartz, however, considerable caution is needed in interpreting these data. Methodology in the various studies is uneven. Many studies suffered from deficient followup procedures and from an exclusive reliance upon subject self-reports. Noteworthy perhaps is the difference in outcome between nicotine polacrilex gum trials using gum alone and those combining nicotine polacrilex gum with behavioral intervention. Reported outcomes for programs including multiple components (40 percent 1-year median abstinence) are encouraging. The relative success achieved by cardiac patients indicates that treatments delivered at the time of a health crisis may be especially effective.

Aversion Procedures

Aversive strategies have involved pairing smoking with unpleasant imagery scripts (covert sensitization), with electric shock, or with the unpleasant effects produced by smoking itself (directed smoking procedures). All these techniques are designed, at least in part, to create aversions to cigarette smoke—affective reactions characterized by distaste, disgust, fear, or displeasure. The presumption is that such reactions will reduce the incentive to smoke. A wide variety of directed smoking strategies have been used. These include satiation, rapid smoking, and focused smoking.

Satiation

In this procedure cigarette consumption is dramatically increased prior to attempted abstinence. Smokers typically are asked to at least double their smoking intake. Despite promising early results (60 percent abstinence at 4-month followup, N=40; Resnick 1968), satiation procedures by themselves do not produce effects greater than those of attention/placebo interventions (Claiborn, Lewis, Humble 1972; Lando 1975; Sushinsky 1972).

In its most recent application, satiation has been used in multicomponent programs (Best, Owen, Trentadue 1978; Lando 1977), in which its contribution to outcomes has been difficult to ascertain.

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TABLE 2.—Summary of followup quit rates (percentages) of 416 smoking cessation trials, by method, reported 1959–1985

Intervention method	Quit rate (at least 6-mo followup)				Quit rate (at least 1-yr followup)			
	Number of trials	Range	Median	Percent 33%	Number of trials	Range	Median	Percent 33%
Self-help	11	0–33	17	18	7	12–33	18	14
Educational	7	13–50	36	71	12	15–55	25	25
Five-day plan	4	11–23	15	0	14	16–40	26	21
Group[1]	15	0–54	24	20	31	5–71	28	39
Medication	7	0–47	18	14	12	6–50	18.5	17
Nicotine chewing gum	3	17–33	23	33	9	8–38	11	11
Nicotine chewing gum and behavioral treatment or therapy	3	23–50	35	67	11	12–49	29	36
Hypnosis, individual	11	0–60	25	36	8	13–68	19.5	38
Hypnosis, group	10	8–68	34	50	2	14–88	—	50
Acupuncture	7	5–61	18	29	6	8–32	27	0
Physician advice or counseling	3	5–12	5	0	12	3–13	6	0
Physician intervention more than counseling	3	23–40	29	33	10	13–38	22.5	20
Physician intervention, pulmonary patients	10	10–51	24	20	6	25–76	31.5	50

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TABLE 2.—Continued

Intervention method	Quit rate (at least 6-mo followup)				Quit rate (at least 1-yr followup)			
	Number of trials	Range	Median	Percent 33%	Number of trials	Range	Median	Percent 33%
Physician intervention, cardiac patients	5	21–69	44	80	16	11–73	43	63
Risk factor	—	—	—	—	7	12–46	31	43
Rapid smoking	12	7–62	25.5	33	6	6–40	21	17
Rapid smoking and other procedures	21	8–67	38	57	10	7–52	30.5	50
Satiation smoking[2]	11	14–76	38	64	12	18–63	34.5	58
Regular-paced aversive smoking[2]	13	0–56	29	31	3	20–39	26	33
Nicotine fading[2]	7	26–46	27	29	16	7–46	25	44
Contingency contracting[2]	9	25–76	46	89	4	14–38	27	25
Multiple programs[2]	13	18–52	32	38	17	6–76	40	65

NOTE: Percent 33% is percentage of trials with quit rates of at least 33 percent. Median not calculated for fewer than three trials. Caution: Quit rates provided suggest overall trends. Most quit rates were based on self-reports. Some quit rates were recalculated to include all subjects, but most quit rates were based on reports by investigators. Some quit rates omitted subjects who did not complete treatment or persons who did not reply to followups. Definitions of followup may vary between trials.

[1] Three group trials had 5-month followups.

[2] Other procedures may have been used, and some trials may be included in more than one method.

SOURCE: Schwartz (1987).

Lando (1982) conducted a dismantling strategy in which he attempted to isolate the specific contributions of individual treatment components to gauge the relative contribution of satiation to a multicomponent treatment. By itself satiation produced dismal results (15 percent 1-year abstinence, N=13). When satiation has been incorporated into multicomponent treatments that include maintenance, 1-year followup results have approached 50 percent (Lando and McGovern 1985). Lando (1986) has suggested that satiation represents a plausible preparation strategy for quitting. However, there is little evidence that satiation results in an aversion to cigarettes (Baker et al. 1984; Tiffany, Martin, Baker 1986).

Rapid Smoking

Rapid smoking typically requires smokers to inhale cigarette smoke every 6 sec until they reach the point that they would become ill if they were to continue. Whereas early interventions varied the number of rapid smoking sessions to fit client needs (Lichtenstein et al. 1973), more recent applications have tended to use standardized regimens involving six to eight sessions (Erickson et al. 1983; Hall, Rugg et al. 1984).

Multicomponent programs including rapid smoking generally yield good outcomes, but when used by itself, rapid smoking continues to yield variable results. Raw and Russell (1980) found that rapid smoking, cue exposure, and group/therapist support all produced poor outcomes when used separately (only 1 of 16 (6 percent) rapid smoking subjects was abstinent at 1 year). Similarly discouraging results have been reported by Poole, Sanson-Fisher, and German (1981) and by Corty and McFall (1984). In contrast, Hall and associates have consistently obtained high rates of success (50 percent 6-month abstinence levels) using rapid smoking alone, both with normal volunteers (Hall, Sachs, Hall 1979) and medical patients (Hall, Sachs et al. 1984).

Hall, Sachs, and colleagues (1984) observed that, in contrast to many recent applications of rapid smoking, their procedure was similar to that of early, successful rapid-smoking interventions (Lichtenstein et al. 1973). Their procedure involved (a) a single client format, (b) a warm client-therapist relationship, (c) positive expectations of success, (d) individualized scheduling, (e) office rather than home treatment, and (f) warnings against smoking outside of therapy sessions (Danaher 1977). However, Hall's research involved either elaborate physiological/medical assessment (Hall, Sachs, Hall 1979) or the use of medical patients as subjects (Hall, Sachs et al. 1984). Either of the latter two factors could have enhanced the effectiveness of rapid smoking. At this point, the weight of evidence suggests that rapid smoking by itself can have a substantial immediate impact on cessation (Poole, Sanson-Fisher, German 1981).

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The long-term effects of rapid smoking do not appear to be sufficient by themselves to prevent relapse. Hall's results suggest that rapid-smoking effectiveness is greatly influenced by auxiliary treatment elements such as a warm interpersonal atmosphere, positive expectations, and admonitions regarding smoking.

Multicomponent programs involving rapid smoking have generally obtained reasonably high long-term cessation rates, i.e., 40 percent abstinence at 6 to 12 months posttreatment (Brandon, Zelman, Baker, in press; Erickson et al. 1983; Hall, Rugg et al. 1984; Tiffany, Martin, Baker 1986). The relative success of multicomponent programs comprising rapid smoking has been noted by earlier reviewers (Lichtenstein 1982; Pechacek 1979). Considerable research has been conducted to characterize the nature of the processes subserving rapid-smoking effectiveness. One approach to this problem is to determine whether rapid smoking results in a conditioned aversive response. In this regard, researchers have demonstrated that after rapid smoking, individuals show a conditioned tachycardia to cigarettes. The magnitude of this tachycardiac response is increased when the aversive smoking procedure produces intense gastrointestinal discomfort. The magnitude of this response is positively related to relapse latency—the greater the tachycardiac response, the longer smokers take to relapse (Erickson et al. 1983; Tiffany, Martin, Baker 1986). The similarity of these results to those found with chemical aversion treatments of alcoholism (Baker, Cannon et al. 1984; Cannon et al. 1986) suggests that part of the success of rapid smoking may be due to taste aversion learning. Thus, some aversion indices may constitute rare examples of therapy process measures that are predictive of treatment success. Previous attempts to assess aversion acquisition may have yielded inconsistent findings because the investigators attempted to relate clinical outcomes to unconditioned stimulus magnitude (e.g., number of cigarettes smoked in aversion sessions) or to unconditioned response magnitude (rapid-smoking-induced malaise) rather than to conditioned response magnitude (e.g., the cardiac response elicited by the taste of cigarettes; Glasgow et al. 1981; Norton and Barske 1977; Merbaum, Avimier, Goldberg 1979; Russell, Epstein, Dickson 1983).

Reduced-Aversion Techniques

Some investigators have compared rapid smoking and alternative low-aversion treatments for their abilities to enhance the effectiveness of a behavioral counseling or self-management treatment. Focused smoking, in which the person smokes for a sustained period but at a slow or normal rate, and rapid puffing, in which a person smokes rapidly but does not inhale, often are used as comparison conditions in order to permit assessment of specific effects of aversion (Danaher et al. 1980; Erickson et al. 1983; Hall, Rugg et al.

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1984). While these treatments are unpleasant, they differ from rapid smoking in that they do not elicit the dysphoria produced by rapid smoking and they are less risky (Erickson et al. 1983; Glasgow et al. 1981; Tiffany, Martin, Baker 1986). Most research suggests that these alternative treatments produce long-term outcomes that are quite similar to, or just moderately lower than, those produced by rapid smoking (Danaher et al. 1980; Erickson et al. 1983; Hall, Rugg et al. 1984; Powell and McCann 1981; Tiffany, Martin, Baker 1986). Moreover, research shows that these treatments do not produce the conditioned cardiac response produced by rapid smoking. Thus, these treatments probably produce their effects through routes other than aversion conditioning. That low-aversion treatments produce effects comparable to those of rapid smoking indicates that aversion acquisition per se is not essential to successful treatment outcome. Other active components might be habituation to cigarettes, withdrawal reduction due to nicotine intake, and removal of control over smoking.

There has been concern about the possible effects of rapid smoking on the cardiovascular system. Horan and coworkers (1977) reported that rapid smoking produced elevations in blood pressure, heart rate, and carboxyhemoglobin levels as well as electrocardiographic abnormalities. Lichtenstein and Glasgow (1977) provided recommendations for screening and subject selection. Recent research suggests that the rapid-smoking procedure is fairly safe when used with healthy adults screened for such conditions as cardiovascular disease, diabetes, chronic obstructive pulmonary disease, seizure disorder, and hypertension (Hall, Sachs, Hall 1979; Sachs et al. 1979). Rapid smoking has been used safely even with medical populations (cardiac and pulmonary patients) in the presence of close medical supervision (Hall, Sachs et al. 1984). However, given that in the context of multicomponent programs focused smoking and rapid puffing yield results roughly comparable to those of rapid smoking, there appears to be little need to use rapid smoking with at-risk populations (e.g., cardiac and pulmonary patients).

Aversion therapies for smoking are constrained by some of the same limitations that apply to the use of aversion therapies for other forms of substance seeking. The aversions are rarely permanent, and the aversive conditioning is less effective in attempts to establish an aversion to substances that have had a history of repeated use.

Relaxation Training

Progressive relaxation is a popular treatment for anxiety-related disorders (Haugen, Dixon, Dickel 1958). As noted previously, smokers often report smoking to cope with anxiety and stress (Chapter VI). A large proportion of smoking relapses occurs during negative emotional states (Brandon, Tiffany, Baker 1986; Marlatt and Gordon

1980; Shiffman 1982). In theory, relaxation training should provide smokers with a means other than smoking for coping with stress and negative emotion. In a nontreatment experiment, relaxation was found to reduce levels of smoking in the face of external stress (Dobbs, Strickler, Maxwell 1981). Today, relaxation is rarely used as a sole treatment and is instead incorporated into multicomponent behavioral skills training programs (Erickson et al. 1983; Hall, Rugg et al. 1984; Hall et al. 1985; O'Connor and Stravynski 1982; Tiffany, Martin, Baker 1986); it may best be conceptualized as one of many possible stress-coping skills taught to clients. Poole, Sanson-Fisher, and German (1981) found that relaxation training did not improve the outcome of a rapid-smoking treatment. Seventy-five subjects were assigned to rapid smoking only; rapid smoking and relaxation training; rapid smoking, relaxation, and contingency contracting; or contingent rapid smoking. In none of these conditions did 1-year abstinence exceed 25 percent.

Contingency Contracting

Operant conditioning techniques have been used in smoking treatments to reward clients for not smoking and/or to punish them for smoking. The usual procedure is to collect monetary deposits from clients early in treatment with periodic repayments contingent on client achievement of abstinence goals. Variations include having the client pledge to donate money to a disliked organization or individual for every cigarette smoked, or contracting for nonmonetary rewards and punishments based on smoking status (Lando 1977; Tiffany, Martin, Baker 1986).

The rationale behind contracting techniques is that they may bolster commitment to abstinence by providing contingent concrete rewards. Contracts are in effect until withdrawal has abated and the individual has had an opportunity to begin alternative, nonsmoking activities that may be rewarding. Murray and Hobbs (1981) compared the effects of self-reinforcement ($1 reward per day for meeting smoking reduction goal), self-punishment ($1 forfeited for not meeting goal), combined self-reward and self-punishment, and self-monitoring alone on cessation. They found that only self-punishment led to improved outcomes: 11 of 20 subjects (55 percent) in the two self-punishment conditions reached abstinence versus only 1 of 20 subjects (5 percent) in the other two conditions. Three years posttreatment, 25 percent of self-punishment subjects still reported abstinence. A small sample size and reliance on self-report, however, indicate the need for caution in interpreting these findings.

Paxton (1980) compared multicomponent behavioral interventions with and without contingency contracting (weekly repayments if subjects were abstinent) and found that contracting significantly improved maintenance of abstinence, but only during the 8 weeks of

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repayment. The end of the repayment schedule was followed by a sharp increase in relapse, and no subsequent difference between conditions was found. Overall abstinence at 6-month followup was 42 percent (25 of 60 subjects). Bowers, Winett, and Frederiksen (1987) also reported that extended contingency contracting delayed and decreased relapse, but they did not report abstinence rates. In a variation of the contracting procedure, Stitzer and Bigelow (1982) provided contingent payments of $5 to subjects for reducing carbon monoxide (CO) levels by 50 percent. Other attempts to increase the effectiveness of contingency contracts by manipulating the length, frequency, or amount of repayment or the frequency or size of deposits have largely been unsuccessful (Paxton 1981, 1983). Yet when it is part of a multicomponent program, contingency contracting appears to aid smoking cessation, at least over the short term.

Social Support

Attempts to capitalize on the effects of social support in treatment settings have met with mixed results. Hamilton and Bornstein (1979) developed a package that included a buddy system among group members and public announcements of client successes at quitting smoking. When this package was appended to a behavioral treatment program, it significantly increased abstinence rates compared with those for behavioral treatment alone both at treatment termination (55 vs. 27 percent) and during the 6 months of followup (27 vs. 9 percent; N = 12 in each of these two conditions). Etringer, Gregory, and Lando (1984) were able to improve smoking treatment outcome over the short term by emphasizing group cohesion. McIntyre-Kingsolver, Lichtenstein, and Mermelstein (1986) examined the effects of including clients' spouses in a smoking cessation program and teaching them how to be supportive of the clients' quitting attempts. At the end of treatment, 73 percent of clients in the spouse-training condition (total N = 33) were abstinent compared with only 48 percent in the condition without spouse training (total N = 31). This difference failed to reach significance, however, and diminished during followup. In another study, the outcome of a worksite-controlled smoking program was not affected by encouraging the social support of quitting coworkers (Malott et al. 1984). Lichtenstein, Glasgow, and Abrams (1986) summarized the results of five recent smoking cessation studies from three separate research programs (including McIntyre-Kingsolver, Lichtenstein, and Mermelstein (1986) and Malott and coworkers (1984)). Results generally indicated a positive relationship between measures of social support and treatment outcome. However, specific attempts to improve outcome by enhancing social support were uniformly unsuccessful.

Coping Skills Training

The value of coping skills training is suggested by evidence that smokers who use cognitive and/or behavioral coping responses when they are tempted to smoke reduce their likelihood of relapsing (Shiffman 1984a). The rationale for coping skills training of tobacco-dependent individuals is similar to that for such training in other forms of drug dependence. Alternative behavioral repertoires are developed that help to maintain comfortable, satisfactory functioning in the absence of drugs (Grabowski and Hall 1985; Jasinski and Henningfield 1987).

Examples of behavioral coping responses are distracting activities, escape from a stressor, relaxation, and physical activity. Cognitive coping may involve reminding oneself of the benefits of quitting or the negative consequences of smoking or simply telling oneself that smoking is not an option. Coping responses may be directed either at the smoking temptation/urge itself or at a precipitating stressor (Wills and Shiffman 1985).

Coping skills training is generally used in cessation research as part of multicomponent treatments (Brandon, Zelman, Baker, in press; Davis and Glaros 1986; Erickson et al. 1983; Hall, Rugg et al. 1984; Tiffany, Martin, Baker 1986). There is considerable variation, however, in the specific coping skills taught, in the strategies used to teach them, and in the names given to the treatment. Coping skills training appears to be effective in enhancing short-term outcomes, especially when combined with an aversive-smoking procedure. The long-term effects are less clear. This strategy has the potential for maintaining changes in smoker behavior because, presumably, once the skills are learned they may be used long after treatment has terminated. Nevertheless, in studies of maintenance of abstinence, results are mixed but generally negative (Glasgow and Lichtenstein 1987). These generally negative results may be a function of the diversity of treatments in which coping skills training is incorporated and of inadequate compliance with coping skills techniques. Adherence to coping skills instructions should be monitored more closely. Hall, Rugg, and colleagues (1984) found that the outcome differences between coping skills and discussion conditions were seen only in clients who smoked 20 or fewer cigarettes/day. It should be noted, however, that the outcome differences were computed for the number of cigarettes smoked per day and not for abstinence rates. Coping skills training may be most effective for certain subpopulations of smokers, such as less-dependent smokers (Hall, Rugg et al. 1984; Hall et al. 1985) who smoke primarily to cope with emotional stress (O'Connor and Stravynski 1982).

Stimulus Control

Stimulus control treatments are based on the assumption that a wide variety of environmental cues are associated with and serve to trigger smoking. A gradual reduction in smoking is accomplished by having clients progressively eliminate situations in which they smoke. In some cases, temporal, rather than situational, constraints upon smoking are instituted (e.g., the individual is permitted to smoke only on the half hour; Shapiro et al. 1971). In theory, a gradual reduction in smoking should result in a weaker, more manageable withdrawal syndrome.

Stimulus control procedures generally have produced weak, transient results when used alone and have been of questionable value when combined with other self-management techniques (Lando 1978). In more recent studies stimulus control has been used primarily as an element in multicomponent programs in which its effectiveness is difficult to ascertain (Best, Owen, Trentadue 1978; Colletti and Kopel 1979; Colletti, Supnick, Rizzo 1982; Karol and Richards 1981; Lando 1982; Rabkin et al. 1984).

Nicki, Remington, and MacDonald (1984) added a stimulus control component, which was designed to maximize client self-efficacy (Bandura 1977a), to a nicotine fading treatment. The combined treatment produced a 5-month abstinence rate of over 50 percent—twice that of the fading procedure alone. This level of success is unusual in research on stimulus control techniques and may be due to the self-efficacy manipulation rather than stimulus control per se. Also, as is true for so much of the smoking cessation literature, the small sample size used by Nicki and colleagues (fewer than 15 subjects per condition) requires that their results be interpreted cautiously.

Nicotine Fading

Nicotine fading (or brand switching) is based on a straightforward pharmacologic rationale. The intensity of the withdrawal syndrome, including both physical and psychological discomfort, can be reduced when the dependence-producing drug is gradually withdrawn (at least within certain limits). The procedure generally involves clients monitoring their nicotine consumption while switching (in three to six stages) to cigarette brands with progressively lower rated tar and nicotine deliveries, and then quitting completely. Chapter V supports this approach for drugs other than nicotine, and Chapter IV indicates this for nicotine as well. Foxx and Brown (1979) specifically assumed that nonabstinent nicotine fading subjects would benefit from continued smoking of low-tar and low-nicotine brands. In this study as well as in more recent nicotine fading studies, actual nicotine dose levels have been uncontrolled. At least some compensa-

tion is likely to be occurring, and nicotine reduction is undoubtedly significantly less pronounced than would be expected based upon machine-rated nicotine yields (McMorrow and Foxx 1983).

The treatment is based primarily on the idea that a gradual phaseout of smoking will minimize nicotine withdrawal symptoms. Nicotine fading can be viewed as an alternative to "cold turkey" quitting. However, to the extent that actual nicotine intake is not decreased or is decreased only minimally (Benowitz et al. 1983), this procedure might more appropriately be viewed as an additional preparation method for abrupt cessation. Furthermore, even when nicotine intake is decreased, thereby potentially reducing physiological dependence, postcessation cravings may be relatively unaffected. These continued cravings can be important in leading a newly abstinent individual to relapse. Lando and McGovern (1985) suggested that self-efficacy is increased by allowing clients to experience a series of successes (in reducing apparent nicotine intake) prior to quitting.

Nicotine fading should be distinguished from gradual reduction procedures in which smokers are instructed to progressively reduce their *number* of cigarettes. Procedures that emphasize progressive reductions in the number of cigarettes generally have been ineffective. Smokers typically report that the remaining cigarettes are more reinforcing. Furthermore, they often reach a "stuck point" beyond which additional reduction does not occur (Levinson et al. 1971).

A preliminary study by Foxx and Brown (1979) assessed a combination of nicotine fading and self-monitoring, nicotine fading alone, self-monitoring alone, and a modified American Cancer Society clinic program. Results at 18-month followup favored the combined nicotine fading and self-monitoring procedure (4 of 10 subjects or 40 percent were abstinent in this condition as opposed to no more than 10 percent of the subjects in any of the other three conditions). In several other studies, however, nicotine fading and self-monitoring produced less encouraging results (Beaver, Brown, Lichtenstein 1981; Brown et al. 1984; Foxx and Axelroth 1983; Nicki, Remington, MacDonald 1984). Lando and McGovern (1985) added a systematic behavioral maintenance procedure to nicotine fading with disappointing results (only 8 of 42 or 19 percent of subjects assigned this procedure were abstinent at 1-year followup). Lando (1987) obtained somewhat more positive findings for a treatment including nicotine fading and behavioral maintenance (35 percent abstinence at 12-month followup). However, nicotine fading subjects in this study were self-selected.

Results for nicotine fading in a field application (community rather than laboratory setting, lay rather than professional group leaders) have been encouraging (Lando 1986). Participants were

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given a choice of preparation strategy (satiation or nicotine fading). Approximately 80 percent elected the nicotine fading procedure. Outcomes for nicotine fading and satiation treatments were virtually identical. Survival analyses performed on field data for several hundred participants yielded a projected permanent smoking cessation rate of 32 percent. This projection was based on relapse curves from 3- to 5-year followup data. The choice of preparation strategy may be effective in enhancing both compliance and outcome.

There is also some evidence that nicotine fading may be useful in minimal intervention programs (Prue et al. 1983; Scott et al. 1986). A strategy similar to nicotine fading involves the use of progressively stronger graduated filters (Martin et al. 1981). Hymowitz, Lasser, and Safirstein (1982) found low abstinence rates with this method and also continued use of the filters by few nonabstinent smokers after the end of treatment. Improved outcomes might occur if filters are more systematically linked with multifaceted behavioral intervention.

Controlled Smoking

Controlled-smoking programs have been developed to treat smokers who are unable or unwilling to quit completely. This approach is based in part on the assumption that reduced smoking will be associated with diminished health risk. The prototypical program attempts to decrease risk by reducing cigarette consumption, altering smoking inhalation patterns (e.g., number of puffs, duration of puffs, CO intake), and minimizing the tar and nicotine content of cigarettes (e.g., nicotine fading). A key is to change multiple aspects of the smoking behavior to minimize compensation.

Stimulus control procedures may also be used (Glasgow, Klesges, Vasey 1983). In addition, clients may be taught coping skills to use as substitutes for smoking (Frederiksen 1979). Controlled-smoking treatments have produced reductions of at least 50 percent in the rated nicotine content of cigarettes smoked, with more modest reductions in reported numbers of cigarettes, the percentage of each cigarette smoked, and CO levels (Glasgow, Klesges, Vasey 1983; Godding and Glasgow 1985; Malott et al. 1984). In general, however, by the 6-month followup the magnitude of these initial reductions had diminished by approximately one-half.

Reservations about the controlled smoking approach center around the premise that smokers can substantially diminish their health risk without total abstention. The change in health risks associated with moderate reduction is not known. Moreover, there is experimental evidence that smokers regulate their bodily levels of nicotine through compensatory changes in smoking patterns (McMorrow and Foxx 1983). These compensatory changes are not complete, however. In a short-term (3- or 4-day) restriction study, a

reduction from an average of 37 cigarettes to 5 cigarettes/day was associated with a threefold increase in the intake of tobacco toxins per cigarette (Benowitz et al. 1986). Daily exposure to tar (estimated by mutagenic activity of the urine), nicotine, and CO declined only 50 percent from the baseline. Thus, consistent with the tendency to maintain intake of nicotine, the benefit of smoking fewer cigarettes was much less than expected. Benowitz and associates used laboratory volunteers rather than smokers who were specifically concerned with reducing their levels of tar and nicotine exposure.

The basic premise of the controlled-smoking approach—that it reduces health risk—remains to be validated. Some investigators have argued that until there is clear evidence that controlled smoking actually decreases health risks, it should not be recommended as a treatment option. Finally, there is concern both that smokers who otherwise may have been successful quitters will instead be attracted to controlled-smoking programs (at this point no data are available) and that these programs may provide an illusion of safety.

If reductions in smoke exposure can be maintained over time, if a reduction in health risk can be established, and if clients can be limited to those for whom the prospect of total abstinence is highly unlikely, then reduced smoking may be an alternative for recalcitrant smokers. Given all these conditions, controlled smoking does not appear likely to represent an effective treatment. However, possible risk reduction is not the only rationale for this type of approach. Controlled-smoking interventions may appeal to a larger cross-section of smokers, may have a positive impact upon self-efficacy, and may facilitate subsequent progress toward complete abstinence. Currently, empirical data on these points are lacking.

Multicomponent Programs

In recent years, multicomponent programs have been a principal target of research. This is due to both the relatively high level of clinical success produced by these programs (Lichtenstein 1986) and the recognition that smoking is multidetermined and relatively invulnerable to any single intervention (Schwartz 1987). The most effective multicomponent programs yield almost universal short-term abstinence and long-term abstinence rates that approach or exceed 50 percent (Brandon, Zelman, Baker, in press; Elliott and Denney 1978; Erickson et al. 1983; Hall, Rugg et al. 1984; Hall et al. 1985; Fagerström 1982b; Killen, Maccoby, Taylor 1984; Lando 1977; Tiffany, Martin, Baker 1986). These results are extremely encouraging and are rarely matched in trials that place exclusive emphasis upon pharmacologic intervention. Dismantling or constructive studies have shown that combinations of treatments generally outperform any single constituent treatment (Lando 1982).

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