
Assessing the reach of nicotine replacement therapy as a preventive public health measure

S. J. Bondy, PhD (1, 2); L. M. Diemert, MSc (2); J. C. Victor, MSc (2, 3); P. W. McDonald, PhD (2, 4); J. E. Cohen, PhD (1, 5)

This article has been peer reviewed.

Abstract

Introduction: Access to Nicotine Replacement Therapy (NRT) is a key public health intervention to reduce smoking. We assessed prevalence and correlates of use of NRT in Ontario, where NRT is available without prescription.

Methods: Participants were a representative sample of 2262 adult smokers in the Ontario Tobacco Survey cohort. Prospectively measured use of NRT over a 6-month period was reported in relation to smoking behaviour and history, attempts to quit, receipt of other supports for cessation supports and attitudes toward NRT.

Results: Overall, 11% of smokers used NRT over the six-month follow-up period. Prevalence was 25% among the 27% of smokers matching clinical guidelines that recommend NRT as a therapeutic option, and low among smokers not trying to quit.

Conclusion: With increasing accessibility of NRT, further surveillance and research are warranted to determine the impact of the reach and benefits of NRT, considering both the general and targeted smoking populations.

Keywords: smoking cessation, nicotine, evidence-based medicine, population surveillance

Introduction

In trials, nicotine replacement therapy (NRT) nearly doubles the likelihood of smoking cessation,¹⁻³ and so has the potential to reduce the disease burden from tobacco.⁴ Ensuring access to NRT is a required public health intervention for all nations, including Canada, that have signed the World Health Organization Framework Convention on Tobacco Control.^{5,6} Several jurisdictions (e.g. Canada, United States, United Kingdom, Australia and much of Europe) have made NRT available over the counter (OTC) without

prescription, while others propose to do the same.

Several authors have stated that measures to make NRT more available have increased its use,^{7,8} while others argue it is still underutilized.⁹⁻¹¹ However, few reports have described uptake of NRT at population levels where these have been made available OTC.⁹⁻¹⁴ The cost of NRT in Canada has been described both as a serious barrier¹⁵ and a contribution to inequality in access to effective cessation services.¹⁶ New publicly funded programs are being considered and enacted to increase access and use of this treat-

ment.¹⁷ The effectiveness of making NRT readily accessible should be evaluated with quantitative surveillance data on the size of the ideal target population as well as the proportion of the population reached by the intervention.¹⁸ These data have not been available in Canada.

This report addresses a gap in knowledge about the size of the population of smokers representing unmet need for increased use of NRT in Ontario. There is some controversy about whether all, or only specific, smokers should be encouraged to use NRT, and if medication is over-promoted to smokers who do not need it to quit.¹⁹ Therefore, we report on prevalence of NRT use in all smokers and those matching *de jure* guidelines applied in programs providing publicly funded NRT in Ontario²⁰ and elsewhere^{1,21} to quantify reach of this preventive measure in smokers representing targeted and not targeted users. Targeting criteria used are drawn from evidence-based reviews,²² including Cochrane reports^{1,2} and meta-analyses.^{23,24} These have concluded that there is strong evidence of the benefit of NRT for smokers who are both nicotine dependent (largely defined as consuming more than 10 to 15 cigarettes per day) and motivated to quit smoking.^{1,2} It is also recommended as a best practice that NRT users receive behavioural counselling, to achieve the additive effects of both interventions.^{1,2,22} Authors who advocate that NRT is suited to all smokers without restrictions^{8,11,25} argue that NRT may be effective without clinical help and that

Author references:

1. Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada
2. Ontario Tobacco Research Unit, University of Toronto, Toronto, Ontario, Canada
3. Institute for Clinical Evaluative Sciences, Toronto, Ontario, Canada
4. School of Public Health and Health Systems, University of Waterloo, Waterloo, Ontario, Canada
5. Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, United States

Correspondence: Susan Bondy, Dalla Lana School of Public Health, 6th Floor, 155 College Street, Toronto, ON M5T 3M7; Tel.: 416-978-0141; Fax: 416-978-8299; Email: Sue.Bondy@utoronto.ca

the number of cigarettes smoked per day may not correlate with the presence or severity of withdrawal symptoms targeted by the medication or the perceived need for the medication.^{11,24–33} Others have suggested there may be increased use of NRT for reasons other than quitting (e.g. to postpone quitting or to cut down but continue smoking), and they have indicated a need to monitor such potential trends.^{34–38}

Evidence for the effectiveness of NRT obtained OTC also remains weaker than for clinical settings. This will depend on who uses it and how it is used, which makes patterns of NRT use important to monitor.³⁹

Methods

Study population and design

We conducted our research in Ontario, Canada, a province with a comprehensive Tobacco Control Strategy. Throughout the study period, NRT patch and gum forms were readily available OTC at pharmacies, grocery stores and convenience stores. No other forms of NRT (e.g. inhaler, lozenge) were licensed for use, and NRT products were licensed for use in immediate cessation (i.e. not to be used while still smoking or quitting gradually). Most OTC products were paid for privately⁴⁰ and not covered in universal drug benefits.

Data were from the Ontario Tobacco Survey, a population-representative telephone survey and panel study of adult smokers^{41,42} recruited from July 2005 through June 2007 (for whom NRT attitude questions were included in the interview). Of 2681 smokers at baseline (daily or occasional smokers who had smoked within 30 days and 100 or more cigarettes in their lifetime), 2262 had complete baseline and first six-month follow-up data (84.4% retention). Approximately 12% of the sample were studied during a time when they could have been eligible for a free, government-funded NRT distribution program.²⁰

The University of Toronto and the University of Waterloo provided ethical

approval to conduct and use the data from the Ontario Tobacco Survey.

Study variables

Respondents were asked at baseline if they had ever or never previously used NRT. At the six-month interview, respondents were asked if they had used either the nicotine patch, gum or inhaler in the preceding six months “to quit or reduce smoking.” We defined six-month period prevalence of NRT use as any use of NRT during follow-up, regardless of history.

A number of smokers’ characteristics were considered as predictors of NRT use. These included factors known to be associated with quit attempts and measures derived to reflect practice guidelines around NRT (intention to quit; indications of nicotine dependence assessed through consumption level, typically 10 or more cigarettes; and receipt of behavioural supports for cessation). Six-month intention to quit smoking was obtained at baseline by asking, “Are you planning to quit smoking within the next month, within the next six months, sometime in the future, beyond six months, or are you not planning to quit?”^{43,44} A second derived covariate classified smokers as intending to quit if they intended to do so at baseline or reported having made a serious attempt to quit during the six-month follow-up. We calculated baseline consumption, time to first cigarette after waking⁴⁵ and Heaviness of Smoking Index.⁴⁶ Respondents were also asked if they considered themselves “very,” “somewhat” or “not at all” addicted to cigarettes.⁴⁷ Derived variables were also created for combinations of indications for NRT (defined as above).

Respondents’ confidence in their ability to quit was measured in four levels from “not at all” through “very confident” that they would succeed if they decided to quit completely in the next six months. Reports of having made a serious attempt to quit smoking, having received physician advice to quit smoking and using specific behavioural supports for cessation were obtained at baseline and follow-up. Attitudes toward pharmaceutical smoking cessation aids were determined at baseline

from agreement with the following statements: “stop-smoking medications make it easier to quit than trying to quit on your own”; “the cost of stop-smoking medications makes it difficult to use them”; “stop-smoking medications are hard to get”; and “the risk of side effects from stop-smoking medications concerns you.” The demographic characteristics considered were age, sex, education and rural residence.⁴⁸ Rural residence was considered as a potential indicator of relatively poorer access to NRT (due to any of the following: limited access to primary care providers who might recommend pharmacotherapy; larger distances to pharmacies that carry the product; or greater cost of the product in more remote locations).

Analyses

Use of NRT was reported in bivariate analyses and multivariable models relating NRT use to smoker demographics, baseline attitudes and smoking characteristics and to behaviours related to smoking cessation.

We obtained prevalence ratios for NRT use in relation to covariates using log-binomial regression models including all smokers. We restricted this to smokers who reported making a quit attempt during the six-month follow-up period. Regression diagnostics included assessment for non-linearity and multi-collinearity. All descriptive and multivariable analyses used sampling weights for the Ontario Tobacco Survey smoker cohort, which were calculated to produce estimates representative of the underlying population of Ontario adult recent smokers at baseline.⁴¹ Variance estimates took the sampling design into account and were obtained using the Taylor series expansion methods in Stata version 11 (StataCorp LP, College Station, TX, United States).⁴⁹

Results

Table 1 presents the characteristics of 2262 respondents with complete six-month follow-up data, along with six-month prevalence of NRT use by smoker characteristics, predictors of cessation and attitudes toward NRT. Similarity of the sample to the underlying population is

TABLE 1
Sample characteristics and prevalence of NRT use in six months by smoker characteristics, in a population-representative cohort of adult smokers, Ontario, Canada

Characteristic of smoker, history of smoking and cessation attempts, and attitudes	Unweighted sample size, n	Percent of sample, weighted		Prevalence of NRT use in 6 months, by group	
		%	%	%	95% CI
All smokers with complete 6 month data	2262	100	11.4	9.7–13.1	
Demographics					
Age, years	2261				
18–34	592	33.4	11.0	7.8–14.2	
35–54	1120	49.1	12.2	9.8–14.6	
55+	549	17.4	10.1	7.0–13.1	
Sex	2262				
Male	993	52.5	11.2	8.8–13.6	
Female	1269	47.5	11.7	9.4–13.9	
Education	2256				
Some post-secondary education	1178	54.5	13.0	10.6–15.3	
High school or less	1078	45.5	9.6	7.3–11.9	
Heaviness of smoking at baseline					
Number of cigarettes smoked/day ^a	2239				
0–9	695	36.4	9.3	6.3–12.2	
10–15	568	25.1	15.1	11.1–19.0	
16+	976	38.5	11.4	9.1–13.7	
Time from waking to first cigarette, minutes	2256				
≤ 30	1300	51.5	12.4	10.2–14.6	
> 30	956	48.5	10.2	7.7–12.8	
Quit attempts and intentions					
Lifetime number of quit attempts at baseline ^a	2260				
0	321	16.7	6.4	2.1–10.6	
1	514	23.2	8.2	5.3–11.0	
2	506	23.1	10.6	7.1–14.1	
≥ 3	919	37.0	16.3	13.3–19.3	
Intended to quit at baseline ^a	2230				
Yes	914	40.2	17.5	14.4–20.5	
No	1316	59.8	7.6	5.6–9.5	
Made a serious attempt to quit smoking during 6-month follow-up period (reported at follow-up) ^a	2098				
Yes	467	25.5	29.6	24.2–35.0	
No	1631	74.5	3.9	2.9–4.9	
Supports for cessation					
Lifetime history of NRT use ^a	2262				
Yes	1177	46.8	19.4	16.5–22.3	
No	1085	53.2	4.4	2.6–6.2	
Lifetime history of any behavioural supports (including physician advice) ^a	2262				
Yes	415	16.0	23.7	18.3–29.2	
No	1847	84.0	9.1	7.4–10.8	
Physician advice or use of behavioural supports during follow-up ^a	2235				
Either	959	43.6	17.2	14.1–20.4	
Neither	1276	56.4	7.3	5.6–9.0	

Continued on the following page

reported elsewhere.^{41,42} In this cohort 64% smoked 10 or more cigarettes per day at baseline, and 52% reported smoking within 30 minutes of waking. Most respondents (83%) had previously tried to quit, and 47% had previously used NRT. In our sample, 40% reported an intention to quit smoking at baseline, which is somewhat lower than estimates from other sources for the same population (55%–59%,^{50,51} although with different measures of intention⁵²).

Between baseline and the first six-month follow-up, 11% reported using NRT (see Table 1). Overall, 26% reported making a serious quit attempt and just 2% of all smokers in the sample were first-time users of NRT in this six-month period. There was no detectable difference in NRT use among the 12% of respondents whose time on study coincided with a free NRT give-away program in Ontario (data not shown).

Table 1 also shows the prevalence of NRT use by smoker characteristics. Use was significantly higher among respondents who intended to quit altogether (using various measures), who made serious attempts to quit, and who had received behavioural or professional supports for cessation. NRT use was also positively associated with baseline cigarette consumption, lifetime number of quit attempts, prior use of NRT, perceived addiction, confidence in ability to quit and attitudes toward stop-smoking medications. Age, sex or education were not associated with NRT use; nor was rural/urban residence in our analyses (data not shown).

Among smokers who intended to quit altogether (either a prior intention to quit at baseline or a reported serious attempt during the follow-up period) and a baseline consumption of 10 or more cigarettes per day (the 27% of smokers meeting explicit practice guidelines), 25% used NRT. The highest prevalence of NRT use observed by subgroup, at 31%, was among smokers who exactly met the most conservative eligibility criteria and also reported past or recent receipt of behavioural support (Table 1).

TABLE 1 (continued)
Sample characteristics and prevalence of NRT use in six months by smoker characteristics, in a population-representative cohort of adult smokers, Ontario, Canada

Characteristic of smoker, history of smoking and cessation attempts, and attitudes	Unweighted sample size, n	Percent of	Prevalence of NRT use	
		sample, weighted %	in 6 months, by group %	95% CI
Attitudes and beliefs				
Perceived addiction ^a	2253			
Not at all	151	8.8	2.1	0.0–6.0
Somewhat	603	30.7	8.1	5.2–10.9
Very	1499	60.5	14.5	12.2–16.8
Confident of quitting altogether in the next 6 months ^a	2248			
Not at all confident	310	12.0	9.9	5.4–14.4
Not very confident	654	27.3	12.3	9.1–15.4
Fairly confident	753	33.8	14.4	11.0–17.7
Very confident	531	26.8	7.9	5.2–10.5
Stop-smoking medications make it easier to quit than trying to quit on your own ^a	2261			
Agree	1656	70.5	13.6	11.4–15.8
Disagree	494	24.8	6.8	4.2–9.4
Don't know	111	4.8	3.3	0.8–5.7
The cost of stop-smoking medications makes it difficult to use them ^a	2261			
Agree	1334	55.5	12.0	9.8–14.2
Disagree	771	37.0	12.4	9.4–15.4
Don't know	156	7.5	2.4	0.4–4.5
Stop-smoking medications are hard to get ^a	2262			
Agree	344	14.2	7.6	4.2–11.1
Disagree	1776	79.5	12.6	10.6–14.6
Don't know	142	6.3	5.3	1.2–9.5
The risk of side effects from stop-smoking medications concerns you ^a	2262			
Agree	1309	56.1	10.5	8.4–12.6
Disagree	840	38.5	14.2	11.1–17.3
Don't know	113	5.5	1.5	0.1–3.0
Combination of indications for NRT use				
Intention or attempts to quit plus 10+ cigarettes/day ^a	2206			
Yes	658	26.6	25.3	21.0–29.6
No	1548	73.4	6.5	4.8–8.1
Intention or attempts to quit plus 10+ cigarettes/day plus any support ^a	2223			
Yes	349	13.9	30.8	24.4–37.3
No	1874	86.1	8.3	6.7–10.0
Intention or attempts to quit plus any supports ^a	2212			
Yes	526	23.6	26.8	21.7–32.0
No	1686	76.4	6.8	5.3–8.2

Source: Ontario Tobacco Survey, Ontario Tobacco Research Unit, July 2005 to December 2007 (Cohorts 1 to 4 with 6-month follow-up data).

Abbreviations: CI, confidence interval; NRT, nicotine replacement therapy.

^a Statistically significant bivariate association as indicated using global chi-square test for association.

Table 2 shows the characteristics and responses of the 301 individuals who used NRT in the six-month follow-up window. The large majority of NRT users had a history of quit attempts at the baseline interview (91%), expressed an intention to quit (as baseline intention to quit [61%] or attempt in follow-up [72%]), had used NRT at or before the baseline interview (80%) and reported themselves to be “very addicted” (77%). NRT users tended to believe stop-smoking medications made it easier to quit (84%) and that they were readily available (88%), but also that the cost made it difficult to use them (58%).

Table 3 shows the results of simultaneously adjusted log-binomial regression models predicting use of NRT during six-month follow-up among all smokers and among only those who reported attempting to quit during the same follow-up window. Demographic characteristics including age and education were not associated with NRT use after adjustment for smoking behaviour and history.

Among all smokers, history of quit attempts at baseline was unrelated to NRT use. However, respondents were over 6 times more likely to use NRT if they reported a serious attempt to quit smoking over the same six-month follow-up period; they were also more likely to use NRT if they had previously used it. Both a lifetime history of physician advice or behavioural supports for cessation and reported receipt of advice or support during the same follow-up window were statistically significant predictors of NRT use in the fully adjusted model. Consumption-based smoking behaviour measures at baseline (number of cigarettes per day and time to first cigarette) and confidence in ability to quit were not statistically significant after adjustment for history of quitting behaviour.

When the analysis of predictors of NRT use was restricted to smokers who made a serious attempt to quit in the six-month time frame, history of support for cessation was positively associated with NRT use. However, after adjustment for this, behavioural support reported during the same reference period was not related to

TABLE 2
Characteristics of a population-representative cohort of adult smokers who reported using NRT products “to quit or cut down” in a six-month follow-up period, Ontario, Canada

Characteristics of smokers (n = 301)		Weighted, %	95% confidence interval
Demographics			
Age, years	18–34	32.2	24.6–39.9
	35–54	52.4	44.7–60.1
	55+	15.4	10.7–20.0
Sex	Male	51.5	43.8–59.1
	Female	48.5	40.9–56.2
Education	Some post-secondary	61.8	54.2–69.3
	High school or less	38.2	30.7–45.8
Heaviness of smoking at baseline			
Number of cigarettes smoked/day	0–9	29.1	21.5–36.8
	10–15	32.8	25.4–40.2
	16+	38.1	31.1–45.2
Time from waking to first cigarette, minutes	≤ 30	56.4	48.5–64.2
	> 30	43.6	35.8–51.5
Quit attempts and intentions			
Lifetime number of quit attempts at baseline	0	9.3	3.3–15.4
	1	16.6	11.1–22.0
	2	21.3	14.8–27.8
	≥ 3	52.8	45.1–60.5
Intended to quit at baseline	Yes	60.8	53.0–68.5
	No	39.2	31.5–47.0
Made a serious attempt to quit smoking during the 6-month follow-up period (reported at follow-up)			
	Yes	72.3	65.5–79.0
	No	27.7	21.0–34.5
Supports for cessation			
Lifetime history of NRT use	Yes	79.6	72.4–86.8
	No	20.4	13.2–27.6
Lifetime history of any behavioural supports (including physician advice)	Yes	33.3	26.2–40.3
	No	66.7	59.7–73.8
Physician advice or use of behavioural supports during 6-month follow-up	Either	64.6	57.5–71.7
	Neither	35.4	28.3–42.5
Attitudes and beliefs			
Perceived addiction	Not at all	Suppressed ^a	Suppressed ^a
	Somewhat	21.6	14.8–28.4
	Very	76.7	69.6–83.8
Confidence of quitting altogether in the next 6 months	Not at all confident	10.3	5.7–15.0
	Not very confident	29.1	22.4–35.8
	Fairly confident	42.2	34.5–49.9
	Very confident	18.3	12.6–24.0

Continued on the following page

NRT use. (Additional models, not shown, indicate substitution effect where either past or same-time period history of behavioural supports were positively associated with NRT use, and the two were correlated.) Unlike the associations found among all smokers, among those who made a quit attempt higher number of cigarettes per day at baseline was positively associated with reported use of NRT in the next six months, but not previous quit attempts. A “don’t know” response to the attitude item about price of NRT was negatively correlated with use. Conversely a “don’t know” response to the question on ease of access was positively associated with use ($p = .048$ for the contrast).

Discussion

In Ontario, 30% of those making a quit attempt used NRT. This is lower than that found in a study by Reid and Hammond⁵³ that showed that a fairly stable 50% of smokers making quit attempts over two years used medication. Our study is the first to consider which smokers should be using NRT, based on evidence-based guidelines for NRT effectiveness. Of the 27% of smokers who met guidelines for use in our analysis, just under 25% used NRT. This leaves roughly 20% of all Ontario smokers as, arguably, an “ideal” but unreachable target population.

Despite the importance of quantitative data on the reach of public health interventions,¹⁸ few reports have estimated population prevalence of NRT in specific time periods. Population health surveys often lack the precision to quantify NRT conditional on smoking and quit attempts. In 1990, in a sample of Minnesotans with access to NRT through insurance plans with co-payment,⁵⁴ roughly half of those trying to quit used aids, primarily pharmacotherapy; in California between 1999 and 2002, 17% of all smokers used pharmacotherapy in the past year.⁵⁵ In the U.S. in 2003, 32% reported a quit attempt in the past year using medication,⁵⁶ whereas in 2010, 30% of all smokers used medication in the past year.⁵⁷ In the United

TABLE 2 (continued)
Characteristics of a population-representative cohort of adult smokers who reported using NRT products “to quit or cut down” in a six-month follow-up period, Ontario, Canada

Characteristics of smokers (n = 301)	Weighted, %	95% confidence interval
Stop-smoking medications make it easier to quit than trying to quit on your own		
Agree	83.9	78.5–89.3
Disagree	14.8	9.5–20.1
Don't know	1.4	0.4–2.4
The cost of stop-smoking medications makes it difficult to use them		
Agree	58.2	50.5–65.9
Disagree	40.2	32.5–47.9
Don't know	1.6	0.3–3.0
Stop-smoking medications are hard to get		
Agree	9.5	5.3–13.7
Disagree	87.6	82.9–92.2
Don't know	3.0	0.7–5.3
The risk of side effects from stop-smoking medications concerns you		
Agree	51.5	43.8–59.2
Disagree	47.8	40.1–55.5
Don't know	0.7	0.0–1.4
Combination of indications for NRT use		
Intention or attempts to quit plus 10+ cigarettes/day		
Yes	58.6	50.7–66.4
No	41.4	33.6–49.3
Intention or attempts to quit plus 10+ cigarettes/day plus any support		
Yes	37.3	29.8–44.7
No	62.7	55.3–70.2
Intention or attempts to quit plus any support		
Yes	55.0	47.3–62.7
No	45.0	37.3–52.7

Source: Ontario Tobacco Survey, Ontario Tobacco Research Unit, July 2005 to December 2007 (Cohorts 1 to 4 with six-month follow-up data).

Abbreviation: NRT, nicotine replacement therapy.

^a Cell size less than 5: estimates have been suppressed to maintain confidentiality.

Kingdom, where NRT is publically funded through the National Health Service, roughly half of smokers used it in recent quit attempts.¹²

Not all smokers feel medications are necessary,^{13,14,58} and many quit on their own.^{56,59} However, Ontario utilization rates may not reflect lack of interest; in 2006, a provincial NRT giveaway attracted 16 000 people in six weeks.⁶⁰ We found no difference in use by education, as anticipated and seen in American data;⁵⁷ however, we did not have access to more direct measures of insurance or ability to pay.⁴⁰

Earlier studies showed that ever users of NRT tend to be more dependent or smoke

more cigarettes.^{7,45,54,61–63} In our study, number of cigarettes smoked did not predict NRT use, which contrasts with several retrospective studies;^{7,54} however, cigarette consumption was associated with NRT use among smokers trying to quit, as elsewhere.¹² Among all smokers, lower consumption may follow from efforts to cut down.⁶⁴ American guidelines on NRT cite a minimum number of cigarettes primarily because of a lack of clinical trials data for people who smoke less.^{1–3} Australian practice guidelines, in contrast, state that NRT should be offered with evidence of dependence.⁶⁵ We found that over 90% of respondents who smoked fewer than 10 cigarettes at baseline and who used NRT perceived themselves to be very or somewhat addicted.

Intending or actually trying to quit were significantly associated with NRT use, which was consistent with findings from California.⁶³ Just 3% of Ontarians who neither intended nor tried to quit used NRT. This does not suggest widespread use of NRT with no intention to quit, as has been suggested as a negative consequence of NRT availability.^{34–38,66,67} However, we asked about NRT use “to quit or reduce smoking” (to exclude use of services for a different health reason) and may not have captured all NRT use, for example, by people who planned only to reduce, but not discontinue, smoking. Intention to quit may also change or be unreliably measured.⁶⁸ We addressed this by considering intention with and without subsequent attempts to quit.

In our study, smokers who received non-pharmaceutical support were more likely to use NRT, whereas previous studies report mixed findings. NRT users rarely used behavioural supports in Minnesota,⁵⁴ whereas in California⁷ and Australia⁶² NRT users were more likely to use behavioural supports. Ontario data may reflect consistency of advice from professionals and packaging to use behavioural supports. However, as in most studies,⁶⁹ we have no information on the intensity or quality of the supports received. Our study, like others,^{45,61} found that past use of NRT was associated with prospective use, but some use may have started before the baseline interview and continued into follow-up. Not surprisingly, smokers with positive attitudes towards NRT were more likely to use these medications.^{62,70–72}

Our analysis used data to 2008, after which time NRT manufacturers were permitted to advertise NRT for use while cutting down to quit. Future studies should ask about NRT for use only to cut down or only when one cannot smoke.^{63,66,67,73} Our study will provide baseline data to evaluate the impact of these changes and recent initiatives to publicly fund NRT.

Conclusion

Widely available NRT is a recommended population-based measure to reduce tobacco-related health burden. In this population, where NRT was available over

TABLE 3
Results of multiple log-binomial regression models predicting NRT use, in six-month follow-up, for all smokers and for those who attempted to quit over the same six-month period

Characteristic	Predicting 6-month prevalent use of NRT in all smokers (N = 2031)		Predicting NRT use among those who made a quit attempt in 6-month follow-up (N = 439)	
	PR (95% CI)	p value	PR (95% CI)	p value
Age (continuous, per 10 years of age)	0.94 (0.84–1.05)	.250	1.01 (0.90–1.14)	.853
Sex				
Female (reference)	1.00		1.00	
Male	0.86 (0.65–1.15)	.319	0.73 (0.53–1.02)	.065
Education				
High school or less (reference)	1.00		1.00	
More than high school	1.09 (0.80–1.47)	.582	1.27 (0.89–1.81)	.183
Consumption (continuous, cigarettes/day)	1.01 (0.99–1.03)	.226	1.02 (1.00–1.04)	.025
Time from waking to first cigarette, minutes				
≤ 30	0.90 (0.65–1.24)	.516	0.69 (0.47–1.00)	.053
> 30 (reference)	1.00		1.00	
Previous number of quit attempts at baseline				
≥ 1	0.69 (0.40–1.22)	.201	0.49 (0.27–0.88)	.017
0 (reference)	1.00		1.00	
History of NRT use at baseline				
Yes, ≥ 1 times	3.04 (2.04–4.54)	< .001	2.68 (1.69–4.26)	< .001
No (reference)	1.00		1.00	
History of behavioural support at baseline ^a				
Yes, ≥ 1 times	1.35 (1.02–1.79)	.038	1.40 (1.06–1.87)	.020
No (reference)	1.00		1.00	
Baseline intention to quit in 6 months				.042
Yes	–	–	0.68 (0.47–0.99)	
No (reference)			1.00	
Made a serious attempt to quit smoking during 6-month follow up period				
Yes	6.76 (4.72–9.69)	< .001	–	–
No (reference)	1.00		–	–
Use of any behavioural supports during follow-up				
Yes	1.53 (1.11–2.11)	.009	1.15 (0.82–1.63)	.418
No (reference)	1.00		1.00	
Confidence in ability to quit				
Very confident	0.78 (0.44–1.39)	.403	0.90 (0.48–1.70)	.751
Fairly confident	1.14 (0.68–1.93)	.611	1.30 (0.75–2.24)	.345
Not very confident	1.16 (0.68–1.98)	.584	1.36 (0.78–2.39)	.278
Not at all confident (reference)	1.00		1.00	
Stop-smoking medications make it easier to quit than trying to quit on your own ^a				
Disagree	0.71 (0.44–1.13)	.150	0.76 (0.43–1.33)	.334
Don't know	0.62 (0.26–1.47)	.276	0.57 (0.23–1.41)	.221
Agree (reference)	1.00		1.00	
The cost of stop-smoking medications makes it difficult to use them				
Disagree	1.04 (0.79–1.39)	.768	1.09 (0.80–1.50)	.579
Don't know	0.27 (0.08–0.97)	.045	0.09 (0.02–0.58)	.011
Agree (reference)	1.00		1.00	

Continued on the following page

TABLE 3 (continued)

Results of multiple log-binomial regression models predicting NRT use, in six-month follow-up, for all smokers and for those who attempted to quit over the same six-month period

Characteristic	Predicting 6-month prevalent use of NRT in all smokers (N = 2031)		Predicting NRT use among those who made a quit attempt in 6-month follow-up (N = 439)	
	PR (95% CI)	p value	PR (95% CI)	p value
Stop-smoking medications are hard to get				
Disagree	1.32 (0.78–2.25)	.296	1.18 (0.66–2.13)	.574
Don't know	1.98 (0.86–4.59)	.110	2.72 (1.01–7.34)	.048
Agree (reference)	1.00		1.00	
The risk of side effects from stop-smoking medications concerns you				
Disagree	1.13 (0.85–1.50)	.413	1.25 (0.90–1.73)	.181
Don't know	0.26 (0.06–1.14)	.073	[excluded] ^b	
Agree (reference)	1.00		1.00	

Abbreviations: CI, confidence interval; NRT, nicotine replacement therapy; PR, prevalence ratio.

^a Behavioural support considered as either advice from a physician or other forms.

^b Excludes fewer than 5 observations who said “Don't know.”

the counter and use of supplemental behavioural supports advocated, most smokers trying to quit were not using NRT. Approximately 20% of Ontario smokers were an “ideal” but unreached target population for NRT use. Ontario has recently implemented new initiatives to increase the accessibility of NRT. As such, further surveillance and research are warranted to determine the impact of the reach and benefits of NRT, considering both the general and targeted smoking populations.

Acknowledgements

Support for this research was provided by the Ontario Tobacco Research Unit, which receives funding from the Ontario Ministry of Health Promotion and Sport, and the University of Toronto Dalla Lana School of Public Health.

The authors have no conflicts of interest. None of the authors work or have worked in any capacity with, or received remuneration from, the manufacturers or sellers of tobacco products or nicotine replacement therapy products. The lead author was an investigator on The Stop Smoking for Ontario Patients study funded by the Ontario Ministry of Health and Long-Term Care and which received support in kind from manufacturers of nicotine replacement therapy products without intellectual restriction.

References

1. Stead LF, Perera R, Bullen C, Mant D, Lancaster T. Nicotine replacement therapy for smoking cessation. *Cochrane Database Syst Rev.* 2008;1:CD000146. doi: 10.1002/14651858.CD000146.pub3.(2)
2. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. *Cochrane Database Syst Rev.* 2004;3:CD000146. doi: 10.1002/14651858.CD000146.pub3
3. Clinical Practice Guideline Treating Tobacco Use and Dependence Update Panel. A clinical practice guideline for treating tobacco use and dependence: 2008 update. A U.S. Public Health Service report. *Am J Prev Med.* 2008;35(2):158–76.
4. World Health Organization. WHO Framework Convention on Tobacco Control. Geneva (CH): World Health Organization; 2003.
5. World Health Organization. WHO Framework Convention on Tobacco Control [Fifty-sixth World Health Assembly Resolution WHA56.1. Agenda item 13, 21 May 2003] Resolution WHA56.1. WHO Framework Convention on Tobacco Control. In: 56th World Health Assembly, Geneva, 19–34 May 2003 [Internet]. Geneva (CH): World Health Organization; 2008 [cited 2010 Jul 1]. Available from: http://apps.who.int/gb/archive/pdf_files/WHA56/ea56r1.pdf
6. World Health Organization. WHO Framework Convention on Tobacco Control: guidelines for implementation Article 5.3; Article 8; Articles 9 and 10; Article 11; Article 12; Article 13; Article 14 -2011 edition. Geneva: World Health Organization; 2011.
7. Pierce JP, Gilpin E. Impact of over-the-counter sales on effectiveness of pharmaceutical aids for smoking cessation. *JAMA.* 2002;288:1260–4.
8. Shiffman S, Gitchell J, Pinney JM, Burton SL, Kemper KE, Lara EA. Public health benefit of over-the-counter nicotine medications. *Tob Control.* 1997;6:306–10.
9. Cummings KM, Hyland A. Impact of nicotine replacement therapy on smoking behavior. *Ann Rev Public Health.* 2005;26:583–99.
10. Hyland A, Rezaishiraz H, Giovino G, Bauer JE, Michael Cummings K. Over-the-counter availability of nicotine replacement therapy and smoking cessation. *Nicotine Tob Res.* 2005;7(4):547–55.
11. Shiffman S, Sweeney CT. Ten years after the Rx-to-OTC switch of nicotine replacement therapy: what have we learned about the benefits and risks of non-prescription availability? *Health Policy.* 2008;86:17–26.
12. Kotz D, Fidler J, West R. Factors associated with the use of aids to cessation in English smokers. *Addiction.* 2009;104(8):1403–10.

13. Vogt F, Hall S, Marteau TM. Understanding why smokers do not want to use nicotine dependence medications to stop smoking: qualitative and quantitative studies. *Nicotine Tob Res.* 2008;10(8):1405–13.
14. Ismailov RM, Leatherdale ST. Smoking cessation aids and strategies among former smokers in Canada. *Addict Behav.* 2010; 35(3):282–5.
15. Penz ED, Manns BJ, Hebert PC, Stanbrook MB. Governments, pay for smoking cessation. *CMAJ.* 2010;182(18):E810.
16. Smoke-Free Ontario Scientific Advisory Committee. Evidence to guide action: comprehensive tobacco control in Ontario. Toronto (ON): Ontario Agency for Health Protection and Promotion; 2010.
17. Schwartz R, O'Connor S, Minian N, Borland T, Babayan A, Ferrence R, et al. Evidence to inform smoking cessation policymaking in Ontario [Internet]. Toronto (ON): Ontario Tobacco Research Unit; 2009 [cited 2012 Jul 18]. Available from: http://www.otru.org/pdf/special/special_CAP_august2010.pdf
18. Jilcott S, Ammerman A, Sommers J, Glasgow R. Applying the RE-AIM framework to assess the public health impact of policy change. *Ann Behav Med.* 2007; 34(2):105.
19. Chapman S, MacKenzie R. The global research neglect of unassisted smoking cessation: causes and consequences. *PLoS Med.* 2010;7(2):e1000216.
20. Zawertailo L, Dragonetti R, Bondy SJ, Fictor JC, Selby PL. Reach and effectiveness of mailed nicotine replacement therapy for smokers: six-month outcomes in a naturalistic, exploratory study. *Tob Control.* 2012. doi: 10.1136/tobaccocontrol-2011-050303
21. Miller N, Frieden TR, Liu SY, Matte TD, Mostashari F, Deitcher DR, et al. Effectiveness of a large-scale distribution programme of free nicotine patches: a prospective evaluation. *Lancet.* 2005;365(9474):1849–54.
22. Clinical Practice Guideline Treating Tobacco Use and Dependence 2008 Update Panel, Liaisons and Staff. A clinical practice guideline for treating tobacco use and dependence: 2008 update: a U.S. Public Health Service report. *Am J Prev Med.* 2008;35(2):158–76.
23. Etter JF, Burri M, Stapleton J. The impact of pharmaceutical company funding on results of randomized trials of nicotine replacement therapy for smoking cessation: a meta-analysis. *Addiction.* 2007;102(5):815–22.
24. Etter JF, Stapleton J. Nicotine replacement therapy for long-term smoking cessation: a meta-analysis. *Tob Control.* 2006;15:280–5.
25. Shiffman S, Rolf CN, Hellebusch SJ, Gorsline J, Gorodetzky CW, Chiang Y-K, et al. Real-world efficacy of prescription and over-the-counter nicotine replacement therapy. *Addiction.* 2002;97(5):505–16.
26. Hughes JR, Peters EN, Naud S. Relapse to smoking after 1 year of abstinence: a meta-analysis. *Addict Behav.* 2008;33:1516–20.
27. West R, Zhou X. Is nicotine replacement therapy for smoking cessation effective in the “real world”? Findings from a prospective multinational cohort study. *Thorax.* 2007;62(11):998–1002.
28. Hughes JR, Shiffman S, Callas P, Zhang J. A meta-analysis of the efficacy of over-the-counter nicotine replacement. *Tob Control.* 2003;12:21–7.
29. Cummings KM, Hyland A, Fix B, Bauer U, Celestino P, Carlin-Menter S, et al. Free nicotine patch giveaway program 12-month follow-up of participants. *Am J Prev Med.* 2006;31(2):181–4.
30. Shiffman S, Gorsline J, Gorodetzky CW. Efficacy of over-the-counter nicotine patch. *Nicotine Tob Res.* 2002;4(4):477–83.
31. Hays JT, Croghan IT, Schroeder DR, Offord KP, Hurt RD, Wolter TD, et al. Over-the-counter nicotine patch therapy for smoking cessation: results from randomized, double-blind, placebo-controlled, and open label trials. *Am J Public Health.* 1999; 89(11):1701–7.
32. Davidson M, Epstein M, Burt R, Schaefer C, Whitworth G, McDonald A. Efficacy and safety of an over-the-counter transdermal nicotine patch as an aid for smoking cessation. *Arch Fam Med.* 1998;7(6):569–74.
33. Sonderskov J, Olsen J, Sabroe S, Meillier L, Overvad K. Nicotine patches in smoking cessation: a randomized trial among over-the-counter customers in Denmark. *Am J Epidemiol.* 1997;145(4):309–18.
34. Levy DE, Thorndike AN, Biener L, Rigotti NA. Use of nicotine replacement therapy to reduce or delay smoking but not to quit: prevalence and association with subsequent cessation efforts. *Tob Control.* 2007;16:384–9.
35. Moore D, Aveyard P, Connock M, Wang D, Fry-Smith A, Barton P. Effectiveness and safety of nicotine replacement therapy assisted reduction to stop smoking: systematic review and meta-analysis. *BMJ.* 2009;338:b1024.
36. Hammond D, Reid JL, Driezen P, Cummings KM, Borland R, Fong GT, et al. Smokers' use of nicotine replacement therapy for reasons other than stopping smoking: findings from the ITC Four Country Survey. *Addiction.* 2008;103(10):1696–703.
37. Etter JF, Laszlo E, Zellweger JP, Perrot C, Perneger TV. Nicotine replacement to reduce cigarette consumption in smokers who are unwilling to quit: a randomized trial. *J Clin Psychopharmacol.* 2002;22:487–95.
38. Wang D, Connock M, Barton P, Fry-Smith A, Aveyard P, Moore D. ‘Cut down to quit’ with nicotine replacement therapies in smoking cessation: a systematic review of effectiveness and economic analysis. *Health Technol Assess.* 2008;12(2):1–135.
39. Walsh RA. Over-the-counter nicotine replacement therapy: a methodological review of the evidence supporting its effectiveness. *Drug Alcohol Rev.* 2008;27:529–47.
40. Temple NJ. Governments, pay for smoking cessation. *CMAJ.* 2010;182(16):1761–2.
41. Diemert L, Victor JC, Bondy SJ. Ontario Tobacco Survey Technical Report 1: Baseline Data [Internet]. Toronto (ON): Ontario Tobacco Research Unit; 2010 [updated 2010 Apr]. Available from: http://www.otru.org/ots_doc.html
42. Diemert L, Victor JC, Bondy SJ. Ontario Tobacco Survey Technical Report 2: Six and Twelve Month Data [Internet]. Toronto (ON): Ontario Tobacco Research Unit; 2010 Apr [updated 2010 Apr]. Available at: http://www.otru.org/ots_doc.html
43. Bondy SJ, Victor JC, O'Connor S, McDonald PW, Diemert LM, Cohen JE. Predictive validity and measurement issues in documenting quit intentions in population surveillance studies. *Nicotine Tob Res.* 2010;12(1):43–52.

44. Etter JF, Perneger TV. A comparison of two measures of stage of change for smoking cessation. *Addiction*. 1999;94(12):1881-9.
45. Shiffman S, Di Marino ME, Sweeney CT. Characteristics of selectors of nicotine replacement therapy. *Tob Control*. 2005; 14:346-55.
46. Etter JF, Duc TV, Perneger TV. Validity of the Fagerstrom test for nicotine dependence and of the Heaviness of Smoking Index among relatively light smokers. *Addiction*. 1999;94(2):269-81.
47. Okoli CT, Richardson CG, Ratner PA, Johnson JL. Non-smoking youths' "perceived" addiction to tobacco is associated with their susceptibility to future smoking. *Addict Behav*. 2009;34(12):1010-6.
48. Du Plessis V, Beshiri R, Bollman RD, Clemenson H. Definitions of "rural". Agriculture and Rural Working Paper Series Working Paper No. 61 [Internet]. Ottawa (ON): Statistics Canada; 2002 [cited 2008 Dec 12]. [Statistics Canada, Catalogue No.: 21-601-MIE — No. 061]. Available at: <http://www.statcan.gc.ca/pub/21-601-m/2002061/4224867-eng.pdf>
49. StataCorp. Stata Statistical Software: Release 10 (SE). College Station, TX: StataCorp LP; 2007.
50. Ialomiteanu AR, Adlaf EM. CAMH Monitor Technical Guide 2006. Toronto (ON): Centre for Addiction and Mental Health; 2007.
51. Health Canada. Microdata User Guide: Canadian Tobacco Use Monitoring Survey (CTUMS): Annual: February to December 2006. Report. Ottawa (ON): Health Canada; 2007.
52. Prochaska J, DiClemente C. Stages and processes of self-change of smoking: toward an integrative model of change. *J Consult Clin Psychol*. 1983;51:390-5.
53. Reid JL, Hammond D. Tobacco use in Canada: patterns and trends, 2011 ed. Waterloo (ON): Propel Centre for Population Health Impact, University of Waterloo; 2011.
54. Solberg LI, Boyle RG, Davidson G, Magnan S, Link Carlson C, Alesci NL. Aids to quitting tobacco use: how important are they outside controlled trials? *Prev Med*. 2001;33(1):53-8.
55. Gilpin EA, Messer K, Pierce JP. Population effectiveness of pharmaceutical aids for smoking cessation: what is associated with increased success? *Nicotine Tob Res*. 2006;8(5):661-9.
56. Shiffman S, Brockwell SE, Pillitteri JL, Gitchell JG. Use of smoking-cessation treatments in the United States. *Am J Prev Med*. 2008;34(2):102-11.
57. Centers for Disease Control and Prevention. Quitting smoking among adults—United States, 2001–2010. *MMWR*. 2011; 60:1513-9.
58. Hughes JR, Marcy TW, Naud S. Interest in treatments to stop smoking. *J Subst Abuse Treat*. 2009;36(1):18-24.
59. Shiffman S, Brockwell SE, Pillitteri JL, Gitchell JG. Individual differences in adoption of treatment for smoking cessation: demographic and smoking history characteristics. *Drug Alcohol Depend*. 2008;93(1-2):121-31.
60. Selby P, Zawertailo L, Dragonetti R. The STOP Study, Eighth Interim Progress Report to the Ministry of Health Promotion. Toronto (ON): Centre for Addiction and Mental Health; 2008.
61. Alberg AJ, Patnaik JL, May JW, Hoffman SC, Gitchelle J, Comstock GW, et al. Nicotine replacement therapy use among a cohort of smokers. *J Addict Dis*. 2005; 24(1):101-13.
62. Paul CL, Walsh RA, Girgis A. Nicotine replacement therapy products over the counter: real-life use in the Australian community. *Aust N Z J Public Health*. 2003;27(5):491-5.
63. Al-Delaimy WK, Gilpin EA, Pierce JP. When California smokers use nicotine replacement therapy, most are trying to quit smoking. *Tob Control*. 2005;14(5): 359-60.
64. Peters EN, Hughes JR. The day-to-day process of stopping or reducing smoking: a prospective study of self-changers. *Nicotine Tob Res*. 2009;11(9):1083-92.
65. Department of Health and Ageing. Smoking cessation guidelines for Australian general practice: practice handbook. Canberra (AU): Department of Health and Ageing; 2004.
66. Shiffman S, Hughes JR, Di Marino ME, Sweeney CT. Patterns of over-the-counter nicotine gum use: persistent use and concurrent smoking. *Addiction*. 2003;98(12): 1747-53.
67. Shiffman S, Hughes JR, Pillitteri JL, Burton SL. Persistent use of nicotine replacement therapy: an analysis of actual purchase patterns in a population based sample. *Tob Control*. 2003;12(3):310-6.
68. West R, Sohal T. "Catastrophic" pathways to smoking cessation: findings from national survey. *BMJ*. 2006;332(7539): 458-60.
69. Walsh RA. The Cochrane review on nicotine replacement therapy: incorrect or uncertain classifications of additional support levels. *Tob Control*. 2007;16(3): 215-6; author reply 6.
70. Bansal MA, Cummings KM, Hyland A, Giovino GA. Stop-smoking medications: who uses them, who misuses them, and who is misinformed about them? *Nicotine Tob Res*. 2004;6(Suppl 3):S303-10.
71. Mooney ME, Leventhal AM, Hatsukami DK. Attitudes and knowledge about nicotine and nicotine replacement therapy. *Nicotine Tob Res*. 2006;8:435-46.
72. Shiffman S, Ferguson SG, Rohay J, Gitchell JG. Perceived safety and efficacy of nicotine replacement therapies among US smokers and ex-smokers: relationship with use and compliance. *Addiction*. 2008;103(8): 1371-8.
73. Raw M, McNeill A, West R, Arnott D, Armstrong M. Nicotine Replacement Therapy. Guidance for health professionals on changes in the licensing arrangements for nicotine replacement therapy [Internet]. London (UK): Action on Smoking and Health (ASH);2005 [cited 2012 Jul 18]. Available from: http://www.ash.org.uk/files/documents/ASH_445.pdf