Impact of Canadian Tobacco Packaging on Quitline Utilization:

An Interrupted Time Series Analysis of Call Volume and New Callers

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Abstract

Introduction: A new set of pictorial health warning labels were introduced by Health Canada in 2012 and included, for the first time, a quitline toll-free number as part of Canadian tobacco packaging warning label policy. This study uses data from the Ontario provincial quitline to investigate whether there were changes in call volumes and new callers receiving treatment in the months before compared to months after the new policy.

Methods: An interrupted time-series analysis examined trends in Ontario quitline monthly call volume and number of new callers receiving treatment between January 2010 and December 2013 after adjusting for the January effect, cigarette prices and a major promotional campaign. Data were analyzed using Box-Jenkins autoregressive integrated moving average models.

Results: There was a 160% increase in average monthly call volume for the seven months after the introduction of the new warning label policy (baseline 870/ month; after policy 1391 additional calls/ month [S.E. 108.94, $p < .0001$]) and a sustained increase of 43% in subsequent months. For new callers, there was a relative increase of 174% (baseline 153/ month; after policy 267 additional callers/ month [S.E. 40.03, $p < .0001$]) and a sustained increase of 80%.

Interpretation: There has been a sustained increase in both overall calls and new callers to the quitline after the introduction of the health warning labels. This increase is not attributable to other promotion campaigns or seasonality effects. The new policy was associated with a significant increase in quitline call volumes.

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Introduction

Tobacco is a leading cause of preventable illness and death in Canada and throughout the world.(1,2) In Canada, it is estimated that approximately 100 Canadians die each day from a smoking-related illness.(3) The economic impact of tobacco related illness in Canada is also significant, with the annual burden of tobacco smoking estimated to be $21.3 billion.(4) In Ontario—Canada's largest province— smoking is the biggest factor for hospital bed-utilization, accounting for 22% of men's and 12% of women's hospital bed-days and almost $1 billion in hospital costs for 2011.(5) In 2013, smoking prevalence in Ontario was 12.6%, below the national average of 14.6% for Canadians aged 15+. (6)

Canada introduced pictorial health warning labels on cigarette packs in the year 2000. A new set of pictorial health warning labels (HWLs) were introduced by Health Canada in 2012 (see Figure 1) and included, for the first time, a quitline toll-free number.(7) Manufacturers were prohibited from producing cigarette packages and retailers were prohibited from selling cigarettes without the new HWLs as of March 21 and June 18, 2012 respectively. Including a quitline telephone number in tobacco warnings on cigarette packages has been found to increase call volume(8,9) and number of registrants.(10,11) For example, following the introduction of graphic warning labels with a quitline number in Australia, there was a 84% increase in the number of calls to the Quitline.(12)

Quitlines are an effective population health intervention that can be used by smokers who are motivated and seek support to quit using tobacco.(13) They can be easily accessed free of charge, have no eligibility restrictions, and provide evidence-based information, advice and motivational counselling to callers. Therefore, the volume of calls to a quitline has frequently been used as an indicator of

interest in quitting in response to population-based cessation policies such as HWLs with a toll-free quitline number.(9,12,14)

This study uses data from the Ontario provincial quitline, Smokers' Helpline (SHL), to investigate whether there were changes in SHL call volumes, the number of new callers receiving treatment and the characteristics of new callers in the months leading up to, and after, the introduction of the new HWLs with a toll-free quitline number as part of Canadian tobacco packaging warning label policy. Implementation of the new HWLs and pan-Canadian quitline number on tobacco packaging is an ideal example of a natural experiment – i.e. a rapidly unfolding policy that is not under the control of the investigation team.

Methods

We used an interrupted time-series analysis (15,16) to identify patterns over time, in the sequence of SHL overall monthly call volume and number of new callers receiving treatment. An interrupted time-series design, adjusting for secular trends, is an ideal design for assessing the effects of a population-wide intervention such as a toll-free quitline number on tobacco packaging.(15,16) Since the new HWLs were phased in from 21 March 2012, we considered March, 2012 the start of the intervention and looked at SHL call volume and number of new callers before and after this date, while adjusting for other SHL promotion campaigns, the January effect, and Ontario tobacco pricing. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline statement was used to assist in the reporting of this study. (17) The study was reviewed by the University of Waterloo, Office of Research Ethics.

Measures

Overall switchboard call volume and number of new incoming callers were the two variables used to determine the impact of HWLs on SHL utilization. Switchboard call volume (including both calls handled

and calls abandoned) and new caller data were collected for 48 months between January 2010 and December 2013 from the SHL telephone switchboard and intake database, respectively. New incoming callers are defined as callers who initiated contact by calling the quitline, were age 18 and over, smoked daily or occasionally at intake or had recently quit (within the past 30 days), received treatment from SHL (at least one counselling session), and had no contact with SHL in the 12 months prior to calling(18). Tracking the number of new callers receiving treatment from SHL over time allows for a better determination of the impact of the new HWLs on encouraging callers to use the promoted quitline. Age, gender, education, ethnicity, smoking status (daily or occasional), cigarette consumption, quit intentions, and the heaviness of smoking index (HSI) were collected at intake from new incoming callers. (19,20)

Other variables that could increase the volume of calls to SHL included the promotional campaign Driven-to-Quit (D2Q), the January effect, and tobacco pricing. D2Q is a media campaign run in February that promotes SHL through a contest that offers smokers a chance to win prizes if they quit. The D2Q campaign was run in February 2010, 2011 and 2012, but not in February 2013. The January effect is a seasonal phenomenon where people decide to make lifestyle changes such as stopping smoking as a New Year's resolution resulting in increased calls to SHL.(21,22). The January effects in 2010, 2011 and 2012 affect the pre-HWL period, while the January 2013 effect occurs in the post-HWL period. Finally, Ontario tobacco prices ($ for 200 cigarette pack) were included to adjust for the effect of price on desire to quit smoking.(23) Ontario tobacco prices adjusted for inflation (2002=100) for each month were provided by Statistics Canada.(24)

Analysis

Caller characteristics during the pre- and post-label periods were summarized using the mean ± SD for continuous variables and compared using the *t*-test for independent groups. For categorical variables, the pre- and post-label periods were summarized with frequency percentages and compared with a χ^2

test. SHL monthly call volume and new caller data were plotted on a graph over 48 months. Means, 95% confidence intervals and percent change of monthly call volume and number of new callers before and after the HWL introduction, with and without the D2Q campaign, and in January or not were calculated for descriptive purposes.

To identify whether changes in SHL overall monthly call volume and number of new callers overtime were related to the new HWLs, the model used for analysis was Box-Jenkins auto-regressive integrated moving average (ARIMA*(p, d, q)*) model.(25) ARIMA was preferable to traditional regression techniques as it took into account whether subsequent values were correlated; such autocorrelation violates the assumption of independence central to linear regression. There were three years with D2Q in the pre-intervention period and none in the post-intervention period. Similarly, the January effect was present in three of the twenty-six pre-intervention months but only one of the twenty-two post intervention months. Therefore, it is important to adjust for the effect of the D2Q campaign and the January effect when comparing pre- and post-intervention outcomes.

We investigated a number of possible models using autocorrelation and partial autocorrelation functions and checked the stationarity properties of the residuals from models for both the overall call volume and new caller time series to identify statistically adequate and parsimonious models. The adequacy of candidate models was assessed by examining the autocorrelation function (ACF) and partial autocorrelation function (PACF) plots of residuals, Ljung-Box chi-square tests for normally distributed white noise residuals, and Q-Q plots of residuals. The Akaike Information Criterion (AIC) was used to compare two nested candidate models, when needed. ARIMA (1,0,0) models provided adequate fits for both the overall call volume and new caller time-series data subsets.. We compared the fit from the predicted model and the observed series using the adjusted R^2 measure and the Root Mean Square

Error for ease of interpretation. We describe the HWL intervention in terms of time to peak, duration of the initial effect and the sustainability of the effect in months for both call volume and new callers.

To obtain an understanding of impact of the introduction of the new HWLs over the long-term, two ARIMA models, one for overall call volume and one for number of new callers, were investigated covering the period of 48 months (26 months before intervention, and 22 months after intervention). The two models included binary dummy variables to model the effect of the introduction of the new HWLs (coded as 1 for March 2012 to December 2013, and 0 otherwise), the sustainability of the effect (coded as 1 for October 2012 to December 2013, and 0 otherwise), the seasonal January effect to account for the increase in number of calls in the New Year, and the D2Q campaign in February 2010, 2011 and 2012, as well as Ontario tobacco prices as a continuous variable. We coded for the sustainability effect to account for the decline in the call volume and new callers after September 2012 as found in other quitline studies.(8,12) The effects of the potential confounders of the January effect and D2Q were significant and so were retained in the final model but tobacco pricing was discarded as it was not statistically significant. Analyses for this project were conducted using SPSS version 22.0 (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp).

Results

The characteristics of new SHL callers receiving treatment changed after the introduction of the new HWL. For example, the proportion of callers who were male and those with high school education or less each increased significantly. Post HWL with the quitline toll-free number, the average age of callers was significantly younger and there was a significant increase in the proportion of callers that were daily smokers compared to non-daily and who intended to quit in the next 30 days. In addition, the proportion of callers with a reported ethnicity other than 'white' increased significantly (see Table 1).

Figure 2 illustrates changes over time in the overall call volume and number of new callers receiving treatment from January 2010 to December 2013. Overall call volume and new callers was noticeably higher for the seven months from March 2012 to September 2012, and peaked in the fourth (June 2012) and third month (May 2012) respectively, after the introduction of the HWLs before stabilizing at higher values than pre-policy. Table 2 describes the mean changes in overall call volume and the number of new callers before and after the introduction of the new HWLs, as well as a result of the D2Q campaign and the seasonal January effect. After the introduction of the new HWLs, overall call volume increased by 52.5% to a mean of 1,591 (95% *CI* 1,355-1,827) calls per month compared to a mean of 1043 (95% *CI* 868-1218) prior to March 2012 (see Table 2). Similarly, the number of new callers receiving treatment increased 80.5% from a monthly average of 185 (95% *CI* 146-224) before the HWL policy to an average of 334 (95% CI 288-380) after the policy. It is important to note that the differences between the pre- and post-HWL periods are affected by the imbalance in the number of months with the D2Q intervention, and the relative number of months of the January effect, as described above.

Table 3 provides the ARIMA model estimates and Figure 2 includes the fitted model values for overall call volume and number of new callers while adjusting for the confounders of the January effect and the D2Q promotion campaign. For the overall call volume data, the auto-regressive parameter was not significant. However, we retained it in the model for comparability with the model for the number of new callers. Based on the model for overall call volume, the SHL baseline level, defined as the average monthly overall call volume, adjusting for the January effect and the D2Q promotion campaign, was 870 calls per month before introduction of the new HWLs; these numbers significantly increased by an average of 1391 additional calls (to 2261 calls per month on average) per month from March 2012 to September 2012 – a 160% relative increase. In subsequent months (October 2012 to December 2013) ,

there were 1019 fewer calls on average than during the first seven months; however, the average number of calls was still 43% higher than in the baseline period.

For number of new callers, the auto-regressive parameter was significant. The baseline level was 153 new callers per month before introduction of the new HWLs; these numbers significantly increased by an average of 267 additional calls per month – a relative increase of 174% - during the period March 2012-September 2012. This effect was sustained in subsequent months. While there was an average of 145 fewer new calls per month relative to the first seven months of the intervention, an estimated 80% of new calls per month were retained. Both D2Q and the January effect were significantly associated with call volumes and number of new callers. The analysis shows that the association of the HWL policy intervention on both overall call volume and number of new callers was stable and long term while adjusting for the confounders of January effect and the D2Q campaign.

Interpretation

This paper was a natural experiment that investigated the impact of the implementation of the new toll-free quitline number as part of Canadian tobacco packaging warning label policy on changes in SHL call volumes and number of new callers receiving treatment. We found a significant increase in both overall call volume and number of new callers coinciding with the introduction of the new HWLs while controlling for other promotion campaigns and the January effect. Call volumes and new callers after the introduction of the new HWLs peaked in four months and three months respectively and the effect lasted for 7 months after the introduction of the new HWLs and was sustained for an additional 15 months. These findings will support other countries that are considering the introduction of HWLs with a toll-free quitline number.

This study adds to the evidence of the benefit of inclusion of a toll-free quitline number on tobacco packages. (8,9,11,12,26,27) We found a 43% and 80% sustained increase in call volumes and number of new callers attributable to the HWLs with a toll-free quitline number which is similar to the experience from other countries that show calls increase substantially with the introduction of numbers on tobacco packaging. (8,12) For example, when Australia introduced new plain packaging and health warnings with the quitline number prominently displayed, the number of calls to their quitline increased 78%.(12) Whereas the study by Bot and colleagues demonstrated a mean relative increase of 100% one year after the introduction of HWLs across seven European countries. (8) Similar to Young et al.(12), this study found the January effect to be significant and did not find cigarette prices to be a significant factor related to quitline utilization. However, the province of Ontario has had no increases in tobacco taxes during the period under study with the rise in tobacco price at July 1, 2010 due to the implementation of the 8% provincial portion of Harmonized Sales Tax (HST). Further, Canada's new HWL policy has demonstrated increased population level awareness of the quitline toll-free number as well as use of quitline services in terms of both overall population level reach and the reach equity into sub-populations of smokers that bear an undue burden from tobacco. (28) The HWL policy has reduced inequity with the characteristics of callers to the quitline having changed significantly in terms of being younger, male, lower educational status and non-white.

Strengths of the study include accounting for other known influences on use of a quitline, such as promotion campaigns. In addition, this study has introduced the indicator number of new callers which other studies to-date have not used. We believe that this indicator better reflects the impact of a new policy implementation such as HWLs with a toll-free quitline number as one would expect to see calls from new smokers not familiar with quitline services to increase. Call volumes and number of new callers are direct behavioural indicators of quitting intentions and are not subject to the social

desirability and measurement biases that may occur in self-report surveys. Further, quitline data allow the ability to assess the impact of the new HWL policy in real-time and are ideal for interrupted time-series analysis as a robust method for the evaluation of a policy that affects the whole population and where randomization or a control group is impossible.(29) Limitations are those typical of studies that use administrative data.(30) The quitline data were cleaned, coded and checked for consistency to ensure quality; however, some errors in reporting may exist. Despite these limitations, the data represent all caller activity for the province of Ontario over a four year period and thus we believe our findings are significantly robust to provide an understanding of the association between the new HWLs and increased use of the quitline in Ontario. Although the time-series study design cannot prove causation, we have shown a positive and sustained association between a policy intervention and smoker response.

In conclusion, the combination of a quitline toll-free number and the new labels on tobacco packaging was associated with a significant increase in call volumes and the number of new callers to SHL Ontario as well as significant changes in the characteristics of callers. It is an effective policy for increasing and maintaining quitline call volumes. Future research should investigate the impact of the policy on other provinces given the differences that exist across Canada with regard to promotion and tobacco taxation. Finally, future research needs to consider the impact of the policy on smoking cessation outcomes and the overall prevalence of smoking.

Competing interests

None declared.

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Authors' Contributions

HSC and NBB led the conceptualization and design of the study and LH, NCN, DH, RDK and KSB contributed to the design of the study. NBB drafted the manuscript. NBB, NCN, LH, DH, RDK, KSB and HSC critically revised the manuscript for important intellectual content. NBB and HSC are co-principal investigators and DH, RDK and KSB are co-investigators on the research funding application. NCN and LH provided administrative, technical, and material support. NBB supervised the study. NBB is the guarantor.

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Table 1: Characteristics of new incoming callers receiving treatment during pre- and post-label periods for Ontario

Characteristics*	Period; no.(%) of new callers			
	Total (n= 12,157)	Pre-HWL Policy (n=4815)	Post-HWL Policy (n=7342)	P value
Mean age, years (SD)	45.6 (14.9)	47.0 (14.1)	44.6 (15.3)	p<0.0001
Gender, male	5709 (47.0)	1966 (40.8)	3743 (51.0)	p<0.0001
Education, high school or less	4160 (46.1)	1384 (37.7)	2766 (51.9)	p<0.0001
Ethnicity, white	6730 (81.7)	2400 (85.7)	4330 (79.6)	p<0.0001
Smoking status at intake				p<0.0001
Daily	10115 (83.2)	3692 (76.7)	6423 (87.5)	
Occasionally	133 (1.1)	47 (1.0)	86 (1.2)	
Recent quitter	1909 (15.7)	1076 (22.4)	833 (11.4)	
For Smokers (Daily or Occasional):	(n=10248)	(n=3739)	(n=6509)	
Cigarette consumption per day				p=0.79
1-10	2904 (24.5)	1151 (24.9)	1753 (24.3)	
11-20	3967 (33.5)	1546 (33.4)	2421 (33.5)	
21-30	3420 (28.9)	1335 (28.9)	2085(28.9)	
31+	1563 (13.2)	595 (12.9)	968 (13.4)	
Time to first cigarette in the morning score				p=0.04
61+ minutes	1118 (11.8)	391 (11.1)	727 (12.3)	
31-60 minutes	884 (9.4)	327 (9.3)	557 (9.4)	
6-30 minutes	2856 (30.2)	1025 (29.2)	1831 (30.9)	
within 5 minutes	4592 (48.6)	1773 (50.4)	2819 (47.5)	
Heaviness of Smoking Index				p=0.15
Low	2518 (26.7)	913 (26.0)	1605 (27.1)	
Medium	4028 (42.7)	1544 (44.0)	2484 (42.0)	
High	2886 (30.6)	1053 (30.0)	1833 (31.0)	
Intend to quit in 30 days	9199 (90.4)	3276 (88.6)	5923 (91.3)	p<0.0001

* Missing: Age=824; Gender=6; Education=3134; Ethnicity=3915; Smoking Status=0 (selection criteria); Cigarette consumption=303; Time to first cigarette=798; Heaviness of Smoking Index=816; Intent to quit=67

Table 2: Descriptive Changes in Overall Switchboard Call Volume and Number of New Callers Per Month Before and After the Introduction of the New Health Warning Labels, for Driven to Quit, and the January Effect.

	Overall Call Volume		New Callers	
	Mean	95% CI of mean	Mean	95% CI of mean
HWL Intervention[1]				
Before HWL policy	1043	868-1218	185	146-224
After HWL policy	1591	1355-1827	334	288-380
Percent Difference	52.5%		80.5%	
Driven-to-Quit				
Months without D2Q	1246	1086-1407	246	209-283
Months with D2Q	2016	1783-2248	363	226-500
Percent Difference	61.8%		47.5%	
January effect				
Not in January	1287	1113-1461	247	209-286
In January	1376	1234-1518	318	252-384
Percent Difference	6.9%		28.7%	

[1]Unadjusted for the effects of D2Q and the January effect.

Table 3: Health Warning Label Intervention Autoregressive Integrated Moving Average (ARIMA) Results for Overall Switchboard Call Volume and Number of New Callers

Parameter	Overall Call Volume		New Callers	
	Estimate (SE)	P value	Estimate (SE)	P Value
Intervention[1]				
Baseline[2]	869.79 (55.40)	<.0001	152.81 (20.68)	<.0001
HWL Intervention[3] (Mar 2012 - Dec 2013)	1390.62(108.94)	<.0001	267.02 (40.03)	<.0001
Sustainability[4] (Oct 2012 - Dec 2013)	-1018.99(113.54)	<.0001	-145.04 (40.64)	.001
Other Events				
Driven-to-quit	1087.37(130.43)	<.0001	168.36 (32.88)	<.0001
January effect	433.17 (117.35)	.001	135.80 (29.22)	<.0001
Auto-Regressive Parameter	0.175 (0.169)	.305	0.460 (0.163)	.007
Model Diagnostics				
Stationary R-squared	.87		.82	
RMSE	212.25		55.36	

RMSE root mean square error

[1] Adjusting for the Driven-to-Quit and January effects

[2] Constant in model (the average monthly call volume and new callers adjusting for months with no intervention and no D2Q or January effects).

[3] Additional average monthly call volume and new callers over baseline for March 2012-December 2013, adjusting for D2Q and January effect.

[4] Average monthly reduction in call volume and new callers from peak months of March 2012-September 2012 adjusting for January effect.

Figure 1: Example* Cigarette Package Health Warning Label - March 2012 to Present

* additional examples can be found at http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/legislation/label-etiquette/cigarette-eng.php

Figure 2: Ontario Monthly Overall Switchboard Call Volume and New Caller Volume Before and After the Introduction of the New Health Warning Labels