Can Mass Media Influence Emergency Department Visits for Stroke?

Corinne Hodgson, MA, MSc; Patrice Lindsay, RN, PhD; Frank Rubini, BA

Background and Purpose—Television advertising has been associated with significant increases in the knowledge of the warning signs of stroke among Ontarians aged 45 and older. However, to date there has been little data on the relationship between knowledge of the warning signs of stroke and behavior.

Methods—Data on presentation to regional and enhanced district stroke center emergency departments were obtained from the Registry of the Canadian Stroke Network for a 31-month period between mid 2003 and the beginning of 2006. Public opinion polling was used to track knowledge of the warning signs of stroke among Ontarians aged 45 and older.

Results—The public’s awareness of the warning signs of stroke increased during 2003 to 2005, decreasing in 2006 after a 5-month advertising blackout. There was a significant increase in the mean number of emergency department visits for stroke over the study period. A campaign effect independent of year was observed for total presentations, presentation within 5 hours of last seen normal, and presentation within 2.5 hours. For TIA s there was a strong campaign effect but no change in the number of presentations by year.

Conclusions—Continuous advertising may be required to build and sustain public awareness of the warning signs of stroke. There are many factors that may influence presentation for stroke and awareness of the warning signs may be only one. However, results of this study suggest there may be an important correlation between the advertising and emergency department presentations with stroke, particularly for TIA s. (Stroke. 2007;38:2115-2122.)

Key Words: acute care ■ education ■ stroke ■ symptoms

It has been argued that prehospital delay comprises the majority of time from symptom onset to potential treatment, and thus poses a significant barrier to stroke care.1,2 Previous data from Ontario, for example, suggests that even in a jurisdiction with organized stroke care, only 27% of patients arrive in an emergency department (ED) within 2 hours of stroke onset.3

A number of factors have been shown to influence time to hospital presentation of stroke patients. They include personal demographics such as age, race/ethnicity, gender, history of stroke or cardiovascular disease, dependence in the activity of daily living, and socioeconomic status;4–9 the number, severity, or duration of stroke symptoms;5,8,10–14 mode of transportation (ambulance or emergency medical services transportation being associated with shorter delays);5,7,10,14,15–19 and referral patterns (consultation with a general practitioner or family physician can significantly delay presentation).8,20

Based on the theory that awareness of stroke warning signs is needed to ensure individuals recognize and seek immediate medical attention,21–23 over the past 2 decades considerable time, money, and efforts have been expended on assessing the level of public knowledge21–24 and the effect of awareness-building initiatives, including mass media campaigns.21,27,39,40 However, research on the relationship between knowledge of stroke warning signs and time to presentation at hospital remains limited, and the ability of advertising to shorten time to presentation is unclear. In 1992, Alberts et al21 reported that an educational campaign increased the proportion of patients arriving at a specialist (tertiary) medical facility within 24 hours from 39.2% to 85.5%, and a 2000 study of 259 stroke patients in the Philippines found that failure to recognize symptoms as serious and stroke-related was associated with delayed presentation.22 However, in a retrospective study of 241 consecutive patients with TIA in the UK, correct recognition of symptoms (42.2% of patients) was not associated with less delay.23 Other studies have also failed to find a relationship between stroke knowledge and time to presentation.24–46

Looking at another type of acute cardiovascular event, acute myocardial infarction, the evidence to date has also been mixed. Although at least one study has reported that public education or mass media campaigns can increase knowledge and even self-reported intention to call emergency medical services,47 there is little or no evidence that they can change behavior when acute myocardial infarction symptoms are experienced.48 In Australia, for example, researchers found that despite several National Heart Foundation campaigns there were no significant differences in pre-hospital
patient delay. Likewise, in the Rapid Early Action for Coronary Treatment (REACT) Trial, despite the fact that polling showed that adults in the intervention cities were more knowledgeable about what to do in the case of acute myocardial infarction (32.6% said they would call 911 versus 22.8% for the reference population; *P*<0.006), data collected on ED presentation showed no difference between the 2 populations in delay from symptom onset to hospital arrival.

Between 2003 and 2005, the Heart and Stroke Foundation of Ontario (HSFO) conducted 2 province-wide television advertising campaigns on the warning signs of stroke, targeting adults aged 45 and older. In a report by investigators of the Registry of the Canadian Stroke Network (RCSN), it was stated that the mean number of stroke visits per month and of visits within 2.5 hours of “last seen normal” increased significantly between the 3 months preceding the first television campaign and the 9 months of the campaign itself. As well, the report notes that ED personnel in Ontario stroke centers have reported anecdotes of patients and families saying they came to the hospital because they had seen the television advertisement. However, to date there has been no means of establishing whether the significant investment the HSFO has made in mass media advertising has had a significant effect on the number of presentations for stroke care or the time to presentation. An editorial accompanying the HSFO’s previous report on its mass media strategies suggested that an important missing piece was establishing the Foundation’s previous report on its mass media strategies.

With funding from the Ontario Ministry of Health Promotion, the HSFO conducted 2 paid television advertising campaigns on the warning signs of stroke. The first was from October 2003 to June 2004, and the second was between December 2004 and July 2005. Air time was purchased province-wide during popular, prime-time programming aimed at those aged 45 years and older at media intensities of 1990 gross rating points for the 9 months of the 2003/2004 campaign, and 2515 for the 8 months of the 2005 campaign (generally considered in the industry as moderate intensity). Associated costs were $1.76 million for the 2003/2004 campaign and $1.91 million for 2004/2005.

The advertisement used by the HSFO illustrates the key words of the 5 stroke warning signs (weakness, trouble speaking, vision, headache, and dizziness), with an overlaying stamp reading “sudden.” It concludes with a call to action in the form of a voiceover encouraging viewers to call 911 or their local emergency number if they experience any of these symptoms.

There was no paid advertising during the period before the first advertising campaign (July to September 2003) or during the 2 “blackout” periods (July to November 2004, after campaign 1, and August 2005 to January 2006, after campaign 2; Figure 1). Throughout the entire 31 months, a low level of unpaid print and television public service announcements was maintained. As public service announcements, this advertising tends to occur during nonprime hours, and although gross rating points are not tracked, they are typically low.

### Knowledge of Stroke Warning Signs

Public knowledge of the warning signs of stroke was monitored among Ontarians by means of telephone public opinion polling. The Ipsos Reid Ontario omnibus reaches a cross-sectional sample of 1000 Ontarians stratified by census division and households, selected by a central telephone-sampling program using modified random-digit dialing. Survey data are weighted by age and gender to reflect the actual adult Ontario population according to the most recent Canadian Census data (at that point, the 2001 Census). For a 95% CI, Ipsos Reid estimates the margin of error to be ∈ 3.1%. For these surveys, the question used in the HSFO’s 1999 to 2003 research study of public knowledge of the warning signs of stroke was used: “Can you tell me what warning signs or symptoms people might experience when they have a stroke?” After each response, respondents were prompted with: “Can you think of any other warning signs or symptoms people might experience when they have a stroke?” until a maximum of 5 responses were obtained. Only respondents aged 45 and older were questioned, because this is the target audience for the HSFO’s media campaign.

Responses were entered into pre-coded categories, of which the correct warning signs, as determined by the Heart and Stroke Foundation, were:

- **Headache**—sudden or severe headache, excluding migraine headaches.
- **Weakness or paralysis**—weakness, numbness, losing feeling, sudden weakness, weakness of one side.
- **Trouble with speech**—sudden difficulty talking or understanding speech, including lay descriptions such as cannot talk or talking gibberish.
- **Vision problems or trouble seeing**—including tunnel vision and double vision.
- **Dizziness**—lightheadedness, or unexplained falls.
- **“Difficulty breathing.”** Primary outcome measures were the mean number of warning signs named by respondents, as well as the proportion of respondents who could name ≥2 of the correct warning signs. Weighted numbers and percentages are given but all testing (*χ*2 with a Yates correction for proportions and ANOVA or *t* tests for means) was performed on unweighted numbers.

For analysis, education was divided into 4 categories: (1) did not complete high school; (2) completed high school; (3) technical, trade
community college, or incomplete university; and (4) completed university (undergraduate and graduate).

Surveys were conducted just before the first advertising campaign (poll 1, August 2003), during, and immediately after the first campaign (poll 2, February 2004; and poll 3, July 2004), during, and in the weeks after the second campaign (poll 4, March 2005; and poll 5, August, 2005), and after the second blackout period (poll 6, February 2006). The last poll is the only one that can be said to represent awareness after several months of no advertising. Each survey was conducted with an independent sample of citizens.

Ethics approval for the study was granted by the Canadian Stroke Network. All data were analyzed using SPSS 14.0 (SPSS, Chicago, Ill).

Results

ED Visits
Over the 31 months, a total of 12 534 ED visits for stroke were recorded, of which 4303 (34.3%) arrived within 2.5 hours of last seen normal and an accumulated total of 6024 (48.1%) within 5 hours. Of all 12 534 presentations, 3040 (24.3%) were identified as TIAs. Figure 1 illustrates the number of ED visits by month, as well as the campaign periods and when polls were conducted.

Table 1 shows data from 2003, 2004, and 2005 (excluding the 1 month of data from 2006), showing mean number of ED presentations for the 4 categories by year and for the campaign and noncampaign months. In regression analysis, the $r^2$ for total visits was 0.51 ($P<0.001$) for year, and increased to 0.60 when campaign status was added ($P<0.001$); for 5 hours, the values were 0.41 ($P<0.001$) and 0.56 ($P<0.001$); and for 2.5 hours the values were 0.63 ($P<0.001$) and 0.67 ($P<0.001$). The individual contribution of campaign to the model was thus 0.09 for total visits, 0.15 for visits within 5 hours, and 0.05 for visits within 2.5 hours. For TIAs, the $r^2$ value was 0.01 ($P=0.671$) for year alone and 0.30 when campaign status was added ($P=0.007$). The individual contribution of campaign status for TIA was 0.29.

The relationship between season and number of ED presentations was also tested with ANOVA. When data from 2003 to 2005 were combined, there was no significant variation by season for any of the categories ($P>0.05$). There was also no significant variation by season in 2003 or 2004 (all $P>0.05$). In 2005, when the second advertising campaign was held during 3 of the 4 seasons, there was significant variation by season for TIAs ($P=0.003$) and presentation within 5 hours ($P=0.013$) but not for the other categories.

Knowledge of Stroke Warning Signs
Table 2 shows the result of the polling data. Between August 2003 and August 2005 there was a consistent increase in the proportion who could name $\geq 2$ correct warning signs of
stroke ($P<0.001$), as well as the mean number of warning signs ($P<0.001$). The proportion who could not name any warning signs of stroke also decreased from 21.7% in August 2003 to 10.2% in August 2005 ($\chi^2_{(1)}=54.68; P<0.001$).

Between August 2005, the poll immediately after the second campaign, and February 2006, at the end of the blackout period, the proportion who could name $\geq 2$ warning signs decreased (from 72.7% to 63.6%; $\chi^2_{(1)}=20.43; P<0.001$), as did the mean number of warning signs correctly named (from 2.30 [1.29] in August 2005 to 1.99 [1.30] in February 2006; $t [2133]=5.55; P<0.001$). There were significant decreases in the proportions who named paralysis ($\chi^2_{(1)}=4.11; P<0.05$), difficulty talking ($\chi^2_{(1)}=16.60; P<0.001$), vision problems ($\chi^2_{(1)}=20.98; P<0.001$), and dizziness ($\chi^2_{(1)}=11.45; P<0.001$).

Figure 2 shows the proportion by gender who could name $\geq 2$ correct warning signs of stroke. At all polls, significantly more women than men were able to name $\geq 2$ warnings signs of stroke ($\chi^2$ for all comparisons had $P<0.001$). Between polls 5 and 6 (ie, after the 5-month blackout period), there were significant decreases for both women (80.5% to 71.2%; $\chi^2_{(1)}=13.402; P<0.001$) and men (63.1% to 56.3%; $\chi^2_{(1)}=4.836; P=0.030$).

For all polls there was no significant variation in the proportion who could name $\geq 2$ correct warning signs by age group (for poll 1 the values were 54.0% for the younger and 47.8% for the older age group; poll 2 65.3% and 51.3%; poll 3 69.5% and 66.9%; poll 4 72.0% and 69.5%; poll 5 73.2% and 72.2%; and poll 6 65.2% and 62.0%; all $P>.05$). After the blackout (ie, between polls 5 and 6) there were significant declines for the 45 to 64 age group (from 73.2% to 65.2%; $\chi^2_{(1)}=10.604; P<0.001$) and the 65 and older age group (72.2% to 62.0%; $\chi^2_{(1)}=6.738; P=0.006$).

### TABLE 1. Mean Number (SD) of Stroke ED Visits by Year and Campaign Status

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Visits</th>
<th>Within 5 Hours</th>
<th>Within 2.5 Hours</th>
<th>TIs,</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
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<tr>
<td>2003</td>
<td>381.33 (10.02)</td>
<td>182.33 (15.31)</td>
<td>122.67 (2.52)</td>
<td>105.00 (18.03)</td>
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<tr>
<td>March (3)</td>
<td></td>
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<tr>
<td>No campaign (3)</td>
<td>353.00 (29.82)</td>
<td>155.33 (12.70)</td>
<td>100.33 (3.51)</td>
<td>94.67 (17.67)</td>
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<tr>
<td>Both (6)</td>
<td>367.17 (25.23)</td>
<td>168.83 (19.42)</td>
<td>111.50 (12.53)</td>
<td>99.83 (16.94)</td>
</tr>
<tr>
<td>2004</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>March (7)</td>
<td>403.00 (33.22)</td>
<td>198.14 (19.84)</td>
<td>134.71 (12.13)</td>
<td>105.71 (15.34)</td>
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<td>No campaign (5)</td>
<td>368.60 (29.06)</td>
<td>182.60 (19.35)</td>
<td>134.00 (13.34)</td>
<td>89.40 (12.54)</td>
</tr>
<tr>
<td>Both (12)</td>
<td>388.67 (34.97)</td>
<td>191.67 (20.37)</td>
<td>134.42 (12.05)</td>
<td>98.92 (16.00)</td>
</tr>
<tr>
<td>2005</td>
<td></td>
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<tr>
<td>March (8)</td>
<td>438.75 (26.68)</td>
<td>212.75 (15.30)</td>
<td>157.75 (15.64)</td>
<td>103.13 (7.34)</td>
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<td>No campaign (4)</td>
<td>420.50 (10.66)</td>
<td>199.00 (10.68)</td>
<td>150.75 (6.50)</td>
<td>81.75 (4.92)</td>
</tr>
<tr>
<td>Both (12)</td>
<td>432.67 (23.77)</td>
<td>208.17 (15.03)</td>
<td>155.42 (13.38)</td>
<td>96.00 (12.31)</td>
</tr>
<tr>
<td>Total</td>
<td>415.28 (34.92)</td>
<td>202.00 (19.79)</td>
<td>142.94 (18.89)</td>
<td>104.44 (12.04)</td>
</tr>
<tr>
<td>March (18)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>No campaign (12)</td>
<td>382.00 (36.74)</td>
<td>181.25 (22.25)</td>
<td>131.17 (21.93)</td>
<td>88.17 (12.16)</td>
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<tr>
<td>Both (30)</td>
<td>401.97 (38.75)</td>
<td>193.70 (22.90)</td>
<td>138.23 (20.64)</td>
<td>97.93 (14.38)</td>
</tr>
</tbody>
</table>

### TABLE 2. Knowledge of Correct Warning Signs of Stroke

<table>
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<td>Weighted, n</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td></td>
<td>1153</td>
<td>1192</td>
<td>1.69 (1.27)</td>
<td>1.99 (1.30)</td>
<td>2.15 (1.31)</td>
<td>2.26 (1.30)</td>
<td>2.31 (1.29)</td>
</tr>
<tr>
<td>Signs</td>
<td>621 (52.1%)</td>
<td>742 (63.3%)</td>
<td>713 (67.8%)</td>
<td>758 (70.8%)</td>
<td>743 (72.3%)</td>
<td>621 (64.2%)</td>
<td></td>
</tr>
<tr>
<td>Paralysis</td>
<td>584 (49.0%)</td>
<td>551 (47.0%)</td>
<td>488 (46.4%)</td>
<td>473 (44.1%)</td>
<td>493 (48.0%)</td>
<td>425 (44.0%)</td>
<td></td>
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<tr>
<td>Speech</td>
<td>275 (23.1%)</td>
<td>358 (30.5%)</td>
<td>388 (36.9%)</td>
<td>422 (39.4%)</td>
<td>425 (41.4%)</td>
<td>325 (33.6%)</td>
<td></td>
</tr>
<tr>
<td>Headache</td>
<td>343 (28.8%)</td>
<td>380 (32.4%)</td>
<td>355 (33.8%)</td>
<td>383 (35.8%)</td>
<td>328 (31.9%)</td>
<td>304 (31.4%)</td>
<td></td>
</tr>
<tr>
<td>Vision</td>
<td>290 (24.3%)</td>
<td>399 (34%)</td>
<td>389 (34%)</td>
<td>469 (43.8%)</td>
<td>465 (45.3%)</td>
<td>354 (36.6%)</td>
<td></td>
</tr>
<tr>
<td>Dizziness</td>
<td>508 (42.7%)</td>
<td>643 (54.9%)</td>
<td>618 (58.8%)</td>
<td>669 (62.5%)</td>
<td>642 (62.5%)</td>
<td>538 (55.6%)</td>
<td></td>
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<tr>
<td>Number known</td>
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<tr>
<td>0</td>
<td>259 (21.7%)</td>
<td>176 (15.0%)</td>
<td>152 (14.5%)</td>
<td>120 (11.2%)</td>
<td>105 (10.2%)</td>
<td>149 (15.4%)</td>
<td></td>
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<tr>
<td>1</td>
<td>312 (26.2%)</td>
<td>255 (21.7%)</td>
<td>186 (17.7%)</td>
<td>193 (18.0%)</td>
<td>179 (17.4%)</td>
<td>197 (20.4%)</td>
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<tr>
<td>2</td>
<td>289 (24.2%)</td>
<td>334 (28.4%)</td>
<td>273 (26.0%)</td>
<td>279 (26.1%)</td>
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<tr>
<td>3</td>
<td>232 (19.5%)</td>
<td>253 (21.6%)</td>
<td>275 (26.2%)</td>
<td>280 (26.1%)</td>
<td>285 (27.8%)</td>
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<td>4</td>
<td>84 (7.0%)</td>
<td>126 (10.7%)</td>
<td>145 (13.8%)</td>
<td>172 (16.1%)</td>
<td>147 (14.3%)</td>
<td>106 (11.0%)</td>
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<tr>
<td>5</td>
<td>16 (1.3%)</td>
<td>30 (2.6%)</td>
<td>20 (2.5%)</td>
<td>27 (2.5%)</td>
<td>36 (3.5%)</td>
<td>21 (2.2%)</td>
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</tbody>
</table>
Could age in years have a different effect on the ability to name ≥2 warning signs? Logistic regression found that although gender was significant ($P<0.001$) age in years was not ($P=0.067$). The analysis was also conducted individually for each poll and results were similar for all 6 (data not shown).

Univariate ANOVAs showed there were statistically significant variation between educational groups in the ability to name ≥2 warning signs at poll 1 (August 2003, $P=0.028$) and 4 (March 2005, $P=0.010$), but not for polls 2, 3, 5, and 6 (all $P>0.05$; Figure 3). Although there was a decrease between polls 4 and 5 for those with less than a high school education (from 64.4% to 56.7%), it was not significant ($\chi^2_{(1 df)}=1.612; P=0.127$).

Between polls 5 and 6 (the blackout period), the ability to name ≥2 warning signs declined in all education groups. The decline for those with less than high school was not significant (from 56.7% to 44.0%; $\chi^2_{(1 df)}=3.346; P=0.072$), but it was for those with a high school education (72.1% to 61.0%; $\chi^2_{(1 df)}=5.692; P=0.006$), some technical or college training (75.6% to 64.9%; $\chi^2_{(1 df)}=8.916; P=0.002$), and university education (75.7% versus 68.9%; $\chi^2_{(1 df)}=4.276; P=0.023$).

**Discussion**

The polling data suggest there is a relationship between mass media advertising and the knowledge of adults about the warning signs of stroke. The HSFO’s previous research in 1999 and 2001 found knowledge of stroke warning signs higher among women as opposed to men, those aged 45 to 64 years as opposed to those 65 and older, and those with higher, as opposed to lower, levels of education. In the polling conducted between 2003 and 2006, women continued to demonstrate greater knowledge of stroke warning signs than men. Although the differences by age groups and education level trended in a manner similar to that observed earlier, they were no longer statistically significant. This suggests that television advertising may have contributed to a reduction in...
age and education-related differences in knowledge of the warning signs of stroke. The results also show that for all segments of society the absence of advertising is associated with significant declines in knowledge. Polling after a 5-month hiatus showed a decrease in knowledge among both sexes, both age categories, and most education groups. Continuity appears to be essential for not only increasing knowledge of the warning signs of stroke but sustaining these gains.

Did the greater knowledge of stroke warning signs associated with the advertising help to drive stroke patients to seek medical care? In most jurisdictions, it would be difficult to address this question outside of the confines of a clinical trial. The situation in Ontario, in which there is a stroke registry and province-wide advertising campaigns of specific duration, presents a unique opportunity. Because our data are at the population level, a direct or causal relationship between the advertising and individual ED presentation cannot be proven. However, the Ontario data has been able to demonstrate that at the population level mass media has a significant effect on ED presentations. For most strokes, the effect is not huge (9% of variance for total visits, 15% for visits within 5 hours, and 5% for visits within 2.5 hours); for TIA, however, campaign status explained almost 30% of the variance in ED visits. The ability of television advertising to drive people experiencing stroke symptoms, particularly when they are transitory and might otherwise be ignored, is important. ED presentations are not only opportunities for stroke care but also, in the case of TIA, opportunities for ongoing stroke prevention.

A recent study suggests that the prevalence of stroke symptoms in the general population may be higher than previously suspected, with 17.8% experiencing one or more symptoms. Our results suggest that sustained television advertising is one means of ensuring such people seek immediate medical attention.

Our results are in keeping with a growing body of evidence suggesting that mass media campaigns can change awareness, knowledge, and even behavior, particularly if campaigns concentrate on single efficacious and clear messages and have prolonged exposure. Although some information about stroke may be provided through the news media, mass media is probably the most feasible means of providing this education at the population level. A number of factors may influence the rate of stroke presentation in a jurisdiction, such as incidence, case finding rate, and seasonal variations. A previous report from the RSCN found that between 2000 and 2003, the number of stroke presentations increased from 9.9% to 10.3%. A system of organized stroke care, such as implemented across Ontario in 2001, may have also improved the identification of stroke at both the pre-hospital and hospital phase.

The issue of seasonal variations was also addressed, as there have been reports of significant variation from a number of jurisdictions, including Italy, Finland, Japan, Australia, and the US. However, other studies have failed to produce consistent support for this hypothesis. Moreover, it is unlikely that season could have confounded the data presented here, because both advertising campaigns covered more than one season (late autumn, winter, spring, and early summer for the first campaign, and winter, spring, and most of the summer for the second campaign).

Because this was an observational rather than an experimental study, it is not possible to prove causation. For example, the campaign period could have been contaminated by other sources of stroke information (eg, physicians, the Internet) and the blackout periods by recall of information from earlier advertising campaigns and the low level of continuous public service announcements. To pursue this research further, alternative methods may be required, such as using a control group or querying stroke patients or their families about their recall of the stroke advertisement or their television viewing habits (although validating the accuracy of such data would be difficult). Despite these problems, this study provides the best data to date on the utility of funding public education campaigns on the warning signs of stroke. Although the effects may be small, it suggests that significant benefits can be expected, particularly for TIA. Based on these results, the HSFO is planning to continue its mass media strategy and is considering new approaches to optimize its impact.

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Disclosures
None.

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