The National Stroke Foundation of Australia ran 12 stroke awareness public media campaigns between 2004 and 2014. These campaigns aimed to increase Australians’ awareness of stroke symptoms and the need to call an ambulance. An established method for exploring the reach and effectiveness of these campaigns is to examine their effect on emergency calls to ambulance for stroke.

Bray et al. examined the effect of campaigns on calls to ambulance for stroke in Melbourne (Australia). They found a significant increase in the number of stroke-related calls in years after the National Stroke Foundation campaigns began, particularly in years that received greater funding, and after calling an ambulance was added to the campaign message. However, it is not known what the effect of the campaigns was in other Australian states, where campaign funding and exposure has varied (Table).

The aim of this study was to measure the effect of exposure to campaigns, through either paid or pro bono advertising, on the volume of stroke-related calls to ambulance across Australia. We also aimed to estimate the duration of any effect and the additional effect of paid advertising and regional variations.

Methods—All ambulance services in Australia provided monthly ambulance dispatch data between January 2003 and June 2014. We performed multivariable regression to measure the effect of campaign exposure on the volume of stroke-related emergency calls, after controlling for confounders.

Results—The final model indicated that 11 of the 12 National Stroke Foundation campaigns were associated with increases in the volume of stroke-related calls (varying between 1% and 9.9%) in regions with exposure to advertising. This increase lasted ≈3 months, with an additional 10.2% relative increase in the volume of the calls in regions with paid advertising. We found no significant additional effect of the campaigns on stroke calls where ambulance services are publicly funded.

Conclusions—The National Stroke Foundation stroke awareness campaigns are associated with increases to calls to ambulance for stroke in regions receiving advertising and promotion. Research is now required to examine whether this increased use in ambulance is for appropriate emergencies.

Key Words: ambulances ■ diagnosis ■ emergency medical services ■ health promotion ■ stroke

The online-only Data Supplement is available with this article at http://stroke.ahajournals.org/lookup/suppl/doi:10.1161/STROKEAHA.114.008515.V1.
advertising included a mix of media including television, radio, newspapers, public transport advertising, cinema and digital advertising. Pro bono advertising and community announcements were not tracked. All campaign materials featured the main message of the campaign, common stroke symptoms, and, since 2007, the need to call an ambulance.

Ambulance Service and Dispatch

Each Australian state and territory has one ambulance service. Australian ambulance services are not covered under the government-funded national insurance scheme. In 2 states, ambulance services are provided free of charge funded by state governments; elsewhere, residents pay directly if not covered under private health insurance or ambulance subscription.

All Australian ambulance services, except the Australian Capital Territory Ambulance Service, currently use the Medical Priority Dispatch System to assist in emergency call taking. Both systems use chief complaint/incident type protocols and will allocate the call as a stroke (eg, Medical Priority Dispatch System card 28) if the caller identifies stroke as the chief complaint or describes specific stroke symptoms.

Data Collection and Statistical Analysis

For the period January 2003 to June 2014, ambulance services were asked to provide monthly numbers of the (1) emergency incidents for stroke (defined above) and (2) total emergency incidents. The data were requested to be split into major metropolitan and rural regions if possible. Nonemergency calls and multiple calls for one incident and cancellations were excluded. The list of regions and the availability of data are provided in Table I in the online-only Data Supplement.

To examine the effect of the campaign on calls to ambulance, we used multivariable regression. Full details of the model are available in the Methods in the online-only Data Supplement. In brief, we used the volume of calls as the primary outcome and each region month as an observation. Separate variables were used for each campaign to indicate whether a given region was exposed to a particular campaign in a given month or whether the campaign had been run 3 months before. We controlled for paid campaign funding, the number of days in the month, the season (winter versus nonwinter months), the population size of each region, a temporal proxy to account for population growth, and an interaction term between the region and temporal variable to adjust for varying population growth by region. We also tested to see whether there was a heightened effect of the campaign

<table>
<thead>
<tr>
<th>Year, Advertising Dates</th>
<th>Campaign Name/Aim</th>
<th>Regions Receiving Advertising (Funding)</th>
<th>Difference in Call Numbers in Regions With Campaign, n</th>
<th>Proportional Difference in Regions With Campaign, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004, 20 September to 30 October</td>
<td>Missing out strokesafe for life/ focused on the reality that many Australians do not know the signs of stroke and if they did, they might have been able to avoid a stroke or achieve better recovery</td>
<td>NSW metro VIC metro QLD SA metro WA metro</td>
<td>+519</td>
<td>4.8%</td>
</tr>
<tr>
<td>2005, 18 September to 31 October</td>
<td>It’s only designed to highlight the significant signs of stroke and not to ignore them</td>
<td>QLD WA</td>
<td>+233</td>
<td>7.6%</td>
</tr>
<tr>
<td>2006, 17 September to 30 October</td>
<td>FAST—seek immediate attention/to provide an easy way to recognize the signs of stroke and acting FAST</td>
<td>NSW VIC QLD (paid) SA WA</td>
<td>−345</td>
<td>−2.2%</td>
</tr>
<tr>
<td>2007, 16 September to 28 October</td>
<td>FAST—call ambulance/focused on the FAST symptoms and the need to call ambulance</td>
<td>NSW VIC (paid) QLD (paid) SA WA</td>
<td>+159</td>
<td>1.0%</td>
</tr>
<tr>
<td>2008, 14 September to 22 November</td>
<td>FAST—call ambulance/focused on the FAST symptoms and the need to call ambulance</td>
<td>NSW VIC (paid)—FAST QLD SA WA</td>
<td>+1042</td>
<td>5.2%</td>
</tr>
<tr>
<td>2009, 13 September to 15 November</td>
<td>FAST—with visual/used images to depict FAST symptoms and calling an ambulance 000 with the aim of reaching more members of the community</td>
<td>NSW VIC (paid) QLD SA WA</td>
<td>+967</td>
<td>4.7%</td>
</tr>
<tr>
<td>2010, 5 September to 10 October</td>
<td>FAST—with visual</td>
<td>NSW VIC (paid) QLD SA WA</td>
<td>+1250</td>
<td>6.9%</td>
</tr>
<tr>
<td>2011, 2–23 October</td>
<td>Fire in the brain/FAST/adapted the UK campaign with the aim of showing the onset of symptoms and the need for immediate attention</td>
<td>VIC (paid)</td>
<td>+284</td>
<td>5.7%</td>
</tr>
<tr>
<td>2012, 4–24 March 7 to 28 October</td>
<td>Fire in the brain/FAST</td>
<td>VIC (paid)</td>
<td>+1029</td>
<td>9.9%</td>
</tr>
<tr>
<td>2013, 3–31 March</td>
<td>Fire in the brain/FAST</td>
<td>VIC (paid)</td>
<td>+501</td>
<td>9.3%</td>
</tr>
<tr>
<td>2014, 1 February to 31 March</td>
<td>Fire in the brain/FAST National (paid)</td>
<td></td>
<td>+1478</td>
<td>6.7%</td>
</tr>
</tbody>
</table>

FAST indicates face, arm, speech, time; NSW, New South Wales; QLD, Queensland; SA, South Australia; VIC, Victoria; and WA, Western Australia.
in (1) 2014 in urban regions by removing available rural data (from New South Wales and Victoria) from the model and (2) regions where ambulance services were publicly funded (compared with user pays) by entering a binary variable to indicate the regions (Tasmania and Queensland) and campaign periods. All analyses were conducted using Stata 12.1 (Release 12, College Station, TX).

Results
All state ambulance services in Australia contributed data to the study, but the dates of available data varied (Table I in the online-only Data Supplement). Data for the Northern Territory was only available for some regions (Darwin, Palmerston, Katherine, and Nhulunbuy). Generally, the annual numbers for all emergency dispatches for each state were proportional to the region’s population size (Table I in the online-only Data Supplement). We separately tested alternate lag periods beyond the campaign period, but we found 3 months best described the data based on overall model performance.

Adjusting for underlying trends and confounders, the final model indicated that regions exposed to advertising (paid or pro bono) experienced an associated increase in the volume of stroke-related calls for 11 of the 12 campaigns (Table). In these 11 campaigns, the relative difference in calls varied between 1% in 2007 and 9.9% in 2012. In the 2014 campaign of 2014, a 6.7% increase was seen which was equivalent to an additional 1478 calls during the period February 2014 to June 2014. Regions receiving paid campaigns were associated with an average relative increase of 10.2% in the volume of the calls compared with pro bono campaigns.

We only had separate urban/rural data for 2 of the largest Australian states, New South Wales and Victoria. When we excluded rural data from these regions from the model, we found that the overall effect of the campaign increased for the 2014 campaign to 8.8% (versus 6.7% in all regions), suggesting a greater effect of the campaign in urban areas of New South Wales and Victoria for that year. We found no difference in regions where the user pays for ambulance services compared with regions where ambulance service is provided free of charge.

Discussion
This study showed an association between an increase in calls to ambulance for stroke and exposure to public stroke awareness campaigns in Australia. This increase varied annually, and was 10% greater in regions receiving funded campaigns. The model also suggests a greater effect of the campaign in metropolitan regions but no difference in regions where the user pays for ambulance services.

Our analysis also showed the campaign’s effect on calls to ambulance lasted for ≈3 months beyond the campaign period. International studies examining emergency department attendances for stroke also report a similar pattern of decline after campaigns, suggesting that campaigns could have a sustained effect when run every 6 months. This is supported by data from the 2012 to 2013 Victorian campaign, where paid campaigns were run for the first time at three 6-month intervals and a sustained increase in calls to ambulance for stroke in Victoria of 9% to 10% was seen.

The fluctuations in the calls to ambulance for stroke in the later years, after calling an ambulance was added to the campaign message, is most likely related to variations in campaign funding, and thus exposure. Although we do recognize that there is also potential for an undetected cumulative effect over time, particularly as awareness of the campaigns among Australians has steadily increased over time, with the use of consistent messages and similar branding. In addition, visualization of the Face, Arm, Speech, Time (FAST) symptoms in the 2007 to 2014 campaigns may have facilitated reaching more of the community, such as those who are illiterate or non-English speaking. However, it is difficult to unpack these effects in this study because of the temporal trends in the data because of population growth, increase urbanization, and potentially underlying changes in attitudes to ambulance use.

The success of health awareness campaigns is dependent on a multitude of factors, including the adequacy of funding, frequency of advertising, retention of the message, competing health messages, audience ownership of the health message, and use of appropriate media. Success in changing health behavior is substantially increased by the application of multiple interventions, the ease of access to the key health services recommended, and when the targeted behavior is one-off or episodic, as is the case in stroke.

Emergency ambulance services are available across the whole of Australia but at a cost to the user (via health insurance, ambulance subscription, or payment) in all states except Queensland and Tasmania, where the service is publically funded and free to users. Of interest in our study, there was no difference between regions where ambulance services are free to users and those where the user is charged. Our study also suggests a greater effect in urban regions, although data for this exploration was not widely available; so, this finding must be treated with caution. The regional differences seen may relate to differences in access to the campaign or remoteness—rural patients often will use private transport to hospital for emergencies because of distance and time.

Our study is the first to examine the effect of a stroke campaign on calls to ambulance nationally, after adjusting for underlying trends. The major limitation of the study is the inability to determine whether these increases in calls are for true stroke and transient ischemic attacks, or other acute emergencies, or whether they are for stroke mimics. However, recent reports have shown that stroke campaigns are associated with increased stroke knowledge and improved health seeking behavior for stroke. As with all statistical modeling and as detailed in the methods, we also had to make several assumptions in the modeling. Nonetheless, we do not think that these will affect the interpretation of our main findings.

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Disclosures
Dr Bray provides unpaid consulting services to the National Stroke Foundation on campaign evaluations. Dr Finn receives salary support from St John Ambulance Western Australia. B. Barger is employed by Ambulance Victoria. The other author report no conflicts.

References


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Data Supplement (unedited) at:
http://stroke.ahajournals.org/content/suppl/2015/04/01/STROKEAHA.114.008515.DC1

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The impact of public awareness campaigns on calls to ambulance across Australia.

Janet E Bray, PhD, Monash University, Curtin University

Lahn Straney, PhD, Monash University

Bill Barger, ADHS, Ambulance Victoria

Judith Finn, PhD, Monash University, Curtin University

Includes:

Full details of Statistical Model –Page 2

Supplemental Table I: Dates of data provided by the ambulance services, regional population sizes and annual number emergency incidents. –Page 3
Statistical Model

Using data from January 2003 to June 2014, we used the log-transformed volume of calls as the primary outcome and each region-month as an observation, thus the Victorian Metro region in January 2005 constitutes one observation. We controlled for the number of days in the month using an index equal to the number of days in the observed month divided by 28. We modelled season separately and found that only winter was associated with a significant positive association. Thus we controlled for the winter season on the volume of calls using a dichotomous variable. To account for differences in the population sizes of each region, we entered each region as a categorical predictor in the model. We modelled population growth using a linear monthly index starting from January 2003. The rate of growth was allowed to vary by region using an interaction term between the index and the region.

We used separate variables for each campaign to indicate if a given region was “exposed” to a particular campaign in a given month. We assumed a region was exposed to the campaign if the campaign ran in that region in that month, or if the campaign had been run in the 3 months prior. Thus we allowed for a residual effect of the campaign after the advertising dates had been completed. We separately tested alternate lag periods, but found 3 months best described the data based on overall model performance. To account for differences in campaign funding, we used a binary variable to indicate if a campaign was paid in a given region.
**Supplemental Table I:** Dates of data provided by the ambulance services, regional population sizes and annual number emergency incidents.

<table>
<thead>
<tr>
<th>State (Region)</th>
<th>Dates of data available</th>
<th>Number of months of data</th>
<th>Population size 000’</th>
<th>Annual number of emergency incidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Victoria</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metropolitan</td>
<td>January 2003 - May 2014</td>
<td>137</td>
<td>5,791.0</td>
<td>536,872</td>
</tr>
<tr>
<td>Rural</td>
<td>October 2011 -- May 2014</td>
<td>32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New South Wales</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metropolitan</td>
<td>January 2003 - June 2014</td>
<td>138</td>
<td>7,465.5</td>
<td>733,635</td>
</tr>
<tr>
<td>Rural</td>
<td>January 2003 - June 2014</td>
<td>138</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Queensland</td>
<td>July 2003 - May 2014</td>
<td>131</td>
<td>4,690.9</td>
<td>644,376</td>
</tr>
<tr>
<td>South Australia</td>
<td>June 2009 - June 2014</td>
<td>61</td>
<td>1,677.3</td>
<td>226,225</td>
</tr>
<tr>
<td>Western Australia*†</td>
<td>January 2003 - May 2014</td>
<td>137</td>
<td>2,550.9</td>
<td>126,480</td>
</tr>
<tr>
<td>Metropolitan</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tasmania</td>
<td>January 2003 - June 2014</td>
<td>138</td>
<td>514.0</td>
<td>38,369</td>
</tr>
<tr>
<td>Australian Capital</td>
<td>August 2003 - May 2014</td>
<td>118</td>
<td>242.6</td>
<td>34,622</td>
</tr>
<tr>
<td>Territory†</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northern Territory‡</td>
<td>July 2005 - May 2014</td>
<td>107</td>
<td>384.1</td>
<td>20,022*</td>
</tr>
</tbody>
</table>

*Western Australia data for 2008 were excluded as the data provided was affected by industrial action and rural data were excluded as the dispatch service was centralised over the study period. † All ambulance services except Australian Capital Territory use Medical Priority Dispatch System (MPDS) and Western Australia switched to MPDS in May 2011. ‡ Northern Territory data were only available for Darwin, Palmerston, Katherine and Nhulunbuy regions.