**Manuscript title:**

Did the “croaky voice” public health campaign have any impact on the stage of presentation of 84 cases of laryngeal cancer in the Humber and Yorkshire Coast Cancer Network

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**Abstract**

**Introduction**

A public health campaign on laryngeal cancer was conducted in 2011 in the Humber and Yorkshire Coast Cancer Network (HYCCN). This study evaluated for subsequent impact (if any) upon the stage of presentation of laryngeal cancer.

**Materials and Methods**

Laryngeal cancers diagnosed in the HYCCN from January 2009 to July 2014 were identified from cancer registries and were dichotomised into early (T1-T2) and late (T3-T4) disease. Statistical analysis using segmented regression analysis of interrupted time series data was performed.

**Results**

There were no statistically significant changes in laryngeal cancer cases immediately after the intervention for both early (p=0.191) and late (p=0.680) laryngeal cancers. There were also no significant changes to monthly rates of detection in both groups on follow-up.

**Conclusion**

We describe findings of the first public health campaign on laryngeal cancer in the UK. Such processes are complex and we subsequently discuss implications for future study.

Keywords: Laryngeal cancer, cancer, public health, health campaign, health promotion

**Introduction**

Analysis of former cancer networks throughout the UK has shown the highest incidence of laryngeal cancer to be in parts of Scotland and Northern England; with lowest rates being recorded in the South of England1. The population served by the Humber and Yorkshire Coast Cancer Network (HYCCN) has one of the highest incidence of laryngeal cancer in the country amongst older males (age 50-74 years)2. A five-year epidemiological study performed by the local health authority identified up to a ten-fold difference in incidence of laryngeal cancers between 106 electoral wards within the HYCCN3. The electoral Wards with the lowest incidence reported rates of 3 per 100,000, whereas incidences of 25-30 per 100,000 were recorded for the wards of Myton and Marfleet in Hull2-3. Public health data indicated that Myton ranked in the top five electoral wards for risk factors associated with laryngeal cancer to include binge drinking levels, smoking prevalence and social deprivation.

A public health campaign targeting specific high-risk electoral wards in the Hull and Grimsby areas was launched in September 2011 and lasted for three months. The campaign used a multi-modal approach to public engagement which included radio, television, internet and poster media coverage. Further details of the campaign can be found at [www.getitchecked.co.uk](http://www.getitchecked.co.uk)4. It was considered that the public health campaign would improve knowledge, health-seeking behaviour and prompt earlier presentation and diagnosis of laryngeal cancer thus improving survival outcomes. Existing publicised analysis upon the effectiveness of the campaign (cancer awareness measure and recall) has shown a limited effect3. This study specifically assesses the early impact of the public health campaign upon the stage of presentation of laryngeal cancer in HYCCN after September 2011 to present date.

**Materials and Methods**

*Data collection*

Details of patients presenting with laryngeal carcinoma within the HYCCN were obtained from the regional cancer database and DAHNO (Data for Head and Neck Oncologists) registry for the dates inclusive of January 2009 to July 2014 (67 months total). This included the dates of the public health campaign which was conducted from September 2011 for three months.

Stage of laryngeal cancer presentation was dichotomised into either, early (T1 and T2) or late (T3 and T4) disease. Staging of laryngeal cancer followed the standardised consensus technique for Head and Neck Squamous Cell Carcinoma5. Trends related to stage of presentation were evaluated, particularly in relation to the public health campaign. The findings were statistically analysed using segmented regression analysis of interrupted time series.

*Statistical analysis*

Segmented regression analysis of interrupted time series data allows assessment, in statistical terms, of how much an intervention changed an outcome of interest, immediately and over time (Figure 1).

To assess the fit of the final model, we examined residuals around the predicted regression lines. The partial autocorrelation function (PACF) and autocorrelation function (ACF) residual plots were examined. The Durbin-Watson statistic is used to assess remaining auto-correlation. The Durbin–Watson statistic, reported by most least squares regression programs, tests for serial autocorrelation of the error terms in the regression model. Values close to 2 indicate no serious autocorrelation. Statistical significance was set at (p < 0.05).

*Ethical considerations*

The public health campaign was registered with the Hull and East Yorkshire Research and Development committee.

**Results**

A total 198 laryngeal cancers were diagnosed in the HYCCN during the study period (January 2009 to July 2014). Prior to the public health campaign, 114 laryngeal cancers were diagnosed whereas 84 laryngeal cancers were diagnosed following (and inclusive) of the campaign. The number of early (T1-T2) laryngeal cancers diagnosed totalled 46 pre-campaign, and 46 post-campaign. For late (T3-T4) laryngeal cancers, there were a total of 68 and 38 diagnosed pre- and post-campaign respectively.

*Early (T1-T2) laryngeal cancer*

Findings from the regression analysis for early stage (T1-T2) patients can be found in Table 1 and Figure 2. Prior to the intervention there was an annual rise of 0.039 in the number of cases, but this was not statistically significant (p=0.115). There was no statistically significant change in the number of cases immediately after the intervention (p=0.191).

Following the intervention there was a rise of 0.013 (0.039-0.026) in the number of rate of cases per month. These trends were not statistically significant (p=0.443).

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*Late (T3-T4) laryngeal cancer*

Findings from the regression analysis for late stage (T3-T4) patients can be found in Table 1 and Figure 3. Prior to the intervention there was an annual fall of -0.036 in the number of cases, but this was not statistically significant (p=0.052).

There was no statistically significant change in the number of cases immediately after the intervention (p=0.680).

Following the intervention there was a decrease of -0.028 (-0.036+0.008) in the number of rate of cases per month. These trends were not statistically significant (p=0.767).

**Discussion**

*Summary of main findings*

Results show no statistically significant differences in the stage of presentation of early (T1-T2) and late (T3-T4) laryngeal cancers following the public health campaign. Prior to the campaign, the annual number of early (T1-T2) laryngeal cancer presentations were steadily increasing (+0.039), whereas the number of late (T3-T4) were falling (-0.036). These numbers were not affected (statistically) by the campaign.

Monthly rates of early (T1-T2) and late (T3-T4) laryngeal cancers increased (+0.013) and decreased (-0.028) respectively in relation to the public health campaign, however, were not statistically correlated with the intervention.

Although our study did not identify any significant correlation, it is interesting and useful to highlight the current trends in laryngeal cancer for the region. Our analysis may serve as a useful barometer into the ongoing trend in stage of presentation of laryngeal cancer (on a larger scale) and may help reflect the current status of public health awareness. These trends may be associated with evolving awareness from growing local, regional national media coverage, access to social media and existing public health campaigns for detecting cancer. Some of the findings that were observed from our study may be expected following a public awareness campaign particularly in the early period, where participants would be expected to seek medical attention for key symptoms highlighted in the media. Theoretically, rates of detection of early cancers would be expected to rise as was the case with the findings observed in our study. However, due to the pre-existing trend in cancer detection rates (early and late cancers as shown by Figures 2 and 3) it would be difficult to comment on the role of such a short lived campaign to the findings at this current stage. It is more likely that such a limited public health campaign would lead to changes in presentation of patients to General Practitioner’s (GP) and urgent 2-week wait referrals to specialists. Previously published work performed upon this campaign (Sethi et al3) has shown that there to be an increase in numbers of those presenting to the GP with symptoms of throat cancer (activity peak and post campaign), however did not show any significance when compared to the control group (appropriately matched electoral Ward). Despite an apparent increase in 2-week wait referrals with relation to the campaign, the authors concluded that due to the pre-existing trend of year-on-year increase in referrals, it would be difficult to fully attribute the changes seen to the public health campaign.

*Implications for future study*

Due to the complexity of public health campaigns, evaluation of their effectiveness is often difficult. It is considered that to fully evaluate the impact of the public health evaluation, that the “credibility, completeness and transferability” of the evidence should be examined6.

Although, it is not in the scope of this article to discuss the effectiveness and limitations of this public health campaign, it is evident that there are several factors which directly or indirectly effect interpretation of the data derived from it. The occurrence of negative findings within our study (i.e. no statistical significance) must raise several questions. Has the research failed to identify an effect when one truly exists? (failure in evaluation) or is there truly no effect? (program failure)7. Increasing the follow-up period may help further evaluate latent (post-campaign) responses. However, programme failure may be further dichotomised by considering it as an inadequacy of the campaign itself or its implementation. The public health campaign was targeted towards high-risk electoral Wards in the HYCCN identified from preliminary epidemiological data. As our study looked retrospectively at the total number of laryngeal cancers presenting to the HYCCN, and not by electoral Ward, a true reflection of the effectiveness of the campaign may not have been identified from our analysis as results may have become “diluted” by the regions not exposed to the intervention. A more accurate picture could be seen if stage of presentation of laryngeal cancer by electoral Ward was assessed following the intervention. However, a counter-argument may suggest that the study would expect to detect a significant change in cancer diagnosis as it would be expected that a larger number of laryngeal cancers would arise from those geographical areas at highest risk, thus increasing overall cancer detection numbers. In addition, it may also be postulated that the effect of the campaign may not truly be localised to the electoral Ward, due to the wider reaching effects of media coverage (e.g. radio, sports events and internet advertisement) and local migration. These issues make assessment of the effectiveness of public health campaigns difficult to interpret. Sethi et al3 suggested that inadequate implementation could be related to several factors to include the length of campaign and limited use of the most effective medium (Television). It is more than likely that a single 3-month period represented too short and infrequent time-frame to influence a significant change in behaviour and ultimately stage of presentation of laryngeal cancer for the region. This theory may be supported by previously published findings from the post-campaign survey which showed limited improvement in awareness and a rapid decline in recall3.

Our findings suggest that the “croaky voice” public health campaign had a limited effect upon the number of presentations of laryngeal cancer in HYCCN. It is difficult to currently attribute any of the changes seen in our analysis to the campaign due to the complexities within the design and assessment of public health interventions. For this reason, the several factors discussed must be taken into account in any future public health campaign targeting populations with Head and Neck cancer.

**Conclusion**

The “croaky voice campaign” was the first of its kind to address laryngeal cancer in the UK. Our evaluation of the initial results has shown trends to suggest limited alterations in the rates of early (T1-T2) and late (T3-T4) laryngeal cancers relative to the campaign. However, at this stage the relationship remains unclear. Several key factors have been described in the setting of performing public health campaigns and evaluating the results which must be considered when planning future study. These include use of more effective media channels, longer implementation of intervention and a prolonged follow-up period.

Conflict of interest: none declared

**Summary**

* This was the first public health campaign for laryngeal cancer performed in the UK
* Findings suggest limited changes in stage of presentation of laryngeal cancer in relation to campaign
* Public health campaigns are complex processes
* more effective media channels, longer implementation of intervention and a prolonged follow-up period are required for future study

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**Tables**

**Table 1 – Parameter estimated from the Segmented Regression analysis for early stage (T1-T2) and late stage (T3-T4) laryngeal cancer patients with relation to the public health campaign**

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| --- | --- | --- | --- | --- | --- | --- |
|  |   | **Coefficient** | **SE** | **Beta** | **t-statistic** | **p-value** |
| **Early stage (T1-T2) laryngeal cancer** | DW=2.1 |  |  |  |  |  |
| Intercept | 0.729 | 0.477 |  | 1.530 | 0.131 |
| Baseline Trend | 0.039 | 0.024 | 0.570 | 1.599 | 0.115 |
| Level change after intervention | -0.865 | 0.654 | -0.326 | -1.322 | 0.191 |
| Trend after intervention | -0.026 | 0.034 | -0.220 | -0.772 | 0.443 |
| **Late stage (T3-T4) laryngeal cancer** | DW=1.5 |  |  |  |  |  |
| Intercept | 2.710 | 0.358 |  | 7.573 | 0.000 |
| Baseline Trend | -0.036 | 0.018 | -0.631 | -1.984 | 0.052 |
| Level change after intervention | 0.203 | 0.491 | 0.091 | 0.414 | 0.680 |
| Trend after intervention | 0.008 | 0.025 | 0.076 | 0.297 | 0.767 |

**Figures**

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| Y *t* = β0 + β 1 x time *t* + β 2\*intervention + β 3\*time after intervention *t* + et |

Figure 1: Segmented regression model - Yt is the outcome in month t; β0 estimates the baseline level of the outcome at time zero; β1 estimates the change in the outcome that occurs with each month before the intervention (i.e. the baseline trend); β2 estimates the level change in the outcome immediately after the intervention, that is, from the end of the preceding segment; and β3 estimates the change in the trend in outcome after the intervention, compared with the monthly trend before the intervention; The error term (et) at time t represents the random variability not explained by the model

**Figure 2 – Regression analysis for early stage (T1-T2) patients**



**Figure 3 – Regression analysis for late stage (T3-T4) patients**

