The Potential Impact of Air Pollution Coverage in the Media on Respiratory Disease Admissions

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Introduction

Air pollution is well known to exacerbate respiratory disease [1, 2]. However, when air quality warnings are provided by authoritative bodies (e.g. MET office) subsequent media coverage may be disproportionate. In this study we explore whether there is an association between respiratory admissions and media pollution coverage via non-linear predictive models, and to potentially predict respiratory admissions.

Method

The relationship between media coverage of pollution and respiratory admissions was examined as follows:

1. Baseline regression models were generated to predict daily respiratory admission episodes over the period 1st January 2009 - 9th April 2014. Predictors consisted of daily logs for PM10 particulate matter, PM2.5, Nitric oxide, Nitrogen dioxide, Ozone, Black carbon, Mean Temperature, Precipitation (obtained from National Oceanic and Atmospheric Administration data) and the DAQI Air Pollution Index. Models were optimized via cross-validation using daily number of admissions to Nottingham University Hospitals, which were identified by over 70 ICD10 codes.

2. Time series of levels of media coverage were generated by applying kernel density estimation (KDE) to daily counts of online news articles featuring pollution and air quality issues from 1st January 2013 – 9th April 2014. A range of bandwidths were examined (1, 10, 25, 50 and 100 days) in order to reflect the ongoing impact these news stories might have, using both linear and exponentially decaying kernels.

3. Relationships between the input variables (pollution levels and media coverage) and the target variable (respiratory admissions) were examined using both 1. traditional linear regression techniques, and 2. non-linear predictive models drawn from the field of machine learning. The accuracies of these models were tested with and without integration of media coverage in order to ascertain the contributing impact of that variable.

Results

- There were a total of 16,756 emergency admissions for respiratory problems over the whole period, and the predictive model was trained on a subset of this (4,133 emergency admissions).
- Of the multiple baseline predictive models tested a random forest provided optimal results for air-quality predictors. When predicting daily respiratory admissions, the model’s accuracy was 19.90% better than simply predicting mean daily admissions, with an average root mean square error (RMSE) of 7.50.
- However, introduction of the media-coverage variable, this RMSE was reduced to 7.32, increasing improvement over mean prediction to 21.85%. While this did reflect an improvement in admissions forecasting, a corrected t-test indicated that these differences were not statistically significant (with a p-value of 0.06).

Conclusion

Initial results indicate that consideration of media coverage may well offer improvements in predicting respiratory admissions. However, more datapoints are required as currently this effect was not found to be statistically significant. While this relationship requires further investigation, models informed by media coverage cannot currently be considered to be accurate enough for use in a practical setting.

Next Steps

The effect of Media on health seeking behaviour is still relatively unexplored and our attempt to model it using KDE could be refined through further qualitative research. There’s also a need to define what is considered “media” - in this study only online news stories were used in the model, but media coverage of this and similar events was evident in different platform/formats (e.g. TV, Radio, Social Media, Printed Newspapers). The advantages of using machine learning techniques were restricted due to limitations in the quantity and quality of data currently available.

References

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