ALCOHOL RESEARCH UK

Nowcasting of population alcohol-related harms using novel Bayesian timeseries methods and synthetic controls
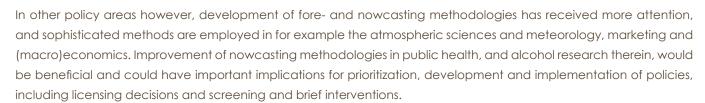
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Key findings

- This Bayesian structural time-series modelling framework can provide relatively accurate 1-5 year forecasts of temporal trends in local alcohol-related hospital admissions in England for all lower tier local authorities.

- The number of annual alcohol-related hospital admissions in England is forecasted to increase by just over 4,000 in 2021, corresponding to a decrease of 2.3% in the crude rate.

- Forecasted regional average 2021 forecasts indicate highest increases in the North West and East Midlands, and largest decreases in London and East of England.

- Largest increases in 2021 are forecasted in areas classified as 'Urban Living', 'Seaside Living' and 'Prosperous Semi-rural', and largest decreases in 'Ethnically Diverse Metropolitan Living' and 'London Cosmopolitan'.

- 5-year forecasted impact from alcohol taxation on alcohol-related hospital admissions is small but beneficial, with a 0.2% decrease in expected alcohol-related hospital admissions, with a greater reduction in areas with higher levels of deprivation.

- Trends seem related to alcohol harms disproportionally affecting more deprived communities a demographic trend of middle-aged and older adults moving away from cities to (semi-) rural and seaside towns.

Researchers

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Background

Fore- and nowcasting of expected population trends in the burden of alcohol-related harms is undertaken in order to plan for the future and to examine whether policies are likely to lead to positive or negative impacts. Nowcasting is the prediction of the present, the very near future and the very recent past, while Forecasting refers to the process of making predictions of the future. However, current methods are mainly based on straightforward extrapolation of observed trends and standard regression models. Also, forecasts are generally not, but would ideally be, available at different geographical levels to provide additional information on local variations in the expected burden of alcohol, or the likely effect of specific policies in different areas of the country.

In other policy areas however, development of fore- and nowcasting methodologies has received more attention, and sophisticated methods are employed in for example the atmospheric sciences and meteorology, marketing and (macro)economics. Improvement of nowcasting methodologies in public health, and alcohol research therein, would be beneficial and could have important implications for prioritization, development and implementation of policies, including licensing decisions and screening and brief interventions.

Project Aims

This 'proof of principle' study aimed to utilize a novel analysis framework, Bayesian structural time series, to improve now/forecasting for alcohol research and public health policy making.

Methods

Bayesian structural time series (bsts) combine a basic structural model for trends and seasonality, spike and slab regression for variable selection, and Bayesian model averaging over the best performing models to produce forecast for timeseries data. This methodology may be more beneficial than other methods as it allows for temporal trends in the associations between outcomes and predictors to be incorporated, while also Bayesian model averaging makes forecasting minimally dependent on specific hypothesized (and therefore potentially incorrect) model specifications.

Bsts were used to independently nowcast (to compare to known, measured, annual alcohol-related hospital admissions, and assess accuracy) and forecast most likely alcohol-related hospital admissions in 2021 for each of 326 local authorities in England.
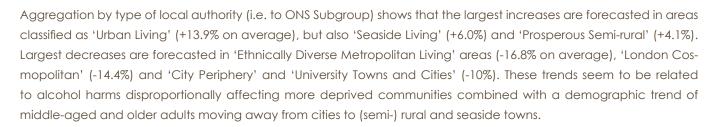
In addition, this project explored whether the same modelling strategy can be used to estimate the local and national impact of alcohol policies implemented in the past, which would similarly be important for evidence-based future policy making with respect to alcohol-related harms.

Analyses were based on freely available data on alcohol-related hospital admissions from the Local Alcohol Profiles for England (2003/4 to 2015/16) and historical and projected demographic trends (in 10-year age strata) in England from ONS. Data were available for 324 of 326 English lower tier local authorities (City of London and Isles of Scilly were excluded).

Results

5-year nowcasting models were run to estimate alcohol-related hospital admissions in each of 324 local areas for 2015/16, which were then directly compared to the measured numbers available from LAPE. The Bayesian structural time-series approach generated relatively accurate and acceptable estimates of time trends with an average 5-year (to 2015/16, based on 2002/3 to 2010/11 timeseries) casting error of approximately -2% and average local error 13% (increasing from 6%-10% for 1 to 10-year nowcasts), ranging -48.7% to 62.0% for individual local authorities but within 10% for about half. There was no evidence of geographical correlation in nowcasting errors.

Forecasting the trends in the annual number of alcohol-related hospital admissions to 2021 showed that, at the national level, these are estimated (if no other changes occur) to increase by an extra 4,265 by 2021. However, in relative terms this corresponds to a reduction in the crude rate of 2.3%. The individual local area models enable aggregation to higher-level geographies, and average 2021 forecasts by region indicated highest increases (relative to 2016) in the North West (+4.3% on average) and East Midlands (+1.3%), while the highest average reductions in rates are forecasted for London and the East of England (-14.6% and -4% on average, respectively).

Aggregation by type of local authority (i.e. to ONS Subgroup) shows that the largest increases are forecasted in areas classified as 'Urban Living' (+13.9% on average), but also 'Seaside Living' (+6.0%) and 'Prosperous Semi-rural' (+4.1%). Largest decreases are forecasted in 'Ethnically Diverse Metropolitan Living' areas (-16.8% on average), 'London Cosmopolitan' (-14.4%) and 'City Periphery' and 'University Towns and Cities' (-10%). These trends seem to be related to alcohol harms disproportionally affecting more deprived communities combined with a demographic trend of middle-aged and older adults moving away from cities to (semi-) rural and seaside towns.

The 5-year forecasted impact from forecasted real alcohol taxation on alcohol-related hospital admissions is, overall, small but beneficial, with a 0.2% decrease in expected alcohol-related hospital admissions. Alcohol taxation is expected to lead to a greater reduction in alcohol-related hospital admissions in areas with higher levels of deprivation.

Conclusion

This 'proof-of-principle' study showed that this novel modelling framework can provide accurate forecasts of temporal trends in local alcohol-related hospital admissions in England for all lower tier local authorities and may well be useful for future policy making at the local, regional and national level.

Future work will include detailed assessment of the precision of these estimates, optimization of model specifications including the possibility of including additional modifiable factors, and will also explore applications to other scenarios, including non-alcohol related outcomes.

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