The Alcohol Systems Model

Symmetric

System Dynamics was used to represent the impact public health interventions could have on alcohol attributable hospital admission, which can amount to over a million hospital admissions per annum. The model enabled time profiled cost-benefit to be calculated, clearly showing that a modest investment in a high-volume, low-intensity, brief intervention would result in reduced hospital admissions.

Background

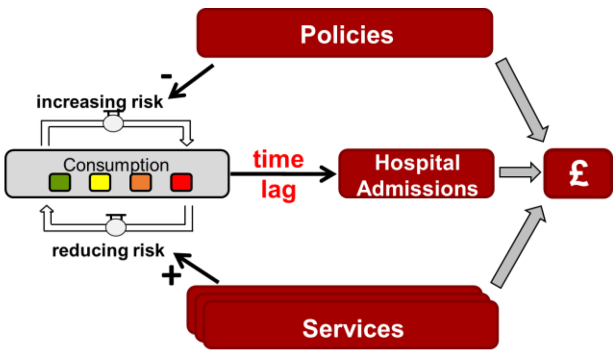
The Department of Health (DH) engaged Symmetric to build a simulation model exploring the case for commissioning innovative, low-cost services designed to reduce harmful alcohol consumption, and to support capacity planning at local level. The model was intended to replace an established spreadsheet 'ready reckoner'. Using group model-building, the model drew on expert opinion, integrated research findings from a range of sources, and highlighted a familiar, non-linear, commissioning conundrum that 'things may have to get worse before they get better'. The model was approved as a commissioning tool, and made available for use by Primary Care Trusts.

Approach

The model was developed by an expert group comprising clinical and academic experts in alcohol abuse and the adverse impacts of alcohol, health economists, social and operational researchers and policy makers. A further strand was an academic evaluation carried out by management scientists.

The issue addressed here was not alcohol dependence, alcoholism, or anti-social behaviour, but the much wider problem that 20% of the adult population regularly drink at a level that increases their risk of being admitted to hospital for a wide range of 'alcohol attributable' reasons. At the time of the study, this amounted to over a million hospital admissions per annum, wholly or partly attributable to alcohol consumption, in England, across a range of conditions such as various cancers, diabetes, heart conditions, liver disease, and accidents. Providing as little as four sessions of 'brief advice' to people admitted to, or attending, hospital, or in primary care settings, where alcohol consumption might be a factor, has been shown to help individuals reduce alcohol consumption. Because there is a time-lag between a change in alcohol consumption and an improvement in health, it may take some time for investment in low-cost 'brief interventions' to translate into a saving in occupied bed days.

A population-level System Dynamics model was developed, model conceptualisation shown below. The entire adult population is represented as four stocks, Consumption groups from the government's annual General Lifestyle Survey (abstainers, drinking at low risk, drinking at increasing risk, drinking at high risk). People move (flow) between these stocks in both directions, not necessarily stepwise.

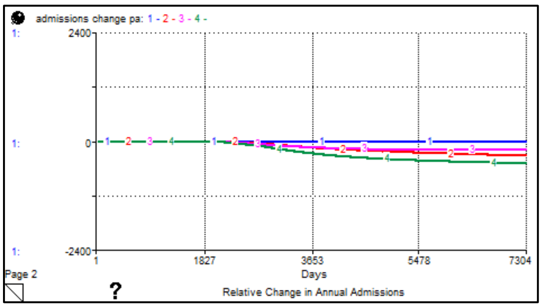


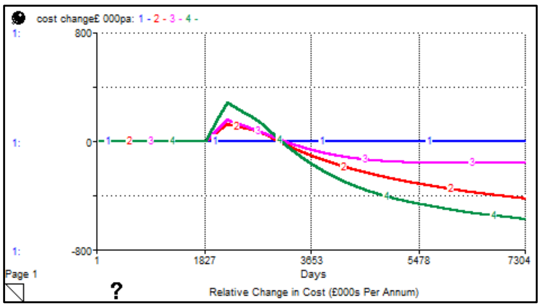
These flow rates had not previously been measured; an analysis which became an informative by-product of the project. To estimate the underlying flows between consumption groups, DH researchers conducted a secondary, longitudinal analysis of household data, drawn from two consecutive years of the General Lifestyle Survey. This involved making assumptions about individual behaviour based on household-level data. When these estimates were used to drive flows in the SD model they produced a good fit with the Department's own assumptions about consumption distribution.

The distribution by consumption group produces a rate of *Hospital Admissions*. By commissioning *Services*, over time there is an increase in flow rates in the direction of reduced consumption. This change in consumption, after a *time lag*, manifests itself in fewer hospital admissions. The time lag varies for different conditions; for example, there is an immediate change in people's propensity to have accidents, but liver damage takes longer to heal. Another part of the model is *Policies*, such as strategies to reduce alcohol sales, and hence, *Consumption*.

Results

The model contains much detail representing multiple medical conditions and several types of intervention, but its basic dynamics are shown on these two graphs, showing change in admissions and cost, over time, comparing each run against a Base run (do nothing) over a 20 year period in days.





A new intervention is introduced at the five year point (day 1827). Run 1 is the Base Run - there is no 'change in' anything, so it takes the value 0. Run 2 and Run 3 show two different interventions (brief advice provided in primary care, and in secondary care). Finally Run 4 combines both interventions modelled in Runs 2 and Run 3.

The left hand graph shows clearly the time lag between the intervention point and a gradual reduction in hospital admissions. The right hand graph shows the cost implications. There is an initial increase in expenditure but it takes time for savings realised from reductions in hospital utilisation to be realised. It takes more than two years for total expenditure to reduce and around five years before cumulative spend is lower.

Worth noting is the unique contribution of System Dynamics. Because the behaviour of the whole system depends on the dynamics of the consumption chain, where, at all times, people (treated or not) flow between consumption groups, the impact of treatment on reducing hospital use is significantly muted, compared with the Department's spreadsheet extrapolations. The spreadsheet forecasts of the impact of brief interventions were shown to be unrealistically optimistic.

Impact

The model provided for the first time a means of integrating a range of research findings (population consumption, impact of brief interventions on consumption, impact of change in consumption on hospital use) at population-level, over time, in the form of a model that could be used to support local commissioning.

Further information

At the time of writing, the model is available to download and use from Public Health England.

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The prize was awarded to Douglas McKelvie, Steve Arnold, Eric Wolstenholme and David Monk from Symmetric.