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▶ Modeling the cost-effectiveness of health care systems for alcohol use disorders: how implementation of eHealth interventions improves cost-effectiveness.

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Computer simulation suggests that health would improve and/or costs be reduced if on-line brief interventions and therapy were added to or replaced conventional alcohol-related health care; these results for the Netherlands are based on a simulation model applicable as an aid to national policymaking in other countries.

Summary Emergence of evidence-based eHealth technologies offers opportunities to reach population segments hitherto not reached because they live in rural areas or have shied away from face-to-face services out of fear of stigma. The new technologies are also very scalable and could be cost-effective, especially when offered as well-structured self-help interventions or as interventions with (minimal) therapist support. Given the global health gap with regard to alcohol use disorders, these developments could become quite important. However, to date there is only limited evidence for their cost-effectiveness.

The featured analysis aimed to address this gap by conducting a population-level evaluation of the possible health gains and costs of adding new eHealth technologies to an existing 'base-case' health care system for alcohol use disorders. The aim is to enable planners to select the optimal mix of interventions to cost-effectively advance public health. An optimal health care system might meet the following criteria:

- acceptable to recipients;
- scalable to absorb increasing demands for health care;
- effectively generates the required health gains; and
- sufficiently inexpensive to be sustainable.

With these aims in mind, we developed a mathematical model (ALCMOD) of how a mix of alcohol interventions might affect public health in a country and how much they would

cost. ALCMOD is programmed in Microsoft Excel, available on most computers. An important limitation is the model's focus on short-term impacts up to one year. This avoids making some unproven assumptions and simplifies the model but also limits its ability to fully represent health gains and costs. Strengths include its ability to evaluate combinations of interventions, adaptability to different populations and settings, its capacity to handle uncertainty, and the way it incorporates coverage (the proportion of the target population reached by the intervention) and adherence rates (the proportion of the reached population who complete the intervention) for each of the modelled interventions.

The Netherlands is used an example to illustrate how one might compute the impact of changes in alcohol health care, in this case by augmenting or partially replacing the current system with three eHealth interventions:

- DrinkTest, a brief on-line intervention consisting of screening one's alcohol use followed by automated personalised advice;
- DrinkingLess, an on-line four-step cognitive-behavioural intervention involving exploring one's alcohol use, setting goals, changing behaviour, and maintenance of behaviour change;
- OnlineTreatment, an on-line therapist-led treatment for problem drinking; communication between participant and therapist is conducted over the internet in seven chat sessions of 45 minutes each covering setting goals, self-control techniques, monitoring, recognising relapse-precipitating situations, and relapse prevention techniques.

These three eHealth interventions increase in intensity and could be used in a stepped-care framework, starting with the least intensive intervention, the DrinkTest, and if needed moving up to the more intensive levels of DrinkingLess and OnlineTreatment.

How ALCMOD works

Given the country, ALCMOD automatically uploads the age and sex distribution of the population and corresponding mortality rates. ALCMOD needs to be told the size of the target population (in the Netherlands, 993,200 male and 222,800 female adult problem drinkers) and how they score on the AUDIT screening questionnaire for risky drinking. By default, the model assumes a range of face-to-face and eHealth interventions for heavy, hazardous, and harmful alcohol use and alcohol dependence, which can be changed to represent the current situation and the envisaged changes.

For each intervention the model needs the coverage rate and adherence rates and the full per-participant costs – in the example, expressed in €s (euros) for the Netherlands for the year 2009.

The impacts of these interventions on health-related quality of life are calculated from the effect sizes of their impacts on the severity of drinking, using the conversion formula that an effect size shift of 1 results in a quality of life shift of 0.18 on a scale of 0 to 1. Impacts in terms of the % reduction in alcohol intake are used to model effects on mortality, effects attenuated somewhat by the persisting effects of pre-intervention drinking. In the example, effect sizes were extracted from research findings, but all interventions were assumed to reduce alcohol intake by 20%, the effects of which on mortality were attenuated by 20% for pre-intervention drinking. Another assumption (the

adherence rate) was that half the people reached by an intervention completed it.

Together impacts on health and deaths can be used to calculate savings in disability adjusted life years (DALYs − a combination of lost years of life due to problem drinking and quality detriments during life) generated by a new mix of interventions as opposed to the current situation. In turn these savings can be expressed as a ratio of the difference in costs to arrive at the incremental cost-effectiveness ratio (ICER). In one figure, this expresses whether the envisaged health care system offers better value for money (saves a disability adjusted life year at lower cost) than the current system.

Main findings

This model was applied to a scenario in the Netherlands in which eHealth alcohol interventions were added to conventional care in different mixes depending on the severity of the user's drinking, from heavy (in excess of guidelines but not yet substantially risking health) through to dependent. The (unrealistic) assumption was made that the new delivery vehicles would attract new segments of each of these target populations to alcohol-related health care. DrinkTest was assumed to impact on heavy and hazardous drinkers, DrinkingLess on hazardous and harmful drinkers, and OnlineTreatment on harmful and dependent drinkers.

The model calculated total current alcohol health care costs at €233 million. Adding the eHealth interventions would raise this to €319 million, but at the same time increase the saving in disability adjusted life years from 5022 to 10,319 (including avoiding 32 alcohol-related deaths). In turn this means each extra disability adjusted life year costs about an extra €16,000. For other disorders, the Netherlands is prepared to pay at least €20,000 to save an extra year, making the addition of alcohol eHealth interventions an acceptable expense.

Taking in to account a degree of uncertainty in the figures, it can be calculated that if each saved year is considered worth at least €30,000, the new eHealth-supplemented health care system is virtually certain to be more cost-effective than the current system. Assuming that each saved year is 'worth' €50,000 − the lowest figure customarily accepted in the Netherlands − the current alcohol health care system saves €1.08 for each € spent, but the new system would save €1.62.

It is also possible to make the same calculations on the assumption that instead of supplementing current interventions, eHealth interventions partially replace them. That is, instead of engaging new populations in health care, the same populations as before are engaged by a mix of eHealth and conventional interventions. Then the model calculates that virtually the same number of disability adjusted life years are saved but for €68 million less in health care costs, meaning that (again assuming each year is worth €50,000) a saving of €1.06 per € spent rises to €1.52.

The authors' conclusions

ALCMOD's simulations suggest that added to conventional care, widespread implementation of eHealth interventions for alcohol use disorders would substantially increase population health in the Netherlands, albeit at higher costs as more people become the recipients of the expanded system. The cost-effectiveness of the Dutch health system would also substantially improve if the new interventions partially replaced

some current face-to-face interventions. The actual result is probably somewhere between these extremes, because it is unlikely that the new eHealth interventions would exclusively recruit people who would not otherwise have received conventional health care, or, at the other extreme, only such people. But whatever the mix, widespread introduction of eHealth technologies would substantially increase the efficiency of the Dutch health care system.

While such calculations will aid decision-makers, they are not the whole story. Most fundamentally, setting priorities for health care delivery is about acceptability and equity as well as cost-effectiveness. Also, ALCMOD only models clinical interventions, disregarding other public health options such as banning alcohol advertising, taxing, restricting access to alcoholic beverages, and improving road safety. Correspondingly, it is also concerned solely with costs incurred by the health care system. Within this limited remit, the model takes no account of start-up costs or delays in impact or less or un-predictable consequences of introducing the new technologies, such as perhaps an increased demand for conventional health care. On the other side, ALCMOD ignores the longer-term impacts of the modelled interventions on quality of life, mortality, and health care utilisation. In other words, ALCMOD only models incremental health gains and health care delivery costs over a short time horizon, assuming a steady state in the modelled health care systems.

FINDINGS The key figures generating the results of the analysis are the costs of the different interventions and their relative effectiveness in terms of impacts on problem drinking and thereby quality of life. While costs can be estimated on a comparable basis, the same is not necessarily the case for effectiveness. On these grounds it can be questioned whether the featured analysis − though a valid *illustration* of the use of the model − has returned a valid *result* in terms of the benefits of introducing on-line therapies in the Netherlands. Details below.

Standing out is the presumed effectiveness of OnlineTreatment, an on-line therapist-led treatment for problem drinking. Based on a single Dutch study, the intervention is modelled as around twice as effective as comparator face-to-face treatments. For example, the effect size of 0.59 for dependent patients appears to contrast well with the 0.32 of a comparator cognitive-behavioural programme. However, the contrast is of the classic 'apples and pears' variety. Firstly, the comparator's impact is derived not from a single study in the same country as the on-line option, but from a synthesis of mainly US studies. For the on-line option, the effect size reflected its benefits in relation to offering no intervention but placing patients on a waiting list. In contrast, the comparator effect size cited in the featured analysis includes studies comparing the face-to-face approach to another active treatment as well as to no treatment. Yet, like the on-line alternative, face-to-face therapy was significantly more effective when contrasted to no treatment than to another treatment; on this yardstick, its effect size was 0.94 − not almost half the impact of the on-line treatment, but nearly 60% greater. Though this figure did not derive specifically from dependent drinkers, across all the studies the impact of the face-to-face approach was virtually identical for dependent versus problem drinkers.

See other Findings analyses for a review of computer-delivered self-help interventions for drinking and smoking and a review focused on drinking. These analyses offer further commentary on the role of computer delivery and on UK findings.

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