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A collaborative approach to bridging the research-policy gap through the development of policy advice software

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Abstract

We have developed a software-based tool to support a dynamic micro-simulation model of life-course development (to age 13) as an aid to policy makers assessing the impact of policies affecting children. We demonstrate how this approach bridges the research-policy gap by creating: (i) an easy transfer of evidence in a form that policy-makers can use (e.g., “What is the policy influence of X on Y?”); and (ii) a “pull” system of knowledge transfer by which policy makers control the knowledge they access. The advantage of close collaboration with policy makers in the development and implementation phases is also discussed.

Background

There is a growing body of literature on how best to translate research evidence into policy. Historically, linear models of knowledge translation have been prominent whereby researchers produce knowledge which is then disseminated to end users (Best & Holmes, 2010). This is often described as a “push” system whereby the knowledge produced is “pushed” to policy makers for their use (Stewart and Oliver, 2012). This approach can suffer from mismatches between the knowledge that the researcher produces and the knowledge that the end-user wants. Indeed, governments have sometimes found it necessary to establish research institutes to undertake policy research because of the unwillingness or unpreparedness of traditional research ‘producers’ (i.e., universities) to do so (Nutley et al., 2010).

A “pull” system of knowledge translation involves policy makers seeking out or requesting information to fit their purpose (Stewart and Oliver, 2012). The “pull” system can work in place of or as complementary to the “push” system, though both emphasise the gap between researchers and policy makers across which information needs to be pushed and pulled.

To bridge this gap, some institutions have employed ‘knowledge brokers’ whose role it is to ‘translate’ the evidence produced by researchers into a form that is readily understood and usable by policy makers (Frost et al., 2012; Knight and Lightowler, 2010; Lomas et al., 2007). More recently, a partnership approach between researchers and policy-makers has been suggested by which both partners work together to produce the evidence needed for policy (Best and Holmes, 2010; van Egmond et al., 2011). Such research-policy collaborations have been shown to engender greater commitment to the project goals (Newman et al., 2011) and better translation of research findings (van Egmond et al., 2011). For example, a policy-

research partnership to evaluate a policy initiative was found to increase the acceptance of the findings by both parties (Newman et al., 2011).

The aim of this paper is to describe how a decision support software tool bridges the research-policy gap and thereby provides unique benefits for policy makers. This tool has been developed specifically to help policy makers assess the impact of policies affecting children, and is the result of collaboration between researchers and policy makers. This tool runs a micro-simulation model called Modelling the Early Life-course (MEL-C), which uses the results of longitudinal analyses to determine both the normal transition of children through the life course, and also the impact of policy interventions on determining outcomes for children. The tool includes a graphical user interface and allows policy makers a ‘window’ into research in a way that allows an easy translation to policy.

In the following sections, we will describe the MEL-C micro-simulation model and the software application that supports it, demonstrate how this model offers an opportunity for policy makers to extract research findings for their policy needs, and details how the development of the model has benefitted from the collaborative approach taken.

Methods

The Modelling the Early Life-course (MEL-C) model and decision support tool

MEL-C uses micro-simulation methods to develop an accurate model of early life-course development in New Zealand. Micro-simulation relies on data from the real world to create an artificial one that mimics the original but upon which virtual experiments can be carried out (Gilbert and Troitzsch 2005). Micro-simulation operates at the level of individual units, in our case these are children. Each child has a set of associated attributes as a starting point,

e.g., age, gender, ethnicity, birth characteristics. A set of rules is then applied in a stochastic manner to this sample to simulate changes in state or behaviour over time. Modifications of influential factors can then be carried out to test hypothetical ‘what if’ scenarios on key down-stream outcomes of policy interest.

For MEL-C, the set of rules is derived by analysing New Zealand child cohort studies (i.e., Christchurch Health and Development Study, Fergusson & Horwood, 2001; Dunedin Multidisciplinary Health and Development Study, Silva and Stanton, 1996; Pacific Islands Families Study, Paterson et al., 2008) to create a micro-simulation model of the first thirteen years of children’s lives. Each of these studies has obtained ethical approval for the collection and use of data on their sample, and the directors of each of these studies have agreed to our use of their data for data analysis purposes. We have focussed on simulation of three main outcomes: health service use, early literacy, and antisocial behaviour. Potential predictors that have been modelled include: demographic characteristics, family characteristics, pre- and peri-natal influences, and participation in early childcare education.

To enable policy makers and other interested parties to test the impact of influential factors, a software-based tool has been developed that acts as a ‘window’ into the micro-simulation model. This tool was programmed in JAVA and R with a graphical user interface called JAMSIM (Mannion et al. 2011; Parker 2011).

The following case study illustrates how a policy analyst might use the software tool to test a policy scenario (see also Figure 1). Suppose a policy analyst is interested in the impact of decreasing smoking in pregnancy on later child outcomes, especially on children from disadvantaged backgrounds. The tool could be used to test this scenario in the following way.

First, the tool can be used to check the proportion of mothers who smoke in pregnancy (and the quantity they smoke), both for the population as a whole and for those who are from disadvantaged families. These results are based on simulation runs in which no features have been changed in the system (i.e., 'base' simulation runs). Second, the policy analyst can use these descriptive results to help decide a realistic change to these proportions or quantities that might result from an intervention to decrease smoking in pregnancy. Third, having decided a realistic change, this can be programmed into the software tool by changing the proportion of mothers who smoke in pregnancy and/or by changing the quantity pregnant mothers smoke. Fourth, a 'policy' simulation based on this change can be run. Fifth, the results of the 'policy' simulation run can be compared with the results of the 'base' simulation run for outcomes of interest (note that an entire system is simulated so results can be viewed for all outcomes). In particular, results can be generated to compare whether differences between children from disadvantaged families and the remaining children are smaller in the policy scenario versus the base scenario. Sixth, having viewed the effect of the policy scenario programmed, policy analysts can use the software tool to try out different policy scenarios for smoking in pregnancy and compare the results. Scenarios and the results produced can be saved to allow for ease of comparison between policy scenarios run during different sessions. Note that while the software tool can be used to assess and quantify the impact of any factor in the model on any outcome in the model, the onus remains on the user to interpret the importance of a policy change in relation to all of its impacts.

Figure 1 about here

Collaboration between researchers and policy makers

The project was supported by a public good research grant to researchers at the University of Auckland, New Zealand, who then sought policy makers and analysts to help with the development of the micro-simulation model and policy decision-support tool. Two representatives from each of four New Zealand government ministries - Health, Education, Justice, and Social Development - formed a “policy reference group” for the project. No member of the funding agency collaborated in the development of the model, nor did policy makers receive any funds from the funding agency.

The process of collaboration between researchers and policy makers has involved regular (two-monthly) face-to-face meetings to discuss the development of the model. At an early stage of the project, the policy reference group suggested the types of questions that should be answered using the model. The policy reference group stressed that the model should be able to identify all factors that are important to life-course development and well-being, regardless of whether a policy lever exists for these factors. Policy-relevant questions suggested by the policy-reference group tended to take the form, ‘What is the influence of X on Y?’, and included:

1. Do any interventions have any impact on later (health, wealth, social, education, justice) outcomes for Māori, Pacific or low-income groups?
2. Does good quality early childhood education overcome disadvantage in early life, and is it a marker of later good outcomes?
3. Are children in households where both parents are working better off, and does the child’s age at which parents work have an influence?”

A conceptual model of the early life-course forms the basis of the micro-simulation model, and this was developed by both researchers and policy reference group representatives. This

followed a framework based on the social determinants of health (Solar and Irwin 2010), where structural elements related to social disadvantage fundamentally determine intermediate parental and family factors and final health, education and psycho-social outcomes.

Analyses of the longitudinal data to determine associations between each of the factors (outcomes and predictors) in the conceptual model was undertaken by researchers. The ‘best’ models for each outcome were chosen using a stepwise procedure in SAS 9.3 (SAS Institute Inc, 2010). For example, analysis of reading ability from these studies revealed that factors such as parental education, birth weight, breastfeeding, welfare receipt, and household overcrowding all had an impact. The strength of the associations between these factors and reading (in the form of regression estimates) were then used in the micro-simulation model, and users could view the simulated results of modifying any or all of these.

Identification of benefits of the tool for policy makers and the advantages of the collaboration for the development of the tool

Benefits of the tool and advantages of the collaboration for tool development were identified through several means, including discussions between researchers and policy makers on the perceived advantages, reviewing notes from the policy reference group meetings, and reflecting on the work undertaken on the project and on the finished product. These benefits and advantages will be described in the section to follow.

Results

Benefits of the decision-support tool for policy makers

As a knowledge product, the tool has a number of benefits for policy-makers. First, the ability of policy makers to interrogate the tool to explore the likely impact of policy interventions makes for a very easy transfer of evidence to policy. Policy makers often lack the time to search for policy-relevant research evidence (Stewart and Oliver, 2012). The micro-simulation model developed is made available to policy makers to interrogate and extract the evidence they require without the effort and time typically required to search for it. Moreover, the research findings have been integrated and embedded in a working model of the life-course and so represent the societal and population context within which policy makers are operating. Thus, policy makers do not need to interpret isolated findings which may or may not be applicable to the population in which policies are to be implemented.

Further, while the model currently contains the results of analyses of several New Zealand longitudinal studies, the micro-simulation framework allows for integration of findings from other sources (e.g., meta-analyses or results of systematic reviews). In this sense, the model will never be ‘finished’, but will continue to be refined via feedback from those using deployed versions of the model. Throughout the process of refinement, we will evaluate the performance of the model by validating results against external benchmarks. The findings produced by the model will thus represent an up-to-date resource of policy-relevant information on life-course development and well-being.

Second, the micro-simulation model is designed to answer policy-relevant questions, e.g., of the form, “What is the policy influence of X on Y?” (see examples above). Thus, policy makers are not reliant on searching the literature for research papers and then interpreting their results. Such papers may not have been written for policy purposes and so may not be the best fit for the policy question under consideration.

Third, the model combines the best aspects of the “push” and “pull” systems of knowledge transfer. Research findings are “pushed” - and can continue to be pushed - to the micro-simulation model by researchers. However, as the development of the model has been shaped by policy-makers to reflect their needs, a “pull” system has been established whereby policy makers are able to access results from the micro-simulation model directly. A number of different analyses are integrated into the micro-simulation model and the policy maker has the ability to explore intended and unintended consequences of potential policy options, based on simulations based on these analyses. The nature of the micro-simulation model is such that the impact of any feature on any outcome can be tested. Thus, unlike a traditional “pull” system by which policy makers request the evidence they want from researchers, using the tool allows policy makers to directly access evidence on the impact of different policy interventions.

Fourth, policy makers have control over the research evidence they access. Policy makers are able to interrogate the tool (e.g., to check the simulated rates of risk factors and outcomes), and also to manipulate the model to test the impact of policy (e.g., by simulating the effect of changing factors thought to influence children’s outcomes). Because every factor in the model can be modified, policy makers can also compare the effect of changing different factors on the childhood outcome under investigation. Similarly, the effect of the *same* factor on *different* outcomes can also be tested, or indeed the effect of a combination of factors on a combination of outcomes. The differential effect of policies on different population subgroups can also be tested - for example, examining the effects on ethnic subgroups or those from the most deprived socio-economic subgroups. Changes affecting these subgroups are often of more interest to policy makers than changes to the overall population.

Fifth, the tool can be used not only to test the likely impact of a policy intervention, but also to test the impact of more speculative “what-if” scenarios, which may or may not represent realistic policy interventions. This is useful to policy makers wishing to understand the impact of hypothetical “best-case” or “worst-case” scenarios (e.g., ‘what if smoking was abolished in families of young children?’; ‘what if no children were breastfed?’). As with any other scenario in which policy makers may be interested, the results of these scenarios are at the fingertips of policy makers simply by interrogating the tool.

Advantages of the collaborative approach between researchers and policy makers

The benefit to policy makers of the decision-support tool owes a great deal to the collaborative approach that has been adopted in the tool’s development. The process of feedback and interaction developed as part of the collaboration between the researchers and policy makers has led to a number of advantages in developing the tool.

First, the collaborative approach has allowed policy makers to influence the direction of the project. Ultimately, the policy makers will be the beneficiaries of the research - in the form of a decision support tool - so engaging them to influence the direction of the project helps to ensure that the tool serves their interests. For example, the policy reference group suggested that they would like to know about all of the factors that are important, so all such factors should be modelled even if it is not clear whether or not some of these factors are modifiable by policy. Moreover, the policy reference group suggested that the interplay between risk factors need to be explored by considering, for example, the modelling of combinations and/or interactions of risk factors, and considering the extent to which the impact of some factors are mediated by other factors.

Second, the collaboration allowed policy makers to give advice on the policy options and scenarios that were of interest to their respective government agencies.

Third, the policy reference group was able to give feedback on the functionality of the tool, and how it should be used and deployed. On the functionality of the software application the policy reference group suggested a number of added features, including (i) the ability to run more than one scenario at a time and to compare the results across scenarios; (ii) the ability to see a list of the factors likely to impact each outcome; (iii) enabling policy scenarios to be tested on subgroups of the population; and (iv) the ability to view the impact of policy scenarios across the whole distribution of an outcome rather than just on the mean level of an outcome. On the deployment of the tool the policy reference group contrasted two competing risks. On the one hand there was a risk of *misuse* of the modelling software (e.g., misinterpretation of results) if it was made widely available to the policy community without guidance as to its use and its limitations. On the other hand there was a risk of *under- or non-use* of the modelling software if it was kept in-house and modelling was undertaken by the research group. The policy reference group advised that, on balance, the risk of under- or non-use is greater than the risk of misuse, and so the deployment strategy should involve having desktop access by policy-makers, with associated support and training from the researchers who developed the tool. Many of the benefits to policy makers of the tool (e.g., ease of access to policy-relevant evidence) derive directly from the decision to make the tool readily available to policy-makers.

Fourth, the link with policy makers from different government agencies produced an accumulation of knowledge across a number of different subject areas. The benefits of this

were demonstrated most clearly in the validation of the micro-simulation model, in that the policy reference group was able to suggest a number of different datasets across the subject areas of interest to their agencies against which the simulated results could be validated.

Fifth, the partnership between researchers and policy makers engendered trust in each other and in the knowledge product. This reduced barriers and facilitated knowledge translation and the uptake of tool use.

Discussion

We aimed to bridge the gap between research and policy by developing a decision-support tool for policy makers. This tool integrates research evidence from analysed data, and this research evidence can be explored easily (through interrogating the tool), flexibly (in that the effects of many factors on many outcomes can be assessed), and in a policy-relevant way (i.e., as answers to the question “What is the policy influence of X on Y?”).

The difficulty of bridging the gap between research and policy has been well documented (Black, 2001; Lomas, 2007; van Egmond et al., 2011). Attempts to bridge the gap between research and policy have often involved the use of ‘knowledge brokers’ to act as the link between researchers and policy makers, and these have met with some success (Lomas, 2007; Knight and Lightowler, 2010; Frost, 2012). The knowledge transfer system described in this paper attempts to go one step further by enabling policy makers to explore the impact of changing factors on later outcomes directly through use of the decision-support tool. This tool runs a micro-simulation model which integrates data and research findings from a number of sources into a working model.

The knowledge transfer benefits for policy makers described in this paper derive not only from the application of micro-simulation methods to policy questions, but also the packaging of a micro-simulation model in user-friendly software designed to meet the needs of policy makers. Here, the input of policy-makers themselves was a key factor. A policy reference group was formed comprising likely users of the tool. This group gave guidance and feedback throughout the development of the tool regarding its look, functionality and usability.

There are other examples of the use of software specifically designed for knowledge translation. For example, two online databases - 'Rx for Change' and 'Health Systems Evidence' - can be searched to find systematic reviews and other relevant documents synthesising evidence for policy making (Grimshaw et al., 2012). The decision-support tool described in this paper differs from these two excellent evidence repositories in that, with the decision-support tool, the evidence is embedded in a working model and can be interrogated to address specific policy questions. With the online databases the onus is still on policy makers to search for relevant papers, assess their content for relevance, and evaluate their importance for the policy question under consideration.

Nonetheless, these online databases do suggest a challenge for the future development of the tool regarding how to develop a process for integrating additional information. As described, the model contains the result of analysing data from New Zealand longitudinal studies. These data sources do not contain information on all key determinants of child outcomes, and it is also possible that estimates for some determinants can be improved. Thus a process is needed to (i) identify determinants that are missing or are represented inaccurately; (ii)

identify the relevant literature pertaining to these determinants and seek out reliable estimates of effect; and (iii) update the model with the new estimates of effect.

A further challenge is to ensure that the micro-simulation model realistically represents the underlying system; i.e., that the model is *valid*. The MEL-C model has undergone some tests of its validity but more are required to ensure confidence in the results of the policy “what-if?” questions asked of the model, both for the population as a whole and for particular population subgroups (e.g., Māori, high deprivation groups).

Conclusions and implications

We have described the advantages of a micro-simulation model packaged in user-friendly software to test policy scenarios relating to the early life course. Researchers and policy makers should consider the value of micro-simulation models as a mechanism to test the potential impact of policy interventions. Researchers and policy makers should also consider the benefits of adopting a collaborative approach to producing research for use in policy. The decision support tool described in this paper was developed in a partnership between researchers and policy makers so that the tool serves the interests of policy makers, with features that they want and with the ability to test the policy scenarios of greatest importance to them. Close partnerships of this type have been found to facilitate uptake (Innvær et al., 2002), and early signs suggest there is willingness to use the tool among a number of government agencies.

Knowledge transfer has become a hot topic for those undertaking research, and a continuing frustration for those in policy. The approach to knowledge transfer described in this paper,

by which policy makers obtain the answers to policy questions using an empirically-based model, may offer a way forward that bridges the gap researchers and policy makers.

References

- Best, A. & Holmes, B. (2010) 'Systems thinking, knowledge and action: towards better models and methods', *Evidence and Policy*, 6(2): 145-159.
- van Egmond, S., Bekker, M., Bal, R. and van der Grinten, T. (2011) 'Connecting evidence and policy: bringing researchers and policy makers together for effective evidence-based policy in the Netherlands: a case study', *Evidence and Policy*, 7(1): 25-39.
- Favreault, M. and Smith, K. (2004) *A primer on the dynamic simulation of income model (DYNASIM3)*, Washington: The Retirement Project, Urban Institute
- Fergusson, D.M. and Horwood, L.J. (2001) 'The Christchurch Health and Development Study: Review of Findings on Child and Adolescent Mental Health', *Australian and New Zealand Journal of Psychiatry*, 35: 287-296.
- Frost, H., Geddes, R., Haw, S., Jackson, C.A., Jepson, R., Mooney, J.D. and Frank, J. (2012) 'Experiences of knowledge brokering for evidence-informed public health policy and practice: three years of the Scottish Collaboration for Public Health Research and Policy', *Evidence and Policy*, 8(3): 347-359.
- Gilbert, N. and Troitzsch, K. (2005) *Simulation for the Social Scientist*, Maidenhead: Open University Press.
- Grimshaw, J.M., Eccles, M.P., Lavis, J.N., Hill, S.J. and Squires, J.E. (2012) 'Knowledge translation of research findings', *Implementation Science*, 7:50.
- Immervoll, H. and O'Donoghue, C. (2001) 'Towards a multi-purpose framework for tax-benefit microsimulation', *EUROMOD Working Paper EM2/01*, University of Essex: Institute for Social and Economic Research.
- Innvær, S., Visy, G., Trommald, M. and Oxman, A. (2002) 'Health policy-makers' perceptions of their use of evidence: a systematic review', *Journal of Health Services Research and Policy*, 7(4):239-244.

- Knight, C. and Lightowler, C. (2010) 'Reflections of 'knowledge exchange professionals' in the social sciences: emerging opportunities and challenges for university-based knowledge brokers', *Evidence and Policy*, 6(4): 543-556.
- Lomas, J. (2007) 'The in-between world of knowledge brokering', *Lancet*, 334: 129-132.
- Mannion, O., Lay-Yee, R., Wrapson, W., Davis, P. and Pearson, J. (2012) 'JAMSIM: A Micro-simulation Modeling Policy Tool', *Journal of Artificial Societies and Social Simulation*, 15(1): 8.
- Morris, M. and Kretzschmar, M. (2000) 'A microsimulation study of the effect of concurrent partnerships on the spread of HIV in Uganda', *Mathematical Population Studies*, 8: 109-133.
- Newman, L., Biedrzycki, K., Patterson, J. and Baum, F. (2011), 'Partnership in knowledge creation: lessons learned from a researcher-policy actor partnership to co-produce a rapid appraisal case study of South Australia's Social Exclusion Initiative', *Evidence and Policy*, 7(1): 77-96.
- Nutley, S., Morton, S., Jung, T. and Boaz, A. (2010) 'Evidence and policy in six European countries: diverse approaches and common challenges', *Evidence and Policy*, 6(2): 131-144.
- Parker, M. 2011. Ascape. [accessed on November 28, 2011]. Available at:
<http://ascape.sourceforge.net/>
- Paterson, J., Percival, T., Schluter, P., Sundborn, G., Abbott, M., Carter, S., Cowley-Malcolm, E., Borrow, J., Gao, W. and the PIF Study Group (2008), 'Cohort profile; The Pacific Islands Families (PIF) Study', *International Journal of Epidemiology*, 37: 273-279.
- Rutter, C.M. Zaslavsky, A.M. and Feuer, E.J. (2011), 'Dynamic Microsimulation Models for Health Outcomes : A Review', *Medical Decision Making*, 31: 10.
- SAS Institute Inc. SAS 9.2. Cary, NC, USA: SAS Institute Inc.

Silva, P. and Stanton, W. (eds) (1996) *From child to adult: The Dunedin Multidisciplinary Health and Development Study*, Auckland: Oxford University Press.

Solar, O., and A. A. Irwin. 2010. "A Conceptual Framework for Action on the Social Determinants of Health." Geneva: World Health Organization. Discussion paper 2.

Spielauer, M. (2007) 'Dynamic microsimulation of health care demand, health care finance and the economic impact of health behaviours: survey and research', *International Journal of Microsimulation*, 1(1): 35-53.

Spielauer, M. (2011) 'What is social science microsimulation?', *Social Science Computer Review*, 29(1): 9-20.

Stewart, R. and Oliver, S. (2012) 'Making a difference with systematic reviews', in D. Gough, S. Oliver and J. Thomas (eds) *An introduction to systematic reviews*, London: Sage

Will, B.P., Berthelot, J-M., Nobrega, K.M., Flanagan, W. and Evans, W.K. (2001) 'Canada's Population Health Model (POHEM): A tool for performing economic evaluations of cancer control interventions', *European Journal of Cancer*, 37: 1797-1804.

Figure caption:

Figure 1. Case study of how to use the software tool to test a policy scenario

