Use of Bayesian networks to facilitate evidence synthesis and evaluation of interventions in complex systems

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Background

Evaluations of initiatives to improve health service delivery and public health face many challenges arising from the complexity of the health system (Lilford et al. 2010). Evidence in different forms (both qualitative and quantitative) and of different types (e.g. clinical trials, observational studies and expert opinions) are often required. But this raises the question of how to integrate these diverse sources of information to derive parameters to inform decisions. Commonly used methods of evidence synthesis, such as meta-analyses, are limited in providing the evidence decision makers need in this setting. Bayesian networks can be used to express the joint distribution of many variables and can be used to encode qualitative causal assumptions to facilitate inferences when an intervention has an uncertain effect on a primary outcome but there is good evidence on its effects on intermediary outcomes. Bayesian networks are commonly applied in other disciplines that share the need to assimilate evidence from diverse sources and to explore the relationship between many variables in complex systems, but their uptake seems to be very limited so far in health services research (Chen et al. 2016). The proposed workshop is timely given recent calls for the adoption of novel approaches to tackle methodological challenges in health services research (Stewart et al. 2014, Watson & Lilford 2016), and its objectives fit well with the Society of Social Medicine’s aim of promoting methodological and scientific rigour.

Aims

(1) To increase the awareness of Bayesian networks as a potential tool for health service delivery and public health research. (2) To provide an introduction to Bayesian networks to health service researchers and practitioners who are interested in this method. (3) To provide a forum for exchanging experience of using Bayesian networks, discussing the merits and limitations and stimulating further research in the application of this method.

Educational objectives

At the end of the workshop, participants will be expected to: (1) be familiar with the philosophy of Bayesian approach to data synthesis; (2) know what a Bayesian network is and the potential applications of this method; (3) become aware of examples of applications of Bayesian networks in service delivery research and useful resources.

Structure

The workshop will consist of a mix of presentations, small group tasks, and feedback and discussions. At the beginning of the workshop, the aims, objectives and structure of the session will be described. This is followed by a couple of short presentations to introduce Bayesian philosophy and Bayesian networks for participants who are not familiar with them. The participants will then be divided into small groups of up to 8 people each to develop a theoretical model of the effects of an intervention in a complex system and represent it as a Bayesian network. They will then consider how this model relates to observed data and available evidence.
To enhance participant engagement, we will allow participants to come up with their own topic/research question for constructing Bayesian networks, but will have worked-up topics (evaluation of the impact of electronic prescribing systems on patient safety and evaluation of the impact of 7-day consultant-led acute care on health resource utilisation and patient outcome) that can also be used. Following the breakout session for the small group tasks, we will invite each group to present the Bayesian network that they have come up with, and discuss any issues identified in the process of constructing the Bayesian network and the consideration of evidence that provides information on the relationships between variables in the model and how this evidence might be synthesised. The feedback and discussion session will be followed by short presentations of published/work-in-progress examples in the field of health services research – the length and detail of which can be flexible depending on how the feedback and discussion session from the small groups goes. Additional examples/experiences will be invited from the floor. The workshop will be concluded with comments and thoughts from the workshop leader, who will summarise key issues and identify potential areas for further exploration and development.

**Schedule**

(1) Opening remarks & aims – 5 mins; (2) Short presentations: introduction to Bayesian statistics and Bayesian networks – 15 mins; (3) Small group work: conceptualising a Bayesian network (on a topic chosen by the participants or alternatively suggested by us, e.g. evaluating 7-day service on patient outcomes) – 25 mins; (4) Reports from groups & discussions – 25 mins; (5) Presentation of worked out examples - 15 mins; (5) Closing remarks – 5 mins.

**Target group**

While some level of numeracy will facilitate understanding of the method, we assume minimum prior knowledge on Bayesian methods. Any service delivery or public health researchers and practitioners who would like to know more about what Bayesian network is and how it might be useful in planning and evaluating complex service interventions can attend. People who have used or are thinking of developing research using Bayesian networks are also very welcomed to raise their questions and/or share their experience with the audience. To ensure effective running of small groups, we expect a minimum of 15 and a maximum 40 participants (3-8 per group x 5 groups).

**Requirements**

A middle-sized meeting room with a capacity of approximately 40 people. The meeting room should be equipped with an overhead projector and projection screen, a flipchart and 5 sets of marker pens, and have a flexible sitting plan that allows the participants to be broken into 5 group (or additional breakout rooms/space near the meeting room).

**References**


