RCTs in complex nursing interventions and laboratory experimental studies

David A. Richards\textsuperscript{a,}\textsuperscript{*}, Jan P.H. Hamers\textsuperscript{b}

\textsuperscript{a}Mood Disorders Centre, School of Psychology, University of Exeter, Exeter EX4 4QG, United Kingdom
\textsuperscript{b}Department of Health Care and Nursing Science, Maastricht University, The Netherlands

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Abstract

The randomised controlled trial (RCT) is at the heart of the evidence-based medicine movement and by implication should also be central to evidence-based nursing. One objection to RCTs in nursing science is that nursing is too complex an activity to be subjected to a carefully controlled experimental paradigm. We suggest that this argument is false and use examples from complex interventions research in nursing and experimental laboratory methods to demonstrate that RCTs can bring much needed clarity to the search for nursing knowledge.

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What is already known about the topic?

- The randomised controlled trial (RCT) is at the heart of evidence-based medicine and nursing.
- One major objection to RCTs in nursing science is the complexity of nursing.

What this paper adds

- This review demonstrates how complex nursing activities can be investigated using RCTs.
- Experimental laboratory studies of nursing are also able to shed further light on nursing decision making.

1. Introduction

In this article, we will consider the place of randomised controlled trials in nursing. We will use two specific examples of situations where we believe that randomised controlled trials can generate nursing knowledge. Proponents and detractors of the randomised controlled trial in nursing generally take up polarised defensive positions characterised more by fundamentalist belief systems than genuine debate. It is not our purpose to revisit these arguments in depth, but as in any discourse on the scientific method in nursing, we will be unable to avoid dipping in our toes. Our principal contention will be that RCTs have an important place in generating nursing knowledge and should not be rejected because of the fallacy of complexity. We will illustrate the importance and feasibility of the use of RCTs in testing complex nursing interventions. Finally, we will elaborate on a special type of experimental research – laboratory experimental studies – as we believe this can broaden the continuum of nursing research.

2. The randomised controlled trial

Randomised controlled trials (RCTs) are part of an epidemiological research tradition that stretches back many hun-
dreds of years. For most of mankind’s history, people have tried to establish association, causation and effect. The native healer, as much as the modern clinician, has been interested in understanding links between the environment, disease and potential therapeutic compounds to relieve human distress. This tradition developed in western medicine following the enlightenment and during the colonial expansion period attempts were made to understand both the cause of infections and diseases such as scurvy and methods to cure them.

In the 1950s, Sir Austin Bradford Hill (Bradford Hill, 1962) articulated both a set of theoretical principles and a method of ensuring that the results of clinical research could be considered reliable. He established that association or causality could only be reliably promoted if the relationship between the proposed cause and effect was temporal, reversible, possessed a strong association, the effect was related to exposure to the causal agent in a consistent, biologically plausible and specific manner.

Bradford Hill was responsible for many of the methodological initiatives at the UK Medical Research Council (MRC) during the 1950s and 1960s. When establishing causation and in order to satisfy the Bradford Hill criteria above, one can either conduct observational research when it is either impossible or undesirable to experimentally manipulate causal factors (for example, cigarette smoking) or one can undertake experimental research where one can manipulate such factors (for example, different treatments for lung cancer). It is widely accepted that the first truly randomised controlled trial was conducted in the 1940s to test the effectiveness of streptomycin in treating tuberculosis (Medical Research Council, 1948).

The rationale for randomisation in experimental research is quite simple and rests on the desire to control confounding factors. Confounding factors are characteristics of research participants or their environment, separate from the independent variable being tested and which may have an influence on the outcome under study. Their presence may lead researchers to misattribute results to the intervention in question, when it is really another ‘confounding’ variable which is influencing the outcome. This kind of bias is termed ‘selection bias’. Confounders which are known about prior to the experiment can be directly targeted by allocating them equally across groups, a procedure common in many randomised and non-randomised trials, for example by matching, stratification or minimisation. This is not possible for factors which are unknown to the experimenter. Randomisation is the only method by which one can ensure that unknown, potentially confounding factors can be randomly distributed between experimental and comparison groups in the hope that they may be evened out. Of course, the larger the number of participants, the more likely this will occur, one reason why one has greater confidence in the results of large randomised controlled trials than small trials in which variations in unknown confounding variables are more likely to be unevenly distributed between groups and influence the results. Whilst statistical estimates of the role of chance in determining a trial’s findings may help reduce the likelihood of a spurious result, only randomisation gives researchers the best opportunity for truly balanced group allocations.

From this beginning has spawned a huge movement, now known as evidence-based medicine, which has as its daughters, evidence-based nursing and evidence-based practice. In nursing, more than in any other profession allied to medicine, the proponents of evidence-based nursing (e.g. Cullum, 2000) find themselves in conflict with those that reject the positivist approach to science (e.g. Rolfe, 2002). Readers will be familiar with the case made by objectors suggesting that since nurses do not ‘treat’ patients (in itself a questionable assertion), the search for association and causation in RCTs has no role to play in nursing research. The argument goes that since the RCT is part of an explicit ‘medical’ research paradigm, it has no place in nursing.

We will now challenge this assertion by considering how nurses have applied and adapted randomised controlled trial methods in nursing to investigate ‘complex’ interventions and to understand the determinants of nursing behaviours.

3. Investigating complex interventions

In nursing science, a major objection to RCTs is that nursing is such a complex endeavour that it is impossible to identify the component elements of nursing and devise controls which provide meaningful comparisons. Complexity is certainly one of many factors which inhibit RCTs (Prescott et al., 1999) but it is not a problem unique to nursing. Many clinical interventions in fields such as medicine and psychology are also very complex. As a consequence the last decade has seen much methodological thinking expended on developing new research strategies to address this issue (Campbell et al., 2000, 2007; Medical Research Council, 2000), thinking that can usefully be applied to nursing research (Blackwood, 2006; Thompson, 2004; van Meijel et al., 2004). Recently, a major revision of guidance on investigating complex interventions has been published (Medical Research Council, 2008).

Methodologists and researchers acknowledge that complex interventions are built up from a number of components, which may act both independently and interdependently (Medical Research Council, 2000, 2008). These components were initially identified as including behaviours, parameters of these behaviours (e.g. frequency, timing) and methods of organising and delivering those behaviours (e.g. type(s) of practitioner, setting and location). More recently, methodologists have extended these components (Craig et al., 2008) to include consideration of the inherent variation in the populations targeted by interventions (e.g. age; stage of disease), the number and variability of potential outcomes (e.g. possible levels of mobility) and the degree to which researchers and clinicians are prepared to allow flexibility in intervention fidelity. All these criteria are characteristic of nursing activity and the source of many
objections to the use of RCTs in nursing science (Rolfe, 2002).

It was originally suggested that researchers adopt a five-phase strategy to address this complexity (Medical Research Council, 2000) so that theoretical, modelling and exploratory trial phases would precede any ‘definitive’ RCT, with a final stage being an examination of long-term feasibility in uncontrolled environments. The original guidance suggested a linear process based on that traditionally used to evaluate new drug treatments. More recently, however, it has been acknowledged that whilst in theory it may be best practice to carefully develop and test interventions through a phased programme of pilot studies, in reality interventions can arise from ‘past practice, existing evidence, theory, an investigator, policy makers or practitioners, new technology, or commercial interests’ (Medical Research Council, 2008 p. 8). This is certainly true of many nursing innovations. The preferred understanding is that complex interventions should be investigated through a process of development, feasibility/piloting, evaluation and implementation, where there is a dynamic interchange between stages, for example traditional latter stages such as implementation often feed back into the development of the intervention itself.

As well as the importance of identifying and specifying relevant theory when developing an intervention to be tested in an RCT, it is essential to be able to describe the intervention in sufficient detail for it to be researched and replicated and to specify the intended outcomes fully. Many potential methods exist to do this, for example consulting clinical experts, undertaking theoretical modelling exercises, rigorous qualitative study, dismantling and factorial designs, systematic reviews, meta-analysis and meta-regression. Campbell et al. (2007) suggest careful consideration of problem definition, population, causal and sustaining pathways and points most amenable to change in the intervention design process. Pilot work should specifically address uncertainties in all these areas rather than merely being a smaller version of a planned larger trial.

Methodological questions can also be addressed during the development phase to ensure that any subsequent RCT is able to justify its design and recruitment strategies, its sample size and its choice of outcomes. Finally, it is an extremely useful addition to any RCT to run a parallel high quality process evaluation alongside the main trial, addressing the ‘black box’ problem of RCTs, where an intervention is known to work but not the method by which it does so. All these developmental and process procedures hark back to the fundamental principles first outlined by Bradford Hill (1962) where mechanisms of effect are explored before and during clinical trials.

A number of nursing researchers have implemented this framework to good effect. Blackwood (2006) used a combination of semi-structured interviews, questionnaire survey and observational methods to design an intervention to assist in the design of a nurse-led intervention to help patients withdraw from mechanical ventilation. This was subsequently tested in a non-randomised comparative trial, an RCT thought to be impractical in this situation. Nonetheless, the modelling and pilot trial work was thought to provide sufficient information for the design of a large scale cluster randomised RCT.

van Meijel et al. (2004) cite a number of examples from their own research where various methodological strategies have been used to design and test nursing interventions. These include a sequential programme of literature review, observational research into current nursing practice, multidisciplinary expert evaluation, case study feasibility testing and finally an exploratory RCT to design and test nursing interventions for the early detection of relapse in schizophrenia. They also cite the importance of theory in designing nursing interventions.

Richards et al. (2008) also report the use of multiple methods for adapting organisational interventions from other cultures – in this case the USA – to a European health care environment. They used systematic review, meta-analysis and meta-regression techniques (Bower et al., 2006) together with expert consultation and qualitative interviews (Richards et al., 2006) to develop the components of an intervention – ‘collaborative care’ – delivered by nurses and other health care workers to support and treat patients with depression in primary care. This work was tested in a pilot RCT (Richards et al., 2008) which included a process evaluation to refine the intervention, attracting subsequent funding to test the intervention in a large scale multi-centre ‘definitive’ RCT by the MRC.

Complex interventions are not, therefore, a reason to avoid randomised methods. In fact, their very complexity makes it even more important to use rigorous methods to test for their effect. Landmark recent publications (Campbell et al., 2007; Craig et al., 2008; Medical Research Council, 2008) have built on thinking over the last 10 years (Medical Research Council, 2008) to provide nurses with guidance on how they and others can design and evaluate complex interventions to improve health care. Some nurses have embraced this careful approach and we would argue that such methods should become adopted more widely by nursing researchers.

4. ‘Laboratory’ experimental research in nursing

We would like to elaborate further on a special form of experimental research: laboratory experimental research. Experiments and RCTs in particular, cannot only be applied to investigate the effects of (complex) interventions. As we know that experimental research offers the most convincing evidence concerning causation, we can also use experiments in laboratory type settings in order to test hypotheses. For instance, we can use laboratory type experimental methods to examine what factors determine the assessment of a patient or nursing problem (e.g., fear, pain or quality of care) or predict nurses’ decision-making regarding interventions. These types of experiments are often conducted in social sciences, especially in (experimental) psychology, but are not frequently used in nursing research.
In a ‘true experiment’, there are a number of characteristics: randomisation, control and manipulation (Polit and Beck, 2003) and all factors other than the independent variable are controlled. A laboratory experiment has the same characteristics as a true experiment in that subjects are randomly assigned to two or more groups and are exposed to different tasks. In comparison to an RCT, the manipulation is not of a nursing intervention but of the task, which often is an (unexpected) situation a subject is confronted with, a problem that has to be solved, or a decision that has to be made. This can be best illustrated by an example.

Hamers et al. (1994) published a framework of factors influencing pain assessments and intervention in children. This framework was mainly based on qualitative studies (using clinical observations and in depth interviews) and surveys exploring nurses’ opinions about their decision-making. The main factors identified which determined pain assessments were the medical diagnosis, child’s age and pain expression, information from the child’s parents, and nurses’ knowledge and experience. The researchers derived hypotheses from this framework, which were tested in different experimental studies (Hamers et al., 1996, 1997). One of the hypotheses was that the more serious the medical diagnosis is, the more pain will be attributed to the patient. A second hypothesis was that more pain will be attributed to a child that expresses his/her pain vocally (e.g., by crying).

To examine the influence of the medical diagnosis and the child’s pain expression on nurses’ pain assessment a sample of experienced paediatric nurses were exposed to sequential cases, each of which consisted of a vignette and a videotape. Medical diagnosis was operationalised in the vignettes; the child’s expressions were operationalised via videotapes of the child. The nurses were randomly assigned to two groups. The cases shown to the nurses were manipulated. One group of nurses were informed that the medical diagnosis was mild; the other that the diagnosis was severe. One group saw a videotape of a child with less vocal expression; the other saw the same child, but now with more vocal expression. After they saw the combination of vignette and videotape, they were asked to rate their pain assessments on a 100-mm Visual Analogue Scale (0, no pain; 100, extreme pain).

In their study, the researchers found evidence for the hypothesis regarding the child’s expression, but not for the medical diagnosis. They concluded that vocalizations do in fact predict paediatric nurses’ pain assessments.

This example illustrates how experimental studies can be applied to examine causation and prediction of phenomena other than the effectiveness of interventions. It seems to be a rather easy way to control for many confounding variables in laboratory experiments and to study relations between variables. Evidently, this adds a different and valuable perspective to the continuum of nursing research.

It must be underlined that laboratory experimental research, like all types of research has its weaknesses. In fact, all the limitations of experimental research are equally applicable to laboratory studies. However, the weakness most often mentioned is artificiality (e.g. Polit and Beck, 2003). This criticism is that laboratory experiments may not approximate sufficiently to real-life clinical situations, which of course is true. Some critics even argue that there is a serious risk of overestimating the strength of relations between the variables of interest. However, if this argument is valid, we must conclude that if no relation is found in a laboratory type study, no relation will exist in real life.

5. Conclusions

It has not been our intention to adopt polarised positive or negative positions regarding experimental research. We have tried to suggest that two major objections to experiments in nursing – that nursing is too complex and that experiments are artificial – can be overcome by careful methodological thought and that the application of experiments in nursing can produce extremely useful information for practice. We would like to emphasize that the strength of nursing research in our opinion lies in the combination of different types of (qualitative and quantitative) research, and in the replication of research findings. Innovative nursing science needs innovative research and researchers who broaden the horizon by using combinations of innovative and sophisticated designs, and sometimes go beyond the beaten track of nursing science.

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