Knowledge development in nursing
Pragmatic, randomized controlled trial as a methodological approach to support evidence based practice

Ingrid Liodden
RN, NP, MNSc • Department of Clinical Dentistry, University of Oslo • ingrid@liodden.no

Anne Moen
Professor RN, PhD • Institute of Health and Society, University of Oslo • anne.moen@medisin.uio.no

Evidence based practice is a strategy to utilize research findings in clinical practice and stimulate discussion of what counts as evidence, and whether findings from RCT-trials constitute valid and objective knowledge. Findings from studies conducted under conditions far from reality may not produce results relevant for practice, and opponents claim that findings from RCT-trials are not applicable to complex interventions common in health care, including nursing. The pragmatic RCT-trial complements the traditional RCT-trial and is part of the suite of designed controlled studies that contribute to methodologically sound research findings. The pragmatic RCT design is more flexible than the traditional RCT-trial, allowing complex and context-dependent interventions to be performed under natural conditions. This paper presents the pragmatic RCT design, depicting the flexibility of the pragmatic approach by explaining the dimensions in the tool «PRECIS-wheel». We exemplify our discussions using findings from an empirical study and discuss inherent weakness and strength of the design in terms of internal and external validity. We believe the pragmatic RCT-design will be instrumental and contribute to highly relevant findings for best practice development in nursing.

Key words: evidence hierarchy, everyday practice, external validity, generalizability, study design
Knowledge in nursing may stem from research, experience, aesthetic considerations and practice (Carper, 1978). Tradition, culture and intuition are also important sources of knowledge for nursing, but the reliability and validity of these sources vary a lot (Polit & Beck, 2004).

«Evidence-based practice» (EBP) gained much momentum as a strategy to actively utilize research findings to inform health care delivery in the 1990s (Holmes, Murray, Amélie, & Rail, 2006). Evidence-based practice is practice understood as «the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients» (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996, p. 71). The core idea is to move from practice based on tradition, culture, experience, and intuition to one based on research. EBP should secure patient care and treatment of highest quality and prevent inappropriate or potentially harmful practice (Polit & Beck, 2004). EBP rests on identification, utilization of knowledge from updated, valid, and objective research results largely from effect studies using research methods considered robust (Pearson, 2001). To discriminate sources, the evidence is ranked according to the principle that some research designs contribute to more robust findings than others; and knowledge from randomized controlled trials (RCTs) is given more weight than knowledge from all other methods (Scott & McSherry, 2009). Application of high quality knowledge in practice is not straightforward. This is rather a process that requires deliberations of what constitutes best available evidence to resolve a particular problem presented by the particular patient (Holmes et al., 2006; Rycroft-Malone et al., 2004; Sackett et al., 1996). EBP has therefore stimulated discussions and controversies in the nursing community of what counts as evidence. Controversies relates to accusations like objectification, control, «cookbook medicine» and undesirable standardizing in health care (Holmes et al., 2006; Walker, 2003). Findings from studies conducted under conditions that are far from reality may not produce results relevant for practice (Alford, 2007; Glasgow, Lichtenstein, & Marcus, 2003; Zwarenstein et al., 2008). There are unresolved questions about the suitability and feasibility of the RCT-trials for guiding complex, and context-dependent interventions common in health care, including nursing. At the heart of the disputes is criticism of preferring findings from RCT-trials as the most desirable, highest ranked evidence and, accordingly, the most valid and objective knowledge (Ravaud & Tubach, 2005). Rather than engaging in efforts to discriminate or rank sources of evidence or discussing what constitutes appropriate and valid knowledge to support complex, context dependent judgments and interventions, we will add a methodological argument to the discussion. Based on a study of symptom management strategies using acupuncture and acu-
pressure to alleviate postoperative vomiting in children undergoing tonsillectomy and/or adenoidectomy (Liodden et al., 2011), we will present and illustrate a methodological approach called «Pragmatic RCT-trial».

Therefore, our paper expands on the discussions of research methodologies, as the pragmatic RCT-trial complements traditional RCTs and still adheres to the tradition of designed controlled studies that contribute to methodologically sound research findings highly relevant to nursing practice.

**Pragmatic RCT-trial – What is it?**

Traditionally there are two main groups of experimental design for effect studies labeled 1) true experimental design with randomization assignment and 2) quasi-experimental design without randomization. Both designs include manipulation of at least one independent variable (Lund, 2002), and subjects are assigned to either an intervention group subject to the specific interventions, or a control group receiving placebo or usual care (Alford, 2007; Key, 1997). Randomized Controlled Trial (RCT) is regarded as the methodological gold standard for effect research (Gribbons & Herman, 1997). Findings from RCT-trials enjoy thus highest status when ranking information sources to guide evidence based practice (Sackett, Straus, Richardson, Rosenberg, & Haynes, 2000; Timmermans & Berg, 2003). To ensure effect(s) can be attributed to the intervention and not to external or confounding factors, studies employ strong control and ideal experimental conditions (Godwin et al., 2003; Macpherson, 2004; Zwarenstein & Treweek, 2009). The less flexibility, the more control and the stronger internal validity (Godwin, et al., 2003).

In this paper, we introduce pragmatic RCT-design as a promising research design to produce reliable and valid knowledge for clinical practice and establish EBP. Compared to the traditional and much more familiar RCT-trials, the pragmatic RCT-trial allows more flexible, complex, and context-dependent interventions similar to natural conditions. The outcome measures include both treatment and associated non-specific effects, such as placebo and interactions between caregiver and patient. Findings from a pragmatic RCT-trial provides knowledge to the care-provider about effective treatment in real everyday practice. This implies a strong external validity (Alford, 2007; Godwin et al., 2003; Thorpe et al., 2009). The pragmatic RCT-design is a relatively new methodological research approach, first described by Schwartz and Lellouch (1967), but increasingly seen published in scientific journals during the last decade (Godwin et al., 2003). As explained by Thorpe and colleagues (2009), the pragmatic RCT seeks answers to research questions like «can an intervention produce an effect in clinical practice?». This has for example been employed in research design by Voogd-Pruis and colleagues (2010) in a study of the effectiveness of nurse-delivered cardiovascular risk management, and
by Dormaenen and colleagues (2011) studying the effect of acupuncture therapy for menopausal hot flushes and depressive symptoms.

Pure explanatory or pure pragmatic design may not be an optimal option. Experimental designs are thus designed in various degrees of a continuum of an explanatory or pragmatic RCT approach (Thorpe et al., 2009). Table 1 summarizes the features of explanatory and pragmatic RCT-trials, thus contrasting and explicating the differences of the two designs.

Table 1. Features of explanatory and pragmatic RCT-trials

<table>
<thead>
<tr>
<th>Explanatory RCT-trials</th>
<th>Pragmatic RCT-trials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental setting</td>
<td>Routine care settings</td>
</tr>
<tr>
<td>Evaluate efficacy</td>
<td>Compare effectiveness</td>
</tr>
<tr>
<td>Placebo controlled</td>
<td>Not placebo controlled</td>
</tr>
<tr>
<td>Patients blinded to minimize bias</td>
<td>Patients unblinded to maximize synergy</td>
</tr>
<tr>
<td>Aim to equalize non-specific effects</td>
<td>Aim to optimize non-specific effects</td>
</tr>
<tr>
<td>Standardized treatment, simple interventions</td>
<td>Routine treatment, complex interventions</td>
</tr>
<tr>
<td>On-treatment-analyse</td>
<td>Intention-to-treat-analyse</td>
</tr>
<tr>
<td>Homogenous group of patients</td>
<td>Heterogeneous group of patients</td>
</tr>
</tbody>
</table>

The table is modified from Alford (2007) and Macpherson (2004).

Compared to the explanatory RCT-design’s strong control of conditions in an experimental setting (Alford, 2007), the pragmatic RCT-design displays flexibility, accommodating natural, or normal, conditions found in usual clinical practice. A pragmatic RCT-trial aims to attain a strong external validity (Godwin et al., 2003) and demonstrates that the results are of interest beyond the specific effects. When the sample and setting in a particular study are relevant to clinical practice, results can easier be generalized beyond the study. To investigate the effectiveness of a treatment conducted under conditions fairly similar to real world, the pragmatic RCT seeks endpoints relevant to a patient’s situation and quality of life (Macpherson, 2004).

To attain a heterogeneous sample in a naturalistic setting, exclusion criteria are few, individual adjustments to the intervention are allowed, and adherence to study protocol is less rigorous (Alford, 2007; Godwin et al., 2003). Still it is important to emphasize that reports on the methods, choices, and strategies must be clear and complete. Further elaboration of the importance of improving the reporting of pragmatic trials may be found in a special issue of the CONSORT Statement; discussing the features of the pragmatic RCT-design in more depth is available at http://www.consortstatement.org/extensions/designs/pragmatic-trials/.

The deliberations of flexibilities and degrees of control in a pragmatic RCT
can be expressed by the PRECIS (PRagmatic-Explanatory Continuum Indicator Summary) tool (Thorpe et al., 2009).

The dimensions identified in Figure 1 provide a concrete picture of the choices in the design of the specific study. The hub (E) depicts the traditional control in the explanatory RCT, and the lines from the hub represent the explanatory – pragmatic continuum, illustrated as spokes in a wheel. The extreme limit for a pragmatic approach is outwards to the rim, while restrictions, limitations or adjustments implying a more explanatory approach are thus represented by congregation around the hub (Thorpe et al., 2009). PRECIS points thus out whether an intervention is conducted under usual conditions or under conditions narrowly «focused» near the hub. The pragmatic RCTs attend to clinical realities like human relations, ambiguity, individual needs, general and subjective symptoms, that must be appraised when research questions, design and methods are worked out (Alford, 2007; Godwin et al., 2003; Thorpe, et al., 2009). Therefore, pragmatic RCT-trials can demonstrate the effectiveness and still acknowledge that not all variables can be controlled.
To elaborate the pragmatic RCT design further we will illustrate the considerations outlined by PRECIS, drawing on experiences designing a study using acupuncture and acupressure as strategies to alleviate postoperative vomiting in children undergoing tonsillectomy and/or adenoidectomy (Liodden et al., 2011).

**Pragmatic RCT-trial – exemplifying application of PRECIS**

We will use the PRECIS wheel to elaborate how the pragmatic RCT-design’s hallmarks and features can illustrate design choices on the continuum of an explanatory – pragmatic approach (Thorpe et al., 2009).

The PRECIS summary in Figure 2 situates the pragmatic RCT-design choices on the explanatory – pragmatic continuum in the investigation of acupuncture/acupressure as strategies to prevent postoperative vomiting following pediatric tonsillectomy and/or adenoidectomy (Liodden et al., 2011). This concrete, elaborated picture helps compare the superior features of any familiar and traditionally designed RCT.

**Participants’ eligibility criteria**

At the core of a pragmatic RCT-trial is that the patients are representative of the population the treatment is intend-
ed for. Compared to traditional RCT-trials, a pragmatic RCT-trial has broader inclusion criteria (Thorpe et al., 2009). In the empirical example all children referred to the hospital for tonsillectomy and/or adenoidectomy during the intervention period, were eligible for participation in the trial. Children age 1 to 11 years with an American Society of Anaesthesiologists grade 1-2, were included, including children with a predisposition to PONV. Since the exclusion criteria were few, the eligibility criteria and inclusion strategy are closer to the extreme pragmatic than the explanatory end of the scale.

**Flexibility of intervention and control treatment**

A pragmatic RCT permits flexible intervention and treatment. The more local contingencies are allowed for when administering the intervention or control, the more the design is leaning to the pragmatic end of the continuum. In pragmatic RCTs, standard treatment is normally the control, in contrast to placebo in traditionally designed explanatory RCTs (Thorpe et al., 2009). In the empirical example, eligible patients were assigned to either intervention group or standard treatment. Special instructions to apply the intervention with acupuncture and acupressure were provided. The intervention group received standard treatment plus the intervention with acupuncture intended to last for 20 minutes or more during surgery, followed by wristbands for acupressure for 24 hours during recovery. However, in the case of a shorter duration of surgery, the acupuncture treatment was terminated accordingly (Liodden et al., 2011). This is an example where the actual situation was deviating; permitting some degree of flexibility. This dimension is not on the extremely pragmatic end of the continuum. Standard treatment was performed in the control group.

**Practitioner expertise in intervention and control treatment**

In a pragmatic RCT, the intervention and control treatment would be entrusted to all practitioners in the treatment setting. Selection of practitioners in terms of their skills or experience restricts a study's flexibility (Thorpe et al., 2009). All clinical nurse anesthetists and surgeons were involved in the empirical example, but only four anesthesiologists, trained for the purpose, administered the acupuncture and acupressure intervention. This choice restricted the flexibility, thus the specific example is not on the extremely pragmatic end of the continuum.

**Follow-up intensity**

Follow-up beyond normal practice may lead to increased compliance with, or improve intervention response and may move the study toward the explanatory end (Thorpe et al., 2009). No follow-up was scheduled in the empirical example, and this is therefore example of an extreme pragmatic end of the continuum.
Primary trial outcome

Traditional explanatory RCT-studies normally identify end-point(s) measurement of the effect of a specific intervention. Designs employing patient-important outcomes with relevance for practice are more pragmatic (Thorpe et al., 2009). The primary endpoint in the empirical example was identified as occurrence of vomiting or retching during 24 hours postoperatively. Secondary endpoints were effect of acustimulation in associations with possible factors of predisposition to postoperative nausea and vomiting (PONV). Furthermore, the parents evaluated their child’s experience of discomfort. These flexibilities place the design towards the pragmatic end of the continuum.

Participants compliance with «prescribed» intervention

Noncompliance is a reality in daily practice, but general attention and measurement of compliance may enhance compliance. In a pragmatic RCT measures of or use of compliance information are not performed (Thorpe et al., 2009). Compliance was not measured or responded to in the empirical example. This is an example of extremely pragmatic end of the continuum at the rim.

Practitioner adherence to study protocol

The pragmatic approach takes account of care-providers modifying an intervention to suit their setting (Thorpe et al., 2009). The guidelines for the execution of the intervention were relatively simple and easy to follow. The intervention was not monitored, and with this lack of monitoring and acting on protocol non-adherence, the empirical example is placed towards the pragmatic end of the continuum, but not extreme.

Analysis of the primary outcome

For the analyses of outcomes, the intention-to-treat-principle is appropriate for pragmatic RCTs since data from all patients are included (Macpherson, 2004; Thorpe et al., 2009). Lack of adherence to the protocol and different ways to conduct the intervention are recognized as parts of the result, and may have direct relevance for the patients and the population they represent (Thorpe et al., 2009). In the empirical study, the analysis was conducted according to the intention-to-treat-principle, and all specific as well as unspecific effects were recognized as parts of the results. This places the empirical example on the extreme pragmatic end of the continuum.

To sum up, the PRECIS wheel plot in Figure 2 illustrates the design choices in the empirical example. The wheel plot shows two domains closer to the hub (explanatory approach), namely «practitioners adherence to protocol» and «practitioner expertise in control treatment», but overall the study design is predominantly placed on the pragmatic end of the continuum.

Discussion

We examined the domains suggested by the PRECIS wheel in the empirical study of acupuncture/acupressure as
strategies to prevent PONV following pediatric tonsillec- 
tomy and/or adenoidectomy. As shown in the previous 
section the design of this empirical study is leaning towards the pragmatic 
ends of the continuum. For the discus-
sion, we will thoroughly assess the va-
lidity of findings coming from a prag-
matic RCT, and point to strength and 
weakness of the design in terms of in-
ternal and external validity.

**Internal and external validity**

Effect studies, including explanatory 
and pragmatic RCTs, should demon-
strate validity of the findings. Cook 
and Campbell (1986) present four di-
mensions of validity: Statistical validi-
ty, construct validity, internal and ex-
ternal validity. The two latter are of 
specific interest for the discussion of a 
pragmatic RCT. An explanatory RCT 
aims to attain a strong internal validity 
to demonstrate a causal relation be-
tween independent and dependent vari-
ables so the results can be fully attrib-
uted to the intervention (Godwin et al., 
2003). Strong, internal validity can be 
achieved when the variables are con-
trolled for, and the study conditions are 
ideal. Co-morbidity, age, and lack of 
compliance may be common exclusion 
criteria, and only a minimum of flexi-
bility according to the study protocol is 
permitted (Alford, 2007; Godwin et 
al., 2003).

The relationship between internal 
and external validity is also a means to 
distinguish between pragmatic and ex-
planatory RCTs; and the approaches 
have strengths and weaknesses. It is 
difficult to maximize both internal and 
external validity in a trial (Alford, 2007; 
Macpherson, 2004). The strength in an 
explanatory RCT-trial is the opportu-
nity to draw valid inference(s) about a 
specific effect of an intervention. The 
weakness is limitations of the general-
izability of findings produced by the in-
tervention. In a pragmatic RCT-trial, 
the opposite is the case, and it is easier 
to understand the differences by look-
ing closer at the characteristics.

**Assessing the validity of results in the empirical example**

Strong external validity is important 
for the results to become relevant for 
practice. External validity may com-
promise the internal validity, and the 
robustness and reliability or the preci-
sion of the results may be weaker 
(Godwin et al., 2003).

In the empirical study the inclusion 
criteria reflected the hospital’s practice 
for surgical treatment: Children less 
than 10 kg or suffering from a serious 
organic disease are not scheduled for 
surgery. Children with identified risk 
factors for postoperative nausea and 
vomiting were included. The latter may 
reduce the effect of the intervention, al-
beit reflect practice. To prevent ob-
liqueness that might influence the re-
sults either way, children with known 
gastrointestinal illness or who had tak-
en antiemetic drugs during the last 24 
hours were excluded. We also excluded 
children where the parents would need 
an interpreter, owing to the importance 
of understanding information and in-
structions. Strategies for inclusion and
exclusion criteria lead to a compromise between internal and external validity.

The children were either allocated to a control or intervention group by randomization. Randomization avoids possibilities of selection bias (Altman & Bland, 1999), and thus strengthens the internal validity (Polit & Beck, 2004). The external validity is not affected. Blinding is also an important strategy in reducing bias in traditional RCTs (Macpherson, 2004). For practical reasons, there was no blinding in the empirical study. The internal validity was accordingly weaker. Lack of blinding may on one hand be regarded as a weakness. On the other hand, it may contribute to a more natural way of conducting the intervention and more in accordance to real life.

The study protocol focused on acupuncture and acupressure to alleviate PONV, and the anaesthetic treatment was conducted according to the anaesthesiologist’s discretion. Personal preferences and individual variations in the treatment are accepted both in the department's guidelines and in the study. Such flexibility may reduce the internal validity while strengthening the external validity because practical realities are allowed for.

In pragmatic RCTs, noncompliant patients are regarded as part of the result. If compliance is low, it is likely that the effectiveness is low (Godwin et al., 2003). In the empirical example, the children might rotate the wrist-bands, while the parents were probably not able to survey the position. Lack of compliance weakens the internal validity and is not desired in explanatory RCTs, but in the empirical study, lack of compliance may actually strengthen external validity. The intention-to-treat principle implied that results from all the patients were included in the analysis. The efficacy of the intervention may be reduced by non-compliance, but the results are still important for the effectiveness of the intervention in practice (Macpherson, 2004).

In Figure 2, two dimensions on the PRECIS wheel are close to the hub, or the explanatory extreme, i.e. «practitioner adherence to protocol» and «practitioner expertise in control treatment». Adherence and expertise are characteristics of great importance to strengthen internal validity; however, external validity may accordingly be weaker. In the empirical study, the intervention was easy to accomplish and complemented solid expertise in anaesthesia. This may support that the external validity was not particularly affected.

It is difficult to gratify concurrently strong internal and external validity in a study. The conflict arises when one kind of validity is optimized at the expense of another, resulting in difficulties in attaining valid inferences. Accordingly, a quest for strong external validity should not open for methodological solutions producing distortions difficult to control. The empirical study was designed to answer research questions and objectives of the study. The adaptation to characteristics of the intervention and premises in clinical practice may weaken internal validity.
for the benefit of a stronger external validity.

The image produced when plotting the empirical study in PRECIS’s dimensions (Figure 2) and the concern to secure strong external validity leads to a predominantly pragmatic approach. Therefore, the core question in pragmatic RCT-designed studies «Can the intervention be useful in our clinical practice?, can be answered with a reasonable degree of validity. Findings from the empirical study indicate effectiveness of acustimulation as an adjunct to standard treatment. The treatment is easy to implement and may be incorporated into established routines without additional resources. The study was conducted without disturbing the daily routines in a busy day-surgery department. The setting was similar to clinical practice, which is profitable in generalizing to similar departments in other hospitals.

**Conclusion**

Research based knowledge is one of the cornerstones of EBP, and results from explanatory RCTs rank highest in Cochrane’s evidence hierarchy (Scott & McSherry, 2009). However, setting up explanatory RCTs may be less suitable for studying care and treatment repertoires in clinical practice (Fønnebo et al., 2007; Glasgow et al., 2003). As an approach to controlled outcome studies, pragmatic RCT-designs can be very attractive due to allowed flexibility that renders possibilities for a broader context perspective. The design is thus suitable and feasible for studying complex and context-dependent treatments, which often exist in nursing. Moreover, results can easily be generalized across settings in clinical practice (Boon et al., 2007).

The pragmatic RCT-design treats practical realities like ambiguity, complexity, and subjective experiences as parts of the results, and not as biases or casual noise. If findings from a pragmatic RCT show that an intervention makes a significant difference compared to usual treatment, the study demonstrates that the intervention works in real clinical settings. Findings from pragmatic RCT-studies can be important contributions for the development of treatments and symptom management strategies administered as part of nursing care. The pragmatic RCT-design may complement the traditional explanatory RCT design, and findings should be actively used for EBP. At the same time, two approaches may lead to different conclusions in terms of the effect of an intervention. A treatment may have a documented clinical effect in an ideal setting, but the effects can be difficult to reproduce in usual clinical setting (Roland & Torgerson, 1998). Nurses assessing the relevance of research findings in their own field, should recognize the differences between explanatory and pragmatic RCT-designs.

Our paper contributes to discussions in nursing research on appropriate strategies to develop a richer knowledge-base for EBP. Future studies ought to focus on how to comprehend and manage inherent complexity and ambi-
guity, and employ strategies to expand available quantitative research designs for complex interventions. Methodological approaches should supplement each other to produce relevant knowledge to advance research in all fields of nursing. The pragmatic RCT-design is a method contributing highly relevant research-based knowledge as a solid foundation to select proper actions in nursing practice. Therefore, we argue that the pragmatic RCT-design has great potential to assist the nursing profession’s knowledge development to achieve best practice.

Different strategies to conduct effect studies should gain a more prominent position in the nursing education programs, among clinical nurses, and in research. There is a call for studies of existing treatment and caring strategies in nursing to explicate the actions and accumulated experiences, and to document the effects systematically. Dissemination of findings from pragmatic RCTs should enjoy the same status as findings from explanatory RCTs, systematic reviews and meta-analyses, and can contribute to bridge the gap between research and practice. Another important aspect is providing systematically developed knowledge from effect studies to decision makers and stakeholders. Here are exciting, unexplored opportunities for nursing research to influence health care priorities and quality development in nursing.

About the article
Ingrid Liodden designed and carried out the empirical study, analysed and interpreted the data and is responsible for the content in the final version for publication. She has been the lead to write up the article’s intellectual content and been responsible for the version to be published. Anne Moen has been involved in conceiving the ideas in the study, bridging to evidence based practice, structure and writing up the article as well as revising a previous version of the discussion presented here. She has approved the version to be published.

References


