Interventions Aimed at Increasing Research Use in Nursing: A Systematic Review

David S Thompson, BScN, RN (corresponding author)
Knowledge Utilization Studies Program
Masters Student, Faculty of Nursing
5-112 Clinical Sciences Building,
University of Alberta,
Edmonton, Alberta, Canada
T6G 2G3 (780) 492-6836
e-mail: dst3@ualberta.ca

Carole A. Estabrooks, PhD, RN
Professor, Faculty of Nursing, University of Alberta
Canada Research Chair in Knowledge Translation
Principle Investigator, Knowledge Utilization Studies Program
5-112C Clinical Sciences Building,
University of Alberta,
Edmonton, Alberta, Canada
T6G 2G3 (780) 492-3451
e-mail: carole.estabrooks@ualberta.ca

Shannon Scott-Findlay, PhD(c), RN
Post Doctoral Fellow, Faculty of Medicine,
Centre for Health Promotion Studies
Alberta Research Centre for Child Health Eviudence
Room 9432, 4th Floor
Aberhart Centre One
11402 University Avenue,
Edmonton, Alberta, Canada
T6G 2J3 (780) 492-5074
e-mail: shannon.scott-findlay@ualberta.ca

Katherine Moore, PhD, RN
Associate Professor, Faculty of Nursing, University of Alberta
3rd Floor, Clinical Sciences Building
University of Alberta
Edmonton, Alberta, Canada
T6G 2G3 (780) 492-1541
e-mail: katherine.moore@ualberta.ca

Lars Wallin PhD, RN
Researcher, Clinical Research Unit,
Karolinska University Hospital, Stockholm Sweden,
CRU, Karolinska University Hospital
Eugeniahemmet T4:02
SE-171 76 Stockholm
Sweden
Phone +46-8-517 754 54
Fax +46-8-517 760 95
e-mail: lars.wallin@karolinska.se
Affiliations: Department of Neurobiology, Care Sciences and Society,
Division of Nursing, Karolinska Institutet, Stockholm, Sweden

Abstract

Background: Investigators have developed and evaluated interventions to increase research use. While there are reports on the effect of these interventions in medicine, there is no assessment to date in nursing.

Objectives: To assess the evidence on interventions aimed at increasing research use in nursing.

Methods: A systematic review of research using computerized databases (Medline, CINAHL, Healthstar, ERIC, Cochrane Central Register of Controlled Trials and Psychinfo), grey literature, ancestry searching (Cochrane Database of Systematic Reviews), key informants and manual searching of journals. Randomized controlled trials and controlled before and after studies were included if they examined nurses, the intervention was explicitly aimed at increasing research use or evidence based practice and the author explicitly linked study outcomes to research use. Methodological quality was assessed independently by three authors using pre-existing tools. Data on interventions and outcomes were extracted and categorized using a pre-established taxonomy of interventions.

Results: Over 8000 titles were screened. Three randomized controlled trials and one controlled before and after study were included. The methodological quality of included studies was generally low. Three investigators evaluated single interventions. The most common intervention was education. Investigators measured research use using a combination of surveys (three studies) and compliance with clinical practice guidelines (one study). Researcher led educational meetings were ineffective in two studies. Educational meetings led by a local opinion leader and the formation of multidisciplinary committees were both effective at increasing research use.

Conclusion: Little is known about how to increase research use in nursing. Educational meetings lead by a local opinion leader and multidisciplinary committees show promise. Educational

strategies alone do not appear effective. To advance the field, we recommend investigators use theoretically derived outcomes to measure research use, use theory and research to design interventions and use methodologically sound study designs to evaluate interventions.

Introduction

Nurses constitute the largest group of health care providers and their care influences patient outcomes [1-3]. This group's size and influence should ensure that health care is effective and efficient. While most nurses align themselves with these intentions, nursing, like other professions, often fails to incorporate research findings [4]. Investigators have reported that a lack of research use contributes to as many as 30%-40% of patients not receiving care according to current scientific evidence and that some 20%-25% of patients may receive potentially harmful care [5]. In response, much attention has been paid to the development of interventions to increase research use and several systematic reviews have been published [6-8]. However, studies in these reviews focus primarily on interventions aimed at guideline implementation among physician procedures.

While physicians and nurses experience similar challenges in incorporating evidence, there are differences that influence how each group uses research in practice. A key issue is the social structure of the two professions. Nurses typically work in hierarchical social structures as salaried employees. Conversely, physicians typically work in more autonomous group practices or in hospitals, not as salaried employees, but as attending physicians with privileges [9]. Therefore, results from existing reviews may not transfer readily to nursing practice. The purpose of this systematic review was to assess the evidence on interventions aimed at increasing research use in nursing practice.

Methods

Search Strategy

In consultation with a Library Information Specialist familiar with the field, we searched Medline, CINAHL, Healthstar, ERIC, Cochrane Central Register of Controlled Trials and Psychinfo from inception to February 2006 (see Additional file 1). Ancestry searches were done on

relevant studies and systematic reviews indexed in the Cochrane Database of Systematic Reviews. We searched grey literature using the System for Information on Grey Literature database (SIGLE), the New York Academy of Medicine and the Sarah Cole Hirsch Institute. We retrieved the majority of relevant studies from our database search from the *Journal of Nursing Care Quality, MEDSURG Nursing, Journal of Clinical Nursing* and *Journal of Gerontological Nursing*. We manually searched these journals from 1990 (or their inception) to 2006.

Inclusion Criteria

A study was eligible for inclusion if: (a) it was a randomized controlled trial (RCT) or controlled before and after (CBA) design, (b) authors evaluated interventions aimed explicitly at increasing research use or evidence based practice, (c) participants were nurses, and (d) outcomes captured research use. Only studies in English were assessed.

For *criterion a* we defined RCT and CBA using Cochrane definitions [10]. To meet *criterion b*, investigators must have explicitly stated the research purpose was to test an intervention aimed at increasing research or evidence based practice. For c*riterion c* we included registered and student nurses. To meet *criterion d*, investigators must have used an instrument to measure research use or identified how the chosen outcomes represented research use. To identify how an outcome represented research use using a change in provider behavior as an outcome, an investigator needed to explain how the behavior reflected research use. For example, in evaluating the implementation of a clinical practice guideline, the investigator needed to measure all recommended behaviors outlined in the guideline or identify the percentage of recommended behaviors that signified research use.

Screening Process

The search resulted in over 8000 titles. One author reviewed titles and abstracts and selected studies. Two reviewers each screened 20% of the titles and abstracts. Inter-rater reliability between reviewers was greater than 90%. The initial screening process resulted in 117 studies. Manual and ancestry searching produced an additional 21 studies. Further review of the 138 studies narrowed them to 14 and the final result was four studies meeting the inclusion criteria [11-14]. (see Figure 1).

Methodological Quality

We evaluated the studies for methodological quality using two tools available from the Cochrane Collaboration Effective Practice and Organization of Care Group (EPOC) [10]. The RCT tool consisted of items related to unit of analysis, power, baseline measure, concealment of allocation, blinded or objective assessment of outcome(s), protection against contamination, reliable outcome(s) and completeness of follow-up. The CBA tool consisted of items related to unit of analysis, power, baseline measure, comparability of groups, blinded or objective assessment of outcome(s), protection against contamination, reliable outcome(s) and completeness of follow-up. In both tools, unit of analysis errors were determined using the unit of allocation and unit of analysis items. That is, if authors allocated by cluster and analyzed by individual without reporting appropriate statistical measures to account for clustering we reported unit of analysis errors. If in these cases the authors reported power calculations and did not account for intra cluster correlations, we scored the power calculation item as *done* but accounted for the error in the overall rating. We report results in Table 1.

One reviewer independently assessed each study and two reviewers each screened 50% of the studies. Discrepancies were resolved between the three reviewers through discussion. Each

item was scored in the following way: *Done*; *Not Done*; and *Not Clear*. A quality rating was assigned to each study as *low*, *medium*, or *high* depending whether it scored *done* on 0-4, 5-6, or 7-8 items respectively. Unit of analysis errors and incorrect power calculations were noted. We did not use quality assessment ratings to exclude studies because we sought to explore the general state of the science in this field.

Data Extraction

We extracted data from four studies representing five experimental cohorts where an intervention was compared to a control. One reviewer independently extracted data from all studies while two reviewers extracted data from 50% of the studies. Discrepancies between the reviewers were resolved through discussion. We used extraction tools and dictionaries available from EPOC [10]. Data on design, subjects, setting, interventions and outcomes were extracted.

To facilitate comparison and discussion, we classified interventions using an EPOC classification system [10]. Interventions were classified as: educational meetings, multidisciplinary committees and local opinion leaders. The EPOC classification and a description of the intervention are illustrated in Table 2. We use only the EPOC classification in the text.

Several studies included in this review reported additional outcomes, for example, on predictors of research use, changes in *knowledge* or *attitudes*, or patient outcomes. These were not extracted or reported on as they are not measures of research *use*.

Results

Methodological Quality of Included Studies

Overall the studies were of low quality (Table 1). Two had unit of analysis errors where the investigators allocated by group but did not account for clustering in the analysis [11-12]. Of the two studies without unit of analysis errors, the investigators of one allocated by unit and accounted

for clustering [13] while the other allocated and analyzed at the provider level [14]. No power calculations were presented in any studies. Two studies had substantial differences in outcomes prior to the intervention [11, 13]. Allocation concealment was not reported in two RCTs [11, 13]. None of the investigators used blinded or reliable outcome assessments. The CBA investigators did not protect against contamination of the intervention across study groups [14]. However, the RCT investigators all randomized by ward and attempted to protect against contamination [11-13]. The CBA investigator reported adequate provider follow up [14]. However, the RCT investigators either used non-matched samples [12-13] or did not report on follow up [11].

Included Studies

Four studies representing five intervention cohorts in Canada, USA, Taiwan, and Hong Kong met our inclusion criteria (Table 2). Three were RCTs (four intervention cohorts) [11-13] and one was a CBA (1 intervention cohort) [14]. All studies included nurses from inpatient clinical settings; oncology, medicine, surgery and multiple specialties.

Investigators assessed educational meetings delivered to nurses in three studies [12-14]. In one study, the investigators compared two investigator-provided educational interventions to a control [13]. Because these interventions varied in content and duration, we identified this study as having two cohorts. Another study used a combination of local experts and educators to deliver the intervention [14]. The third study that assessed educational meetings used local opinion leaders identified by the study participants to conduct a demonstration tutorial which was supplemented with education delivered by a local expert [12]. The study that did not assess educational meetings investigated the formation of a multidisciplinary team of practitioners and researchers [11]. Within this intervention there were components of education and marketing. However, the primary

investigators based their conclusions on the entire intervention (the multidisciplinary team) rather than the components, therefore, we did not separate the components of this intervention.

The investigators of three studies used nurse-administered instruments to measure research use. Dufault [11] used Kim's [15] 13-item Likert-type scale which asked participant to rate their research utilization competency on a 1-7 scale. Tranmer [13] used the Research Utilization Questionnaire (RUQ) developed by Champion and Leach [16-17]. This 42-item Likert-type questionnaire measured attitudes towards research, access to research, support of the use of research and research use. The questionnaire was divided into corresponding subscales. Because Tranmer [13] reported and analyzed the results of each subscale, we extracted only the data that pertained to the *use of research* subscale. Finally, using an instrument based on her previous work, Tsai [14] assessed whether research utilization was implemented in nursing practice and to what degree. The instrument consisted of 11 items including one single-choice non multiple-choice and one open-ended question.

In the final study, investigators used self report and participant observation to assess practice compliance with *all* the recommendations from a clinical practice guideline [12]. This study differed from many of the excluded studies that assessed provider behavior change. Specifically, the investigators linked *all* eight outcomes to the eight practices recommended by the clinical guideline, which was referenced to research, thus supporting that the outcomes reflected research use.

Excluded Studies

The final ten studies were excluded for two reasons: uncertainty that the outcomes were measuring research use [18-21] and interventions not explicitly aimed at increasing research use or evidence based practice [22-28].

Findings

Methodological weaknesses, varied interventions and outcomes across health contexts, incomplete reporting and the small samples prevented meta-analysis. Instead, we present narrative results. The characteristics and findings of the four studies included in this review are summarized in Table 3 and 4.

Educational Interventions. Two studies representing three cohorts tested the effect of educational interventions on research utilization [13-14]. Direct or indirect participation in educational interventions did not have an effect on nurses' research utilization. Tranmer [13] measured research use both in nurses who participated and nurses from the same unit as those who participated. The investigators reported that there were no significant changes in research utilization scores in either group. This suggests that educational interventions are ineffective whether a nurse participates directly or indirectly.

Educational interventions of varying content, frequency and duration were also found to be ineffective. Tranmer [13] reported non significant changes in research utilization scores regardless of whether the intervention was 20 hours and focused on literature critiquing, research design, and protocol implementation or eight hours and focused solely research design and implementation. Tranmer [13] did not report the frequency of their intervention. These results are supported by Tsai's [14] study which tested a series of educational strategies focused on research use totaling 65 hours and delivered over eight weeks.

Educational interventions did not have a delayed effect on research utilization. Tsai [14] measured research use at two points: immediately and six months following the intervention. In both cases there were no significant changes in research utilization. This was supported by

Tranmer [13] who measured research utilization only once but waited for one year following the start of the intervention and also reported non significant results.

In summary, educational interventions of varying content, duration, and frequency do not appear to be effective research utilization interventions in nursing whether nurses are directly or indirectly involved in the intervention. The timing of outcome assessment does not appear to influence the ineffectiveness of educational interventions.

Educational interventions and local opinion leaders. One study [12] tested the effect of educational interventions combined with a local opinion leader and found that nurses who attended both the lecture and the tutorial (led by a local opinion leader) reported increased research utilization related to urinary catheter practices. It was not possible to determine whether the positive effect was due to the local opinion leader, the educational intervention, or a combination of both. The intervention consisted of a 30 minute lecture by an educator followed one week later by a demonstration tutorial conducted by a local opinion leader. The length of the demonstration tutorial was not reported. No data were collected during the lapse between interventions. Outcomes were assessed at two points; at two weeks following the intervention and at two months. The authors used a practice survey at two weeks and direct observation at two months. Longitudinally, education and local opinion leaders appeared to sustain an increase in research utilization.

Multidisciplinary committees. Formation of multidisciplinary committees was found to be effective at increasing nurses' research use related to oncology pain [11]. The intervention lasted 28 weeks and was divided into six stages. Each stage was sequential and lasted between two and nine weeks. Stages were constructed around collaboration of members of the multidisciplinary team working to operationalize an existing research utilization process (the Conduct and Utilization of Research in Nursing Project) [28]. Unlike the previous interventions, education was

not the primary component. Outcomes were assessed at one point using a research utilization scale. The investigators did not report the time period between the intervention and outcome measurement.

Summary of Findings

In summary, the four studies reviewed were of poor quality [11-14]. The findings do not provide enough evidence to support or refute the benefit of educational interventions for increasing research utilization in nursing. The combination of educational interventions and local opinion leaders may be an effective intervention, as may the formation of multidisciplinary committees.

Discussion

This review focused on interventions to increase research use in nursing practice. We located four studies that met our inclusion criteria; all of which were of low quality [11-14). Clearly, study design and implementation must improve before one can confidently comment on effectiveness of interventions aimed at increasing research use in nursing practice. In its current state, the literature provides little guidance to individuals charged with increasing research use in nursing practice. In the following sections we relate our findings to current literature and provide a discussion of conceptual challenges, methodological challenges, and recommendations for future research.

Comparison with Existing Reviews

Grimshaw and colleagues [6-8] published comprehensive reviews of provider behavior change reviews and guideline dissemination strategies. While we were interested specifically in nurses' research utilization and Grimshaw and colleagues [6-8] examined broader outcomes (provider behavior change and guideline dissemination), these reviews were all aimed at improving understanding of how to translate research findings into practice where they can be

used, for example, to change provider behavior or improve patient outcomes. Grimshaw and colleagues [7] concluded that interventions with different educational strategies showed mixed effects depending upon a combination of strategies. Findings of the four studies reviewed do not support these results [11-14]. We found that educational interventions of varying duration, content, and frequency appeared ineffective at increasing research use by nurses. Educational interventions included in our review were small interactive group sessions. In medicine, these types of educational strategies showed the most promise. We found two effective interventions: multidisciplinary committees and local opinion leaders. Grimshaw and colleagues [7] also found that multidisciplinary collaboration was effective and that use of local opinion leaders showed mixed effects.

Similarities and differences between these reviews can be attributed to multiple factors. Perhaps the most obvious is in the review methods. Grimshaw and colleagues [8] derived a single effect size for each of the 235 studies reviewed and summarized the range of effects and median effects across studies for each intervention. In contrast, we were only able to locate four studies and were limited to a narrative analysis based on the number of positive and negative results (vote counting).

A second contrast, and the impetus for our review, are the differences between physician and nursing practice. Although nursing studies are not explicitly excluded from these reviews [6-8], nursing studies represent a small portion and their results may not be captured by the overall conclusions. Moreover, many of the conclusions that Grimshaw and colleagues make are based on physician outcomes such as prescribing behavior, referral practices, and diagnostic ordering. These practices do not typically occur in nursing so results from existing reviews cannot be readily applied to nursing practice.

Conceptual Challenges

A major conceptual issue we identified is related to outcome measurement. We excluded multiple studies due to unclear conceptualizations of research use related to outcomes. Investigators have commonly aligned themselves with a model of evidence based practice consisting of five steps: (a) converting information needs to an answerable question, (b) locating the evidence, (c) critically appraising the evidence, (d) implementing the evidence in practice and (e) evaluating care performances [29]. Our decision to exclude studies that did not explicitly measure research use was based on; first, the lack of empirical evidence to support a substantive link between using research (step d) and care performances (step e) and second, the possibility that studies claiming to report on nurses' research use may not be reporting on the same phenomena due to conceptual confusion [30].

There is uncertainty in the research community about what constitutes an appropriate measure of research use [31-33]. Debate surrounding outcome measures can be attributed to a poor understanding of the conceptual structure of research utilization [30-31]. Ideally, outcome selection is informed by an explicit conceptualization of research use (34-35). Only two authors in our review explicated how they conceptualized research utilization (11, 13); both offered different conceptualizations and it was not clear from either how their conceptualization informed outcome selection. Rich [36] noted that misconceptions of how research-based knowledge enters the decision-making process leads to inaccurate measures of research use. Estabrooks and colleagues [34] suggested that "unresolved measurement challenges present an important and practical problem" to advancing the field of research utilization. Our findings support these claims and suggest that such issues persist.

Several conceptualizations of research use are available [36-39] and include instrumental, conceptual, and symbolic forms. Instrumental use is the concrete application of research; conceptual use is a change in one's perspective but not necessarily one's action; and symbolic use is the application of research findings to influence decisions. While Estabrooks [37] offered a preliminary empirical verification of these in nursing, little work has been done since and many investigators rely on provider behaviors or patient outcomes as proxies. While this approach may capture changes in behavior or organization of care, it is not a reliable measure of *research use* because not all forms of research use consistently result in visible practice changes.

Drawing from literature on guideline effectiveness, the common assumption that patients will do better if treated according to guidelines based on research has not yet been widely demonstrated [41]. Clearly investigators are interested in the link between using research in practice and improving patient outcomes. However, establishing this link is best accomplished if we first develop sufficient evidence to support the relationship between specific interventions and research use. From this, we can explore the relationship between effective interventions and patient outcomes. If studies aim to evaluate an intervention to increase research use, outcomes must be structured to capture changes in *research use*. More attention to the fit between study outcomes and the conceptual structure of research use will advance the field by producing more accurate results.

Methodological Challenges

The studies were published between 1990-2003. Methodological quality (Table 1) was low in all four [11-14]. The absence of progressive improvement suggests that the field is not developing within nursing as would be expected. We present what we believe are the most urgent methodological challenges facing the field.

Identification of Primary Outcomes. A primary outcome helps determine the key endpoint signifying the efficacy of an intervention [41]. Explicit reporting of the primary outcome enables the reader to determine whether or not the study results provide sufficient evidence for an intervention and to whom the study results apply. In our review, we extracted only research use outcomes (i.e., the score of a research utilization questionnaire). However, three investigators in this review also reported outcomes additional to research use and all three assessed *attitude towards research* [11, 13-14]. The relationship between such characteristics and research use is not well supported [42]. When authors report on multiple outcomes without discussing why particular measures were chosen or what constitutes the primary outcome, it is difficult to interpret study findings in the context of research utilization.

Use of Multiple Outcomes. The challenge in using multiple outcomes to evaluate research utilization interventions is determining the number that must be changed to indicate effectiveness [33]. We excluded many studies due to uncertainty that the investigators were actually measuring research use. In these cases, investigators did not provide rationale or support for multiple outcomes in the context of research utilization. It is challenging to determine whether an intervention was effective at increasing research use if there are sporadic changes in the outcomes. More challenging is determining how many recommendations from clinical practice guidelines must be met to indicate research use and for this review, we included only one study that measured *all* recommended practices [12]. Measuring all outcomes may not be the most accurate or feasible approach, especially if guidelines recommend large numbers of practices or procedures.

Intervention Sustainability. Two studies [11, 14] measured longitudinal outcomes; one illustrated a benefit of intervention over time (two months) [11] and the other illustrated no effect either immediately or six months following [14]. Longitudinal outcome measurements are needed to

establish the sustainability of research use. Titler [33] has described two challenges in assessing sustainability of research utilization interventions: (a) defining the boundary between the end of the intervention phase and the start of the sustainability phase, and (b) timing the outcome measurement to differentiate between sustained improvements and residual effects. Compartmentalizing these stages becomes increasingly challenging when multiple interventions are tested because there may be overlap between interventions. Thus far, the literature on research utilization provides little guidance on the optimal timing or length of outcome measurement for different interventions. Hong [12] and Tsai [14] did not report why they assessed outcomes at two and six months.

Unit of Analysis Errors. Two RCTS included in our review [11-12] had unit of analysis errors (Table 1). Unit of analysis errors occur when investigators assign clusters or groups of individuals to a study group (i.e., intervention or control) and then analyze as if each individual had an equal chance of being assigned to either group [43]. When this occurs, outcomes for each individual are not independent of others within same group. This is a unit of analysis error because people within clusters share similarities (i.e., burn unit nurses may be more familiar with certain treatments than psychiatric nurses) that may not be accounted for during analysis. When clustering is ignored, the number of participants required (sample size) is underestimated and the level of study significance (P value) is overestimated resulting in a greater chance of arriving at incorrect results [44].

Limitations

This systematic review has some limitations. First, we did not conduct a meta-analysis because of lack of effect sizes and a small size. The method we used (vote counting) is a crude estimate of effectiveness. Second, we used the EPOC classification that was developed for broad

use [10]. Its applicability specifically to nursing has yet to be established. Third, the four studies included were all of low quality. Including studies of low quality limits the strength of any positive conclusions drawn. Our results should therefore be interpreted *with caution*.

Recommendations

Based on our findings, we developed a series of recommendations addressing the following topics: outcome measurement, intervention development, and study design and reporting. If implemented, we believe they could advance the study of research utilization in nursing.

Outcome Measurement

A common set of problems are inherent in the instruments used to measure research use in the studies we reviewed and elsewhere. They include lack of theory (measurement or research utilization), lack of construct clarity, lack of psychometric assessment, a presumption of linearity, lack of longitudinal work, and influential yet unacknowledged assumptions [34]. Such instruments were used in three studies included in this review [11, 13-14]. Until more reliable and valid instruments are developed, investigators should present explicit statements outlining the conceptual and practical basis for chosen outcomes. Making use of available conceptualizations [36-39] to operationalize research use would decrease conceptual confusion and increase the validity of study results. At minimum, investigators should include longitudinal outcomes sensitive to the intervention being tested. Repeated longitudinal measurement will advance our understanding of the optimal timing and frequency of outcome evaluation.

Intervention Development

Interventions need to be developed using theory [45]. Explicit use of theory helps link elements associated with the study participants, the intervention, and the setting and offers a framework for generalizing the findings [46]. Several applicable theoretical perspectives exist.

Grol and colleagues [47] provided an overview of such theories, Estabrooks, Thompson, Lovely, and Hofmeyer [48] presented a guide to theoretical perspectives related to knowledge translation, and Estabrooks, Scott-Findlay, and Winther [49] offered a chapter outlining research utilization models specific to nursing. Examples of theories suitable for use include: Rogers' Diffusion of Innovation [50] which explains the spread of new ideas; the Promoting Action on Research Implementation in Health Services (PARIHS) Framework (51-52] which captures the factors that influence the uptake of evidence; and Social Capital Theory [53] which uses bonding, bridging and linking capacities to explain knowledge transfer.

Additionally, investigators in nursing should build on existing evidence. For example, over 15 years ago Hong [12] illustrated that local opinion leaders combined with education was an effective intervention for increasing research use. These results require further exploration in the context of current health services. Furthermore, Angus, Hodnett, and O'Brien-Pallas [54] used ethnography to illustrate how contextual factors influence success of an intervention and on a larger scale, Dopson and Fitzgerald [55] reported similar results. Investigators should build upon these findings, for example, by incorporating contextual elements into intervention design. The Medical Research Council [56] developed a framework for developing and evaluating complex interventions [57] that included qualitative modeling and exploratory trials for this purpose. Using such a framework could decrease resource expenditure on ineffective interventions and produce more fruitful results.

Investigators need to consider how implicit assumptions influence intervention selection and development. For example, authors have mainly targeted knowledge, attitudes, or behaviors of practitioners [58] and have assumed that individual characteristics, such as practitioner knowledge deficit, result in under-utilization of research. However, the effectiveness of such strategies is

equivocal [9]. Instead, investigators need to broaden efforts and explore additional strategies. For example, the authors of the PARIHS framework [51-52] theorized that organizational context is critical to the successful implementation of research in practice. Such theories should be rigorously evaluated.

Study Design and Reporting

Studies in this review were of poor methodological quality. To improve, investigators need to address several areas. First, studies should be designed and analyzed using methods that account for clustering if allocation is done by groups of individuals. Second, allocation procedures should be unbiased (i.e., central randomization) and explicitly outlined in study reports. Third, investigators should clearly describe interventions in study reports. Characteristics such as duration and frequency, deliverer and receiver, and mode of delivery must also be clearly reported. Guidelines such as the Consolidation of Standards for Reporting of Trials (CONSORT) [59] or the CONSORT statement for cluster RCTS [60] should be followed. Future reviews would also benefit from using a common classification system for interventions. We used a classification system proposed by EPOC. However, this approach may require adaptation for use in nursing and this needs to be examined and validated.

Conclusion

Little is known about how to increase research use in nursing. Local opinion leaders and multidisciplinary committees may be effective strategies. Advancing the field in nursing requires methodological and conceptual advancement. If we aim to establish a link between using research and improved patient outcomes we must first establish what interventions are most effective at increasing research use.

Competing interest

All authors declare that they have no conflicting competing interests.

Authors' contributions

CE, SSF and LW conceived the study

CE, SSF, LW and KM supervised DT's thesis.

SSF and LW validated the search design, article selection, data extraction, and quality assessment.

CE, SSF, and LW validated the analysis.

DT designed and performed the search, selected the articles, assessed the quality of included studies, extracted the data, analyzed the results and wrote the manuscript.

CE, SSF, LW, and KM reviewed the paper and participated actively throughout the writing of the paper.

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References

1. Aiken LH, Clarke SP, Sloan DM: **Hospital staffing, organization, and quality of care: Cross-national findings.** *Nurs Outlook* 2002, **50:**187-94.

2. Blegen M, Goode C, Reed L: **Nurse staffing and patient outcomes.** *Nurs Res* 1998, **47:**43-50.

3. Estabrooks CA, Midodzi W, Cummings G, Ricker K, Giovannetti P: **The impact of hospital nursing characteristics on 30-day mortality.** *Nurs Res* 2005, **54:**74-84.

4. Estabrooks CA, Chong H, Brigidear K, Profetto-McGrath J: **Profiling Canadian nurses' preferred knowledge sources for clinical practice.** *Can J Nurs Res* 2005, **37:**118-140.

5. Schuster M, McGlynn E, Brook R: **How good is the quality of health care in the United States.** *Milbank Q* 1998, **76:**517-563.

6. Bero L, Grilli R, Grimshaw J, Harvey E, Oxman A, Thomson M: **Closing the gap between research and practice: an overview of systematic reviews of interventions to promote the implementation of research findings.** *BMJ* 1998, **317:**465-68.

7. Grimshaw JM, Shirran L, Thomas R, Mowatt G, Fraser C, Bero L, Grilli R, Harvey E, Oxman A, O'Brien MA: **Changing provider behavior: An overview of systematic reviews of interventions.** *Med Care* 2001, **Supp 39:**2-45.

8. Grimshaw JM, Thomas R, MacLennan G, Fraser C, Ramsay C, Vale L, Whitty P, Eccles MP, Matawe L, Shirran L, Wensing M, Dijkstra R, Donaldson C: **Effectiveness and efficiency of guideline dissemination and implementation strategies.** *Health Technol Assess* 2004, **8:**1-72.

9. West E, Barron D, Dowsett J, Newton J: **Hierarchies and cliques in the social networks of care professionals: implications for the design of dissemination strategies.** *Soc Sci Med* 1999, **48:**633-44.

10. **Cochrane Collaboration: Effective Practice and Organization of Care Group** [http://www.epoc.uottawa.ca/]

11. Dufault M, Bielecki C, Collins E, Willey C: **Changing nurses' pain assessment practice: a collaborative research utilization approach.** *J Adv Nurs*1995, **21:**634-645.

12. Hong SW, Ching TY, Fung JP, Seto WL: **The employment of ward opinion leaders for continuing education the hospital.** *Med Teach* 1990, **12:**209-218.

13. Tranmer JE, Lochaus-Gerlach J, Lam M: **The effect of staff nurse participation in a clinical nursing research project on attitude towards, access to, support of and use of research in acute care settings.** *Can J Nurs Leadersh* 2002, **15:**18-26.

14. Tsai S: **The effects of a research utilization in-service program on nurses.** *Int J Nurs Stud* 2003, **40:**105-113.

15. Kim HS: **A study of three approaches to research utilization.** Unpublished manuscript. *University of Rhode Island, Kingston, Rhode Island*. 1988.

16. Champion V, Leach A: **The relationship of support, availability and attitude to research utilization.** *J Nurs Adm* 1988, **16:**19-37.

17. Champion V, Leach A: **Variables related to research utilization in nursing: An empirical investigation.** *J Adv Nurs* 1989, **14:**705-10.

18. Davies B, Hodnett E, Hannah M, O'Brien-Pallas L, Pringle D, Wells G: **Fetal health surveillance: a community wide approach versus a tailored intervention for the implementation of clinical practice guidelines.** *Can Med Assoc J* 2002, **167:** 469-474.

19. Hodnett ED, Kaufman K, O'Brien-Pallas L, Chipman M, Watson-MacDonell J, Hunsburger W: **A strategy to promote research-based nursing care: effects on childbirth outcomes.** *Nurs Res* 1996, **19:**13-20.

20. McDonald M, Pezzin L, Feldman P, Murtaugh C, Peng T: **Can just-in-time, evidence-based "reminders" improve pain management among home health care nurses and their patients.** *J Pain Symptom Manage* 2005, **29:**474-488.

21. Murtaugh C, Pezzin L, McDonald M, Feldman P, Peng T: **Just-in-time evidence based e-mail "reminders" in home health care: Impact on nurse practices.** *Health Serv Res* 2005, **40:**849-864.

22. Feldman PH, Murtaugh CM, Pezzin LE, McDonald MV, Peng TR: **Just-in-time evidence-based e-mail "reminders" in home health care: impact on patient outcomes.** *Health Serv Res* 2005, **40:**865-85.

23. Feldman PH, Peng T, Murtaugh C, Kelleher C, Donelson S, McCann E: **A randomized intervention to improve heart failure outcomes in community-based home health care.** *Home Health Care Serv Q* 2004, **23:**1-23.

24. Gould D, Chamberlain A: **The use of a ward-based educational teaching package to enhance nurses' compliance with infection control procedures**. *J Clin Nurs* 1997, **6:** 55-67.

25. Jones K, Fink R, Vojir C, Pepper G, Hutt E, Clark L, Scott J, Martinez R, Vincent D, Mellis K: **Translating research in long-term care: Improving pain management in nursing homes.** *Worldviews Evid Based Nurs* 2004, **Supp 1:**13-20.

26. Moongtui W, Gauthier D, Turner J: **Using peer feedback to improve handwashing and glove usage among Thai health care workers**. *Am J Infect Control* 2000, **28:** 365-369.

27. Krichbaum K, Pearson V, Savik K, Mueller C: **Improving resident outcomes with GAPN organization level interventions**. *West J Nurs Res* 2005, **27:**322-37.

28. Horsley JA, Crane J, Bingle JD: **Research utilization as an organizational process.** *J Nurs Adm* 1978, **8:** 4-10.

29. Sackett DL, Richardson S, Rosenberg W, Haynes RB: *Evidence based medicine: How to practice and how to teach EBM*. Edinburgh: Churchill Livingtsone; 2000.

30. Thompson C: **Fortuitous phenomena: On complexity, pragmatic radomised controlled trials, and knowledge for evidence-based practice.** *Worldviews Evid Based Nurs* 2004, **1:**9-17.

31. Donaldson E, Rutledge D, Ashley, J: **Outcomes of adoption: Measuring evidence uptake by individuals and organizations.** *Worldviews Evid Based Nurs* 2004, **Supp 1:**S41-S51.

32. Kirchoff KT: **State of the science of translational research: From demonstration projects to intervention testing.** *Worldviews Evid Based Nurs* 2004, **Supp 1:**S6-S12.

33. Titler M: **Methods in translation science**. *Worldviews Evid Based Nurs* 2004, **1:**38-48.

34. Estabrooks CA, Wallin L, Milner, M: **Measuring knowledge utilization in health care.** *International Journal of Policy Evaluation & Management* 2003, **1:**3-36.

35. Rich R: **Knowledge and policy.** *The International Journal of Knowledge Transfer and Utilization* 1997, **10:**11-4.

36. Rich R: **Knowledge creation, diffusion, and utilization.** *Knowledge: Creation, Diffusion, and Utilization* 1991, **12:**319-337.

37. Estabrooks CA: **The conceptual structure of research utilization.** *Res Nurs Health*1999, **22:**203-216.

38. Rich, RF: **Use of social science information by federal bureaucrats: Knowledge for action vs knowledge for understanding**. In *Using social science in public policy making.* Edited by Weiss C. Lexington: Lexington Books; 1977:199-233.

39. Weiss C, 1979: **the many meanings of research utilization**. *Public Adm Rev*1979 Sep-Oct, **39**:426-431.

40. Marshall D, Simpson K, Norton E, Biddle A, Youle, M: **Measuring the effect of clinical guidelines on patient outcomes.** *Int J Technol Assess Health Care* 2000, **14:**1013-23.

41. Freemantle N: **Interpreting the results of secondary end points and subgroup analyses in clinical trials: should we lock the crazy aunt in the attic?** *BMJ* 2001, **322:**989-991.

42. Estabrooks CA, Floyd JA, Scott-Findlay S, O'Leary K, Gushta, M: **Individual determinants of research utilization: a systematic review.** *J Adv Nurs* 2003, **43:**506-520.

43. Whiting-O'Keefe Q, Henke C, Simborg D: **Choosing the correct unit of analysis in medical care experiments.** *Med Care* 1984, **22:**101-114.

44. Gilbody S, Whitty P: **Improving the delivery and organization of mental health services: beyond the conventional randomized controlled trial.** *Br J Psychiatry* 2002, **80:**12-8.

45. Eccles M, Grimshaw, J, Walker, A, Johnston M, Pitts, N: **Chanting the behavior of healthcare professionals: The use of theory in promoting the uptake of research findings.** *J Clin Epidemiol* 2005, **58:**107-112.

46. Improved Clinical Effectiveness through Behavioral Research Group: **Designing theoretically-informed implementation interventions.** *Implement Sci* 2004, **4**.

47. Grol R, Wensing M, Hulscher M, Eccles M: **Theories on implementation of change in healthcare.** In *Improving patient care: The implementation of change in clinical practice.* Edited by Grol R, Wensing M, Eccles M. Edinburgh: Elsevier; 2005:15-40.

48. Estabrooks CA, Thompson DS, Lovely JJ, Hofmeyer A: **A guide to knowledge translation theory.** *J Contin Educ Health Prof* 2005, **26:**25-36.

49. Estabrooks CA, Scott-Findlay S, Winther C: **A nursing and allied health perspective on knowledge utilization.** In *Using knowledge and evidence in health care: Multidisciplinary*

perspectives. Edited by Lemieux-Charles L, Champagne F. Toronto: University of Toronto Press; 2004:242-280.

50. Rogers EM: *Diffusion of Innovations.* New York: Free Press; 2003.

51. Kitson A, Harvey G, McCormack B: **Enabling the implementation of evidence-based practice: a conceptual framework.** *Qual Health Care* 1998, **7:**149-158.

52. Rycroft-Malone J, Kitson A, Harvey G, McCormack B, Seers K, Titchen A, Estabrooks, CA: **Ingredients for change: Revisiting a conceptual framework**. *Qual Saf Health Care* 2002, **11:**174-180.

53. Szreter S, Woolcock M: **Health by association? Social capital, social theory, and the political economy of public health.** *Int J Epidemiol* 2004, **33:**650-667.

54. Angus J, Hodnett E, O'Brien-Pallas L: **Implementing evidence-based nursing practice: a tale of two intrapartum nursing units.** *Nurs Inq* 2003, **10:**218-228.

55. Dopson S, Fitzgerald L: **The active role of context**. In *Knowledge to action?* Edited by Dopson S, Fitzgerald L. Oxford: University Press; 2005**:**79-102.

56. Medical Research Council: *A framework for development and evaluating of RCTs for complex interventions to improve health.* London: Medical Research Council; 2000.

57. Campbell M, Fitzpatrick R, Haines A, Kinmonth A, Sandercock P, Spiegelhalter D, Tyrer P: **Framework for design and evaluation of complex interventions to improve health.** BMJ 2000, **1:**694–696.

58. Wensing M, Wollersheim H, Grol R: **Organizational interventions to implement improvements in patient care: a structured review of reviews**. *Implement Sci* 2006, **1**.

59. Begg C, Cho M, Eastwood C, Horton R, Moher D, Olkin, I, Pitkin R, Rennie D, Schulz KF, Simel D, Stroup DF: **Improving the quality of reporting of randomized controlled trials. The CONSORT statement**. *J Am Med Assoc* 1998, **276:**637-639.

60. Elbourne D, Campbell M: **Extending the CONSORT statement to cluster randomized trials: for discussion.** *Stat Med* 2001, **20:**489-496.

Table 1:
Methodological Quality of Included Studies

CBA Methodological Quality Assessment Results and Rating											
First Author	Unit of Allocation	Unit of Analysis	Power Calculation	Baseline Measure	Characteristics of Control	Blinded Outcome Assessment	Protection Against Contamination	Reliable Outcomes Measure	Provider Follow Up	Patient Follow Up	Rating
Tsai [14]	Provider	Provider	NC	√	√	X	NC	X	√	n/a	Low

RCT Methodological Quality Assessment Results and Rating											
First Author	Unit of Allocation	Unit of Analysis	Power Calculation	Baseline Measure	Allocation Concealment	Blinded Outcome Assessment	Protection Against Contamination	Reliable Outcomes Measure	Provider Follow Up	Patient Follow Up	Rating
Dufault [11]	Ward	Provider *	NC	X	NC	X	√	X	NC	n/a	Low
Hong [12]	Ward	Provider *	NC	√	√	X	√	X & NC	NC NMS	n/a	Low
Tranmer [13]	Ward	Provider *	NC	X	NC	X	√	X	NC NMS	n/a	Low

√: Done
X: Not Done
NC: Not Clear
NMS: Non Matched Sample
* Unit of analysis error

4/8 or less – low quality
5/8-6/8 – medium quality
7/8 or higher – high quality

Table 2
Outcome Measure and Classification of Research Utilization Intervention

Author/ Year/ Country	Study Design	Setting and Specialty	Description of Intervention(s)	Classification Using EPOC Method	Outcome Measure
Dufault, 1995 United States[11]	RCT	Hospital/ Oncology	1. Organization of practitioners and researchers aimed at solving a clinical problem using research findings	1. Multi-disciplinary team	Kim's Research Utilization Competency Scale[15]
Hong 1990 China[12]	RCT	Hospital/ Inpatient	1. In-service education and demonstration tutorial by opinion leader	1. Educational meetings 2. Local opinion leaders	Compliance with all clinical practice guideline recommendations
Tranmer 2002 Canada [13]	RCT	Hospital/ Medical & Surgical	1. Workshops about conducting a research study and using the findings	1. Educational meetings	Champion and Leach Research Utilization Questionnaire[16-17]
			1. Workshops about research findings	1. Educational meetings	Champion and Leach Research Utilization Questionnaire[16-17]
Tsai, 2003 Taiwan [14]	CBA	Hospital/ Inpatients	1. Workshops about research utilization	1. Educational meetings	Tsai Research Utilization Questionnaire

Table 3
Effect of Interventions on Research Use

First Author	Intervention(s)	Outcome(s) of Interest	Effect of Intervention(s) on Outcome(s) of Interest
Dufault[11]	Multidisciplinary team	1. Kim's research utilization competency scale	Significant change
Hong[12]	Educational meetings led by local opinion leader	1. Proportion of reported catheter practices meeting guidelines recommendations 1. Proportion of observed catheter practices meeting guideline recommendations	Significant change Significant change
Tranmer[13],	Educational meetings #1	1. Champion and Leach Research Use Questionnaire	No significant change
Tranmer[13]	Educational meetings #2	1. Champion and Leach Research Use Questionnaire	No significant change
Tsai[14]	Educational meetings	1. Tsai Research Utilization Questionnaire.	No significant change

Table 4
Characteristics of Included Studies and Detailed Description of Intervention

First Author	Study Subjects	Deliverer/ Recipient of Intervention	Length of Intervention	Detailed Description of Intervention
Dufault [11]	27 nurses from 4 oncology units	Both nurses and researchers/ nurses	28 weeks consisting of 6 sequential phases	Nurses and investigators participated in activities related to optimal pain management. The phases included: 1. Problem identification and assessment of research bases for utilization 2. Evaluation of research relevancy to problem selection, nursing department values, standards and policies, and potential cost and benefit 3. Innovation design to meet the needs of the problem within the scope of the research base. 4. Actual or construct replication and evaluation of the innovation. 5. Decision to adopt, alter or reject the innovation. 6. Development of means to extend the innovation within and outside of the setting.
Hong [12]	220 nurses surveyed/ 255 episodes of care observed from 3 medical and 3 surgical units	Local opinion leaders and infection control nurses/ Nurses and student nurses	30 minute lecture and unspecified length demonstration tutorial	Infection control nurses provided lectures on research based practices surrounding catheter care. Local opinion leaders provided demonstration tutorials to group of 6-10 nurses following the lectures.

Tranmer [13]	235 nurses from 6 medical/ surgical units	Researchers /nurses	20 hours for 'high' intervention and 8 hours for 'low' intervention	High intervention: Nurses learned how to review and critique research literature, completed a literature review on a clinical practice, participated in the design of a research study to address the identified clinical problem, and participated in the implementation of the study. Low intervention: Nurses learned about the literature related to a clinical problem and discussed now best to implement the research study.
Tsai [14]	89 nurses from multiple clinical units	Clinical experts/ nurses	65 hour workshops delivered over 8 weeks	Research utilization education designed and based on steps of research utilization: 1. Preparation stage 2. Confirmation stage 3. Comparison and assessment stage 4. Decision stage 5. Implementation stage 6. Evaluation stage

Additional Files

Additional file: Figure 1: Search and Retrieval Process.PDF

Additional file: search strategy by database.pdf

Search and retrieval process

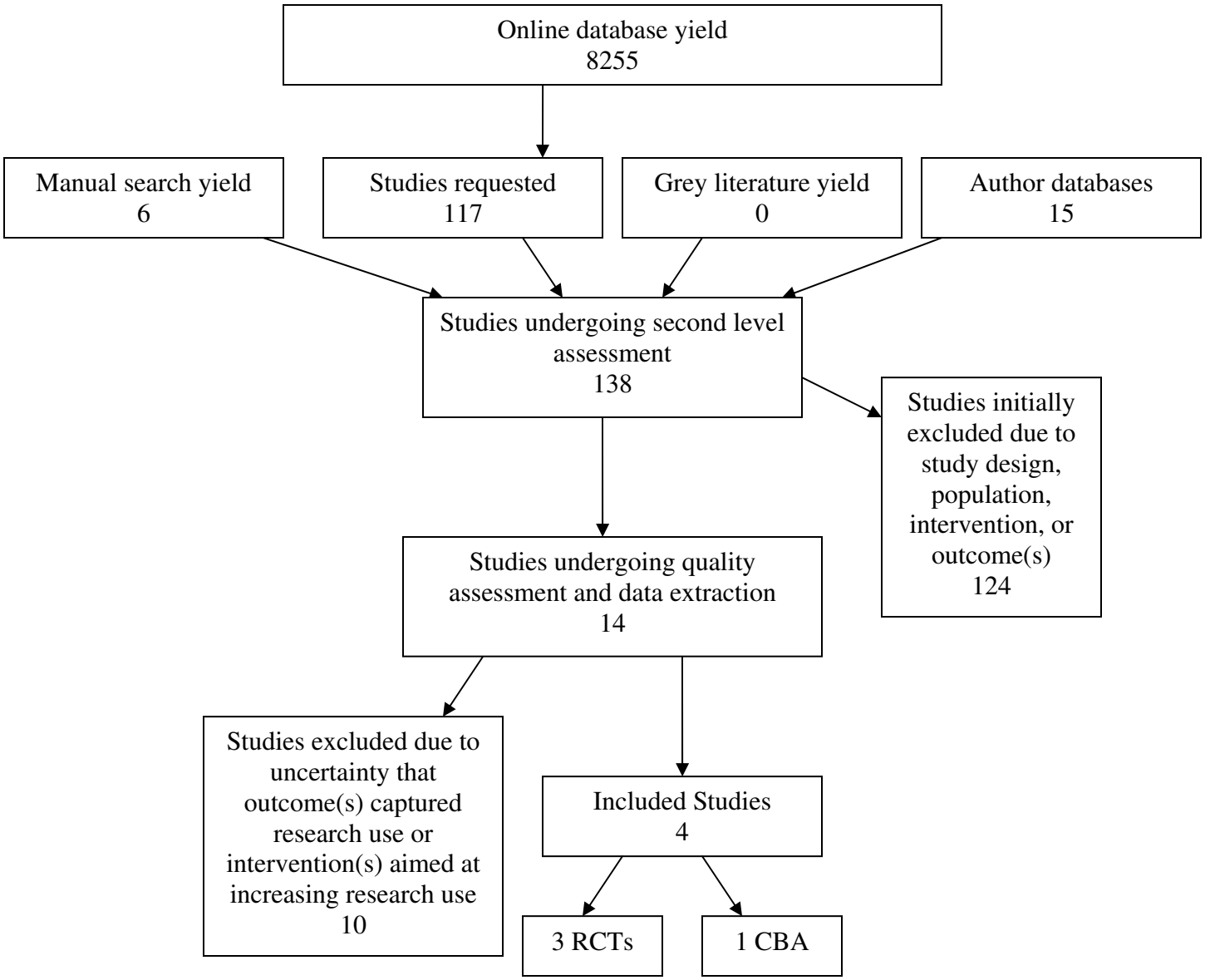

Figure 1

Additional files provided with this submission:

Additional file 1 : Search Strategy by Database.pdf : 15Kb
http://www.implementationscience.com/imedia/5600797581127295/sup1.PDF