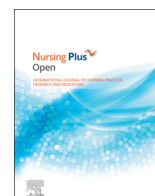




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Review article

Assessing the quality of economic evaluations of clinical nurse specialists and nurse practitioners: A systematic review of cost-effectiveness

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ABSTRACT

A limited number of randomized controlled trials (RCTs) including economic analysis have supported the cost-effectiveness of nurse practitioners and clinical nurse specialists delivering care in a variety of settings. Our objective was to examine the quality of economic evaluations in this body of literature using the Quality of Health Economic Studies (QHES) tool, and highlight which questions of the quality assessment tool are being addressed adequately or require further attention within this body of literature. Of 43 RCTs included in our systematic review, the majority (77%) fell in the poor study quality quartile with an average total QHES score of 39 (out of 100). Only three studies (7%) were evaluated as high quality. Inter-rater agreement (prior to consensus process) was high (83% agreement). Four criteria for the quality of economic evaluations were consistently addressed: specification of clear, measurable objectives; pre-specification of subgroups for subgroup analyses; justified conclusions based on study results; and disclosure of study funding source. A clear statement of the primary outcome measures, incremental analysis, and assessment of uncertainty were often unclear or missing. Due to poor methodological quality, we currently lack a solid evidence base to draw clear conclusions about the cost-effectiveness of nurse practitioners and clinical nurse specialists. Higher quality economic evaluations are required to inform these questions.

Abbreviations: QHES, Quality of Health Economic Studies; RCT, randomized controlled trial

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Introduction

Two top priorities within the current health care environment are the reduction of costs without deteriorating the quality of health care, and the improvement of patient outcomes while maintaining reasonable costs (Gerkens et al., 2008; Ofman et al., 2003). As a result, to help formulate health policy decisions there is a growing interest in economic evaluations comparing costs and outcomes within a wide range of health care programs (Gerkens et al., 2008; Spiegel et al., 2004). One of the decisions health policy makers face is whether and how they should integrate nurse practitioners and clinical nurse specialists in the health care system and they often request evidence about the cost-effectiveness of these roles.

Review of literature

Clinical nurse specialists and nurse practitioners are considered advanced practice nurses (International Council of Nurses, 2009). Clinical nurse specialists are registered nurses with a graduate degree in nursing who have expertise in a clinical specialty and perform an advanced nursing role that includes practice, consultation, collaboration, education, research, and leadership (Affara, 2009). Nurse practitioners are defined as registered nurses who have additional education, preferably at the graduate level with advanced competencies to autonomously diagnose, prescribe medications and treatments, order and interpret diagnostic tests, and perform specific clinical procedures, as authorized by legislation and their regulatory scope of practice (International Council of Nurses, 2009).

Studies on the effectiveness of nurse practitioners consistently demonstrate high quality care and patient satisfaction (Horrocks, Anderson, & Salisbury, 2002; Newhouse et al., 2011), and studies on the effectiveness of clinical nurse specialists have shown reductions in hospital length of stay, readmissions, emergency room visits and associated costs (Fulton & Baldwin, 2004; Newhouse et al., 2011). However, questions often arise about the cost-effectiveness of these roles. Few attempts have been made to consolidate and evaluate the quality of this specific body of evidence. If we assume that higher quality health economic analyses lead to better health care decisions, then the methodological quality of health care studies is important (Au, Prahardhi, & Shiell, 2008). To this end, it is essential for evaluators and users of this evidence to have a way to assess the quality of these studies (Ofman et al., 2003).

We selected the Quality of Health Economic Studies (QHES) instrument to evaluate the quality of cost-effectiveness analyses of randomized controlled trials (RCTs) of nurse practitioners and clinical nurse specialists. We selected this tool because it addresses specifically questions about study quality of health economic analyses and was designed by health economics experts to assess three types of health economic analysis: *cost-minimization*, *cost-effectiveness*, and *cost-utility* (Chiou et al., 2003; Ofman et al., 2003).

The purpose of our study was threefold. First, to highlight which questions of the QHES are being addressed within this body of literature and which require further attention; second, to assess inter-rater agreement using the QHES tool on nurse practitioner and clinical nurse specialist health economic studies; and third, to evaluate study quality in three areas of nurse practitioner and clinical nurse specialist health care economics: in-patient, out-patient and transition care.

Materials and methods

Study identification

This paper is one of a series of papers reporting findings from our systematic review entitled, *A systematic review of the cost-effectiveness of nurse practitioners and clinical nurse specialists: 1980 to July 2012* (Donald et al., 2015; Donald et al., 2014; Kilpatrick et al., 2014). The methods for our systematic review are described in detail elsewhere (Donald et al., 2014). Briefly, we searched electronic databases and relevant websites, hand-searched key journals, reviewed reference lists of relevant papers, and contacted authors to identify all relevant published and unpublished RCTs of nurse practitioner or clinical nurse specialist cost-effectiveness reported from 1980 to July 2012 with no restrictions on jurisdiction or language. RCTs met inclusion criteria if they evaluated nurse practitioners or clinical nurse specialists, if the impact of the nurse practitioner or clinical nurse specialist could be isolated (e.g., if part of a multi-component or multi-disciplinary intervention), and if the study included any objective measures of health system utilization. These included length of stay, re-hospitalization, costs of health care (e.g., hospital, professional, family costs) and health resource use (e.g., diagnostic tests, prescriptions).

Relevant studies were categorized into six groups in which the nurse practitioner or clinical nurse specialist was working in an inpatient setting, outpatient setting (including primary care and long-term care) or in a transition role. Transitional care referred to the role of a nurse practitioner or clinical nurse specialist in providing a range of health services designed to promote the safe and timely transfer of patients between one level of care to another or between health care settings (Naylor, Aiken, Kurtzman, Olds, & Hirschman, 2011).

Study assessment using QHES

The QHES has been validated and shown to be simple and reliable (Ofman et al., 2003). This tool includes 16 questions answered as “yes” or “no” and each question has an assigned value ranging from 1 to 9 (Ofman et al., 2003). It assesses several economic study criteria including whether the stated objectives, analytical perspective and time horizon, outcome measures, data abstraction methods, and analysis (incremental analysis and handling of uncertainty) are clearly stated; the appropriateness of selected economic models and associated cost measurements; and whether a clearly defined process to reduce the risk of bias was included (Table 1). Questions answered “yes” receive the full point value and those answered “no” receive no points. The sum of these points generates a summary score on a scale of 0–100, with 0 indicating extremely poor quality and 100 indicating high quality.

Two research assistants (SL [BSc with a background in actuarial science and statistics] and KR [MSc with a background in the conduct of systematic reviews]), trained by a health economist investigator (DM), independently assessed the quality of each study with respect to health economic analyses using the QHES tool. Prior to implementing the QHES tool, the criteria for each question were reviewed by the two assistants together with the health economist investigator to determine whether more specific guidance was necessary to ensure consistent interpretation for each question. These elaborated descriptors are noted in Table 1 in italics. The QHES tool was also pilot-tested on four studies by the two research assistants prior to completing the evaluations.

Table 1
The 16 questions that comprise the Quality of Health Economic Studies Tool.

QUESTIONS	POINTS
1. Was the study objective presented in a clear, specific, and measurable manner? <i>A study has to report that they explicitly measured costs and/or resource use in the abstract or introduction section of the report.</i>	7
2. Were the perspective of the analysis (societal, third-party payer, etc.) and reasons for its selection stated? <i>All of the following criteria must apply:</i> <i>a. Authors must explicitly state the perspective of the analysis;</i> <i>b. Authors must state the reasons why they chose the perspective; and</i> <i>c. Authors must have measured outcomes that were relevant to the stated perspective e.g. productivity (loss of work) for societal perspective.</i>	4
3. Were variable estimates used in the analysis from the best available source (i.e., randomized controlled trial – best source, expert opinion – worst source)? <i>As all studies included in the review were RCTs, all studies received 8 points.</i>	8
4. If estimates came from a subgroup analysis, were the groups pre-specified at the beginning of the study? <i>A point was lost only if a subgroup analysis was completed and subgroups were not pre-specified in either the protocol or methods section (i.e. if there was no subgroup analysis, a point was assigned as default).</i>	1
5. Was uncertainty handled by (1) statistical analysis to address random events, (2) sensitivity analysis to cover a range of assumptions? <i>For economic analyses only: Authors applied some kind of statistical analysis to examine joint uncertainty by reporting (1) Confidence intervals around the ICER or a cost-effectiveness acceptability curve (using bootstrapping), or (2) sensitivity analyses around the ICER, where the authors examine how a change made to input values (costs and/or effects and/or resource use) changes the ICER.</i>	9
6. Was incremental analysis performed between alternatives for resources and costs? <i>For economic analyses only: ICER (or the change in cost and change in effectiveness) had to be clearly reported. Studies must show the difference in costs and the difference in effectiveness.</i>	6
7. Was the methodology for data abstraction (including the value of health states and other benefits) stated? <i>Only awarded if there was explicit methodological detail on costing/resource use and health/patient measures, above and beyond the source of costs and the name of the scale used to measure health states or other effectiveness outcomes.</i>	5
8. Did the analytic horizon allow time for all relevant and important outcomes? Were benefits and costs that went beyond 1 year discounted (3–5%) and justification given for the discount rate? <i>This category is study/disease/outcome dependent – need to assess whether the follow-up time was long enough to capture any differences between groups (e.g. travel costs more expensive early after discharge; resource use also likely to change over time), or appropriate for the measured outcome (e.g. if analyzing chronic disease, a longer term of 10–20 years would be necessary; if the outcome is survival, lifetime costs would be appropriate)</i> <i>Flag studies where it is unclear what the appropriate time horizon should be. Clinical investigator will then assist with the assessment.</i>	7
9. Was the measurement of costs appropriate and the methodology for the estimation of quantities and unit costs clearly described? <i>Measurement (e.g. costs vs. charges; median reported instead of mean because of skewed data) must be appropriate and source of costing must be provided with specific unit costs that either are reported or are calculable.</i>	8
10. Were the primary outcome measure(s) for the economic evaluation clearly stated and were the major short-term, long-term, and negative outcomes included? <i>An incremental cost-effectiveness measure had to be a primary outcome and the primary outcomes had to reflect the objective of the study. Similar to category 8, the inclusion of major outcomes will be dependent on the study/disease. For example, an economic evaluation examining clinical nurse specialist intervention in patients with diabetes should consider long-term and negative outcomes associated with the chronic condition (e.g. HbA1c levels at one year) whereas long-term outcomes in an economic evaluation of an acute care nurse practitioner intervention may be less critical.</i>	6
11. Were the health outcomes measures/scales valid and reliable? <i>If previously tested valid and reliable measures were not available, was justification given for the measures/scales used? Authors needed to report validity of the health outcome measure of effectiveness or reference a previous study where validity was confirmed in a similar population. For example, was an appropriate measure for utility used to calculate a quality adjusted life year?</i>	7
12. Were the economic model (including structure), study methods and analysis, and the components of the numerator and denominator displayed in a clear, transparent manner? <i>For economic analyses: authors must reference a model or a previous method used in a similar study.</i>	8
13. Were the choice of economic model, main assumptions, and limitations of the study stated and justified? <i>For economic analyses: the assumptions and limitations of the model must have been discussed.</i>	7
14. Did the author(s) explicitly discuss direction and magnitude of potential biases? <i>Usually in the discussion section – authors must discuss limitations and biases and must explicitly state how the bias would have affected results, and by how much.</i>	6
15. Were the conclusions/recommendations of the study justified and based on the study results? <i>Usually in the discussion section – data should support the authors' conclusions and recommendations.</i>	8
16. Was there a statement disclosing the source of funding for the study?	3
TOTAL MAXIMUM SCORE	100

ICER=incremental cost-effectiveness ratio, RCT=randomized controlled trial.

Discrepancies between research assistants were resolved by discussion and if necessary, consultation with the health economist investigator. In some instances, a registered nurse investigator was consulted about expected time horizons for different patient outcomes based on specific health conditions and interventions. Percent agreement between the two evaluators was determined for each of the 16 QHES questions by calculating the percentage of observed agreements for each question addressed or not addressed (categorized as “yes” for question that was addressed vs. “no” for not addressed).

We calculated the average total QHES score, with a standard deviation, minimum and maximum value for all studies, and also classified by the 6 groups representing combinations of nurse practitioners and clinical nurse specialists in different roles. Studies were classified according to quartiles for extremely poor

quality (0–24), poor quality (25–49), fair quality (50–74), and high quality (75–100) as outlined by Spiegel et al. (2004).

Results

The search yielded 43 relevant RCTs. All were English language published papers. The number of RCTs in each of the six categories was as follows: clinical nurse specialist delivering in-patient care $N=1$; clinical nurse specialist delivering out-patient care $N=11$; clinical nurse specialist delivering transition care $N=13$; nurse practitioner delivering in-patient care $N=2$; nurse practitioner delivering out-patient care $N=11$; and nurse practitioner delivering transition care $N=5$.

Frequency of QHES questions addressed

For all studies combined, the questions of the QHES tool that were most frequently addressed in the studies related to the specification of clear, measurable objectives (Q1); pre-specification of subgroups for subgroup analyses (Q4); justified conclusions based on study results (Q15); and disclosure of the study funding source (Q16) (Q3 was not considered here because it automatically received the maximum eight points as all studies were RCTs) (Fig. 1). By comparison, the areas of the QHES that were not well addressed related to the study methodology such as the handling of uncertainty (Q5), whether the duration of the study allowed for all important or relevant outcomes to be captured (Q8), discussion of potential biases (Q14), as well as other methodological items such as the inclusion of appropriate reliable and valid outcomes (Q10, Q11), data abstraction methods (Q7) and appropriate economic modeling (Q2, Q6, Q12, Q13).

Even when analyzed by study group, the same four questions related to stating objectives (Q1), pre-specifying subgroups (Q4),

justifying conclusions (Q15) and disclosing the study funding source were answered most frequently (Q16) (Table 2). The remaining questions (Q2, Q5–Q14) which were not often addressed mostly related to the quality of the study design.

Inter-rater agreement

Average inter-rater percent agreement across the 15 questions of the QHES (before the consensus process) was high at 83% (SE 4%). Percent agreement ranged from the lowest value of 36% (Q8), related to the selection of an appropriate time horizon, to a high of 100% (Q6), asking whether an incremental analysis was performed between alternatives for resources and costs (Table 3).

The two raters showed strong agreement for 9 questions, (Q1, Q2, Q4, Q5, Q6, Q10, Q12, Q13 and Q16) in their ratings (more than 80%) (Table 3). For the remaining 6 questions – related to the description of the methodology (data abstraction, appropriate time horizon, costing methodology), validity of the methods (valid measures and effect of biases) and justification of the conclusions – inter-rater agreement was poor to moderate.

Results of quality QHES scoring among 43 RCTs

For all studies combined, the average total QHES score demonstrated poor study quality at 39 (standard deviation=15; minimum=19 and maximum=83) points according to the QHES quartiles (Spiegel et al., 2004) (Table 4). The majority of these studies (77%) fell in the poor study quality quartile. Of note, the quality of studies since 2000 was on average 13 points higher (mean 43 ± 17 points) versus those published before 2000 (mean 30 ± 7 points), reflecting a trend towards improvement in the overall quality of these studies.

When analyzed by groups, study quality was primarily in the poor and fair quartiles (Table 5). None of the study groups achieved an average score of 75 points or higher which is considered to be high study quality (Spiegel et al., 2004). The average total QHES scores by study groups ranged from 19 to 47 with the highest averages noted in the nurse practitioner and clinical nurse specialist out-patient care groups (47 and 46 respectively) (Fig. 2).

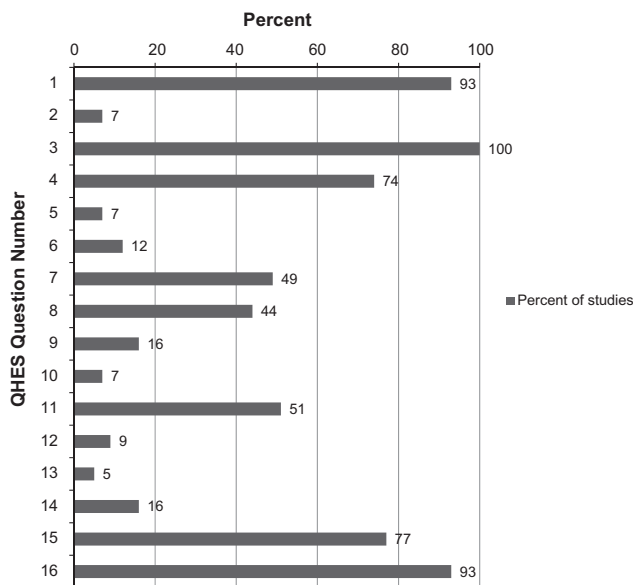


Fig. 1. Percentage of nurse practitioner and clinical nurse specialist studies addressing each question of the QHES (N=43). QHES=Quality of Health Economic Studies. *Q3 automatically received full score for each study as all were randomized controlled trials.

Table 2 Percentage of studies that addressed each question of the Quality of Health Economic Studies Tool by groups (N=43).

QHES question	CNS inpatient, N=1	CNS outpatient, N=11	CNS transition, N=13	NP inpatient, N=2	NP outpatient, N=11	NP transition, N=5
1	100	91	100	100	82	100
2	0	0	8	0	18	0
3 ^a	100	100	100	100	100	100
4	100	82	54	100	82	80
5	0	9	0	0	18	0
6	0	18	0	0	27	0
7	0	82	38	0	64	0
8	0	55	38	0	64	20
9	0	27	8	0	27	0
10	0	9	0	0	18	0
11	0	82	46	0	55	40
12	0	18	0	0	18	0
13	0	9	8	0	0	0
14	0	27	8	50	18	0
15	0	82	69	100	100	40
16	100	73	100	100	100	100

CNS=clinical nurse specialist, NP=nurse practitioner, QHES=Quality of Health Economic Studies.

^a Q3 automatically received full score for each study as all were RCTs.

Table 3
Inter-rater agreement between two evaluators for 43 studies of nurse practitioner and clinical nurse specialist effectiveness using the QHES tool.

QHES question	Topic	% Agreement
1	Clear objective	89%
2	Perspective stated	91%
3	Best data source	Not assessed as all the studies received the maximum 8 points for Q3 because our inclusion criteria excluded non-RCT designs.
4	Subgroups pre-specified	89%
5	Uncertainty considered	98%
6	Incremental cost-effectiveness ratios reported	100%
7	Data abstraction methodology	61%
8	Appropriate time horizon	36%
9	Costing methodology	73%
10	Primary outcomes	96%
11	Valid measures	77%
12	Model description	93%
13	Model appropriateness	98%
14	Effect of biases	75%
15	Conclusions justified	77%
16	Funding reported	93%
Average inter-rater agreement across 15 questions		83%

QHES=Quality of Health Economic Studies; RCT=randomized controlled trial.

Table 4
Breakdown by QHES quartile for all studies combined (N=43).

Score range	Quality quartile	Number of studies	Percentage of studies
0–24	Extremely poor	4	9
25–49	Poor	33	77
50–74	Fair	3	7
75–100	High	3	7

QHES=Quality of Health Economic Studies.

Discussion

We assessed study quality using the QHES tool for 43 RCTs of nurse practitioners and clinical nurse specialists in multiple contexts that included health system outcomes. The majority of these studies (77%) fell in the poor study quality quartile as defined by Spiegel et al. (2004) with an average total QHES score of 39 ± 15 , although there was a trend towards improvement in the overall quality of these studies over time. Even when average QHES scores were analyzed by the six nurse practitioners and clinical nurse specialist groupings, the quality rating remained fair to poor for all groups. The questions most frequently addressed in the studies focused on the inclusion of clear objectives, pre-specification of subgroups, justification of study conclusions and the disclosure of funding for the study. By comparison, the areas of the QHES that were not well addressed related to the study methodology such as the handling of uncertainty, whether the duration of the study allowed for all important or relevant outcomes to be captured, discussion of potential biases, as well as other methodological items such as the inclusion of appropriate valid and reliable outcomes, data abstraction methods and appropriate economic modeling.

Our findings show only 3 of 43 studies met the criteria for high quality (75–100) as measured by the QHES (Chiou et al., 2003). Two were cost-effectiveness analyses of nurse practitioners in an outpatient setting - one examined the effect on lowering blood lipids in patients with coronary heart disease based on an RCT (Paez & Allen, 2006) and one examined quality of life improvements in children with eczema (Schuttelaar, Vermeulen, & Coenraads, 2011). Paez and Allen (2006) conducted a cost-effectiveness analysis in which costs (nurse practitioner time,

Table 5
Breakdown of 43 studies by QHES quartiles and by groups.

	Score range	Quality quartile	Number of studies	Percentage of studies
CNS inpatient (N=1)	0–24	Extremely poor	1	100
	25–49	Poor	0	0
	50–74	Fair	0	0
	75–100	High	0	0
CNS outpatient (N=11)	0–24	Extremely poor	1	9
	25–49	Poor	8	73
	50–74	Fair	1	9
	75–100	High	1	9
CNS transition (N=13)	0–24	Extremely poor	1	8
	25–49	Poor	12	92
	50–74	Fair	0	0
	75–100	High	0	0
NP inpatient (N=2)	0–24	Extremely poor	0	0
	25–49	Poor	2	100
	50–74	Fair	0	0
	75–100	High	0	0
NP outpatient (N=11)	0–24	Extremely poor	0	0
	25–49	Poor	7	64
	50–74	Fair	2	18
	75–100	High	2	18
NP transition (N=5)	0–24	Extremely poor	1	20
	25–49	Poor	4	80
	50–74	Fair	0	0
	75–100	High	0	0

CNS=clinical nurse specialist, NP=nurse practitioner, QHES=Quality of Health Economic Studies.

lipid-lowering drugs, lab monitoring) were linked to outcome (low-density lipoprotein cholesterol) and found the annual incremental cost-effectiveness ratio (ICER) of nurse practitioner case management was \$26/mg/dL reduction in low-density lipoprotein cholesterol and \$39 per percent reduction in low-density lipoprotein cholesterol. Schuttelaar et al. (2011) estimated savings of €925 per one point less improvement in infant quality of life, savings of €751 per one point less in child quality of life, and €251 savings per

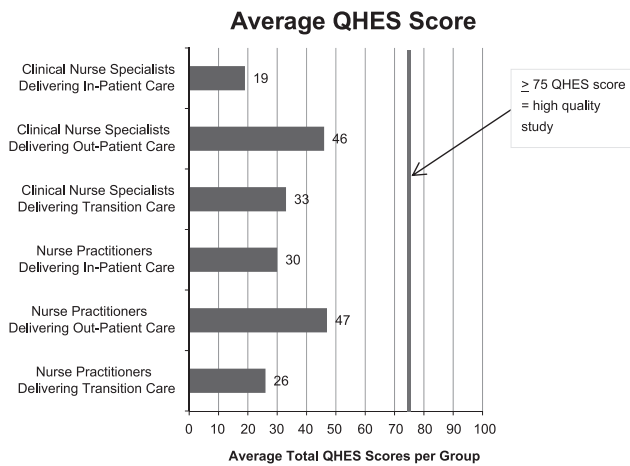


Fig. 2. Average total QHES scores by groups (N=43). QHES=Quality of Health Economic Studies.

one point *more* satisfaction in the nurse practitioner group compared with the dermatologist group at 12 months. The third was a cost-effectiveness of clinical nurse specialists in an out-patient setting in patients with rheumatoid arthritis (Tijhuis, Zwiderman, Hazes, Breedveld, & Vliet Vlieland, 2003, 2002; van den Hout, Tijhuis, Hazes, Breedveld, & Vliet Vlieland, 2003). van den Hout et al. (2003) concluded that clinical nurse specialist care was cost-saving – with an equivalent quality of life and utility at lower societal cost by at least €5400.

All of these three high quality studies clearly defined the study objective and the approach and methods describing the economic evaluation approach, including both the measures of effects and costs. Of critical importance in the context of economic evaluation methods, all of these studies combined costs and outcomes of the intervention relative to the comparator and estimated an incremental cost-effectiveness ratio. Further, these studies discussed explicitly the direction and magnitude of potential biases and justified their conclusions.

In our study, percent agreement between the two raters (before the consensus process) was high at 83%, based on dichotomous scoring, where “yes” indicated the question was addressed and “no” indicated it was not addressed.

Other health economic evaluation studies, for example, in digestive diseases (Spiegel et al., 2004) and physical therapy (Peterson, Goodman, Karnes, Chen, & Schwartz, 2009) and surgical treatment for obesity (Gerkens et al., 2008) also used the QHES tool to evaluate the quality of economic evaluation studies. It is difficult to make a direct comparison of rater agreement because methods varied. For example, Spiegel et al. (2004) reported a kappa of 0.80 with a 10% random sampling of economic analyses in digestive diseases, which does not reflect a total inter-rater agreement across all the studies.

In obesity, Gerkens et al. (2008) found that inter-rater agreement for most items was less than 0.40, but they did not provide a single overall average over the 16 questions of the QHES for comparison. They proposed several reasons for this poor agreement. First, the time available to analyze studies varied between the two raters and the methods of evaluation varied. One of the raters chose to refer to other sources when there was insufficient information, whereas the other rater based their analysis on the main article only. Second, the subjectivity of the experts may have influenced the response. For example, severe raters may have been more likely to grade a 0 value when a criterion was incomplete, while the other rater may have tended to state full points if a study addressed a criterion even if not completely. A third explanation for poor agreement with the QHES may relate to the experience of the rater in economic evaluation, and

fourth, the questions could be interpreted in various ways. Based on our experiences with this tool, we would also add that the experience of the raters needs to be sufficiently broad to include the range of health care disciplines assessed by the QHES tool. Ideally, to skillfully use this tool, the evaluators would be at an advantage if they have knowledge in three areas: clinical expertise about health conditions, expected health care outcomes, and economic evaluation. This broad scope of expertise may be difficult to achieve and may explain the varied range of percentage agreement over the 15 questions between the two raters in our study, despite the overall high percent agreement.

Finally, Peterson et al. (2009) based their final QHES scores on consensus and consulting a third rater in instances of inter-rater disagreement. Based on our experience with the QHES, we also recommend that two people complete all the ratings independently for all studies and that raters should undergo a consensus process in order to reach a final score when there are differences in ratings (Gerkens et al., 2008; Peterson et al., 2009).

Since we further delineated the criteria for each question in the QHES to improve rater agreement, there were instances where a study did not receive points, but it may have by other raters. For example, for Q5 regarding uncertainty, we further specified that the authors needed to assess joint uncertainty of cost and effects. Similarly, for Q11, we specifically required that the validity of outcome measures was reported or justification was given for the measure with supporting references. Finally, none of these studies received the seven points allocated by QHES scoring for stating the assumptions and the limitations of the economic model. A limitation of our study was related to the limited expertise of our raters regarding some health conditions. In particular, the lower inter-rater agreement for Q8 may be associated with limited background knowledge of health conditions by the two research assistants. Closer involvement of a clinician would have helped in arriving at consensus on the rating for this question.

The point of our evaluation was not to achieve perfect accuracy in QHES scoring, but to assess consistently the quality of these studies across the range of QHES scores and determine the distribution across the QHES quality quartiles. It could be argued that our evaluation criteria were too strict, but we attempted to apply these consistently across the studies to enable comparisons. Further, although QHES is a validated instrument, it was designed to assess economic evaluation studies including cost-minimization, cost-effectiveness and cost-utility analyses. Close to half of the 43 studies we assessed included measures of health care resource utilization only with no costing, and were therefore not full economic evaluation studies.

Recommendations for future research

With these qualifiers, the majority of studies (93%) were scored less than high quality. These findings are concerning and reflect the need for future economic evaluations of nurse practitioners and clinical nurse specialists that better address the criteria outlined in the QHES. Our findings highlight the importance of clear criteria for interpreting and applying each of the 16 questions in the QHES. We developed our own specific criteria to assist independent raters in evaluating each question in a similar manner. We recommend that raters should undergo a consensus process in order to reach a final score when there are differences in ratings (Gerkens et al., 2008; Peterson et al., 2009).

Using the QHES, we were able to identify the key health economic-related criteria that need to be better addressed in future research regarding the cost-effectiveness of nurse practitioners and clinical nurse specialists. Our findings suggest that more attention is needed in the economic evaluation methods that include both costs and outcomes combined to estimate

incremental cost-effectiveness using clearly described and validated instruments and assessment of uncertainty.

Based on our experiences with the QHES tool we make four key recommendations. First, we need to develop improved descriptions of the specific criteria/guidelines for each of the QHES questions in order for raters to evaluate study quality in a similar manner. Second, expert consultants need to be made available to the raters as a very broad scope of background knowledge is needed for the health conditions assessed, outcome measurements and economic analyses. Thirdly, all studies should be evaluated by two independent raters when scoring studies with QHES because of the complexity of the questions. And finally, a consensus process needs to be in place when there are differences in ratings.

Conclusion

Before we can draw conclusions or make recommendations regarding the cost-effectiveness of nurse practitioners and clinical nurse specialists, we need to better understand the quality of the existing research. Despite finding 43 RCTs of these advanced practice nurses, almost half of these studies were not designed to provide a comprehensive economic evaluation. Thus, we still lack the required evidence to draw clear conclusions about APN cost-effectiveness. Using the QHES tool, we found that only three studies met the criteria for high quality economic evaluations. In order to answer the question of cost-effectiveness of these APNs, higher quality economic evaluations must be conducted that include the relevant components. There is a clear need for more research that incorporates standardized outcome measures, such as the use of quality adjusted life years, and details both health care costs and resource utilization. Only through comprehensive high quality research that details the methods used, can we gain a better understanding of the effectiveness and cost-effectiveness of nurse practitioners and clinical nurse specialists.

Conflict of interest

We wish to draw the attention of the Editor to the following facts which may be considered as a potential conflict of interest to this work:

Deborah A. Marshall discloses ad hoc consulting for Optum Insight, a global health economics and outcome research company.

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