

BEME GUIDE

Are journal clubs effective in supporting evidence-based decision making? A systematic review. BEME Guide No. 16.

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Abstract

Background: Journal clubs (JCs) are a common form of interactive education in health care aiming to promote the uptake of research evidence into practice, but their effectiveness has not been established.

Objective: This systematic review aimed to determine whether the JC is an effective intervention in supporting clinical decision making.

Methods: We searched for studies which evaluated whether clubs promote changes in learner reaction, attitudes, knowledge, skills, behaviour or patient outcomes. We included undergraduate, postgraduate and practice JCs and excluded studies evaluating video/internet meetings or single meetings.

Results: Eighteen studies were included. Studies reported improvements in reading behaviour ($N=5/11$), confidence in critical appraisal ($N=7/7$), critical appraisal test scores ($N=5/7$) and ability to use findings ($N=5/7$). No studies reported on patient outcomes. Sixteen studies used self-reported measures, but only four studies used validated tests. Interventions were too heterogeneous to allow pooling. Realist synthesis identified potentially 'active educational ingredients', including mentoring, brief training in clinical epidemiology, structured critical appraisal tools, adult-learning principles, multifaceted teaching approaches and integration of the JC with other clinical and academic activities.

Conclusion: The effectiveness of JCs in supporting evidence-based decision making is not clear. Better reporting of the intervention and a mixed methods approach to evaluating active ingredients are needed in order to understand how JCs may support evidence-based practice.

Introduction

A journal club (JC) is an interactive approach to making sense of evidence, which is commonly defined as 'a group of individuals who meet regularly to discuss the clinical applicability of articles in current medical journals' (Linzer 1987). In his 1998 review of JCs, Alguire described them as 'ubiquitous in graduate medical education training' (Alguire 1998) and in tandem with the growth of the evidence-based practice (EBP) movement they are found internationally across most health professions, at both undergraduate, graduate and practitioner levels. Their popularity can be attributed to a number of perceived benefits – proponents of JCs believe that they help students and practitioners to keep up to date with health care literature, become more critical consumers of research evidence, and become better practitioners (Moberg-Wolff & Kosasih 1995). Positive attitudes about JCs have changed little over the past 15 years, with articles continuing to promote them as effective avenues for raising research awareness and bridging the theory–practice gap (Sherratt 2005; Thompson 2006).

There are several assumptions behind the belief that JCs may be effective in promoting evidence-based (EB) care, which are supported by educational theory.

Practice points

Research into JCs could be optimised by

- Promoting more consistent reporting of intervention.
- Describing the educational models and teaching and learning principles underpinning the intervention.
- Developing valid and reliable tools to evaluate how the learning environment supports the process of learning.
- Using logic models to evaluate how different elements of JCs promote decision making about using research in practice.
- Evaluating the relative success of the intervention by different levels of learner – medical student, intern, research fellow, faculty and practitioner.

JCs are based on the premise that interactive learning, tailored to the needs of adult learners, is important. Systematic reviews indicate interactive approaches to sharing information – such as academic detailing, outreach visits, opinion leaders, audit with feedback and practice-based reminders – promote practice change to a greater or lesser degree.

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Box 1. Educational interventions to promote evidence based practice.

1. Design: length of educational sessions, number of sessions, duration of training, content of sessions
2. Training: how educators were trained and their expertise in teaching and facilitating during the sessions
3. Delivery: How the educational intervention was actually delivered and whether it was delivered according to plan
4. Receipt: participants' comprehension of the material, their ability to perform the skills that were taught, strategies to improve performance of skills during the training period
5. Enactment: performance of the skills that were taught in settings where they might be applied

Modified from Borelli et al. 2005

(O'Brien et al. 2007; Jamtvedt et al. 2009). Conversely, research shows passive approaches to disseminating evidence, such as lectures, conferences, mailings and printed materials are less likely to promote changes in practice (Davis et al. 1995, 1999). JCs have the potential to focus on answering real-time information needs, and education research tells us that finding the 'teachable moment' and providing relevant learning materials can lead to a change in clinical behaviour and, consequently, improved patient outcomes (Schon 1987). JCs create an opportunity for discussion, and the assumption that discussion helps people to make sense of evidence is supported by research showing that to discuss and make sense of new knowledge is a critical component in transferring and applying knowledge in the workplace (Eraut & Hirsh 2007).

Finally, there is growing interest in the concept that 'communities of practice' which foster interaction and discussion help people to negotiate meaning and decide upon the relevance and utility of knowledge (Wenger 1998), with some research indicating that social learning promotes EB decision making (Fairhurst & Huby 1998). These constructs form an attractive causal pathway, implying that if environments are tailored to adult learners then they will promote positive attitudes about evidence, and that if they also provide opportunities for people to discuss the quality and application of evidence, then we will achieve more EBP and consequently better patient outcomes.

Although education research would support a JC approach, there is little direct evidence that JCs are actually effective in reaching their stated goals. This has prompted a number of evaluative studies, which respectively assess whether clubs could improve reading habits, teach critical appraisal skills and improve knowledge of clinical epidemiology and biostatistics. Several systematic reviews have reviewed elements of JC interventions, but they have included one-session workshops and short courses teaching critical appraisal and EB skills rather than specifically evaluating the JC milieu (Taylor et al. 2000; Parkes 2001; Coomarasamy et al. 2003; Coomarasamy & Kahn 2004). Only one review has focused on JCs as an educational intervention (Powell 2004). The Powell review examined the ability of JCs to promote critical appraisal skills. Although this may be an essential component of the 'evidence into practice' pathway, it stops short of examining whether the interactive JC environment promotes knowledge transfer to the clinical setting and improved decision making that benefits patients.

Researchers in the field of EB education agree that studies need to be conducted that focus on the relationship between providing education in EBP and facilitating the use of evidence

in practice (Hopayian et al. 2007). These studies are difficult to conduct because they are interventions with a number of educational components, and the causal pathway from teaching and learning to using knowledge and skills in the workplace is longer. Ideally, each stage of the pathway should be evaluated in order to assess the relative effectiveness of each component. Five elements can usefully be considered when delivering an educational intervention to promote behaviour change (Box 1).

In EB teaching research, we have information primarily on the design of the training and the receipt, but little information on how EB skills are enacted in the work setting (Hopayian et al. 2007). The ability of JCs as a complex intervention encompassing all five elements (Box 1) needs evaluation.

Objectives and review question

The objective for this systematic review was to determine whether the JC is an effective intervention in supporting EB decision making in health professionals, and to explore whether it is possible to determine which elements of a JC contribute to effectiveness. The question for this review is: Is the JC effective in supporting EB decision making?

JCs are a complex intervention, and effective clubs need to lead to a positive change at one or more stages of learning. Outcomes at different stages may include more positive learner reaction, change in attitudes, increased knowledge, improved skills, change in clinical behaviour and better patient outcomes. This definition is based on Kirkpatrick's model for learning, as adapted by Freeth et al. (Kirkpatrick 1967; Freeth et al. 2002). The model implies a relationship between satisfaction with learning, positive attitudes to the experience and the acquisition of new information that results in a modification of the existing knowledge base (Figure 1). The presumed relationship can be presented as a logic model – a model that postulates relationships between a cause and an effect. Logic models are useful devices for assessing complex interventions, because they enable the assessment of each element of the intervention. They can also help to explain whether and how the final outcomes may be the result of an aggregation of smaller effects during the different stages of delivering the intervention (Pawson 2006).

When this logic model is applied to JCs, we could make a number of theoretical assumptions, based on what is already known about adult learning, teaching EBP, knowledge transfer and strategies to promote clinical behaviour change (Table 1).

We used the logic model as an analytical tool to map the characteristics of JCs, and to look for single elements or

Question elements	Levels of educational effectiveness
Learner reaction	Level 1: Participation - covers learners views on the learning experience, its organization, presentation, content, teaching methods, and aspects of the instructional organization, materials, quality of instruction
Change in attitudes	Level 2a: Modification of attitudes / perceptions -outcomes here relate to changes in the reciprocal attitudes or perceptions between participant groups toward intervention/simulation
Change in knowledge	Level 2b: Modification of knowledge/skills -for <i>knowledge</i> , this relates to the acquisition of concepts, procedures and principles; for <i>skills</i> this relates to the acquisition of thinking/problem-solving, psychomotor and social skills
Change in skills	
Change in behaviour	Level 3: Behavioral change -documents the transfer of learning to the workplace or willingness of learners to apply new knowledge & skills
Patient outcomes	Level 4a: Change in organizational practice -Wider changes in the organization/delivery of care, attributable to an educational program
	Level 4b: Benefits to patient /clients -any improvement in the health & well being of patients as a direct result of an educational program

Figure 1. Mapping question elements to learning and service improvement. Adapted from Belfield et al. (2001); Freeth et al. (2002).

clusters of elements that appear to be present in JCs which demonstrate effectiveness in any one of the domains of learner reaction, attitudes, knowledge, skills or behaviour.

Review methodology

We used Linzer's (1987) definition of a JC: 'A journal club is a group of individuals who meet regularly to discuss the clinical applicability of articles in current medical journals'. Individuals needed to be in a position where the JC could be used to inform clinical practice – librarians were therefore excluded. Individuals included people in any type of health care field currently training (undergraduate level) or practicing after completing their training (postgraduate). Undergraduate groups include learners who are acquiring JC skills, such as critical appraisal, within the context of an educational setting (Table 2). Postgraduates may be working in academic environments, but they may also be health care practitioners who are acquiring skills in a work-based context. The degree of organisational support may be quite different across academic and practice environments. This variation is an important element of developing a theory for what works for whom in what circumstances (Pawson 2006).

We excluded studies with video/internet and one-off clubs because they could present limited opportunities for interactive discussion and social learning. Research into EB teaching has noted the need for qualitative research and mixed method approaches to capture important information about the learning context and the environment where skills are applied

(Jeffery et al. 2004; Straus et al. 2005). Both attitudes towards and experience of training, as well as the organisational setting where training is applied, may influence the impact of educational interventions, such as JCs (Shuval et al. 2007). Including different types of studies is established practice in health areas that involve complex interventions (Pawson et al. 2005; Petticrew & Roberts 2006; Armstrong et al. 2008) and realist reviews draw upon diverse sources of information to develop theory for what works (Pawson 2006).

The search strategy was developed using Medline (Table 3) and adapted for the requirements of other databases.

Bibliographies of relevant publications and review articles were scanned and relevant references were retrieved. No language restrictions were applied.

Selection methods and judgement of methodological quality

Three reviewers read the abstracts and compared them to the inclusion and exclusion criteria. Where the abstract did not contain enough information to exclude it, the entire study was retrieved. We divided the retrieved studies into subsets and randomly assigned two reviewers for each subset. The reviewers independently extracted data. Initially we used a modified BEME template, adding additional categories to include qualitative information that might contribute to JC effectiveness (Table 1). However, the template did not enable us to collect detailed information on the evaluation methods, so we decided to use a modified version of the criterion

Table 1. A logic model for JCs.

Design	Training	Delivery	Receipt	Enactment
Participation	Resources invested	Activities during sessions	Outcomes (short term)	Impact (longer term)
Length of meetings Duration of meetings Frequency of meetings Content of meetings	Time	Question formulation	Ability to recognize uncertainty and question practice	
Type of participants	Staff expertise: in searching, statistics, facilitating critical appraisal, facilitating discussion	Searching	Skills to find relevant evidence efficiently	Willingness to apply EB skills acquired in the journal club in the workplace
Attendance		Preparing for presentation	Knowledge of clinical epidemiology	
Size of group	Money	Critical appraisal	Knowledge of critical appraisal concepts, procedures and principles	
Level of participation/ interaction			Skills in summarizing evidence	
		Discussion on clinical applicability	Skills in judging the quality of evidence Skills in using evidence to solve problems	Ability to use evidence to facilitate decision making Using evidence from JC to change organization/delivery of care Less harmful interventions for patients/ Improvement in health as a direct result of the journal club process
Outcomes assessed:		Learner reaction to participation - learners views on the learning experience, its organization, presentation, content, teaching methods, and aspects of the instructional organization, materials, quality of instruction Change in attitudes: of participant groups toward EBP	Modification of knowledge/skills - for <i>knowledge</i> , this relates to the acquisition of concepts, procedures and principles; for <i>skills</i> this relates to the acquisition of thinking/problem-solving, psychomotor and social skills	Behavioral change - transfer of learning to the workplace or willingness of learners to apply new knowledge & skills Change in organizational practice - Wider changes in the organization/delivery of care, attributable to an educational program

suggested by Reed et al. (2005) for conducting a systematic review of educational research. We divided the studies into subsets and randomly assigned two reviewers for each subset. The reviewers independently extracted the data. The entire set was then reviewed by one reviewer (Janet Harris) who documented disagreements which were resolved through group discussion.

The number of studies excluded at each stage, by population group, is shown in Figure 2. Using the Reed template excluded eight additional studies. Six were excluded because they lacked a description of the evaluation and conclusions were made without any supporting evaluation data (Burrows, Goodfellow, Langkamp, McQueen, Naranjo, Thompson). Two studies evaluated submission of letters to the editor as a proxy

for knowledge and skills (Edwards, Sandifer) and were therefore excluded because the outcomes differed from those in our review question.

We separated papers to allow analysis by JCs occurring at postgraduate level and at undergraduate level. Of the five undergraduate studies (Burrows, Edwards, Elnicki, Goodfellow, Thompson), however, only one was included in the final review (Elnicki).

Data analysis and synthesis

At the first stage of analysis, we mapped the key characteristics of the included studies using a template. Data relating to the

Table 2. Inclusion criteria for the review.

	Inclusion criteria	Exclusion criteria
Population	Health care professionals	Librarians
Intervention	Regular meetings to discuss research articles in current medical journals	Video/internet meetings One off interventions
Outcomes	<ul style="list-style-type: none"> • Learner reaction • Change in attitudes • Change in knowledge • Change in skills • Change in behaviour • Patient outcomes 	No assessment of learner reaction, knowledge, skills, attitudes, behaviour or patient outcomes Reporting only on publication of a critically appraised topic
Study type	All quantitative and qualitative studies which evaluate any of the outcomes All languages	Surveys reporting on prevalence of journal clubs and journal club activities (unless data has also been collected from participants of the journal club) Opinion papers Articles with no abstract

Table 3. Search strategy.

Journal club	AND education	AND evaluation
Journal club\$	Educate\$ or learn\$ or teach\$ or tutor\$ or train\$ Exp Education/ Learning/Teaching	Evaluate\$ or effect\$ or react\$ or outcome\$ or assess\$ or appraise\$ or measure\$ or trial\$ or random\$ or cohort or (case control) or qualitative\$ or quantitative\$ or test\$ or exam\$ or pre-test\$ or post-test\$ or feedback or explore\$ or competence\$ or change\$ Program-evaluation Evaluation Healthcare quality Clinical competence

review question were then extracted using Excel spreadsheets. The extraction was checked by two reviewers (Karen Kearley and Janet Harris). To determine whether the JC is effective in supporting EB decision making, we analysed whether studies were similar enough to be aggregated.

The populated template was then used to decide whether studies with similar approaches could be lumped together as a case, and to determine whether there was a core group of ‘active ingredients’ that contribute to successful JCs (Table 1). Finally, we analysed whether effects occurring at different stages of the JC influence the ability to apply research in clinical practice.

Findings

We found 18 studies of which 11 were from the USA with the remainder conducted in Canada, England, Australia and Pakistan. Eight different specialities all in the field of medicine were represented (Figure 3).

Eight studies were before–after (Bazarian, Cramer, Elnicki, Kellum, Khan, Lee, Seelig, Swift), six questionnaire surveys (Akhund, Heligman, Linzer 1987, Mazuryk, Spillane) and one each of observational (Mukherjee), case control (Bazarian), controlled trial (Fu) and randomised controlled trial (Linzer). No qualitative studies containing primary data were found,

although several of the quantitative studies contained qualitative information obtained from interviews or from open ended response sections of surveys designed to assess self-reported attitudes, knowledge and behaviour (Heligman, Mazuryk, Spillane).

Findings

Heterogeneity across JC interventions

Several characteristics may influence effectiveness of JCs. Frequent meetings, longer sessions, and more well-established clubs may enable more reinforcement of learning. Support may also be a key factor in determining learner response, attitudes, satisfaction, change in knowledge and skills. This is acknowledged by several authors (Spillane; Elnicki) but is not generally identified as a key variable across the studies. Support includes help – in the form of informal mentoring or faculty assistance – in selecting an article for critical appraisal, preparing the presentation, support during the presentation in terms of facilitating or chairing, and help with the appraisal and discussion of clinical applicability.

Descriptions of the intervention were too heterogeneous to allow pooling and a meta-analysis. Only eight studies reported the average length of each session, while 14 reported how

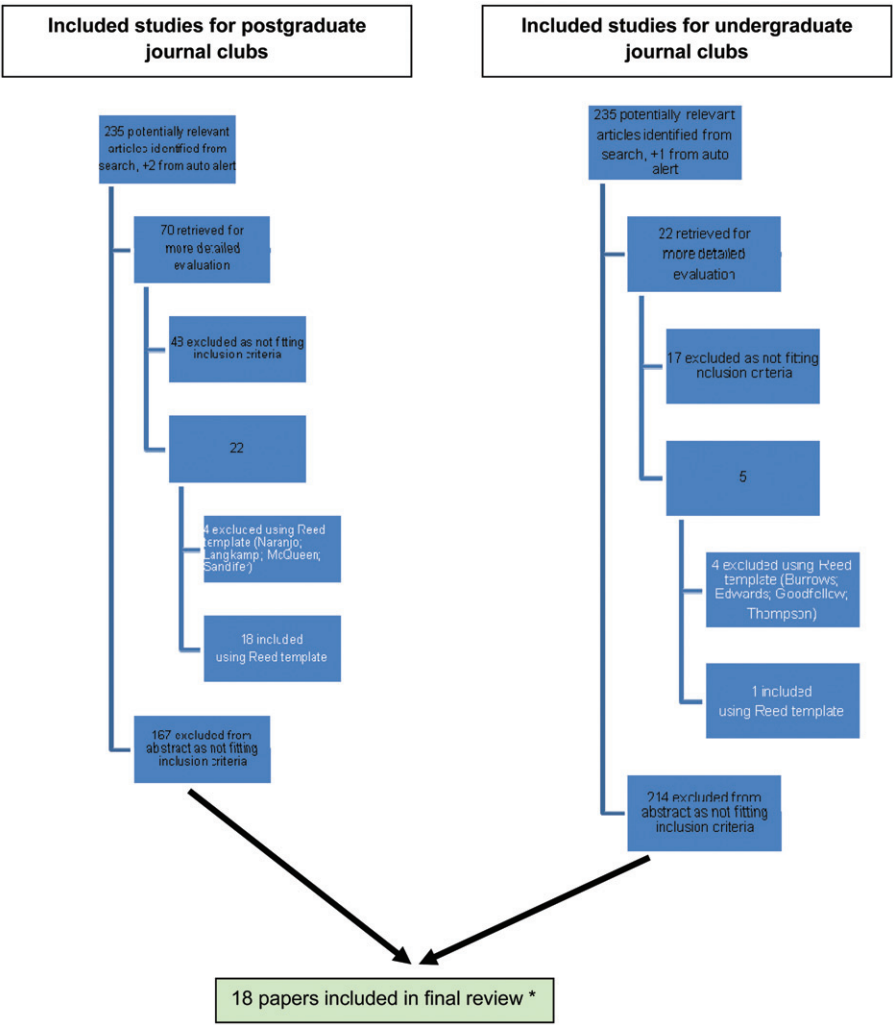


Figure 2. Included studies.
Note: *One paper (Elnicki) included in both postgraduate and undergraduate JCs.

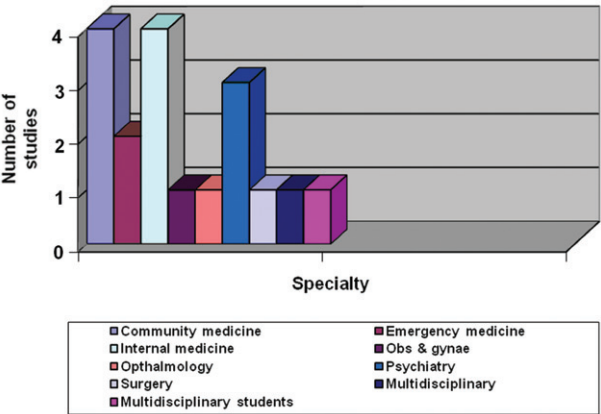


Figure 3. JCs by specialty.

frequently sessions were held. Duration varied considerably from 3 months to 15 years. Only seven studies reported whether learners received any support for preparation. Preparation for JCs was done alone, in teams or with faculty

advice or mentoring. In three clubs pre-session support appeared high, with faculty and resident jointly choosing the topic, reading and summarising literature (Bazarian, Burstein, Linzer 1988).

Twelve studies reported but did not describe the type of presentation that was made, so it was not possible to assess the level of interaction.

Interaction during meetings was generally described as a presentation by the person responsible for finding articles, followed by a discussion. The articles described various levels of involvement. In eight clubs, the responsible resident presented the summary and/or chaired the discussion (Akhund, Bazarian, Burstein, Fu, Heligman, Kellum, Khan, Seelig). In four clubs it was a joint effort by mentor and presenter (Elnicki, Linzer 1988; O'Sullivan, Spillane) with varying levels of input from the faculty facilitator during or immediately after the presentation. One club used small group work to appraise and fed findings back to the larger group (Swift). Eleven reported that the applicability of the evidence was covered, but only seven of these specifically mention discussion of applicability during the sessions, with the other four evaluating it without describing it. It was therefore difficult

to tell the depth or quality of the discussion regarding the feasibility of using evidence in practice. In some cases, applicability was summarised by the attending coordinator and faculty, listing the lessons to be learned in terms of clinical practice (Burstein, Linzer 1988), while other clubs had a more interactive group discussion (Khan, Heligman). Two articles document how skills in deciding clinical applicability were developed through use of case scenarios and post-test questions (Fu, Bazarian). The remaining five studies stated that clinical applicability was addressed but there is no further information on the process.

The size of JC groups ranged from 7 to 43 members. The variation in size of group was surprising, given that many studies adopted Linzer's definition of a club in which discussion was part of the process. In Linzer's studies, the groups were 22 and 43 participants, respectively (Linzer et al. 1987, 1988). Clearly in large groups discussion would be difficult if not impossible. Eight studies had between 9 and 16 participants. This may be small enough to promote learning and decision making through interaction, although it is argued that optimal group size is eight participants (Elwyn et al. 2001).

The distinction between knowledge and skills was not consistent in the JC evaluations. What was called 'change in knowledge' in one study was termed 'change in skill' in another. For example, knowledge of clinical epidemiology and biostatistics was operationalised as ability to use critical appraisal skills. Conversely, skill in critical appraisal was operationalised as ability to answer knowledge questions in clinical epidemiology and biostatistics.

In a hierarchy of learning and service improvement, skill is the process of actively translating knowledge into meaningful information that can be used to change professional practice. Skills in the studies, however, were defined more as academic knowledge, focusing on the first four steps of EBP: question formulation, accessing literature, critically appraising literature and determining the applicability of the evidence to a clinical scenario. Only one study adopted a definition of skills that was more closely related to learning transfer, assessing ability to use problem-based learning approaches to resolve clinical questions (Lee).

Change in behaviour is defined as transfer of learning to the workplace or willingness of learners to apply new knowledge and skills in the hierarchy of learning and service improvement. In our review, we referred to this concept as the ability to determine whether evidence was clinically relevant to a patient scenario and the actual steps taken to use evidence in practice. Only one study (Linzer) reported that participants discussed the ways in which they now utilised the literature in their practice of medicine.

Clinical applicability was defined by some articles but not operationalised. Clinical applicability includes the process of discussing whether journal information is applicable to a clinical situation, and the ability to apply literature to clinical practice. Articles referred to clinical applicability as the 'ability to determine clinical usefulness of an article' (Cramer, Heligman, O'Sullivan), 'to appraise and assimilate evidence leading to improvement in patient care (Lee)' and 'evidence sufficient enough to influence practice' (Kellum, Khan).

Change in practice is defined as wider changes in the organisational/delivery of care, attributable to an educational programme. Changes in practice were self-reported and include:

- an improved ability to apply reading to patient care (Elnicki, Linzer 1987),
- a taught 'analysis of clinical practice' (Burstein),
- 'It provided me with information that I have been able to apply in my clinical practice' (Mazuryk),
- self-reported change in utilising literature in practice (Linzer 1987),
- self-reported alteration in clinical practice: 'It had an impact on my work' (Fu, Spillane).

None of the evaluations considered the relationship between individual behaviour change and improvements in delivery of care.

In the hierarchy of learning, improvements in health or well-being of patients is the final step in linking JC learning to actual service improvement. There were no studies reporting patient outcomes.

Levels of measurement

Self-reported measures were used in the majority of studies across all variables. Change in knowledge was self-reported in four of the seven studies assessing knowledge. Perceptions of improved knowledge are open to bias, as demonstrated by Davis et al. (2006) who have showed that estimates of improvement made by individual doctors are usually optimistic when compared to objective measures of performance.

Objective tests were only used in nine studies. Although four authors reported using validated tests (Bazarian, Fu, Kellum, Linzer 1988), none of the studies used the validated tests described in a recent systematic review (Shaneyfelt et al. 2006) and the actual reliability and validity of validated tests was not reported in any studies. Observation was only used in two studies, to count attendance.

Evaluation occurred at different stages of club development. Some studies evaluated a long standing club in order to make decisions about changing the format (Heligman, Linzer 1987; O'Sullivan, Swift) while others chose to evaluate a new or modified club to determine the impact (Burstein, Cramer, Fu, Kellum, Khan, Lee, Linzer 1988, Mukherjee, Seelig, Swift).

In systematic reviews that focus on randomised controlled trials, studies are lumped together by population, intervention and outcomes. Our first stage of data synthesis demonstrated that there was too much heterogeneity in JC studies to take this approach to answering the question of whether JCs are effective in promoting EB decision making.

Findings from the realist synthesis

The elements commonly provided across JCs include:

- mentoring where a more senior clinician provides advice and technical support to a less experienced clinician in preparing for a session;
- providing brief didactic training in literature searching, critical appraisal, principles of clinical epidemiology and/or

biostatistics to give clinicians the knowledge needed to find and judge the quality of research; providing expert support from a statistician;

- using a structured learning materials, such as a critical appraisal review instrument to lift analysis and discussion from the informal to a more systematic approach;
- using principles of adult learning, such as identifying relevant clinical questions, applying the learning tasks to actual patient cases, answering questions in 'real time', promoting active learner participation and providing timely and constructive feedback;
- using multifaceted approaches to teaching and learning, such as one-to-one mentoring/supervision, small group discussion, formal presentations and interactive large group discussion and
- integrating and reinforcing JC learning by choosing topics that are linked to clinical lectures and supported by academic modules with related content and skills.

Although there was heterogeneity in terms of how variables were defined, we found studies could be grouped together for four basic outcomes: (1) change in reading behaviour; (2) confidence in ability to critically appraise research; (3) demonstrated knowledge and critical appraisal skills and (4) ability to apply findings to clinical practice. The common elements of JCs were mapped for each study by outcome as a first step in determining the active ingredients of successful clubs.

Improvements in reading habits

Eleven of the eighteen studies assessed changes in reading habits. Reading habits were not always defined (Linzer 1988, O'Sullivan) but three authors defined this as motivation to read or stimulation to review a subject further (Akhund, Elnicki, Spillane), or change in use of journals or textbooks (Fu). Researchers also used the number of articles read and time spent reading as a proxy outcome for testing the assumption that JCs lead to more positive attitudes towards reading and therefore inspire participants to keep updated. Reading patterns were defined as time spent reading (Bazarian, Khan, Seelig), the number of articles read per week or month (Burstein, Khan, Linzer 1987), and reading articles more completely (Linzer 1987). Five studies noted a self-reported improvement in reading patterns (Khan, Linzer 1988, O'Sullivan, Seelig, Spillane). It is worth noting that reading less articles per month was associated with reading more completely (Linzer 1987) and that improvement in critical reading habits is not necessarily associated with the amount of time spent reading (Linzer 1988). Seelig described this as an increase in perceptions of spending more 'useful' time reading.

Positive attitudes towards participation in JCs is not necessarily related to a change in reading behaviour. The Akhund study found that although 70% believed the JC provides stimulus to further reading, and 89% agreed it was educationally valuable to prepare, only 44% associated participation with improved reading behaviour.

Of the seven studies using mentoring and assessing reading habits, four reported positive change in reading habits. Where didactic support was used, three studies produced improved

reading habits, but three did not. Three of five studies using adult learning showed improved reading. Of the five using a structured review instrument, three showed improved reading.

Increased confidence in ability to critically appraise the quality of research

The seven studies assessing confidence reported an overall increase in perceived ability to critically appraise (Akhund, Elnicki, Kellum, Lee, Mukherjee, O'Sullivan, Seelig). One study noted that although confidence increased, perceptions of ability varied by the level of learner (Elnicki). Medical residents and faculty were more confident than students, and faculty noted that 'although some [students] enjoyed the sessions, others felt them to be a distraction from other tasks'. Faculty noted that the JC was confusing for students and beginners had problems with critical appraisal. The authors suggested that 'what we may be observing is variability in the students' capacity for independent study at this point in their medical education.' In contrast, residents found the JC experience was 'easily translated into patient care' and faculty found the club promoted 'useful skills, often overlooked in training'.

Kellum also raised the point that a significant increase in perceived confidence did not correlate with actual performance on critical appraisal tests.

Four of the studies reporting positive change included mentoring, four used didactic support, four used adult learning and four used a structured review instrument.

Increased knowledge and skills in critical appraisal

Five of the seven studies that used objective tests of critical appraisal demonstrated an improvement. Two of these studies used validated knowledge tests (Khan, Linzer 1988), and three used unvalidated tests (Cramer, Kellum, Seelig). Although all five reported a statistically significant increase in knowledge, interestingly the Linzer study produced an increase in clinical epidemiology and statistics knowledge without a corresponding improvement in critical appraisal skills. Critical appraisal is a complex skill which includes, but is not limited to, knowledge of epidemiology and statistics. Participants attended a mean of five sessions over 9.5 months which may not be adequate for development of skills.

Two studies assessed both increased confidence to critically appraise and actual performance on tests of critical appraisal skills (Kellum, Seelig). Although both found improvements across confidence and test performance, Kellum noted that one fellow had increased confidence with no change in test score, while one had an increased test score with no change in confidence. The fellow with the largest increase in ability had no change in confidence. This indicates that self-report of increased knowledge and skills is a weak indicator of actual performance.

Three of the studies demonstrating improvement in knowledge and skills included mentoring in JCs, while four included didactic support and four used a structured review instrument.

Ability to apply evidence in clinical contexts

Seven of the eighteen studies looked at the ability of JCs to promote application of evidence in practice (Appendix 11.7), and five found a self-reported positive relationship (Elnicki, Lee, Linzer 1988, O'Sullivan, Spillane). The Linzer study compared a control group that participated in a seminar series with an intervention group who participated in a JC. Although there was no significant difference in critical appraisal knowledge scores between the two groups, the JC group reported greater perceived ability to use information in practice. The active ingredients in this study were mentoring to promote understanding and group discussion to consider applicability. The O'Sullivan study contains the same active ingredients, noting that although both JCs included critical appraisal, the learner centred club which had interactive discussion was better at promoting ability to determine clinical utility. Four of the studies reporting ability to use evidence in practice included mentoring.

What type of JC works for whom in what circumstances?

The synthesis indicates mentoring was present in some of the JCs where there were improvements in reading, confidence in critical appraisal, knowledge and skills and ability to apply evidence. Didactic support was present in six of the studies that assessed improved reading and in half of these clubs reading actually improved. It was present in four of the five studies where knowledge and skills improved. Similarly, a structured review instrument appeared to be an active ingredient in four of the five studies where knowledge and skills improved. Adult learning was an ingredient in some studies across all areas, but the influence of adult learning is difficult to assess because it may have been underreported when the educational intervention was described. This may also be the case with multifaceted approaches to teaching and learning, as well as integration with other learning or clinical activities.

One of the key mediating factors in terms of JC success may relate to whom the club is designed for. Although this review originally intended to analyse results by professional group and student group, this was not possible due to quality of studies and lack of multidisciplinary clubs. Similarly, O'Brien's (2001) review, where the authors attempted to include type of health professional as an explanatory variable, were unable to do so due to a lack of studies including groups other than doctors.

We did, however, find within our population of doctors variation by level of training. For example, the Bazarian study, which contained a number of active ingredients, compared interactive case-based presentation and mentoring with a traditional JC that did not have faculty support for preparation or systematic analysis. The authors posited that the lack of statistical significance may be due to the level of learners and number of sessions. Residents and interns participated in intervention and control groups for a total of 12 sessions over 12 months, with only one participant dropping out of each group. The authors noted that 'The important variable may not be the degree of structure in the teaching method but the total

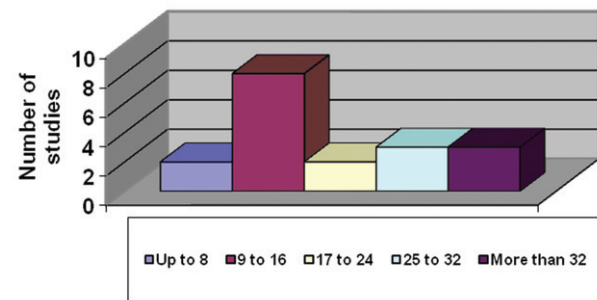


Figure 4. JCs by size of group.

exposure time to the teaching method.' When the intervention group was exposed to a new activity – the JC – some demonstrated remarkable improvement during the year while others regressed. This wide variation was not seen in controls, who were not exposed to a new way of learning. Bazarian hypothesised that unlearning may need to occur for residents before they can learn EBM.

The concept of unlearning is described by Eraut in relation to stages of learning that were originally outlined by Dreyfus and Dreyfus (1986). Introducing an EB JC format into clinical learning may have different effects, depending on the stage of the learner. Novices and advanced beginners, for example, are at the stage where they are mastering content and learning rules (Figure 4). This may explain why Elnicki's medical students found critical appraisal more challenging than the residents and faculty in his study.

Residents will be at Dreyfus level four and fellows will be reaching level 5 (Figure 5). This has implications for performance in JCs. For example, Kellum suggests that fellows will be more knowledgeable than students or residents about the literature in their field. Lee notes that residents will also have proficiency in assimilating evidence from journal articles. This knowledge may help in mastering critical appraisal techniques, because residents and fellows will not need to familiarise themselves with the content, just the skills. On a related point, O'Sullivan states that familiarity with the literature is crucial to the thorough review of an article. Less mature learners, therefore, will struggle more with critical appraisal, as was demonstrated in Elnicki's study, because they are more focused on mastering content than they are on critiquing it.

Mazuryk suggested the focus of learning is different for residents and fellows. Residents are fulfilling a rotation in a limited time period, so their interest may be more clinically oriented, while fellows are focusing on a specialised area implying greater interest in the research topic and a more academically oriented approach. The take away message here is JCs need to consider the level of proficiency in the group, and research on the effectiveness of JCs needs to select assessment measures reflecting the 'educationally important difference' by level of learner.

Other mediating factors that could influence success, particularly in relation to the level of learner, are the duration of the club and frequency of exposure. When questioning why clinical epidemiology and biostatistics knowledge improved but critical appraisal did not, Linzer noted more prolonged

Level 1 Novice

Rigid adherence to taught rules or plans
Little situational perception
No discretionary judgement

Level 2 Advanced beginner

Guidelines for action based on attributes or aspects (aspects are global characteristics of situations recognisable only after some prior experience)
Situational perception still limited
All attributes and aspects are treated separately and given equal importance

Level 3 Competent

Coping with crowdedness
Now sees actions at least partially in terms of longer-term goals
Conscious deliberate planning
Standardised and routinised procedures

Level 4 Proficient

See situations holistically rather than in terms of aspects
See what is most important in a situation
Perceives deviations from the normal pattern
Decision-making less laboured
Uses maxims for guidance, whose meaning varies according to the situation

Level 5 Expert

No longer relies on rules, guidelines or maxims
Intuitive grasp of situations based on deep tacit understanding
Analytic approaches used only in novel situations, when problems occur or when justifying conclusions
Vision of what is possible

(Source: Eraut & Hirsh 2007)

Figure 5. Summary of the Dreyfus model of progression.

exposure to the practice of EBM may be needed before a widespread improvement in critical appraisal can be demonstrated, a 'dose-response' relationship, where proficiency increased over time. This is supported by Eraut's research, which points out that when more proficient practitioners are exposed to new ways of learning, they find themselves in a situation where they 'return to being a novice without the excuse of being a novice. Hence, the need for more time and support is an order of magnitude greater than that normally provided' (Eraut 2004).

The overall message, across studies in the review, was that there is no ideal format for a JC. Groups need to tailor the club according to learner needs and level of training (Alguire 1998). There are, however, key ingredients that contribute to the success of JCs, and each of these potentially active ingredients needs to be considered when doing the tailoring.

Conclusions

Using the review findings

The included studies reported improvements in reading behaviour ($N=5/11$), increased confidence in critical appraisal ($N=7/7$), improved test scores on critical appraisal ($N=5/7$), and increased ability to use findings in clinical practice ($N=5/7$). Conclusions from the review need to be made in the context of the methodological quality of studies.

There was a wide range of heterogeneity of the JC intervention, as discussed in section 'Heterogeneity across JC interventions' making it difficult to answer our effectiveness question 'Is the JC effective in supporting EB decision making?' We cannot conclude that JCs are effective in supporting EB decision making, because only seven studies attempted to measure this endpoint and they relied on self-report.

Methodological weaknesses in the studies

The first stage of our review revealed some problems with research design, which have been noted by authors of reviews in related topic areas (Ebbert et al. 2001; Marinopoulos et al. 2007): (1) the description of the interventions lacks attention to detail, preventing adequate replication. (2) There was a paucity of learner assessment and few validated tools were used for quantitative assessment. This finding is supported by a review conducted by Shaneyfelt et al. (2006) which found only 53% of studies evaluating EB teaching used some form of validated assessment tool. Further, a recent systematic review of continuing medical education (CME) found only 33% of the studies reported validity of evaluation tools (Marinopoulos et al. 2007). Qualitative assessment had corresponding problems with rigour, lacking descriptive data to support research conclusions. (3) The large variation in JC design and delivery limits comparison. Heterogeneity was noted as an issue in Ebbert

et al.'s (2001), review and is also pointed out in reviews of CME (Marinopoulos et al. 2007) and EB medicine teaching (Coomarasamy & Khan 2004). Sources of variation include the size of the group, the frequency of meetings, the mode of presentation, the preparation required, the level of interaction, the level of facilitation and the skills and knowledge acquired.

One area of contention is the size of JCs. Perhaps there are two competing types of club: an interactive club which can be defined by a group size less than 16 and a more didactic club that has a number of participants greater than 16. Otherwise it would be hard to compare the level of interaction and learner reaction with two diverse group sizes. A second area of contention concerns the frequency of meetings. We would argue that relationships between group participants can only develop if the meeting is regular, and CME evidence indicates that multiple exposures to learning are more effective in promoting and maintaining changes in practice over time (Marinopoulos et al. 2007).

Information on presentation, preparation, interaction and facilitation is missing in a number of articles, despite the fact that context is key to determining whether there is a basis for comparison across different clubs. Another problematic area concerns the lack of importance placed upon selection of relevant patient problems and articles relating to these problems. Thus, we are unable to determine which of the components of the JC are more important than others and likely to lead to improved outcomes.

In terms of change in attitudes these were mainly assessed with regard towards the material and activities required by the JC. Knowledge and skills was not consistent throughout JC evaluations. Only one study adopted a definition of skills that was more closely related to learning transfer, assessing ability to use problem-based learning approaches to resolve clinical questions (Lee). Only one study (Linzer) reported that participants discussed the ways in which they now utilised the literature in their practice of medicine.

Self-reported assessment has its limitations and further evaluation should aim to use validated scales. Only two studies (Heligman and Spillane) collected some qualitative data, but methods used by the other five to select important dimensions of learner reaction were not reported. Perhaps the most we have to gain right now is through qualitative investigation of the components of a JC that are most likely to lead to improved knowledge and skills and changes in practice, particularly with respect to direct patient problems.

Several systematic reviews have been conducted on topics related to JCs. These include reviews of the effectiveness of teaching critical appraisal skills (Taylor 2000; Parkes 2001), the effectiveness of teaching EB skills (Coomarasamy et al. 2003; Coomarasamy & Kahn 2004), and the use of instruments to evaluate EB teaching (Flores-Mateo & Argimon 2007). It is difficult to compare the findings of these reviews to the effectiveness question for our JC review for two reasons. First, the outcomes of knowledge, attitudes and skills were defined differently. For example, Flores-Mateo and Argimon (2007) defined skills as 'the participant applying knowledge by performing EBP steps in some scenarios', where our BEME

definition emphasises transfer of skills to the workplace. Behaviour is defined as actual performance of EBP in practice, where the BEME definition includes the dimension of organisational change. Across all of the reviews, definitions of knowledge and attitudes were assumed to be homogeneous across individual studies. Our review found on closer inspection these definitions were operationalised in different ways, and we therefore question whether data synthesis and meta-analysis can actually be performed. There may be important issues of heterogeneity in intervention design that warrant further investigation before conducting a meta-analysis. For example, the JC interventions may be delivered differently than described in the study, presenting major issues with what Bellg et al. (2004) describe as 'treatment fidelity'.

Identifying active ingredients

Analysis of the various elements contained in JCs produced a cluster of elements that may contribute to the overall effect. These were termed active ingredients, and included mentoring, didactic support, use of structured review instruments, adhering to principles of adult learning, using multifaceted approaches to learning, and integrating learning with other academic and clinical activities. Due to incomplete reporting some clubs may have actually had far more of the potentially active ingredients than reported.

Definitions of 'positive' outcomes may also bias the findings of this review. We took a conservative approach, defining positive outcomes as those where authors either reported a substantial improvement in pre- and post-test surveys or a statistically significant difference. But some studies reported a positive trend which did not reach statistical significance (Burstein, Fu, Linzer 1987), while others reported internal variation with some individuals achieving much more substantial educationally important differences than others (Mukherjee, Bazarian). As study sizes were small, some were not adequately powered. Finally, some studies noted positive effects that were not systematically assessed, such as the fact that participants were actively talking about and using EBM concepts more than they had previously, and felt that EB concepts were useful in designing and conducting their research projects (Bazarian). This indicates that participants' definitions of meaningful outcomes may differ from researchers' definitions.

Implications for practice

Our review illustrates that JCs are used widely across different sectors of the healthcare and used in a variety of different ways. Active ingredients are found at each stage of the educational intervention (Table 4).

It is not possible to determine whether one format of JC is superior to another, but certain elements are linked to success and can be included at the stages of design, training, delivery, receipt and enactment. For example, if a JC is being designed for residents, the content should be directly applicable to patient cases they find problematic, enabling application of evidence in a real-time setting; didactic support could be

Table 4. What type of JC works for whom in what circumstances?

Design	Training	Delivery	Receipt	Enactment
Participation Length, duration, frequency of meetings: Partially documented, not systematically analysed Content of meetings: Topics need to be relevant to learner needs and applicable to patient cases	Resources invested Time: Not documented Staff expertise: in searching, statistics, facilitating critical appraisal, facilitating discussion: didactic support in the form of lectures, workshops or expert assistance before the club or during sessions Money: Not documented	Activities during sessions Question formulation: Not documented Searching: Only documented in one study	Outcomes (short term) Ability to recognise uncertainty and question practice: Not documented Skills to find relevant evidence efficiently: Problems finding relevant studies	Impact (longer term) Willingness to apply EB skills in workplace Ability to transfer knowledge to practice
Type of participants: Level of learner (Student, intern, resident, fellow, faculty) was influential		Preparing for presentation	Skills in summarising evidence; Ability to judge the quality of evidence; Positive results in clubs containing active ingredients	Less harmful interventions for patients
Attendance: Documented but not systematically analysed		Critical appraisal	Decision-making regarding use of evidence: Positive results in clubs containing active ingredients	Improved patient care: Not documented
Size of group: Not identified as an active ingredient		Discussion on clinical applicability		
Level of participation/interaction: Not described		Supported by mentoring, structured materials/review instruments, adult learning, multifaceted approaches to teaching, integrated with other academic and clinical activities Tailored to level and needs of learner		

provided based on an educational needs assessment (e.g. for statistical support). Critical appraisal and discussion of clinical applicability could be facilitated by senior clinicians who are in supervisory positions, enabling the transfer of discussion into practice. A JC for students or interns may include the same ingredients, but in different proportions, with more emphasis on learning the 'rules' of critical appraisal and the topics of clinical epidemiology and biostatistics. The content of these clubs could mirror the topics that students are currently learning in the medical curriculum and on which they expect to be examined.

Implications for future evaluations

We have several recommendations for improving the research base for JCs which reiterate the recent systematic review of CME conducted by Davis et al. (1999). First, the study design should be based on pedagogical theory, for example using the principles of adult learning. This is in line with recommendations that research into the effectiveness of EB teaching needs to be more closely aligned with theory (Coverdale et al. 2008) particularly educational theories that support real-time integration of education with clinical practice (Mascola 2008). The findings from this realist synthesis suggest an emerging theory for effective JCs; effective clubs will use a multifaceted approach providing mentoring, didactic support when needed, structured instruments for critical appraisal, and experts to facilitate interactive discussion of clinical applicability.

Second, the goals of the JC need to be explicitly stated (Alguire 1998). Future evaluations of JCs can only produce valid results if the elements of the complex educational intervention are explicitly described. Third, each element of the intervention needs to be operationalised with sufficient definition of the variables to facilitate comparison of the active ingredients within the delivery framework. Fourth, evaluation questions need to be matched to the goals of the intervention, to the effectiveness measures, and to the level of effect. In qualitative studies, evaluation questions need to match the methods for data collection and analysis. Where qualitative research is used, findings need to be underpinned with primary data. Fifth, effectiveness measures, such as knowledge, attitudes and skills, require more consistent definitions to facilitate comparison across studies (Belfield 2001). Tools for assessing effectiveness can be selected from the validated tools that currently exist (Shaneyfelt et al. 2006). Where this is not possible, tools can be internally validated and the degree of reliability and validity reported in the paper (Marinopoulos et al. 2007). Finally, systematic reviews in CME have identified studies that investigate the relationship between CME learning and performance in practice (Davis et al. 1995; Oxman et al. 1995; Marinopoulos et al. 2007). Lessons could be taken from these studies to explore the relationship between JC learning, changes in clinical behaviour, and changes in organisational practice. Researchers have acknowledged that using a randomised controlled trial design presents challenges in educational research (Coomarasamy & Khan 2004). Mixed method research needs to be conducted, where randomised or

before–after studies are supplemented with qualitative research to help explain levels of effect.

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