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Same-level peer-assisted learning in medical clinical placements: A narrative systematic review

Abstract

Introduction Peer assisted learning (PAL) is increasingly used in medical education, and benefits of this approach have been reported. Previous reviews have focussed on the benefits of peer tutoring, by senior of junior students. Forms of PAL such as discussion groups and roleplaying have been neglected, as have alternative teacher-learner configurations (e.g. same-level PAL), and effects on other stakeholders including clinician educators and patients. This review examines the benefits of same-level PAL for students, clinician educators and patients in pre-registration clinical medical education.

Method: Medline, PsycINFO, CINAHL and ERIC were searched in March 2014. 1228 abstracts were retrieved for review; 64 full text papers were assessed. Data were extracted from empirical studies describing a same-level PAL initiative in a clinical setting, focussing on effects beyond academic performance and student satisfaction. Qualitative Thematic Analysis was employed to identify types of PAL, and to cluster the reported PAL effects.

Results: 43 studies were included in the review. PAL activities were categorised into roleplay, discussion, teaching and assessment. Only 50% of studies reported information beyond self-report and satisfaction with the PAL intervention. Benefits for students (including development of communication and professional skills) and clinician educators (developing lesser used facilitation skills) were reported. Direct patient outcomes were not identified. Caveats to the use of PAL emerged, and guidelines for the use of PAL were perceived as useful.

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Discussion: Many student-related benefits to PAL were identified. PAL contributes to the development of crucial skills required for a doctor in the workplace. Vertical integration of learning and teaching skills across the curriculum and tools such as feedback checklists may be required for successful PAL in the clinical environment. Patient and educator benefits were poorly characterised within the included studies. Future work should evaluate the use of PAL with regards to student, clinician educator and patient outcomes.

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Background

Peer assisted learning (PAL) is a valuable adjunct to conventional teaching methods, especially in clinical environments. Originating in primary and secondary education, it has been implemented in higher education for many years (1), including in medical education (2). The term PAL encompasses a range of learning activities including peer tutoring, peer observation, peer feedback, and peer assessment. A commonly cited definition of PAL is "people from similar social groupings, who are not professional teachers, helping each other to learn and by so doing, learning themselves"(3). PAL may occur between near-peers, where senior students nearing completion of their studies teach junior cohorts, who are relative novices, or between students of the same level, where students are encountering new material together, though they may not be at the exact same point in their studies (3). The evidence to support the use of PAL is vast, with several systematic reviews of PAL in healthcare settings. The argument for implementing PAL in medical education has been previously justified with both hypothesised and evidence-based benefits (4). While the evidence base grows for students' knowledge gain and performance on examinations (e.g. (5)), there are a number of published benefits of PAL that remain speculative.

Previous reviews of PAL in health professions education have focussed largely on peer teaching (5–8). Two reviews focussed specifically on the benefits for the tutors alone (5,6), while two identified the effects on students receiving the peer based tutelage (7,8). However, studies involving medical students were not included in the Secomb (7) review. Additionally, most of the studies included in these reviews occurred in near-peer settings, where a more senior, experienced group of students taught a more junior cohort (5–8). There is no doubt that peer tutoring is comparable to other more conventional teaching methods when it comes to effects on knowledge. While knowledge gain has been demonstrated for both peer tutors and tutees, the benefits for peer tutors in terms of knowledge gain and performance on examinations are greater (5). Yu et al (6) identified that a relaxed environment and better understanding of learning difficulties were developed, though there was concern that PAL reduced contact time with educators. Burgess et al (5) identified a range of professional attributes that peer tutors developed, namely facilitation skills, teaching, assessment, feedback, leadership, ability to admit uncertainty, development of confidence, contribution to education, and autonomy in learning.

Peer assessment in medical education has also been well studied: Speyer et al (9) included 22 studies of peer assessment in their review. Many uses and goals for peer assessment were identified, including generating marks,

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learning to be an assessor, student interaction, social control, development of self-regulation and self-monitoring, and active participation in learning. The focus of the peer assessment was largely professional behaviour, with few studies asking students to assess each other on their clinical performance. The studies that were identified were heterogeneous in design, with a diverse range of peer assessment tools, and data on psychometric characteristics of these tools were often restricted or unavailable. It was concluded that statistical pooling was not possible, and that further research should investigate the psychometric properties of assessment tools. Caution was therefore recommended when using peer assessment (9). Moreover, the broader educational outcomes of engaging in peer assessment were not a focus of the review.

These reviews have not made the distinction between same-level and near-peer PAL. Wadoodi (2) suggested same-level PAL would have the "advantage of greater informality", but was concerned about a lack of direction for learners. From a practical perspective, same-level PAL would be more easily implemented, as students are more likely to have similarly timetabled commitments, in similar locations.

The implementation of PAL in clinical environments has had several driving forces, including theoretical and reported benefits. Knowledge gain has been demonstrated in many studies (7,8), however many theorised benefits of PAL remain theoretical. Table 1 provides an overview of hypothesised and evidence supported PAL benefits. Both Lincoln & McAllister (4) and Topping (1) identified technical skills, affective components which may increase student motivation to engage in learning, deeper cognitive aspects of learning, and some practical benefits to PAL activities. Though Secomb (7) identified some of these aspects for health professions students on clinical placements, and Burgess et al. (5) identified a range of professional behaviours engendered by PAL for peer tutors, neither study examined the benefits of PAL for all medical students in a clinical context. PAL activities such as peer discussion and role-playing have not been investigated in previous reviews. More broadly, the effects of PAL for other stakeholders in medical education such as clinician educators, and importantly, patients, have not been well investigated. We use the term "clinician educators" to mean any qualified clinician involved in the direct education or supervision of medical students, regardless of formal university or faculty appointment. Clinicians within our local context are called upon to teach students with little prior training; novel educational methods may impact on their willingness to contribute their time and services gratis.

This review seeks to determine the effects of same-level PAL in clinical environments, for medical students themselves, clinician educators and patients.

Methods

This review was conducted in a systematic fashion, with minor variations on the standard systematic literature review approach. An inspection of the included studies indicated that a quantitative meta-analysis of the effects was inappropriate. The research questions, where given, had a wide range of foci, and outcomes were measured with a

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variety of methods. A thematic analysis and realist synthesis was undertaken (10), resulting in a more narrative review on PAL in same-level, undergraduate clinical medical education (11). From this point, we refer to same-level PAL simply as "PAL".

Procedure

The question for the review was "What are the effects of same-level, peer assisted learning in undergraduate clinical medical education?" Relevant search terms and their synonyms were used within four databases: Medline, PsychINFO, CINAHL and ERIC. The search was run on 14 March 2014. The search aimed to capture all studies published in English, reporting on PAL activities which medical students from the same year level undertook during clinical placements. Studies which did not meet these criteria were excluded (Figure 1). The search was updated on 27 January 2015, following the same procedure, where one additional citation was identified. The reference lists of included papers were also hand-searched for additional references for inclusion.

Search terms

The PICO framework (12) was used to develop the search terms. For 'P', the people or group of interest were medical students in clinical environments. Cognizant of the varying entry schemes to study medicine worldwide, while "undergraduate" was included as a search term, "student" was also used to capture all pre-registration trainees. The following terms were used: (medic* and (undergraduat* or student*)) AND (placement* or clinic* or practic*). The intervention of interest ("I") was a peer assisted learning or teaching program. Search terms used were: (peer* or student-led or student-run) AND (learn* or teach* or educ* or PAL or "supplemental instruction" or SI). There was no specific comparison group of interest ("C"). Whilst it was known that some studies would compare peer teaching to clinician, expert or educator teaching, studies with no comparison group were also of interest. The outcomes ("O") sought were any impacts or changes in perceptions or performance: (chang* or evaluat* or compar* or effect* or impact) and (attitud* or percept* or perform* or result* or score or competen*). The results of these above searches were combined with the 'AND' operator to search for papers with all three elements.

Inclusion criteria

At each stage of the review, papers were excluded if they did not meet all of the following inclusion criteria:

- Participants must be medical students (undergraduate or graduate entry) (i.e. pre-registration, not interns or residents or completing post-graduate training, or physicians)
- Participants must be in the same year level (i.e. near-peer tutoring is excluded – senior students working with junior students, paid peer tutors in a more senior year level). Where students had the same level of prior experience (e.g. all year 3 and 4 students who were learning musculoskeletal ultrasound), they were deemed to be of the same year level.
- Setting must be clinical (i.e. must not be preclinical; students should be undertaking a clinical placement at the time of the intervention – simulation and role-play is included if it is part of a clinical placement)

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- The study must focus on an intervention or phenomenon that involves peer-assisted learning (e.g. peer teaching, peer case presentation, peer feedback, peer assessment, peer discussion). The intervention may be a comparison arm of a larger trial involving multiple education methods (e.g. PAL compared to traditional methods, PAL compared to other novel teaching methods), or a PAL intervention alone with no comparison.
- Outcomes of the intervention must be reported (i.e. purely descriptive studies with no evaluation component are excluded).
- Report must be published in English

Screening and selection of studies

A pragmatic approach to ensure accuracy and consistency with respect to abstract and paper review was adopted. Previous systematic reviews have engaged a second reviewer to check a proportion of decisions made by the primary reviewer, including decisions on exclusion by title, paper categorisation and data extraction (13–16). The proportion of double-checking has ranged from 10% (14) to 37.5% (15) of all citations. We took a sensitive rather than a specific approach (i.e. tried to be inclusive rather than exclusive); any papers for which decisions were uncertain were discussed between JT and BC, and a relatively high proportion of citations were double reviewed. The principal reviewer (JT) assessed all citations at abstract and full text levels, and undertook all quality appraisal and data extraction. Between the secondary reviewers (BC & TH), 156 (30%) abstracts were reviewed and assessed for inclusion, with 94% agreement initially. There were nine abstracts for which two reviewers were uncertain about inclusion at the abstract screening stage: five were excluded entirely on re-reading, two were included at the abstract stage but failed to meet all criteria on a full-text reading, and another two were included in the review. The secondary reviewers (EM, BC & TH) then assessed 27 (40%) papers for eligibility, for which there was 100% agreement for inclusion or exclusion of papers.

Quality appraisal and data extraction

The criteria published by Buckley et al (17) were used for the Quality Appraisal (QA) tool, to assess the risk of bias and trustworthiness of findings in each paper. These quality indicators which examined study design, process, data analysis, and conclusions drawn, were used due to their applicability to quantitative and qualitative research methods, and their formulation for the medical education context. Several items within the QA tool were adapted to allow for more detailed consideration of qualitative studies. The “Confounding variables acknowledged” item was considered met if other, external influences on results were discussed. The “triangulation of data” included triangulation through researchers’ interpretation of the data, along with data collection from separate sources. Papers were scored on eleven criteria, with a seven or above indicating a lower risk of bias (Table 2). This enabled a judgement to be made on how likely the findings were to be trustworthy on the basis of the published report. For the 18 double-reviewed studies included, reviewers’ scores were identical for 56% (n=10) of the studies. Scores differed by 1 for 28% (n=5) of studies, and by 2 for 16% (n=3) of studies. The lower of the two scores was reported. Critically, none of these score differences altered the classification of the study.

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A simple data extraction (DE) tool was developed on the basis of the required information for the review, separating out quantitative and qualitative findings, largely to sharpen the reviewers' focus for both types of data. In addition to the results reported pertaining to the papers' research questions, effects mentioned in the text as incidental findings were also extracted by reviewers for completeness of data. Included in the DE tool was an assessment of educational outcome. A modified version of Kirkpatrick education outcome levels published by Barr et al (18) was used: Level 1, learners' reaction; Level 2a, modification of attitudes/perceptions; Level 2b; acquisition of knowledge/skills; Level 3, Change in behaviour; Level 4a, Change in organisational practice, and Level 4b, benefits to patients/clients (14). These descriptors were included as part of the document to assist reviewers. To ensure consistency of approach and interpretation of the text within the tools, both DE and QA tools were piloted on three papers by JT and EM.

Data analysis and synthesis

Descriptive statistics were calculated for the studies based on year of publication, quality, level of educational outcomes, and type of study conducted. The remainder of data were heterogeneous, requiring a qualitative synthesis where results are pooled and then collectively interpreted. A realist approach was taken, which requires the context of the results to be considered (e.g. for whom does the intervention work, and in what circumstances) and described, with an equal emphasis on summarising what is known, and developing theory on the subject of the review (10). Qualitative analysis of the data was therefore undertaken in a number of aspects. Data on the PAL activity or intervention were firstly examined then coded by the primary reviewer (JT) according to the type of activity undertaken to identify the contexts in which findings were made. The coding categories were examined by a secondary reviewer (EM) for fit, and the classification of individual studies was changed where necessary. For instance, the paper by Fornari et al (19) was originally classified as being a roleplay activity on the basis of students assuming patient roles, however on further inspection, students were actually required to present their experiences as a patient in a teaching session, and therefore the study was reclassified as a teaching activity. Findings from included studies were examined using thematic analysis (20). Outcomes were coded by JT. The codes were then discussed with BC for agreement, and initially sorted according to the CanMEDs framework (21), Australian Curriculum Framework for Junior Doctors (22) however, they did not account for the effects identified for patients and educators. An alternative was considered: "Non-technical skills" (NTS) is a well-used term, defined more by what it is not (that is, technical, procedural skills that can be learned), though Nestel et al. (23) argues that communication skills can be taught and therefore NTS is a poor descriptor. However, most of the codes aside from knowledge gain and technical ability could have been placed in the "non-technical skills" category. These frameworks were found to be unhelpful in developing meaning from the identified codes. Therefore, we chose to synthesise the effects of PAL by codes alone; any further collapsing resulted in a loss of detail. Some grouping was then provided through the group or stakeholder that benefited from them. Pitfalls of PAL were also coded in a separate category. This approach was therefore realist in being attentive to surrounding context and direction of effects, and also ensured that attention was paid to situations where further clarifying work was required.

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Results

A total of 43 papers met the inclusion criteria and underwent data extraction (see Table S1 online - for summary) and quality appraisal (see Table 2 for scoring). The publication date of papers ranged from 1975 to 2014, with 23 (53%) papers published since 2010, which may reflect the increasing interest in this area in medical education. Quality appraisal resulted in a wide range of scores, from two to the maximum of eleven. Thirty-six papers (84%) were considered of be of good quality, scoring a seven or above. Lower quality studies were not excluded as they did contribute some additional information on the effects of PAL. Thirty-two studies (74%) provided Kirkpatrick level 1 (i.e. participant satisfaction) information in their results, while only half the studies (50%) examined the effects on learning or flow-on effects (2b, 3, 4b). Fifteen studies were controlled trials with a comparison control group (24–28,19); nine of these were randomised (29–37). Qualitative analysis of the papers' results revealed that there were four main groups of PAL interventions: Facilitated discussion between peers, role-playing a patient for a peer, peer teaching, and peer evaluation (Table 3). The effects of PAL described were mostly benefits, which could largely be described as "non-technical skills". The relationship between type of PAL and effect of PAL is detailed in Table 3. Some caveats to the use of PAL were identified.

Benefits for learners

The benefits of PAL for learners were numerous, and are listed below.

Ability to reflect

Students described a greater capacity to reflect on their practice and deal with emotions through taking part in a discussion group focusing on students' experiences of a clinical placement. In two studies, a facilitator was used to encourage open sharing and discussion, which helped students to vent or deal with emotions (38,39).

Confidence (or self efficacy)

Engaging more deeply in topic material led to students reporting being more confident about their own abilities, or their familiarity with the topic area, usually as a result of having taught it to someone else (25,29,40). Additionally, participating in a role-play with peers increased students' confidence with the skill they performed (26,28,33).Taking part in an activity to evaluate peers helped students to gain confidence in their ability to accurately assess peers on a skill (32,41,42).

Motivation to participate

One study reported that students were more motivated to participate in clinical placements as a direct result of the PAL intervention. Highly successful students became role models for their peers. Through this interaction, the larger group of students reported being more motivated to be involved on clinical placements when they had someone encouraging them to do so (43).

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Problem solving

Discussion groups enabled students to share dilemmas encountered during clinical placements, including diagnostic decisions and issues of ethics. Students were able to collaboratively problem solve, with minimal clinician input (24,38). In a study of laparoscopic suturing training methods, there was little difference in the suturing performance of the two groups immediately following the teaching intervention. However, when re-assessed after four months, the peer taught group had superior suturing skills compared to the expert taught group. Van Bruwaene et al. (27) therefore suggested that the group which received peer feedback gained greater problem solving skills, as they were less dependent on expert feedback.

Evaluative judgement

Evaluative judgement is related to the ability to self-evaluate, but also extends to the evaluations of others, and understanding the underlying standards of performance (44). Students in several studies reported that, through engaging in an assessment and/or feedback activity, they were able to make judgements on the quality of others' work, through gaining a better understanding of quality (45,46). Explicit criteria helped the students to develop this ability (31,47).

Feedback

By engaging in peer assessment, students were provided with more feedback than they would have received otherwise, and from a different perspective (41,47–58). Several studies highlighted the immediacy of the peer feedback as an advantage compared to commonly delayed feedback from a clinical supervisor (27,51,56).

Navigation of placements

Students reported that PAL was useful to help them navigate placements and maximise learning opportunities, in both formal teaching sessions, and informal peer-led sessions (43,59,60). Here, the benefit of articulating learning strategies also aided the students who were reflecting on their experiences, as well as their peers who could adopt similar strategies in their own placements.

Responsibility to peers

By participating in peer assessment, students reported a sense of responsibility to their peers' development and progress (45,61). This was described as a reflexive process, where students became familiar with the concept of being reviewed by a peer (62).

Supportive environment

The co-creation of a supportive environment was of benefit to students. This was reported to occur across a range of PAL activities, including the discussion of common clinical dilemmas (24,38,39), in peer teaching sessions, where students presented work and discussion was facilitated by a tutor (40), and also in assessment activities (48). Reasons cited for feeling safe and supported including being free from embarrassment (48), that students were friendly (40), and caring for each other (39).

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Communication skills

Role-playing as a patient was reported to improve students' advice giving and formulation of behaviour strategies for smoking cessation, as opposed to the standard lecture format used for this topic (35). Students reported perceiving peer role-play and feedback as useful for developing their communication skills, though it was hypothesised that peers would tend to focus more on clinical aspects than simulated patients in the comparison group (37). Students also reported that a Group Objective Structured Clinical Experience, where feedback was obtained from the simulated patient, facilitator and students, increased their confidence in communicating with patients (41).

Procedural skills

Some studies measuring the impact of PAL on procedural skills found that peer teaching was at least the equivalent of expert tutelage (25,29). However, both Kühl et al (34) and Knobe et al (30) reported that the gains for students taught by peers rather than experts were significantly lower, though both groups had improved from their baseline, pre-intervention scores. Students who were designated teachers benefited more from a PAL intervention, outperforming their fellow students whom they had taught (25,29,30,34). Two studies involving peer role-play included the practice of a procedural skill, such ophthalmoscopy (26) or injection skills (28): in these studies, students who were required to practise the skill with a peer performed better than those who did not.

Education skills

Improved educational skills, such as feedback and the ability to teach, were reported as effects of PAL (60). Many studies did not include training in education-related skills prior to the study, even when peer teaching was the main activity (40,59,63). Some studies included student training on the subject they were to teach (25,29,30,34). The effect of previous peer-learning relationships on feedback was examined by Chou et al (50), who found that those who had been exposed to peer-learning were able to provide more specific corrective feedback.

Empathy

Students reported that they developed a deeper understanding of the patient experience. This was achieved through role-playing patients with their peers (28,19,33). Students additionally developed empathy for each other through the sharing of experiences in peer discussion groups (38,39,64).

Rapport building

Discussion groups were reported to develop rapport between students (38,39), as students were able to interact in a non-threatening environment where they were not required to compete with one another.

Benefits for clinician educators

Clinician educators were also a group who reported benefits from a PAL process. Clinicians were able to build upon some less frequently used educational skills, such as facilitating performance discussions and giving feedback (40,49).

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In the case of peer assessment, additional information about student performance was gained, as a way to complement the educator's appraisal of student performance. This was particularly useful when students were rating each other on professional qualities, which clinicians were not always able to directly observe due to time constraints. It was also hypothesised that students may exhibit different behaviours when not in the presence of seniors (52,54,65,66).

The data on the correlation between peer appraisals and other measures of performance were equivocal. When peer and educator ratings were compared, there were a range of weak but significant scores from r= 0.28 to r = 0.33 (31,54,66). Two studies did not identify a significant correlation (53,62), though Burnett and Cavaye (61) found a strong correlation of r = 0.99. McLeod et al (51) simply noted that peer ratings were consistently higher than tutor ratings of performance. Correlations between peer ratings and other tests of knowledge or performance were significant but weak, with board examination correlations of r = .37 (66) and r = 0.28 (54). Schwartz et al (62) found a stronger correlation of r = 0.51 with knowledge gain in a board examination, using the difference calculated from pre- and post-clerkship scores. Linn et al (55) found that peer ratings of knowledge had an r = 0.50 correlation with students' final grades, while Burnett and Cavaye (61) calculated a r = 0.99 correlation. While peer assessment may provide additional information on performance, any attempt to replace educator assessments with peer ratings should proceed with caution.

Efficiency in teaching and time saving is a frequently speculated advantage of PAL (48,67,68) however there was no evidence across the included studies that workload was reduced for faculty. In many situations, experts' time was still required to facilitate discussion or train the peer teachers. What was reported however was that the nature of clinician educator involvement changed to a more satisfying educational interaction (39). An example of this was that tutor enjoyment and involvement in peer-led presentations increased after shifting the responsibility for the preparation of materials to the students, and the clinician's role was to oversee and participate in the discussion (40).

Benefits to patients

No included studies were designed to detect improved patient outcomes. One study (28) did include patients however, in examining the impact of PAL on students' abilities. After a standard education session on administering injections to children (involving both didactic information and the chance to practise with a manikin), the intervention group were supervised in practising their injection skills on a peer. Both control and intervention groups were then assessed on their ability to administer an injection to a paediatric patient. The intervention group were more likely to satisfactorily prepare the child and administer the injection itself, and this difference was statistically significant. However, a patient-based (or patient's parent) score was not included, and the trial was not blinded. This amounts to a small amount of evidence for the direct effect of PAL based activities on patient satisfaction and patient outcomes.

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Caveats in forming strong conclusions based on this evidence

Alongside the largely positive effects of PAL, there were some common pitfalls identified amongst the included studies. These were presented as conditions necessary for PAL to result in productive outcomes for the various stakeholders in clinical education.

Firstly, clear standards or guidelines for the PAL activity were needed, and students highlighted this transparency led to meaningful interactions (47,51,63). This included specific tools for peer assessment and feedback. Lawton & McDougall (58) found that 8 of 11 students performed better on an examination if they had received feedback from a peer using a checklist (rather than freeform feedback).

Despite the positive reports of peer based feedback on performance, there were still concerns from both students and educators that peer feedback was inaccurate (47,48). Peer feedback and assessment were commonly not well aligned with performance judgement by others, as reported earlier (under benefits for clinician educators). Some studies proposed that the lack of alignment between peer assessment and expert assessment could be due to assessment of different dimensions of student performance on the same rubric (53), or not understanding the standards by which they were marking their peers (47,57).

Self-efficacy was suggested to be a crucial element in learning (32), which may contribute to improved health outcomes (41). While studies examining self-efficacy found it to be higher as a result of PAL activity (33), this was not necessarily correlated to improved cognitive performance (32).

Generally, students felt comfortable being assessed by their peers, but not all did. Kovach (54) reported that 71% of students felt comfortable grading their peers in a summative assessment. Some students refused to take part in peer assessments (55), whilst others were hesitant to give negative feedback about other students (66). Students reported feeling self-conscious about revealing their own deficits to their peers (46), leading to a less honest appraisal of observed performance.

Expert involvement was still greatly valued. Where there was a comparison between peer and senior tutors, the senior tutors were the preferred teachers (25) or givers of feedback (42,46). Students perceived their peer teachers as less competent compared to experts (29,30). Expertise was hypothesised to still be necessary for teaching complex skills such as echocardiography (34).

Discussion

This review examined the reported effects of same-level peer assisted learning on clinical placements for pre-registration medical trainees. While there have been several reviews of PAL in recent years (5,6,9), this study captured data from the increasing number of studies recently undertaken and published. Many studies were of high quality, though were largely based on students' self-report of satisfaction and knowledge gain. The analysis revealed

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information about the broader effects of PAL on students and educators, and identified common pitfalls and suggestions for the implementation of PAL.

It was clear that there were benefits of PAL for learners other than gaining content knowledge and technical skills. The effects identified in this review largely aligned with the previously hypothesised benefits of PAL as listed in Table 4 (1,4). A model of benefits is presented in Figure 2: learners themselves, their peers, their educators and their future patients are all potential beneficiaries of PAL. Though all elements are grounded in the empirical data, the amount of supporting evidence varies. There was little evidence for the impact of PAL on patient outcomes, which would add greater weight to the argument for the use of PAL. Some proposed benefits (metacognitive awareness, higher self-disclosure and professional identity formation) were not mentioned within the included studies. Burgess et al (5) also identified the development of some of these "professional" qualities, however their review was restricted to peer tutors only.

Few clinician educator outcomes relating to PAL were identified in this study. This may be due to a lack of the measurement of outcomes or that there are, indeed, few effects of PAL on clinician educators. The reported correlation of peer and clinician educator or external assessments ranged from weak to very strong; this may be due to differing study design, constructs measured, and the stakes of the assessment. Speyer et al 's (9) systematic review focussed on the reliability and validity of peer assessment, however were also unable to draw conclusions about the reliability, given the heterogeneous nature of studies. The commonly proposed benefit of improving efficiencies for clinician educators was not supported by this review, in line with a recent trial of PAL with physiotherapy students, which measured the associated workload for clinician educators (69). However, Sevenhuysen et al (69), as with many of the studies in this review, introduced the PAL intervention for the first time. This may mean that, over time, increasing familiarity with the PAL method may result in eventual time savings. Longitudinal studies of an implemented PAL program may be required to confirm this, and further investigation of clinician educator outcomes may be warranted to explore the effects of PAL for this group.

Several studies in the review introduced a tool, form or other explicit framework for students to engage in a PAL interaction (such as criteria for giving each other feedback). This may have contributed to the utility of the PAL interaction. Stegmann et al (70) have demonstrated in an RCT in a simulated setting, that the provision of a framework for how to interact with peers was associated with more favourable outcomes than just allowing peer interaction on their own. This suggests that expert input into PAL activities, through provision of guidance and supervision, or forms and checklists, will make any planned peer interaction more useful.

Limitations

The papers included in this study represented the 'organised models' of PAL that have been implemented in clinical education. It is likely that much of the PAL undertaken in clinical environments occurs outside formal settings, as has been described previously (71,72), and therefore we cannot measure the effects of initiatives or interactions we are

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unaware of. We did attempt, however, to collect and analyse a broader range of activities and their effects, so more studies were included rather than excluded, and older papers were not excluded.

The majority of papers included contained a large component of self-report, which is known to be more subject to bias. Though self-report may be a valid form of measurement for dimensions such as self-efficacy, the benefits as reported by learners in these studies would ideally have been further explored by external assessment, and potentially in experimental (i.e. randomised controlled trial) conditions. Patient and long-term outcomes were not extensively examined within the included studies. Favourable outcomes in these areas may also assist with the argument for the implementation of PAL.

The systematic review methodology also has its limitations: by using a defined set of search terms, papers which discuss the same topic of peer learning in different terms will not have been detected in the search. The process of screening and excluding papers, whether carried out by one or more reviewers (even when using a decision guide) may result in the omission of relevant papers. This was mitigated through the hand searching of reference lists of included papers for additional references. Eva (11) additionally argues that, in a quasi-experimental field such as medical education, the biases may in fact be constant (e.g. results are in favour of the novel educational method) and as such, a pooled analysis is also likely to be in favour of the intervention. We specifically searched for and identified pitfalls within the included studies to ensure a balanced review.

Conclusion

This review identified the effects of same-level PAL aside from improving students' content knowledge and procedural skills. The included studies suggested that PAL assists learners to develop evaluative judgement, teaching skills and collaborative skills. Some benefits for clinician educators and patients were also uncovered, which warrants further investigation. The additional value that same-level PAL could contribute to learning in the clinical environment, developing qualities required for a doctor in the workplace, suggests that PAL could be integrated across all clinical placements. Both clinician educator and student training would be required to ensure the educational potential of PAL is harnessed, and this may extend to exposing students to a curriculum on educational principles and skills in both their pre-clinical and clinical years. Including learning outcomes relating to the ability to interact appropriately with peers and assessment of students' involvement in PAL activities is also likely to encourage uptake of PAL. The more widespread use of PAL would enable higher-level outcomes (i.e. the impact of PAL on collaboration, teaching skills, practice development and patient care) to be more readily measured in the future, thus providing an even stronger evidence base for the use of PAL.

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Table 1 Benefits of PAL as reported in the literature (1,4–8)

Hypothesised	Supported by evidence
• Ability to reflect • Application of skills and knowledge (communication and procedural) • Collegial relationships with peers (i.e. supportive, rapport building) • Compatibility with adult learning theory (active participation) • Deeper learning resulting in improved retention • Higher self-disclosure • Immediate feedback • Lowered anxiety • Metacognitive awareness • Professional identity formation • Reduced clinician/educator input; increased teaching efficiency • Student ownership of activity • Scaffolded exploration	• Cognitive development (i.e. academic performance) • Psychomotor (clinical skills) development • Empathy towards clients • Satisfaction with peer teaching • Increased learning opportunities • Leadership skills • Appreciation of lifelong learning • Teaching skills (facilitation, feedback) • Confidence

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Table 2 Quality appraisal of included studies using criteria from Buckley et al. 2009 (12)

Study	Year	Research question	Study subjects	'Data' collection methods	Completeness of 'data'	Confounding variables	Analysis of results	Conclusions	Reproducibility	Prospective	Ethical issues addressed	Triangulation	Total Score /11
Al-Kadri et al (48)	2013	1	1	1	1	0	1	1	0	0	1	1	8
Aper et al (32)	2012	1	1	1	1	1	1	1	0	1	1	0	9
Asch et al (52)	1998	0	1	1	0	0	0	0	1	1	0	1	5
Bennett et al (47)	2012	1	1	1	0	0	0	1	1	1	0	1	7
Bosse et al (37)	2010	1	1	1	1	1	1	1	1	1	1	0	10
Bosse et al (33)	2012	1	1	1	1	1	1	1	1	1	1	0	10
Brazeau et al (49)	2002	0	1	0	0	0	0	0	1	0	0	0	2
Burgess et al (45)	2013	1	1	1	1	1	1	1	1	1	1	0	10
Burnett and Cavaye (61)	1980	0	1	1	1	0	1	1	0	0	0	0	5
Cave et al (31)	2007	1	1	1	1	1	1	1	0	1	0	1	9
Chou et al (38)	2011	1	1	1	1	1	1	1	1	1	0	1	10
Chou et al (50)	2013	1	1	0	1	1	1	1	1	1	1	1	10
Chunharas et al (28)	2013	0	1	1	1	1	1	1	1	1	0	0	8
Fornari et al (19)	2011	1	1	0	0	1	1	1	1	1	1	1	9
Fryer-Edwards et al (39)	2006	0	1	1	1	0	1	1	1	0	1	1	8
Hahn et al (24)	1991	1	1	1	1	0	1	1	1	1	0	0	8
Halder (40)	2012	0	1	1	1	0	1	1	1	1	0	0	7
Harker and Jones (53)	1977	1	1	1	1	0	1	1	1	0	0	0	7
Kernan et al (63)	2005	1	1	1	1	0	1	1	1	0	0	1	8
Knobe et al (29)	2010	1	1	1	1	1	1	1	0	1	0	1	9
Knobe et al (30)	2012	1	1	1	1	1	1	1	0	1	1	0	9
Konopasek et al (41)	2014	1	1	1	1	0	0	1	1	1	0	0	7
Kovach et al (54)	2009	1	1	1	0	1	1	1	1	0	1	1	9
Kühl et al (34)	2012	1	1	1	1	1	1	1	1	1	1	0	10
Lawton and MacDougall (58)	2004	0	1	0	1	0	0	1	0	1	0	1	5
Levine et al (66)	2007	1	1	1	1	0	1	1	1	1	0	1	9

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Study	Year	Research question	Study subjects	'Data' collection methods	Completeness of 'data'	Confounding variables	Analysis of results	Conclusions	Reproducibility	Prospective	Ethical issues addressed	Triangulation	Total Score /11
Lie et al (64)	2010	1	1	0	1	0	0	0	1	0	0	0	4
Linn et al (55)	1975	0	1	1	1	1	1	1	1	1	0	1	9
Masters et al (59)	2013	1	1	1	1	1	1	1	1	1	1	0	10
Mauksch et al (42)	2013	0	1	1	1	1	1	1	1	1	1	0	9
Magzoub et al (65)	1998	1	1	1	1	1	1	1	1	1	0	0	9
McLeod et al (51)	2012	1	1	1	1	0	0	1	0	1	1	0	7
Merglen et al (60)	2008	0	1	1	1	0	1	1	0	1	0	1	7
Milani et al (26)	2013	0	1	1	1	0	1	1	1	1	1	0	8
Mounsey et al (36)	2006	1	1	0	1	1	1	1	1	1	1	0	9
Parish et al (46)	2006	1	1	1	1	1	1	1	0	1	1	0	9
Paul et al (57)	1998	1	1	1	1	1	1	0	1	1	0	0	6
Perry et al (25)	2010	1	1	1	1	1	1	1	1	1	1	1	11
Roche et al (35)	1996	1	1	1	1	0	1	1	1	1	0	0	8
Schwartz et al (62)	1994	1	1	1	0	0	1	0	1	1	0	0	5
Sharma et al (56)	2012	1	1	1	1	1	1	1	1	1	1	1	11
Van Bruwaene et al (27)	2009	1	1	1	1	1	1	1	1	1	1	1	11
Zaidi et al (43)	2012	1	1	1	1	0	1	1	0	1	0	1	8

A score of "1" indicates that the criterion has been met within the paper. A score of "0" indicates that the criterion was not met, or not mentioned within the paper.

Table 3 Number of studies in each PAL type; contribution to learner, clinician educator and patient benefits

	Recipient of benefit		
	Learner	Clinician Educator	Patient

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Type of PAL	total N	Studies reporting results classified higher than Kirkpatrick Level 1 N	Topic content & metacontent	feedback	teaching skills	Empathy	Problem solving	Reflection	Interpersonal interactions	confidence, motivation	teaching skills	additional information on performance	enjoyment	Communication and procedural skill
Facilitated discussion between peers	4	2	2	0	0	0	2	2	3	0	0	0	1	0
Role-playing a patient for a peer	6	5	4	0	0	2	0	0	0	3	0	0	0	1
Peer teaching														
Content knowledge	3	2	3	0	0	1	0	0	1	1	1	0	0	0
Psychomotor skills	4	4	4	0	0	0	0	0	0	2	0	0	0	0
Attitudes and approaches to learning	3	1	3	0	1	0	0	0	0	1	0	0	0	0
Peer evaluation														
Discrete episodes	14	6	4	9	2	0	0	0	2	2	0	0	1	0
Over a period of time	9	3	0	5	0	0	0	0	2	0	0	3	0	0

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Table 4 Benefits of PAL: supported by this review as compared to benefits hypothesised in the literature (1,4,69)

Benefits of PAL supported by this review	• Ability to reflect • Collegial relationships with peers (i.e. supportive, rapport building) • Lowered anxiety • Student ownership of activity • Compatibility with adult learning theory (active participation) • Scaffolded exploration • Immediate feedback • Application of skills and knowledge (communication and procedural) • Deep learning, improved retention
Benefits of PAL not previously hypothesised, identified through this review	• Problem solving • Empathy for fellow students and patients • Evaluative judgement • Navigation of placements • Greater clinician satisfaction with education interactions • Patient benefits – improved care from medical students*
Benefits of PAL not identified within this review	• Metacognitive awareness • Higher self-disclosure • Professional identity formation • Reduced clinician educator input; increased teaching efficiency

* = weak supporting evidence

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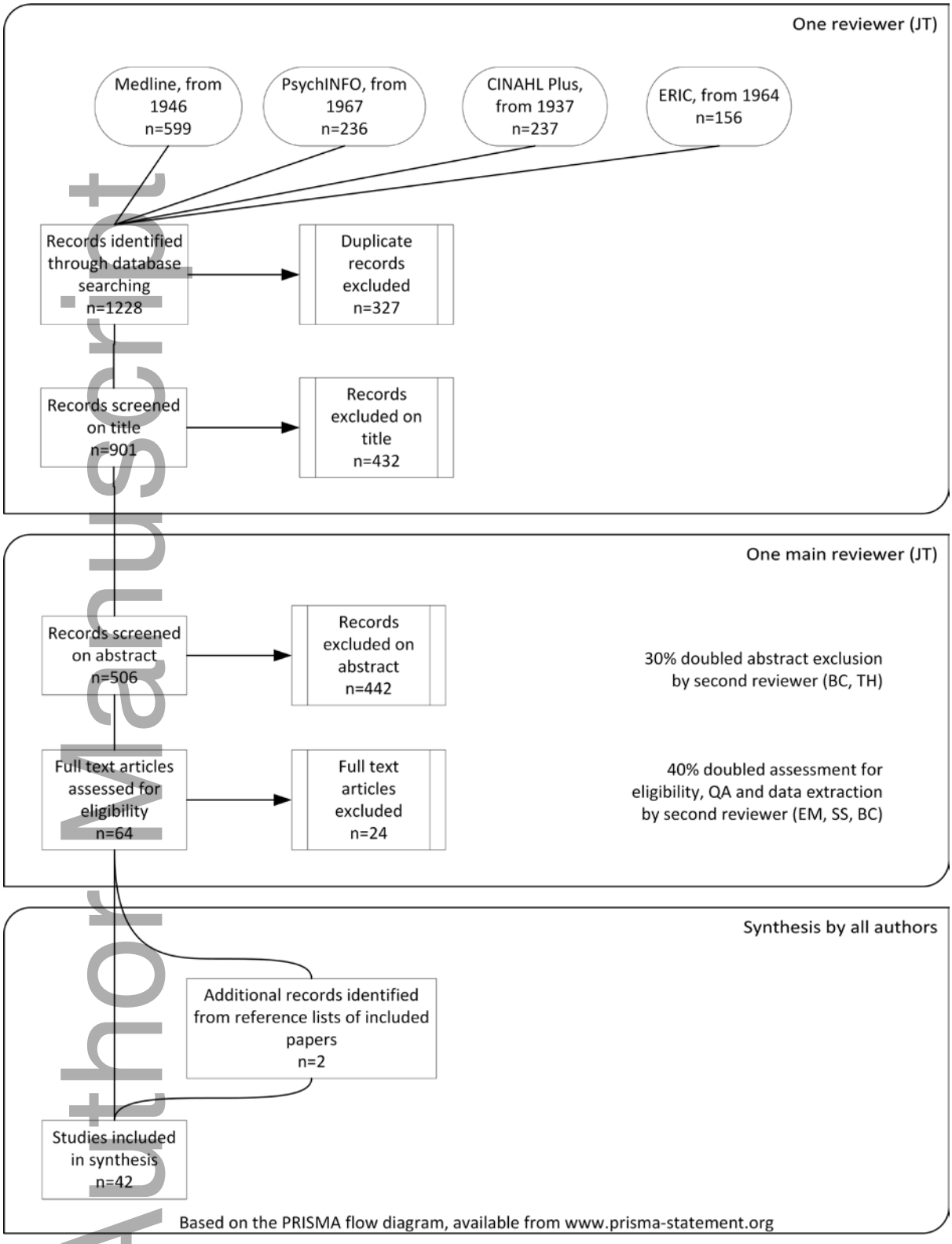

Figure 1 PRISMA Flowchart of citation handling for original search, March 2014

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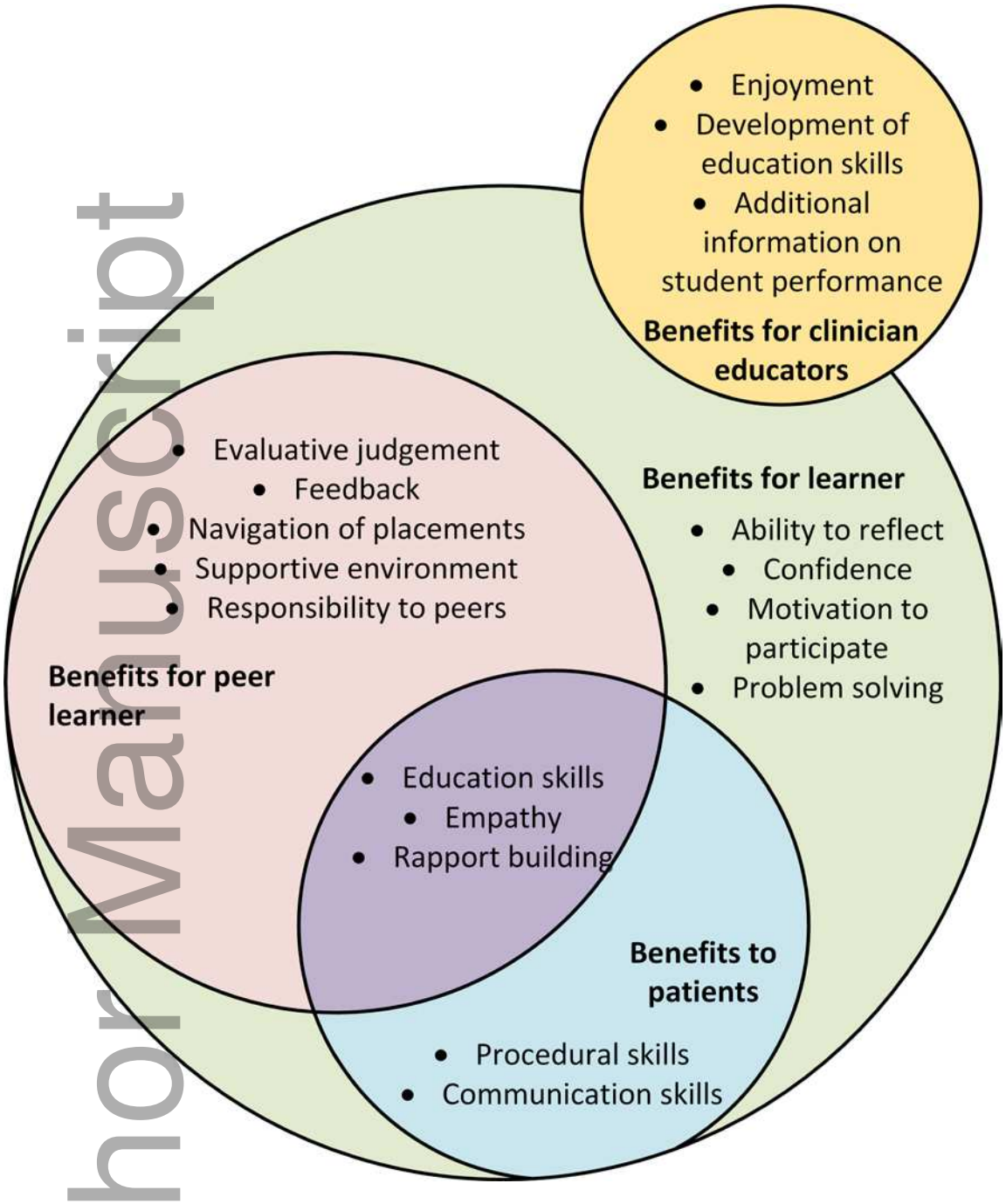

Figure 2 Demonstrated benefits of PAL to stakeholders

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