ABSTRACT

CONTEXT: Student-run clinics (SRCs) have existed for many years and may provide the most realistic setting for context-based learning and legitimate early clinical experiences with responsibility for patient care. We reviewed the literature on student outcomes of participation in SRCs.

METHODS: A systematic literature review was performed using the PubMed, EMBASE, PsycINFO and ERIC databases. Included articles were reviewed for conclusions and outcomes; study quality was assessed using the Medical Education Research Study Quality Instrument (MERSQI).

RESULTS: A total of 42 articles met the inclusion criteria and were included in the quantitative synthesis. The effects of participation on students’ attitudes were mainly positive: students valued the SRC experience. Data on the effects of SRC participation on students’ skills and knowledge were based mainly on expert opinions and student surveys. Students reported improved skills and indicated that they had acquired knowledge they were unlikely to have gained elsewhere in the curriculum. The quality of specific aspects of care delivered by students was comparable with that of regular care.

CONCLUSIONS: The suggestion that students should be trained as medical professionals with responsibility for patient care early in the curriculum is attractive. In an SRC this responsibility is central. Students valued the early training opportunity in SRCs and liked participating. However, little is known about the effect of SRC participation on students’ skills and knowledge. The quality of care provided by students seemed adequate. Further research is needed to assess the effect of SRC participation on students’ skills, knowledge and behaviour.
INTRODUCTION

Context learning is defined as learning in a setting (context) similar to that of the future profession. It increases the intrinsic motivation and willingness of students to invest in themselves and relies on four basic principles: setting; repetition; feedback, and responsibility for learning. Learning is an active process in which each student develops a particular knowledge network built on that student’s experience. This experience can be based on, for instance, fictional cases, patient demonstrations during lectures, or being seated next to a specialist conducting a consultation. In the early clinical experience concept, experiences should be real and legitimate in order to achieve optimal learning effects and engagement. Furthermore, engendering a sense of responsibility for patient care in the student would promote the perception of the event as a legitimate clinical experience as it not only contributes to patient care, but is part of a health professional’s daily work. The concepts of context learning, early legitimate clinical experience and a sense of responsibility can be conceptualised as learning by doing, an overarching concept. The optimal and most realistic form of learning by doing is learning in a student-run clinic (SRC). An SRC is an out-patient clinic run and organised by undergraduate medical students from Year 1 onwards. In an SRC, medical students prepare and perform diagnostic and therapeutic consultations with real patients under the direct supervision of clinical specialists. Student-run clinics have existed for many years and studies have shown them to be useful to participating students. A study from 2012 reported that over 62% of US medical schools have at least one SRC. Most SRCs were founded as clinics for the delivery of free care to homeless or poor people and others who otherwise could not afford or attain regular, insured health care. Although these clinics are focused solely on the provision of care to the needy, they may provide a setting for context-based learning and early legitimate clinical experiences. We aimed to review the literature on the outcomes of student participation in SRCs using the four levels of learning outcomes as described in Kirkpatrick’s hierarchy, namely: attitudes and motivation; skills and knowledge; behaviour, and patient and health care.

METHODS

General methodology

A systematic review of the effects of participation in an SRC on student outcomes was performed using the four levels of learning outcomes described in Kirkpatrick’s hierarchy [attitudes and motivation, skills and knowledge, behaviour, and patient and health care]. The PRISMA (preferred reporting items for systematic reviews and meta-analyses) guidelines for systematic reviews were followed where possible, given the diversity of the results and outcome measures reported in the included studies. Because of this diversity of outcome measures, no meta-analysis or additional analyses of risk for bias were performed. The review protocol is available upon request.

Data sources and search strategy

The PubMed, EMBASE, PsycINFO and ERIC (Education Resources Information Center) databases were searched for articles on SRCs. The PubMed database was used as the standard medical research database, and the EMBASE, PsycINFO and ERIC databases were used as supplements to detect articles published in more education-oriented journals. All references of selected articles were screened and reviewed as stated in ‘Study selection’. All databases were searched with different queries (Appendix S1). Articles were based on ‘student run’ and ‘clinic’ or commonly used abbreviations of similar terms (e.g. SRFMC, student-run free medical clinic). Articles that were not available in digital form were retrieved via the local university library or from the original author(s), institution or publisher.

Study selection

Our aim was to review student outcomes and participation in SRCs. First, all articles were screened for eligibility based on their titles. Articles about (ambulatory) clerkships and general service learning projects were excluded. Although SRCs could be described as related to or examples of service learning, studies on the latter were excluded because their focus is much wider (i.e. it includes experience-based learning with specific learning goals rather than learning following experience with responsibility for patients). The focus of this review is on SRCs. Two authors (TS and JT) selected articles independently of one another on the basis of the article title. If the title mentioned ‘student-run clinic’ or a synonymous phrase, it was considered to be eligible. If there was doubt about the content of the study, the abstract (if available) or full-text article was screened. All publications were screened separately; discrepancies regarding inclusion were resolved by a third review author (RSD). The references of all eligible articles were screened for eligibility based on their titles. Articles about (ambulatory) clerkships and general service learning projects were excluded. Although SRCs could be described as related to or examples of service learning, studies on the latter were excluded because their focus is much wider (i.e. it includes experience-based learning with specific learning goals rather than learning following experience with responsibility for patients). The focus of this review is on SRCs. Two authors (TS and JT) selected articles independently of one another on the basis of the article title. If the title mentioned ‘student-run clinic’ or a synonymous phrase, it was considered to be eligible. If there was doubt about the content of the study, the abstract (if available) or full-text article was screened. All publications were screened separately; discrepancies regarding inclusion were resolved by a third review author (RSD). The references of all eligible articles were screened for eligibility (snowball search) based on the title, similarly to the primary inclusion criteria. All eligible articles were then assessed for study characteristics (year of publication, type of publication, characteristics of the clinic described if applicable). Original research studies reporting quantitative student outcomes were included; nonoriginal research studies (reviews, editorials, letters to the editor) were excluded. Experimental, quasi-experimental and observational studies (e.g. case–control, cohort and cross-sectional studies) were considered as original research. Qualitative studies were excluded because of their incompatibility with the quality evaluation instrument used, but we briefly summarised their findings. Articles on quality of care were included because improved patient outcomes and care remain the ultimate goal of medical education. Eventual discrepancies regarding final inclusion were resolved by the third author.

Data extraction

Data were extracted using a coding sheet, based on the Best Evidence Medical Education (BEME) Collaboration coding sheet. The BEME coding items used were: the administrative; stated aim of study, and documented improvement in learning/performace. In order to evaluate study quality, the Medical Education Research Study Quality Instrument (MERSQI) was added to
53 described a specific clinic (but described only the organisation or the patient population, and did not detail the intervention or original research design), seven were qualitative studies and 13 were other types of article (editorials, letters to the editor and reviews).

Qualitative analysis
The 42 articles were analysed for information on student outcomes, namely: attitudes and motivation; skills and knowledge; behaviour, and patient and health care outcomes. The aims, student outcomes and conclusions of these articles are summarised in Table 1. The entire table including the MERSQI (sub)scores per article is available online as Table S1. The data presented in the table are sorted hierarchically according to student outcomes, based on Kirkpatrick’s hierarchy [11].

RESULTS

Search results
The PubMed, EMBASE, PsycINFO and ERIC databases were searched on 21 March 2014. Figure 1 shows a flowchart of the search, selection and review process. Of 240 unique hits, 84 were categorised as eligible. The 1356 references of the 84 eligible articles were snowball-searched, which yielded 55 new hits. After the exclusion of duplicate publications, 30 unique new (eligible) articles remained. The references (n = 316) of these 30 eligible articles were also searched and screened for eligibility, which identified one new article. Further snowball searching yielded no new eligible articles. A total of 115 eligible articles about SRCs were identified through regular (84 articles) and snowball (31 articles) searches. All were reviewed for general characteristics. Publication years ranged from 1963 to 2014. A total of 105 articles provided information about a specific SRC: 90 SRCs were located in the USA, four in Canada, three in South Africa, three in Singapore, two in Australia, two in Brazil and one in Mexico. Of the 105 articles, 91 (86.7%) described the SRC population as being uninsured, homeless, poor or underserved; the SRC population was not clearly described in the remaining 14 (13.3%) articles. Of the 115 potentially eligible articles, 42 met the inclusion criteria and were selected for qualitative analysis (34 were sourced from the initial search and eight from the snowball search). Of the 73 articles excluded,
<table>
<thead>
<tr>
<th>Author; Year</th>
<th>Aim/Goal ;</th>
<th>Study design</th>
<th>MERSQI Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Kirkpatricks’ hierarchy level Attitudes/opinions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Christensen et al. 2013 [31]</td>
<td>Explore student and faculty interest in a student-run health clinic (SRC); There is sufficient student interest to start a SRC</td>
<td>Single group cross-sectional/ posttest only</td>
<td>9/18</td>
</tr>
<tr>
<td>Smith et al. 2012 [17]</td>
<td>Assess medical student perceptions of the educational value of an SRC; The majority felt participation a valuable educational experience</td>
<td>Single group cross-sectional/ posttest only</td>
<td>10.5/18</td>
</tr>
<tr>
<td>Doyle et al. 2012 [18]</td>
<td>Assess medical student satisfaction with the Magis Psychiatry Clinic as a training site; Medical–student participants were largely satisfied with their training experience</td>
<td>Single group cross-sectional/ posttest only</td>
<td>7/18</td>
</tr>
<tr>
<td>Gu et al. 2012 [19]</td>
<td>Evaluate influence of a SRC on recruitment and matriculation of medical student class; Students valued the SRC, some groups more than others. Further research needed to explore potential for recruitment of class</td>
<td>Single group cross-sectional/ posttest only</td>
<td>9/18</td>
</tr>
<tr>
<td>Hamso et al. 2012 [20]</td>
<td>Assess students’ experiences in clinical teaching; The practical experiences in clinical teaching students had at SRCs could supplement classroom-based trainings</td>
<td>Single group cross-sectional/ posttest only</td>
<td>7.5/18</td>
</tr>
<tr>
<td>Sheu et al. 2012 [22]</td>
<td>Systematically analyze the impact of SRCs on students; Participating students perceived positive benefits, but did not score differently on validated attitude and interprofessional learning questionnaires</td>
<td>Non-randomized 2 group</td>
<td>11.5/18</td>
</tr>
<tr>
<td>Sheu et al. 2011 [21]</td>
<td>Evaluate students’ perceptions of the educational value of this interprofessional HBV elective; Students who participated in clinic reported enhanced skills compared to those who did not attend</td>
<td>Non-randomized 2 group</td>
<td>10.5/18</td>
</tr>
<tr>
<td>Shrader et al. 2010 [23]</td>
<td>Describe interprofessional elective at SRC and evaluated student outcomes; An interprofessional service-learning elective using didactic and experiential learning in an interprofessional SRC sustained or improved student attitudes toward interprofessional teamwork</td>
<td>Single group pre and posttest</td>
<td>10/18</td>
</tr>
<tr>
<td>Wee et al. 2010 [24]</td>
<td>Assess the pedagogical value of a student-led community-based experiential learning project called the Public Health Screening (PHS); PHS was a positive learning experience in a wide range of domains for all students involved. This suggests that student-organized community-based experiential learning projects have potential educational value</td>
<td>Single group cross-sectional/ posttest only</td>
<td>11/18</td>
</tr>
<tr>
<td>Simmons et al. 2009 [25]</td>
<td>Survey students about preparedness for work at SRCs, and for addressing patients’ access to care, and social issues; Most students did not know how to get uninsured patients ongoing care, a large majority of students desired an orientation addressing these issues</td>
<td>Single group cross-sectional/ posttest only</td>
<td>8/18</td>
</tr>
<tr>
<td>Abrão et al. 2008 [26]</td>
<td>Describe the clinic; Update 10 year experience; Students reported perceived improvement in scientific writing and reading, clinical skills and knowledge in general internal medicine;</td>
<td>Single group cross-sectional/ posttest only</td>
<td>6/18</td>
</tr>
<tr>
<td>Simpson et al. 2007 [27]</td>
<td>Describe the prevalence and operation of SRCs nationwide (USA); Medical student-run health clinics offered myriad services to disadvantaged patients and were also a notable phenomenon in medical education</td>
<td>Single group cross-sectional/ posttest only</td>
<td>9/18</td>
</tr>
<tr>
<td><strong>Borges et al. 2007 [28]</strong></td>
<td>Describe design, development, implementation and evaluation of service learning project (SRC); Students reported increases in attitudes, knowledge and skills related to community health resources and service</td>
<td>Single group pre and posttest</td>
<td>9.5/18</td>
</tr>
<tr>
<td>Gilkey MB et al. 2006 [29]</td>
<td>Identify essential elements of effective interdisciplinary training through evaluation of SRC; Effective interdisciplinary training went hand in hand with five elements identified from the community capacity literature: participation, training in group skills, information sharing, networking, and critical reflection</td>
<td>Single group cross-sectional/posttest only</td>
<td>7.5/16</td>
</tr>
<tr>
<td>Clark et al. 2003 [30]</td>
<td>Student response assessed in terms of educational value using a survey in participants; Student participants, especially basic science medical students, valued the program</td>
<td>Single group cross-sectional/posttest only</td>
<td>7/18</td>
</tr>
<tr>
<td><strong>Kirkpatricks’ hierarchy level Knowledge/skills</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stoddart et al. 2011 [32]</td>
<td>Determine whether participation in SRC resulted in compromised medical school grades; The grades for SHARING Boardmembers and non-members were not statistically different</td>
<td>Non-randomized 2 group</td>
<td>11/16.5</td>
</tr>
<tr>
<td><strong>Kirkpatricks’ hierarchy level Behaviour</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schweitzer et al. 2012 [33]</td>
<td>Investigate educational impact of novel behavioral health program focused on depressive disorders; Students were better able to diagnose and treat major depressive disorder after implementation of the program</td>
<td>Single group pre and posttest</td>
<td>11/16.5</td>
</tr>
<tr>
<td><strong>Kirkpatricks’ hierarchy level Patient/healthcare</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gorondo et al. 2014 [57]</td>
<td>Examine clinical impact of a SRC health educator program for diabetic patients; This health educator program at an SRC provides high-quality diabetes care and facilitates clinical improvement.</td>
<td>Single group pre and posttest</td>
<td>14/16.5</td>
</tr>
<tr>
<td>Ouyang et al. 2013 [56]</td>
<td>Assess efficacy of improving patient health knowledge of hepatitis B (HBV) after receiving student-led education in SRC; Students in a SRC can effectively impart health knowledge, retained by patients for ≥ 1 month</td>
<td>Single group pre and posttest</td>
<td>15.5/18</td>
</tr>
<tr>
<td>Butala et al. 2013 [55]</td>
<td>Examine change in provision of preventive services in a SRC after start of a student-led quality improvement intervention; providing prevention in the SRC increased following the quality improvement intervention.</td>
<td>Single group pre and posttest</td>
<td>14/16.5</td>
</tr>
<tr>
<td>Bowen et al. 2013 [54a]</td>
<td>Evaluate new policy of indefinite care to transferring patients to other care site after 2 visits; The 2-visit limit did not increase the number of diabetic patients linked to long-term primary care</td>
<td>Non-randomized 2 group</td>
<td>12.5/16.5</td>
</tr>
<tr>
<td>Zucker et al. 2013 [34]</td>
<td>Assess preventive medicine service quality on seven preventive medicine services in a SRC; The SRC met or exceeded national preventive service goals on smoking cessation, alcohol abuse screening and mammography; however, it did not meet colonoscopy, pap smear and influenza vaccination goals</td>
<td>Single group cross-sectional/posttest only</td>
<td>12.5/16.5</td>
</tr>
<tr>
<td>Kent et al. 2013 [53]</td>
<td>Describes patient outcomes from interprofessional student teams delivering primary care for older people; Patient perceptions of the consultation indicated this was a very well-received patient-centered intervention and that the student teams provided useful information and education about self-management strategies</td>
<td>Single group cross-sectional/posttest only</td>
<td>12.5/18</td>
</tr>
</tbody>
</table>

Berman et al. 2012 [35] Describe founding and development of the SRC, Increase internal medicine, family medicine, and primary care residency applications, prelim. Percentage of controlled hypertension above national average (prelim.) Single group cross-sectional/ posttest only 10.5/16.5

Butala et al. 2012 [36] Examine the rate of preventive care provided in a SRC and compare it to national data; The SRC provided preventive services at comparable rates to national levels Single group cross-sectional/ posttest only 12.5/16.5

Liberman et al. 2011 [37] Met and in some areas exceed the quality of depression treatment when compared to regular care Single group cross-sectional/ posttest only 13.5/16.5

Lough et al. 2011 [38] Report case series of patients receiving smoking cessation in SRC (SCC); The clinic provided effective and safe experience for medically underserved patients who might not have access to conventional programs Single group pre and posttest 14/16.5

Zucker et al. 2011 [39] Evaluate the quality of hypertension treatment at an SRC (SFHCIC); Patients in the SRC received pharmacotherapy as recommended by guidelines and attained blood pressure goals set by health people 2010 Single group cross-sectional/ posttest only 12.5/16.5

Wee et al. 2011 [40] Evaluate service learning program, Neighborhood Health Screening (NHS); Patients were satisfied with NHS; Most students felt NHS was beneficial to them. Controlled hypertension treatment rates increased Single group pre and posttest 12.5/16.5

Elliot et al. 2010 [41] Report patient satisfaction in our SRC (CARES clinic); seen at a SRC were very satisfied with the services they received Single group cross-sectional/ posttest only 11/18

Dvoracek et al. 2010 [42] Evaluate impact of cost control measures on drug use and financial performance of a SRC and assess effects on patient care; Medication management with closed formulary reduced expenditures, similar level of care Single group pre and posttest 13.5/16.5

Ryskind et al. 2009 [43] Evaluate diabetes quality of care in our SRC (EHHPIC clinic); Quality of diabetes care was comparable to or better than average previously reported for uninsured populations Single group cross-sectional/ posttest only 13.5/16.5

Spector et al. 2007 [44] Study feasibility, obstacles, effect, and differences between the therapy formats of medical students’ smoking cessation in SRC; The homeless subjects significantly reduced their smoking frequency Single group pre and posttest 12/16.5

Niecieirenko et al. 2006 [45] Evaluate student performance to help SRC patients enroll in government sponsored insurance plans; A majority of patients attending clinic were uninsured. Of 97% of eligible for insurance, applications were initiated, 23 (40%) were completed and accepted. This project supports the use of medical student (volunteers) to assist in insurance application Single group cross-sectional/ posttest only 12.5/16.5

Bennard et al. 2004 [46] Describe the development of the SRC, Opportunity for hands-on experience, working together with other health professionals, a feeling of autonomy, practicing preventive medicine. Patients were satisfied Single group cross-sectional/ posttest only 08/18

Hsu LD et al. 2003 [47] Describe the student run Hepatitis B initiative; 997 patients received free hepatitis B screening, 384 patients (39%) were deemed susceptible to the hepatitis B virus and provided with free vaccination Single group cross-sectional/ posttest only 9.5/16.5

Der et al. 2001 [48] Describe a medical student run smoking intervention clinic and assess student competence; Medical students believed they improved their smoking cessation counseling skills. Patients reported less smoking Single group cross-sectional/ posttest only 12.5/18

Mota A et al. 1999 [49] Report preliminary results of a student staffed oncology outpatient clinic; Patients were satisfied, students valued the clinic as most interesting (ambulatory) experience they had had Single group cross-sectional/ posttest only 8.5/18

Haq et al. 1996 [50] Describe the development and operation of a volunteer clinic; Most participating students highly valued the experience, patients rated rated care very satisfactory Single group cross-sectional/ posttest only 08/18

Werman et al. 1976 [51] Evaluate psychotherapeutic interventions by medical students in a outpatient clinic; Patients reported improvement after student-psychotherapy intervention. Mutually positive attitude appeared to be important Single group cross-sectional/ posttest only 13/18

CamposOutcalt et al. 1985 [52] Retrospective study about which residency participants of Clinica Tepati choose; Participants chose more internal medicine, family medicine, and pediatrics (all primary care) residencies compared to non-participants Non-randomized 2 group 12.5/16.5

Table 1: Published articles on SRCs reporting quantitative student outcomes, sorted on student outcomes, displayed are goal as stated/ implied in article and outcomes/conclusion, in addition to MERSQI scores, Original Table 1 with sub-scores available online.

**Students’ attitudes and opinions**

Fifteen articles described the effects of SRC participation on students’ attitudes and opinions. [17–31] Students were generally satisfied [18] and appreciated the clinical experience they had acquired in the SRC. [17, 19, 30] Moreover, their attitude and compassion towards (caring for) patients improved (all homeless, poor or underserved patients). [17, 18, 21, 22, 24, 28] Students reported that their skills had improved [21, 28] (i.e. in history taking, physical examination and multidisciplinary collaboration) [23] and indicated that they had gained knowledge [28] they had not acquired elsewhere. They valued the SRC as being educationally relevant. [17]

**Students’ skills and knowledge**

Data on the effects of SRC participation on medical students’ skills and knowledge were based mainly on expert opinions and student self-reported competencies, knowledge and skills assessments, which we categorised as representing attitudes and opinions. A single study reported that there was no significant difference in study grades between board members (students who had organising and governing roles) and regular participants or other students. [32]

**Students’ behavior**

Only one article investigated behavioural student outcomes. [33] It reported an increased frequency of screening patients for depression after students had followed an educational programme on depression screening in an SRC. [33]
Patient and health care

Twenty-five articles described general health care outcomes of SRC participation.[10,34–57] This category was divided into three subgroups: patient satisfaction; quality of care provided, and future specialisation and career choice. Patients were generally satisfied with the care provided in SRCs,[40,41,46,49,50] and the quality of care for hypertension,[39,40] diabetes,[43,57] psychiatric health,[37,51] and preventive health care (screening programmes and smoking cessation programmes).[36,38,44,48] met national standards.[39] One study reported a better or comparable quality of care[43] and two studies reported a better quality of care than that provided by regular health services for insured patients.[34,37] Future primary care career choice following SRC participation was evaluated in three studies, but findings were contradictory [10,35,52].

Study quality

Of the 42 articles, 36 (85.7%) were classified as being of a single-institution design and 21 (50.0%) reported objectively measured outcomes. Almost all articles (n = 36, 85.7%) used appropriate data analysis; however, only 23 articles (54.8%) used analytical methods other than descriptive analysis (Table 2). The mean standard deviation (SD) MERSQI score (corrected for not applicable) of all 42 articles was 11.54 +/- 2.79 (Table 2).

The two largest outcome groups (students’ attitudes and opinions, and patient outcomes) were significantly different (uncorrected, p < 0.001; corrected, p < 0.001, for MERSQI subdomain) than those of provider satisfaction. The difference was most pronounced for patient outcomes (Table 2). The mean standard deviation (SD) MERSQI score (corrected for not applicable) of all 42 articles was 11.54 +/- 2.79 (Table 2).

Qualitative studies

Seven of the excluded articles were qualitative studies.[6,58–63] Of these, five used (semi-structured) interviews, one used a focus group and one reported an analysis of written student reflections. Two articles described system-based care and learning in SRCs; one of these identified six major domains related to system-based care learning opportunities in SRCs.[58] The other identified system issues affecting the delivery of and access to care in an SRC.[59] One article described the role, barriers, benefits and future directions of a specific SRC in providing primary care according to its stakeholders[60]. Another explored the dynamic role and contributions of pharmacy students in an interprofessional SRC.[61]. Doctor–patient communication as it is taught to medical students in an SRC was analysed and described from an anthropological point of view in one article[62]. Another described students’ written reflections on their experience[63]. The last article identified legitimate workplace roles and activities for early learners, and described the SRC as an example of a source of such early legitimate experiences[6].

### Table 2 MERSQI subdomain scores/characteristics of 4 groups of student outcomes (i.e. attitudes/opinions, skills/knowledge, behaviours and patient/healthcare)

<table>
<thead>
<tr>
<th>Number of articles</th>
<th>Attitudes/opinions/general facts</th>
<th>Knowledge/skills</th>
<th>Behaviour</th>
<th>Patient/healthcare</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(100%)</td>
<td>(100%)</td>
<td>(100%)</td>
<td>(100%)</td>
<td>(100%)</td>
</tr>
<tr>
<td>MERSQI subdomain design</td>
<td>Study phase</td>
<td>Single group cross-sectional</td>
<td>11 (73.3%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Phase</td>
<td>Single group posttest only</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Non-randomized group</td>
<td>-</td>
<td>1 (100%)</td>
<td>1 (100%)</td>
<td>3 (12.0%)</td>
</tr>
<tr>
<td></td>
<td>Randomized controlled trial</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MERSQI subdomain</td>
<td>Institutions</td>
<td>Single institution</td>
<td>13 (86.7%)</td>
<td>1 (100%)</td>
<td>1 (100%)</td>
</tr>
<tr>
<td></td>
<td>&gt;2 institutions</td>
<td>7 (46.7%)</td>
<td>1 (100%)</td>
<td>1 (100%)</td>
<td>16 (64.0%)</td>
</tr>
<tr>
<td></td>
<td>&lt; 50% or not reported</td>
<td>4 (26.7%)</td>
<td>-</td>
<td>-</td>
<td>2 (8.0%)</td>
</tr>
<tr>
<td></td>
<td>50–74%</td>
<td>5 (33.3%)</td>
<td>-</td>
<td>-</td>
<td>4 (16.0%)</td>
</tr>
<tr>
<td></td>
<td>&gt; 75%</td>
<td>6 (40.0%)</td>
<td>-</td>
<td>-</td>
<td>3 (12.0%)</td>
</tr>
<tr>
<td>MERSQI subdomain</td>
<td>Type of data</td>
<td>Assessment</td>
<td>15 (100%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>by study participant</td>
<td>-</td>
<td>1 (100%)</td>
<td>1 (100%)</td>
<td>19 (76.0%)</td>
</tr>
<tr>
<td>MERSQI subdomain</td>
<td>Internal structure</td>
<td>Not applicable</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Reported</td>
<td>6 (40.0%)</td>
<td>-</td>
<td>-</td>
<td>17 (68.0%)</td>
</tr>
<tr>
<td></td>
<td>Not reported</td>
<td>9 (60.0%)</td>
<td>1 (100%)</td>
<td>1 (100%)</td>
<td>7 (28.0%)</td>
</tr>
<tr>
<td></td>
<td>Content</td>
<td>Not applicable</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Reported</td>
<td>13 (86.7%)</td>
<td>1 (100%)</td>
<td>1 (100%)</td>
<td>20 (80.0%)</td>
</tr>
<tr>
<td></td>
<td>Not reported</td>
<td>2 (13.3%)</td>
<td>-</td>
<td>-</td>
<td>4 (16.0%)</td>
</tr>
<tr>
<td></td>
<td>Relationship to other variables</td>
<td>Not applicable</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Reported</td>
<td>8 (53.3%)</td>
<td>-</td>
<td>-</td>
<td>12 (43.5%)</td>
</tr>
<tr>
<td></td>
<td>Not reported</td>
<td>7 (46.7%)</td>
<td>1 (100%)</td>
<td>1 (100%)</td>
<td>11 (47.8%)</td>
</tr>
<tr>
<td>MERSQI subdomain</td>
<td>Appropriateness of analysis</td>
<td>Appropriate</td>
<td>12 (80.0%)</td>
<td>1 (100%)</td>
<td>1 (100%)</td>
</tr>
<tr>
<td></td>
<td>Not appropriate</td>
<td>3 (20.0%)</td>
<td>-</td>
<td>-</td>
<td>3 (12.0%)</td>
</tr>
<tr>
<td></td>
<td>Descriptive only</td>
<td>9 (60.0%)</td>
<td>-</td>
<td>-</td>
<td>10 (40.0%)</td>
</tr>
<tr>
<td></td>
<td>Beyond descriptive</td>
<td>6 (40.0%)</td>
<td>1 (100%)</td>
<td>1 (100%)</td>
<td>15 (60.0%)</td>
</tr>
<tr>
<td>Mean MERSQI total score (corrected for not applicable)</td>
<td>8.93 (SD 1.61)</td>
<td>12</td>
<td>12</td>
<td>13.06 (SD 2.26)</td>
<td>11.54 (SD 2.79)</td>
</tr>
<tr>
<td>Mean MERSQI total score (corrected for student outcomes)</td>
<td>8.39 (SD 1.71)</td>
<td>11.40</td>
<td>11.17</td>
<td>12.00 (SD 2.73)</td>
<td>10.67 (SD 2.89)</td>
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</table>
DISCUSSION

It seems attractive to train students as medical professionals early in the curriculum. Major triggers for learning include active training in real-life situations and being given a feeling of responsibility for patient care. In an SRC this responsibility is central. This is the first systematic review to analyse student outcomes after SRC participation. Students liked participating in these clinics, patients were satisfied with the quality of care provided, and the quality of care seemed adequate. As only two studies reported on the effects of SRC participation on students’ skills, knowledge and behaviour, no conclusions could be drawn on these aspects.

Students’ attitudes, motivation and opinions
Not only did students like participating in SRCs, but they also thought that participation increased their knowledge and skills, a perception based on self-rated rather than objective measures. The positive attitude of students to participation is consistent with the findings of earlier reviews on problembased learning and SRCs. Although self-rated competency is known to be limited in terms of accuracy and validity, student satisfaction and willingness to participate are important factors because they enhance intrinsic motivation, an important component of the learning process.

Patient and health care
Patients were satisfied with the care received, and the quality of care seemed adequate and in some studies even comparable with that of regular (insured) care. However, these patients did not have access to regular care and may therefore have been overly positive about SRCs. Furthermore, it is arguable that the quality of care provided may reflect the clinical skills of the students’ supervisors rather than those of the students themselves.

Study quality
The studies that reported on patient outcomes were generally of better quality, assessed with the MERSQI instrument, than the studies that reported on students’ attitudes and opinions, even after correction for MERSQI outcomes subdomain scores. If more than one student outcome category was mentioned, the quality of the study may have been overestimated. The MERSQI also identifies low-scoring subdomains, which may provide information about how the quality of research can be enhanced by, for instance, using better research designs and improving the reporting of methods and interventions. The research design of future studies of student outcomes of SRC participation may be improved by choosing a quasi-experimental design, preferably a pre–post design, with two (randomised) groups (intervention and control groups). The intervention studied and baseline characteristics should be adequately described. However, it is recognised that it is difficult to perform randomised trials in the context of medical education, especially with regard to randomisation. In addition, the evaluation of clinical skills and knowledge development during SRC participation might be improved by, for instance, using (multiple) individual (mini)–clinical evaluation exercises (mini-CEX) rather than a retrospective assessment of an entire student group via a single supervisor survey.

Observations
The categorising of study outcomes resulted in two large categories, namely: students’ attitudes, motivation and opinions, and patient and health care. These categories probably reflect the reasons why SRCs were established: to deliver free care provided by volunteer medical students to needy groups. Almost all of the eligible articles reported that their target populations consisted of underserved, homeless or uninsured patients. Of the 42 articles identified that investigated student outcomes, only one (objectively) investigated whether SRC participation improved students’ skills and knowledge beyond self-report or expert opinion (excluding expert assessments of knowledge and skills). One would expect much more attention to be focused on this category if SRCs had been founded for educational purposes. Although the total number of publications reporting student outcomes is low, this number is increasing, which suggests that greater attention is being focused on the educational aspects of SRC participation. Furthermore, many articles described interprofessional collaboration and learning in the SRC. Attention to this topic is important because interprofessional collaboration is integral to future patient care. The World Health Organization (WHO) issued a report on interprofessional education and collaboration in 2010, which stated: ‘Interprofessional education is a necessary step in preparing a “collaborative practice-ready” health workforce that is better prepared to respond to local health needs’. The SRC may contribute by preparing future health professionals for collaborative patient care.

Limitations
This review has some limitations. Articles may have been missed, although we attempted to minimise the likelihood of this by searching four databases and using a snowball strategy. We selected quantitative studies for extensive analysis and, although we excluded them, we have briefly described the qualitative studies we found. The effect of SRC participation on patient and health care may have been overestimated as a result of a publication bias that favoured positive outcomes, but this may also have been true for all outcomes.

Recommendations and future directions
This review emphasises the success of the SRC in providing care for needy groups within populations. As we would like to use the SRC concept within medical education, we need to determine whether the SRC is a suitable place for medical education. Good medical education should have clear goals (learning outcomes) and equip students with the competences and behaviour that are expected of a doctor. Pharmacotherapeutic skills are best learned in the context of the delivery of patient care, with its attendant responsibilities. Responsibility and independence contribute to intrinsic motivation, which is associated with deep learning. These criteria could all be met in an SRC. Therefore, we agree with Chen et al. that we have
reached the stage at which the SRC should be recognised as a promising new setting for early clinical experience and medical education. However, there is a problem associated with starting an SRC for educational purposes. Student-run clinics were initially established to provide care to homeless, poor and underserved patients, but in many countries, such as the Netherlands, the proportion of individuals without medical insurance is much lower (< 1%[70]) than it is in the USA (15%[71]), where SRCs were first started. This may mean that fewer patients will attend such clinics. We wonder whether the current SRC format could be redesigned into a new learner-centred type of SRC for insured patients with a primary focus on medical education. Further research is needed because the benefits of SRC participation are theoretical and evidence on student outcomes, such as skill and knowledge gains, is lacking. The best location for such educational research would be an SRC that is (primarily) focused on student learning, taking into account the recommendations for future study design. The concept of learning by doing in an SRC may support the provision of optimal context-based early clinical experience with its attendant responsibilities, and thereby improve medical education.

DECLARATIONS

Ethics approval: not applicable.

Conflicts of interest and Funding: All authors have completed the ICMJE uniform disclosure form at http://www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years, no other relationships or activities that could appear to have influenced the submitted work. There was no external funding for this study.

Authors’ contributions: TS and JT contributed to the study conception and design, the acquisition, analysis and interpretation of data, and to the statistical analysis. RSD contributed to the acquisition, analysis and interpretation of data. MAvA contributed to the analysis and interpretation of data, and the supervision of the study. TPGMdV contributed to the study concept and design, the analysis and interpretation of data, and the supervision of the study. MCR contributed to the study concept and design, the analysis and interpretation of data, the statistical analysis, and the supervision of the study. All authors contributed to the drafting and revision of the paper, approved the final manuscript for publication and agree to be accountable for all aspects of the work in ensuring that questions related to its accuracy or integrity are appropriately investigated and resolved.

SUPPLEMENTARY MATERIAL

Additional Supporting Information may be found online in the supporting information tab for this article:

Table S1. The aims, student outcomes and conclusions of studies included in the present review, with MERSQI (sub)scores per article.

Appendix S1. Queries used to search the PubMed, EMBASE, PsycINFO and ERIC databases.
REFERENCES


A NOVEL APPROACH TO TEACHING PHARMACOTHERAPEUTICS – FEASIBILITY OF THE LEARNER-CENTERED STUDENT-RUN CLINIC


