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REVIEW

Patient Outcomes from Student-Run Health Services: An Integrative Review

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Background: Student-run clinics (SRCs) offer an innovative approach to expand healthcare access and equity and increase clinical placement opportunities for students. However, research on the health benefits and/or outcomes of such clinics is currently fragmented.

Methods: An integrative review was conducted to capture and synthesize findings across a range of study types involving varied student disciplines, student delivered intervention types, and health conditions addressed or care areas of focus. Only published and peer reviewed studies were included. Studies needed to report outcomes in a defined study group measured over time, or report SRC data with explicit comparisons to non-SRC settings. Data were analyzed using inductive content analysis to identify major themes and natural clustering of health outcomes measured.

Results: Fifty-one articles were selected for review based on the eligibility criteria. Studies were predominantly from the United States, and most (n = 34, 67%) adopted a case review methodology for measuring outcomes. Health outcomes were evaluated in relation to a range of health conditions that, for the purposes of this review, were considered to naturally cluster into eight categories: diabetes, hypertension, functional health/quality of life, depression, hospital utilization, substance use, weight, health screening/vaccinations, and others.

Conclusion: This integrative review sought to evaluate the health outcomes accrued by patients in student-run health clinics. Taken as a whole, the literature suggests positive health outcomes resulting from student-run clinics across a range of health conditions. Greater confidence in care-related findings would be achieved from future research utilizing more robust and prospective study designs.

Keywords: student-run clinic, student-led clinic, student-delivered, patient outcomes, interprofessional education, medical education

Background

Student-run, student-led or student-assisted health services or clinics (hereafter described as student-run clinics or SRCs) are dedicated settings where students are integrally engaged in delivering healthcare delivery during their studies. Such clinics offer expanded clinical placement opportunities, "real world" learning experiences for students, and improved access to care for underserved populations by delivering care at no or low cost.[1–3] SRCs have been established in various countries, operate under various labels and models, and may involve students in single, or multiple health professions, providing care under professional supervision.

The literature related to health outcomes achieved through SRCs is growing, if somewhat fragmented. A preliminary search of the literature revealed a wide range of health outcomes measured and study methodologies used (both experimental and non-experimental). Descriptive accounts of SRCs and their patient or student characteristics are common (see, for example,[4–12]). Evaluative studies, while less common, have measured a range of outcomes in particular clinical contexts, but overviews of available evidence have generally been lacking. Earlier reviews have examined the

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learning outcomes that result for students involved in such clinics.[13–15] Smaller-scale reviews have also been published on health outcomes specifically for SRC patients with cardiovascular disease or risk factors[16] and on student-delivered care in a physical rehabilitation context,[17] but the totality of evidence related to patient outcomes for patients in SRCs has not yet been systematically explored. Seeking to address this gap in knowledge, this integrative review aims to synthesize literature evaluating clinical patient outcomes of SRCs.

Integrative reviews are the broadest type of research review, allowing for a diverse range of the literature on a topic to be usefully summarized.[18] By drawing together diverse and siloed knowledge, the objective is to reach a more comprehensive understanding of the patient outcomes associated with SRCs.

Methods

Study Design

An integrative review methodology was adopted as this enables wide inclusion criteria, incorporating a multiplicity of study methodologies and purposes to capture the depth and breadth of a topic.[18,19] Current SRC outcome evidence is fragmented across health disciplines/professions and areas of care focus, and has not previously been synthesized for analysis. Whittemore and Knafl's[18] five-stage approach to undertaking integrative reviews by was followed, involving a) problem identification; b) literature search; c) data evaluation; d) data analysis and e) presentation of findings.

Literature Search

A systematic search of several databases, including PubMed (MedLine), CINAHL (EBSCOHost), and Web of Science (Clarivate) was conducted in September 2020. The search strategy and queries were reviewed and approved by a reference librarian. Strategies were uniquely designed relative to each database, and integrated controlled vocabulary for databases (for example, MeSH terms for PubMed). Additional sources were identified by checking the reference lists and subsequent citations of all included articles.

Three search term groups were included in the search strategies (see Box 1). The first included terms indicating college/university/higher education students, including "tertiary" – which, while not a term common in all jurisdictions, indicates education after secondary schooling, including at universities as well as technical or trade schools or colleges. The second search included terms that implied students were facilitating interventions, such as "run" or "led". Finally, the third used various terms indicating that the texts related to clinics or health delivery settings. Regarding search filters, the search was restricted to English only, and no restrictions were placed on year or location.

Following the database search, sources were aggregated within a database manager (EndNote). Next, duplicates were removed using The Systematic Review Assistant-Deduplication Module (SRA-DM), a program shown to reliably remove duplicate records with excellent sensitivity and specificity.[20] The remaining duplicates were removed using EndNote software de-duplication function,[21] and manually during title and abstract review.

Inclusion Criteria

Authors PB, ET, and OW collectively screened the remaining sources at the level of title and abstract to exclude ineligible records. Source selection was guided by the inclusion and exclusion criteria detailed in Table 1. Studies could be published in any year and relate to SRCs in any country, but only peer reviewed, English-language studies were included. Studies needed to clearly establish that students delivered a health-related intervention, regardless of location, degree of student supervision, or the nature or extent of student–patient interactions. Studies needed to focus

Box 1 Search Terms Used

Tertiary OR student* OR undergraduate* OR graduate* OR volunteer*
AND led OR run OR facilitated OR managed OR assisted
AND service* or centre* OR center* OR clinic*

Notes: The * (asterisk) here is a truncation symbol added to the end of the root of a word in Boolean searches to search for all forms of a word where this word could have multiple endings. Clinic* thus searched databases for, inter alia, clinic, clinics, and clinical.

Table 1 Eligibility Criteria for Articles

Criterion	Inclusion	Exclusion
Language	English	Non-English
Population	Recipients of health interventions delivered by students at a student-run clinic	Recipients of health interventions delivered by a registered health professional at a student-run clinic
Study design	Comparative analysis between one or more samples, or between one or more time points within a single sample	Descriptive only, cross-sectional analysis (without comparison)
Outcome	Assessed patient clinical outcomes, including anthropometric, medical and functional	Assessed patient satisfaction or experiences of intervention
Source type	Peer-reviewed publications	Conference abstracts and proceedings, dissertations and theses, editorials, commentaries, letters to editor, reviews

on human health outcomes, broadly defined, so that studies of, for example, student veterinary or legal clinics were not included.

Studies reporting patient satisfaction in SRC settings were excluded. While indicative of patient experiences and, arguably, broad SRC effectiveness, satisfaction is subjective and not a measure of clinical outcome which is the focus of this review. Given the focus on outcomes and impact, studies of non-comparator design were also excluded. Studies needed to report outcomes in a defined study group measured over time, or report SRC data with explicit comparisons to non-SRC settings (for example, rates for patients in a SRC compared to statewide or national standards). Information on the health status of SRC patients or of procedures performed in SRC settings may be of clinical interest but do not indicate outcome or impact. To expand on this point, studies were excluded where the health status of SRC patients were described without further data reported on how SRC engagement impacted on their health status, or where studies provided information on the number of treatments or level of services provided in an SRC setting but did not expand on this to identify how these rates compared to other populations or national standards to demonstrate impact.

Data Evaluation

Data evaluation involved extraction of specific methodological and design features of each of the included studies by authors PB, ET and OW. As the sampling frame was deliberately wide, incorporating a diverse range of clinical outcomes and study methodologies, a systematic quality appraisal approach was not adopted. Sources were evaluated via careful narrative consideration of the authenticity, methodological quality, informational value, and representativeness[18] of included studies, as outlined in the discussion section. This approach reflects both the complex and differing nature of "quality", and the primary review focus on informing SRC service development as opposed to clinical practice.

Data Analyses

Data analyses followed established integrative review processes for data reduction, data display, and data comparison.[18] Data reduction involved determining an overall classification system for managing data followed by extraction and coding of data independently by authors PB, ET and OW. Data were extracted for the study setting (state and country), student disciplines involved, study design, sample size and characteristics, descriptions of the intervention, outcome measures used and study findings. Only data relating to patient clinical outcomes were extracted, and any broader data in each study that did not directly pertain to patient clinical outcomes (for example, parallel measures of patient satisfaction) were excluded. Discrepancies or uncertainties in how to reduce data were resolved through discussion. Whittemore and Knafl have noted how sources included in the integrative review need to be divided into subgroups according to some logical system to facilitate analysis.[18] Inductive content analysis was therefore used to identify major themes and natural

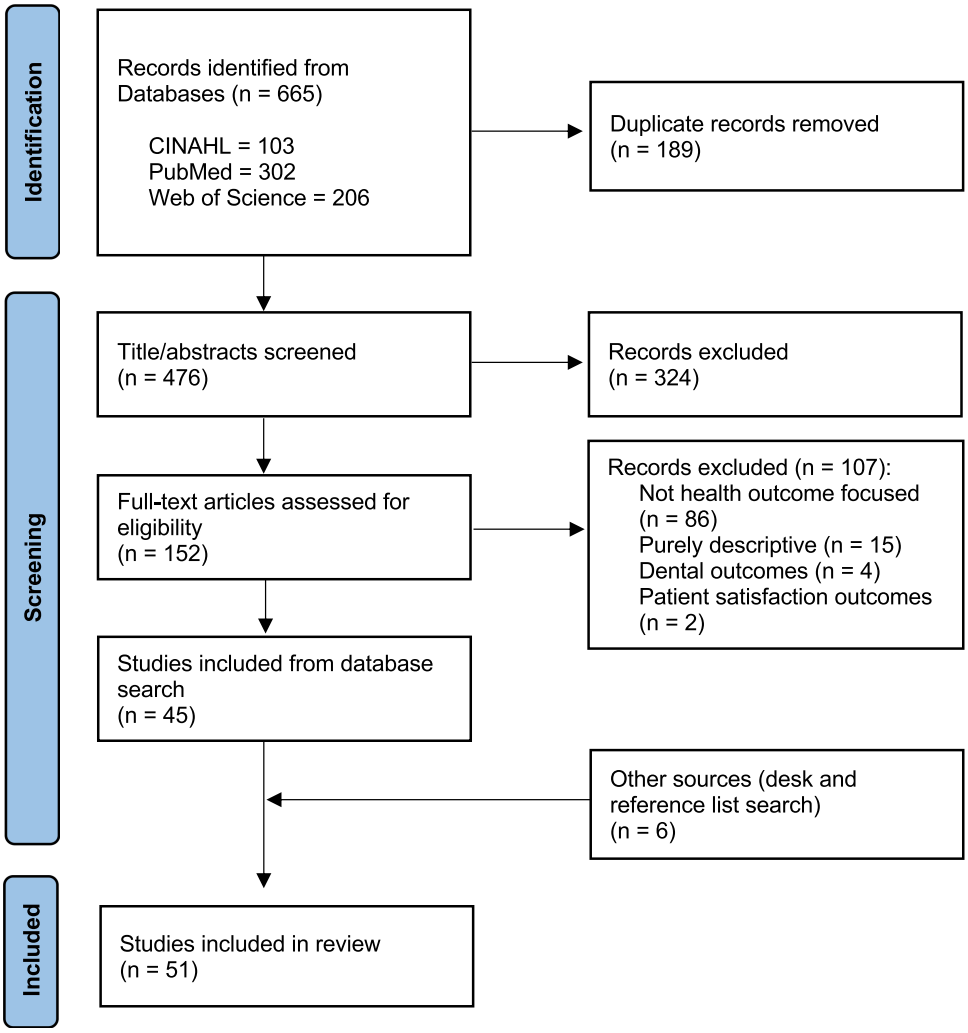

Figure 1 PRISMA flow diagram.
Notes: Adapted from: Liberati A, Altman D, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *Journal of Clinical Epidemiology.* 2009;62(10)e1-e34. Creative Commons.[95]

clustering[18] of clinic outcomes evaluated before being displayed on a table and prepared for comparison in a narrative synthesis.

Results

From an initial result of 665 articles, 152 progressed to full-text review against the eligibility criteria, leaving 51 articles evaluating health outcomes for clients attending a SRC (see Figure 1).

Most studies were conducted in the United States with the exceptions of two studies of outcomes from SRCs in Australia[22,23] and one in each of the United Kingdom,[c] Ecuador,[25] and Canada.[26] The most common study method used were case reviews (n = 34) either in the context of a pre-post or a cohort study design. Health outcomes were evaluated in relation to a range of health conditions and, for the purposes of this review, were clustered into eight categories: diabetes, hypertension, functional health/quality of life, depression, hospital utilization, substance use, weight, health screening/vaccination, and others (see Table 2). There was some overlap in the specific outcomes evaluated across the various health conditions, as represented in Figure 2.

Table 2 Overview of Articles Selected for Review

Author	Discipline(s)	Study Method	Participants				Assessment and Intervention Characteristics		
			N	Age*	Sex (%F: M)	Ethnicity**	Intervention Duration/ Description	Outcome Measured	Results
Diabetes									
Adams et al. 2015[24]	Pharmacy	PP PPS	671 66C	69y I 68y C	32:68 I 42:58 C	-	Individualised pharmaceutical care plan developed in advance of patient consultation	HbA1c Cholesterol BP mmHg EQ-5D Medication adherence	Potential non-significant improvements across all health indicators – feasibility study so underpowered to detect significance
Gorrindo et al. 2014[27]	Medicine	PPCR	45	49y	62:38	33% Hispanic 36% Black 29% White	Routine care, including visits and phone calls, at SRC, over a period of 12 months	HbA1c	Significant improvement in blood glucose levels after 12 months, with trend indicating a correlation between better outcomes and more frequent touchpoints
Janson et al. 2009[28]	Medicine Nursing Pharmacy	NRCT	221 I 163 C	65y I 63y C	53:47 I 56:44 C	Intervention: 25% Asian 31% Caucasian 22% African American 20% Other Control: 31% Asian 30% Caucasian 19% African American 19% Other	Individual 30-minute appointments, based on the Improving Chronic Illness Care (ICIC) Model from teams of interprofessional clinical learners, offering education and self-management support, and targeted phone support	HbA1c LDL BP mmHg Vaccinations Prescriptions Hospital utilization	No significant differences between groups post intervention; significantly more frequent screening occurred for the intervention group across all clinical indicators

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Table 2 (Continued).

Author	Discipline(s)	Study Method	Participants				Assessment and Intervention Characteristics		
			N	Age*	Sex (%F: M)	Ethnicity**	Intervention Duration/ Description	Outcome Measured	Results
Kahkoska et al. 2018[29]	Medicine Physician assistant Pharmacy	PPCR	8	-	63:37	25% White	Triage, medication reconciliation, brief history, and physical exam, after which patients participated in the 60–90 minute shared medical appointment (SMA)	HbA1c	Improved blood glucose levels in 6 out of 8 participants, although much variability within individuals - study underpowered to detect significance
Laitman et al. 2017[30]	Medicine	CCCR PPCR	44	50y	50:50	83% Hispanic	Routine diabetes care at SRC, mostly drug therapy, over a period of 2+ years	HbA1c	Significant improvement in blood glucose levels at 6m, 1y, 2y, and 2y+. It took an average 288 days for participants to achieve an ADA goal of 7.0%
Lee et al. 2016[31]	-	PP PPS	22	38–67y range	64:36	-	Attendance at DSME (Diabetes self-management education) course, support at follow up visits and regular check-ins by phone, over a period of 12 months	HbA1c ADA survey results	An average 10.8% improvement in diabetes knowledge in ADA pre- and post- intervention tests. Non-significant cohort improvement in blood glucose - study underpowered to detect significance
Martin et al. 2015[32]	Pharmacy	PPCR PPS	48	-	-	American Indian/ Alaska Native	Medication audit, assessment of clinical needs, medication management therapy, pre/post phone calls, over a period of 6 months	HbA1c	Improvement in blood glucose levels was non-significant comparing pre-post means but significant comparing pre-post medians
Mehta et al. 2016[33]	Medicine	PP	68	47y	46:54	54% African American 31% White 9% Hispanic 6% Other	Patient education prior to expedited referral for routine care at SRC, over a period of 9 months	HbA1c BMI	Significant improvement in blood glucose levels; and a statistical increase in BMI for those attending <2 appointments not evident in those who attended more

Nagelkerk et al. 2018[34]	Medicine Physician assistant Pharmacy	PPCR	250	57y	61:38	48% Black 38% White 9% Asian 5% Other	Phone calls, monthly group diabetic classes and medication reconciliation audits	HbA1c BMI BP mmHg LDL and HDL and Triglycerides	Significant improvement in triglycerides and non-significant improvements in lipid ratios and BMI (but most clinical indicators showed no significant improvement). For a sub-sample of higher-risk patients, significant improvements were found in blood glucose levels and cholesterol
Nuffer 2012[35]	Pharmacy	PPCR	417	-	-	-	Six 1-hour appointments, which included an initial assessment, self-care education, health education and management strategies, reinforcement and reassessment, over a period of 6 months	HbA1c BP mmHg LDL and HDL and Triglycerides	Significant improvements across all clinical indicators (except HDL levels)
Ryskina et al. 2009[36]	Medicine	CCCR	25	49y	40:60	80% Hispanic 12% Black 4% Asian 4% White	Diagnosis + one or more follow up visits at SRC	HbA1c LDL BP mmHg Screening: • Nephropathy • Retinopathy • Foot exam	Comparable or better than averages reported for uninsured populations in blood glucose levels, cholesterol, blood pressure and screening rates
Smith et al. 2014[37]	Medicine	CCCR PPCR	182	53y	59:41	75% Latino 15% Caucasian 4% Asian 3% African American 3% Other	Routine care at SRC over mean period of 2.6 years	HbA1c LDL and HDL and Triglycerides BP Creatinine Screening: • Ophthalmology exam	Significant improvement in blood glucose levels, cholesterol and blood pressure, rates generally compare favourably to uninsured in other settings

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Table 2 (Continued).

Author	Discipline(s)	Study Method	Participants				Assessment and Intervention Characteristics		
			N	Age*	Sex (%F: M)	Ethnicity**	Intervention Duration/ Description	Outcome Measured	Results
Stroup et al. 2003[38]	Pharmacy	RCT	30 I 40 C	52y I 59y C	42:58 I 67:33 C	-	Monthly 1-hour appointments, via home visit or phone, for 2 years duration. Visits included review of pharmacological treatment, clinical monitoring and management, discussion of diabetes related complications and responding to patient questions	HbA1c Weight BP LDL and HDL and Triglycerides Diabetes related ED admissions Hospital visits	No significant difference in clinical indicators after 2 years; non-significant reduction in diabetes related ED admissions and hospital visits in the intervention group
Wilcox 2020[39]	-	PPCR	56 I 53 C	52y I 56y C	50:50 I 49:51 C	Intervention: 48% White 46% Hispanic 4% Black 2% Asian/ Pacific Islander Control: not provided	Impact of quality improvement intervention (flow sheet) on routine diabetes care provided at clinic	HbA1c Screening: • Urine protein • Foot exam • Eye exam	Patients who received care in 1y post flow sheet introduction were more likely to receive at least two HbA1c tests (53%), a microalbumin test (46%), and a foot exam (46%) compared to those receiving care before the flow sheet was introduced (28%, 2%, and 25%, respectively), with no difference in eye exam rates
Hypertension									
Atkinson et al. 2018[40]	Medicine	CCCR PPCR	97	56y	62:38	70% Hispanic 8% White 8% Black 13% Other	>2 visits for routine care of patients with hypertension at primary care SRC	BP mmHg (initial vs follow-up and compared to national average)	Clinically significant decreases in BP post intervention and controlled BP rates similar to national averages for insured/uninsured
Berman et al. 2012[41]	Medicine	PP	17	-	-	-	Routine care of patients with hypertension at primary care SRC	BP mmHg	76% of patients with previously uncontrolled BP had controlled BP

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Leung et al. 2012[42]	Medicine Nursing Pharmacy	PP	25	54y (med)	40:60	53% Latino 24% Black 24% White	Two clinic visits and 6×20 minute phone calls, focused on medication review and goal setting, over a period of 3–6 months	Medication adherence BP mmHg	Significant improvements in medication adherence
Smith et al. 2017[43]	Medicine	PPCR	496	51y	-	71% Hispanic	Routine care of patients with hypertension at primary care SRC, over a period of 1 year	BP mmHg	Significant reduction in BP over time
Taylor et al. 2015[44]	Medicine	CCCR PPCR	65	53y	60:40	55% Hispanic 29% Black 5% Asian 3% White	>2 visits for routine care of patients with hypertension at primary care SRC	BP mmHg	Clinically significant decreases in BP post intervention and controlled BP rates similar to State-wide averages in other care settings
Wahle et al. 2017[45]	Medicine Pharmacy	CCCR PPCR	64	55y	52:48	-	Routine care of patients with hypertension at primary care SRC	BP mmHg	Hypertension control rates similar to national averages
Functional health/quality of life									
Arkin 2003[46]	Various (including non-health)	PP	24	79y	67:33	-	Students led clients with Alzheimer's in 16–20 exercise sessions and 10 group activity sessions per semester, for 2 to 8 semesters	Six-minute walk test Duration of aerobic exercise (mins) Upper body strength (lbs) Lower body strength (lbs)	Highly significant fitness gains were achieved in the six-minute walk test, upper and lower body strength, and duration of aerobic exercise
Doherty et al. 2020[47]	Occupational therapy	PP	26	52 y	50:50	58% African American/ Black 39% Caucasian/ White	Treatment activities centered on client-chosen goals that emphasized occupational Performance and participation in functional tasks, 45–60 mins weekly, over a period of 12–14 weeks	MCID in: COPM ACS ARAT PROMIS MoCA BBS PHQ-9	A small effect of treatment was found on all outcome measures, with statistically significant MCID change scores found for COPM and ARAT

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Table 2 (Continued).

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			N	Age*	Sex (%F: M)	Ethnicity**	Intervention Duration/ Description	Outcome Measured	Results
Lavelle et al. 2001[26]	Occupational therapy	PPCR	85	66y	32:68	-	Students led clients who had had cerebrovascular accident (stroke) 6 +mo previous in 12 (mean) 1-hour occupational therapy sessions	Patient-selected rehabilitation goals	All except one patient in the sample made progress towards rehabilitation goals, group mean goal progress score indicate significant overall gains
O'Brien et al. 2017[48]	Physical therapy	PPCR	71	62y	45:55	-	Students led physical therapy, once weekly, for 60 minutes, over a period of 10–11 weeks	"Minimum detectable change" (MDC) in at least one of 19 objective measurement tools	MDC achieved in approximately 70% of cases, and success was shown to be impacted by number of visits
Stickler 2016[49]	Physical therapy	PPCR	28	20–69y range	54:46	-	Attendance at student PT clinic (average 3 visits)	Functional quality of life scores in: NPRS QOL VAS SF-8 BP mmHg	Significant improvement in NPRS pain scale and physical component of SF-8
Walcott 2018[25]	Nursing	NRCT	43 I 55 C	46y I 37y C	79:21 I 64:36 C	-	8x weekly home visits by nursing students (needs assessment and personalised care plan)	Health related quality of life scores in SF-12	Intervention group demonstrated improvement in the physical component and physical function domain of SF-12 compared to control group
Zylstra et al. 2020[50]	Occupational therapy	PPCR	56	6y (paediatric) 63y (adults)	-	-	Student-designed interventions to address identified needs for adult and paediatric groups, sessions were held twice weekly, attended 7 (or more) sessions	COPM	For both age-groups there was a statistically significant improvement in perceived performance and satisfaction with participation in meaningful occupations, and a clinically significant improvement in satisfaction

Depression									
Liberman et al. 2011[51]	Medicine	CCCR	49	61% 18–44y 29% 45–64y 4% 65y+	78:22	82% Hispanic 8% Black 4% Caucasian 4% Other 2% Unknown	Routine depression treatment at primary care SRC	Number of visits post diagnosis Medication adherence	Quality of depression treatment meets or exceeds that of insured populations in city (New York) and state (New York)
Mann et al. 2019[52]	Medicine	CCCR	79	-	-	71% Hispanic	Routine depression treatment at primary care SRC	Medication adherence	Adherence rates generally lower than for New York State Medicaid or New York State commercially insured
Soltani et al. 2015[53]	Medicine	PPCR	215	49y	80:20	99% Latino 2% Non-latino	Depression screening and treatment following implementation of universal screening, diagnosis, and management program	PHQ-2 PHQ-9	Depression screening resulted in an increase in diagnoses made; clinically significant improvements in depression reported
Hospital utilization									
Kramer et al. 2015[54]	Medicine	CCS	245	41y	53:47	60% African American 26% Caucasian	Routine care at SRC	ER visits	Number of ER visits significantly decreased compared to those newly enrolled
Thakkar et al. 2019[55]	Medicine	PPCR	796	18–65+ range	52:48	64% White 13% Black 9% Hispanic 7% Asian 7% Other	Routine primary care at SRC	ER visits	Per-patient ER utilisation significantly decreased
Trumbo et al. 2018[56]	Medicine Nursing Pharmacy	PPCR	262	45y (med)	64:36	58% African American or Hispanic or Minority	Routine primary care at SRC	ER visits Hospital admissions	May reduce hospital admissions

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Table 2 (Continued).

Author	Discipline(s)	Study Method	Participants				Assessment and Intervention Characteristics		
			N	Age*	Sex (%F: M)	Ethnicity**	Intervention Duration/ Description	Outcome Measured	Results
Szkiladz et al. 2013[57]	Medicine Pharmacy	NRCT	86 I 94 C	70y I 72y C	56:44 C 48:52 C	-	Student-delivered counselling upon discharge	Hospital readmissions	No difference observed in readmission rates
Substance use									
Der et al. 2001[58]	Medicine	PPS	88	42y	58:42	89% White	Smoking cessation programme including counselling, follow-up contact and pharmacologic treatment	Tobacco use	Follow-up data from 44 (of 88) patients at 6mo found an 18% abstinence rate, comparable to other treatment programmes
Lough et al. 2011[59]	Medicine	PP	257	42y	45:55	88% White 4% Native American 4% African American 2% Hispanic	Smoking cessation intervention, over a period of 12 weeks	Tobacco use	Reductions in tobacco use were achieved
Myers Virtue et al. 2018[60]	Dentistry Pharmacy	NRCT	25 I 25 C	48y I 48y C	64:36	Intervention: 36% White 60% Black 4% Other Control: 20% White 72% Black 8% Other	Tobacco cessation intervention at student dental clinic	Tobacco use	Education was delivered successfully and increased knowledge, but had no apparent impact on quit attempts

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Spector et al. 2007[61]	Medicine	PP	11	41y	18:82	-	Smoking cessation intervention for homeless subjects (cognitive behavior therapy or unstructured support), 9-session protocol	Tobacco use	For 6 of 11 participants completing programme, decreases in self-reported mean number of cigarettes smoked daily (19 to 9) and carbon monoxide mean level (28.0 to 20.2), pilot study underpowered to detect significance
Stuhlmiller et al. 2018[23]	-	CCCR	2068	26y	52:48	75% Aboriginal or Torres Strait Islander	Smoking cessation programme and alcohol harm education; comparison between patients seen <12 months vs >12 months prior	Tobacco use Alcohol use	Slight reduction in relative risk of smoking and drinking alcohol
Weight									
Brown et al. 2015[62]	Medicine Nursing Health professions	NRCT	25 I 21 C	-	96:4 I 95:5 C	Intervention: 24% White 68% Black 4% Hispanic Control: 24% White 86% Black 14% Hispanic	Student vs professional led weight management intervention, over a period of 10 weeks	Weight (kg) BMI	Patients in both student-led and professional-led) programs lost a statistically and clinically significant amount of weight. No difference between student and professional led interventions
Burrows et al. 2013[22]	Dietetic	PPCR	26	56y	58:42	-	Student-delivered dietetic weight loss program, within a period of 12 months	Weight (kg) BMI	Significant decreases in weight were reported
Cusumano et al. 2017[63]	Physician assistant	PPCR	28	-	-	-	Student-delivered motivational interviewing and counselling intervention	Weight (kg) BMI	A significant decrease in weight was achieved, and maintained 3 and 6 months post intervention

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			N	Age*	Sex (%F: M)	Ethnicity**	Intervention Duration/ Description	Outcome Measured	Results
Health screening/vaccination									
Abuelenen et al. 2020[64]	Medicine	CCCR	236	>18y	-	62% Hispanic or Latino 3% Black/ African American 2% Asian 5% White 5% Bi-racial 24% Did not specify	Vaccination initiative in a SRC offering primary care	Vaccination rates	Vaccination rates at a SRC were comparable to or exceeded national averages
Butala et al. 2012[65]	Medicine	CCCR	114	35y	49:51	90% Hispanic 8% African American	Screening rates	Screening: • HIV • Diabetes • Cholesterol • Cervical cancer	Screening rates were lower than national averages, but exceeded national uninsured average
Khalil et al. 2020[66]	Medicine	CCCR	194	40–75y range	100:0	79% Hispanic	Screening rates	Screening: • Breast cancer	Screening rates for women aged 45+ exceeded national insured and uninsured averages
Price et al. 2020[67]	Medicine	CCCR	239	21–64y range	100:0	85% Hispanic	Screening rates	Screening • Cervical cancer	Screening rates exceeded national insured and uninsured averages

Zucker et al. 2013[68]	Medicine	CCCR	119	3% <18y 47% 18–49y 44% 50–64y 6% >65y	55:45	60% African American 29% Hispanic 4% Asian 3% Caucasian 4% Other/ Unknown	Routine primary care at SRC: Smoking cessation Screening rates Vaccination rates	Screening: • Alcohol abuse • Colon cancer (50y+) • Breast cancer (40y+) • Cervical cancer (21y+) • Pneumococcal (65y+) • Influenza	Met or exceeded state and national smoking cessation counselling and alcohol abuse screening rates and state colonoscopy rate, but not mammography, pap smear, pneumococcal or influenza vaccination rates
Other									
Burger et al. 2020[69]	Medicine	PPCR CCCR	134–334 (range of n's across groups)	53–58y (range of means across groups)	-	-	Impact of quality improvement intervention which included patient education, provider education on preventative measures and correct technique for BP measurement, and introduction to EMR	HbA1c BP Screening: • Urine protein • Eye exam • Colon cancer • Breast cancer	Intervention improved screening rates for breast and colon cancer, urine protein screening but did not improve control of diabetes or hypertension or eye exam screening. Most preventive measures exceeded national averages
Felder-Heim et al. 2020[70]	Medicine Physician assistant Dental Pharmacy Psychology Physical therapy	CCCR	30 (diabetes) 75 (hypertension)	23% 19–44y 56% 45–64y 13% 65–74y 5% 75–84y 3% 85y+	60:40	-	Routine primary care of patients diagnosed with diabetes or hypertension	HbA1c BP Screening: • Diabetes • Nephropathy • Retinopathy	Diabetes care standards were approximately the same, but hypertension care standards lower, than comparator safety-net providers (local community health center, local federally qualified health center, and Colorado State Medicaid)
Peluso et al. 2014[71]	Medicine Physician assistant Nursing	CCCR	39	34y	44:56	92% Latino/a 5% Black 3% Asian	Latent tuberculosis infection treatment (isoniazid regimen), over a period of 9 months	Medication adherence	Isoniazid adherence rates were comparable to other reported programs

(*Continued*)

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Table 2 (Continued).

Author	Discipline(s)	Study Method	Participants				Assessment and Intervention Characteristics		
			N	Age*	Sex (%F: M)	Ethnicity**	Intervention Duration/ Description	Outcome Measured	Results
Rojas et al. 2015[72]	Medicine	PPCR	96	50y	52:48	54% Hispanic 34% Caucasian 5% Black	Routine primary care of patients diagnosed with hyperlipidemia, followed up after a period of 5.5 months	LDL mg/dL	LDL levels decreased among cohort, exceeding national care standards

Notes: *Mean, unless otherwise stated (med=median); **Rounded to the nearest whole number.

Abbreviations: I, intervention; C, control; ED, emergency department; EMR, electronic medical records; HIV, human immunodeficiency virus; mg/dL, milligrams per decilitre; N, number; PT, physical therapy. Health outcomes abbreviations: ACS, Activities Card Sort; ADA, American Diabetes Association; ARAT, Action Research Arm Test; BBS, Berg Balance Scale; BMI, body mass index; BP, blood pressure; BP mmHg, blood pressure, millimetres of mercury; HbA1c, glycated haemoglobin (blood glucose level); COPM, Canadian Occupational Performance Measure; EQ-5D, EQ-5D self-rated quality of life scale; Weight (kg), weight in kilograms; LDL, low-density lipoproteins (cholesterol); HDL, high-density lipoproteins (cholesterol); MCID, minimum clinically important difference; MoCA, Montreal Cognitive Assessment; NPRS, Numeric Pain Rating Scale; PHQ-2, Patient Health Questionnaire-2; PHQ-9, Patient Health Questionnaire-9; PROMIS, Patient Reported Outcomes Measurement Information System; QOL VAS, Quality Of Life Visual Analog Scale; SF-8, Short Form 8 health survey; SF-12, Short Form 12 health survey. Study type abbreviations: CCCR, cohort comparison chart review; CCS, cohort comparison survey; NRCT, non-randomised controlled trial; PP, pre-post study; PPCR, pre-post chart review; PPS, pre-post survey; RCT, randomised controlled trial.

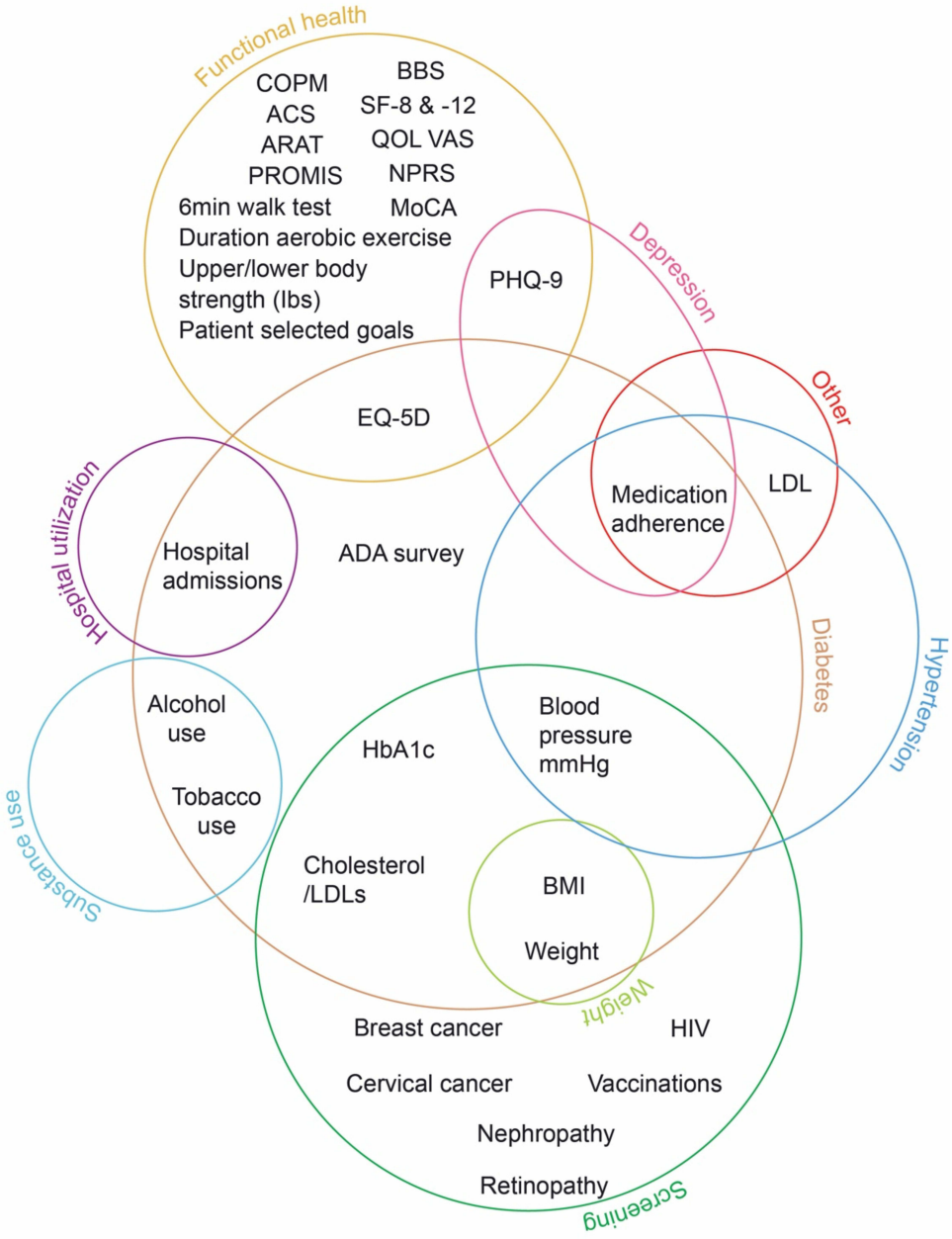

Figure 2 Summary and overlap of outcome measures in reviewed studies.

Abbreviations: ACS, Activities Card Sort; ADA, American Diabetes Association; ARAT, Action Research Arm Test; BBS, Berg Balance Scale; BMI, Body Mass Index; COPM, Canadian Occupational Performance Measure; EQ-5D, EQ-5D self-rated quality of life scale; HbH1c, glycated haemoglobin/blood glucose levels; HIV, human immunodeficiency virus; lbs, weight in pounds; LDL = low-density lipoproteins; MoCA, Montreal Cognitive Assessment; mmHg, millimetre of mercury; NPRS, Numeric Pain Rating Scale; PHQ-9, Patient Health Questionnaire-9; PROMIS, Patient Reported Outcomes Measurement Information System; QOL VAS, Quality Of Life Visual Analog Scale; SF-8, Short Form 8 health survey; SF-12, Short Form 12 health survey.

Diabetes

Diabetes was the most evaluated outcome, and the focus of 14 articles. Five evaluated health outcomes for SRCs run by medical students,[27,30,33,36,37] four by pharmacy students,[24,32,35,38] three medical and pharmacy students with either trainee physician assistants or nursing students,[28,29,34] and two studies did not define student's programme/s of study.[31,39] Glycated haemoglobin (HbA1c) was used to measure diabetes status in all 14 studies, with blood pressure (n = 7) and cholesterol (LDLs; n = 7) also commonly measured. Interventions described ranged from routine care and drug therapy alone, medication management, patient education, screening, and follow-up phone calls. Periods of engagement ranged from two sessions involving assessment and one follow-up, to ongoing involvement and follow-up over a period of 2.6

years, although most commonly about 12 months. In most studies, an improvement (significant or non-significant) in blood glucose levels,[24,27,29,33,35,37] or outcomes comparable to national standards[36,37] were observed. Three studies[28,38,73] found no statistically significant differences between groups; it should be noted that the student-run interventions in these studies were more focused on screening/diagnosis and patient education rather than ongoing intervention/treatment. Some studies that included blood pressure as an outcome found improvements[35,37] or outcomes comparable to national standards,[73] while others[24,28,34,38] found no significant differences. Of studies that included cholesterol as an outcome, two found no significant difference in lipid levels post intervention,[28,38] while four noted some improvements[24,34,35,37] and one outcome comparable to national standards.[36]

Hypertension

Treatment outcomes regarding hypertension were the second-most examined after diabetes, with six studies published since 2012. All studies relate to US-based SRCs involving medical school students, with one also including pharmacy students[45] and another pharmacy and nursing students.[42] Five[40,41,43–45] involved chart review of recorded blood pressure (mmHg) for patients receiving care in a primary care SRC. Usually, this was via a pre-post methodology measuring rates over time, sometimes incorporating cohort comparison of clinic rates with national or statewide averages. All found clinically significant decreases in blood pressure for hypertensive SRC patients, and – where assessed – control rates similar to those for hypertensive patients cared for in other clinical settings. The remaining study[42] investigated antihypertensive medication adherence rates for patients in a student-delivered medication review, education, and goal setting initiative. Significant improvements were observed in medication adherence and systolic BP, but not diastolic BP.

Functional Health and Quality of Life

Seven studies explored the impact of SRCs on the functional health or quality of life of participants across the lifespan and with a wide range of health conditions. A range of measurement tools, not all named, were utilized. Five functional health studies[26,46–48,50] included participants with diagnoses of Alzheimer's disease, stroke and/or traumatic brain injury. Interventions were provided by students of physical[48] or occupational therapy,[26,47,50] across a number of (10+) sessions, typically of one-hour duration. In the physical therapy study, routine care, not described in more detail, was provided. In the studies involving occupational therapy, students provided client-driven, tailored interventions to address identified needs and goals relevant to everyday functional tasks. All five studies measured outcomes based on clinically significant levels of change. Varying effects of treatment, from small to large, were noted. In the two quality of life studies, in which no specific health conditions were described, interventions were provided by physical therapy students in a clinic setting[49] or nursing students undertaking home visits.[25] In both cases, significant improvements in physical quality of life ratings were observed, with no significant changes found in other areas of health quality of life.

Depression

Three studies[51–53] focused on treatment outcomes for SRC patients with depression. Two related to the same SRC, the earlier of which found that the percentage of depressed clinic patients who had three follow-up visits within 12 weeks of diagnosis exceeded state averages for patients with commercial health plans or on Medicaid; and patients with newly diagnosed acute depression had better medication adherence rates than these comparison groups.[51] By contrast, the more recent measured antidepressant medication adherence rates and found generally *lower* rates than in these comparison groups.[52] Another study, of a program attempting depression screening of all patients presenting to a SRC, diagnosed 19 previously undiagnosed cases of depression amongst 206 patients screened. Of patients with depression cared for in this clinic with two or more PHQ-9 tests at least four weeks apart, 57.1% saw clinically significant improvement.[53]

Hospital Utilization

Of four studies that examined the impact of SRCs on hospital utilization, three[54–56] focused on the impact of SRC care on emergency department visits (and one of these[56] also on hospital observation admissions). Of these, one surveyed new and returning SRC patients regarding their ED visits in the past 3 months, finding returning patients had around half the per-patient ED visits of new patients.[54] The other two used pre-post chart review to assess hospital utilization prior to and

subsequent to enrolling in a SRC, one finding a qualified lessening in hospitalizations[56] and the other, with a larger sample, a significant decrease in ED utilization in the 18 months subsequent to SRC enrolment compared to the 18 months previous.[55] A further non-randomized control study,[57] of the results from a medical resident/pharmacy student-delivered counselling programme for heart failure patients prior to their discharge from hospital, found no difference in readmission rates compared to a control group.

Substance Use

Five studies looked at the success of substance use prevention/cessation in SRC contexts: four in the United States involving tobacco cessation interventions delivered to SRC patients[58–60] and one in Australia that examined both alcohol and tobacco use.[23] One US study evaluated an intervention where smokers identified in a student-delivered dentistry clinic were referred to smoking cessation education delivered by pharmacy students.[60] An increase in these patients' knowledge regarding tobacco cessation was found, but there was little impact on the likelihood of making a quit attempt compared to the control group. In the three other US studies, tobacco cessation programmes delivered by students resulted in reduced tobacco use.[58,59,61] The Australian study observed a slight reduction in the relative risk of alcohol use or smoking amongst those who had attended an SRC within the previous 12 months, compared to those who had last attended 12+ months previously.[23]

Weight Loss

Three studies reported on weight loss interventions delivered or facilitated by students. These studies, from the US[62,63] and Australia,[22] involved physician assistant students,[63] medicine/nursing and other health professional students[62] and dietetics students.[22] Interventions differed: physician-assisted students delivered motivational interviewing and counselling, students in the mixed-discipline study led a ten-week weight loss program (compared to one similarly delivered by professional psychologists and dietitians) and dietetics students ran a weight loss counselling program. The reported results were positive, with significant decreases in weight loss and minimal difference in comparison to professional-led interventions.

Health Screening/Vaccination

Another group of five studies, all from the US, measured SRC rates of health condition screening or vaccination rates, population-level public health interventions where improved coverage is the care goal. These studies used a cohort comparison methodology, whereby in-clinic coverage rates were determined by chart review and compared to reported state or national rates. Only one[64] was focused solely on vaccination rates – in this case, in a medical student-run clinic in Florida with a vaccination programme – and found vaccination rates in the clinic near or exceeding national rates. Two studies regarding screening, related to the same Florida clinic, found breast cancer screening rates greater than national rates for insured and uninsured women[66] and rates of cervical cancer screening exceeding national rates.[67] Two further studies explored coverage more comprehensively. One looked at rates of HIV, cholesterol (fasting lipid panel), diabetes (fasting blood glucose), and cervical cancer (pap smear) screening at a Connecticut SRC, observing rates lower than national averages but exceeding national uninsured averages.[65] A further study examined rates of smoking cessation counselling, alcohol abuse screening, colposcopy, mammography, pap smear, and pneumococcal and influenza vaccination rates in a New Jersey SRC, with some rates greater and some lower than state or national rates.[68]

Other

Four studies did not fit into the aforementioned categories. One measured longitudinal outcomes for 96 patients newly diagnosed with high cholesterol in a San Diego SRC, finding over a mean follow-up period of 5.5 months that mean LDL levels decreased from baseline to a level exceeding national care standards.[72] Another compared medication adherence rates for patients with latent tuberculosis infection undertaking a 9-month isoniazid treatment regimen in a SRC setting, finding adherence rates comparable to other clinics.[71] One focused on the impact of a SRC quality improvement intervention, finding improvements in some areas of care,[69] while a study of both diabetes and hypertension care in

a Colorado SRC found diabetes care standards better, but hypertension care standards worse, than those of patients in comparable settings.

Discussion

This integrative review sought to evaluate the health outcomes, broadly defined, and accrued by patients in student-run health clinics. A total of 51 studies were reviewed, representing a recent and burgeoning literature, with the first studies having been published in 2001[26,58] and 32 in 2015 or later. For context, the first SRC in the United States opened in 1967.[74]

Taken as a whole, the literature suggests that positive patient outcomes are associated with SRCs. For diabetes, the condition with the largest body of published evidence, the preponderance of studies indicated routine SRC care resulted in clinically significant improvements in clinical indicators and/or levels of care comparable to other settings. Although all studies measuring the impact of *routine* in-clinic SRC diabetes primary care were positive, one study[38] could not demonstrate clinically significant decreases in blood glucose in patients completing a student-delivered 24-month diabetes home visitation programme, and another[34] found a student-delivered education programme improved blood glucose only in a sub-sample of patients with especially poor baseline measures. Positive results were observed in all the published studies examining functional health/quality of life, those examining SRC hypertension care, those examining SRC depression treatment (relative to other settings), and those investigating student-run weight-loss interventions. It is important to caution, however, that while the literature is almost universally favourable, for most areas of patient care it remains limited, and evidence may be impacted by publication bias whereby null/negative results have remained unreported. This may be especially the case for this review, which does not include "grey" literature produced informally or remaining unpublished. Moreover, as Felder-Heim and Mader[70] have pointed out, it may be that only robust and well-established SRCs have the resources to conduct patient outcome evaluations, thus positively skewing reported results.

Diabetes, followed by hypertension, have been the subject of the greatest number of articles published to-date, reflecting the preponderance of these conditions in the US context where most studies were based.[75,76] A survey of US SRCs published in 2014 found diabetes and hypertension amongst the most commonly treated diseases.[77] Patient status for these conditions can also be measured by relatively straightforward biomarkers (ie, blood glucose/blood pressure), and so outcomes can be more practically and accurately assessed than can those for other conditions.

The patient groups and student-delivered interventions described in the reviewed studies merit some discussion. Patient characteristics in each of the studies were generally well described – as recorded in Table 2, almost all studies reported patient age, sex and ethnicity. Other characteristics not shown in the table but commonly reported, depending on clinic setting, were insurance status, employment status, housing/homeless status, migration status/origins and languages spoken. Some patient groups are not widely represented in the literature, notably Indigenous peoples (with some exceptions[23,32]), and also rural populations (except[23,25,35]), reflecting the urban nature of most medical schools and SRCs. Most reviewed studies involved only medical students in care delivery (n = 27, 51%). Compared to patient characteristics, details of clinic operations and the interventions provided were often limited. Future studies should clearly describe the duration, frequency, activity, intensity, etc., of interventions and the precise degree of student involvement, to aid readers in determining relevance to their interests and seeking to replicate successes.

In terms of coverage, some areas of care seem notably absent. A 2005 survey of the prevalence and operation of SRCs in all US medical schools[78] found 36% of SRC visits (across 57 clinics reporting) were for acute/emergent complaints, but these are essentially missing from studies of patient outcomes. Respiratory diseases are also missing (except for one study of a student-led tuberculosis treatment regimen), despite being a leading cause of death and disability[79] and also having been reported as amongst the chief clinical presentations in SRC contexts.[9,11,12] Notably, no included outcomes studies assessed SRC care for COVID-19. Many student-delivered interventions have been recorded during the pandemic – in various contexts, students have been engaged in administering vaccinations,[80–82] in telemedicine-based outreach and delivery,[83–85] and in screening, testing and contact tracing activities.[86–89] However, the safe and appropriate level of COVID care able to be provided by students remains a matter of debate (see[90–92]). Certainly, students may be better equipped to provide care for some conditions than others with greater complexity and risk. In this context, it may not be surprising that three studies related to medication adherence rates for depression care in SRCs[51–53] were the

only studies examining the quality of student-run interventions in mental health. While a small number of studies have looked at SRC health screening or vaccination rates, or the impact of student-run substance use and weight loss interventions, the potential for, and impact of, student-delivered health promotion initiatives more widely also seems underexplored.

Integrative reviews allow for findings to be incorporated and integrated into practice from a diverse range of methodologies.[18,19] Most studies reviewed here followed observational methodological approaches, either as pre-post (or case series) studies, comparing patients' status from baseline over a specified period of SRC care, or as cohort comparison studies, comparing SRC results with outcome data for patients in other settings, for example, amongst all local state Medicaid patients. Data collection approaches for both these types of observational studies varied. Most commonly data were gathered via retrospective chart review (PPCR or CCCR), but patient surveys (PPS or CCS) or, more rarely, prospective measurements (PP) were used. Observational methods can allow for meaningful and valid conclusions, particularly as in these cases where baseline or comparator data are included.[93] However, greater confidence in care-related findings would result from more robust future research designs. Few studies used experimental or even quasi-experimental methodologies.

Study quality in this field could also be improved in other important ways. Many of the reviewed studies are underpowered, with a median study sample (including controls where applicable) of 85.0. Detecting anticipated effects with any degree of confidence requires a certain number of subjects, but very few of the studies include any evidence of power calculations being considered or conducted.[94] Data were also typically collected retrospectively and out of convenience. While acknowledging the limited resources of SRCs, robustly planned prospective data collection would maximize study reliability and validity. Studies (with some exceptions[35,43,72]) measured outcomes only at single clinic sites, which may limit the generalizability of findings. This is also true at the national scale: most (n = 46, 90%) located studies related to US SRCs. Given the uniqueness of the US healthcare system, may not be comparable to other national contexts.

Some limitations of the present review must be acknowledged. First is that this study did not incorporate a systematic quality appraisal of reviewed studies. A key strength of integrative reviews lies in allowing for various perspectives on a phenomenon to be synthesized,[18] but the wide and heterogeneous range of interventions and outcomes measured largely precluded an analysis of study quality on a like-for-like, systematic basis. The analyses have nevertheless allowed for drawing conclusions and recommendations for the field from a wide basis. Other limitations include the exclusion of non-English language studies, as well as the possibility of the search not having captured all relevant literature (especially given the plethora of possible terms to describe care or interventions provided by students). Confidence in the findings is nevertheless supported by the broad range of included studies and the general consensus in findings observed in each of the grouped patient outcome types.

Conclusion

Of 51 studies measuring the health outcomes associated with SRCs, nearly all indicate improvements in patient conditions, or outcomes comparable to those of similar patients treated in non-SRC settings. Generally positive findings are observed over a range of clinical focus areas, timeframes, and interventions. As noted, future research would benefit from improvements in study design and reporting, with generalizability of studies limited and some areas of care underexplored. Nevertheless, the evidence published to date suggests that SRCs can achieve positive health outcomes across a range of patient conditions.

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