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Education without walls: Using a street medicine program to provide real-world interprofessional learning

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ABSTRACT

Interprofessional education (IPE) is a core component of the curricula for many healthcare and social work training programs and has been shown to increase student self-efficacy, communication skills, and attitudes toward other professions. Street medicine programs expand options for teaching interprofessional, team-based care of vulnerable populations, such as those experiencing homelessness. Street Medicine Phoenix is an interprofessional team of health professions students and faculty that provides outreach to Phoenix's homeless population. This study demonstrates the impact of volunteering in our street medicine program on the perceived development of interprofessional skills and behaviors. Volunteer teams, with representatives from medicine, nursing, social work, physical therapy, occupational therapy, public health, and undergraduate studies, completed the Interprofessional Collaborative Competencies Attainment Survey (ICCAS) before and after semester-long, monthly outreach events. Results demonstrate statistically significant improvements in overall ICCAS scores for all volunteers, but there was no relationship between number of shifts completed and ICCAS score improvement. Based on these findings, street medicine programs could be considered as an option for providing interprofessional learning to students in healthcare and social work degree programs. Street medicine outreach can supplement didactic and simulation skill-building activities in the IPE curricula with point of care, real-world experiential learning.

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Introduction

Interprofessional education (IPE) is now widely understood as a process where two or more students and/or providers from different disciplines learn from, with, and about one another to achieve improved health outcomes through more effective collaborations (World Health Organization, 2010). IPE reflects the synergy between interprofessional education, interprofessional practice, and collaborative practice (National Center for Interprofessional Practice and Education, n.d.). The benefits of IPE in clinical settings have been demonstrated, such as reduced patient length of hospital stay and fewer medical errors, sparking the development of new IPE models (Barr et al., 2005). In addition, IPE increases mutual respect and trust (Interprofessional Education Collaborative, 2016, p. 13), promotes effective communication (Liaw et al., 2014), and improves understanding of professional roles and responsibilities (Angelini, 2011). For these reasons, IPE has been incorporated into the curricula of many health and social care programs to foster more effective and creative collaboration across professions to improve health outcomes and advance population health (Interprofessional Education Collaborative, 2016, p. 4).

Multiple accrediting bodies currently require IPE training in a variety of degree programs including Doctor of Medicine (MD; Liaison Committee on Medical Education, 2018), Doctor of Osteopathic Medicine (DO; Commission on Osteopathic College Accreditation, 2019), Physical Therapist (PT; Commission on Accreditation in Physical Therapy Education, 2020), Occupational Therapist (OT; Accreditation Council for Occupational Therapy Education, 2018), Master of Public Health (MPH; Council on Education for Public Health, 2016), Master of Social Work (MSW; Council on Social Work Education, 2015), and Bachelor of Science in Nursing (BSN; Commission on Collegiate Nursing Education, 2018). Variability in competencies and assessment methods prompted these accrediting bodies to create a consensus guidance document to support the development of IPE for health professional programs (Buring et al., 2009; Health Professions Accreditors Collaborative, 2019).

One promising practice gaining acceptance in interprofessional application is street medicine. Street medicine is the provision of health and social services developed to address the unique needs and circumstances of the homeless population delivered directly to them in their own environment (Street Medicine Institute, n.d.). Student and preceptor

volunteers from a multitude of disciplines form interprofessional teams and provide outreach services to individuals experiencing homelessness.

Background

High-value, team-based patient care has become a standard across many healthcare systems (Reiss-Brennan et al., 2016). Research on the growing use of high value, team-based approaches in healthcare settings has identified improvements in quality of care, reduced acute care use, and lowered healthcare costs when compared to traditional practice management (Reiss-Brennan et al., 2016). Integration of learners into interprofessional teams is crucial in the professional identity formation of future care providers (Reeves et al., 2017). Students benefit from interactions with peers in a nonhierarchical, open setting that facilitates collaboration and engagement with different styles of patient care (Reeves et al., 2017).

In 2016, the Interprofessional Educational Collaborative (IPEC) provided an updated guide on the core competencies needed for effective practice under one domain, Interprofessional Collaboration (IC). IC consists of four primary topic areas: values and ethics, roles and responsibilities, teams and teamwork, and interprofessional communication (Interprofessional Education Collaborative, 2016).

Overview of street medicine

The goal of street medicine programs is to serve as a form of intermediate “home care” until the patient can be connected with a comprehensive interprofessional team that can longitudinally coordinate the patient’s care (Street Medicine Institute, n.d.). Involvement in street medicine programs improves student knowledge on homeless issues, attitudes toward individuals experiencing homelessness, and skills to assess and manage the healthcare needs of the homeless population (Asgary et al., 2016). In addition, street medicine programs provide opportunities to incorporate social justice and humanism into healthcare education and to sensitize students to the complex realities of caring for the homeless population (Doohan & Mishori, 2020). These complexities necessitate increasing student exposure to other professions to ensure the diverse and holistic needs of this population are met (Doohan & Mishori, 2020).

Our street medicine program, called Street Medicine Phoenix (SMP), provides health care, social work services, and other individualized services to individuals experiencing homelessness across Phoenix, Arizona. We use a comprehensive and inclusive IPE model to provide holistic patient care by integrating a multitude of disciplines to address complex patient needs. These professions include, but are not limited to: medicine, nursing, occupational therapy, physical therapy, public health, social work, and undergraduate college students enrolled in a variety of degree programs, including STEM (science, technology, engineering, mathematics), business, and the humanities. The scope of interprofessional collaboration is unique to SMP; most street medicine program descriptions note inclusion of limited numbers of interprofessional volunteers, such as medical, nursing, social work, and

occasionally pharmacy (Michigan State University College of Osteopathic Medicine, n.d.; Street Medicine Detroit, n.d.; University at Buffalo Jacobs School of Medicine and Biomedical Sciences, n.d.).

Similar to established IPE practice models, SMP provides opportunities for learners to understand others’ disciplines and their own role in the team (Bridges et al., 2011). Early on, learners are provided with a common framework that illustrates a best practice approach for interprofessional interaction and represents a longitudinal developmental goal that learners can work toward (Bridges et al., 2011). In SMP, this framework is presented through live demonstration, whereas in other models this framework is typically presented through didactics. Another area in which SMP overlaps with other IPE models is that learners are able to witness firsthand the impact of their interprofessional efforts through experiential training with real patients. In other practice models, these activities typically represent the culmination of what the learners have learned and enable them to apply their new knowledge and skills to real-world situations (Bridges et al., 2011; Cook, 2005). Additionally, in many IPE models the needs of the patients and the responsibilities of the learners are pre-determined before the clinical-based learning occurs (Bridges et al., 2011). However, in SMP the learners’ responsibilities vary considerably from patient to patient depending on the unique needs of each patient.

The purpose of this study was to ascertain whether a street medicine program could be used as a real world clinical setting for an IPE intervention.

Methods

Study design

We conducted a pre-post prospective interventional study from August 2019-March 2020, which included the Fall 2019 and Spring 2020 semesters. The study was terminated 2 months early due to safety concerns from the COVID-19 pandemic. The intervention was involvement in the preexisting SMP program. We aimed to assess the impact of the normal interprofessional interactions and activities of volunteers in this program on their perceived interprofessional attitudes and skills. Perceived interprofessional attitudes and skills were measured before and after participation in SMP to establish a baseline and measure change.

Study population and recruitment

SMP volunteers were students and faculty preceptors who participated in SMP outreach events in metro Phoenix, Arizona. All were affiliated with one of the three public universities in Arizona: The University of Arizona, Arizona State University, and Northern Arizona University. Inclusion criteria limited the study population to SMP volunteers who completed at least one volunteer shift. SMP student volunteers were enrolled in one of the following programs: medicine, nursing, occupational therapy, physical therapy, public health, social work, or undergraduate non-healthcare major. SMP preceptor volunteers were licensed in Arizona and currently

practicing one of the following professions: medicine, nursing, physical therapy, occupational therapy, or social work. Exclusion criteria included students and preceptors not affiliated with one of the three public universities in Arizona, minors (<18 years of age as defined by our state), and volunteers who were unable to consent. This study was reviewed by the Arizona State University Institutional Review Board and given exempt status (IRB# HRP-503a).

We conducted recruitment for the study before the first SMP shift of each semester. All student and preceptor volunteers on the existing SMP e-mail listserv were invited to participate via an emailed link to an encrypted REDCap® (Version 11.3.3) survey (Harris et al., 2009). Students and preceptors initially learned about SMP through a variety of methods, including class presentations, volunteering fairs, word of mouth, targeted e-mail advertisements to student clubs and professional organizations, and social media. We added those who expressed interest in volunteering to the e-mail listserv. In addition, we recruited many volunteers from another interprofessional service learning program that was developed as a result of a tri-university collaboration among The University of Arizona, Arizona State University, and Northern Arizona University using recruitment e-mails sent through their e-mail listserv and informational in-person presentations targeted specifically to participants in their programs.

ICCAS instrument

The ICCAS was created and validated to assess the perceived development of interprofessional skills and team-based competencies of healthcare providers and students via a 20-item self-rated survey (Archibald et al., 2014; MacDonald et al., 2010). ICCAS items were intentionally grouped to reflect the six interprofessional competency domains outlined in the Canadian Interprofessional Health Collaborative (CIHC) Framework (Canadian Interprofessional Health Collaborative, 2010; MacDonald et al., 2010). These core IPE competencies are communication, collaboration, roles and responsibilities, collaborative patient/family-centered approach, conflict management/resolution, and team functioning. We used the original 2009 version of the ICCAS tool. We did not use the updated 2018 ICCAS version because we believed that the seven-item Likert-type agree-disagree response scale from the original ICCAS tool would yield better response discrimination and was more balanced than the five-item scale from the updated 2018 ICCAS tool (Schmitz et al., 2017).

We selected the ICCAS tool for this study because we wanted to assess the change in perceived interprofessional collaboration-related competencies in students and preceptors who volunteered with SMP. However, perception is not equivalent to competency attainment. The ICCAS enables administrators to measure perceived competency attainment to better evaluate the effectiveness of interventions (Archibald et al., 2014).

Study intervention

The intervention used for this study was a team-based interprofessional street medicine outreach program. At the start of each four-month academic semester, volunteers signed up for

one of four possible teams. We assigned each team to one volunteer shift per month for a total of four shifts over the course of the semester. However, some students and preceptors volunteered with multiple teams in a given semester. Team A provided outreach to individuals living and sleeping on the streets outside of the city homeless shelter. Teams B and C engaged individuals residing in the city homeless shelter and utilizing the associated resource center. Team D cared for individuals at a local church in metro Phoenix. These teams remained together for the entirety of the academic semester. Within each team, we constructed smaller sub-teams consisting of 3–4 students from different disciplines. A few sub-teams had two members from the same discipline due to the unequal distribution of participants in each discipline.

Each sub-team engaged with patients in an adaptable manner based on patient needs as identified by intake survey and conversation with a “patient navigator” member of the sub-team. Patient navigators accompanied patients throughout their visits with various disciplines in a manner that promoted rapport-building, continuity in communication, and “warm handoffs” between various services being provided. Warm handoffs entailed the patient navigator introducing the patient and providing a brief summary of the patient’s needs to the next member of the street medicine team who was going to care for them in front of the patient to provide the patient the opportunity to correct any errors. Services included providing health screenings (e.g., blood pressure, blood sugar.); wound care; vaccinations (i.e., flu and Hepatitis A); health education; vision screenings; community resource referrals; musculoskeletal and mobility assessment; and donations of hygiene supplies, clothes, backpacks, and other life essentials.

Prior to each volunteer’s first shift, we oriented them to the SMP mission, protocols, equipment, interprofessional team structure, and safety information, and provided guidance on how to effectively interact with individuals experiencing homelessness (e.g., de-escalation approaches, trauma-informed care methods). Every orientation followed the same format and was led by the medical student and public health student leaders of SMP, both of whom had no prior formalized training in IPE. In parallel, we provided health professional preceptor volunteers with customized training about their responsibilities as preceptors/mentors and their role within the interprofessional teams. However, preceptors did not receive any form of IPE facilitation training. All of the preceptors had several years of experience with IPE facilitation, but data regarding the exact length of experience were not collected. The preceptor-specific training followed the same scripted format each time and was led by the faculty physician leader of SMP who had almost 10 years of experience in IPE curriculum development and facilitation.

Immediately after each shift, we conducted an oral team debrief in which all volunteers reflected on their experiences, shared lessons learned, and provided feedback for future outreach improvement. Every debrief followed the same format and was led by the medical student leader of SMP who had no prior formalized training in IPE. Neither student nor preceptor volunteers received preparation for or follow-up on this study. The intention was to allow their experiences caring for

individuals experiencing homelessness and their relationships with their interprofessional team members serve as the IPE, creating a real-world IPE classroom.

Study procedures

Individuals agreed to participate in our study by providing consent on the first question of the electronic survey. Following consent, we solicited demographic and other information, including role (student or preceptor), discipline or program (depending on whether the volunteer was a student or preceptor), major (if an undergraduate student), team letter, and number of completed shifts. Study participants completed the survey electronically before their first street medicine shift either on tablets provided by SMP or at home using the encrypted REDCap® (Version 11.3.3) survey link emailed to them (Harris et al., 2009). We did not assess any previous exposure to IPE in the participants prior to their participation in the study.

At the end of each academic semester, we sent participants who completed the pre-survey an encrypted REDCap® (Version 11.3.3) survey link to complete the ICCAS tool again (Harris et al., 2009). Some participants volunteered during both academic semesters (Fall 2019 and Spring 2020); these volunteers were sent the post-survey at the conclusion of each semester. We de-identified all data, and each participant created a unique record ID using their initials and birthdate.

Data analysis

All data analyses were conducted using Stata v15 (College Station, Texas). We reported survey participants, demographics, and volunteer characteristics (number of shifts, team letter, role [student or preceptor], and discipline) as means, standard deviations for continuous variables and frequencies, and percentages for categorical variables. For data analysis, we categorized volunteers who self-identified as Asian Indian and Black or African American into Other for race. Participants representing physical therapy, occupational therapy, public health, and social work were combined into one category due to low sample size. In addition, we combined the results of students and preceptors due to the low sample size of preceptors. Since all of the covariates were categorical, chi-squared analysis and Fisher's exact test were used to compare the covariates among the three shift categories (1–2 shifts, 3–4 shifts, ≥ 5 shifts). If the overall p value was statistically significant, pairwise comparisons were conducted followed by Bonferroni corrections.

We reported items from the ICCAS tool as means and standard deviations for the pre-survey and post-survey. The Wilcoxon signed rank test was used to assess whether the change between pre- and post-survey scores were statistically significant. We calculated Cohen's d effect sizes using the mean and standard deviation of the change scores (i.e., post- minus pre-score for each item). To evaluate the overall impact on each ICCAS core competency, we calculated the mean of the Cohen's d effect size. To interpret the magnitude of change in perceived skills and behaviors, $d < 0.50$, $0.50 \leq d < 0.80$, and $d \geq 0.80$ were considered

small, medium, and large effects, respectively (Cohen, 1988). All p values were two-sided and $p < .05$ was considered statistically significant.

Results

A total of 87 volunteers participated in the study: 67 were students, and 20 were preceptors. There were 21 volunteers who participated in both the fall and spring semesters, 17 of whom were students and 4 preceptors. The number of students and preceptors from each semester along with the total number and average number of shifts can be found in Table 1.

Participants represented several disciplines including medicine, nursing, undergraduate, physical therapy, social work, occupational therapy, and public health. Additional demographic information is listed in Table 2.

Table 3 displays the change in overall ICCAS score from pre- to post-intervention along with the change in means for each ICCAS item, partitioned by core competency. There was a statistically significant increase in the overall ICCAS score between the pre-survey and post-survey. In addition, there was a statistically significant increase in mean ratings of perceived ability for each ICCAS item. However, there was no statistically significant improvement in ICCAS scores based on the number of shifts completed.

Table 3 also shows the mean difference between the pre- and post-intervention means and corresponding effect sizes. Large effect sizes were observed for the following ICCAS items/core competency: "Recognize how others' skills and knowledge complement and overlap with my own"/Roles and Responsibilities; "Use an IP team approach with the patient to assess the health situation"/Collaborative Patient/Family-Centered Care; and "Address team conflict in a respectful manner"/Conflict Management/Resolution. A large effect size was also observed for the overall ICCAS score.

Table 1. Student and preceptor volunteer breakdown for fall 2019 and spring 2020 street medicine.

Semester	Number of Students	Total Number of Student Shifts	Average Number of Student Shifts	Number of Preceptors	Total Number of Preceptor Shifts	Average Number of Preceptor Shifts
Fall 2019	26	175	3.7	8	27	3.4
Spring 2020 ^a	24	56	2.3	8	25	3.1
Fall 2019 and Spring 2020	17	106	6.2	4	25	6.3

Phoenix Outreach Events

This table displays the number of student and preceptor study participants divided by semester. The total number and average number of shifts are shown separately for students and preceptors and divided by semester. The students and preceptors who volunteered in both fall 2019 and spring 2020 are listed separately and not included in the volunteer counts for the individual semesters.

^aThe Spring 2020 semester was terminated two months early due to the COVID-19 pandemic.

Table 2. Demographics of street medicine Phoenix student and preceptor volunteers.

Baseline Characteristic	%	<i>n</i>
Gender		
Female	65.5	57
Male	34.5	30
Race		
White or Caucasian (non-Hispanic)	54.0	47
Asian	23.0	20
Asian Indian ^a	11.5	10
White or Caucasian (Hispanic)	6.9	6
Black or African American ^a	4.6	4
Discipline/Profession		
Medicine	32.2	28
Nursing	25.3	22
Undergraduate	19.5	17
Physical Therapy	8.1	7
Social Work	8.1	7
Occupational Therapy	5.7	5
Public Health	1.1	1
Undergraduate Student Majors ^b		
Medical Sciences	29.4	5
Biological Sciences	23.5	4
Biochemistry	17.7	3
Finance	17.7	3
Nutrition	5.9	1
Kinesiology	5.9	1

N = 87. Demographic information for students and preceptors are combined when reporting gender, race, and discipline/profession.

^aCategorized into the Other race category for data analysis purposes

^bAlthough some undergraduate students had majors unrelated to healthcare, all students were designated as pre-health students (either pre-medical or pre-dental). This meant that they intended to pursue a graduate degree in a health professions program after completion of their undergraduate major. The university that these undergraduate students attended (Arizona State University) did not have a pre-health, pre-medical, nor pre-dental major.

Discussion

The results demonstrate that volunteering in our street medicine program yielded improvements in perceived interprofessional skills and behaviors. To our knowledge, this is the first study to investigate this question. The improvements in perceived interprofessional skills and behaviors were similar among all volunteers and were not affected by the number of shifts completed. This means that students and preceptors who volunteered for only a few shifts in our street medicine program received similar IPE and skill-building as the volunteers who attended more shifts. However, as we did not measure previous exposure to IPE, this limits our ability to conclude that the number of shifts completed was not significant. Future studies are necessary to definitively determine the presence or absence of an exposure-response relationship based on the number of volunteer shifts completed.

SMP was designed as an interprofessional initiative to improve understanding of one's own roles and those of other disciplines and to meet the complex needs of individuals experiencing homelessness (Roles and Responsibilities) using effective, non-judgmental communication (Communication). The perceived improvements in these competencies signify the participants' increased understanding of and ability to perform interprofessional processes in general. SMP also emphasizes a patient-centered, goal-oriented approach to care, which coincides with the significant improvement in the Collaborative Patient/Family-Centered Approach competency. The improvement in perceptions of this competency

demonstrates the participants' increased recognition of how the interprofessional process is used in patient care and enhanced ability to apply the interprofessional approach to provide real-world patient-centered care. The noted perceived improvements across all of these competencies for our participants highlight the utility that street medicine programs can have as IPE experiences and provides another avenue through which educators can augment the perceived interprofessional attitudes and skills of their learners. The street medicine outreaches provided an effective training environment for developing interprofessional attitudes and skills and providing preparation for future interprofessional practice.

Our findings mirror the results of previous studies that used the ICCAS tool to assess the impact of various, non-street medicine oriented IPE activities on perceived interprofessional skills. In these studies, a variety of IPE methods were employed including simulation (Kostoff et al., 2016; Mokler et al., 2020), structured clinical examinations (Doloresco et al., 2019), team-based learning (Wheeler et al., 2019), and immersion events (Houle et al., 2020; Nagge et al., 2017). Other researchers have used novel assessment tools and qualitative methods to demonstrate the positive impact of community service learning on perceived interprofessional skills (Buff et al., 2015; Sevin et al., 2016). Our street medicine program overlaps in numerous respects with these other IPE methods, particularly community service learning courses, but significant differences exist including the lack of formalized didactics and the provision of services in non-clinical settings (e.g., on the streets).

Although many studies have been conducted on interprofessional healthcare teams consisting of traditional health professionals, such as medicine, nursing, and pharmacy, in primary and integrated care settings, few exist including social workers as team members (Fraser et al., 2018), and none were identified in a street medicine setting. The value of social work to the street medicine team stems from their experience in interprofessional team leadership (Lambert, 2019). Social workers are often responsible for bringing awareness to the interprofessional team of the different domains that affect a patient's access to services and advocating on behalf of the patient (Lambert, 2019). Involving more disciplines like social work in the interprofessional team provides additional opportunities for participants to learn about different roles and develop their interprofessional skills, such as communication. The unique skillset of social work enhances the interprofessional growth of participants in ways that could not be replicated without their inclusion.

The ICCAS identifies perceived benefits from respondents, and it is a valuable tool in identifying our volunteers' self-reported progression of skills over time and how it may enhance their learning as well as the therapeutic alliance with those served on the streets. Given these results, SMP can identify how to better adapt future street outreach events and experiences to further improve these ICCAS gains over time. This study provides a framework for other street medicine programs to integrate into their operations to bolster their IPE experiences while strengthening their ability to provide care to individuals experiencing homelessness.

Table 3. Pre-/post-survey mean scores, change in mean scores, and Cohen's *d* effect sizes for ICCAS items.

ICCAS Item	Pre Mean (SD)	Post Mean (SD)	Change in Means (SD) ^a	Cohen's <i>d</i>	Size of Effect
Communication					
Promote effective communication among members of an interprofessional (IP) team	5.8 (1.2)	6.5 (0.8)	0.7 (1.3)	Mean Cohen's <i>d</i> = 0.62 0.63	medium
Actively listen to IP team members	6.2 (1.2)	6.6 (0.7)	0.4 (1.2)	0.49	small
Express my ideas and concerns without being judgmental	5.9 (1.2)	6.5 (0.8)	0.6 (1.2)	0.61	medium
Provide constructive feedback to IP team members	5.8 (1.3)	6.5 (0.9)	0.7 (1.3)	0.64	medium
Express my ideas and concerns in a clear, concise manner	5.7 (1.3)	6.5 (0.8)	0.8 (1.3)	0.72	medium
Collaboration					
Seek out IP team members to address issues	5.7 (1.3)	6.5 (0.8)	0.8 (1.4)	Mean Cohen's <i>d</i> = 0.73 0.76	medium
Work effectively with IP team members to enhance care	5.9 (1.2)	6.6 (0.7)	0.7 (1.3)	0.76	medium
Learn with, from and about IP team members to enhance care	5.9 (1.2)	6.5 (0.7)	0.6 (1.3)	0.68	medium
Roles & Responsibilities					
Identify and describe my abilities and contributions to the IP team	5.6 (1.3)	6.4 (0.9)	0.8 (1.4)	Mean Cohen's <i>d</i> = 0.75 0.75	medium
Be accountable for my contributions to the IP team	5.9 (1.2)	6.6 (0.7)	0.7 (1.2)	0.75	medium
Understand the abilities and contributions of IP team members	5.8 (1.3)	6.5 (0.9)	0.7 (1.4)	0.66	medium
Recognize how others' skills and knowledge complement and overlap with my own	5.7 (1.3)	6.6 (0.7)	0.7 (1.2)	0.83	large
Collaborative Patient/ Family-Centered Approach					
Use IP team approach with the patient to assess the health situation	5.6 (1.3)	6.6 (0.7)	1.0 (1.4)	Mean Cohen's <i>d</i> = 0.75 0.90	large
Use IP team approach with the patient to provide whole person care	5.7 (1.2)	6.5 (1.1)	0.8 (1.3)	0.69	medium
Include the patient/family in decision-making	5.7 (1.4)	6.4 (0.6)	0.7 (1.7)	0.65	medium
Conflict Management/ Resolution					
Actively listen to the perspectives of IP team members	6.0 (1.2)	6.7 (0.6)	0.7 (1.2)	Mean Cohen's <i>d</i> = 0.79 0.75	medium
Take into account the ideas of IP team members	6.0 (1.2)	6.7 (0.6)	0.7 (1.2)	0.75	medium
Address team conflict in a respectful manner	5.7 (1.2)	6.6 (0.7)	0.9 (1.3)	0.86	large
Team Functioning					
Develop an effective care plan with IP team members	5.6 (1.3)	6.3 (1.0)	0.7 (1.6)	Mean Cohen's <i>d</i> = 0.67 0.61	medium
Negotiate responsibilities within overlapping scopes of practice	5.6 (1.3)	6.5 (0.9)	0.9 (1.5)	0.73	medium
Overall Score	116.0 (21.4)	130.4 (12.2)	14.4 (21.8)	0.84	large

This table displays individual items from the ICCAS tool, partitioned by core competency, reported with means and standard deviations (SD) before and after volunteering with Street Medicine Phoenix. Cohen's *d* effect sizes with size of effect are reported for each ICCAS item. Mean Cohen's *d* for each ICCAS core competency are also reported.

^aChange in means calculated by subtracting the pre mean from the post mean.

Through the outreach provided during this study, over 750 individuals experiencing homelessness received services such as health screenings (e.g., blood pressure, blood sugar), wound care, vaccinations (flu and Hepatitis A), sexually transmitted infections testing and treatment, community resource information, hygiene supplies, and other needed services. The preceptorship component allowed students to receive hands-on training from experts in numerous professions and facilitated the development of relationships for mentorship. Moreover, undergraduate student volunteers connected with graduate students in their discipline of interest for mentorship and career guidance.

For future research, a descriptive qualitative study of street medicine programs through a more in-depth look at team dynamics, how the various disciplines are used, and scope of practice overlaps is recommended. A multi-case embedded

qualitative case study would also provide an opportunity to crosswalk student satisfaction and individual characteristics with student educational levels and team roles.

Based on our results, we believe inclusion of street medicine outreaches in IPE curricula for all patient-oriented disciplines, including healthcare and social work, could be beneficial. This may be accomplished through collaboration with an existing local street medicine program or creation of a new street medicine program, based on institutions' and stakeholders' needs. Interprofessionalism didactics can be supplemented with clinical team-based learning experiences, such as street medicine outreaches, to reinforce key theories and provide practical experience working across disciplines. Street medicine options not only teach students how to effectively collaborate with individuals from other disciplines, but also test

their ability to provide care and services to patients in a resource-restricted, austere environment. By providing services directly on the streets where individuals experiencing homelessness live, learners better understand the living conditions and barriers to care of their patients, helping elucidate the context behind their disease and expressed needs.

Limitations

The results of this study should be considered in the context of several limitations. In contrast to most studies that used the ICCAS, we administered the tool in pre- and post-fashion, rather than retrospective pre-post. Because the period between pretest and posttest was roughly 4 months in length for all participants (8 months for participants who participated in both semesters), we were concerned that the participants would have difficulty accurately assessing their interprofessional skills on the pretest, potentially leading to overestimation and reducing the significance of the change from pre- to post-measure. Other studies that similarly used the ICCAS in pre- and post-fashion (Hartnett et al., 2019; Smith et al., 2018) and some experts have called for this modified use to mitigate bias (Archibald et al., 2014). However, the use of the tool in pre- and post-fashion may have introduced response shift bias, which can occur as volunteers change their frame of reference over the course of the program, leading to overestimation of abilities and knowledge prior to volunteering (Drennan & Hyde, 2008; Pratt et al., 2000). This may explain the high baseline scores observed for each ICCAS item.

Although all volunteers were scheduled for four shifts per semester, some volunteers were not able to attend all of their scheduled shifts while others participated in more than their four scheduled shifts based on their desire to increase their involvement in SMP. The COVID-19 pandemic abruptly halted SMP outreach halfway through the Spring 2020 semester, causing most of the volunteers to only be able to complete two of their four scheduled shifts. These differences in shifts likely did not affect overall ICCAS scores based on the lack of an exposure-response relationship between ICCAS score and number of shifts completed.

Due to the subjectivity of the ICCAS tool, a reporting bias may exist. Participants may have felt compelled to report favorable results because they were affiliated with SMP and felt some form of loyalty to the program. Alternatively, students may have overestimated the effect of the program on their interprofessionalism skills and knowledge. Because there was no control group, it was difficult to delineate whether the participants' improvements in ICCAS scores is due to volunteering in our street medicine program, advancement through their training programs which typically contain IPE, or a combination of the two. The ICCAS tool measures self-perceived improvement in interprofessional skills and behaviors, not actual competency.

Another limitation is the variability in outreach settings and team composition. Settings included encampments on the streets, a church, and a homeless shelter, which significantly impacts how interprofessionalism is practiced. Also, each outreach team consisted of different disciplines, further contributing to the diversity in experience. Accordingly, our results are not necessarily applicable to other street medicine programs due to the heterogeneity between programs, including variations in

disciplines represented and outreach settings. Additionally, many of the participants were recruited from a preexisting interprofessional service-learning program, which may have introduced bias due to these participants' affiliation with a program that is IPE in nature. Lastly, the small sample size complicated the ability to perform effective sub-group analysis and to determine whether participant characteristics, such as discipline or role (student vs. preceptor), affected IPE and skill-building. Future researchers should recruit a larger sample size to allow for separate analysis and comparisons between these groups.

Conclusion

Our study demonstrated statistically significant improvements in overall ICCAS scores for volunteers in our street medicine program. We found no exposure-response relationship between number of volunteer shifts completed and degree of improvement in interprofessional skills and behaviors. However, the lack of measurement of baseline IPE exposure limited elucidation of this relationship. Future researchers should measure these variables, and consider an objective method of assessing demonstrable competencies, in addition to perceived improvements. Incorporating street medicine outreach into IPE curricula for health- and social care-oriented disciplines can improve learners' perceived ability to function in an interprofessional team and provide needed services to individuals experiencing homelessness.

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Data Availability Statement

The data that support the findings of this study are openly available in Harvard Dataverse at <https://doi.org/10.7910/DVN/U2AATI>.

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