Journal of Student-Run Clinics
Original Study

Relationship of Volunteer Student-Run Clinic Experience with Future Primary Care and Underserved Practice

Ruby P Shah, MD, MPH[1]; Tonya L Fancher, MD, MPH[1,2]; Anthony Jerant, MD[3]; Anthony Bhe, MD[1]; Mark C Henderson MD, FACP[1,2]

[1]Department of Internal Medicine, University of California, Davis, Davis, California, USA
[2]School of Medicine, University of California, Davis, Davis, California, USA
[3]Department of Family and Community Medicine, University of California, Davis, Davis, California, USA

Corresponding Author: Ruby P Shah, MD, MPH; email: ruby.shah@ucdmc.ucdavis.edu

Published: September 20, 2018

Abstract

Background: Student-run clinics (SRCs) are increasingly common at or in partnership with medical schools, providing service-based learning to students and increasing access to care for underserved populations. Early, small studies suggest that student participation may be associated with eventual practice in primary care and in medically underserved areas, but current career outcomes are largely unknown. The purpose of this study is to determine the relationship between participation in SRCs, primary care (PC) career choice, and future practice setting.
Method: For all graduates of the University of California, Davis from 2004 to 2008 (N=454), the authors determined practice specialty (family medicine, general internal medicine or pediatrics, or not) and practice setting (health professional shortage area [HPSA] or not) two to five years after residency. Multivariate analysis adjusted for level of SRC participation, age, gender, race, more than one language spoken, total dollar debt at graduation, research experience during medical school, Medical College Admission Test, and United States Medical Licensing Examination Step 1 and 2 performance.
Results: Of 454 total graduates, 68% participated in a SRC. In adjusted analyses, committed SRC participation was associated with PC practice after residency (adjusted odds ratio [AOR] 2.15, 95% confidence interval [CI] 1.18-3.75) and intermittent SRC participation was not (AOR 1.13, 95% CI 0.65-1.99). The sole predictor of post-residency practice in a HPSA was more than one language spoken (AOR 1.97, 95% CI 1.20-3.25). Race was not significantly associated with practice in HPSAs.
Conclusions: This study indicates that students who were committed SRC volunteers were more likely to practice in PC after residency. These findings suggest that participation in SRCs may increase graduates practicing in PC, but further studies are required to address the strength of the relationship between SRC participation and future PC practice.

Introduction

The United States (US) faces a shortfall of primary care (family medicine, general internal medicine, and general pediatrics) physicians that will exceed 45,000 by the year 2025.[1] This shortage disproportionately affects the uninsured, racial or ethnic minorities, those living in rural or inner-city areas, and people of lower socio-economic status.[2] As of January 2013, there were 57 million people living in health professional shortage areas (HPSAs) – geographic areas with 3,500 or more people per primary care physician.[3] Access to primary care (PC) remains a critical component of health. While the Affordable Care Act has reduced the number of uninsured Americans, the influx of patients newly insured has further taxed an already burdened PC system.[2] There are currently not enough PC physicians in the medical education pipeline to meet the need. While many residency programs focus on PC careers and medically underserved communities,[4-6]

medical student interest in PC remains low. The number of US medical school graduates matching into PC residencies in 2010 was 16-18%,[2] with as few as 2% of graduating students planning to enter PC internal medicine.[7] Two national surveys found that while students may enter medical school intending to practice PC, their interest erodes as they progress through their medical education and training.[8,9]

Although career choice is a complex, multifactorial process that includes less-modifiable influences such as lifestyle and financial preferences,[7,10-12] medical schools can develop curricula that may enhance the PC pipeline.[13-15] Mentorship by PC physicians, participation in longitudinal patient care experiences, exposure to community-based programs and exposure to underserved communities have all been associated with PC career choice.[14,16-18] Student-run clinics (SRCs) have the potential of bringing all of these influences together while offering low or no-cost care to medically underserved communities.[19-21] SRCs are also increasingly common; as of 2012, at least 72 medical schools had been reported to support at least one SRC.[22] The effects of SRC participation and associations with career outcomes is unclear. Although an early observational study found a positive relationship between SRC participation and PC residency choice,[23] a more recent study found no relationship.[22] For this study, we established a longitudinal student database for tracking of medical student residency choice and eventual specialty and practice setting. Using this cohort, we sought to examine the relationship between SRC participation during medical school and post-residency PC careers and practice in HPSAs.

Methods

Setting

The University of California, Davis (UC Davis) School of Medicine is a public school located in Sacramento, California. UC Davis has an established mission of promoting PC and improving workforce diversity with multiple programs and initiatives to meet that goal. UC Davis started its first SRC in 1972 and now supports seven SRCs that provide free or low-cost primary health services in Sacramento. The majority of first and second year students participate in the SRCs, with most students volunteering for one clinic per month (intermittent volunteers). Third and fourth year students occasionally participate but not as commonly; traditionally at UC Davis the SRC leadership is also left to the first and second year students in order to provide them with clinical experiences and extra-curricular opportunities during their pre-clinical years. A smaller subset devotes more time as clinic leaders. Volunteer faculty provide staffing, mentorship, and sponsorship at the clinics with some volunteering at different clinics and others mainly serving at one clinic. Undergraduate volunteers fill the roles of interpreters, patient advocates, receptionists, and lab workers while first and second year medical students provide medical care. The clinics operate on the weekends and provide a range of services including PC, acute, prenatal, child, and preventive health care. The seven clinics are located in different communities with some focusing on a specific population or at-risk groups.

Participants and Study Design

In order to examine SRC participation, we conducted a retrospective cohort study of all UC Davis School of Medicine graduates from 2004 to 2008 (N=454). We chose this timeframe because PC residency programs (family medicine, general internal medicine, and general pediatrics) are three years in duration, meaning graduates will have finished residency from 2007 to 2011. As a result, current outcome data is two to five years after the cohort has completed residency.

The UC Davis Institutional Review Board has provided exempt status to this study.

Data Collection Methods

A complete list of 2004 to 2008 UC Davis graduates was obtained from the registrar. Practice data were collected on all graduates as of the summer of 2012, the conclusion of the academic calendar year. All data were assessed by two independent reviewers. A third reviewer reconciled discordant findings and repeated data collection on a random sample of 20% of graduates. Variables were entered into a research database and identifying information was removed. A coded key was stored separately. Data on current career specialty and current practice setting were

collected using a systematic internet-based search described below.

PC vs. Non-PC Careers: First, we obtained board certification information from online, publicly available records.[24,25] This information was cross-referenced with UC Davis records on residency match specialty. Then, publicly available physician search websites (healthgrades.com, findadoctor.com) were used to locate individual graduates.[26,27] When no match was found, we used a general internet search. The information was then re-cross-referenced with board certification data.[25] Residency websites, and in some cases the graduates themselves, were contacted directly via email or phone to verify practice location because we were unable to find a practice location with the general search (n=7).

Practice Setting: We searched for practice location (address of clinic or hospital with which the graduate was currently affiliated) using physician search websites.[26,27] When no match was found, a general internet search was used. The practice location address was then entered into the Department of Health and Human Services HPSA tool to categorize into HPSA or non-HPSA.[3]

Graduate Characteristics: Demographic data (gender, race/ethnicity) and performance data (Medical College Admission Test [MCAT] scores, first time United States Medical Licensing Examination [USMLE] Steps 1 and 2 first time pass/fail status) were obtained from school records archived by the UC Davis registrar's office. Data on research experience during medical school, level of participation in SRCs, and languages spoken were abstracted from each graduate's Medical School Performance Evaluation (MSPE). The UC Davis Financial Aid Office provided debt at graduation and it was included as a continuous variable.

Completeness of Data: We attempted to obtain complete data for all variables. Missing data resulted from incomplete registrar records, item non-response (in the case of race/ethnicity), or missing MSPEs. Demographic data (gender or race/ethnicity) were missing for 18 of 454 graduates (4%). Clinic participation or research experience data were missing for 37 of 454 graduates (8.1%). Performance data (MCAT scores, USMLE Steps 1 and 2 first time pass/fail status) and dollar debt at graduation was 100% complete. We were unable to confirm practice specialty for 8 of 454 graduates (1.7%) and practice setting for 46 of 454 graduates (10.1%). All missing variables were excluded from analysis.

Main Measures

Two categorical outcome measures were constructed for each primary outcome: post-residency practice specialty and post-residency practice setting. Practice specialty was categorized as PC if the graduate was currently practicing family medicine, PC internal medicine, or general pediatrics. All other specialties were categorized as not PC. Post-residency practice setting was categorized as a HPSA or not. Although the focus of this study was post-residency practice, residency program type was also evaluated (family medicine, general internal medicine, general pediatrics, or specialty) in order to compare the percentage of graduates in PC practice.

We chose predictor variables based on previous studies and available data in medical school records. The key variable, SRC participation, was defined by the student's self-reported level of participation and categorized as: 1) none; 2) intermittent volunteer; or 3) committed volunteer. Committed volunteers devote more time (10-20 hours per month with at least two clinics per month) and gain greater exposure to the clinic and ambulatory role models. They also assist in clinic administration and are more engaged in patient and fellow student education compared to intermittent volunteers. The no participation group (none) was used as the reference. Other variables including gender, race, more than one language spoken, MCAT scores, USMLE Steps 1 and 2 first time pass/fail status, total dollar debt at graduation, and research experience during medical school were also recorded. Race was evaluated as both a categorical variable and as a binary variable but was included in the final model as a binary variable (under-represented minority status [African Americans, Mexican-Americans, Native Americans, and Pacific Islanders] or not). Gender, USMLE Steps 1 and 2 first time pass/fail status, more than one language spoken, and research experience were binary variables. MCAT score and debt at graduation were evaluated as continuous variables but only debt was included in the final model described below.

Statistical Analysis

In order to independently examine both primary outcome variables, we built two different logistic regression models. We started with models that included gender, race, MCAT score, USMLE Steps 1 and 2 first time pass/fail status, dollar debt at graduation, and research experience. We then performed manual backward selections, retaining variables if they were associated with PC careers or HPSAs at p<0.05 or if the variable was considered important based on past literature (e.g. debt). A goodness-of-fit test was performed on the full models and chi-square statistics were compared. A p-value of <0.05 was required for statistical significance in all cases. All statistical analysis was performed with statistical software package SPSS v. 20.

Results

Overall Graduate Characteristics

A total of 454 medical students graduated from UC Davis from 2004 to 2008 (Table 1). This cohort included 207 male (46.4%) and 234 female (52.5%) graduates; 13 graduates had missing gender data. Graduates were 45.1% white and 15.6% under-represented minorities. Nearly one quarter of the graduates (23.1%) spoke more than one language. The mean MCAT score was 31 and was normally distributed; the first time USMLE Step 1 pass rate was 96.6% and the first time USMLE Step 2 pass rate was 95.7%. Total debt at graduation was not normally distributed; median debt was $113,139 with a range from $0 to $284,087. Almost half of the graduates (47.1%) participated in research during medical school.

Most graduates (68%) participated in at least one SRC during medical school ranging from 62-80% across all five years. Of all the graduates, 28.8% were committed SRC volunteers and 39.2% were intermittent SRC volunteers. Of the volunteers, 65.4% were women, 72.1% were from under-represented minority groups.

Career Outcomes

Committed SRC participation was associated with post-residency PC practice (odds ratio [OR] 2.15, 95% confidence interval [CI] 1.18-3.75), while intermittent SRC participation was not (Table 2). Female gender was positively associated with PC practice (OR 1.93, 95% CI 1.2-3.11), while research during medical school was negatively associated (OR 0.48, 95% CI 0.32-0.77). Under-represented minority status, more than one language spoken, MCAT score, USMLE Steps 1 or 2 first time pass/fail status, and debt at graduation were not associated with PC practice. We attempted to examine the composite outcome of PC practice and practice in HPSAs, but the small number of these graduates (N=38) limited our ability to interpret the relationship.

More than one language spoken was the only variable associated with practice in HPSAs (adjusted OR [AOR] 1.97, 95% CI 1.2-3.25, p=0.01) (Table 3). There was no association between practice in HPSAs and any level of SRC participation or other factors (gender, race, debt at graduation, participation in research, MCAT score, and USMLE Steps

Table 1. Demographic information, performance data, and activities of UC Davis graduates 2004 to 2008 as of the summer of 2012 (N=454)

Characteristic	Number (%)*
Gender	
Men	207 (46.4%)
Women	234 (52.5%)
Race	
Under-represented minority status†	68 (15.6%)
Not under-represented minority status	368 (84.4%)
More than one language spoken	95 (23.1%)
Participation in SRCs‡	
None	135 (32.8%)
Intermittent volunteer	162 (39.2%)
Committed volunteer	115 (28%)
Research experience in medical school	204 (47%)
Median debt at graduation (range)§	$113,139 ($0-$284,087)
Mean MCAT score (standard deviation)	31 (3.4)
USMLE Step 1 first time pass rate	96.6%
USMLE Step 2 first time pass rate	95.7%

UC Davis: University of California, Davis; SRC: student-run clinic; MCAT: Medical College Admissions Test; USMLE: United States Medical Licensing Examination.
**Total number varies from total (N=454 graduates) due to missing data.*
†Self-identified as African American, Hispanic/Latino, Native American, or Pacific Islander.
‡Intermittent volunteers dedicated <10 hours/month to SRCs, while committed volunteers dedicated ≥10 hours/month.
§This variable was not normally distributed so median debt was used as measure of central tendency.

1 or 2 first time pass/fail status). Because many fellowships are located in HPSAs, we adjusted for this variable in the final model but the AORs did not change significantly (Table 3).

At graduation from medical school, 200 of the 454 students (44%) entered a PC residency: 49 (10.7%) in family medicine, 81 (17.6%) in internal medicine, 70 (15.4%) in pediatrics, and one (0.2%) in medicine/pediatrics. Two to five years after residency, 120 of the 454 graduates (28%) remained in PC practice. The percentage of graduates in PC practice after residency varied across specialties and was lowest in internal medicine (Figure 1). Of the 80 graduates who completed internal medicine residency, only 27 (33%) remained in PC practice. By comparison, 44 (63%) of the graduates who completed a pediatrics residency and 47 (96%) of the graduates who completed a residency in family medicine remained in PC practice. After completing residency, 149 (37.2%) of UC Davis graduates were practicing in HPSAs; however, 13.9% of these were in subspecialty fellowship (Table 3). Thirty eight of the 120 graduates in PC practice (31%) were practicing in HPSAs. There was no statistical difference in the percentage of graduates in PC or HPSAs across the 5 years of the cohort (data not shown).

Discussion

This longitudinal cohort study demonstrates that UC Davis graduates who were committed SRC volunteers were more likely to remain in PC practice after residency. Contrary to our expectation, we did not find an association between SRC participation and eventual practice in HPSAs. Only more than one language spoken was associated with eventual practice in HPSAs, consistent with prior studies.[28,29] Unlike prior literature, we found no association between underrepresented minority status and practice in HPSAs.[30,31] We also found no association between debt and eventual PC practice.

In contrast to the considerable literature examining medical student residency choice and student surveys,[10,16,32-34] we report actual practice patterns after residency from a longitudinal cohort of graduates. This and the use of self-reported

Table 2. Results of logistic regression examining PC practice (family medicine, general internal medicine, or general pediatrics) in UC Davis 2004 to 2008 after adjustment for selected graduate characteristics (N=427)

Graduate Characteristic	**PC**	**Non-PC**	**Univariate Analysis** OR (95% CI)	**Final Adjusted Model*** AOR (95% CI)
Female	82 (65.6%)	152 (47.5%)	2.05 (1.35-3.12)	**1.93 (1.2-3.11)**
Under-represented minority†	26 (21%)	42 (13.5%)	1.69 (0.99-2.91)	**1.73 (0.96-3.12)**
More than one language spoken	26 (22.6%)	68 (23%)	0.91 (0.54-1.53)	-
Mean MCAT score	31	32	0.93 (0.87-1.04)	-
USLME Step 1 pass rate	92.7%	98.1%	0.24 (0.08-0.70)	**0.36 (0.12-1.10)**
USMLE Step 2 pass rate	95%	96%	0.83 (0.31-2.25)	-
Level of SRC participation‡				
Intermittent volunteer	40 (35.4%)	121 (40.7%)	1.20 (0.69-2.06)	**1.13 (0.65-1.99)**
Committed Volunteer	44 (38.9%)	71 (23.9%)	2.24 (1.29-3.92)	**2.15 (1.18-3.75)**
Research experience	37.7%	55%	0.48 (0.30-0.75)	**0.48 (0.32-0.77)**
Debt at graduation	$108,522 ($0 - $208,676)	$116,396 ($0-284,087)	1.00 (0.97-1.01)	-

PC: primary care; UC Davis: University of California, Davis; OR: odds ratio; CI: confidence interval; AOR: adjusted odds ratio; MCAT: Medical College Admissions Test; USMLE: United States Medical Licensing Examination; SRC: student-run clinic.
**Bolded ORs represent those included in final model; PC model chi-square 28.8, degrees of freedom 6, p<0.05.*
†Self-identified as African American, Hispanic/Latino, Native American, or Pacific Islander.
‡Type of participation was categorized as: none, intermittent volunteer (<10 hours/month), and committed volunteer (≥10 hours/month) with "none" as the reference category.

Table 3. Results of logistic regression analysis examining practice in medically underserved areas in UC Davis 2004 to 2008 graduates after adjusting for selected graduate characteristic (N=401)

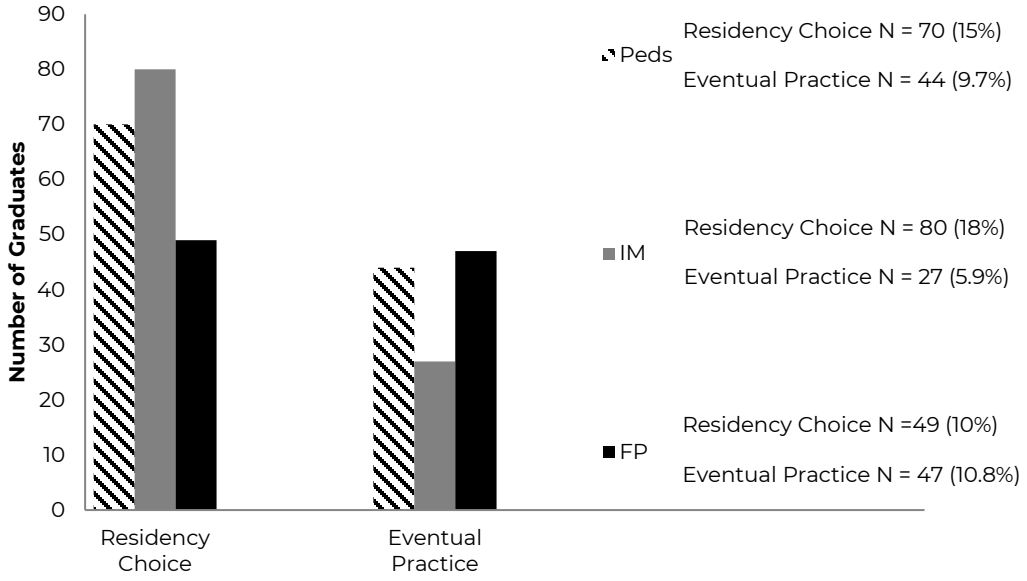
Graduate Characteristic	**MUA**	**Non-MUA**	**Univariate Analysis** OR (95% CI)	**Final adjusted model*** AOR (95% CI)
Female Gender	75 (50.3%)	140 (55.6%)	0.81 (0.55-1.22)	-
Under-represented minority	22 (17%)	27 (12%)	1.45 (0.84-2.53)	**1.43 (0.82-2.52)**
More than one language spoken	42 (29.2%)	45 (18.4%)	1.83 (1.13-2.97)	**1.97 (1.20-3.25)**
MCAT	31	32	0.98 (0.93-1.05)	-
USMLE Step 1 pass rate	97.3%	96.4%	1.33 (0.40-4.39)	-
USMLE Step 2 pass rate	94.6%	96.4%	0.24-1.71	-
Level of participation in SRC†				
Intermittent volunteer	56 (39.2%)	94 (38.2%)	1.03 (0.63-1.67)	**1.16 (0.71-2.01)**
Committed volunteer	39 (27.3%)	69 (28.1%)	0.98 (0.58-1.66)	**1.20 (0.69-2.06)**
Research experience	71 (50.4%)	125 (51.2%)	0.96 (0.64-1.46)	-
Debt at graduation	$121,360	$110,567	0.99 (0.99-1.02)	-
Still in fellowship	33 (22%)	36 (14.3%)	1.71 (1.01-2.88)	**1.81 (1.03-3.17)**

UC Davis: University of California, Davis; MUA: medically underserved area; OR: odds ratio; CI: confidence interval; AOR: adjusted odds ratio; MCAT: Medical College Admissions Test; USMLE: United States Medical Licensing Examination; SRC: student-run clinic.

*Bolded ORs represent those included in final model; MUAs model chi-square 7.8, degrees of freedom 3, p <0.05.

†Type of participation was categorized as: none, intermittent volunteer (<10 hours/month), or committed volunteer (≥10 hours/month) with "none" as the reference category.

Figure 1. Number of UC Davis graduates from 2004 to 2008 (N=454) entering PC residency versus number remaining in PC practice after residency



UC Davis: University of California, Davis; PC: primary care; Peds: pediatrics; IM: internal medicine; FP: family practice.

**Medicine/pediatrics not included in graph (N=1 at residency, N = 2 in eventual practice, one graduate switched from pediatrics to medicine/pediatrics).*

†N varies because three graduates switched from specialty to family medicine and five graduates completing FP residency went on to specialize.

participation in SRCs as opposed to using only the presence of a SRC in a particular medical school may explain why our findings differ from Tong's cross-sectional study which found no association between the presence of a SRC and PC residency choice.[22] As in prior studies, we found an association between female gender and PC practice, and an inverse relationship with research experience.[12] While other studies have reported that under-represented minorities are more likely to choose PC residencies,[7,34] we observed only a trend with eventual PC practice that did not reach statistical significance, possibly due to a smaller sample size. We found no association between debt and eventual practice which while counterintuitive, is consistent with prior literature. [11,33,35] Of note, however, most debt studies examining debt and career choice were completed in early 2000s, and median debt has continued to rise; the effects of this have not been robustly evaluated.[36] More recent survey data from the United Kingdom, Australia, and New Zealand has more mixed findings.[37] More research in this arena in the US is definitely needed, especially that evaluating actual practice patterns and not just residency choice. Not surprisingly, the percentage of UC Davis graduates in PC practice varies dramatically across the three PC disciplines and is lowest in graduates choosing internal medicine, consistent with previous literature.[12] This highlights the importance of using actual post-residency practice patterns rather than residency choice when assessing medical student career outcomes.

Our study has limitations. The decision to practice in PC or in an underserved area is a complicated one which may be difficult to capture in a predictive model. In addition, the observed relationship between committed SRC participation and PC practice is statistically significant but modest. Our model for practice in HPSAs was also statistically less robust perhaps because we did not include factors such as graduate's family background or expected income which have been previously associated with practice patterns.[17,34] Although our data collection was relatively complete (missing data < 10.1%), this database could contain some errors. For example, despite the multi-step process used to confirm practice address, some addresses may be mailing addresses and not actual practice location. This would underestimate the number of graduates practicing in HPSAs. Additionally, the location of a practice in an underserved area does not mean that the patient population is underserved. SRC participation was by self-report from MSPEs, which may overestimate the amount of true participation. We also measured career outcomes as close as two years post-residency which may miss later attrition from PC specialization greater than three years post-residency.[38,39] Finally, the percentage of UC Davis graduates in PC is relatively high: 120 of 200 graduates who entered a PC residency (60%) remained in PC practice. In comparison, a recent analysis of the National Graduate Medical Education Census estimates that the national average is closer to 32%.[40] This difference may affect the generalizability of our findings.

Why is SRC participation associated with eventual PC practice? Our observational design cannot determine whether the findings are due to unmeasured student differences or due to the experience as a committed SRC volunteer. The early exposure to rewarding longitudinal care experiences and PC mentors in SRCs may sustain a student's predisposition towards PC. PC practice is often perceived as having poor work-life balance and associated with a lack of prestige. Many graduates may also feel poorly equipped to enter PC careers due to primarily inpatient rotations during medical school.[39] A lack of exposure to ambulatory experiences may not provide an opportunity for an interest to develop in the first place. We believe that exposure to SRCs can buffer against these strong influences.[14,16] We believe our results could inform the development or further incorporation of existing SRCs into the preclinical experience of medical school. Institutions interested in promoting primary care and care for the underserved could also invest resources in supporting SRCs.

The results of this study have important implications for future research involving medical student career outcomes. They reinforce the notion that PC residency choice is only a surrogate marker for eventual PC practice. More research is needed to elucidate the influences on career choice, but future studies should examine practice patterns rather than residency choice alone.[21] As one of the few studies to examine post-

residency outcomes,[41-42] our findings suggest that intense exposure to rewarding PC experiences with underserved populations may be part of the strategy to strengthen the PC workforce, in addition to selecting incoming students inclined to PC careers. Supporting student interest in primary care and caring for the underserved may also help reinforce students entering primary care practice. Our methods include a longitudinal career database, a tool that could easily be developed by other institutions to understand the impact of their medical education program on the workforce. Such research would guide future efforts by policy makers and medical schools to strengthen the PC pipeline and workforce.

Acknowledgements

The authors wish to thank the staff and faculty from the following University of California programs: Masters of Public Health Program, the Center for Healthcare Policy and Research, the offices of student affairs, registrar, and financial aid at the School of Medicine. We would also like to thank Maricela Rangel Garcia for her persistence and assistance.

Disclosures

Dr. Fancher is supported by a Health Resources and Services Administration American Recovery and Reinvestment Act Training in PC Medicine and Dentistry Pre-doctoral Training in PC grant number D5DHP20522. The authors have no other disclosures.

References

1. Dill M, Salsberg E. The complexities of physician supply and demand: projections through 2025 [Internet]. Washington, DC (DC): Association of American Medical Colleges; 2008 Nov [cited 2012 Sep]. Available from: https://members. aamc.org/eweb/upload/The%20Complexities%20of%20Physician%20Supply.pdf. LINK
2. Council on Graduate Medical Education. Advancing Primary Care Twentieth Report [Internet]. Rockville (MD): Council on Graduate Medical Education; 2010 Dec [cited 2012 Sep]. Available from: https://www.hrsa.gov/advisorycommittees/bhpradvisory/cogme/reports/twentiethreport.pdf. LINK
3. Health Resources & Services Administration. Shortage Designation: Health Professional Shortage Areas and Medically Underserved Areas/Populations [Internet]. Rockville (MD): Health Resources & Services Administration; [cited 2017 Sep]. Available from: https://bhw.hrsa.gov/shortage-designation. LINK
4. Fancher TL, Henderson MC, Harris T, Pitman D. Teaching health centers and the primary care workforce crisis for the underserved. Ann Intern Med. 2010 May 4;152(9):615-616. LINK
5. Fancher TL, Keenan C, Meltvedt C, et al. An academic-community partnership to improve care for the underserved. Acad Med. 2011 Feb;86(2):252-258. LINK
6. Ko M, Heslin KC, Edelstein RA, Grumbach K. The role of medical education in reducing health care disparities: the first ten years of the UCLA/Drew Medical Education Program. J Gen Intern Med. 2007 May;22(5):625-631. LINK
7. Hauer KE, Durning SJ, Kernan WN, et al. Factors associated with medical students' career choices regarding internal medicine. JAMA. 2008 Sep 10;300(10):1154-1164. LINK
8. Compton MT, Frank E, Elon L, Carrera J. Changes in U.S. medical students' specialty interests over the course of medical school. J Gen Intern Med. 2008 Jul;23(7):1095-1100. LINK
9. Zinn WM, Sullivan AM, Zotov N, et al. The effect of medical education on primary care orientation: results of two national surveys of students' and residents' perspectives. Acad Med. 2001 Apr;76(4):355-365. LINK
10. Osborn EH. Factors influencing students' choices of primary care or other specialties. Acad Med. 1993 Jul;68(7):572-574. LINK
11. Woodworth PA, Chang FC, Helmer SD. Debt and other influences on career choices among surgical and primary care residents in a community-based hospital system. Am J Surg. 2000 Dec;180(6):570-575; discussion 575-576. LINK
12. Lawson SR, Hoban JD, Mazmanian PE. Understanding primary care residency choices: a test of selected variables in the Bland-Meurer model. Acad Med. 2004 Oct;79(10 Suppl):S36-39. LINK
13. Bennett KL, Phillips JP. Finding, recruiting, and sustaining the future primary care physician workforce: a new theoretical model of specialty choice process. Acad Med. 2010 Oct;85(10 Suppl):S81-88. LINK
14. Henderson MC, Hunt DK, Williams JW, Jr. General internists influence students to choose primary care careers: the power of role modeling. Am J Med. 1996 Dec;101(6):648-653. LINK
15. Linzer M, Slavin T, Mutha S, et al. Admission, recruitment, and retention: finding and keeping the generalist-oriented student. J Gen Intern Med. 1994 Apr;9(4 Suppl 1):S14-23. LINK
16. Campos-Outcalt D, Senf J, Watkins AJ, Bastacky S. The effects of medical school curricula, faculty role models, and biomedical research support on choice of generalist physician careers: a review and quality assessment of the literature. Acad Med. 1995 Jul;70(7):611-619. LINK
17. Fincher RM, Lewis LA, Rogers LQ. Classification model that predicts medical students' choices of primary care or non-primary care specialties. Acad Med. 1992 May;67(5):324-327. LINK
18. Rabinowitz HK. The role of the medical school admission process in the production of generalist physicians. Acad Med. 1999 Jan;74(1 Suppl):S39-44. LINK
19. Simpson SA, Long JA. Medical student-run health clinics: important contributors to patient care and medical education. J Gen Intern Med. 2007 Mar;22(3):352-356. LINK
20. Smith SD, Johnson ML, Rodriguez N, Moutier C, Beck E. Medical student perceptions of the educational value of a student-run free clinic. Fam Med. 2012 Oct;44(9):646-649. LINK
21. Berman R, Powe C, Carnevale J, et al. The crimson care collaborative: a student-faculty initiative to increase medical students' early exposure to primary care. Acad Med. 2012 May;87(5):651-655. LINK

22. Tong STC, Phillips, Robert L., Berman, Rebecca. Is exposure to a student-run clinic associated with future primary care practice? Fam Med. 2012 Sep;44(8):579-581. LINK
23. Campos-Outcalt DE. Specialties chosen by medical students who participated in a student-run, community-based free clinic. Am J Prev Med. 1985 Jul-Aug;1(4):50-51. LINK
24. National Plan and Provider Enumeration System. NPPES NPI Registry [Internet]. Baltimore (MD): U.S. Centers for Medicare & Medicaid Services; [cited 2012 May]. Available from: https://npiregistry.cms.hhs.gov/. LINK
25. Medical Board of California. Online License Search [Internet]. Sacramento (CA): Medical Board of California; c2010 [cited 2012 May]. Available from: http://www.mbc.ca.gov/lookup.html. LINK
26. Healthgrades [Internet]. Denver (CO): Healthgrades Operating Company, Inc; c2012 [cited 2012 May]. Available from: www.healthgrades.com. LINK
27. Find a Doctor [Internet]. Edison (NJ): Millennium Technology Solutions; c2003-2011 [cited 2012 May]. Available from: www.findadoctor.com/fad. LINK
28. Moreno G, Walker KO, Grumbach K. Self-reported fluency in non-English languages among physicians practicing in California. Fam Med. 2010 Jun;42(6):414-420. LINK
29. Moreno G, Walker KO, Morales LS, Grumbach K. Do physicians with self-reported non-English fluency practice in linguistically disadvantaged communities? J Gen Intern Med. 2011 May;26(5):512-517. LINK
30. Wayne SJ, Kalishman S, Jerabek RN, Timm C, Cosgrove E. Early predictors of physicians' practice in medically underserved communities: a 12-year follow-up study of University of New Mexico School of Medicine graduates. Acad Med. 2010 Oct;85(10 Suppl):S13-16. LINK
31. Rabinowitz HK, Diamond JJ, Veloski JJ, Gayle JA. The impact of multiple predictors on generalist physicians' care of underserved populations. Am J Public Health. 2000 Aug;90(8):1225-1228. LINK
32. Bland CJ, Meurer LN, Maldonado G. Determinants of primary care specialty choice: a non-statistical meta-analysis of the literature. Acad Med. 1995 Jul;70(7):620-641. LINK
33. Kahn MJ, Markert RJ, Lopez FA, Specter S, Randall H, Krane NK. Is medical student choice of a primary care residency influenced by debt? MedGenMed. 2006;8(4):18. LINK
34. Senf JH, Campos-Outcalt D, Kutob R. Factors related to the choice of family medicine: a reassessment and literature review. J Am Board Fam Pract. 2003 Nov-Dec;16(6):502-512. LINK
35. Phillips JP, Weismantel DP, Gold KJ, Schwenk TL. Medical student debt and primary care specialty intentions. Fam Med. 2010 Oct;42(9):616-622. LINK
36. Gil JA, Waryasz GR, Liu D, Daniels AH. Influence of medical student debt on the decision to pursue careers in primary care. R I Med J. 2016 Jul 1;99(7):19-21. LINK
37. Ling S, Jacobs R, Ponton R, et al. Influence of student debt on health career location and specialty. J Prim Health Care. 2018 Mar;10(1):54-61. LINK
38. Spickard A, Jr., Gabbe SG, Christensen JF. Mid-career burnout in generalist and specialist physicians. JAMA. 2002 Sep 25;288(12):1447-1450. LINK
39. Jolly P, Erikson C, Garrison G. U.S. Graduate medical education and physician specialty choice. Acad Med. 2013 Apr;88(4):468-474. LINK
40. Barber S, Brettell R, Perera-Salazar R, Greenhalgh, Harrington R. UK Medical students' attitudes towards their future careers and general practice: a cross-sectional survey and qualitative analysis of an Oxford cohort. BMC Med Educ. 2018 Jul 4;18(1):160. LINK
41. Rabinowitz HK, Diamond JJ, Markham FW, Hazelwood CE. A program to increase the number of family physicians in rural and underserved areas: impact after 22 years. JAMA. 1999 Jan 20;281(3):255-260. LINK
42. Rabinowitz HK, Xu G, Robeson MR, et al. Generalist career plans: tracking medical school seniors through residency. Acad Med. 1997 Oct;72(10 Suppl 1):S103-105. LINK
43. Hojat M, Gonnella JS, Erdmann JB, Veloski JJ, Xu G. Primary care and non-primary care physicians: a longitudinal study of their similarities, differences, and correlates before, during, and after medical school. Acad Med. 1995 Jan;70(1 Suppl):S17-28. LINK