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ORIGINAL ARTICLE

An 8-Year Review of Match Outcomes From a Primary Care Pipeline Program

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ABSTRACT

Background and Objectives: Primary care supports the global health care system. With an increased need for primary care physicians, medical schools must provide resources, role models, and opportunities to increase the number of medical students matching into primary care residencies. Some medical schools have developed primary care pipeline programs for students. The outcomes of one such program—the Primary Care Program (PCP)—at the Keck School of Medicine (KSOM) of the University of Southern California (USC), an urban and private academic medical training center, are evaluated here.

Methods: We reviewed PCP student outcome data for students who graduated between 2015 and 2022. Data were gathered through surveys, residency match lists, and graduation records.

Results: Among PCP matriculates (n=134), 70% were female and 39% were underrepresented in medicine. Thirteen percent (n=16) of PCP graduates (n=122) completed a master of public health (MPH) degree. Among PCP graduates, 70% matched into primary care residencies compared to 36% of non-PCP graduates ($P<.001$). The most common residencies that PCP graduates matched into were family medicine (n=45, 37%), internal medicine (n=20, 16%), pediatrics (n=12, 10%), surgery (n=10, 8%), and psychiatry (n=9, 7%). A higher percentage of KSOM students matched into primary care residencies in the 8 graduation years after PCP was instituted (39%) than in the 8 graduation years before PCP was instituted (33%, $P=.003$).

Conclusions: The PCP data demonstrate the program's success at increasing the number of KSOM graduates matching into primary care residencies. The program provides a replicable training model.

INTRODUCTION

Primary care (PC) is the backbone of a health care system, offering continuity of care, preventive care, an emphasis on the doctor-patient relationship, patient-centered care, and better health outcomes.[1–4] Globally, however, primary care physician workforce shortages persist, worsened by the COVID pandemic and the aging population.[5–7] A consensus among stakeholders is that undergraduate and graduate medical education programs collectively bear responsibility for the primary care physician workforce.[8] Medical students' interest in PC at the time of matriculation, gender, and ethnicity are all predictors of future primary care careers.[9,10] To strengthen the primary care physician pipeline at the undergraduate medical education level, several academic institutions have developed PC tracks. These tracks target PC-interested students to increase the number of students who enter PC residencies.[11–15] They typically highlight early primary care clinical training, exposure, and mentorship, as well as leadership and research training.[11–16] Although a growing number of PC medical school track programs exist, many of the programs focus on training rural physicians and few have published outcome data about the percentage of graduates that match into primary care residencies before and after their programs were instituted. This study adds to the literature by providing an in-depth description and outcome evaluation of a primary care track program at an urban and private medical school in Southern California.

In a scoping review of 43 various medical education pathways that influenced PC specialty choice, 40 pathways were deemed successful by meeting one of the following criteria: career preference/intention, residency match, residency trained, or physicians in practice.[17] While each of these primary care educational pathways are unique, many share the same focus of highlighting early primary care clinical

training, exposure, and mentorship.[11–16] Primary care pathway students have higher match rates into primary care residencies compared to the national match average of 39% of MD allopathic seniors.[18] These programs include University of California, Irvine's PRIME program, where 61% of the 105 primary care longitudinal graduates matched into a primary care residency.[19] At the University of Alabama, an average of 51% of the Primary Care Track graduates matched into primary care residencies.[20] Among the International/Inner City/Rural Preceptorship program students at the Virginia Commonwealth University School of Medicine, 71% matched into primary care residencies.[21] A limitation of these publications is that the authors did not cite the overall change in the university's percentage of PC graduates from before and after the program was initiated.

The purpose of this study is to evaluate the effectiveness of the Primary Care Program (PCP) at the Keck School of Medicine (KSOM) at University of Southern California (USC) in Los Angeles at matching students into primary care residencies, comparing the PCP outcomes to the national average, to the general KSOM graduating medical students, and to match rates before the PCP was in existence. In addition, we describe the gender, ethnicity, and dual degree demographics of PCP students, comparing the differences in underrepresented in medicine (URM) and dual-degree students in the PCP vs non-PCP.

PROGRAM BACKGROUND

The Primary Care Program, developed in 2011, is a primary care pipeline track beginning in the first year of medical school. KSOM is a private, urban, research-focused university. The PCP was initiated through a Health Resources and Services Administration (HRSA) Pipeline grant. With the program's success, growth, and changing university culture around primary care, the program is now supported by the KSOM University budget. The PCP has grown since 2011, and its program resources, funding, and staffing have increased accordingly. Accepted KSOM medical students who have an interest in primary care apply to the PCP and are selected annually prior to starting medical school. The number of students accepted into the program each year has increased from 12 to 32 students out of a class of 186. The curriculum is front-loaded the first 2 years with a large proportion of didactic and experiential learning. PCP is an official certificate program recognized by the Department of Medical Education at graduation. Students are not bound to choose primary care fields when they graduate.

The PCP has five primary care educational, skill-building modules concentrated in the first and second years: (1) clinical care, (2) service learning, (3) educational trainings, (4) leadership development, and (5) research. Another focus is on community building among the students themselves and with primary care physician mentors (Table 1). The PCP's depth and breadth continue to evolve with new KSOM curricular changes and will include more primary care offerings in the third and fourth years starting with the class of 2025.

PCP Curriculum Modules

Clinical Care

All KSOM of USC first- and second-year medical students complete Introduction to Clinical Medicine (ICM), a doctoring course where students learn history-taking and physical exam skills and practice these skills in the hospital weekly for 4 hours. In the PCP, first- and second-year students are paired with community faculty working in ambulatory care clinics in family medicine, general internal medicine, general medicine-pediatrics, and general pediatrics. Students go to these PC clinics instead of the hospital one morning each month for 4 hours during the first 2 academic years (August–May). This clinical experience is designed to teach students how to work in an outpatient primary care community clinic and build longitudinal relationships with primary care physicians, clinic staff, and patients. Students often volunteer additional clinic hours on their own.

Students also optionally can participate in half-day extracurricular clinical experiences working with primary care physicians serving vulnerable populations, including harm reduction clinic, tattoo removal clinic, and backpack street medicine.

Service Learning

Nutrition and Exercise for Chronic Disease Prevention: During the first year, PCP students learn the fundamentals of nutrition and exercise for chronic disease prevention and management during their didactic curriculum. Then, in partnership with the Los Angeles General Medical Center (formerly the Los Angeles County USC) Wellness Center, students lead nutrition, exercise, and healthy cooking presentations under the supervision of a local bilingual chef/nutritionist and the PCP faculty.[22,23,24] These service-learning classes are delivered in English and Spanish, and each student teaches twice (approximately 2 hours) and additionally during an annual Diabetes Day (approximately 3 hours). Students are encouraged to use these nutrition and exercise counseling skills in their monthly continuity clinic. The PCP nutrition service-learning module began in 2016 and the exercise module in 2019.

Interprofessional Geriatrics Curriculum (IPGC): During the second year, PCP students learn the fundamentals of team-based primary care and geriatric core competencies during a 5-month interdisciplinary geriatric experience with teams of USC students from eight graduate disciplines (ie, dentistry, medicine, occupational therapy, pharmacy, physical therapy, physician assistant, psychology, social work). In this program, a team of interprofessional (IP) students and faculty work together with an older adult to develop geriatric, IP, and in-home clinical skills through didactics, student collaboration, and three home visits. Students learn about the various health professions, developing an understanding of how different professions address older adult health concerns.[25]

Educational Trainings

PCP students attend required lectures on primary care skill-building topics throughout their first and second years. These

TABLE 1. **PCP Curriculum**

	First year	Second year	Third year	Fourth year
Primary care clinical experiences	• **ICM (inpatient)** • **Primary care community clinic (outpatient—in place of one ICM session per month) *** Curricular Enhancements: • Pain management clinical experience • Harm reduction clinical experience • Tattoo removal clinical experience • Backpack medicine clinical experience	• **ICM (inpatient)** • **Primary care community clinic (outpatient—in place of one ICM session per month) *** Curricular Enhancements: • Pain management clinical experience • Harm reduction clinical experience • Tattoo removal clinical experience • Backpack medicine clinical experience	• **Clerkship: family medicine, general surgery, internal medicine, obstetrics and gynecology, psychiatry, neurology** Curricular enhancements: • Pain management clinical experience • Harm reduction clinical experience • Tattoo removal clinical experience • Backpack medicine clinical experience	• Optional primary care selective/electives (ie addiction medicine, family medicine, outpatient, inpatient, geriatric medicine) Curricular enhancements: • Pain management clinical experience • Harm reduction clinical experience • Tattoo removal clinical experience • Backpack medicine clinical experience
Service-learning curriculum	• **Wellness center nutrition and exercise classes*** • **Diabetes Day (spring)*** • **Service-learning retreat***	• **IPGC*** • Wellness center exercise class* • **Service-learning retreat***	• N/A	• N/A
PCP educational noontime trainings	• **Orientation (fall)*** • **Introduction to community clinic (fall)*** • **2 nutrition classes (fall)*** • **Exercise classes (fall)*** • **SOAP note (spring)***	• **Orientation (fall)*** • **Advanced nutrition (fall)*** • **Mental health screening (fall)*** • **Sexual health history (fall)*** • **Immunizations (fall)*** • **Preventative health (fall)*** • **2 physical exam (spring)***	• N/A	• Starting with class of 2025 as part of KSOM new curriculum, will have 1 month of primary care curriculum including trainings and educational experiences.
Community building	• **Service-learning retreat*** • **Intersession dinners (fall/ spring)*** • **Holiday dinner (fall)*** • Graduation dinner (spring)* • Peer advising by fourth years to first–third years	• **Service-learning retreat*** • **Intersession dinners (fall/ spring)*** • **Holiday dinner (fall)*** • Graduation dinner (spring)* • Peer advising by fourth years to first–third years	• Intersession dinners (fall/spring)* • Holiday dinner (fall)* • Graduation dinner (spring)* • Peer advising by fourth years to first–third years	• Intersession dinners (fall/spring)* • Holiday dinner (fall)* • **Graduation dinner (spring)*** • Peer advising by fourth years to first–third years
Leadership development	• Primary care summit • Primary care leadership conference • Leaders in primary care SIGs	• Primary care summit • Primary care leadership conference • Leaders in primary care SIGs	• Primary care summit • Primary care leadership conference	• Primary care summit • Primary care leadership conference
Research	• Primary care research oversight and mentoring (concentrated primarily during second year)	• Primary care research oversight and mentoring (concentrated primarily during second year)	• Primary care research oversight and mentoring (concentrated primarily during second year)	• Primary care research oversight and mentoring (concentrated primarily during second year)

* Experience unique to Primary Care Program students.
Note: **Bold font** indicates required; all other activities are optional.
Abbreviations: PCP, Primary Care Program; ICM, Introduction to Clinical Medicine; IPGC, interprofessional geriatrics curriculum; KSOM, Keck School of Medicine; SOAP, subjective objective assessment plan; SIG, special interest group

lectures are developed and delivered by PCP faculty, and topics include mental health screenings, sexual health history, oral health, immunizations, and subjective objective assessment plan (SOAP) note writing.

Leadership Development

PCP students participate in leadership and advocacy training through multiple avenues. The PCP team leads annual student leadership training events, bringing together third- and fourth-year students to train and mentor first- and second-year students in research projects, student interest groups (SIGs), and advocacy efforts. Many PCP students are also leaders of primary care SIGs and help organize an annual student-led primary care conference.

Research

All KSOM students participate in a required second-year scholarly project. PCP students are encouraged to complete primary care scholarly projects and are provided with resources to identify mentors and projects. Many students work together on research projects or complete longitudinal research where one student starts a project and another student takes over to continue the work. Students have access to primary care research mentorship throughout medical school.

Community Building

Critical to the PCP's success has been the development of a community within the medical school. This community is sustained through the shared mission and interest of like-minded students and faculty seeking community-based, service-driven, and primary care-focused careers. The community fosters and nurtures relationships among the PCP students through mandatory lunches, networking dinners, holiday parties, graduation send-offs, peer mentorship, and service retreats. Past retreats have included working in a community food bank and making meals and serving them to unhoused individuals.

METHODS

We reviewed PCP data for students who graduated from 2015 to 2022, which comprised the first eight graduating cohorts. Students who graduated 2015 to 2022 matriculated at the KSOM of USC between 2011 and 2018.

The data we analyzed included the number of matriculating and graduating PCP students, demographics, completion of a dual degree, and residency match. We gathered descriptive data through multiple modalities, including Qualtrics PCP student surveys, KSOM match lists, and graduation records. We determined statistical significance using χ^2 analysis at $P<.05$. The Institutional Review Board deemed this research exempt (UP-20-01459).

Primary care fields have been defined broadly by multiple organizations, and some organizations include obstetrics and gynecology while others do not.[26–28] Primary care specialties, for the purpose of our study, included family medicine, internal medicine, medicine-pediatrics, and pediatrics.

RESULTS

At the time of matriculation, 134 students were admitted into the PCP classes of 2015 to 2022. By May 2022, a total of 122 PCP medical students had graduated from the KSOM of USC. The discrepancy of 12 students between matriculation and graduation included nine students who were taking additional years to graduate (ie, research year, master's degree, personal leave) and three students who left medical school.

Among the PCP students who matriculated (n=134), 70% (n=94) were female and 30% (n=40) were male. Their ethnicities included 31% (n=41) White, 29% (n=39) Asian, 29% (n=39) Latino, 10% (n=13) Black, and 1% (n=2) other. The number of URM students within the PCP (n=52, 39%) was statistically higher than the number of URM students within the non-PCP KSOM population (n=217, 16%) for entering years 2011 to 2018 ($P<.00001$).

Medical students at KSOM of USC can complete a dual degree, mostly commonly a master of public health (MPH), prior to graduation. The MPH year is fully funded by KSOM. Among PCP students that have graduated between 2015 and 2022 (n=122), 13% (n=16) have completed an MPH, compared to only 3% of non-PCP KSOM students (n=39/1,282; $P<.00001$).

We compared PCP graduation data from 2015 to 2022 with graduation data from non-PCP KSOM medical students (Table 2). To date, 70% (n=85/122) of KSOM PCP graduates have matriculated into primary care residencies compared to 36% (n=460/1,282) of KSOM non-PCP graduates ($P<.001$). The percentage of KSOM PCP graduates who matched into a primary care residency was statistically higher than the national percentage of US allopathic graduates who matriculated into primary care residencies (n=55,918, 39%; $P<.001$).[18]

We reviewed PCP student residency match data between 2015 and 2022 (Table 3). Among all PCP students (n=122), the residencies with the highest match percentages were family medicine (n=45, 37%), internal medicine (n=20, 16%), pediatrics (n=12, 10%), surgery (n=10, 8%), and psychiatry (n=9, 7%).

In the 8 graduation years before the PCP was instituted (2007-2014), the total number of KSOM graduates who matched into primary care was 33% (n=448/1,344). In the 8 graduation years after the PCP was instituted (2015-2022), the total number of KSOM graduates (including PCP and non-PCP students) who matched into primary care was 39% (n=545/1,404), which was a statistically significant increase ($P=.003$). In particular, the number of students matching into family medicine (n=85 [6%] versus n=132 [9%], $P=.0028$) and internal medicine (n=225 [17%] versus n=281 [20%], $P=.027$) when comparing years 2007 to 2014 and years 2015 to 2022 was statistically greater (Table 4).

DISCUSSION

Primary care is the foundation of a strong health care system.[29] A critical first step in addressing the primary care needs of the population is to strengthen the pipeline of medical student graduates matching into primary care residencies.[8,30]

TABLE 2. PCP Residency Match Data Comparison

Students graduating 2015-2022	PCP KSOM (N=122)	Non-PCP KSOM (N=1,282)	National MD graduates (N=142,001)
Primary care residency	85	460	55,918
Specialty care residency	37	822	86,083
Percentage in primary care residency (%)	**70***	**36***	**39***

*Statistical significance set at $P<.05$ Abbreviations: PCP, Primary Care Program; KSOM, Keck School of Medicine

TABLE 3. PCP Residency Match Data

Residency	Total PCP students graduating 2015-2022 (N=122) n (%)
Primary care residency	**85 (70)**
Family medicine	45 (37)
Internal medicine	20 (16)
Medicine-pediatrics	8 (7)
Pediatrics	12 (10)
Specialty care residency	**37 (30)**
Dermatology	1 (1)
Emergency medicine	7 (6)
Neurology	1 (1)
Obstetrics-gynecology	8 (7)
Ophthalmology	1 (1)
Psychiatry	9 (7)
Surgery	10 (8)

Abbreviations: PCP, Primary Care Program

TABLE 4. KSOM Graduation Data Comparison Pre- and Post-PCP

Primary care specialties	Number of KSOM graduates 2007-2014 (before the PCP was instituted) n(%)	Number of KSOM graduates 2015-2022 (after the PCP was instituted)n(%)
Family medicine	85* (6)	132* (9)
Internal medicine	225* (17)	281* (20)
Medicine-pediatrics	30 (2)	35 (2)
Pediatrics	108 (8)	97 (7)
Total number of primary care matches/total students	**448/1,344 (33)***	**545/1,404 (39)***

*Statistical significance set at $P<.05$ Abbreviations: KSOM, Keck School of Medicine; PCP, Primary Care Program

Historically, primary care pipeline programs have been shown to provide valuable support for students matching into primary care residencies.[19,20]

Consistent with previous literature on the success of primary care pathways,[17] the KSOM PCP has shown promising results among the first eight student cohorts. At the time of graduation, a statistically significant higher proportion of PCP medical students have matched into PC residencies than the general KSOM class, as well as the national average of medical students (70% vs 36% vs 39%, respectively).[18] Among PCP graduates, the most prevalent primary care residencies were family medicine (37%), internal medicine (16%), and pediatrics (10%).

The KSOM PCP is a longitudinal program that follows students throughout their 4 years in medical school to provide consistent guidance, community, and mentorship. PCP students are not required to choose primary care residencies; however, nurturing, teaching, and supporting students who already have a vested interest in primary care at matriculation leads to high rates of PCP students matching into primary care residencies. Providing students with a multitude of primary care experiences, skill-based training, and role models allows these early learners to experience the depth and breadth of PC. The PCP aims to reduce health disparities by training future physicians who will provide services and resources for vulnerable and marginalized communities. Studies have found

that racial and ethnic minority physicians are more likely to practice primary care and serve in underserved communities,[31] and the PCP program has higher representation of URM students (39%) than the non-PCP KSOM class (16%). In addition, 13% (n=16/122) of PCP graduates pursue an MPH compared to 3% (n=39/1,282) of the non-PCP students. While we are working to determine the impact this may have on PCP alumni, studies have indicated that physicians with an MPH have higher rates of assuming leadership roles and conducting public health research.[32,33]

When the PCP began through the support of an HRSA grant, some stakeholders were concerned about its sustainability in a private medical center with a large focus on research, specialty, and hospital-based training. Over time, sustainable leadership, programming, and institutional funding support have allowed the PCP to thrive and become part of the university fabric. Importantly, the PCP has had a significant impact on the culture of the KSOM medical school, promoting a greater understanding of the clinical, educational, financial, and scholarship value that primary care brings to an academic center.

The impact of the PCP on the culture of the university is further demonstrated when examining the primary care graduation rates at the KSOM over the past 16 years. Increases from 33% to 39% of students graduating into primary care residencies from KSOM before and after the PCP's existence is significant, and likely largely attributable to the PCP given there were no other major primary care curriculum initiatives instituted during that time. Further, the statistically increased rates for students matching into family medicine before (n=85, 6%) and after (n=132, 9%) the PCP's existence is particularly noteworthy because these data demonstrate an increase in the number of graduates who will likely practice PC at the completion of their residency training (92% of family medicine residents stay practicing family medicine).[28,34,35] Nonetheless, the percentage of total KSOM students graduating into primary care residencies (39%) after the PCP's existence is the same as the national average,[18] signaling that work still needs to be done to improve the primary care match outcomes at KSOM.

We acknowledge that primary care match rates overestimate the actual number of primary care physicians in the workforce.[28] The percentage of US allopathic seniors who match into primary care residences averages 39%[18]; however, estimates suggest that the percentage of PC residents who go on to become hospitalists and/or subspecialize is 88% for internal medicine, 43% for medicine/pediatrics, 41% for pediatrics, and 8% for family medicine.[34–36] These data indicate that increasing the percentage of medical school students who match into PC residencies is only the first step in increasing the primary care physician workforce. To continue the progress that medical school primary care pathways make, residency programs also must foster opportunities for primary care training, especially in residencies with high subspecialty percentages, such as internal medicine and pediatrics.[34,35] For instance, findings from the primary care internal medicine residency program at University of California San Francisco showed that only 54% of its residency alumni worked in outpatient primary care,[37] highlighting the need to increase primary care retention among residency programs. While our study showed high rates of PCP students entering PC residencies, we are gathering data from program alumni to better capture the impact of the PCP on graduates' long-term careers.

This study had some limitations. Some inadvertent data reporting errors or omissions are possible. Of note, because the PCP accepts medical students at matriculation only, the data did not capture students who did not know about the program or decided to pursue primary care after matriculation, which could be subgroups in future analyses.

Future studies will explore whether the class of 2025 KSOM curriculum change to an 18-month preclerkship, 12-month clerkship, and 18-month postclerkship structure will impact PCP student outcomes.

CONCLUSIONS

The KSOM PCP provides a replicable training model for other institutions seeking curricula and guidance for early student primary care exposure and strong foundational skills training. Further, the PCP is an effective model that graduates high numbers of students entering primary care residencies in an urban, private, research-heavy, academic medical training center. Early primary care training may advance not only the number of PC medical school graduates but also strengthen the culture of PC within a medical school. These outcomes underscore the importance of a strong PC medical school educational pathway to expose and support interest in primary care. Working in tandem with primary care residency programs, PC medical school tracks provide the foundational training on which residencies can build to train the future primary care workforce.

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