



Addressing the nephrology workforce shortage via a novel undergraduate pipeline program: the Kidney Disease Screening and Awareness Program (KDSAP) at 10 years

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Shortages in the nephrology workforce have threatened the access and quality of health care delivered to the growing population of individuals with kidney disease globally, including in the United States.¹ Although the workforce demand is expanding, interest in nephrology as a career choice has declined continuously among US medical graduates.² Premedical pipeline programs have been proposed as a solution to the physician shortage, especially for increasing the number of underrepresented minorities in medicine.³ However, the long-term effects of these programs on cultivating undergraduate student interest in future choices of medical specialties are currently unknown. Specifically in the field of nephrology, early exposure programs, such as the American Society of Nephrology's Kidney Tutored Research and Education for Kidney Students (TREKS) and Kidney Mentoring and Assessment Program for Students (MAPS), focus on medical students and lack long-term evaluations of their impact.^{4–6}

The Kidney Disease Screening and Awareness Program (KDSAP) is an educational model that strategically targets college undergraduates in the United States and cultivates their interests in nephrology.⁷ KDSAP has developed a community outreach program through which student volunteers organize and provide free health screenings and education on kidney disease and its risk factors to primarily underserved populations. KDSAP has also developed on-campus academic enrichment activities, including seminars on Universal Precaution and Professionalism, professional training workshops, “Meet the Patient” and “Meet the Doctor” colloquia, physician shadowing and mentorship programs, renal disease research opportunities, and career development seminars and lectures. Founded in 2008 at the Asian Renal Clinic, Brigham and Women's Hospital, Harvard Medical School, KDSAP is

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now a nationwide college student-run organization with >20 chapters across the United States. An earlier study assessing KDSAP's impact on active undergraduate members showed that the organization had a positive influence on its members' perceptions toward nephrology and that 26 of 51 alumni at the time had entered medical school, with 3 individuals considering nephrology for their future career.⁷ It is unknown whether the influence of KDSAP on students' interests in nephrology persists beyond college graduation. Therefore, we conducted a survey to evaluate the sustained impact of KDSAP on alumni career choices and perspectives on nephrology-related fields after 10 years of KDSAP's operation.

We invited KDSAP alumni via e-mail to answer an online questionnaire (Supplementary Item S1) and participate in focus groups and semistructured interviews (Supplementary Item S2) from January to April of 2019. The eligible participants were KDSAP alumni from all chapters across the United States who had graduated from college and attended at least one KDSAP community outreach program or academic event during their undergraduate years from January 2009 to April 2019, which resulted in a population size of 214 individuals. After excluding 41 individuals whose contact information was not available, 173 alumni were invited, 112 of

whom responded (response rate, 64.7%). Most of the survey questions (24/28) were statements on a 5-point Likert scale, with "somewhat agree" and "strongly agree" being coded as positive answers. Five one-on-one interviews and 2 focus group sessions (each with 8 participants) were conducted.

Among the 112 respondents (median age, 23 years; 44 males; 47 self-identified Asians, 30 self-identified Whites, and 13 self-identified African Americans; Supplementary Table S1), 94 (83.9%) individuals were pursuing a career in medicine and consisted of 6 attending clinicians (including 2 nephrologists), 21 residents/fellows, 34 medical students, and 33 medical school applicants (Figure 1). Nearly 40% (8 of 21) of residents/fellows and 50% (17 of 34) of medical students indicated their intentions to pursue work related to patients with kidney diseases or research of kidney diseases and related disorders. Overall, 35.7% (40 of 112) pursued or were considering pursuing a future career in nephrology, either related to clinical service or research in kidney diseases.

Among the 112 alumni, 96.5% (108 of 112) indicated that KDSAP increased their knowledge about the field of nephrology, 77.7% (87 of 112) credited KDSAP with increasing their interest in caring for patients with kidney diseases, and 57.1% (64 of 112) noted an increased interest in

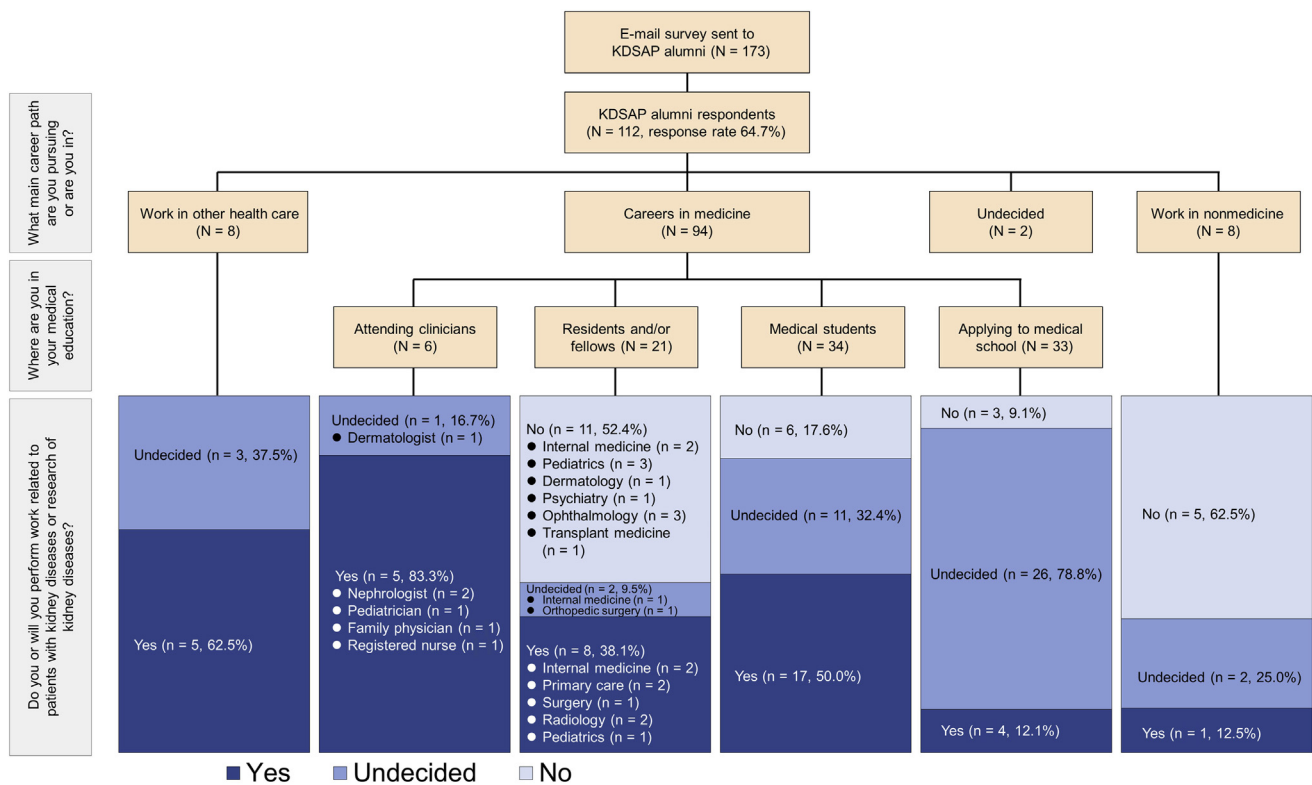


Figure 1 | The Kidney Disease Screening and Awareness Program (KDSAP) has a positive influence on nephrology-related career choices among alumni. Among the 112 alumni who responded to our survey, the primary career paths included medicine (94 individuals), another field of health care (8 individuals), nonmedical role (8 individuals), and undecided (2 individuals). Those who indicated that they were pursuing a career in medicine were stratified by their stage in medical education. When asked "Do you or will you perform work related to patients with kidney diseases or research of kidney diseases?" 40 individuals (35.7%) answered "yes," 27 (24.1%) answered "no," and 45 (40.2%) answered "undecided." (The 2 individuals who were "undecided" in their future career answered "no" to this question.) Filled buckets (dark blue indicating "yes"; blue indicating "undecided"; and light blue indicating "no") are displayed for a visual reference of the breakdown of respondents pursuing work related to kidney diseases.

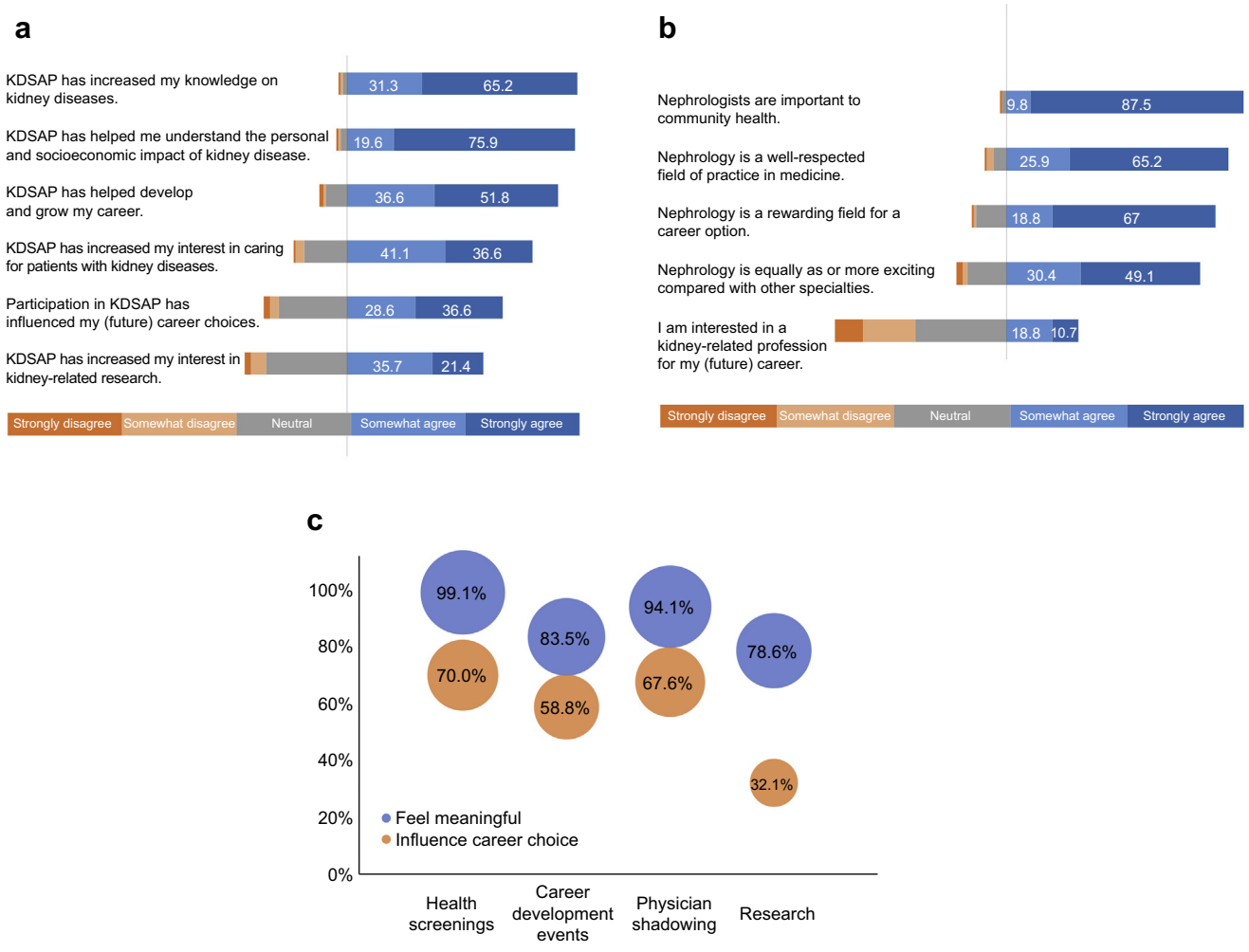


Figure 2 | The Kidney Disease Screening and Awareness Program (KDSAP) has a positive impact on alumni perceptions toward kidney-related career choices and the nephrology specialty, likely due to their positive experiences during KDSAP activities. (a) Alumni maintain positive perceptions of kidney-related knowledge and work. Using a 5-point Likert scale, an answer of “strongly agree” or “somewhat agree” to each of the 6 statements, which are based on respondents’ own perceptions before and after participating in KDSAP, is considered positive or agreeing to the question (displayed by percentage, n = 112). **(b)** Alumni report a favorable view of the nephrology specialty. Using a 5-point Likert scale, an answer of “strongly agree” or “somewhat agree” to each of the 5 statements, which are based on respondents’ own perception before and after participating in KDSAP, is considered positive or agreeing to the question (displayed by percentage, n = 112). **(c)** Alumni have positive perceptions toward KDSAP activities. Questions included “Which KDSAP activities, if any, did you find meaningful? Select all that apply.” and “Which part(s) of KDSAP strongly influenced your career choice? Select all that apply.” Answers included kidney health screenings (recruitment, organization, and volunteering), career development events (e.g., nephrologist talks and medical school application questions and answers [Q&A]), physician shadowing, and research (data collection and data analysis). Attendees of each activity served as each activity’s respective denominator. Each circle’s size corresponds to the magnitude of the percentage, with larger circles corresponding to higher percentages.

kidney-related research (Figure 2a). In addition, 95.5% (107 of 112) indicated that KDSAP had increased their awareness of the socioeconomic impact of kidney disease. Furthermore, 88.4% of respondents (99 of 112) acknowledged that KDSAP has assisted in their career development and 65.2% (73 of 112) indicated that KDSAP had influenced their career choices. Nearly all respondents (109 of 112, 97.3%) believed that nephrologists were important to community health, 91.1% (102 of 112) believed that nephrology was a well-respected field in medicine, 85.8% (96 of 112) agreed that nephrology was a rewarding career option, and 79.5% (89 of 112) concurred that nephrology was equally or more exciting

in comparison to other medical specialties (Figure 2b). Consistent with these positive perceptions, 33 individuals (29.5%) indicated that they had chosen or planned to choose a kidney-related profession as a future career, while 42 individuals (37.5%) remained neutral and 37 (33.0%) did not endorse a future career in nephrology.

Our results also showed that >90% of KDSAP alumni found health screening activities and physician shadowing to be meaningful, and nearly two-thirds of them believed that these activities influenced their career choices (Figure 2c). The on-campus career development events (83.5%) and research opportunities (78.6%) presented via KDSAP were also

meaningful to alumni, but research was the least influential on their career choices (32.1%).

These findings are further supported by alumni responses in interviews and focus group discussions (Supplementary Table S2). One interviewee mentioned that KDSAP increased his/her interest in nephrology, because “things I learned in the community (via KDSAP) made me interested in kidney disease more than other diseases.” With regards to personal enrichment and career development, KDSAP was reported to help build networks, personal growth, professionalism, and leadership. One unique feature of KDSAP was the mandatory Universal Precaution and Professionalism training; one interviewee explained, “we have to be trained to know how to take (correct) measurements and be respectful to the privacy of the participants of each screening. It was really important for [helping guide] me with how I might want to continue on those relationships, such as future patients I interact within a healthcare setting. That was most impactful [for me].” In addition, alumni reported that KDSAP’s mentorship structure provided inspirational role models and helped cultivate future physicians.

In this survey, we showed that KDSAP is a useful model for helping its alumni make medical career choices. Thirty-six percent (40 of 112) of alumni had pursued or were considering nephrology for their future career, showing sustained levels of interest when compared with our previous publication.⁷ Our results also showed that the longitudinal effects of KDSAP on its alumni are likely due to KDSAP’s positive impact on interests in nephrology-related knowledge, research, and patient care. In addition, 43% (40 of 94) of surveyed KDSAP alumni currently on a physician career path are considering or have chosen nephrology as their future career, which is considerably higher than a national survey of medical student and internal medicine residents, where only 25% of participants expressed an interest in nephrology.⁸

KDSAP’s unique educational value can be found in its focus on community outreach to underprivileged populations, multidimensional mentorship and professionalism standards, and flexible autonomy for students to lead and create. Since KDSAP’s inception, community health screenings have been integral to the organization’s mission. On the basis of survey responses, the screenings are also one of KDSAP’s most meaningful and influential activities, as alumni were able to observe health inequities and health care gaps in underserved communities through in-depth, hands-on patient interaction. Networks between KDSAP members and physician advisors have provided a nurturing environment for alumni to develop professional behaviors as well as insights into nephrology through a multidimensional mentorship framework. KDSAP encourages students to lead their respective campus chapter organizations and operations independently, allowing them to cultivate highly valued skills relevant to population health and preventive medicine. In contrast to offering short-term exposures to nephrology or offering solely physician shadowing and clinical observation-based opportunities,^{4–6} KDSAP provides long-term hands-on

clinical experience for students, many of whom start in their first year of college and continue through graduation.

As an organization primarily focused on health screening and raising awareness in the community setting, KDSAP had not implemented longitudinal research projects for its members in its early years, which likely resulted in the finding that research was less influential on KDSAP alumni career choices compared with other activities.

Several studies have shown that patient-physician race concordance improves patient-provider relationships and patients’ health outcomes.⁹ As most of KDSAP’s target community service populations are underprivileged minorities, a unique feature of KDSAP is its ability to attract members from diverse racial/ethnic backgrounds, which allows KDSAP to better engage with local communities. We found that KDSAP alumni of different self-identified races/ethnicities derived different nephrology-related perspectives from various KDSAP activities. Our current data on race/ethnicity among KDSAP alumni are insufficient to draw any definitive conclusion. Nevertheless, we are intrigued and planning to further expand our study on KDSAP’s volunteers, which we hope to gain more insight in guiding KDSAP on recruiting individuals of underrepresented ethnic/racial backgrounds to cultivate a more diverse nephrology workforce.

In search of potential interventions to attract more alumni to the nephrology workforce, we compared responses from the alumni subgroup who was “undecided” about pursuing kidney-related work with those who said “yes” or “no” to the same question (Supplementary Table S3). Among the 34 alumni who were attending medical school, 8 (23.5%) were considering nephrology for postgraduate training, while 14 (41.1%) were “undecided”; 10 of those 14 medical students were considering pursuing a career in primary care (Supplementary Table S4). This suggests that continuous efforts to promote career interests in nephrology beyond the undergraduate level are also important to attract “undecided” individuals, especially for those who already have interests in internal medicine.

Although the survey was completed in 2019 before the coronavirus disease 2019 (COVID-19) pandemic, many of the hands-on KDSAP programs were not in operation during the pandemic for the safety concerns of community population and student volunteers. During the pandemic, KDSAP chapters were instead encouraged to host virtual educational events, such as online “Meet the Patient” and “Meet the Doctor” symposia, journal clubs, and case studies. Student volunteers are also encouraged to engage with their communities. In fact, our preliminary data from 2019 to 2020 showed that the Universal Precaution and Professionalism workshop, professional training workshops, educational events, and kidney screenings all increased compared with those in 2018 to 2019. As for the member retention, our preliminary data showed although the active members were slightly decreased (692 in 2019–2020 vs. 721 in 2018–2019), attendees for Universal Precaution and Professionalism and educational events were increased (689 vs. 641 and 1051 vs.

857, respectively) (data not shown). The KDSAP's effectiveness in fostering an interest in nephrology careers during the era of COVID-19 will be further evaluated in the future.

For organizations seeking to create KDSAP, we recommend inviting nephrologists to serve as faculty advisors. Having nephrologists as faculty advisors provides opportunities for student volunteers working with clinicians side-by-side and fosters better opportunities for professional development in academic and clinical settings. Faculty advisors may also serve as important resources, such as providing guidance and grant writing skills when KDSAP student leaders are seeking to apply for funding support. A template with list of questions to guide prospective universities who are interested in establishing KDSAP (Supplementary Item S3) and KDSAP's estimated annual budget plan (Supplementary Table S5) are provided as references. They are also available at www.kdsap.org.

In conclusion, KDSAP is an effective educational model for promoting kidney-related career choices among undergraduate students, with an impact that continues beyond college. We believe that the KDSAP model can be an effective solution for tackling anticipated workforce shortages in nephrology and in specialties facing similar shortages, both in the United States and globally.

DISCLOSURE

All the authors declared no competing interests.

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AUTHOR CONTRIBUTIONS

RS, JL, RC, M-YJ, and L-LH designed the study. RS, JL, RC, AC, SB, JP, and AR acquired the data. RS, M-YJ, RC, AC, SB, SSM, MZ, and JL analyzed and interpreted the data. M-YJ, RS, and SSM analyzed the statistics. RS, M-YJ, RC, AC, SB, MZ, JL, and KS wrote the draft. EK, JB, DT, and MH reviewed the study design, data analysis, and data interpretation. L-LH researched the concept and supervised. Each author contributed intellectual content during the manuscript drafting/revision process and accepts accountability for the overall work and ensuring that questions pertaining to the accuracy or integrity of any portion of the work are appropriately investigated and resolved. M-YJ, RS, and L-LH have full access to all the data in the

study and take responsibility for the integrity of the data and the accuracy of the data analysis.

SUPPLEMENTARY MATERIAL

[Supplementary File \(PDF\)](#)

Item S1. The Kidney Disease Screening and Awareness Program (KDSAP) Alumni Survey Questionnaire.

Item S2. Interview and focus group discussion guide.

Item S3. Questions to consider for prospective nephrology pipeline programs.

Table S1. The demographic and self-identified racial/ethnic differences among Kidney Disease Screening and Awareness Program (KDSAP) alumni and their responses regarding KDSAP activities and career choices.

Table S2. Quotations and themes from interviews with Kidney Disease Screening and Awareness Program (KDSAP) alumni regarding their experiences in KDSAP and the impacts of KDSAP.

Table S3. The features of "undecided" alumni compared with those who said "yes" or "no" on considering nephrology-related professions for their future careers.

Table S4. Among the medical students, the features of "undecided" alumni compared with those who said "yes" or "no" on choosing nephrology as the future specialty.

Table S5. Template annual budget plan for prospective nephrology pipeline programs.

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