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Evaluating the impact of a year-long external mentorship pilot program in classical hematology

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Key Points

- A national virtual mentorship program that pairs trainees with external mentors facilitated career development in CH.
- Mentorship program participants reported an increase in academic productivity, networking, professional identity, and job opportunities.

Effective mentorship is a pivotal factor in shaping the career trajectory of trainees interested in classical hematology (CH), which is of critical importance due to the anticipated decline in the CH workforce. However, there is a lack of mentorship opportunities within CH compared with medical oncology. To address this need, a year-long external mentorship program was implemented through the American Society of Hematology Medical Educators Institute. Thirty-five hematology/oncology fellows interested in CH and 34 academically productive faculty mentors from different institutions across North America were paired in a meticulous process that considered individual interests, experiences, and background. Pairs were expected to meet virtually once a month. Participation in a scholarly project was optional. A mixed-methods sequential explanatory design was used to evaluate the program using mentee and mentor surveys, a mentee interview, and a mentee focus group. Thirty-three mentee-mentor pairs (94.2%) completed the program. Sixty-three percent of mentee respondents worked on a scholarly project with their mentor; several mentees earned publications, grants, and awards. Mentee perception that their assigned mentor was a good match was associated with a perceived positive impact on confidence ($P = .0423$), career development ($P = .0423$), and professional identity ($P = .0302$). Furthermore, 23 mentees (66%) accepted CH faculty positions after fellowship. All mentor respondents believed that this program would increase retention in CH. This mentorship program demonstrates a productive, beneficial way of connecting mentees and mentors from different institutions to improve the careers of CH trainees, with the ultimate goal of increasing retention in CH.

Introduction

With the projected shortage of classical hematologists, the future classical hematology (CH) workforce soon may not meet the clinical demand.^{1,2} Assessment of factors influencing career decisions in CH

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Original data are available on request from the corresponding author, Soo J. Park (sjp047@health.ucsd.edu).

The full-text version of this article contains a data supplement.

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revealed that mentorship is among the most influential.³ However, mentorship opportunities are perceived as less abundant within hematology compared with medical oncology.¹ More mentorship opportunities within CH are needed to increase interest and retention among trainees.⁴

Patients with classical hematologic conditions often require lifelong, specialized care; however, a shortage of physicians specializing in this field poses a barrier to high-quality care.^{5,6} A survey of hematology/oncology (H/O) program directors conducted by the American Society of Hematology (ASH) in 2003 and the ASH 2018 Hematology and Oncology Fellows Survey demonstrated that only ~5% of adult H/O fellows planned to specialize in CH.^{4,7} Many H/O fellows perceive CH to have fewer research opportunities, less compensation, and fewer available jobs than medical oncology.¹ As recently as 2021, classical hematologists voiced concerns regarding the projected CH workforce shortage, citing lack of research funding, mentorship, and accessible CH-related experiences.⁸ Even in the current era of virtual communication and interviews, combined H/O fellowship websites underemphasize the CH aspects of their program.⁹ The comparative decreased interest in CH is further affected by nomenclature such as “benign” and “nonmalignant,” which are commonly used incorrectly to describe this field.¹⁰ More H/O fellows are ultimately pursuing careers in medical oncology rather than hematology, despite viewing hematology as an intellectually stimulating field,¹ leading to an inadequate number of classical hematologists.

The CH community is trying to determine what factors positively influence H/O fellows in their career decisions in hopes of identifying areas for intervention.^{1,3} Mentorship, which is known to influence career development and opportunities in academic medicine,¹¹ was a critical factor in determining career decisions among H/O fellows, especially those pursuing CH.^{1,3,4,12} Fellow engagement in mentorship activities such as research and career planning has been shown to significantly influence hematology-only career plans.⁴ However, mentorship is perceived among H/O fellows to be less robust in CH compared with medical oncology, and fellows interested in CH are less likely to have mentors in this field compared with fellows interested in medical oncology or malignant hematology.^{1,13}

Leveraging what is known about the influence of mentorship in trainees' career decisions to enter CH, we implemented a year-long external mentorship pilot program through the ASH Medical Educators Institute (MEI) from April 2021 to April 2022. Fellows were paired with a mentor from outside of their institution based on shared interests and backgrounds. Using a mixed-methods analysis of surveys, interviews, and a focus group, we report the feasibility of the program, assessment of mentee-mentor fit, and the impact of the program on academic productivity, networking opportunities, and career development. We believe that information from this analysis demonstrates the critical role of mentorship in increasing retention in CH.

Methods

Program description

The external mentorship program was developed by 1 investigator (S.J.P.) as an ASH MEI project. The program aimed to pair H/O fellows interested in CH with mentors external to their institution for 1 year (April 2021 to April 2022). They were expected to meet

virtually once a month and had the option to complete a scholarly project. This project was not considered to be research on human participants and deemed exempt by the University of California San Diego Oncology Institutional Review Board.

Program applications were open to H/O fellows from all programs and were distributed to fellowship program directors, sent to the Hemostasis and Thrombosis Research Society (HTRS) listserv, and advertised on social media. The application was open from December 2020 to January 2021. To be eligible to participate, each applicant had to submit an application (supplemental Table 1) via Google Forms (Google, Mountain View, CA), a curriculum vitae, and a letter of support from their program director.

Mentors from institutions across the United States and Canada were recruited based on their CH expertise and academic productivity, determined based on whether they had a CH-related publication searchable on PubMed (National Library of Medicine, Bethesda, MD) within the last 2 years. Mentors and mentees were paired manually by 1 investigator (S.J.P.) with the following elements taken into consideration: CH interests (eg, neonatal hematology), areas of expertise (eg, systems-based hematology), lack of opportunities in specific areas at mentee's institution, career plans, reasons for participating in the program, gender, race and ethnicity, personal experiences, and social media analytics. Applicants indicated their top 3 choices from a list of potential mentors. The final matching was completed by 1 investigator (S.J.P.). Mentors volunteered for this program.

Data collection

A mixed-methods sequential explanatory design was used to evaluate the program based on mentee and mentor surveys, mentee interviews, and a mentee focus group.

We created and collected program evaluation surveys using Google Forms. All surveys contained multiple choice, 5-point Likert scale, and free-text items. The mentees filled out a 12-item survey at 6 months into the program, a 34-item survey at the end of the year-long program, and a 19-item survey 6 months after the end of the program (supplemental Tables 2-4). Mentors completed a 25-item survey at the end of the program (supplemental Table 5).

All mentees were asked in the 6-month postprogram survey if they were available for an in-person interview at the 64th ASH annual meeting in New Orleans, LA, and 2 accepted. Two investigators (S.J.P. and Z.Q.) conducted the interview, and 1 investigator (Z.Q.) recorded responses using detailed, typed notes. Interviewees received monetary appreciation gift cards at the end of the session.

A virtual focus group was conducted 8 months after the program ended. All mentees were invited via email to participate; 6 mentees, distinct from the individuals interviewed at the ASH annual meeting, were available. The virtual session was held over Zoom (Zoom Video Communications; San Jose, CA) and moderated by 2 investigators (S.J.P. and Z.Q.). Participants were asked questions that were prepared by both investigators beforehand about the impact of this mentorship program. The meeting was recorded with the participants' knowledge and verbal agreement. Afterward, all participants received a monetary gift card as a token of appreciation. The audio file was transcribed using NVivo software (Lumivero; Denver, CO). Errors in automated transcription were corrected manually by 1 investigator (Z.Q.).

Table 1. Characteristics of total mentees (N = 35) who participated in program

	Median (IQR) or n (%)
Age	32 (30-33)
Sex assigned at birth	
Female	28 (80%)
Male	7 (20%)
Gender identity	
Female	28 (80%)
Male	7 (20%)
Race/ethnicity	
White	16 (46%)
Asian	12 (34%)
Black	2 (6%)
Arab	1 (3%)
White and Native American	1 (3%)
Hispanic	3 (8%)
Type of medical degree	
MD or MBBS	30 (86%)
DO	5 (14%)
Location of medical degree	
United States	25 (71%)
International medical graduate	10 (29%)
Type of H/O fellowship	
Adult	12 (34%)
Pediatric	23 (66%)
Year of training at time of application	
First-year fellow	10 (28%)
Second-year fellow	16 (46%)
Third-year fellow	7 (20%)
Third-year resident*	2 (6%)
Year of training after start of program†	
First-year fellow	2 (6%)
Second-year fellow	10 (28%)
Third-year fellow	17 (49%)
>Third-year fellow	6 (17%)
Location of current US training program	
West	5 (14%)
Southwest	2 (6%)
Midwest	11 (31%)
Southeast	7 (20%)
Northeast	10 (29%)
Previous CH mentorship before program	24 (69%)
Previous research experience in CH before program‡	30 (86%)
Participated in a formal hematology-focused research program before this program§	9 (26%)
Total publications before program	3 (1-6)
CH publications§ before program	1 (0-2)
Total poster/oral presentations before program	6 (3-10)
CH poster/oral presentations before program	2 (1-3)

Table 1 (continued)

	Median (IQR) or n (%)
Medical education or quality improvement activity related to CH before program	22 (63%)
Member of a H/O professional society	28 (80%)

DO, Doctor of Osteopathic Medicine; MBBS, Bachelor of Medicine and Bachelor of Surgery; MD, Doctor of Medicine.

*Pediatrics residents.

†Obtained from survey distributed 6 months into program (N = 35).

‡Based on experiences listed as research or as original publication or presentation (excluding case reports) in curriculum vitae.

§Includes ASH Hematology Opportunities for the Next Generation of Research Scientists (HONORS), HTRS Trainee Workshop, and HTRS Hematology Fellows Consortium.

|| Includes in-preparation, submitted, under review, accepted, and published manuscripts.

Data analysis

Survey items with a 5-point Likert response such as “Participation in this external mentorship program increased my academic productivity” were grouped into 2 categories: strongly agree/agree vs neutral/disagree/strongly disagree. To compare these self-reported outcome items and participant characteristics, χ^2 analysis or Fisher exact test was used. All tests were 2-sided, and a significance threshold was set for *P* value <.05. The analysis was conducted using SAS 9.4 (Cary, NC).

Thematic analysis of free-text survey responses, interview notes, and focus group transcription was conducted by 2 investigators (Z.Q. and P.N.). Text from these sources were pooled and reviewed closely. Codes to describe the text based on patterns were developed and agreed upon. Each investigator assigned codes to corresponding text independently, and any discrepancies in coding were later resolved after discussion between both investigators. Codes were organized into mutually agreed upon themes.

Results

Mentee demographics

Thirty-five trainees applied; all were eligible to participate as mentees, and there were enough mentors to pair with all applicants. Therefore, all 35 mentees were accepted for this program. Eighty percent self-identified as female (Table 1). Almost half of the mentees were White, whereas the other half comprised mentees who identified as Asian, Arab, Black, Hispanic, or White and Native American. Although 86% held Doctor of Medicine degrees, 14% held Doctor of Osteopathic Medicine degrees. Close to 30% were international medical graduates. About twice as many mentees had pediatric medicine training compared with adult medicine training. Most mentees were in their second and third year of fellowship during the program.

Mentee prior experience in CH

Although 70% of mentees had a mentor within CH at their home institution before applying to this program (Table 1), even those with prior mentors reported a need for more mentorship opportunities in their specific areas of interest (supplemental Table 6). Most mentees had prior CH research experiences (86%), and 26% had previously participated in academic hematology-focused programs such as the ASH Hematology Opportunities for the Next Generation of Research Scientists Award Program, HTRS Trainee Workshops, and the HTRS

Hematology Fellows Consortium. The median number of prior publications was 3 (IQR 1-6), and the median number of prior poster and oral presentations at local and national conferences was 6 (IQR 3-10). However, a minority of these publications (median, 1; IQR 0-2) and presentations (median, 2; IQR 1-3) were CH related.

Feasibility of external mentorship program

All 35 trainees who applied were paired with a mentor outside of their training institution (Figure 1A). There were 34 mentors; 1 had 2 mentees because this mentor's field of interest aligned with both those mentees' interests. There was greater interest among recruited faculty to participate as a mentor than there were available mentees to pair them with; 7 adult- and 17 pediatric-interested CH faculty members not paired with a mentee for the pilot program expressed willingness to participate in future cycles (supplemental Figure 1). Thirty-three of the 35 pairs (94%) completed the program; completion was defined as remaining in contact throughout

the year and/or completing the 1-year program survey. One pair did not complete the program due to extenuating health circumstances, and the other pair ended their mentoring relationship amicably after recognizing they had different goals and availability with respect to their scholarly project.

Mentee-mentor relationship

Quality of pairing. Thirty-two mentees and 27 mentors responded to the 1-year survey (supplemental Table 7). Thirty mentees (94%) and 23 mentors (85%) indicated that their assigned mentor or mentee, respectively, was a good match (Figure 1B). We evaluated the percentage of mentees who thought their mentor was a good match across factors related to mentor experience. Sixteen mentors (59%) had ≥ 10 years of faculty experience, and 14 (52%) had previously mentored >6 mentees (supplemental Table 8). However, there was no statistically significant difference in mentee response based on mentor years of faculty experience or number of prior mentees (Table 2).



Figure 1. Mentee-mentor pairing. (A) Thirty-five mentees were paired with 34 mentors (1 mentor with 2 mentees). Each mentee was paired with a mentor outside of their current institution. Each blue triangle represents a mentee and is placed on the map according to the location of each mentee's training institution at the time of the program. Each red circle represents a mentor and is placed on the map according to their place of employment at the time of the program. Each dotted black line connects a blue triangle with a red circle, representing the assigned mentee-mentor pairing. (B) Likert scale type items from the mentee 1-year survey (n = 32) and mentor 1-year survey (n = 27) that specifically assessed perception of pairing and frequency of communication were plotted on a stacked bar graph. (C) Frequency of meetings as reported by both mentees and mentors in the 1-year surveys are graphed. (D) Mentee and mentor responses from the 1-year survey question that assessed whether they had discussed continuing their mentoring relationship forward after the end of the program are graphed. (E) In the postprogram survey (n = 24) distributed 6 months after the completion of program, mentees were asked whether they had been in touch with their mentor at least once since the end of the program; their responses are displayed in the pie chart. Panel A was created with BioRender.com.

Table 2. Factors influencing mentee survey respondent (n = 32) perception of program in the mentee 1-year survey

Factor	Mentee outcome		P value
	My assigned mentor was a good match		
	Strongly agree or agree % (n/N)		
No. of prior mentees that mentor had*	Mentor with >6 mentees	93% (14/15)	1.000
	Mentor with <6 mentees	100% (12/12)	
Mentor duration of time as faculty member*	>10 y	94% (16/17)	1.000
	<10 y	100% (10/10)	
Frequency of communication with my mentor was adequate			
		Strongly agree or agree % (n/N)	P value
Frequency of communication reported by mentee	Less than once a month	50% (8/16)	.0155†
	At least once a month or more	94% (15/16)	
Participation in this program increased my academic productivity			
		Strongly agree or agree % (n/N)	P value
Mentee participation in scholarly project	Yes	70% (14/20)	.7026
	No	58% (7/12)	
Mentee stage of training	First-year fellow	50% (1/2)	.5047
	Second-year fellow	78% (7/9)	
	Third-year fellow	69% (11/16)	
	Postfellowship	40% (2/5)	
Mentee participated in prior formal research program	Yes	57% (8/14)	.4651
	No	72% (13/18)	
Mentee participated in prior formal CH program	Yes	57% (4/7)	.6675
	No	68% (17/25)	
Mentee prior publications in CH	Yes	59% (10/17)	.3885
	No	73% (11/15)	
I connected with other faculty besides my assigned mentor			
		Strongly agree or agree % (n/N)	P value
Type of fellowship that mentee is in	Adult	60% (6/10)	1.000
	Pediatric	59% (13/22)	
I connected with other trainees during this program			
		Strongly agree or agree % (n/N)	P value
Type of fellowship that mentee is in	Adult	20% (2/10)	.6367
	Pediatric	14% (3/22)	
Participation in this program improved my confidence in pursuing a career in CH			
		Strongly agree or agree % (n/N)	P value
Mentee participation in scholarly project	Yes	75% (15/20)	.6833
	No	83% (10/12)	
Mentee perception of whether mentor was good match	Strongly agree + agree	83% (25/30)	.0423†
	Neutral + disagree + strongly disagree	0% (0/2)	
Participation in this program facilitated my career development			
		Strongly agree or agree % (n/N)	P value
Mentee stage of training	First-year fellow	100% (2/2)	1.000
	Second-year fellow	78% (7/9)	
	Third-year fellow	75% (12/16)	
	Postfellowship	80% (4/5)	
Mentee participation in scholarly project	Yes	80% (16/20)	1.000
	No	75% (9/12)	

*Data obtained from mentor 1-year survey; only mentees with mentors who completed the mentor survey (n = 27 mentees) were included in this analysis.

†Boldface P values represent statistical significance.

Table 2 (continued)

Participation in this program facilitated my career development			P value
		Strongly agree or agree % (n/N)	
Mentee perception of whether mentor was a good match	Strongly agree + agree	83% (25/30)	.0423†
	Neutral + disagree + strongly disagree	0% (0/2)	
Participation in this program impacted my sense of professional identity			P value
		Strongly agree or agree % (n/N)	
Mentee stage of training	First-year fellow	50% (1/2)	.7261
	Second-year fellow	89% (8/9)	
	Third-year fellow	81% (13/16)	
	Postfellowship	80% (4/5)	
Mentee perception of whether mentor was a good match	Strongly agree + agree	87% (26/30)	.0302†
	Neutral + disagree + strongly disagree	0% (0/2)	
I was glad I participated in this program			P value
		Strongly agree or agree % (n/N)	
Mentee participated in prior formal research program	Yes	79% (11/14)	.2951
	No	94% (17/18)	
Mentee participated in prior formal CH program	Yes	71% (5/7)	.2005
	No	92% (23/25)	
Mentee participation in scholarly project	Yes	85% (17/20)	1.000
	No	92% (11/12)	
Mentee stage of training	First-year fellow	100% (2/2)	.3715
	Second-year fellow	100% (9/9)	
	Third-year fellow	75% (12/16)	
	Postfellowship	100% (5/5)	
Mentee perception of whether mentor was a good match	Strongly agree + agree	93% (28/30)	.0121†
	Neutral + disagree + strongly disagree	0% (0/2)	

*Data obtained from mentor 1-year survey; only mentees with mentors who completed the mentor survey (n = 27 mentees) were included in this analysis.

†Boldface P values represent statistical significance.

Mentee-mentor communication. Twenty-three mentees (72%) and 16 mentors (59%) thought that their frequency of communication was adequate (Figure 1B). Sixteen mentees (50%) reported meeting their mentor at least once a month (Figure 1C). Adherence to mentorship program guidelines of meeting once a month was associated with positive mentee perception of adequacy of frequency of communication. Fifteen mentees (94%) who met their mentor at least once a month thought this frequency was adequate, but only 8 mentees (50%) who met their mentor less than once a month thought this was adequate ($P = .0155$; Table 2).

Sustainability of mentoring relationships. Eighteen mentees (56%) and 14 mentors (52%) planned to continue their mentoring relationships beyond the 1-year duration of the program (Figure 1D). In a 6-month postprogram follow-up survey, 15 of 24 mentee survey respondents (63%) indicated that they were in touch with their mentor since completing the program, and 2 additional mentees (8%) planned to contact their mentor (Figure 1E).

Emerging themes from qualitative data regarding mentee-mentor fit. We performed a qualitative analysis on mentee and mentor survey free-text responses, mentee interviews, and a

mentee focus group. Mentees described their assigned mentor to be a good match because of (1) common academic interests; (2) mentor traits such as approachability, supportiveness, and expertise; (3) shared background and demographic characteristics such as self-identified gender and/or race; (4) the fact that an external mentor provided alternative perspectives and filled a need for mentees with limited access to CH mentors at their home institution; and (5) good communication from their mentor (Table 3). Barriers identified by mentees that negatively affected mentor-mentee fit included (1) inadequate communication with mentor and (2) minimal mentor engagement (isolated to 1 mentee response). In survey responses, mentors described their pairing to be positively influenced by (1) common academic interests, (2) mentee traits such as level of effort or productivity, and (3) good communication from mentee. A few mentors noted (1) poor mentee communication, (2) low level of mentee engagement, and (3) different academic interests or goals (although mentors noted that, despite this issue, the mentoring relationship was good).

Benefits of external mentorship pilot program

Academic productivity. Twenty mentees (63%) participated in an optional scholarly project with their assigned mentor. Twenty-one

Table 3. Factors influencing success of mentor and mentee pairing

	Theme	Description of theme	Representative quotes*
Mentee response			
Themes indicating positive influence on mentee-mentor relationship	Similar interests	Mentor and mentee had similar interests, which helped strengthen mentoring relationship.	"Superb match. [My mentor] and I are both focused in patient oriented, clinical research, with a focus in thrombosis and haemostasis." "We are both motivated individuals with an interest in thrombosis! We worked well together and were able to get a productive scholarly activity out of the relationship."
	Mentor qualities	Mentees appreciated mentors who were supportive, engaged, approachable, and experts in their field. Many saw their mentor as role models.	"I felt incredibly comfortable working with [my mentor]. He was approachable, always available for questions, and I could tell had a genuine interest in my career and future goals." "[H]e has so far been such a great mentor for me, not just to introduce me to people...but to also be able to see that you can do it all and still be such a kind person."
	Representation	Mentees responded positively to having a mentor with shared demographic characteristics such as self-identified gender or race.	"As a Black male meeting [my mentor] and getting his direct mentorship provided me safety and permission to live up to my dream of being a physician scientist[.]" "I think my mentor allowed me to see that women can have children and still thrive in their careers. I think that representation is important, and I do not think I would have been able to experience that with a male mentor."
	External mentor	Having an external mentor was helpful in expanding opportunities and perspectives.	"[There were] only a handful of hematologists at [my] program...it was nice to have an outside perspective." "Having an external mentor outside of my program helped me consider opportunities outside of my own institution, including collaboration on other projects and committees."
	Good communication	Mentees appreciated good communication from mentor such as being available to meet or being easy to contact.	"Despite our differences in location, he was able to work closely with me via Zoom meetings on various research projects." "Quick contact after initial set up."
	Themes indicating negative influence on mentee-mentor relationship	Level of engagement	Minimal level of mentor engagement negatively impacted the mentoring relationship.
Inadequate communication		Communication difficulties, such as frequency of meetings or contact, sometimes negatively impacted the relationship.	"...I wish our communication was better (both schedules very busy)." "...we only ha[d] 2 meetings, and she seems very busy and we never followed up."
Mentor Response			
Themes indicating positive influence on mentee-mentor relationship	Similar interests	Mentor and mentee shared similar interests, which helped strengthen the mentoring relationship.	"[Mentee] is interested in pursuing a translational research career, so I was able to share my experience of working in a lab while I was a fellow and early career faculty." "We were both interested in exactly the same populations to study."
	Mentee attributes	Mentors appreciated mentees who were engaged and productive.	"[Mentee] was engaged, motivated and a very hard worker. She was a delight to work with and we were able to successfully create a manuscript which has since been published."
	Good communication	Mentors valued good communication with mentees.	"I was able to connect regularly with my mentee and felt I had a lot to offer her after hearing about her goals for our meetings."
Themes indicating negative influence on mentee-mentor relationship	Difference in academic interest and goals	Interests between mentor and mentee were different; however, they still had a good relationship.	"Overall, a good match, however, his interest was general overall and not in my disease focus (VTE). I was still able to provide guidance and mentorship broadly."
	Mentee engagement	Low level of engagement (for personal or other reasons) may have negatively impacted the mentoring relationship.	"Didn't have the feeling that mentee was that engaged or had need/desire for mentorship outside of home institution."
	Inadequate communication	Infrequent communication may have been an obstacle to the success of some mentoring pairs.	"We initially met monthly, but because the mentee was then starting her new position, I left it up to her to plan the next few months meeting, but never heard from her."

VTE, venous thromboembolism.

*Quotes were obtained from surveys, interview, and focus group.

mentees (66%) thought that participation in this program increased their academic productivity (Figure 2A). We found no statistically significant difference in perceived academic productivity based on several factors: working on a scholarly project, mentee stage of training, prior participation in formal research programs, and prior

mentee CH-related publications (Table 2). Forty-seven percent of mentees who responded to the 1-year survey published or submitted for publication at least 1 scholarly product during the program, with another 28% still working on a scholarly product that was not yet completed (Figure 2B). Mentees obtained awards, grants,

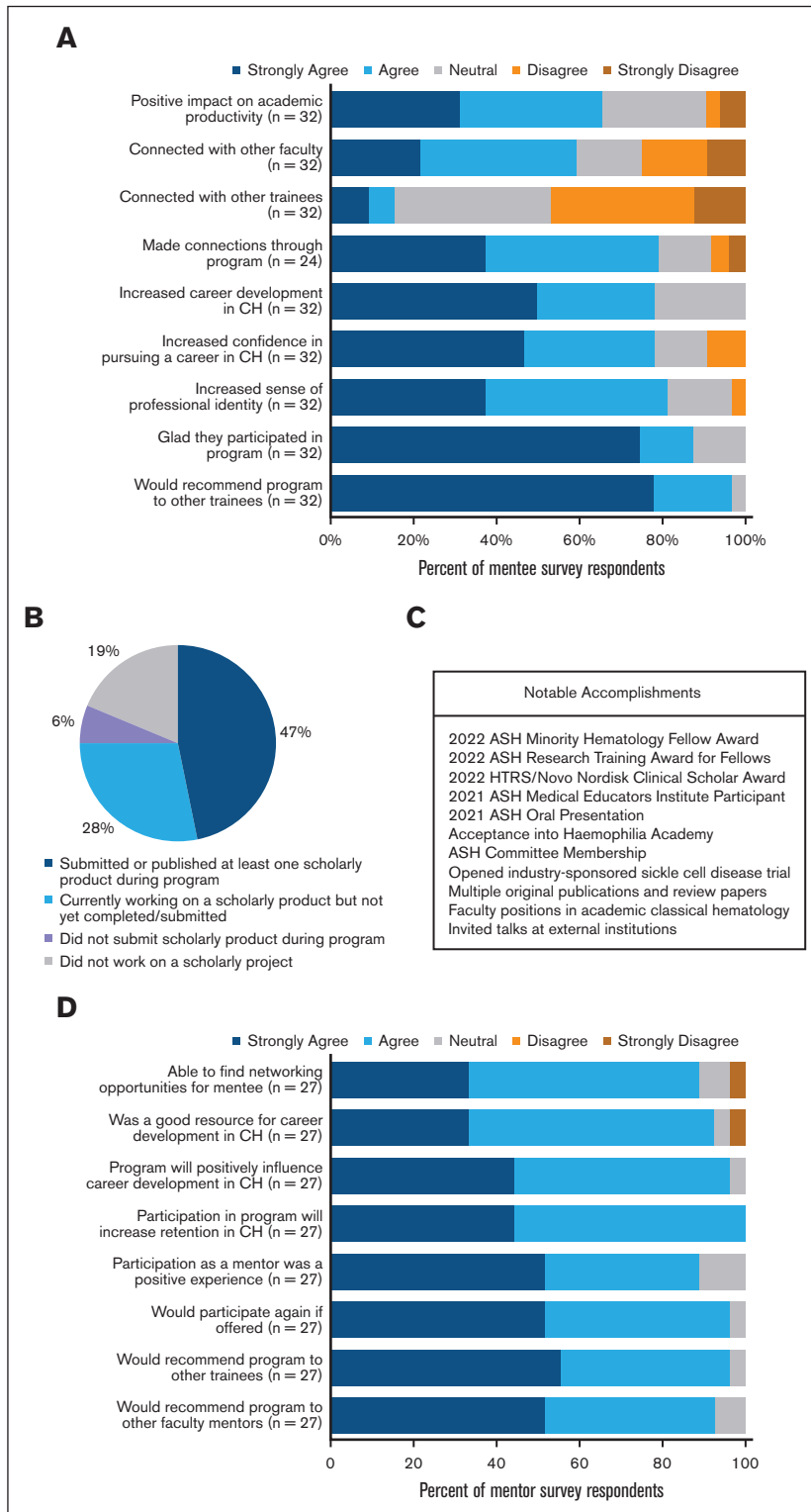


Figure 2. Benefits of external mentorship pilot program. A. Stacked bar graphs represent mentee response to 5-point Likert scale type items in the 1-year survey (n = 32) to questions asking about the impact of program on academic productivity, networking, career development, and professional/personal identity. One item included on this chart was asked in the 6-month postprogram survey (n = 24). (B) Pie chart shows mentee response to 1-year survey (n = 32) question asking about scholarly project and status of deliverable product. (C) List of notable academic accomplishments earned by mentees through their work with their assigned mentor in this program. (D) Stacked bar graphs represent mentor response to 5-point Likert scale type items in 1-year survey (n = 27) assessing their perception of how helpful they were in finding networking opportunities and assisting with career development of mentees, as well as their overall experience in the program.

workshop invitations, committee memberships, conference presentations, speaking invitations, and academic faculty positions through their work with their assigned mentors (Figure 2C).

Networking opportunities. Nineteen mentees (59%) connected with other faculty, apart from their assigned mentor, through this program; however, only 16% of mentees connected with other trainees interested in CH (Figure 2A). There was no statistically significant difference in these responses based on whether the mentee was an adult or pediatric H/O fellow (Table 2). Six months after program completion, 19 mentees (79%) reported having more connections overall because of their participation in the program (Figure 2A). We explored mentor perception of available networking opportunities for mentees, and most mentors (89%) reported being able to find networking opportunities for their mentees if they asked for them (Figure 2D).

Career development and professional identity. Most mentees indicated that participating in this program improved their confidence in pursuing CH as a career (78%), facilitated their career development (78%), and positively affected their sense of professional identity (88%; Figure 2A). The quality of mentee-mentor match appeared to be an important factor because there was a statistically significant difference in perceived positive impact on confidence (83% vs 0%; $P = .0423$), career development (83% vs 0%; $P = .0423$), and professional identity (87% vs 0%; $P = .0302$) between mentees who thought their mentor was a good match vs those who did not (Table 2). Twenty-three of the 35 total mentees (66%) started CH faculty positions at academic and community medical centers after completing their fellowship; 6 mentees (17%) still in fellowship confirmed plans to pursue CH upon graduation (Table 4).

Mentors were also surveyed about their perception of this program's impact on career development in CH. Twenty-five mentors (93%) thought they were a good resource for their mentee's career development, and 26 (96%) thought the program positively affected mentee career development (Figure 2D). All mentor survey respondents (100%) thought this program will increase retention within CH.

Emerging themes in qualitative data regarding benefits of mentorship program. Mentees described several benefits of participating in this program in the surveys, interviews, and focus group. These include (1) academic achievements in the form of

research projects, publications, presentations, and awards; (2) networking opportunities such as introduction to faculty with similar interests or attending conferences; (3) strides in career development such as confirming interest in CH and employment-related benefits such as letters of support, job opportunities, and advice; and (4) impact on personal and professional identity such as increased confidence and increased sense of community (Table 5).

Mentee and mentor satisfaction

Twenty-eight mentees (88%) were glad they participated in this program (Figure 2A). This was not associated with prior participation in formal research programs, participation in scholarly projects during the program, or mentee year in training (Table 2). However, quality of mentee-mentor relationship was statistically significantly associated with whether mentees were glad they participated in the program (93% good match vs 0% not a good match; $P = .0121$). Thirty-one mentees (97%) would recommend this program to other trainees (Figure 2A).

Twenty-four mentors (89%) thought participating in this program was a positive experience (Figure 2D). Twenty-six mentors (96.3%) would participate in this program again, 26 mentors (96.3%) would recommend this program to trainees, and 25 mentors (92.6%) would recommend this program to other CH faculty mentors.

Feedback for improvement

In mentee and mentor surveys, mentee interviews, and a mentee focus group, mentees and mentors provided feedback on improvements that can be made for future cycles. Areas for growth identified from analysis of qualitative data included (1) more structured guidelines to help facilitate mentoring relationships; (2) deliberate timing of program to target certain stages of fellowship; and (3) offering opportunities for in-person or group meetings to foster collaboration and networking (Table 5).

Discussion

We demonstrate the feasibility and impact of a year-long external mentorship program in CH that spanned North America. Given the shortage of classical hematologists, trainees may lack mentors at their local institutions; therefore, more mentorship in CH is needed.¹ Based on the many academic accolades earned by mentees through their work with their assigned mentors and the perceived influence this program had on networking opportunities, career development, and professional identity, we show that positive and productive mentorship is possible via a virtual platform. With most mentees obtaining CH faculty positions after fellowship, we show this mentorship program has the potential to positively influence recruitment and retention in CH.

The opportunity for mentees to connect virtually with a mentor outside of their home institution was a unique and well-received aspect of our program, challenging traditional models of mentorship that emphasized that mentoring must occur in close proximity and rely on face-to-face interactions.¹⁴ Mentees ascribed having an external mentor as a strength of their mentoring relationship because they learned about different perspectives and received assistance with employment opportunities. Virtual modes of communication facilitated mentorship between individuals across different institutions and made this program feasible. Because there is increasing popularity and use of virtual communication, as

Table 4. Current positions of mentees who participated in program (N = 35)

Position type	No. of mentees (%)
Classical hematologist	23 (66%)
Combined practice*	3 (8%)
Medical oncologist	2 (6%)
Current fellow, planning to pursue CH†	6 (17%)
Current fellow, undecided†	1 (3%)

*One-third practiced both classical and malignant hematology; and two-third practiced general H/O.

†Includes third- and fourth-year fellows; career plans confirmed with fellows via email.

Table 5. Benefits of program and areas for improvement

Theme	Description of theme	Representative quotes*
Benefits		
Academic productivity	Mentees found increased academic productivity in the form of research projects, publications, presentations, and awards.	"I was able to have access to a wonderful database and able to get a publication out of the relationship." "I was able to write up an aims page for a future R21 application which helped me with writing a different grant that I submitted to ASH and was awarded! Also, I was able to publish twice since I've started this program."
Networking opportunities	Mentees had the opportunity to meet other faculty and attend conferences.	"It was great being able to see my mentor at the annual ASH meeting where she introduced me to other faculty." "[W]e met during ASH and I felt like a whole another world just like opened up when we met in person. [H]e introduced me to so many different people and I'm in contact with them."
Career development	Mentees received advice on careers in CH and assistance with employment opportunities.	"The mentorship program really hel[p]ed with my job search and advice for my upcoming career and ways to incorporate scholarly activity and involvement into my career." "[O]nce it came time to apply...to jobs [I] also had fantastic support from my mentor for writing letters for me."
Personal and professional development	Mentees felt an increased sense of community and confidence.	"The biggest benefit for me with this program was the creation of a benign heme community for me. I became more confident and excited to pursue a career in this field after being able to connect with and learn from so many fantastic faculty members and trainees." "My mentor has encouraged me to reach out to faculty outside of my current program when pursuing projects and given me the confidence to think outside the box."
Areas for improvement		
Structure	Mentors and mentees report that structured guidelines would be helpful.	"I think a bit of direction for the mentors - frequency of meetings, duration of the program, expectations for an external mentor if people have not done this before- would all be beneficial" "perhaps stay in touch with the mentor/mentee pair through the year, or ask for mid-year feedback"
Timing	Mentees cited timing of program in relation to fellowship impacted experience in program.	"I probably would have had better success with academic productivity if I received this mentorship in my first or second year of fellowship. As a third year, I had already committed to community practice but was still interested in a project if feasible." "[A]s a first year...it was just very busy and I think that I think this program is for a second year and higher."
Networking opportunities	Mentees and mentors suggested more group (virtual or in-person) activities.	"I think the spring of first year...would have been beneficial because that's when you're starting to explore [w]hat will the next two years be[.]" "Maybe one formal in person opportunity to meet, maybe at ASH annual meeting." "May be helpful if all pairs met together and shared their research with each other."

*Quotes were obtained from surveys, interview, and focus group.

well as an interest among H/O fellows in connecting with mentors virtually,¹³ we believe that virtual mentorship can expand the pool of mentors for trainees interested in CH. Programs such as the ASH Clinical Research Training Institute and ASH MEI are examples of hybrid programs with both in-person and virtual aspects that have successfully provided mentorship in clinical research training and medical education, respectively. Participants in our program were also interested in having in-person events, which we plan to incorporate in future cycles.

The positive feedback we received regarding the quality of assigned mentee-mentor pairing, with most pairs continuing their mentoring relationship beyond the duration of the program, demonstrates the potential benefits of assigned mentorship, which is often thought to be less favorable than self-initiated mentorship that develops over time.¹⁴⁻¹⁷ With the shortage of classical

hematologists, it is difficult for trainees interested in CH to develop these local mentoring relationships at their institution.^{1,4} A formal mentorship program such as ours that holistically examines potential mentee and mentor academic and demographic background, experiences, and interests to assign mentee-mentor pairs may help fill this need by opening the door for a potentially successful mentoring relationship. Several mentees in our program also met other faculty through their mentor, indicating that assigned mentorship may provide opportunities for mentees to meet additional potential mentors.

Similar interests and similar self-reported gender and race were cited by mentees as contributing to the success of their mentoring relationship. Mentoring programs may need to include considerations regarding self-identified gender and race, given that these factors positively affected the mentee experience in our study.

These data are supported by another recent study evaluating mentorship in women and trainees underrepresented in medicine pursuing surgical specialties, identifying that trainees who were women or underrepresented in medicine favored and benefited from having gender and race conformant mentors.¹⁸ For CH, this may be currently challenging, given the paucity of CH faculty at many institutions, emphasizing the need for external mentors to expand the pool of ideally matched advisers. The demographic breakdown of our applicant pool seeking mentorship opportunities reflects this need: 80% self-identified as women, who are known to be underrepresented in hematology¹⁹; and almost 30% were international medical graduates, a group that often experiences bias in hematology and academic medicine.²⁰ Diverse representation in medicine is critical and will only grow if individuals underrepresented in medicine are supported at early stages in their career.

Mentee perception of the program's impact on career development was associated with their perceived quality of their mentee-mentor match, suggesting that good mentorship may be an important factor in mentee career development. Formal mentorship has been identified as a key tool in increasing health care worker retention in other domains, such as, but not limited to, nursing, rural medicine, and surgery.^{18,21,22} With a specific focus on the impact of this program on choosing a career in CH, we were impressed that 23 mentees (66%) in our program have already obtained dedicated positions within CH. Mentors predicted that this pilot program will lead to continued careers in CH, and we predict that expansion of this program will further increase retention in CH and expand the CH workforce. Our program adds to an already growing landscape of CH-focused opportunities aimed at increasing retention. An evaluation of the HTRS Trainee Workshop, a 2-day dedicated CH experience, showed a positive influence on trainees' decisions to pursue careers in CH.²³ The ASH Hematology-Focused Fellow Training Program is a new adult hematology-only fellowship that applicants commit to through the National Resident Matching Program.²⁴ We believe our mentorship program shares with ASH Hematology-Focused Fellow Training Program the same goal of increasing retention in CH, with the benefits of being open to both adult and pediatric H/O fellows, having career flexibility for fellows who are interested in but may not be completely decided on CH, and providing a longitudinal experience concomitant with fellowship outside of the mentees' home institutions.

We have identified some limitations of this program and analysis. Program participants may be self-selecting as almost 70% had prior CH mentors, most had prior research experiences, and some had been recipients of prior ASH awards. Outcomes were obtained from nonanonymous mentee and mentor surveys, mentee interviews, and a focus group, making these data vulnerable to self-reporting bias.²⁵ For example, respondents may answer in a manner they think is socially desirable within the hematology community and may overstate the benefits of the program. The data could also be affected by sampling bias, because those who responded to surveys or volunteered to participate in the interview and focus group perhaps had a more impactful experience in the program. The mentees had an opportunity to participate in a free program, which may have led to overreporting positive aspects of the program. Finally, we had a relatively small sample size that affected our ability to detect statistically significant associations in

our data. Although most participants completed the 1-year survey, there was a low rate of participation in the in-person interviews held at the ASH annual meeting ($n = 2$) and virtual focus group ($n = 6$). We attribute this to scheduling and time conflicts, because mentees who were unable to participate in these 2 sessions indicated they would be interested in speaking at a different time.

Our pilot program was positively received by most mentees and mentors, and continuing future cycles of this program may benefit even more trainees. We will continue to assign H/O fellows to external mentors that we predict will be a good fit, because quality of pairing positively affected mentee experience. We hope to recruit mentors who participated in this pilot program, faculty who were not matched with a trainee for the pilot program but indicated interest in participating and mentees from the pilot program who are now faculty. Communication frequency of at least once a month was favorable, and we will also include structured guidelines and scheduled check-ins for future cycles to help improve communication. To strengthen mentoring relationships, increase the opportunity for networking, and foster a sense of community within CH, we envision incorporating at least 1 in-person opportunity for participants. Expanding and refining this program will result in an increased number of external mentorship opportunities in CH with the goal to increase retention of trainees in the field.

Authorship

Contribution: S.J.P. conceived and implemented the mentorship program; S.J.P., A.A.K., and Z.Q. designed evaluation surveys; S.J.P., Z.Q., and I.W.-S. conducted interviews with mentees; S.J.P. and Z.Q. conducted a virtual focus group with mentees; S.J.P., Z.Q., and P.N. participated in data collection and organization; S.K.V. and Z.Q. performed statistical analysis; Z.Q. and P.N. performed content analysis of qualitative data; Z.Q. wrote the manuscript; Z.Q., P.N., and S.K.V. created figures and tables; P.N. created the visual abstract; and all authors reviewed the analysis and final manuscript.

Conflict-of-interest disclosure: N.T.C. is a consultant for Takeda; participates in advisory boards for Takeda, Genentech, Sanofi, and Medzown; has equity in Medzown; and receives honoraria/travel support from Octapharma. A.v.D. has received honoraria for participating in scientific advisory board panels, consulting, and speaking engagements from BioMarin, Regeneron, Pfizer, Bioverativ/Sanofi, CSL Behring, Novo Nordisk, Precision Medicine, Sparx Therapeutics, Takeda, Genentech, and uniQure; and is a cofounder and member of the board of directors of Hematherix LLC, a biotech company that is developing ^{super}FVa therapy for bleeding complications. R.L.Z. is a consultant and stockholder for Triveni Bio. The remaining authors declare no competing financial interests.

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