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TO THE EDITOR:

Single-board hematology fellowship track: a 10-year institutional experience

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In the United States, internal medicine subspecialty training is dictated primarily by the Accreditation Council for Graduate Medical Education (ACGME), which sets standards for clinical and education program requirements for recognized fellowships. For adult hematology and oncology training, the ACGME recognizes 3 distinct programs: hematology, oncology, and combined hematology/oncology. In the adult disciplines, the American Board of Internal Medicine (ABIM) also offers separate board examinations for hematology and medical oncology. However, despite the option to offer single-board training, the vast majority of fellowship programs in the United States (132 participating programs) are constructed as combined double-board programs for hematology/medical oncology, with only 2 institutions currently listing a hematology-only program on the Electronic Residence Application Service (ERAS).[1] It has been hypothesized that this combined structure contributes significantly to the shortage of trainees who ultimately practice academic hematology and, particularly, benign hematology.[2]

In 2005, the Johns Hopkins Hematology/Medical Oncology Fellowship Program introduced a single-board hematology track to promote career development in malignant and benign hematology. We now review the structure of our unique fellowship program. We also examine the 10-year outcome of this program structure from 2005 to 2014, as measured by retention in academic and clinical hematology.

The Johns Hopkins Hematology/Medical Oncology program is a 3-year ACGME-accredited fellowship in Baltimore, Maryland. Since 2005, the program has accepted 1 to 2 applicants per year into a single-board hematology track structured to provide academic training in malignant and benign hematology. In 2017, we administered an 8-question electronic survey to fellows from our program who matriculated into the hematology track from 2005 to 2014 and had graduated by the study date. The purpose of the survey was to assess characteristics of each fellow's current job, specifically with regard to clinical and research involvement in hematology. For this study, benign hematology was defined as

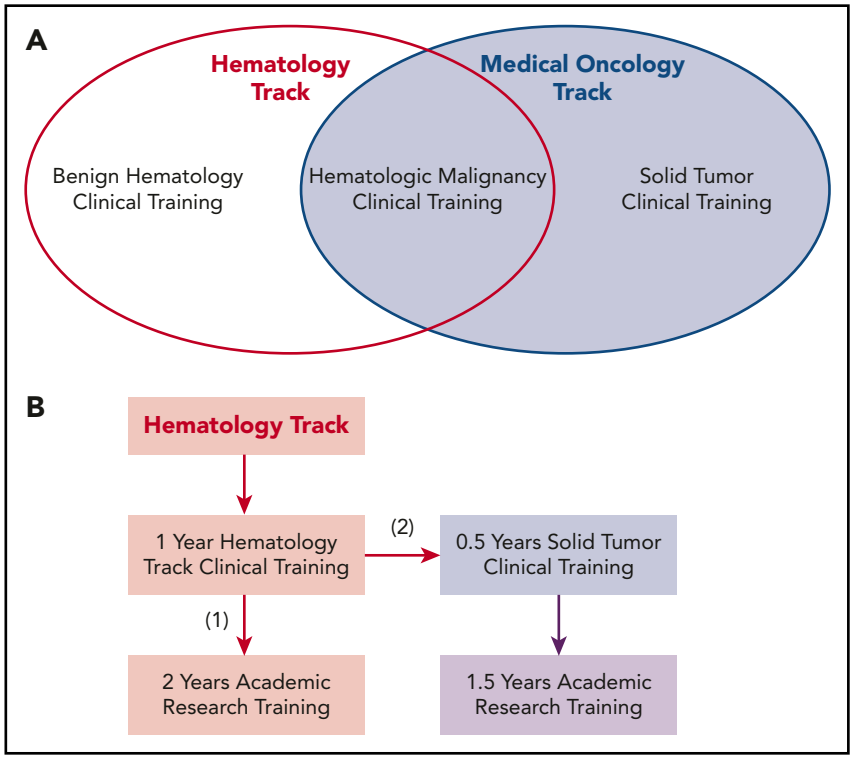

Figure 1. Johns Hopkins Hematology/Medical Oncology Program structure. (A) Schematic of year 1 of clinical training for the hematology and medical oncology tracks. (B) Three-year overall training structure for the hematology track for single boarding (1) and for dual certification (2).

Table 1. Characteristics of prior fellows from the hematology track at Johns Hopkins from 2005 to 2014

Characteristic	N (%) or median (range)
Demographics	
Female	5/14 (36)
MD/PhD	7/14 (50)
MD/Master's	3/14 (21)
Current career	
Academic	11/14 (79)
Government	3/14 (21)
Other	0
Research focus	
Basic science	2/14 (14)
Translational	7/14 (50)
Clinical	5/14 (36)
Percentage of job effort	
Research	57.5 (10-85)
Patient care	27.5 (0-70)
Other	10 (0-90)
Allocation of time spent in research	
>50% benign hematology	4/14 (29)
>50% malignant hematology	8/14 (57)
50/50 benign/malignant hematology	2/14 (14)
Allocation of time spent in patient care	
>50% benign hematology	5/13 (38)
>50% malignant hematology	8/13 (62)
Overall allocation of time	
>50% benign hematology	5/14 (36)
>50% malignant hematology	9/14 (64)

pertaining to normal hematopoiesis, iron metabolism, transfusion medicine, autoimmune or undefined cytopenias, erythrocyte disorders, hemoglobinopathies, porphyria, hemolytic anemias, thrombotic microangiopathies, platelet function, coagulation, thrombotic/bleeding disorders, nonmalignant leukocyte disorders, disorders of phagocytic function, primary immunodeficiency syndromes, bone marrow failure, myeloproliferative neoplasms, mast cell disorders, histiocytic disorders, and hemophagocytic lymphohistiocytosis.

The overall structure of our program is a combined hematology/medical oncology program consisting of a single-board hematology and a single-board medical oncology track. For the first clinical year, the hematology track comprises benign hematology and malignant hematology training and the medical oncology track comprises malignant hematology and solid tumor training (Figure 1A). This year of single-board clinical training is followed by 2 years of research training. After the first year of single-board training, all fellows have the option of extending their clinical training by 6 months to obtain dual certification and thereafter complete 1.5 years of research training (Figure 1B). Didactics, conferences, and research training curriculum are combined for all fellows to allow for full exposure to resources and faculty. For hematology-track fellows, benign hematology clinical training consists of inpatient benign hematology service and consults (3-4 months) and hematology rotations (1 month each) in hematopathology, laboratory medicine, and transfusion medicine. Hematologic-malignancy training is composed of inpatient leukemia (1-2 months), inpatient bone marrow transplant (1-2 months), and inpatient/outpatient hematologic-malignancy consults (1-2 months). Hematology-track fellows hold a malignant hematology continuity clinic their first year and a benign hematology continuity clinic during their second year.

From 2005 to 2014, 16 fellows matriculated into the hematology fellowship track, and 15 fellows had graduated from the program by the study date. Of these fellows, 11 of 15 (73%) trained in single-board hematology, whereas 4 of 15 (27%) additionally received training in medical oncology. The survey was electronically distributed to all 15 fellows with a 93% response rate (14 of 15). As shown in Table 1, 11 of 14 respondents (79%) currently work in an academic setting, with the remaining 21% in government positions. Even among those who obtained dual certification in medical oncology, all respondents (100%) characterized their research and patient-care focus as being in hematology. In terms of research, 4 of 14 (29%) spend >50% of time in benign hematology with an additional 2 of 14 (14%) spending 50/50 time in both benign and malignant hematology. Furthermore, 5 of 14 (36%) allocate the majority of their overall job effort to benign hematology.

Retention into academic hematology has been declining significantly over the past decade due to several factors including inadequate training, lack of mentorship, and insufficient financial compensation.[2-4] In this 10-year review of the structure and outcome of our unique single-board hematology fellowship track at Johns Hopkins, we found that our model results in high retention into both academic benign and malignant hematology. In particular, this study demonstrates that a single-board hematology track results in high recruitment to research and clinical practice in benign hematology, with over one-third of graduates allocating the majority of their effort to benign hematologic endeavors.

Prior studies have shown that even among academic adult hematology/oncology fellowship programs, graduates who maintain a primary clinical focus in benign hematology are <5% and in malignant hematology are <20%.[5] Although there are likely several factors that resulted in high retention in hematology, and particularly benign hematology, in our model, our results suggest that a single-board track may be successful in cultivating and maintaining fellow interest in this specialty. Poor rates of fellow retention in benign hematology are likely, in part, due to marginalization of benign hematology curriculum within an overarching malignancy-based fellowship structure. A single-board track may validate benign hematology as a career choice in the academic setting. For example, in Europe, where hematology was formalized as a monospecialty in 2003, retention into benign hematology has been largely successful.[6] As a result, since 2006, the European Hematology Association (EHA) has developed a harmonized curriculum for all European countries in an effort to maintain academic recruitment in hematology disciplines.[6,7]

A dedicated hematology track has several other potential benefits. At the medical student and resident level, exposure to single-board hematology fellows may spark their interest in hematology, provide role models, and allow them to envision

a career in this specialty. Ultimately, these downstream effects may increase the pool of applicants in this underrepresented field.

Prior to 2017, our program did not have a formal application process for our single-board hematology track, and candidates were identified based on interest expressed during the fellowship interview. In 2017, we formalized a hematology track in ERAS to allow candidates to independently apply to a hematology and/or medical oncology track within our combined hematology/oncology fellowship structure. Of the 414 total applicants to our program for the 2018 season, 212 (45% female) applied to the hematology track, of whom 51 applied to the hematology track only. In addition, 26 candidates expressed an interest in benign hematology as assessed by overt mention in their personal statement. These numbers contradict the perceived lack of enthusiasm for hematology and likely underestimate the true number of candidates with an untapped interest in this field.

At Johns Hopkins, the Division of (benign) Hematology is a free-standing division in the Department of Medicine, which differs from most university programs. However, despite our unique division organization, our fellowship structure provides a widely applicable model for single-track hematology training within a dual-program structure. In many academic programs, fellows serve as an important workforce for patient care. The overlapping structure of our single-board hematology and medical oncology tracks preserves clinical training for hematologic malignancies for all fellows, which allows for extension of our structure to more traditional oncology programs. Furthermore, our structure preserves the option for dual certification from either track to allow flexibility in training.

In conclusion, our 10-year experience of a single-board hematology track demonstrates high retention in academic benign and malignant hematology, both in terms of clinical and research focus. Future efforts should be made to encourage academic programs to implement this system to help build and maintain the pool of academic hematologists in the United States.

Acknowledgments

R.P.N. was supported by National Institutes of Health, National Heart, Lung, and Blood Institute grant K08HL125100.

Authorship

Contribution: R.P.N. and K.M. designed and performed the research, interpreted the data, and wrote the manuscript; S.M. interpreted the data and critically revised the manuscript; R.D. and R.B. contributed to and interpreted the data and critically revised the manuscript; and all authors read and approved the final version of the manuscript.

Conflict-of-interest disclosure: The authors declare no competing financial interests.

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DOI 10.1182/blood-2017-11-816207

TO THE EDITOR:

The addition of IMiDs for patients with daratumumab-refractory multiple myeloma can overcome refractoriness to both agents

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The survival of myeloma patients has doubled in the past decade, but patients refractory to both proteasome inhibitors (PIs) and immunomodulatory drugs (IMiDs) still have poor prognosis.[1] Immunotherapy with monoclonal antibodies targeting cell-surface antigens is a promising new treatment strategy with different mechanisms of action.[2,3] CD38, a transmembrane glycoprotein involved in adhesion, has enzymatic and receptor functions,[4-6] is highly expressed on myeloma cells, and represents an attractive target for myeloma immunotherapy. Monoclonal antibodies targeting CD38, such