American Journal of
Preventive Medicine

TOPICS IN EDUCATION

Alignment of Preventive Medicine Physicians' Residency Training With Professional Needs

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Preventive medicine (PM) physicians promote population-based approaches to health care with training that emphasizes public health, epidemiology, and policy. PM physicians use these skills in varied, often nonclinical, practice settings. PM career diversity challenges educators when designing residency curricula. Input from PM physicians about workforce environments is needed to ensure that residency requirements match skills needed post-residency. Graduates of one PM residency were sent a cross-sectional survey in 2016. Questions included professional experience, importance of 18 Accreditation Council for Graduate Medical Education sub-competencies and 13 leadership/-management skills to current position, and residency training adequacy in those sub-competencies/skills. Responses were rated on 3-point Likert scales. Analyses were completed in 2017. Pearson's chi-square tests examined relationships between position type (academic/government) and perception of competencies' importance and training adequacy. Eighty PM physicians responded (46%): 44% worked in academia and 25% in federal/state/local government. Half (53%) were PM board certified. A total of 88% completed clinical residency prior to PM. Thirteen of 18 competencies were important to work, and respondents felt well trained in 16 of 18 competencies. Respondents did not feel well trained in emergency preparedness and surveillance systems during residency and their opinions about the importance of these sub-competencies varied based on where they worked. Respondents rated all 13 leadership/management skills as important, but reported inadequate residency training. In conclusion, respondents rated most Accreditation Council for Graduate Medical Education sub-competencies as important to current work and felt well trained, indicating good alignment between residency training and professional needs. Respondents also reported leadership/management training deficiencies. PM residencies might consider incorporating formal leadership training into curricula.

Am J Prev Med 2019;56(6):908–917.

INTRODUCTION

Preventive medicine (PM) is recognized by the American Board of Medical Specialties and the Accreditation Council for Graduate Medical Education (ACGME) and emphasizes a population-based approach to healthcare delivery.[1–4] Within PM, public health and general preventive medicine (PH/GPM) is one area in which residents receive training in population health, public health, clinical prevention, environmental health, behavioral health, epidemiology, biostatistics, health services management/administration, and health policy.[3–5] After residency, PH/GPM

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0749-3797/$36.00
https://doi.org/10.1016/j.amepre.2019.01.012

physicians work in diverse practice settings.[6] The heterogeneity of career paths makes optimal PH/GPM residency preparation challenging.

The goal of graduate medical education is to equip physicians with knowledge and skills necessary for care of patients or populations.[6] As for other specialties, ACGME requires competency-based education and evaluates PH/GPM resident training by achievement of milestone benchmarks in core competencies.[6] Following development of six general competencies by ACGME in 2013,[7] the Preventive Medicine Milestone Project produced the first PH/GPM Milestone sets to improve training consistency, and guide semi-annual reviews of resident performance.[8] PH/GPM residents are assessed on 23 sub-competencies from Levels 1 to 5, with Level 4 serving as a target before residency completion. Specific milestones in the PH/GPM ACGME program requirements reflect the unique training needs of PH/GPM physicians.[5] Given the recent development of milestones, input from PH/GPM residency graduates on importance and adequacy of training is needed.

A 1991 national survey of PM physicians found that most are employed in federal/state agencies and academia.[9,10] No national survey has been conducted since then, although a recent single-site survey reported similar results.[11] One study examined resident perception of PM training adequacy, but this was completed prior to the ACGME introduction of milestones and the Next Accreditation System.[12] Examination of competency importance and training adequacy has been studied in other specialties[13–19] but has been limited in PM. One PM residency study mapped learning objectives to competencies to assess the integration of clinical and public health skills,[20] but the study was conducted before the development of milestones.

This study aims to determine whether current PH/GPM residency requirements adequately reflect the skills needed by physicians in the workforce. The objectives are to understand the most common positions and activities of PH/GPM physicians, physicians' perceived importance of ACGME sub-competencies and adequacy of training, and importance of leadership/management skills. From prior surveys,[9,21–23] it was expected that many graduates worked in settings, such as federal, state, or local government, in which non-clinical responsibilities may be particularly important. It is predicted that training needs vary based on employment position and activities because government positions may involve substantial non-clinical responsibilities; however, sub-competencies tied closely to public and population health are expected to be globally important. Finally, it is predicted that leadership skills may be important but are seldom emphasized in graduate medical education.[24,25] These questions are posed within the context of a broader evaluation conducted on the impact of a PH/GPM residency program on population health in North Carolina.

METHODS

The PM residency at the University of North Carolina-Chapel Hill (UNC) is a 2-year ACGME-accredited PH/GPM training program.[26] Incoming residents complete >1 year of clinical training; most are board-eligible or board certified in another specialty. The program contains no tracks. An MPH degree is completed during PH/GPM residency, typically in health care and prevention, epidemiology, or maternal and child health. Additional requirements include a public health agency rotation (2 months), a healthcare administration/quality improvement rotation (2 months), an epidemiology teaching rotation (1 semester), weekly seminar, and at least one research project. Commonly selected rotation and practicum settings include the state Division of Public Health, the Veterans Administration National Center for Prevention, local health departments, federally qualified health center organizations, and local and national private and nonprofit healthcare organizations. Historically the curriculum heavily emphasized epidemiology and clinical preventive services; the quality improvement rotation was added ≅15 years ago. An individual patient care rotation (Years 1–2, 2 months), mirroring ACGME program requirements, is a more recent addition. Otherwise, the curriculum has been relatively stable for >30 years. Leadership/managerial skills have not been formally emphasized in the curriculum; exposure is typically through rotations.

Because the UNC curriculum emphasizes research, it is more flexible and individualized than other programs. Although the residency is housed in an academic center, on training completion graduates have historically sought positions at a variety of institutions in multiple states. PH/GPM physicians frequently seek employment at sites where they have completed either elective or required rotations, including governmental public health agencies, federally qualified health centers, and nonprofit organizations, in addition to UNC.

Study Sample

PH/GPM residency program graduates were invited to participate in an online cross-sectional survey (Qualtrics, version 4/2016, Provo, UT) in 2016. Graduates were contacted with an initial e-mail and two e-mail reminders over 2 weeks, using all available e-mail addresses. Nonresponders to these three attempts had no contact with study staff, and only limited comparison with responders was possible. Two hundred and fifteen PH/GPM physicians graduated between 1975 and 2015. Those with contact information on file were invited to participate. Participation was voluntary, and no compensation was provided. Respondents provided informed consent prior to survey completion. The study was approved by the IRB at UNC (IRB #15-2498).

Measures

Broad guidance for overall residency evaluation was provided by a stakeholder group that included Resident Advisory Committee members; American College of Preventive Medicine staff; employers of PM physicians at one contract research organization, one

governmental organization, and two academic medical centers; and workforce research experts. Several of these individuals were eligible to receive the survey but were not directly involved in survey development. Program leadership developed the survey with input from the stakeholder group. A pilot survey was tested with five residents prior to distribution and modified based on feedback, and these individuals were not included in the sample. The current analysis included 12 demographic questions, two questions on position type and responsibility, and question sets described below on milestone importance and adequacy and managerial/leadership importance and training adequacy. Leadership and management questions were developed by program leadership, and informed by broad evaluation input from stakeholders.

Respondents answered questions on experience including employment status (full time, part time, in training, not employed, other), practice setting for primary position, length of time in position, employment location (in North Carolina, in U.S.), residency training before PM residency, PM board certification, and year of PM graduation. Respondents reported whether they were involved in the following activities: direct patient care, research, non-clinical teaching, governmental public health (epidemiology/evaluation, administration), healthcare administration, consulting, and international health activities. Respondents reported demographic characteristics including age, sex, and race.

Survey developers selected 18 ACGME milestone sub-competencies[5] of highest interest to evaluate the curriculum against respondents' perceptions of importance. All patient care, medical knowledge, and systems-based practice sub-competencies were included. Other sub-competencies were not included (1) because they are not as specific to the field of PH/GPM as other sub-competencies and (2) to keep the survey as brief as possible based on feedback during pilot testing. Milestone sub-competencies were included in the survey per ACGME wording[5] with few exceptions (Medical Knowledge 1–3). For these, language was adapted from the Level 4 milestone (Appendix Table 1). Wording for one sub-competency (Systems-Based Practice 3) was shortened for brevity. For each ACGME sub-competency, respondents rated its importance to current position and the adequacy of residency training. Responses were rated on a 3-point Likert scale (importance: agree/neutral/disagree; adequacy: good/adequate/poor). The relationship of responses to current position type was examined.

Thirteen leadership and management skills were selected. Leadership skills represented various domains including communication, operational, and visionary proficiencies; management skills were also included. Because these items are not currently included in PH/GPM sub-competencies, survey items were developed based on expert opinion and literature review.[27–34] For each skill, respondents indicated its importance to their current position and perceived adequacy of residency training on a 3-point Likert scale (importance: agree/neutral/disagree; adequacy: good/adequate/poor).

Statistical Analysis

Statistical analysis was performed in 2017. Univariate analysis assessed the distribution of study variables. Outcome variables (importance of and training adequacy in 18 sub-competencies and 13 leadership/management skills) were examined for relationship with position type (academic or government) using Pearson's chi-square tests. Results were reported as unadjusted percentages. Analyses were conducted using Stata statistical software, version 14. Descriptive statistics that illustrated respondents' practice characteristics and results of bivariate analyses were selected a priori as main outcomes. Results with cell size <5 were suppressed to protect respondent confidentiality.

RESULTS

Of 215 graduates, 173 had e-mail addresses on file with the residency program and were eligible to participate. Eighty graduates (46%) completed the survey. Respondents had a mean age of 51.3 years (SD=9.4), 67% were female, and 81% were white (Table 1). Analysis of limited administrative program data revealed that mean years since PH/GPM residency completion was higher for survey nonresponders (20.3) compared with responders (16.2, $p<0.05$); fewer nonresponders were female, but this difference was not significant (57%, $p>0.05$). Most respondents (88%) completed a clinical residency before PH/GPM; the most common specialties were pediatrics, family medicine, and internal medicine. Approximately half (53%) were board certified in PM (Table 1). Respondents selected multiple reasons for lack of PM board certification including "unnecessary for current or future work" (59%), "already board-certified in another specialty" (54%), and "too expensive" (31%).

Most respondents (81%) were employed full time and worked in their current position for a mean of 9.4 years (SD=8.2; Table 1). Forty-four percent of respondents worked in academia, and 25% in government. Respondents also worked for nonprofit organizations or healthcare systems (Table 1). Twenty-two percent of respondents indicated holding a secondary position. Academic and government-employed respondents had similar characteristics, although more academic-based respondents completed a clinical residency prior to PM, and fewer were PM board certified.

A majority (59%) provided direct patient care and just more than half (55%) conducted research (Table 1). Respondents also reported involvement in non-clinical teaching (45%), governmental public health (epidemiology/evaluation 33%, administration 23%), healthcare administration (33%), consulting (23%), and international health activities (18%). Because respondents in government had significantly different responsibilities than respondents in academia, their responses were compared using chi-square analyses. Respondents in academic positions reported more involvement in patient care compared with those in government positions (81% vs 33%, $p<0.05$), and more involvement in teaching (75% vs 44%, $p<0.05$) and research (87% vs 50%, $p<0.05$). By contrast, respondents in government positions reported more involvement in governmental

Table 1. Characteristics of Preventive Medicine Physician Respondents for the Overall Sample and Stratified by Current Position.

Characteristic	Overall[a] (*n*=80)	Academic[a] (*n*=32)	Government[a] (*n*=18)
Demographics			
Age, years, mean (SD)	51.3 (9.4)	52.0 (8.3)	53.5 (12.2)
Female	67	70	63
White	81	81	73
Employment			
Employed full time	81	84	89
Time in current position, years, mean (SD)	9.4 (8.2)	11.5 (9.0)	8.4 (9.1)
Employed in NC	**39**	**53**	**22**
Employed in U.S.	96	91	100
Completed clinical residency prior to PM	**88**	**97**	**72**
Board-certified in PM	**53**	**41**	**78**
Time since PM residency completion, years	17	16	19
Current primary position			
Academic/university	44.0	—	—
Federal government	14.0	—	—
Non-profit organization	14.0	—	—
Private, not-for-profit health system	8.2	—	—
State government	6.9	—	—
Local government	4.1	—	—
Private, for-profit health system	4.1	—	—
Military	4.1	—	—
Other	1.4	—	—
Industry/private business	0.0	—	—
International health agency	0.0	—	—
Current responsibilities[a]			
Direct patient care	**59**	**81**	**33**
Research	**55**	**87**	**50**
Non-clinical teaching	**45**	**75**	**44**
Governmental public health epidemiology/evaluation	**33**	**25**	**72**
Governmental public health administration	**23**	**13**	**61**
Healthcare administration	33	38	22
Consulting	23	28	16
International health activities	**19**	**13**	**39**

Note: Boldface indicates statistical significance ($p<0.05$) for difference between academic and government positions. Demographic and employment characteristics of respondents are displayed as well as current position type. Means and SDs are reported for continuous variables. Percentages are reported for categorical variables. Results are reported for the overall sample of 80 respondents and for the subset of respondents employed in academics (*n*=32) or government (*n*=18).

[a]Data are percentages unless otherwise indicated.

[b]Percentages total >100 because respondents could select multiple options.

NC, North Carolina; PM, preventive medicine.

public health epidemiology/evaluation (72% vs 25%, $p<0.05$), governmental public health administration (61% vs 13%, $p<0.05$), and international health (39% vs 13%, $p<0.05$). No significant relationships were found between years since PM graduation and employment responsibilities (not shown in table).

Respondents indicated that 13 of the 18 sub-competencies assessed were important to current work (Figure 1). Sub-competencies rated as less important included monitoring, diagnosing, and investigating community health problems; recommending methods of reducing adverse environmental health effects for individuals and populations; designing and operating a surveillance system; applying skills in emergency preparedness and response; and investigating/responding to a cluster or outbreak investigation.

Importance of six sub-competencies differed based on practice setting (Figure 2). More government-employed

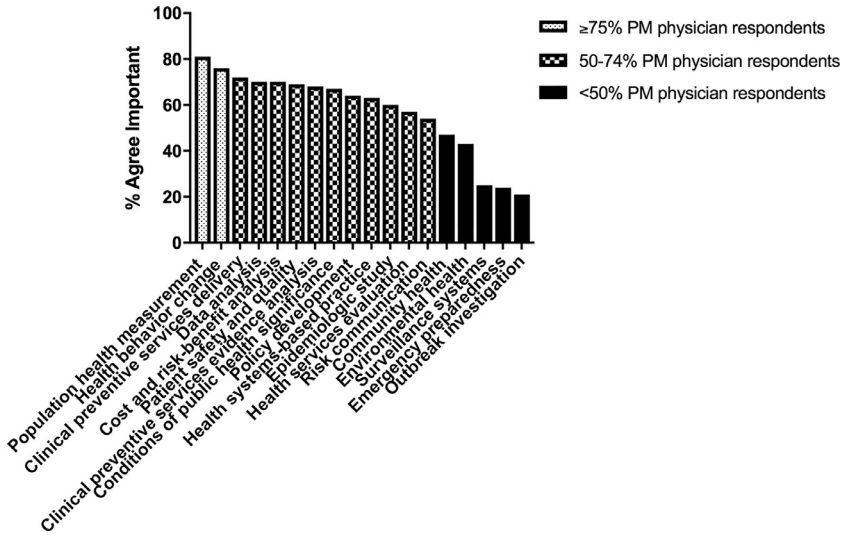

Figure 1. Perception of ACGME milestone sub-competency importance to current position among preventive medicine physicians.
Note: Respondents rated their agreement with 18 statements in the form of "This milestone is important to current position" on a 3-point Likert scale (Disagree/Neutral/Agree). Individual milestone sub-competencies, selected for survey inclusion, are listed on the X-axis. The percentage of respondents answering "Agree" is reported on the Y-axis. Bar shading indicates sub-competencies where ≥75% of respondents answered "Agree" compared to 50%–74% or <50%. Abbreviated sub-competency titles as follows: "Population health measurement" = Use data to characterize the health of a population; "Health behavior change"= Implement approaches to change health behaviors of individuals and/or modify population health behaviors; "Clinical preventive services delivery"= Select and provide appropriate evidence-based clinical preventive services; "Data analysis"= Select appropriate methods for analyzing data and perform data analyses; "Cost and risk-benefit analysis"= Incorporate considerations of cost awareness and risk-benefit analysis in patient and/or population based care; "Patient safety and quality"= Work in interprofessional teams to enhance patient safety and improve patient care quality; "Clinical preventive services evidence analysis"= Analyze evidence regarding the performance of proposed clinical preventive services for individuals and populations; "Conditions of public health significance"= Implement appropriate clinical care for individuals with conditions of public health significance; "Policy development"= Develop policies and plans to support individual and community health efforts; "Health systems–based practice"= Work and coordinate patient care effectively in various healthcare delivery settings and systems; "Epidemiologic study"= Design and conduct an epidemiologic study; "Health services evaluation"= Evaluate population-based health services; "Risk communication"= Inform and educate populations about health threats and risks; "Community health"= Monitor, diagnose, and investigate community health problems; "Environmental health"= Recommend methods of reducing adverse environmental health effects for individuals and/or populations; "Surveillance systems"= Design and operate a surveillance system; "Emergency preparedness"= Apply skills in emergency preparedness and response; "Outbreak investigation"= Investigate/respond to a cluster or outbreak.
ACGME, Accreditation Council for Graduate Medical Education; PM, preventive medicine.

respondents reported that sub-competencies related to surveillance systems and outbreak investigation were important to current work than did academically employed respondents ($p<0.05$). Conversely, more academia-based respondents rated health behavior, clinical care, patient care coordination, and inter-professional teamwork-related sub-competencies as important compared with government-employed respondents ($p<0.05$).

Most (≥75%) perceived training as good or adequate in 16 of the 18 sub-competencies. The two sub-competencies where training was rated as poor were related to emergency preparedness and surveillance systems. Generally, academic and government-employed respondents perceived residency training similarly. However, half of government-employed respondents indicated inadequate training in surveillance systems compared with 31% of academic respondents ($p<0.05$).

Most respondents rated all 13 leadership/management skills as important (Figure 3A). The most important leadership skills were bringing together diverse stakeholders (85%), managing conflict (82%), and providing an organization with innovation (82%). The most important managerial skills were working as a team member (98%) and running meetings (89%). Academic- and government-employed respondents differed on the importance of engagement in advocacy (academic: 75%, government: 44%, $p<0.05$) and handling legally sensitive matters (academic: 44%, government: 75%, $p<0.05$).

Respondents indicated the adequacy of training for each leadership/management skill (Figure 3B). For four skills, 50%–75% of respondents reported inadequate training. These skills included making hiring decisions, creating/managing a budget, managing conflict, and handling legally sensitive matters. The relationship of importance and adequacy of each leadership/management skill

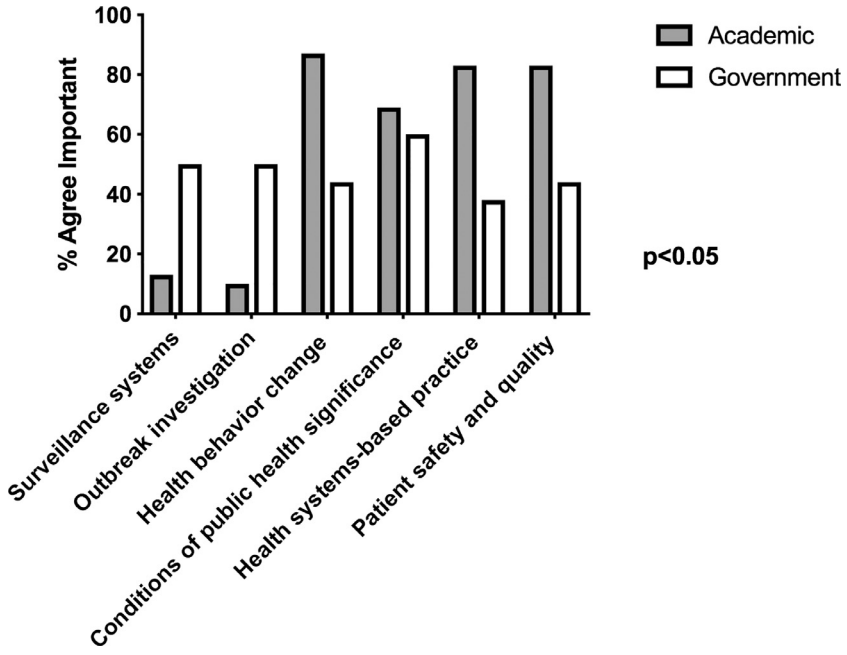

Figure 2. Perception of ACGME milestone sub-competency importance to preventive medicine physicians by position type.
Note: Respondents rated their agreement with 18 statements in the form of "This milestone is important to current position" on a 3-point Likert scale (Disagree/Neutral/Agree). Individual milestone sub-competencies are listed on the X-axis. The percentage of respondents answering "Agree" is reported on the Y-axis. Responses were compared between respondents employed by academic institutions and those employed by government agencies using Pearson's chi-square tests for all 18 sub-competencies. Only the six sub-competencies with a statistically significant difference between academic and government physicians ($p<0.05$) are displayed. No differences in sub-competency importance were found for the remaining 12 sub-competencies. Abbreviated sub-competency titles as follows: "Surveillance systems"= Design and operate a surveillance system; "Outbreak investigation"= Investigate/respond to a cluster or outbreak; "Health behavior change"= Implement approaches to change health behaviors of individuals and/or modify population health behaviors; "Conditions of public health significance"= Implement appropriate clinical care for individuals with conditions of public health significance; "Health systems-based practice"= Work and coordinate patient care effectively in various healthcare delivery settings and systems; "Patient safety and quality"= Work in inter-professional teams to enhance patient safety and improve patient care quality.
ACGME, Accreditation Council for Graduate Medical Education.

to the number of years since PM graduation was also examined. The only significant difference was that mean number of years since PM graduation was higher for respondents who perceived advocacy training as inadequate (21 years) compared with those who perceived it as adequate (15 years, $p<0.05$; not shown in figure).

DISCUSSION

Adequate preparation of the PM physician workforce requires an understanding of where PM physicians are employed, their responsibilities, and the competencies and skills that are important for professional success. Results from this single-site survey of PH/GPM physicians, only the second survey of its type conducted since a 1991 national survey,[9,10] indicate that academia and government remain the most popular position types, with a lower percentage of physicians in government positions compared with the previous national survey.[9] Substantial differences exist in the responsibilities of these position types, with respondents in academic positions more commonly involved in patient care, teaching, and research, and respondents in governmental public health more involved in governmental public health evaluation and administration and international health.

As anticipated, in this program in which all PH/GPM physicians obtained an MPH degree, most felt well trained in sub-competencies that are closely linked to the MPH curriculum. This sample of PH/GPM residency graduates rated sub-competencies related to outbreak investigation, surveillance systems, emergency preparedness, environmental health, and diagnosis of community health problems as less important to their current responsibilities. Overall, respondents perceived the two sub-competencies where they do not feel well trained (emergency preparedness and surveillance systems) as less important to current roles. However, respondents in government positions where these sub-competencies may be more relevant rated them as more important. In response to these findings, the UNC PM

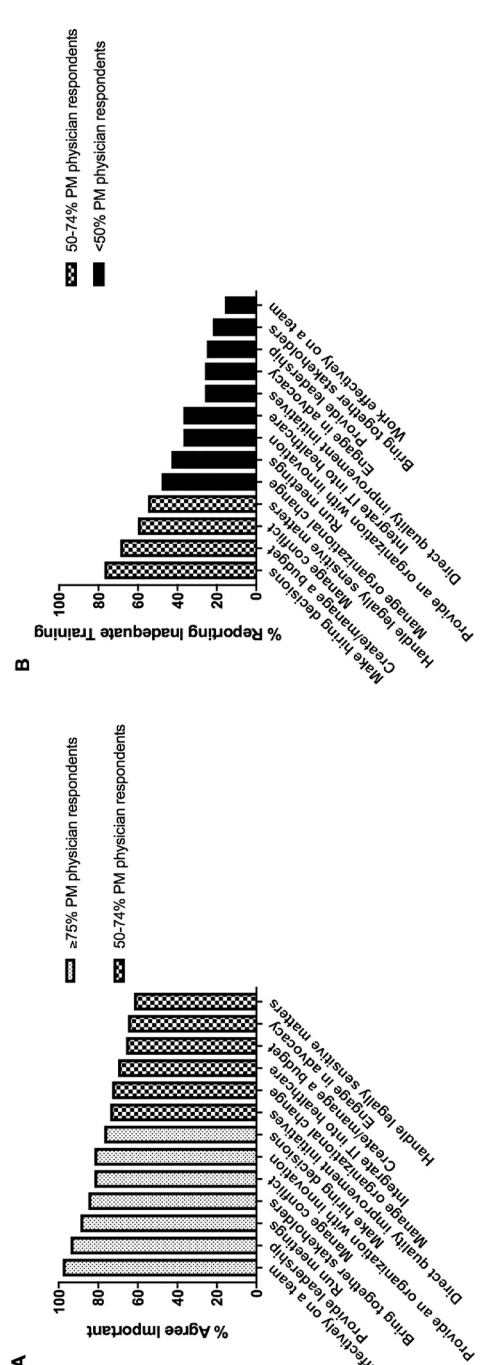

Figure 3. Perceptions of leadership and management skill importance to current position and adequacy of training among PM physicians.
Note: Individual leadership and management skills are listed on the X-axes. (A) Respondents rated their agreement with 13 statements in the form of "This leadership skill is important to current position" on a 3-point Likert scale (Disagree/Neutral/Agree). The percentage of respondents answering "Agree" for each skill is reported on the Y-axis. Bar shading indicates skills where ≥75% of respondents answered "Agree" compared to 50%–74%. (B) Respondents rated the adequacy of residency training for 13 leadership and management skills on a 3-point Likert scale (Poor/Adequate/Good). The percentage of respondents who answered "Poor" for each skill is reported on the Y-axis. Bar shading indicates skills where 50%–74% of respondents answered "Poor" training compared to <50%.
IT, information technology; PM, preventive medicine.

program has begun offering trainees new supplemental training experiences in outbreak investigation and surveillance systems through additional tabletop exercises and rotation opportunities with the state health department. Optimizing the PH/GPM curriculum to anticipate and meet all graduates' needs remains challenging, given the diverse position types and activities described by respondents in this study.

Respondents rated leadership and management skills as important to current work but perceived deficiencies in training during residency. This is discouraging, because 90% of PM residency programs, as early as 1991, reported the inclusion of managerial skills.[35] These results suggest that PM physicians would benefit from even greater training emphasis on leadership and managerial skills. Consideration might be given to how graduates can acquire these skills during residency through rotations and projects.[36]

Limitations

Results from this single-site study may not be generalizable to all PH/GPM physicians, especially because few were in state and local government, limiting analyses for these subgroups. Respondents from this program tended to remain in academia, whereas those employed primarily in government or healthcare systems may have alternate training needs. Additionally, this large program has produced 215 PM physicians over 40 years, with a current average class size of approximately five residents, compared with a national estimated average of 2.5.[37] This results in a potentially heterogeneous sample, making it difficult to draw broadly applicable conclusions about adequacy of training.

Study conclusions are limited by sample size and response rate. At the time of survey administration, the program lacked a standardized process for tracking residency graduates. This led to the development of a process for collecting graduate information such that similar studies can be conducted more readily in the future. Physicians who completed the survey may have stronger opinions than those who did not. Survey responses may reflect experiences prior to current positions, which were not included in this survey and could be a topic for future exploration. Additionally, it is possible that position types and responsibilities of this sample may reflect strengths and emphases of the existing curriculum. Therefore, though perspectives of this sample are valuable in informing curricular changes, additional methods may be needed to identify areas for curricular improvement beyond those that reflect the positions and strengths of this sample. Potential employers of PM physicians and other stakeholders could provide valuable perspectives in future studies. Finally, because of small sample size, adjustment for confounding in the analyses was not feasible.

CONCLUSIONS

The current findings suggest the need for further investigation in a larger, multiprogram sample. A national survey of PM program graduates would be valuable to more completely characterize the position types and activities of PM physicians nationally, and better elucidate training needs across heterogeneous career paths. The use of Level 4 language in phrasing of sub-competencies could provide more highly specific information from PM physicians about training adequacy. Inclusion of more detailed managerial and financial competencies, as developed by the Council on Linkages Between Academia and Public Health Practice,[38] could be valuable for future efforts examining PM physicians' training needs in these areas.

Given the breadth of the field and the limited 2-year training duration, prioritization of milestones[5] is critical to ensure that training is relevant to the breadth of roles PH/GPM physicians hold. Respondents in this sample rated most ACGME sub-competencies as important to current work, regardless of career type, and felt well trained after residency. Surveying graduates of other programs and nationally could yield generalizable conclusions about sub-competency training adequacy and importance. Addition of formal leadership/management skills and administration training into residency curricula may help ensure that all training needs of PM physicians are met.

ACKNOWLEDGMENTS

This study was supported by a Preventive Medicine Residency training grant from HHS, Health Resources and Services Administration (HRSA), #D33HP25771. HRSA had no role in study design; data collection, analysis, or interpretation; manuscript preparation; or publication decisions.

Author contributions: DSP and KBF conceived of the study. MLC acquired data. LBH completed data analysis, data interpretation, and initial manuscript draft with support from SDJ and MLC. DSP and KBF contributed to interpretation of results. SDJ, MLC, DSP, and KBF contributed to final manuscript revisions and approval.

Data contained in this manuscript were previously reported at the Residency Director's Workshop and in a poster session at the American College of Preventive Medicine annual meeting in Portland, Oregon (May 2017).

KBF is a University of North Carolina (UNC) Preventive Medicine Residency Program Faculty Member, LBH and SDH were UNC Preventive Medicine Residents, and LBH is a Resident Member of the Accreditation Council for Graduate Medical Education Preventive Medicine Review Committee; DSP is the

Program Director of the UNC Preventive Medicine Residency, and MLC has no conflicts to report.

No financial disclosures were reported by the authors of this paper.

SUPPLEMENTAL MATERIAL

Supplemental materials associated with this article can be found in the online version at https://doi.org/10.1016/j.amepre.2019.01.012.

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