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Kentucky's Primary Care Workforce Shortages 2016 - 2025 and Recommendations for Increasing the Production of Primary Care Physicians for Kentucky

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Executive Summary

Kentucky and the nation face severe shortages of primary care (PC) physicians. PC physicians are essential to cost-effective healthcare. Kentucky ranks 40th among the United States in its PC physician workforce per 100,000 people, with 2,696 practicing PC physicians statewide.

The purposes of this white paper are to:

1. Present up-to-date data and information about the primary care workforce in Kentucky
2. Describe current trainee pipelines that supply new primary care physicians to Kentucky
3. Recommend strategies and tactics for improving the primary care physician workforce

We define PC physicians as practicing Family Medicine, General Internal Medicine, General Pediatrics, or a combination of these.

In order to achieve the current national median of one primary care (PC) physician per 1,098 persons by 2025, Kentucky would have to add 237 PC physicians per year
In order to not worsen its PC physician shortage, Kentucky would have to add 119 PC physicians per year, bringing their total number in Kentucky to approximately 3,208 in the year 2025.

Although 40% of Kentuckians live in rural areas, only 17 % of PC physicians practice in rural areas. However, 42% of all active Kentucky Family Medicine physicians practice in a rural area.

Advanced Practice Providers will not significantly mitigate Kentucky's PC shortage in the coming decade. Of 4,177 Nurse Practitioners licensed in Kentucky, 234 (5.6%) practice in a PC setting. Of 1,164 Physician Assistants licensed in Kentucky, 305 (26%) are practicing in a PC setting.

Kentucky Medical schools: Since 2012, Kentucky's three medical school have produced an average of 150 graduates per year who enter a residency program in one of the specialties that comprise primary care; of these only 75-80 are expected to actually practice primary care after completing residency training. Of these, only 46% (35-37 physicians) will practice in Kentucky.

Kentucky PC Residency Programs: A maximum of 163 physicians will complete residency training in a primary care specialty in Kentucky in 2017. Of these, 53% (87 physicians) can be expected to practice primary care. An estimated 46% (40 physicians) will stay in Kentucky. Average retention of Family Medicine residency graduates is higher, at 61%.

Evidence on medical student characteristics that favor ultimately practicing primary care can be used in medical school admissions processes, and in pre-medical enrichment programs for college students. Likewise, evidence can be used in medical school curriculum design and delivery to increase the output of PC physicians. Evidence is also available to guide training site selection for better production of well-trained primary care physicians.

Recommendations

Kentucky needs to increase its production and retention of physicians who will practice here, with the primary care workforce a high priority. Specifically:

1. UK should establish two enhanced, coordinated and outcomes-oriented Pre-Medical Enrichment Programs of differing intensity, focused upon producing more physicians for Kentucky. Key recommended elements of these programs are described. The main goal should be to increase the number of UK undergraduates admitted to UK College of Medicine. The first focus should be on increasing the number of these students who are predisposed to becoming primary care physicians. The Provost should establish a Task Force to accomplish this.

2. UK should establish a post-baccalaureate program aimed at having its students gain admission to medical school, with emphasis on the UK College of Medicine (UK COM).

3. The UK COM should intensify its use of available evidence to admit more students with the propensity to choose a primary care career. This may require more holistic methods for student selection, with less importance placed on grades and standardized test performance. Annual goals should be set for the number of such students admitted, and graduate outcomes tracked at least to final specialty selection and first practice site after residency.

4. The UK COM should apply specific evidence on COM faculty composition and curricular elements associated with graduating more physicians who enter primary care specialties.

5. The UK COM should move forward with development and implementation of an accelerated and compressed three-year medical school curriculum, focused initially on Family Medicine, with a target date of August 2019 for matriculation of its first students. The plan for this is detailed in the APPENDIX of this paper.

6. A UK COM Task Force should be established and charged with accomplishing recommendations #4 and #5 above.

7. UK should seek to strategically and deliberately expand primary care GME training in Kentucky through strategies and tactics described herein.

8. Factors that drive primary care physician placement and retention are not addressed herein. UKHC should consider addressing this, working with the Kentucky Health Collaborative, the Kentucky Cabinet for Health and Family Services, and the Kentucky Office of Rural Health

Introduction

Increasing attention is being given to physician shortages and maldistribution nationwide. Kentucky and the nation face especially severe shortages of primary care physicians. In fact, Kentucky ranks 40th among the United States in the size of its primary care workforce (1,2).

Numerous studies have demonstrated that the value of healthcare and the overall health status of general populations rises with the ratio of primary care physicians to populations (3,4). The continued evolution toward value-based health care financing and provider reimbursement requires attention to, and correction of primary care shortages.

The purposes of this white paper are to:

4. Organize and present up-to-date data and information about the primary care workforce in Kentucky and the current trainee pipelines that supply new primary care physicians to Kentucky
5. Recommend strategies and tactics for improving the production of new primary care physicians for Kentucky

Part I
Kentucky's Primary Care Workforce: Current Status and Output of New Trainees

Current status of the primary care workforce in Kentucky

The growth and aging of the US population, implementation of the Affordable Care Act and advances in medical technology, combined with caps in federal funding for residency training, have led to critical shortages of physicians in the US. Physician shortages in multiple *specialties*, including primary care, are expected to further worsen over the next decade, due to physicians retiring or stepping down to part-time work. Kentucky's physician shortages are worse than those for the nation as a whole, with Kentucky ranking 36th among USA states for all physicians per 100,000 population, and 40th for primary care physicians (1).

Calculating physician shortages by specialty is difficult, and wrought with arguable assumptions. That said, the report in 2013 by Deloitte, Inc. provided physician shortage data for Kentucky across various specialties. Although these analyses show shortages across many specialties, the report emphasizes shortages in Primary Care and Psychiatry/ Mental Health as the most dire (5).

Methods: Analysis of Current Primary Care Workforce

For this paper, we performed our own updated analyses of physician shortages focusing upon primary care. We used the Institute of Medicine's definition of primary care: *the provision of integrated, accessible health care services by clinicians who are accountable for addressing a large majority of personal health care needs, developing a sustained partnership with patients, and practicing in the context of family and community* (6). Consistent with most contemporary work on the primary care workforce, we included only the following medical specialties in our analyses and discussions about primary care: Family Medicine, Internal Medicine, Pediatrics and combined Internal Medicine/ Pediatrics, Geriatric Medicine.

Our healthcare workforce data, including current state and future needs, were derived from the Kentucky Board of Medical Licensure, the AMA Masterfile, the US Census, the Kentucky Data Center, the US Health Resources and Services Administration, the American Osteopathic Association, the American Association of Medical Colleges, the Kentucky Board of Nursing, and the National Commission for Certification of Physician Assistants. The trainee data were obtained from the pertinent training programs in Kentucky, and from the National Residency Match Program.

Primary care physicians, nurse-practitioners and physician assistants practicing in Kentucky were tallied using the methods described below.

Primary care physicians: The following criteria were applied to the Kentucky Board of Medical Licensure (KBML) database to tally primary care physicians licensed by the KBML and practicing in Kentucky:

Specialty: Family Medicine, Internal Medicine, Pediatrics, or Geriatric Medicine *and no other* Internal Medicine or Pediatric subspecialty listed. No physician was counted twice. For example, an internal medicine physician also listing geriatrics as a subspecialty or family medicine was counted only once.
Status: Active
Main site of employment address: In Kentucky
Main employment setting: Private practice, hospital-based, or employed outpatient, *and not* emergency medicine

***Advanced Practice Registered Nurses*:** The following criteria were applied to the Kentucky Board of Nursing (KBN) Licensure database to identify Nurse Practitioners licensed by the KBN, and practicing in primary care settings:

Specialty: Geriatric Medicine, Pediatric Medicine, and Public/ Community Health Medicine
Status: Active
Address: In Kentucky All 120 KY Counties
Main employment setting**:** Office, Clinic, Community Health
Type of licensure**:** APRN
Population focus: Adult, Family, Pediatric, Community Health

Primary Care Physician Assistants: This workforce was estimated using data published by the National Commission for Certification of Physician Assistants (PAs) (7). These data do not support mapping of primary care PAs by country, but they do provide a tally of PAs practicing primary care.

Estimates for Kentucky's primary care workforce needs in 2025 were derived from published studies of the impact of population aging, population growth, the Affordable Care Act and physician retirement on physician need (8,9), and Kentucky census data (10,11).

Results: Current Kentucky Primary Care Workforce

Tables 1 through 4 show quantitative data on the current primary care workforce in the Commonwealth, including physicians, nurse-practitioners and physician-assistants.

Kentucky ranks 40th in the number of PC physicians per 100,000 population (or conversely the number of persons per PC physician) (1). These same benchmarking data show that in order to achieve the current national median of 1 PC physician per 1098 persons by 2025, Kentucky would have to add 2,368 PC physicians to our workforce (ie add 237 PC physicians per year). Approaching this shortage more conservatively, we would have to add 1,186 PC physicians by 2025 (or 119 per year) to not worsen our current shortage. This more conservative goal would bring the target for the total number of active PC physicians in Kentucky in 2025 to 3,208.

We could find no sources by which to similarly benchmark the primary care APRN or PA workforce, but the data show that Kentucky has a total of 539 of these PC providers. Expert opinion and simple benchmarking of current PC practices call for roughly one physician extender per two primary care physicians as a cost-effective practice model (12,13). Applying this ratio, we can estimate a reasonable target for the number of APRNs and PAs by 2025 to be 1,604 (50% of 3,208). Presuming that none of the current PC APRNs or PAs leave the workforce, we would have to add 1,065 by 2025 (106 per year). Under the more likely assumption of 25% attrition, we would have to add 1,469 by 2025 (147 per year).

The data in **Table 4** also show continued mal-distribution of physicians around the state. For example, although approximately 40% of Kentuckians live in rural areas, only 17 % of PC physicians practice in rural areas. However, 42% of all active Kentucky family medicine physicians practice in a rural area. This reflects national data showing that US family medicine physicians distribute themselves according to the population (14).

TABLE 1. PRIMARY CARE PHYSICIANS PRACTICING IN KENTUCKY, AND SHORTFALLS

	Total
Primary care physicians practicing in KY in 2016	2,696
Expected Retirees in the Coming Decade	674
Number of additional PCP's needed by 2025 for shortages not to worsen	1,186[1]
Estimated Shortfall in 2025 (compared to the US median)	2,368[2]

[1] Includes expected retirees (674) + effects of population growth and aging (458) + effects of ACA (54)

[2] US median = 1098 persons per primary care physician

TABLE 2. PRIMARY CARE APRNS PRACTICING IN KENTUCKY IN 2016

	Total
APRNs practicing in KY (total)	4,177
Practicing Primary Care (PC)	234
Practicing PC in HPSAs[1]	176
Practicing PC in rural county	91

[1] Federally-designated primary care Health Professions Shortage Area

TABLE 3. PRIMARY CARE PAS PRACTICING IN KENTUCKY IN 2014

	Total
PAs practicing in KY (total)	1,164
Practicing Primary Care (PC)	305
Practicing PC in Rural HC[1]	52

[1] Federally-designated Rural Health Center

Table 4 (on the following page) shows the population-based distribution of PC physicians around the Commonwealth, by county, and which counties are federally-designated as Primary Care Health Professions Shortage Areas (HPSAs).

TABLE 4: RATIO OF PRIMARY CARE PHYSICIANS TO KENTUCKY POPULATION

County	PCP	Ratio
Adair	9	1:2072
Allen	3	1:6652
Anderson	7	1:3116
Ballard	0	0:8332
Barren	33	1:1277
Bath	1	1:11591
Bell	17	1:1687
Boone	93	1:1338
Bourbon	16	1:1249
Boyd	54	1:905
Boyle	30	1:967
Bracken	4	1:2122
Breathitt	8	1:1734
Breckinridge	6	1:3343
Bullitt	26	1:2858
Butler	2	1:6345
Caldwell	5	1:2596
Calloway	20	1:1882
Campbell	49	1:1843
Carlisle	1	1:5104
Carroll	6	1:1825
Carter	12	1:2310
Casey	4	1:3988
Christian	34	1:2175
Clark	22	1:1618
Clay	9	1:2414
Clinton	5	1:2029
Crittenden	4	1:2328
Cumberland	5	1:1371
Daviess	58	1:1693
Edmonson	1	1:12062
Elliott	2	1:3926
Estill	6	1:2445
Fayette	273	1:1083
Fleming	10	1:1450
Floyd	39	1:1011
Franklin	31	1:16015
Fulton	2	1:3406
Gallatin	3	1:2863
Garrard	3	1:5683
Grant	10	1:2475
Graves	12	1:3093

County	PCP	Ratio
Grayson	19	1:1368
Green	3	1:3726
Greenup	27	1:1352
Hancock	1	1:8687
Hardin	58	1:1865
Harlan	16	1:1829
Harrison	9	1:2057
Hart	5	1:3714
Henderson	34	1:1363
Henry	5	1:3083
Hickman	1	1:4902
Hopkins	32	1:1457
Jackson	2	1:6747
Jefferson	591	1:1253
Jessamine	19	1:2640
Johnson	12	1:1954
Kenton	120	1:1359
Knott	4	1:4086
Knox	13	1:2452
Larue	2	1:7096
Laurel	31	1:1898
Lawrence	9	1:1761
Lee	3	1:2629
Leslie	5	1:2262
Letcher	14	1:1751
Lewis	5	1:2774
Lincoln	8	1:3046
Livingston	3	1:3173
Logan	9	1:2981
Lyon	4	1:2078
Madison	45	1:1842
Magoffin	3	1:4444
Marion	11	1:1801
Marshall	8	1:3931
Martin	5	1:2529
Mason	15	1:1151
McCracken	63	1:1037
McCreary	6	1:3051
McLean	2	1:4765
Meade	5	1:5720
Menifee	3	1:2102
Mercer	9	1:2372

County	PCP	Ratio
Metcalfe	0	0:10199
Monroe	6	1:1827
Montgomery	19	1:1394
Morgan	6	1:2320
Muhlenberg	16	1:1968
Nelson	23	1:1888
Nicholas	1	1:7135
Ohio	7	1:3406
Oldham	30	1:2078
Owen	2	1:5420
Owsley	0	0:4755
Pendleton	4	1:3719
Perry	26	1:1104
Pike	66	1:985
Powell	4	1:3153
Pulaski	46	1:1389
Robertson	0	0:2282
Rockcastle	7	1:2384
Rowan	23	1:1022
Russell	10	1:1756
Scott	26	1:1921
Shelby	20	1:2210
Simpson	5	1:3558
Spencer	1	1:17637
Taylor	16	1:1540
Todd	4	1:3115
Trigg	5	1:2867
Trimble	3	1:2936
Union	5	1:3001
Warren	78	1:1458
Washington	3	1:3958
Wayne	12	1:1734
Webster	1	1:13621
Whitley	32	1:1113
Wolfe	6	1:1208
Woodford	8	1:3159

No **PC HPSA's are denoted in blue**

Production of Primary Care Physicians in Kentucky

Methods

The data presented here were obtained from all pertinent training programs based in Kentucky. We then applied estimates from the literature of the proportions of physicians that practice primary care: 90% of Family Medicine physicians, 21% of Internal Medicine physicians, and 45% of Pediatric physicians (15,16). Lacking data for physicians with combined Internal Medicine/Pediatrics board certification, we estimated a 50% rate for primary care practice among these physicians, who in any case comprise a small portion of the total. The emergence of Hospitalists, with as yet no certifying board, makes it likely that our estimates for the current production of PC physicians are inflated above the actual primary care physician workforce numbers.

Results

Tables 5 - 7 show that over the past 5 years, Kentucky's three medical school have produced an average of 150 graduates per year who enter a residency program in one of the specialties that comprise primary care. Applying the best available estimates of the percent of these graduates who actually go on to practice primary care reduces this output to 77 per year for the three schools combined. Thus, about 21% of all Kentucky medical school graduates can be expected to practice primary care if current conditions remain static.

But how many of these medical school graduates will practice in Kentucky? Data from the KBML show that 48% of active primary care physicians in Kentucky graduated from medical school in Kentucky. Also, as shown in **Table 8**, we know that 46% of all active Kentucky medical school graduates are practicing in the Commonwealth. **Thus, we estimate that Kentucky's three medical schools will produce 35 to 37 graduates per year who will go on to practice primary care in Kentucky.**

What about graduate medical education (residency) in Kentucky as a source of new primary care physicians? **Table 9** shows that we can expect 87 new primary care physicians per year to come out of the Commonwealth's residency programs. (It should be pointed out that the number of Kentucky residency program graduates used in our calculations presume that all residency slots are filled each year. This is not the case among some of the osteopathic programs, so our estimates on **Table 8** are at the upper limit.)

Table 8 shows that we can expect to retain 46% of these 87 new PC physicians (40 physicians) in the state. Some of these will be from among the 35 to 37 Kentucky medical school graduates; we do not have statistics for estimating just how many. With complete overlap, we would expect 40 new PC physicians per year as a product of Kentucky medical schools and residency programs. If there were no overlap, this would rise to a maximum of 77 new PC physicians per year.

We chose the middle of these extremes, and thusly **estimate that 40 + 18 = 58 new fully-trained physicians produced in Kentucky annually, will practice primary care here.**

If current trends hold, and roughly half of new primary care physicians come from other states, then we can optimistically estimate that 58 new PC physicians per year from other states might be added to the 58 produced here, for a total of 116 new PC physicians per year. This approximates the 119 new PC physicians needed each year to avoid worsening our shortage, but falls well short of the 237 new PC physicians per year needed to move Kentucky to the US median in PC physician workforce by 2025.

TABLE 5: TOTAL NUMBER OF GRADUATES FROM KENTUCKY'S THREE MEDICAL SCHOOLS 2012-2016

	2016	2015	2014	2013	2012	Total
University of Kentucky College of Medicine	111	115	109	119	100	554
University of Louisville School of Medicine	161	159	175	179	163	837
University of Pikeville Kentucky College of Osteopathic Medicine	113	66	75	76	65	395
Total	**385**	**340**	**359**	**374**	**328**	**1,786**

TABLE 6: KENTUCKY MEDICAL SCHOOL GRADUATES ENTERING PRIMARY CARE SPECIALTY RESIDENCIES: 2012-2016

A. University of Kentucky College of Medicine
B. University of Louisville School of Medicine
C. University of Pikeville Kentucky College of Osteopathic Medicine

TABLE 6 A.	2016	2015	2014	2013	2012	TOTAL
Family Medicine	4 3.6%	6 5.2%	4 3.6%	9 7.5%	6 6.0%	**29** **4.93%**
Pediatrics	10 9.0%	10 8.6%	9 8.2%	13 10.9%	8 8.0%	**50** **8.5%**
Internal Medicine	18 16.2%	22 19.1%	23 21.1%	13 10.9%	20 20.0%	**96** **15.4%**
Medicine-Pediatrics	10 9.0%	4 3.4%	5 4.5%	8 6.7%	8 8.0%	**35** **5.95%**
Total	**42** **37.8%**	**42** **36.3%**	**41** **37.4%**	**43** **36.0%**	**42** **42.0%**	**210** **37.9%**

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TABLE 6B.	2016	2015	2014	2013	2012	TOTAL
Family Medicine	17 10.5%	19 11.9%	16 9.1%	13 7.2%	9 5.5%	**74** **8.8%**
Pediatrics	19 11.8%	16 10.0%	15 8.5%	17 9.4%	15 9.2%	**82** **9.7%**
Internal Medicine	19 11.8%	21 13.2%	18 10.2%	24 13.4%	28 17.1%	**110** **13.1%**
Medicine-Pediatrics	4 2.4%	7 4.4%	6 3.4%	7 3.9%	7 4.2%	**31** **3.7%**
Total	**59** **36.6%**	**63** **39.6%**	**55** **31.4%**	**61** **34.0%**	**59** **36.1%**	**297** **35.4%**

TABLE 6C.	2016	2015	2014	2013	2012	TOTAL
Family Medicine	42 37.1%	27 40.9%	26 34.6%	21 27.6%	22 33.8%	**138** **34.9%**
Pediatrics	9 7.9%	1 1.5%	4 5.3%	4 5.2%	8 12.3%	**26** **6.5%**
Internal Medicine	27 23.8%	15 22.7%	16 21.3%	15 19.7%	11 16.9%	**84** **21.2%**
Medicine-Pediatrics	1 0.8%	1 1.5%	0 0%	0 0%	0 0%	**2** **0.5%**
Total	**79** **69.9%**	**44** **66.6%**	**46** **61.3%**	**40** **52.6%**	**41** **63.0%**	**250** **63.2%**

TABLE 7: ESTIMATED NUMBER OF KENTUCKY MEDICAL SCHOOL GRADUATES 2012-2016 WHO WILL PRACTICE PRIMARY CARE

SPECIALTY	TOTAL MATCHED	ESTIMATED NUMBER THAT WILL PRACTICE PRIMARY CARE
Family Medicine	241	90% = 217
Pediatrics	158	45% = 71
Internal Medicine	290	21% = 61
Medicine-Pediatrics	68	50% = 34
Total	752	383

TABLE 8: RETENTION OF KENTUCKY PHYSICIAN TRAINEES

RETENTION **KENTUCKY MEDICAL SCHOOL GRADUATES** **KENTUCKY RESIDENCY GRADUATES**	
KY medical school graduates active in KY = 4,130 = 41.6% of all (9,936) physicians active in KY	
Total KY medical school graduates active in US	8,947
Percent of active KY medical school graduates who are active in KY	46.2%
KY residency graduates active in KY = 3,682 = 37.1 % of all (9936) physicians practicing in KY	
Total KY residency graduates active in the US	8,061
Percent of KY residency graduates who are active in KY	45.7%
Note: (1) data includes US allopathic and osteopathic schools, and international schools (2) 'active' = working at least 20 hours per week in any combination of patient care, research, teaching and/or administration	
Source: AAMC Data Book April 2016 (17)	

TABLE 9: KENTUCKY RESIDENCY PROGRAMS: MAXIMUM NUMBER OF GRADUATES IN SELECTED SPECIALTIES IN 2016

SPECIALTY	TOTAL RESIDENCY PROGRAMS	ESTIMATED NUMBER THAT WILL PRACTICE PRIMARY CARE
Family Medicine	60	90% = 54
Pediatrics	32	45% = 14
Internal Medicine	60	21% = 13
Medicine-Pediatrics	11	50% = 6
Total	**163**	**87**

Production of Primary Care Physician Assistants and Nurse Practitioners in Kentucky

Methods: We were able to identify all accredited PA training programs in Kentucky, and used their annual enrollment data to estimate the number of annual graduates. We used data published by a national PA organization to estimate the number of these PA graduates who will practice primary care (7). We were not able to estimate the annual number of graduates from Kentucky Nurse-Practitioner (NP) training programs; many programs have on-line 'executive' programs. However, as displayed in Table 2, KBN data show that only 5.6% of Kentucky's NPs practice primary care.

Results:

Table 10 shows annual enrollment statistics at the three Kentucky schools that graduate Physician Assistants (PAs). From this, we estimate that up to 126 new Physician Assistants graduate in Kentucky

each year. Of these, we can expect 26% (32 individuals) to practice primary care. We lack statistics for estimating the proportion of these 32 PA s that will stay in Kentucky.

TABLE 10: PHYSICIAN ASSISTANT PROGRAMS IN KENTUCKY: ANNUAL ENROLLMENT

	Total
University of Kentucky	56
Sullivan University	40
University of the Cumberlands	30
Total	126

The data in **Tables 1 to 3** show that in order to achieve a recommended ratio of two PC physicians per one PA or FNP, we would have to add at least 106 of these advanced practice providers (APPs) to Kentucky's workforce per year, presuming that none of the current primary care APPs left our workforce via retirement or other reasons. We conclude that APPs will not have a significant effect on Kentucky's primary care workforce unless we greatly increase production, or find ways to attract large numbers of them from other states.

Based upon these data, it is obvious that we must significantly increase our production of PC physicians for Kentucky. **Part II** of this paper suggests methods for accomplishing this. Furthermore, these data can and should be used to acquire new state resources to increase the number of primary care physicians in Kentucky through new or reprogrammed state funding resources.

Even with well-funded and coordinated efforts, it is unlikely that we will attain the levels needed to fully prevent worsening primary care physician shortages by 2025. **We recommend** also increasing the production of primary care PAs and NPs, training and placement of ambulatory care managers, patient care navigators, and medical record scribes, greater facilitation of Patient Centered Medical Home (PCMH) functions, more robust use of health IT, and advances in tele-healthcare to improve the efficiency of healthcare (18). These coordinated strategies can decrease the demand for direct physician services and effectively augment the impact of each PC physician on each community served. For example, it is estimated that a single PC physician could double his/her patient panel size through operating a PCMH with optimal staffing, practice integration, routine protocols and effective use of healthcare data (19).

Part II: Approaches to mitigating primary care physician shortages

Overview

We recognize four general levels for innovation and intervention aimed at improving the physician workforce: 1) improving the pipeline of young adults into medical school via improved premedical education and medical school admissions, 2) improving curriculum, socialization, role modeling, and mentorship during medical school, 3) improving training experiences during graduate medical education (residency), and 4) improving placement and retention of fully trained, board certified physicians into communities where they are needed.

In this paper we examine UK's current and potential roles in first three levels above, in the context of the other two Kentucky medical schools and multiple residency programs across the state.

Improving the pipeline

Premedical enrichment programs

Professional or vocational identity formation and socialization are powerful factors in determining career choice and location, and the formative experiences of pre-baccalaureate college students are especially powerful. Curricular and extra-curricular experiences are both important in the process. Extra-curricular experiences can be especially important in forming interpersonal bonds and identifying role models that have enduring effects on professional or vocational self-identity (20-22). These facts support the development and use of extra-curricular (and elective curricular) enrichment programs to identify and mentor selected college students to improve the likelihood that they will be admitted to medical school and practice primary care in rural and underserved communities. As a part of such a program, selected pre-medical enrichment activities could be designed to foster students' propensities to practice in Kentucky and/or choose a primary care career. Such focused enrichment activities should go beyond general pre-medical advising and enrichment activities that target only the downstream outcomes of graduation from college and admission to medical school.

Several US colleges and universities have pre-medical enrichment programs targeted to minority students (23,24) or students from rural backgrounds (25). These include curricular and extra-curricular activities that are designed to help these students gain entry into medical school and/or increase the possibility that they will choose to practice in a rural setting. However, our review of the literature did not identify college-level pre-medical enrichment programs aimed at increasing the likelihood of practicing in a given state or of choosing a *primary care* career.

The theory and practice of enrichment programs designed to facilitate interest and success in any field can be applied to the goal of designing and using enrichment programs aimed at primary care. In that regard, successful enrichment programs include some or all of the following (26-31a):

- information delivered by respected individuals in the targeted field
- role modeling via supervised experiences such as "shadowing" physicians at work
- group activities
- research experiences
- peer mentoring

Using available evidence, premedical enrichment programs and medical school admissions policies and procedures can be tailored to the goal of producing more physicians who will practice primary care in Kentucky. These strategies can focus upon specific student characteristics (31b - 35), and coordinate with the following special programs currently offered or planned by the UK College of Medicine: the *UK Rural Physicians Leadership Program*, the proposed *UK Accelerated Pathway to Becoming a Physician (APBP)* three-year track (see Appendix 1), and the development of regional campuses of the UK COM.

For the desired outcome of increasing the proportion of medical school graduates who ultimately practice primary care, evidence supports *purposefully* including in pre-medical enrichment activities those students with the characteristics shown in **Table 11**. These student characteristics are associated with choosing a career in primary care (31b – 38) With the exception of minority status, female gender and inner-city background, these student characteristics are also associated with ultimately practicing in rural communities (37,39,40).

TABLE 11: CHARACTERISTICS OF STUDENTS ASSOCIATED WITH CHOOSING A CAREER IN PRIMARY CARE

Good Evidence	
1.	In-state student
2.	Plans to attend a public medical school
3.	Rural (or small town) background
4.	Inner city background
5.	Expressed interest in rural practice
6.	Expressed interest in medical school with strong PC training reputation
7.	Older
8.	Married
9.	Female (unless rural practice is targeted outcome)
10.	Minority background
11.	Plans to use armed forces or NHSC scholarship
12.	Expressed or exhibited interest in care for the underserved
Mixed or Less Extensive Evidence	
1.	No physician parent
2.	First generation college-educated
3.	Expects moderate education debt
4.	Not expressing plans for non-primary care career
5.	Interest in addressing societal needs
Specific to the UK Environment	
1.	Honors Student (because mechanisms for enrichment are already in place)
2.	LLC Student (because mechanisms for enrichment are already in place)
3.	Robinson Scholar student (first generation college; rural Kentucky origins)
4.	Past participant in a Kentucky Health Careers Pipeline program
5.	Special interest in attending UK COM over other schools

We did not find published evidence of characteristics that predict practicing medicine in the student's home state. The propensity to practice near the site of residency training is established, but that fact generally does not aid in the identification of undergraduate and medical students likely to practice in their home state. Nevertheless, we believe that it is sensible to also assess students' communities of origin, family ties, work experiences, and expressed interests in where they would like to practice medicine, particularly when it is based on experience in those communities gained during the premedical curriculum. Furthermore, premedical enrichment programs can include learning about the health and healthcare landscape of communities as useful information for career planning, for example the potential for future inclusion in an existing group practice in a rural community or as an employee of a hospital based group.

Pre-medical enrichment programs should be strengthened by enhanced linkages and communication between the College of Medicine leadership and faculty and high-performing students affiliated with selected undergraduate education venues. Logically, this should include the UK Honors Program, the UK Lewis Honors College, the UK Living Learning Communities, the Robinson Scholars program, the Gaines Center, the Chelgren Center for Academic Excellence, UK Premed Advising, UK Pre-Medical clubs and professional fraternities, the UK Professional Education Preparation Program (PEPP), and more broadly, with faculty and advisors in key colleges; e.g. the colleges of *Arts and Sciences (particularly social as well as natural science departments or the Appalachian Center/Studies Program)*, *Agriculture, and Public Health.*

Added value for pre-enrichment might include undergraduate teaching by College of Medicine faculty in the Honors College, and more interaction with Living Learning Program students through presentations and workshops provided by College of Medicine faculty, residents, and students, as well as selected professional faculty from colleges such as Public Health. Special mentoring programs could be established.

We recommend the establishment of two enhanced, coordinated and outcomes-oriented premedical enrichment programs at UK focused on producing primary care physicians for Kentucky communities, as well as enhancing premedical education at UK. We believe this will establish UK as a leader in this effort and provide evidence to other institutions with interest in special programs, such as this. UK has a distinguished record of study of the medical admissions and educational processes, so a strong evaluation and research program would be a part of this effort. While we recommend the basic features of these that are described below, details of their structure, function and funding sources should be worked out by a *Pre-Medical Enrichment Task Force* appointed by the Provost. The first focus of the task force should be increasing the production of PC physicians for Kentucky. This task force would build upon the general models described in this paper to establish at least two practical working premedical enrichment programs that augment and go beyond the current premedical advising infrastructures at UK.

Elements could be subsequently adapted for use at other undergraduate universities, after their demonstrated value, especially those affiliated with UK COM regional campuses.

We are suggesting two premedical enrichment programs of differing intensity from which students could choose. We include recommendations for the key elements of each to be considered by the task force.

Program 1: Physicians for Kentucky Pre-Medical Enrichment Program (P4K PrEP)

This program would be relatively intense and focused upon students who appear likely to practice medicine in Kentucky . The program should begin with a focus on primary care, with subsequent expansion of enrichment activities aimed at other broad areas of need in Kentucky, such as psychiatry and general surgery.

Acceptance into the P4K PrEP program would be competitive and based upon a formal application process designed to choose pre-medical students who are strong academically, demonstrate a strong

propensity to settling in Kentucky and have some of the characteristics listed in **Table 11**. The number and weighting of these characteristics deemed to be sufficient for offering any particular student primary care-oriented premedical enrichment activities will be somewhat arbitrary, and should be decided upon by the task force.

Students would not be accepted into the P4K PrEP program until the conclusion of spring semester of the freshman year. However, acceptance could be as late as two years before graduation. This pre-medical enrichment program would include:

- Summer pre-medical academies for rising college sophomores and juniors
- Assignment to specially-prepared premedical advisors
- Prescribed course requirements that expose P4K PrEP students to psychology, public health, medical care organization, philosophy/ethics and the sociology of health and healthcare
- Elective or selective coursework delivered through the Honors College or STEMCats and designed to address the knowledge bases above
- Facilitated extracurricular experiences (including guided shadowing experiences with specific physicians)
- A longitudinal course (PrEP Path to Success) delivered through a seminar format over a 2-year period starting in the sophomore year and extending through the junior year; this will include MCAT exam preparation, as well as structured exposure to health and health care in selected communities
- Linkages with medical students
- Peer-to-peer mentoring
- A P4K PrEP list-serve, with professional information made available about health and healthcare

This focused and intense program would be limited to approximately 30 undergraduate college students per year, contingent on resources available. Required resources would include Program Coordinator time/effort, faculty advisors/mentors, participating primary care physicians (voluntary faculty), course capacities, and medical students prepared to serve as mentors.

The P4K PrEP Path to Success longitudinal seminar would provide in-depth structured enrichment activities during fall and spring semesters, starting with the sophomore Fall semester and concluding in the summer after the junior year).
Its objectives would be to:
) Promote professional identity formation,
2) Foster effective study habits,
3) Build skills in critical thinking, communication, time-management, self-assessment, and knowing how and when to ask for help,
4) Help students plan for and have experiences in appropriate Kentucky healthcare settings,
5) Facilitate shadowing experiences with physicians,
6) Deepen students' understanding of health and healthcare in Kentucky,
7) Facilitate MCAT practice and preparation,
8) Provide mock medical school admissions interviews, and

9) Provide personalized linkage to other UK academic support services

Offerings would include presentations and engagement with practicing physicians, medical students, medical residents and other health professionals aimed at helping these premedical students grasp the broad scope of contributions that primary care physicians make, imagine the range of career paths that they could take as future primary care physicians, and make connections with potential role models. Medical student members of the UK Family Medicine Interest Group (FMIG) could be an important resource. They can share their experiences and motivations to become family physicians, include P4K PrEP students in FMIG meetings and events, and perhaps become mentors for P4K PrEP students. The FMIG has access to key resources provided by the American Academy of Family Physicians that are specifically designed for students with an interest in family medicine. Medical student interest groups in pediatrics and internal medicine could engage in a similar manner.

The P4K PrEP Summer Academy, would be designed to accomplish the following over two summer experiences for rising college juniors and seniors:
1) help students consolidate their interest in becoming a physician
2) increase their understanding of health and healthcare problems and issues in Kentucky communities
3) help prepare them for successful application to medical school

The first Summer Academy would be a one-week residential experience for students active in the P4K PrEP Program who: are rising college sophomores and have at least a 3.20 GPA. This summer program would include a mini-course on Health Status and Healthcare in Kentucky with public health faculty assistance, presentations by practicing physicians (with Q & A sessions), dinners with medical students, computerized medical mannequin simulations, and practice in the preparation of personal statements for medical school admission. The second P4K PrEP Summer Academy would be a four-week experience preceding the junior year of college for pre-medical students who completed the first summer academy and have at least a 3.20 GPA. This would include observation (shadowing) experiences with practicing primary care physicians, a mentored community health assessment experience or health services research experience, and medical school interview-skills workshops .

Program 2: General Pre-Medical Enrichment Program (G-PrEP)

This program would serve pre-medical students who have completed at least their first year of college and who do not want to commit to the P4K PrEP. Its only other criteria for participation would be academic performance to date (minimum GPA of 3.20) and the formal recommendation of a UK pre-medical advisor. No other special student characteristics would be sought. The G-PrEP would include:

- Faculty member as pre-medical advisor
- Facilitation of physician shadowing opportunities
- Elective courses available through the Honors College and/or the Living/Learning Communities
- Medical school application boot camp that includes MCAT exam preparation and advice/feedback for the preparation of medical school applications

This program would be limited to approximately 50 students per year, contingent on resources available, which include faculty advisors, participating physicians (voluntary faculty), elective course capacities, and program coordinator time/effort.

Alternatives to pre-medical enrichment programs fall into three major categories:

1) Accelerated pre-medical programs that confer provisional medical school admission to college freshmen or sophomores: These programs either do not require a bachelor's degree or confer the bachelor's degree after the first year or two of medical school. The University of Kentucky recently stopped offering a BS /MD program. Considerations for reviving an accelerated premedical program at UK are beyond the scope of this paper.

2) Baccalaureate degree programs in health care or medical science fields: UK does have baccalaureate degrees in medical science and health care fields as follows: bachelor's degree in Public Health, Neurosciences, Biosystems Engineering, Animal Science, and Human Health Sciences. We recommend linking students in these undergraduate degree programs with pre-medical enrichment programs.

3) Post-Baccalaureate programs designed for college graduates who have not yet completed medical school prerequisites. UK does not have a post-baccalaureate program for pre-medical students. University of Louisville does have such a program that includes prescribed coursework, special enrichment activities and an option for provisional medical school admission (41).

A particularly positive characteristic of post-baccalaureate programs is that they attract more mature students, and older age is associated with a primary care career choice. In addition, greater maturity and more life experiences might make students better prepared to pursue an accelerated medical school track (see APPENDIX).

We recommend that UK consider establishing a post-baccalaureate program. However, given the strong UK COM applicant pool, and considering the planning and resources that would be required to establish such a program at UK, we do not think that a post-baccalaureate program should be set as a short-term tactic for increasing the production of primary care physicians.

Medical school admissions policies and procedures related to increasing the primary care workforce

Medical school admissions processes typically aim to fill each class with the candidates most likely to succeed in medical school in terms of unimpeded graduation and high standardized test performance. Other considerations are included in this decision-making process according to more specific goals of the school. These goals might be set by any combination of school charter, the state legislature, the faculty or other university or college-level governing bodies, public funding criteria, or private endowment criteria. Recent and ongoing efforts to link higher education outcomes to state support are a classic example of this and provide a rationale for this proposal.

Depending upon specific outcomes sought (beyond unimpeded graduation and strong performance on standardized tests such as the USMLE) medical schools may establish special admissions criteria or

define certain other favorable characteristics sought in their applicants. Different criteria can be set for different targeted results. For example, medical school admissions criteria would probably be different for the goal of producing physician-scientists than for the goal of producing physicians whose career focuses upon practicing full-time in underserved communities.

Varying criteria can be applied simultaneously to subsets of medical school applicants. The more robust a predictor for a targeted goal (e.g. more graduates practicing primary care in Kentucky), and the more accurate its assessment, the more likely that students admitted in pursuit of that outcome will contribute to it.

Commonly used predictors of unimpeded graduation and strong standardized test performance are undergraduate GPA and MCAT scores (42). Going beyond these basic measures, how might medical schools' admissions policies and procedures be designed and used toward the goal of admitting more medical students likely to choose a primary care career? That is, how can the admissions procedures identify students with the strongest set of predictors of primary care interest listed in **Table 11**?

State of residence, age, gender, minority status, marriage status, college major, parents' education, whether a parent is a physician, financial status, plans for military or NHSC scholarship use, Honors or LLP status, and history of participation in a Kentucky health careers pipeline program are relatively easy to assess objectively. True rural or inner-city upbringing might be assessed objectively.

All of the other factors on **Table 11** must be assessed via combination of interview techniques, review of the applicant's personal statement, and review of letters of recommendation. One interview technique shown to have discriminant functionality is the Multiple Mini Interview (MMI) method. This method has greater reliability than less structured techniques and appears to promote diversity among accepted applicants (43). Its disadvantages are the cost and effort required to maintain trained interviewers to administer the MMI, and the unintended consequence of diminished interviewer enthusiasm that may result from dampening of more intuitive and spontaneous exchanges with applicants.

Without using a heavily standardized method such as the MMI, interviewers can be trained to probe for and assess certain targeted characteristics. This is not to imply that every applicant should be subjected to such techniques. Indeed, attempting to probe for specially-targeted characteristics in all applicants would be counter-productive. For example, applicants with some of the characteristics listed in **Table 11** may express no plausible interest in primary care and should not be probed further.

The concept of Holistic Admissions calls for using methods most likely to reveal the most complete "picture" of an applicant as possible (44a) . Generally, this translates into trying to assess characteristics beyond academic performance and basic demographics. Focused review of personal statements and letters of recommendation and structured interview techniques are used in addition to standard reviews of academic performance and extra-curricular accomplishments. Despite the ability of applicants to express personal attributes that they think will improve their chances of admission, holistic interviewing linked to admissions criteria or preferences can improve outcomes-oriented admissions (44b).

Self-reporting instruments can also be used to partially assess applicant attitudes and personality traits. For example, McMaster University School of Medicine developed and uses the Computer-based

Assessment for Sampling Personal Characteristics (CASPer) Test (45). It is also used by several US medical schools. Others have used the Cambridge Personal Styles Questionnaire® (46).

We recommend that these methods be used to better determine the likelihood that applicants pursue a primary care career. Specifically, we recommend that the UK COM Admissions Committee use **Table 11** to establish guidelines for interviewing and selecting students likely to pursue primary care careers perhaps combined with other evidence-based activities and interview tactics that are successful predictors of success. We suggest that a targeted proportion of primary care – inclined students be set for each class, and attempts be made to admit that number of students.

The available evidence suggests that self-expressed primary care interests among medical students falls by about half between the freshman and senior years of medical school. If holistic admissions procedures were used to admit a certain number of students deemed likely to pursue primary care careers, then the decrease in interest during medical school should be significantly less.

We recommend that the UK College of Medicine set a target for graduating students of each class who go on to practice primary care, then aim to admit 120% of that target. Metrics used to assess the outcome of these efforts should apply evidence-based rates of primary care practice (15,16):

90% of medical students choosing family medicine residency will practice primary care.
45% of medical students choosing pediatrics residency will practice primary care
21% of medical students choosing internal medicine residency will practice primary care
50% of choosing IM/PEDS will practice primary care (suggested 'guess' to be used in model)

Such outcomes data should be used for resource allocation toward alleviating primary care physician shortages, and to drive continuous improvement of the underlying strategies and tactics.

Medical school curricula and characteristics

Training sites and environments play a role in the choice of community in which fully trained physicians settle. Physicians trained in rural environments are more likely to practice in rural environments, and those trained in inner city environments are more likely to practice in inner city environments (37). In a broader sense, among medical specialties, primary care physicians are especially likely to settle in communities in which they train, or in similar communities; the marketplace generally supports this with greater ease than for other specialties (47). Among all medical specialties, family medicine physicians distribute themselves closest to the underlying population (48).

Table 12 shows the medical school characteristics known to affect primary care choice among medical students. Among these, longitudinal, multifaceted learning experiences have the strongest supporting evidence. These include early clinical experiences in a primary care practice, longitudinal clinical clerkships in primary care, and longitudinal seminars or lectures series on population health and the roles of primary care in health care delivery systems. Evidence also supports community based clinical training experiences, especially for graduates in rural practice. (32,37, 49).

TABLE 12 – MEDICAL SCHOOL CHARACTERISTICS AND CURRICULA FAVORING PRIMARY CARE CAREER CHOICES BY GRADUATES

Longitudinal and multifaceted primary care training experiences **
Required family medicine clerkship
Clinical rotations at rural sites
Family medicine faculty advisors **
Larger total number of required weeks in family medicine clinical experiences **
Public medical school
Department of Family Medicine
Association with an AHEC
Affiliated Family Medicine residency program
Proportion of the total medical school faculty who are in the Department of Family Medicine **
Primary care faculty in medical school leadership positions**
School mission consistent with producing primary care physicians **
Special rural UME track
Post-baccalaureate program

The UK COM already has many of the characteristics listed above.

We recommend that focused attention be devoted to establishing or strengthening those characteristics marked with asterisks (**), and that measurable objectives with timelines for this be established.

Also, medical schools with accelerated tracks into family medicine have increased their output of students entering family medicine. (50,51). Published evidence supports three-year medical school tracks as generally successful in producing physicians who perform at least as well as traditional students in terms of graduation rate and standardized test scores (50-53).

We recommend that the UK COM move forward with development and implementation of an accelerated three-year medical school curriculum, focused initially on Family Medicine, with a target date of August 2019 for matriculation of its first students. In February 2016, the LCME approved our application to develop and evaluate this track. Toward that goal, we have joined an international *Consortium of Accelerated Medical Pathways*, lead by New York University and funded by the Macy Foundation. This consortium now has 11 USA members and one Canadian member (54). **Appendix 1** contains a detailed description of preliminary plans for this three-year curriculum, including some details presented in a *Pros/Cons* format. Much work remains to be done to realize this vision.

We recommend that a UK College of Medicine Task Force be established and charged with further development and roll-out of this three-year medical school track, in concert with other changes being made in the COM for the purpose of improving UK's impact on Kentucky physician shortages. The same Task Force should be used to address the other factors marked with asterisks in **Table 12**.

Primary Care Residency Program settings and characteristics

In **Part I** of this paper we describe and discuss physician shortages and the current production of new physicians in Kentucky. Graduate medical education (residency) is a critical factor in producing well trained physicians. Nationally it is estimated that graduate medical education (GME) positions must increase by 21% for primary care, for the nation to effectively mitigate primary care shortages (55). In order to obtain a primary care physician workforce in Kentucky that is close to the US median by the year 2025, we have estimated a need to add 237 new primary care physicians to the state annually.

As shown in **Tables 7 and 8**, Kentucky residency programs can currently produce 87 new PC physicians per year, only 40 of whom can we expect to practice here. Adding the estimated number of PC physicians who immigrate into Kentucky after residency training outside the state, we estimated 116 PC physicians being added annually to our workforce, against the 237 needed annually to reach the US median workforce level.

Retention of Kentucky residency graduates is 46% for all specialties combined (17), but 61% for family medicine residents (47). Nationwide, 55-60 percent of resident graduates practice within 100 miles of their training site (47). We could not find retention rates for the other individual primary care specialties in Kentucky, but none is likely to be higher than 61%, given the overall rate of 46%. Furthermore, the rate of actually practicing primary care after completion of residency training is by far the highest (90%) for Family Medicine (15,16). **We recommend** enlarging existing Family Medicine residency programs and establishing new programs as priority tactics in addressing Kentucky's primary care physician shortage. Furthermore, we suggest that residency programs take into account the likelihood that graduates will settle in Kentucky when they select their new trainees.

We acknowledge that there is currently debate about whether an overall expansion of residency positions is needed in the US, versus redistribution of existing positions (56-60). We will not address the expansion versus redistribution debate here. Rather **we recommend** expeditious growth of the number of primary care residency slots in Kentucky through any means that will endure.

Any expansion of primary care GME should consider available evidence that links the training environment and curriculum to desired outcomes. There is ample evidence that residency graduates tend to practice in environments similar to those in which they are trained (47, 61-64). Given that most counties in Kentucky have primary care physician shortages, and that 40% of Kentuckians live in rural communities, the ideal GME infrastructure would be distributed around the state, including rural training sites. The fact that primary care shortages are least severe in Lexington, Louisville and Pikeville, also argues for having the bulk of expanded primary care GME situated away from these cities and their medical school campuses. However, adequate patient volumes and the expertise required for establishing and maintaining accredited primary care residency programs pose significant challenges to population-based distribution of GME. These challenges can be best addressed through GME programs built upon partnerships between medical schools and community-based healthcare providers.

We recommend establishing new residency programs and new tracks within existing programs, in affiliation with community hospitals and outpatient clinics. Such primary care training models are already in place in Kentucky in Hazard, Morehead, Edgewood, Madisonville, Glasgow, Pikeville, Ashland,

Bowling Green, Henderson, and Somerset. The residency programs in Pikeville, Ashland, Bowling Green, Henderson, and Somerset are all osteopathic training programs, and most are relatively new. These programs will be required by 2020 to meet new accreditation standards set by the convergence of AOA and ACGME around a new single accreditation system (65). Any that fail to achieve accreditation under the new system will be expected to close. Thus, there is a risk of Kentucky producing fewer residency graduates who practice primary care by 2020.

There are four main challenges with expanding primary care GME: 1) funding, 2) pool of qualified applicants, 3) appropriate training sites, and 4) qualified faculty.

Primary Care GME funding

GME funding for primary care at UK comes via three main sources: 1) CMS payments to hospitals linked to the number of residents in training and certain reported costs to care for poorly insured patients (66-67), 2) money earned through clinical services, and 3) the Veteran's Administration which currently supports GME training for 85 residents and fellows across multiple specialties at UK. However, VA sites do not have sufficient pediatric and child-bearing female patients to fulfill Family Medicine or Pediatrics training requirements. That said, the VA does have a program that can provide financial support for Family Medicine GME associated with hosting adult medicine and surgery rotations (68). State funds cover a smaller, but significant, potion of GME funding at UK; the future of this state funding is uncertain.

Some GME programs obtain additional funding through competitive grant awards. These awards are all time limited (i.e. they are not open ended). The Health Resources and Services Administration (HRSA) Teaching Health Centers (THC) Graduate Medical Education Program devoted $ 230 million over 5 years to support expansion of GME-Community Health Center partnerships across the nation. Kentucky earned one of these awards in 2013 which supports an osteopathic family medicine residency program in Morehead, Kentucky at St. Clair Medical Regional Center. These grants all expire at the end of the coming federal fiscal year and congress has not authorized any renewal of funding for these GME programs.

Funding for GME from CMS was capped in 1997 with resulting restrictions on growth in graduate medical education across the nation. After 1997, growth in CMS-funded GME positions was limited to new programs and previously never funded hospitals, plus a few other special types of programs, including certain new programs at rural hospitals (58).

Thus at present, the only substantial funding sources for primary care GME expansion in Kentucky are for new programs based in hospitals never before funded for GME by CMS, certain new programs in rural hospitals, and institutional funding from clinical services revenue. Because primary care physicians rarely provide high dollar services in hospitals, most hospitals and health care provider systems are not motivated to spend regular clinical revenue on primary care training, at least not in the current fee for service environments prevalent in Kentucky. That said, the specter of shared financial risk between payers and providers is fueling reconsideration of such institution-based GME funding in cost-aversion models, which are essentially the opposite of fee for service models. Proposals are before congress now to expand federal funding for GME with emphases on new schools or branch campuses, VA affiliated

programs, community based training programs, and programs that have established that they meet meaningful use criteria for electronic health records.

Applicant pools for primary care GME

The primary care GME applicant pool is not large enough under current conditions to fill expanded primary care GME positions with graduates of US medical schools. Typically, about two-thirds of the residents in Family Medicine GME programs graduated from a US-based allopathic or osteopathic Medical School (69). In 2016, 78% of all first-year allopathic program residents in Family Medicine, Internal Medicine, Pediatrics and Medicine/Pediatrics in Kentucky were graduates of US Medical Schools (70). Kentucky's osteopathic GME programs admit only US-trained osteopathic physicians.

This situation requires realistic appraisal of achievable goals for primary care GME growth in the coming decade, presuming that careers in primary care do not greatly increase in desirability among medical students. With that caveat, we believe that primary care GME expansion in Kentucky will require a multifaceted strategy to achieve the goal of substantially increasing the production of well-prepared primary care physicians for Kentucky.

This will require four main tactics,

1. Tighter integration of UME and GME in a continuum

2. UME admissions and curricula designed to produce a higher percentage of medical graduates seeking a primary care career in Kentucky.

3. Kentucky GME programs with especially attractive training environments and programmatic features compared with regional competitors

4. GME programs with curricula specifically designed to rectify gaps in training and in cultural competence of graduates of non-US medical schools

The first two of these were discussed earlier in this paper in the sections on medical school admissions and undergraduate medical education. The third tactic will require sufficient funding to establish modern training environments that emphasize team-based care, value-based care and resident wellness/resilience (71). The fourth tactic concerning tailored GME curricula should be established regardless of expansion; its necessity is implied by program requirements related to patient care and communication competencies (71).

Appropriate primary care training sites

GME training should occur in settings similar to targeted practice communities and include skills needed for effective primary care practice in modern health care delivery systems (62,63). Competencies beyond the basic clinical skills that are routinely considered (and in some cases required by the ACGME) must be included as training targets. Examples of these competencies include: electronic and telephonic communication with patients, team based care, population health management, data driven CQI, use of remote monitoring of health data and patient-supplied health data, systems based practice, and knowledge of the social determinants of health (62,64,71). At new training sites, related infrastructure

will have to be developed, because the healthcare market place in Kentucky does not yet demand some of these elements. It is anticipated that the ACGME Clinical Learning Environment Review (CLER) Program in combination with the anticipated release of the ACGME revised Common Program Requirements in July 2017 will accelerate change through requiring integration of GME with healthcare institutions' approaches to promoting healthcare quality and patient safety (71). It is hypothetical as to whether the opportunity to establish new primary care GME programs will accelerate healthcare organizations to establish these tools and systems and integrate them into their ambulatory and hospital infrastructures.

All primary care specialties require a range of clinical experiences that typically cannot be fully provided by small community hospitals and clinics; often, even regional medical centers cannot provide all of them. Typically, gaps exist for inpatient pediatrics and neonatology, adult intensive care, and/or obstetrics. Gaps in medicine and pediatric subspecialty experiences can be challenging as well. It is not uncommon for healthcare organizations to have to collaborate around GME to fill such gaps.

Qualified faculty for primary care GME

Faculty recruitment and development is a major challenge for the expansion of GME (and UME). The challenges of financing quality GME that requires physicians to teach outside of patient care and establishing a sufficient cadre of teachers are all substantial.

The strategies and tactics to meet the challenges of financing this work have been discussed broadly above in the section on GME financing. More specifically, there are substantial costs associated with teaching and program administration that cannot be covered by clinical revenue generated during clinical teaching. Even if GME programs' philosophy and approach rendered such non clinical work as unimportant and reduced to a minimum, the ACGME requires substantial non-clinical work by residency program faculty. Therefore these expenses must be covered by CMS, VA allocations, grants, state funds or other institutional resources.

Once an appropriate model for paying for faculty time and effort is established, physicians and other healthcare professionals (e.g. behavioral health providers) must be recruited to the task and trained. Experienced faculty can be recruited from other institutions, but the market demand generally exceeds the supply, and such recruitment carries significant expense.

Training community-based physicians, mental health professionals and pharmacists to be part-time educators for GME is usually a more realistic approach and carries the advantage of the faculty having knowledge about the training site and the environment, both valuable for the residents. The faculty training required can be accomplished over time and a rich library of training resources is available through professional societies such as the Society of Teachers of Family Medicine, the Society of General Internal Medicine and the Association of American Medical Colleges. Deploying experienced college of medicine faculty to design and deliver training for community based faculty will probably be cost - effective but is not cost - free.

In summary, we make the following recommendations for expanding primary care GME in Kentucky.

We recommend that UK seek to strategically and deliberately expand primary care GME training in Kentucky combining the following strategies:

1) obtain expert consultation on current CMS criteria that would allow new CMS funding for GME to flow into the state
2) consider the following proposed criteria now before the US congress for targeted GME expansion as they might apply to UK
    - New schools or branch campuses
    - New or expanded rural programs
    - VA affiliation
    - Community based and or hospital outpatient based training
    - EHR Meaningful Use certified site
3) Explore partnerships with strategically located community hospitals (note that the AAFP offers a formal consultation service for family medicine residency planning) (72).
4) Explore expanded and new GME partnerships with Community Health Centers; especially in the Bluegrass area, Bowling Green area, and Morehead area.
5) Build a continuum for undergraduate medical education to graduate medical education at UK COM regional campuses. Improve this for Lexington campus. Understand and take advantage of exceptions to the NRMP "all in rules" (73). Use the proposed ABPB accelerated medical school track curriculum as a model (See APPENDIX 1).
6) Support the development and implementation of improved GME curricula for the goal of producing physicians prepared to use data, teamwork, and enhanced communication to improve patient care and population health. This will require faculty salary support and IT support. Take advantage of linkages to the UK Center for Health Services Research and UK Center for Population Health.
7) Support some of the cost of community-based faculty development, via deployment of UK College of Medicine Faculty.
8) Consider forming a consortium of interested healthcare provider organizations that could collectively deliver high-quality GME, bridging gaps that exist at any one organization.

Summary and Conclusions

Primary care (PC) physicians are essential to cost-effective healthcare. Kentucky ranks 40th among the United States in the size of its primary care workforce per 100,000 people. Population growth and aging, physician retirement, and (to a lesser extent) increasing demand for primary care resulting from the Affordable Care Act will worsen Kentucky's primary care shortages if bold actions are not taken soon. Physician Assistants and Family Nurse Practitioners working in primary care settings are important resources to augment the work of PC physicians, but their numbers in the state are small.

In order to prevent worsening the PC physician shortage in Kentucky, we will need to add 119 new PC physicians to our workforce each year. We must add 237 new PC physicians to our primary care

workforce each year in order to achieve the US national median PC workforce by the year 2025. Kentucky's medical schools and residency programs now contribute an estimated 55-50 new PC physicians annually who will practice in the Commonwealth. Currently, about half of the PC physicians practicing in Kentucky came from out of state. If we can recruit 55-60 new PC physicians from out of state each year to add to the 55-60 that we produce here, we can hope to see our shortages not worsen.

But we will never be able to *reverse* our PC physician shortage unless we significantly increase the training of new PC physicians in Kentucky, for Kentucky. We recommend and describe the following strategies and tactics to accomplish this.

- Significant enhancement of Pre-Medical enrichment programs at UK (plus possibly a pre-medical post-baccalaureate program) with evaluation of their impacts for dissemination to other Kentucky universities.
- Increased use of available evidence to admit more students into the UK COM who exhibit the propensity to choose a primary care career and to stay in Kentucky.
- Application in the UK COM of evidence on faculty composition, curricular elements and training venues for UME and GME that are associated with higher rates of graduates who enter primary care specialties. This should include development and implementation of an accelerated and compressed three-year medical school track for primary care
- Expansion of UK's primary care GME training programs in collaboration with regional medical centers and community health centers

Such initiatives will require support from the UK Provost, the UK COM Dean and significant engagement of faculty and students in multiple UK colleges.

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