# Residency Footprints: Assessing the Impact of Training Programs on the Local Physician Workforce and Communities

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Background and Objectives: National workforce models fail to capture the regional effect of residency programs, despite local control over decisions to open or close training sites. In the last 5 years, 37 (nearly 8% of total) family medicine residency programs have closed. We report on a novel approach to measuring the regional effect of residency training programs closures using a combination of quantitative and spatial methods. Methods: American Medical Association Physician Masterfile records and residency graduate registries for 22 of 37 family medicine residency programs that closed between 2000–2006 were analyzed to determine regional patterns of physician practice, as well as the effect of graduates from closed programs on areas that otherwise would be Health Professional Shortage Areas (HPSAs). Program graduate data from two sampled programs were mapped using geographic information system software to display the distribution "footprint" of graduates regionally. Results: Of the 1,545 graduates of the 22 programs, 21% of graduates practice in rural locations, and 68% are in full-county or partial-county HPSAs. Without the graduates of these programs, there would have been 150 additional full HPSA counties in 15 states. The spatial distribution of the graduates of two closed programs demonstrates their effect across multiple counties and states. Conclusions: The effect of closing family medicine residency programs is likely to go undetected for many years. Decisions regarding the fate of family medicine programs are often made without benefit of a full assessment. Local and regional effects on physician access are often recognized only after the fact. Novel approaches to analysis and display of local effects of closures are essential for policy decisions concerning physician workforce training.

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Workforce studies and policies tend to be national or regional in scope and cross-sectional in time, yet most decisions that affect physician workforce training are local and are felt years later. Local decisions are often prone to political and financial influences and lack objective data that might help guide these decisions. For family medicine, one instance of the effect of local decision making has been the closure of at least 37 programs since 2002. Many of these programs were high-quality programs and contributors to the rural physician workforce.<sup>1</sup> We have assessed the "footprint" of family medicine programs on their communities and regions using both traditional analytic tools as well as geographic information systems (GIS). The footprint refers to the spatial distribution of a residency program's graduates as it relates to other spatially defined variables such as counties and Health Professional Shortage Areas (HPSAs).

The purpose of our study was threefold: The first was to demonstrate how GIS can inform or convey the effect of family medicine training programs in a more compelling manner. The second, using program closure as an example, is to show how closed programs affect the physician workforce locally. The third is to explore future implications of program closure on the workforce and affected communities.

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#### Methods

The 2004 American Medical Association (AMA) Physician Masterfile and 2005 American Academy of Family Physicians (AAFP) data (members and nonmembers) were used to construct a comprehensive profile of family physician practice location and graduate medical education (GME) history. The AAFP file (n=94,383) includes Federal Information Processing Standard (FIPS) codes of practice location. ArcGIS 9.0 (ESRI, Redlands, Calif) was used to geocode AAFP file practice addresses, and assignment of geographic coordinates was achieved for 91% of physicians for whom we had an address. Removal of students, residents, and inactive physicians yielded 77,630 records. Finally, physicians not practicing in the United States were excluded, yielding a final analysis file of 77,239 family and general practice physicians with a geocoded practice location. Matching on the FIPS code for county of practice, variables were added from the 2003 Area Resource File (Quality Resources Systems, Inc, Fairfax, Va), including county rural/urban continuum codes and primary care Health Professional Shortage Area (HPSA) status. The coordinates from the AMA Masterfile were merged into this AAFP membership file, creating an analysis file of 77,239 records that contained GME history and a code for each physician's GME program (referred to here as "program code"), practice location, and attributes of counties of practice.

The American Council on Graduate Medical Education (AGCME) Web site<sup>2</sup> provided a list of 51 family medicine residency programs that had been withdrawn from ACGME accreditation between the academic years 2000 and 2006. This list contained programs that had been withdrawn for any reason, including closure, consolidation, relocation, or other reasons such as a change from allopathic to osteopathic accreditation. Consultations with AAFP medical education staff, members, and ACGME staff revealed that 37 programs had or would be closed. Fourteen programs that were either missing AGCME codes or had codes unmatchable in the physician files (usually rural training sites for an open program of the same name) were excluded. A program located in Puerto Rico was excluded because urban and rural practice patterns were not known. Collectively, the remaining 22 closed or closing programs had graduated 1,545 actively practicing physicians.

We first assessed the effect of these programs on currently designated rural and/or primary care HPSA counties. Simple frequencies were first performed to determine which of the 1,545 physicians practiced in these counties. The relative contribution to these counties' physician workforces, measured by hypothetically withdrawing these graduates from the physician workforce in these counties, was done by subtracting these physicians from county primary care physician totals. This permitted the identification of counties that otherwise would have had a physician-to-population ratio less 1:3,500 and thus would have met a critical designation criterion for HPSA status. This is one measure of the dependence of these counties on closed or closing family medicine residency programs (Table 1).

Two programs were chosen for further geographic analyses. A comprehensive map of all closing programs was created to present the overall "footprint" of closed programs (Figure 1), but we also present maps focused on two specific programs to depict local impact (Figures 2 and 3). The two programs are the University of North Dakota and Louisiana State University. They were selected for their large numbers of graduates, their rural/urban representation, and their geographic diversity. Our footprint mapping adapted previously used methods of geographic retrofitting clinical service areas<sup>3</sup> and is depicted at the level of county. All analyses were performed using SPSS 11.55 (SPSS, Inc, Chicago) and ArcGIS 9.0.

#### Results

Of the 1,545 graduates of the 22 programs, 21% practice in rural locations, and 68% are in full- or partialcounty primary care HPSAs. Without these physicians, 150 additional full HPSA counties in 15 states would be created (42 that previously had no HPSA designation and 108 partial HPSA counties). The physicians trained in the two footprinted programs, who in the main followed the same practice-location pattern, were similar to the overall picture, with 29% practicing in rural locations and 62% in HPSAs. These location outcomes varied by program (Table 2). More than half of these program graduates are located within the state of their training or in immediately adjacent states.

The footprint maps suggest that the greatest concentration for the programs is in the immediate area surrounding the residency program but also identify other counties with particular dependence on a training program for their physician workforce (Figures 2 and 3). It is also worth noting that the Lousiana State University program was an important supplier to areas of Louisiana affected by Hurricane Katrina.

Table 1

#### One Measure of the Dependence of Counties on Closed or Closing Family Medicine Residency Programs

This could be represented by the equation,

 $\mathbf{r} = \left| \underbrace{(\mathbf{p} - \mathbf{c})}{\mathbf{p}_1} \right| * 3,500$ 

where r=primary care physician to population ratio after the withdrawal of closing program graduates, p=number of primary care physicians per county, c=number of graduates of closing programs practicing in county, P<sub>1</sub>=total county population.

#### Figure 1



Closing Programs (2000-2005) and Concentration of Closing Program Graduates

#### Discussion

Using Spatial Analysis to Display the Impact of Program Closure on Physician Workforce

This study demonstrates the power of GIS to display workforce data in a visually compelling fashion, capable of communicating messages to workforce experts, policymakers, and laypersons alike. Using the capabilities of GIS, specific county-level dependencies on footprinted programs can be identified. For example, the University of North Dakota program placed graduates in six North Dakota counties, four South Dakota counties, 21 Minnesota counties, and three Montana counties. Of these 34 counties, 19 qualify as rural by the 2003 USDA's Economic Research Service Rural-Urban Continuum Codes definition. Only in Montana do less than half of residency graduates practice in rural locations. Thus, South Dakota and Minnesota have accrued significant benefits for their rural and underserved populations through the presence of family medicine training programs, but now may face difficulty recruiting physicians with the closing of the program in Fargo, ND. For other programs facing closure, footprint maps may identify otherwise unnatural allies and advocates. They provide an objective method for identifying historical effects of family medicine programs and potential future effects when there are changes in the structure or existence of a program. Analytic mapping adds to the depth and breadth of the manpower discussion by providing a richer, spatially anchored picture of the health, access, and diversity of rural and underserved communities.

#### The Economic Impact of Program Closure

Apart from the very real contribution in manpower and access to health, physicians contribute substantially to the economy of their communities. In rural economies, the health services sector makes up as much as 20% of the local economy.<sup>4</sup> In 2001, the Oklahoma Physician Manpower Training Commission found that a rural family physician's practice is responsible for the creation of 50 jobs and \$1,156,810 annually in economic impact in their community.<sup>5</sup> Extrapolating the economic impact from the Oklahoma study to the rural graduates from these 22 closed programs considered in

#### Figure 2



Concentration of Graduates of the University of North Dakota Program

Source: AMA, AAFP, ACGME; Prepared by the Robert Graham Center

Graduate practice characteristics: 87 grdauates

	# Practicing in North Dakota	% Practicing in North Dakota	# Practicing in Rural Areas	% Practicing in Rural Areas	# Practicing in HSPAs	% Practicing in HPSA
Program graduates	37	43%	27	31%	47	54%

HPSA-Health Professional Shortage Area

our study, one can project that the 337 rural graduates of closing programs have generated approximately 16,850 jobs and \$389,844,970 in economic benefit per year. The economic effect of the rural primary care workforce is considerable, and footprint maps make clear that closed programs represent a loss of economic empowerment for rural communities.

#### Limitations

The AMA Physician Masterfile and AAFP physician data have limitations with regard to lags in tracking physician location and with completeness and accuracy of graduate medical education training identification. While it has been suggested that the Masterfile overestimates the number of physicians located in rural areas, other analyses have found it to be more accurate in locating physicians in rural areas.<sup>6</sup> We tried to minimize these limitations by using only programs for which we had greater certainty of closure by excluding program codes that did not clearly match with physician files and using multiple datasets to triangulate physician and community physician resource information.

#### Conclusions

Using the geographic analysis described in this paper, an interactive database has been developed for

# Figure 3



Concentration of Graduates of the Louisiana State University Program

Source: AMA, AAFP, ACGME. Prepared by the Robert Graham Center

Graduate practice characteristics: 122 graduates

	# Practicing in Louisiana	% Practicing in Louisiana	# Practicing in Rural Areas	% Practicing in Rural Areas	# Practicing in HSPAs	% Practicing in HPSA
Program graduates	95	78%	21	17%	111	91%

HPSA-Health Professional Shortage Area

### Table 2

## Rural and HPSA location of Graduates of Closed Residency Programs

	Graduates 2000–2005	Rural	% Rural	HPSA (Whole or Partial)	% HPSA (Whole or Partial)
University of North Dakota	98	34	35%	49	50%
Lousiana State University	140	34	24%	105	75%
Total including all 22 program graduates	1,545	337	22%	1,057	68%
Total (in United States)	77,239	14,593	19%*	55,462	73%*

HPSA-Health Professional Shortage Area

\* includes only physicians for whom rural or HPSA data are available

all non-military family medicine residency programs in the United States. We believe these graphical and tabular data will permit local and regional stakeholders to engage in informed debates about the role and value of particular family medicine residency programs for their communities, states, and regions. They may have additional value for regional workforce planners in assessing the relationships between existing programs and the health care safety net.

By combining physician demographic, HPSA, and rural designation data within GIS tools, it is possible to get a spatially anchored understanding of the effect that individual family medicine training programs have on communities at the local and regional level. Comprehensive evaluations of the implications of program changes for local consumption, such as those described in this paper, are needed to complement national workforce studies.

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#### References

- Gonzalez EH, Phillips RL Jr, Pugno PA. A study of closure of family practice residency programs. Fam Med 2003;35(10):706-10.
- Accreditation Council for Graduate Medical Educcation. List of ACGME accredited programs and sponsoring institutions: List of withdrawn programs. Available at www.acgme.org/adspublic/default. asp. Accessed September 16, 2005.
- Mullan F, Phillips RL Jr, Kinman EL. Geographic retrofitting: a method of community definition in community-oriented primary care practices. Fam Med 2004;36(6):440-6.
- Department of Health and Human Services. One department serving rural America: HHS rural task force report to the Secretary. Washington, DC: Department of Health and Human Services, 2002.
- Oklahoma Physician Manpower Commission. 25+ years. Tulsa, Okla: Center for Health Policy Research, 2001.
- Fink K, Phillips RL, Fryer GE, Koehn N. International medical graduates and the primary care workforce for rural underserved areas. Health Aff 2003;22(4):255-62.