

Research Series

Geographic Retrofitting: A Method of Community Definition in Community-oriented Primary Care Practices

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Community definition is an important aspect of community health work in general and community-oriented primary care (COPC) in particular. Yet, community definitions are often nonspecific, relying on geopolitical boundaries or local presumptions about patient populations. Such definitions are an impediment to the precise application of sociodemographic or health status data to community health problems or to targeted community organizing. This paper describes a technique called "geographic retrofitting" that has proved useful in establishing a rigorous definition of a practice's community based on current patterns of health care by the community. It also demonstrates how this approach, used in conjunction with geographic information systems software, facilitates more-powerful capabilities in community characterization and intervention.

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Community-oriented primary care (COPC) is an approach to the delivery of primary care that systemically establishes priorities for health care interventions in a defined community.¹⁻⁵ COPC melds clinical and public health competencies and provides a regularized format for a practice to involve itself in outreach to its community. The principles of COPC have been applied to clinical practices in a variety of settings, including rural villages in South Africa, general practices in the United Kingdom, and urban safety-net clinics in the United States.⁶⁻⁸

The COPC process starts with a definition of the community and a characterization of its demographics and health status.⁹ Community definition is a crucial first step in COPC for two reasons. First, COPC presumes involvement of the community throughout the process. To undertake this sort of involvement, it is essential that there be clarity about the population being served since casual definitions of "the community" are subject to many interpretations. The second reason for

a clear community definition is that the COPC process will use data to characterize the nature of health, social, economic, and environmental problems in the practice community. It will be the goal of the COPC team to match sociodemographic and health-related data to the population of the practice and to compare them to those of the general population. Since population data are reported by geographic units such as census tracts, zip codes, health service areas, and political jurisdictions, it will be important for the COPC practice to have a sound definition of its own geography.

The concept of COPC was first developed in rural settings in South Africa in which community definition was not a difficult challenge, the boundaries being set according to the definition of the village or town in question.¹⁰ Today, rural and, especially, urban practices are rarely the sole health care provider in an area. While many practices may have general ideas about the nature and extent of "their community," the specifics of the patient population are rarely known with accuracy or precision. Practices may presume that their community is the area contiguous to the office location, or communities along bus routes, or neighborhoods inhabited by certain ethnic or linguistic groups, or parts of town populated by members of health plans, or insurance groups served by the practice. Typically, however, practices are influenced by a variety of access factors that complicate simple definition.

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Community Geography: The Challenge of Definition

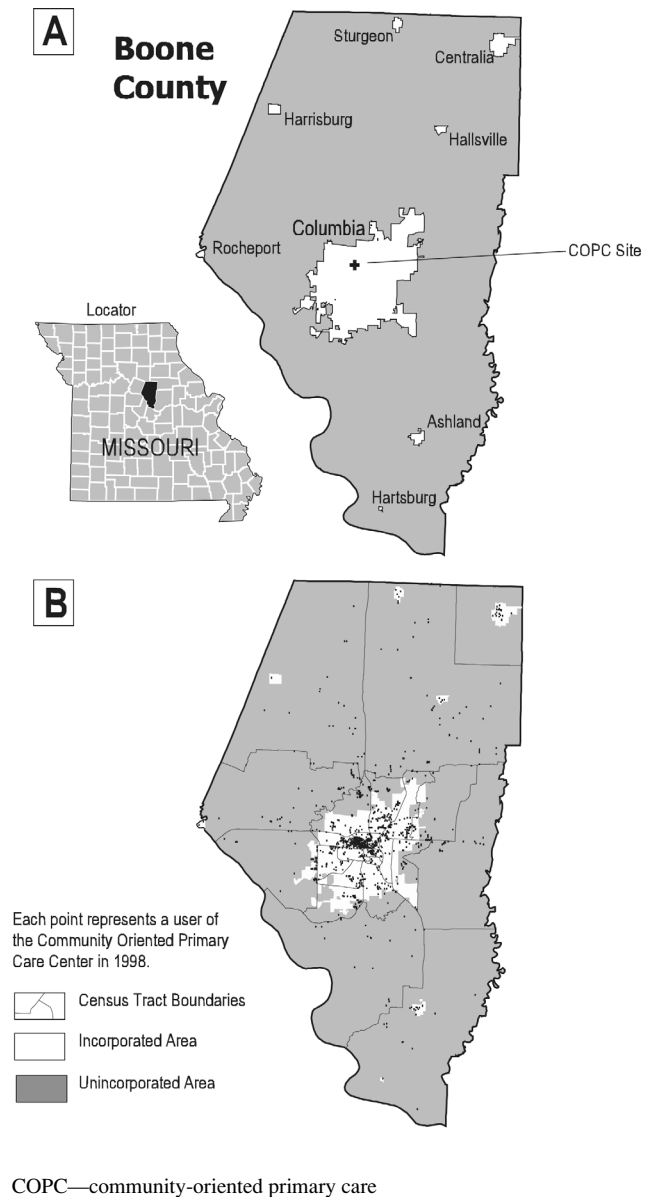
While the aforementioned informal approaches to community definition have some validity and some utility, they represent nonquantitative estimates and are not refined enough to be useful for analytic, service delivery, and intervention planning purposes. We propose a process that we call “geographic retrofitting” that uses the patient database of a practice to establish a more-precise definition of the community of the practice. Geographic retrofitting proceeds from the premise that for whatever set of reasons (geography, insurance status, patterns of transportation, tradition, language, etc.) patients have chosen to obtain care in a particular practice, and the collectivity of those patients represent the de facto community of that practice. Identifying and delineating the geography of that de facto community will help the practice in its service delivery and analytic activities and provide an accurate point of departure for the COPC process.

The retrofit process can range from the simple to the complex. The most important ingredient in the process is the patient’s address, as this is what permits a geographic definition. In its simplest form, patient addresses can be plotted by hand on a map of the area, resulting in visual display of the users of a clinical facility.¹¹ Widely available geographic information system (GIS) software,¹² however, makes this process much more efficient and opens up a variety of more sophisticated analytic possibilities.^{13,14} The first and most difficult step in retrofitting is geocoding patient data, or using GIS software to link patients’ addresses to map coordinates. Geocoding allows patients’ addresses to be displayed on an area map (dot map) and summed by geographic unit (ie, census tract, census block group or block). The results will be a map that provides visual representation of the community of current users and a histogram displaying the same information graphically.

To demonstrate this process, we will use the patient records from the Family Health Center of Boone County, Mo (Figure 1a), a metropolitan statistical area in central Missouri with a population of 135,000. Figure 1b contains Boone County’s census tract boundaries and the geocoded users of the Family Health Center (“the practice”), creating a dot-density map. The practice is located within the inner city of Columbia but serves patients residing throughout the county.

This visual representation will provide a precise picture of the pattern of practice usage in a geographical format that will be easily comprehended by clinicians and community members alike. The map will be useful in developing a final community definition and will confirm or deny the premise of contiguity—do patients really come from the adjacent areas or are there high-density enclaves or outlying satellites of use that bear

Figure
 1A—Boone County, Mo, Incorporated Areas and COPC Clinic Site
 1B—Patient Residences (1998), Incorporated Areas, and Census Tracts (2000)



analysis? Does the map support previous definitions of the practice’s community or catchment area?

Refinements of these basic measures will provide more-precise analytic information for the COPC team, such as the proportion of a practice’s patients that come from given areas. For example, the Griffith’s Commit-

ment Index has been used to define service areas in regard to institutions such as hospitals. It is calculated as the number of visits from a given geographic unit divided by the total number of visits to the facility.¹⁴⁻¹⁶ We have chosen to display the population in a similar fashion by dividing users per census tract by the total users of a practice. In this way, census tracts can be ranked by proportion of users of the practice and mapped to show which census tracts comprise the most active geographic areas within the practice community. Figure 2 is a histogram that arrays these same data by rank-ordered census tracts, indicating which areas of the county are the heaviest users of the practice. The ogive, or cumulative frequency line on the histogram, enables the calculation of the percent of the practice's patients who come from the rank-ordered census tracts.

Since the number of people who live within geographic units is variable (census tracts in Boone County, for example, range between 800 and 10,000 people), relying on the absolute number of users per census tract may create a distorted view of the actual density of use for tracts with particularly small or large populations. Dividing the user-per-census tract figure by the population of the census tract gives a more precise measure of the "penetration" of the practice in a given area and may identify small, high-use areas, providing a different picture of the community utilization of the prac-

tice. Figure 3 shows census tracts arrayed in the original order but now adjusted for the population of each tract—the penetration rate. The practice utilization picture changes with several tracts with small absolute usage showing higher degrees of penetration. The penetration rates of census tracts can also be mapped using a shaded gradient to indicate relative levels of clinic use as in Figure 4.

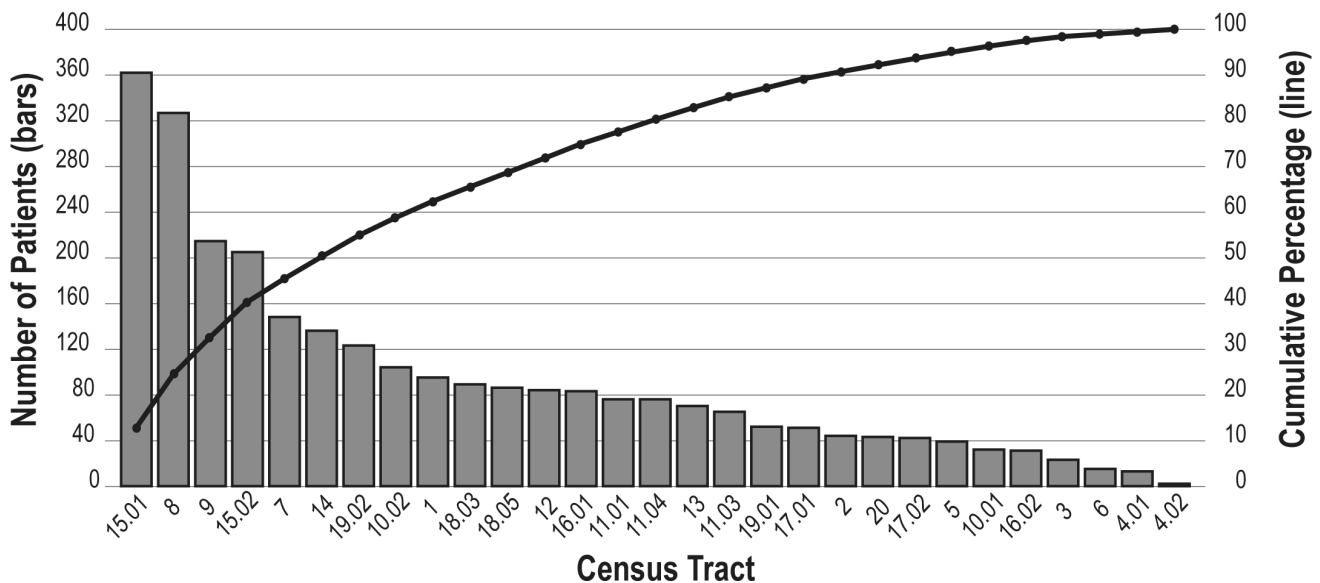
While an examination of users per unit tells a lot about absolute patient usage, the penetration analysis tells more about the market and the reach of the practice into specific areas and may reveal areas that should be included in the community definition. Both are useful in considering the definition of the practice's community.

Geographic Retrofitting

Equipped with the analytic data just described, a practice is now in a position to establish a more-refined definition of its community—that is, to retrofit the definition to the geographic reality. Deciding on a definition will necessarily place some of the practice's patients outside of the defined community. The question that the COPC team will have to decide, with help from community members, is literally where to draw the line. Many different geographic realities are possible, ranging from practices whose patients are tightly clustered

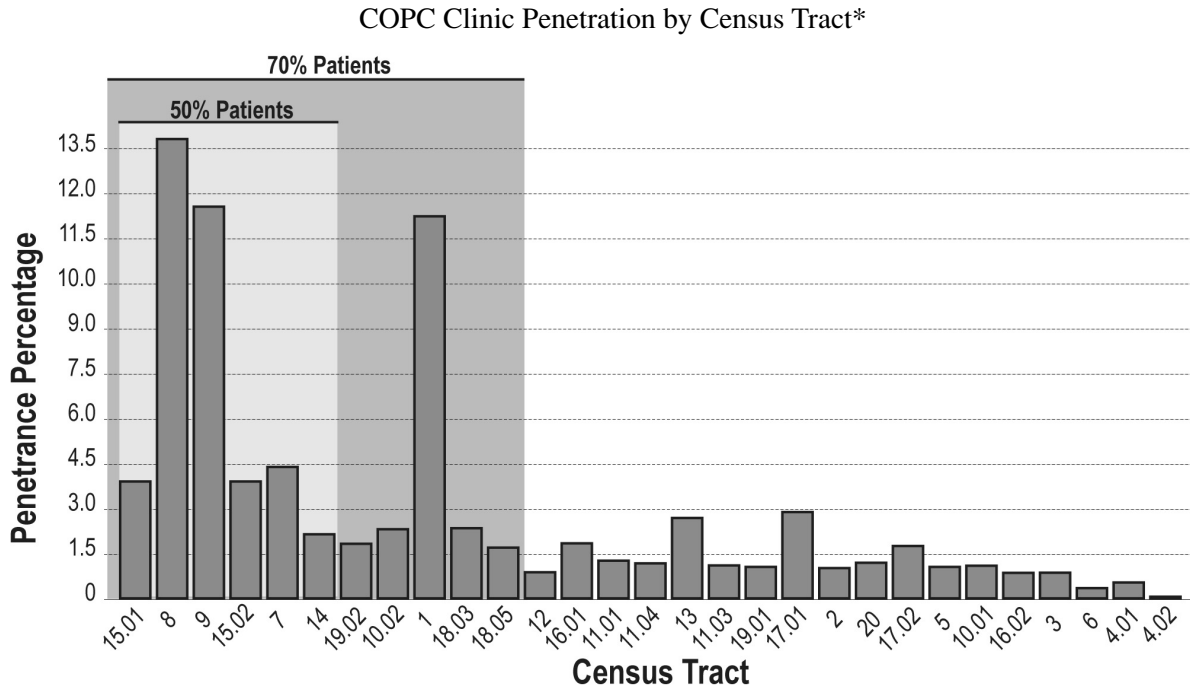
Figure 2

Census Tracts in Descending Order of Total Patients



Line represents cumulative proportion of patients from rank-ordered census tracts. Point for census tract 15.02 indicates that approximately 40% of the clinic patients reside in tracts 15.01, 8, 9, and 15.02.

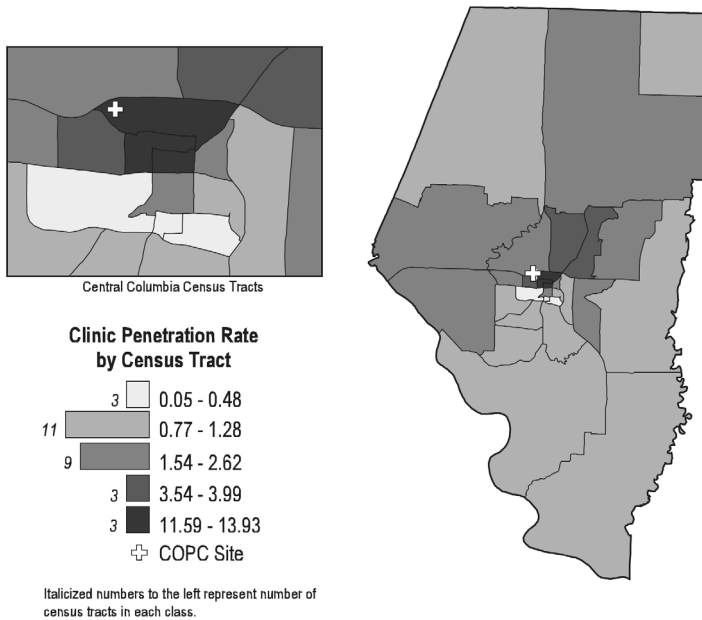
Figure 3



* Ranked as in Figure 2. Penetration rate is calculated by dividing total patients from a given census tract by that tract's 2000 total population.

Figure 4

Levels of Penetration (Proportion of Population Using the COPC Clinic, by Census Tract)



Data classified by Fisher-Jenkins optimal algorithm, which places like values in the same class while maximizing values among classes.

around the practice to situations in which patients are dispersed widely across large areas. Definitions that include 50% or 70% of the practices' patients drawn from the areas of absolute highest use is a good point of departure for the definition discussion. Figure 5 shows the census tracts that would be included under a 50% and a 70% premise for the sample practice. At 50%, six census tracts would be included and at 70%, 11 tracts. In both cases in this example the census tracts are contiguous and relatively concentric from the office location.

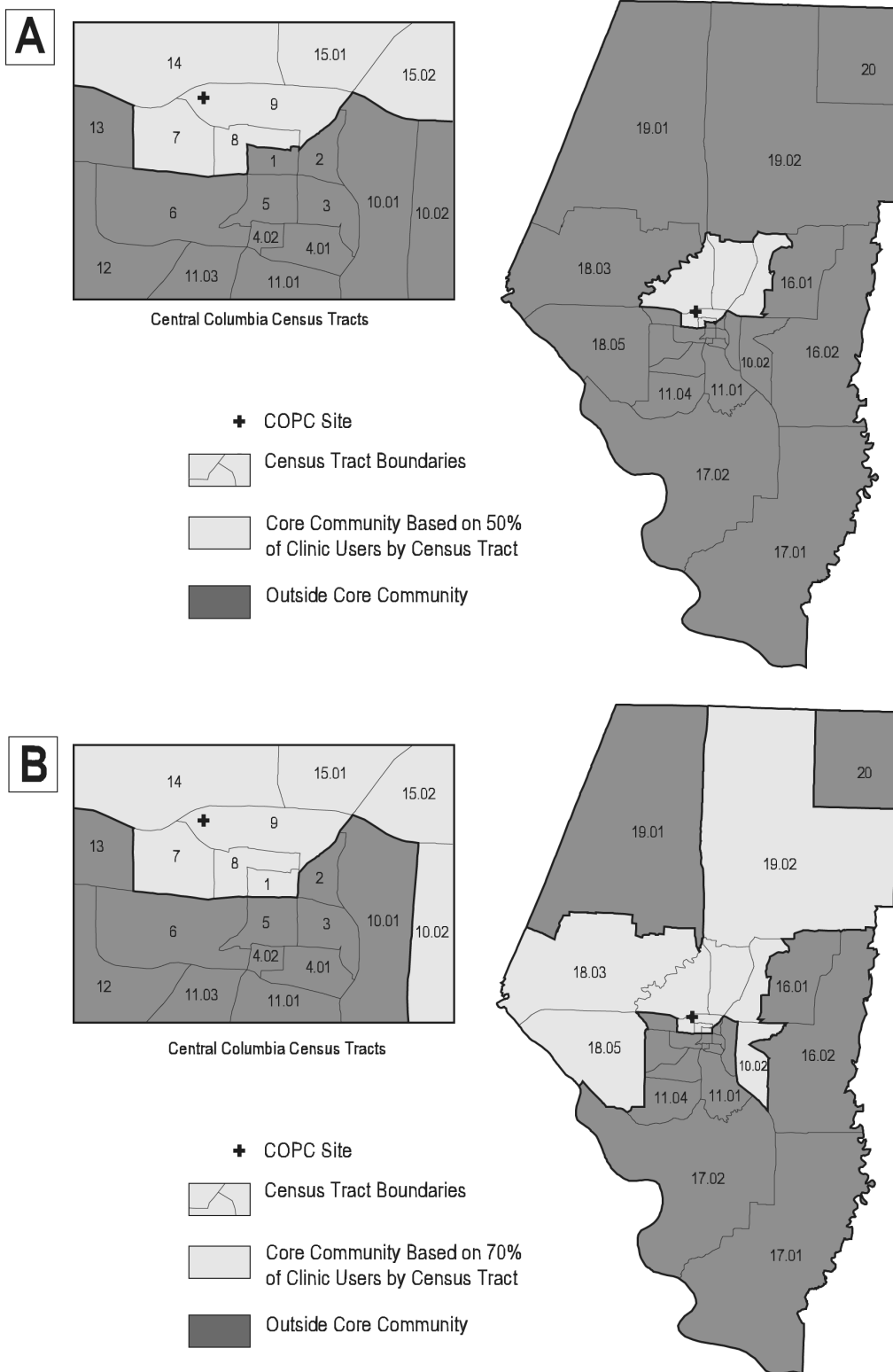
A reexamination of Figure 3 now indicates that one census tract (1) that is highly penetrated would not be included in the 50% definition, and two others (13 and 17.01) that are relatively heavily penetrated would not be included under the 50% or 70% definition. This analysis demonstrates the utility of measuring user penetration in addition to the absolute number of users per area and that the final decision on definition might well take the results of both of the analyses into account.

There are no rules of statistics or community organizing that dictate exactly

Figure 5

A—Census Tracts That Comprise 50% of Clinic Users Based on Rank Order of Total Patients Per Census Tract

B—Census Tracts That Comprise 70% of Clinic Users



which geographic areas to include or to exclude in formalizing a community definition, but several functional principles are suggested in applying the retrofit process. The first principle is that any community definition should include geographical areas that include a minimum 50% of the practice population. Ranking areas by absolute use or commitment indices in descending order with a cumulative frequency graph will facilitate this process.

The second principle is that using penetration rates (users per geographic unit divided by the population of the unit) rather than absolute user numbers will provide a higher degree of precision in the selection of areas of highest usage. The third principle is that the smallest geographic unit feasible (ie., census tracts as opposed to larger postal or geopolitical units) should be used in the retrofitting since this will increase the potential precision of subsequent data linking activities. This is true because the larger the unit of analysis, the greater the likely sociodemographic variability within it.¹⁷ Finally, as with all steps of the COPC process, community involvement in validating, challenging, and deciding on final community definition is critical.

This process inevitably will limit the definition of the practice to some subset of possible geographic areas which, in turn, will enable the practice to map its community of use and characterize its patient population based on secondary data such as census data, vital statistics, hospital discharge information, and health department morbidity data. The practice will be able to analyze the nature of their community with greater specificity and make comparisons to local and national health and demographic indicators. The refined definition will be useful for both specific COPC interventions as well as general community-oriented and marketing activities.

Discussion

The geographic retrofit approach may help community-based practices arrive at a common and focused definition of their community and help target subsequent community-oriented interventions. The definition process with the map as its visual outcome is a powerful, easily understood vehicle for characterizing the practice, stimulating ideas, and focusing debate for staff and community alike.¹⁸ GIS software and hardware requirements are becoming sufficiently simple and inexpensive enough that computer-assisted geographic retrofitting is possible for many practices. The real limitation for most retrofit efforts is the ease with which patient data can be accessed from a practice's information management system and the quality of the demographic, address, diagnoses, and economic data available in the system.

The same technique has utility for all community-based clinical programs that wish to clarify and refine the definition of their service area. This would be true of both non-COPC practices and managed care organizations. In the latter case, the geographic locale of the patient base may be quite disparate given the fact that it is an insurance mechanism that defines the particular practice. When designing patient education and intervention programs in a managed care organization, it would be of considerable use for the physicians to have a geographic handle on the residential and sociodemographic patterns of their patients. Geographic retrofitting can help with this.

Practices that use GIS technology to retrofit their community definition to the locations of their current patients will be able to use the same GIS programs to analyze and map patterns of disease and demographics of their population. This will enable them to undertake subsequent steps in the COPC process (including the characterization of the community, prioritizing and selecting problems, and designing and monitoring interventions) in a much more proficient manner. Moreover, having GIS capability will make comparative analyses with all forms of population data (health conditions, demographics, education, insurance status, etc) much easier with the added feature of producing layered maps that display information in a dramatically different fashion than data tables. It will be possible, for example, to measure observed clinic use by target populations relative to expected use or to measure practice penetration in specific sociodemographic populations or geographic areas.

Limitations

There are, however, several limitations to this approach. The first is that the application of GIS to community-based practices is a relatively new phenomenon, and extensive experience with the effectiveness and the cost/benefit of investment in this methodology does not yet exist. Second, the retrofit approach reflects and reinforces current patterns of patient use. However, one of the important roles of COPC, and a role that GIS stands to augment, is the identification of nonusers of service in contiguous areas or other target populations for the purpose of bringing them into the practice.¹⁹ The retrofit model will identify areas of nonusers as well as users.

A third limitation of this approach is the quality and nature of the geocoded data—both patient data and any secondary population data that might be used in the analysis. The decennial nature of the US Census means that in the early part of the decade, population data are relatively current, but as time passes, these data will become less reliable. Communities are always changing, and the value of the retrofit process to COPC may be compromised by any data that is not recent. Clinic

data systems may be designed to store patient data in a format that can be taken directly to GIS to make timely analyses more feasible. Geographic boundaries used to define community can also be problematic. Census enumeration areas were created for purposes of facilitating data collection and do not necessarily reflect the geographic extent of the phenomenon being mapped. This is more pronounced for zip codes, whose purpose is mail delivery. Further, census tracts, census block groups, zip codes, and health service areas may change over time. Care needs to be taken in using appropriate geographies for summarizing and comparing patient and reported secondary data.

A fourth problem with the retrofit model is that while it supplies a more standardized basis for making decisions about community definition, its results should be compared with the experience of practice and community leaders who may be able to identify trends or changes in the community that suggest other realities. Finally, the ease with which the retrofit process is carried out depends on the quality of the patient data captured by the practice and the data management capability of the practice. Practices with patient databases that are easily manipulated and staff who can learn to use GIS programs will be able to carry out the retrofit process relatively easily. Practices without good information management systems will need to develop such systems and capture data prospectively for this purpose.

Conclusions

Geographic retrofitting offers a number of benefits to community-based physicians and managers. First of all, it provides information for the practice leadership as to the actual scope and penetration of the practice. Similarly, it provides community members with a clear and specific picture of the presence of the practice in their community. Who does the practice reach, and who does it not reach? Second, it offers the basis for a systemic approach to the targeting of health-related programs and initiatives in a given community. Third, it sorts the patient population based on geographic unit allowing health and demographic data to be attributed accurately to the neighborhood of the practice, enabling the COPC team to design interventions based on quantified community problems. In this way, it provides the practice with the ability to focus its resources intelligently and accurately. And, finally, it provides data for the planning of future initiatives of the practice.

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