GOING THE EXTRA MILE: BEFORE AND AFTER RECONFIGURATION OF THE PUBLIC HEALTH CARE SYSTEM IN LOS ANGELES COUNTY- A GEOGRAPHICAL INFORMATION SYSTEMS ANALYSIS

BACKGROUND

The public health care system in the USA has been undergoing major changes in response to regulatory, competitive, and financial pressures. In Los Angeles County (LAC), cost-cutting efforts resulted in the closure of 23 of 36 existing public health centers in October 1995. Consequently, public health nurses (PHNs) from closed sites were reassigned to the 13 remaining centers, but were still required to perform field duties in their previously assigned areas.

In 1995, LAC received approximately 8,000 confirmed communicable disease (CD) reports.* PHNs at the local health centers conducted most of the epidemiologic investigations of these CDS and initiated home visits when needed. Given the widespread geographic distribution of the 13 remaining public health centers, it was hypothesized that PHNs would travel farther to conduct home visits for CD patients. For many CDS, the initial report is not confirmed; therefore, using only confirmed cases does not capture the PHN=s true workload for CD investigations. One way to assess the impact on the PHN's workload is to measure the changes in distance traveled from their base offices to home investigations in their catchment areas.

Geographical Information Systems (GIS) are powerful automated systems for the capture, storage, retrieval, analysis, and display of spatial data (1,2,3,4). What distinguishes GIS from other types of information systems is that objects within the database are stored according to location. GIS can generate spatial relationships between objects. Topology also allows the identification of all objects lying within the limits of a specific distance from a selected object (e.g., patients living within a five-mile radius from a public health center). These spatial query operations and related capabilities make GIS ideally suited for measuring the physical distance traveled during the work day.

The application of GIS to study geographical distance in public health did not occur until the late 1980s. However, to our knowledge, no studies have documented the geographical distance for PHNs to travel to patients= homes. Love and Lindquist employed GIS to study the geographical accessibility of the aged population to hospital facilities within Illinois (5). Gressel, Lynch, and Clay also used GIS to calculate the distances traveled for hospital visits by payor type in Pinellas County, Florida (6). To assess the impact of geographical distance traveled by PHNs for CD-related home visits, the current study used GIS to empirically

* Except sexually transmitted diseases, tuberculosis, and AIDS, since these diseases are handled by different disease control programs.

measure the differences between former and current public health offices in geographical distance from each health center to the new catchment area.

METHODS

The study period was from January to December 1995. Routinely, when a possible CD report is received by the local health center, a PHN conducts an investigation by home visit or phone call. Each month, the PHN completes a Nurses Field Visit Report (NFVR) which specifies date of the visit, type of service (e.g., child abuse, CD, mental health, sexually transmitted diseases, etc.), and census tract of that visit. A home visit, used in this study, is defined as a visit to the patient=s residence to obtain significant disease information.

NFVR data for 1995 was imported into MapInfo 3.0, a mapping program (7), and each home visit was geocoded by census tract utilizing 1990 census data. If the census tract could not be matched to 1990 census data, then it was matched with 1980 census data. The latitude and longitude coordinates of each health center were obtained through geocoding its address. The Los Angeles County health district boundary map was provided by the Department of Health Services.

The straight-line method was used to calculate the geographical distance between two points, the location of the health center and the centroid (center) of the census tract of the patient's home address (8). The total distance traveled within a health district was determined by the distance between health center and home visit multiplied by the number of visits. Distance traveled was calculated for both previous and new health center configurations. Thematic maps were generated to show the average distance traveled by PHNs for each health center according to previous versus new health center configuration. All calculated distances represented a two-way visit, unless stated otherwise.

RESULTS

During 1995, a total of 25,106 PHN field visits in LAC were related to CD. Close to 75% (18,807 visits) of total home visits can be geocoded by their census tract.

By using the previous health center configuration of 36 health centers, the total distance traveled was 94,781.9 miles (average: 5.0 miles), compared with 177,397 miles (average: 9.4 miles) using the new configuration of 13 health centers. The average travel distance per CD for each health center varied greatly for both previous (0.8 - 9.3 miles) and new configurations (1.9 - 9.3 mile) (Tables 9 and 10).

Figure 2 details the proximity of the health centers to the CD patient=s home, the horizontal axis measures the radius of the health center in miles and the vertical axis measures the percent of the home visits. By using the previous configuration, a three-mile radius of all health centers covers 72% of all the visits, and a five-mile radius could cover almost 91% of all the visits. In contrast, using the new configuration, a three-mile radius of the health centers covers just 32% of all the CD visits, and a five-mile radius covers 58.5% of all the visits. However, more than 95% of all CD patients live within a ten-mile radius of the health centers according to either the previous or the new configuration.

Maps 1 and 2 display the average home visit travel distance for individual health centers by the previous and new configurations. Map 1 indicates that only five out of the previous 36 health centers required travel of 10-20 miles per home visit. In contrast, more than half of the health centers required travel of 10-20 miles for home visit under the new configuration (Map 2).

DISCUSSION

The reconfiguration of the Los Angeles County Department of Health Services almost doubled the average travel distance for CD home visits, although almost all CD patients lived within a ten-mile radius of a health center. Home visits provide needed educational, health, and social services for families at risk (9). Reduction in home visits prevents detection of complex family dysfunction (10) or common and unusual environmental hazards. Consequently, delays in case investigation and disease outbreaks may occur. The National Commission to Prevent Infant Mortality proposed non-medical solutions such as a rediscovery of home visits to respond to social and health needs (11,12). Since the new configuration of the LAC health delivery system results in a much longer travel distance than before, PHNs may have to cut down the number of home visits per day or conduct more telephone interviews rather than actual home visits. The stated purpose of the reconfiguration was to decrease costs. However, data for this study suggest that it may actually increase costs for the health delivery system. It may increase costs for controlling possible disease epidemics due to fewer home visits. Also, the doubled expense for mileage coverage and increased costs covering other liabilities while PHNs traveled on the road should not be ignored.

This study reveals the advantage of incorporating GIS analysis when planning a reconfiguration of public health delivery systems. GIS demonstrated the ability to quickly obtain geographical coordinates of each health center and patients' home addresses and easily calculate the physical distance of each PHN=s home visit in a county that has close to nine million residents. GIS analysis also pointed out that the current 13 health centers provide uneven geographically distributed public health services for the community. Some health centers required travel distances of nine miles for a home visit, while other centers required travel distances of less than two miles. GIS can easily calculate the physical distance between health centers and patients= homes under various combinations of public health sites. It is strongly suggested that GIS and its related tools be used to facilitate the selection of public health sites and to ensure that each site can cover most of the patients within a similar geographical area.

Limitations inherent in this study need to be addressed. For practical reasons, the "straight-line" method was used to compute the travel distance. Factors such as road and traffic conditions, familiarity with the route, and travel time may all have an effect on the true travel distance. However, some studies showed that even a more sophisticated model for calculating geographical distance may still fail to account for road conditions (13). Williams et al. believed that straight-line measurements are not unreasonable in estimating the distance between residences and physicians' offices for automobile travel and walking (14). However, the straight-line method may lead to underestimation of the true mileage by up to 20-25% (14). Since the focus of this study was the change in travel distance due to reconfiguration, the straight-line approach should at least provide us with an insight into the change in travel distance due to public health reconfiguration. Also, it should be noted that this study used spatial analysis to understand the possible impact on the accessibility of the PHN to CD-home visits; no assumption was made to indicate that "geographical distance" is equivalent to "accessibility." Accessibility is a multidimensional variable, requiring information such as patient's characteristics, PHN's perception about home visit, PHN's daily-activity, etc. Due to the unavailability of these data, it is felt that geographical distance provides a surrogate for potential accessibility. Also, a home visit was defined as "a visit to the patient=s residence to obtain significant disease information." There are situations in which PHNs may have to visit several times to obtain any significant disease information. Current analysis did not account for any unsuccessful home visits. Therefore, due to possible underestimation of distance by employing the "straight-line" method and the stringent definition for "home visit," the calculated distance for traveling should be treated as baseline information. In reality, PHNs may have to travel even longer distances to complete a home visit.

In summary, this study showed that the current 13 public health sites require PHNs to travel substantially farther to make CD home visits. Future research is needed to evaluate the possible impact on home visits due to reconfiguration, such as measuring the changing pattern from home visit to telephone calls and the occurrence of CD outbreaks due to decreased home visits.

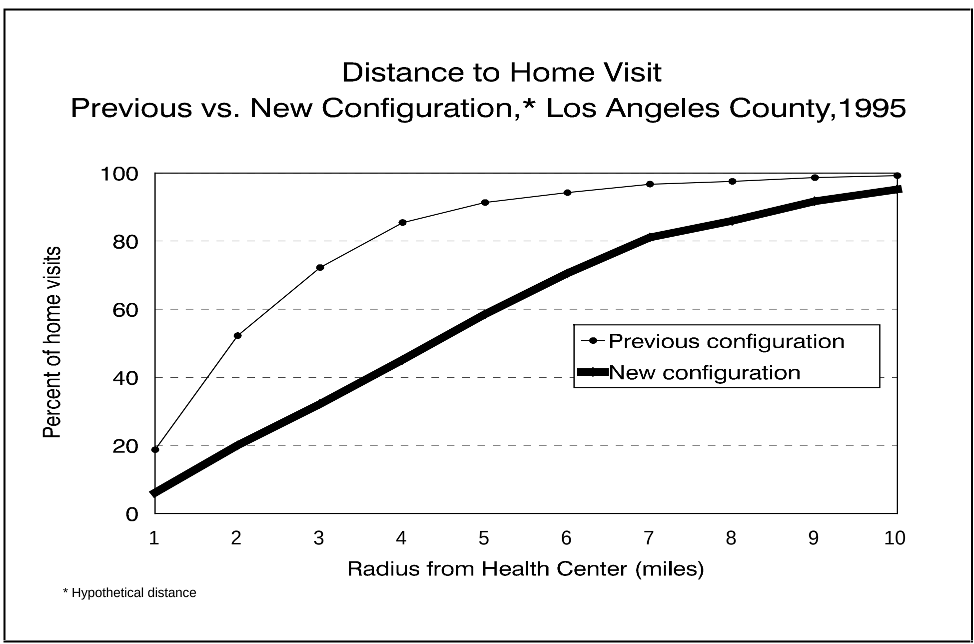
Table 9. 1995 CD-Related Nurse Field Visits:
Total Travel Distance and Average Travel Distance per Visit by Previous Configuration, 1995

Health Centers	Total Number of Visits	Total Travel Distance (mi)	Average Travel Distance (mi)
Alhambra	306	1,109.4	3.6
Antelope Valley	194	3,596.6	18.6
Azusa	131	406.6	3.1
Bellflower	654	3,458.6	5.3
Burbank	22	58.8	2.7
Burke	591	5,378.8	9.1
Canoga Park	171	941.0	5.5
Central	1,801	6,231.0	3.5
Compton	1,058	4,211.6	4.0
El Monte	898	3,842.6	4.3
Glendale	664	4,151.6	6.3
Harbor	175	746.0	4.3
Humphrey	1,225	3,999.8	3.3
Hollywood-Wilshire	721	2,755.4	3.8
Imperial	281	938.0	3.3
La Puente	210	1,060.6	5.1
Lawndale	228	707.6	3.1
Monrovia	296	3,705.4	12.5
North East	1,906	8,143.4	4.3
North Hollywood	713	3,860.0	5.4
Pacoima	47	63.6	1.4
Pico Rivera	86	183.8	2.1
Pomona	209	2,136.6	10.2
Roybal	1,180	4,063.2	3.4
Ruth Temple	407	1,486.8	3.7
San Antonio	1,151	7,372.2	6.4
San Fernando	502	3,142.0	6.3
South	680	2,499.6	3.7
Torrance	372	2,388.0	6.4
Tucker	660	3,545.4	5.4
Tujunga	80	519.4	6.5
Valencia	90	1,604.6	17.8
Van Nuys	373	1,702.6	4.6
Venice	200	1,389.8	6.9
Whittier	209	2,161.4	10.3
Wilmington	316	1,221.2	3.9
Summary	**18,807**	**94,781.9**	**5.0 (range: 1.4 -18.6)**

**Table 10. 1995 CD-Related Nurse Field Visits:
Total Travel Distance and Average Travel Distance per Visit by New Configuration, 1995**

Health Center	Total Number of Visits	Total Travel Distance (mi)*	Average Travel Distance (mi)*
Antelope Valley**	194.0	3,596.6	18.6
Burke**	591.0	5,378.8	9.2
Central	3,707.0	19,610.0	5.2
Glendale	1,479.0	17,658.8	11.8
Hollywood-Wilshire	799.0	4,443.0	5.6
Monrovia	1,631.0	19,569.0	12.0
Pacoima	1,093.0	10,227.2	9.4
Pomona	419.0	6,754.6	16.0
South	2,889.0	21,462.2	7.4
Tucker	3,001.0	29,053.8	9.7
Valencia**	90.0	1,604.6	17.8
Whittier	2,129.0	31,687.6	14.8
Wilmington	863.0	6,319.4	7.4
Summary	**18,807.0**	**177,397.0**	**9.4** (range: 5.2-18.6)

* Hypothetical distance
** These facilities do not belong to the new configuration, but PHNs are currently using these facilities as their headquarters.



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