Population-Based Spot Maps: An Epidemiologic Technique

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Spot maps, on which cases of illness are indicated by a dot or a pin, are one of the commonest tools of epidemiologists. Vaccinations, cancer cases, accidents, and infectious diseases are routinely plotted on physical or political maps, and rates, if needed, are portrayed by different sized spots, shading, or other means. This simple technique was used effectively by John Snow in his studies of cholera cases and their clustering around the Broad Street pump, and health departments and researchers alike now use it to locate cases geographically.

To interpret case-plotting on a geographic map one must know the population at risk, which is not shown on the map. In Arkansas (Figure 1), Pulaski County, in the center of the state, has more than three times the population of any other county and thus would have more cases (dots) of almost any disease. Although one can convert the dots to rates and get an accurate idea of disease incidence, this is a nuisance when done on a daily or weekly basis, and the "dot" system is normally used until the end of the year or some other time of reckoning arrives. Meanwhile, the map remains uninterpretable or misleading to the layman and others who do not know the population at risk.

These problems can be avoided if the cases are plotted on a population-based map, drawn so that areas are proportional to the population at risk rather than to geographic areas.[1] This is not a new concept since a similar suggestion was published in 1926,[2, 3] but the method does not seem to have been widely used in recent years.[4–6] Such maps are ideally drawn by computers but may be approximated by trial and error on graph paper. The map in Figure 2 was drawn by hand, setting each square on a piece of graph paper equal to a convenient number of persons at risk, in this case 2,000, and drawing the geographic boundaries so that the correct number of squares were enclosed in each county. Boundaries were drawn so that each county touches those with which it is contiguous geographically. The shape of the county was altered if necessary to preserve these relationships.

In plotting cases on such population-based maps, dots are placed so that they are evenly distributed within the county. The result is a visual impression of rates without any calculations. The impression of an "epidemic" of *Salmonella newport* infection in Pulaski County in Figure 1 has disappeared in Figure 2, and the highest incidence of disease is seen to have occurred in a broad band across the middle of the state rather than primarily in Pulaski County. Both for

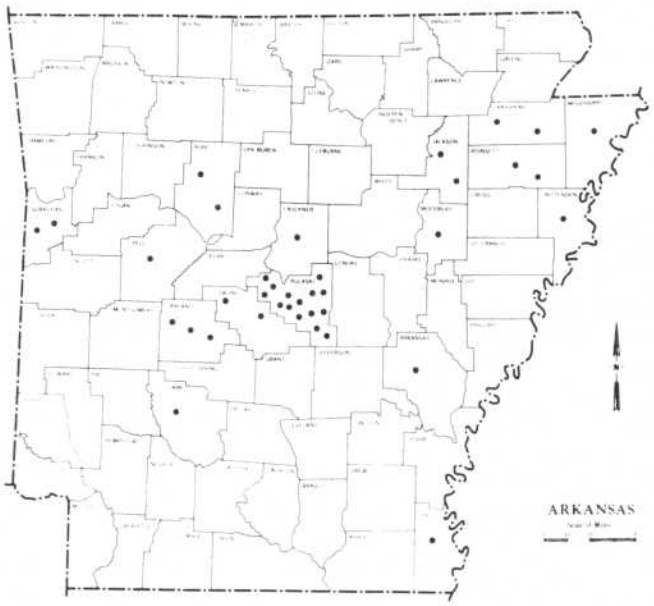

FIGURE 1—*Salmonella newport* in Arkansas, January 1 through August 31, 1974 plotted on a routine geopolitical map, by county. Each dot represents one case.

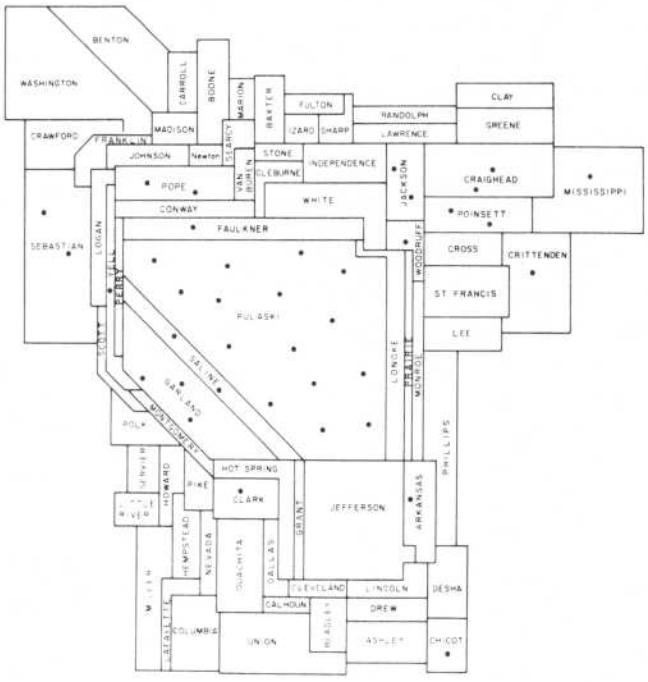

FIGURE 2—The same data shown in Figure 1, (*Salmonella newport* in Arkansas, January 1 through August 31, 1974) plotted on a population-based map, by county. The area of each county is proportional to its population in the 1970 U.S. Census. Each dot represents one case.

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the layman and the professional this represents a truer picture of the disease problem.

The appearance of widely spaced cases within Pulaski County would be misleading if all the cases had occurred on a single block within the city of Little Rock, and having used population-based case plotting to detect problem areas, one must examine the geographic location of the cases in more detail.

Population-based maps can be made for any entity whose population at risk is known—census tracts, blocks, floors of a building, states, counties, cities, nations, or combinations of these. The area may be made proportional to the total population or to any subpopulation—children, childbearing women, the elderly, persons with telephones, welfare recipients, cows, dogs, horses, or any other convenient parameter. A different map would have to be constructed for each group at risk.

The dots may represent any condition as long as the map represents the population at risk for that condition. Dots might represent new cases, currently active cases, or the number of practicing physicians. In these instances, the final map will show disease incidence, disease prevalence, or the prevalence of practicing physicians in the population.

A particularly useful application of the population-based maps is in plotting the cases of disease seen in a particular practice or hospital on a map of that facility's "catchment area". The areas of the adjacent entities (counties or towns) would reflect the number of patients from these places seen in the practice or hospital over a prolonged period, such as the preceding ten years. A map of this type, maintained for problem diseases, will reflect geographic differences in incidence or prevalence of particular diseases without using either the total population or any reports from outside the facility in the calculations.

Population-based spot maps, within their limitations, are more effective than other methods in portraying incidence or prevalence rates, and have the advantage of being updated instantly, case by case, without calculations of rates. They portray approximate, not precise, geographic relationships, but should be useful in routine public health work, in office-based and hospital-based epidemiology, and for health-planning purposes. Although the method is intended to help those who do not have access to a computer, computers can easily be programmed to represent data on population-based maps, and these maps may thus be useful even where rates can be calculated automatically.

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