Tools of the Trade:

RELIABILITY of RATES

A common problem experienced by public health professionals and agencies, especially at the local level, is how to reliably use rates when the number of events being studied are small. All statistics are subject to chance variation. However, rates based on an unusually small number of events should be of particular concern and caution. An example of this problem is mentioned below and recommendations on how to cope with it are also discussed.

A public health objective is usually stated in terms of reaching a certain point or level over time. For example, the 1990 objective (set by the U.S. Public Health Service) for the infant death rate is 9.0 per 1,000 live births. An infant death rate is a standard computation and routinely compared over time for achievement purposes. However, for areas with few infant deaths, the statistical unreliability of such a rate can cause problems. For example, if a county agency chose the 9.0 infant death rate as its goal for 1990 and computed a rate of 11.0 in 1990, they might assume that they did not reach their goal. Yet, if the annual rate was based on only 50 deaths, the rate has a 95% confidence interval of 8.0-14.0, which happens to include 9.0. In reality, the actual rate of 11.0 is not statistically different from the goal of 9.0.

When setting standards for achievement that requires the use of measurements such as rates, stating what the goal will be and when it is to be reached may not be enough. Some people may not be satisfied that the true rate falls within a 6 point spread.

A rather easy solution to this problem is to increase the number of events in the computation. This could be done in two ways. First, one could enlarge the population base being studied so that more events are included. For example, instead of setting objectives for a small, rural county, several adjoining counties could be included. Changing the rate from an annual to a multi-year rate is a second approach. Three and five-year summary rates provide more accurate descriptions of events that do not occur very often. Also, use of "moving averages" can be another alternative. It is a more advanced use of multiple year rates which involves the computation of several multi-year rates over an extended period of time, such as five separate three-year summary rates for the last seven years of available data. For example, if 1986 was the most recent year for which data were available, a moving average over seven years (1980-1986) would involve computation of three-year summary rates for the periods 1980-82, 1981-83, 1982-84, 1983-85 and 1984-86. However, these "easy" solutions can create other problems. A county agency solely responsible for a small, rural area cannot justifiably include other adjoining counties in its figures. Also, use of only one or two multi-year rates due to the unavailability of much historical data can limit the range of trend analysis and both a multi-year rate and "moving averages" may not reflect recent medical advances or the timely testing of any new program interventions. Therefore, if these "easy" solutions do not work for you, your only alternative may be to use an unstable rate that can fluctuate widely from year to year and is not truly representative.

What can be defined as stable and unstable rates and how do you cope with unstable rates? If we defined a stable rate as one whose 95% confidence interval is ±5% of the rate, then 1600 events

are needed. This is generally a rare number of events for any annual measurement below the state level in Pennsylvania. Because such a large number of events is necessary to compute a stable rate, you should always be cautious when setting health objectives that involve computation of rates. Regardless of the number of events involved, it's probably a good idea to compute and list a confidence interval for the rate to compare with the goal. If the goal lies within the confidence interval range, then you can state that the actual rate and the goal are not statistically different. As a rule, setting objectives based on 20 or more events (infant deaths, low birth weight infants, etc.) is a good standard to follow. If an objective involving more events can be created, then that objective should be used.

The following table shows you how to compute the length of 95% confidence intervals for rates based upon the number of events in the numerator of the rate. It can be used to measure the reliability of a rate you may have to use.

95 PERCENT CONFIDENCE INTERVALS FOR RATES BY THE NUMBER OF EVENTS INVOLVED

NUMBER OF EVENTS	CONFIDENCE INTERVAL
20	Rate ± 0.40 x Rate
30	Rate ± 0.36 x Rate
40	Rate ± 0.31 x Rate
50	Rate ± 0.28 x Rate
75	Rate ± 0.23 x Rate
100	Rate ± 0.20 x Rate
150	Rate ± 0.16 x Rate
200	Rate ± 0.14 x Rate
300	Rate ± 0.11 x Rate
400	Rate ± 0.10 x Rate
800	Rate ± 0.07 x Rate
1600	Rate ± 0.05 x Rate

In addition to the problems associated with rates based on small numbers, please remember that any rate in any given time frame for any given population is the ACTUAL rate. However, it may not represent the UNDERLYING rate - the rate that one would expect over time or a rate free of random variation from year to year. The implicit assumption is that a rate in a particular year represents a single selection from a collection of rates over a number of years.