Calculating a Rate

It is customary to use rates per 100,000 population for deaths and rates per 1,000 population for live births.

To calculate the rate for deaths from injuries and poisoning for Allen County in 2000, do the following calculation:

$$\frac{\text{Number of deaths from injuries/poisoning in 2000}}{\text{Estimated county population in 2000}} \times 100{,}000$$

$$\text{Or,} \quad 100/331{,}849 \quad \times \quad 100{,}000 = 30.13$$

There may or may not be 100,000 residents in the county under review, but multiplying the result by 100,000 makes that rate comparable with counties with more than 100,000 or less than 100,000 (such as Bartholomew County).

Make sure you use the same population base when calculating rates for comparison. For comparing Allen County with Bartholomew County, use the 2000 population estimates for each population base. Population data can come from the Census Bureau (www.census.gov) or the Indiana Business Research Center (www.stats.indiana.edu/).
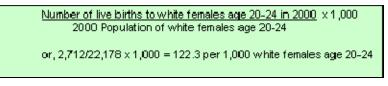
Another example is the number of deaths from communicable diseases is 18 per 100,000. A rate of 18 per 100,000 is not 18 percent, but .018 percent. To make a rate into a percent, for the example of 18 deaths per 100,000 population, divide by 1,000:

$$18/1{,}000 = .018$$

Be careful about the decimal point. This formula cannot be used with age-adjusted rates. Be very clear about the denominator.

Age/Race-Specific Rates

For particular age, race or sex groups, you can calculate a rate for that specific group. For example, to calculate the 2000 birth rate for white females age 20-24 for Marion County, do the following calculation:

$$\frac{\text{Number of live births to white females age 20-24 in 2000}}{\text{2000 Population of white females age 20-24}} \times 1{,}000$$

$$\text{or, } 2{,}712/22{,}178 \times 1{,}000 = 122.3 \text{ per 1{,}000 white females age 20-24}$$

The same calculation can be used for the black birth rate (number of live births to black females divided by the population of black females age 15-44 multiplied by 1,000). The calculation can also be used for the sex-specific rate of heart disease to males age 65-74 (number of deaths from heart disease to males age 65-74 divided by the population of males age 65-74 - remember to use the same years for deaths and population - multiplied by 100,000.

Age-Adjusted Rates

The age-adjusted death rate is a good way to compare death rates between counties, states and the U.S. The Epidemiology Resource Center at the Indiana State Department of Health uses the direct method to age-adjust. In this method, the age-specific rates are first calculated for the various age groups (e.g. <1, 1-4, 5-14, 15-24, etc.). An example of an age-specific death rate would be the total number of deaths for residents age 15-24 divided by the population for that age group then multiplied by 100,000 (use the same year for the number of deaths and population). The age-specific rates are then weighted according to the standard million. The standard million is the proportion of the total U.S. population for the same age groups used to determine the age-specific death rates. The year 2000 standard million is used in ERC mortality reports for 1999 forward. Prior to 1990, the 1940 standard million was used. After each age-specific rate is multiplied (weighted) according to the standard million, the age-specific rates are added together, and the sum of each of those weighted rates equals the age-adjusted death rate. Deaths of unknown age are not included. An example is below:

Age Group	2000 standard million	2000 Indiana population	CAUSE OF DEATH (all causes used)	Age-specific death rate	age-specific death rate x standard million
0-1	0.013818	81,378	676	830.6913	11.47849296
1-4	0.055317	327,764	142	43.3239	2.396545685
5-14	0.145565	867,821	163	18.7827	2.73410012
15-24	0.138646	866,188	735	84.8546	11.76474507
25-34	0.135573	821,920	848	103.1731	13.98748102
35-44	0.162613	952,889	1,824	191.4179	31.12703704
45-54	0.134834	811,110	3,495	430.8910	58.09875726
55-64	0.087247	526,580	5,632	1069.5431	93.31442592
65-74	0.066037	393,375	10,601	2694.8840	177.9620558
75-84	0.044842	264,661	16,345	6175.8249	276.9363412
85+	0.015508	91,127	14,748	16184.0069	250.9815796
Total	1.000000	6,004,813	55,209		**930.78**

 *The number in **red** is the age-adjusted death rate.

Two counties may each have an identical number of deaths; however, the age-adjusted death rates would not be the same unless the deceased were the same age and the population data were the same..

An age-adjusted death rate can be calculated for all causes of death (total) or individual causes, as is done in Tables 1 and 5 in the Mortality Report.

When comparing age-adjusted death rates between different reports and years, be sure that the same standard million is used (remember that the 1940 standard million was used prior to 1999 in mortality reports). Age-adjusted death rates using different standard millions are **NOT** comparable. Also remember that the ICD code changed from ICD-9 to ICD-10 in 1999. Even if you are using the same standard million, unless you are looking at the age-adjusted death rate for deaths from all causes (total), make sure the ICD codes are comparable.

Incidence Rate

The incidence rate, usually referred to as incidence, is the number of <u>new</u> cases in a given time frame. For example, to calculate the incidence rate for the number of HIV cases diagnosed in Indiana during 2000, the following formula would be used:

(Number of HIV cases diagnosed in 2000/2000 population)*100,000

(291/6,080,485)*100,000 = incidence of 4.78 per 100,000 population

As with the other rates discussed above, incidence rates can be calculated by race, sex, age, etc.

Prevalence Rate

The prevalence rate, often referred to as prevalence, is the total number of cases (both new and pre-existing) in a specific period of time. A case is counted in prevalence until death or recovery. For example, to calculate the prevalence rate of HIV cases diagnosed in Indiana through 2000, the following formula would be used:

(Number of living cumulative cases of HIV dagnosed through 2000/2000 population)*100,000

(3103/6,080,485)*100,000 = prevalence of 51.0 per 100,000 population

Small Numbers

The Epidemiology Resource Center (ERC) at the Indiana State Department of Health follows the "Rule of Twenty" when examining rates. There should be at least twenty events in the numerator in order to produce a stable rate. While the ERC uses the rule for vital statistics events, it is also recommended for calculating rates for other areas of interest, such as traffic accidents or playground injuries.

When the numerator is less than 20, the rate is unstable, meaning that a small change in the numerator can lead to a large change in the rate from one year to the next. Unstable rates do not lend themselves to being used to make decisions.

An example of small numbers is found in infant mortality. As illustrated below, a small change in the numerator results in a large change in the rate.

> For mula for infant mortality rate = (number of infant deaths/number of live births) x 1,000
>
> (10 infant deaths/300 live births) x 1,000 = 28.6 infant mortality rate
> (12 infant deaths/320 live births) x 1,000 = 37.5 infant mortality rate
> (8 infant deaths/310 live births) x 1,000 = 25.8 infant mortality rate

An option when dealing with small numerators is to combine years of data. Using the infant death information from the example above, a three-year rate is calculated:

> ((10+12+8)/(300+320+310)) x 1,000
>
> (30/930 x 1,000) = 32.3 infant mortality rate for 1998-2000

The numerator is now 30 and the rate is more stable.

Percentage Change

To figure the percentage change, for example, Indiana's population from 1990 to 2000, use the following calculation:

> ((Most recent number - previous number)/Previous number) x 100 = percentage change
>
> ((6,080,485 - 5,544,159)/5,544,159) x 100 = 9.67 percent increase from 1990 to 2000

The percentage change calculation will also work if there is a decrease from one year to the next. For example, to figure the percentage decrease in infant deaths for Indiana from 1996 to 2000:

> (Most recent number - previous number)/ Previous number x 100 = percentage change
>
> (676-724)/724 x 100 = -6.63 percent decrease from 1996 to 2000

Percent changes aren't always useful. For example, a county newspaper reports that drowning deaths to children age 5-14 has increased 300% in the past year. This increase appears to be appalling, but is it? The information is below:

> Number of drowning deaths for County X, residents age 5-14:
>
> 1998 = 1
> 1999 = 1   % change from 1998 to 1999 = 0%
> 2000 = 4   % change from 1999 to 2000 = 300%

Again, the numerator is less than 20. Changes in small numbers can lead to large, but meaningless, increases or decreases to the percent change.

Keep in mind that sometimes the most current information is "provisional," which means the data are not final and are incomplete. Provisional means that some numbers and rates may change when the data are final. Therefore, caution should be used in interpreting the data, and you may want to wait until the final data are released. Provisional data are released in order to help organizations that use vital statistics data begin looking at the most current year available.