Oregon Environmental Public Health Tracking (EPHT)

Asthma and Acute Myocardial Infarction (Heart Attack) Hospitalizations (2000-2006)

Nationally Consistent Data and Measures

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Introduction to EPHT

Environmental Public Health Tracking (EPHT) is the ongoing collection, integration, analysis, interpretation and dissemination of data from environmental hazard monitoring, human exposure and health effects surveillance.

The Centers for Disease Control and Prevention (CDC) funded the Environmental Public Health Tracking Program with the following goals:

- Build a sustainable national environmental public health tracking network.
- Enhance environmental public health tracking workforce and infrastructure.
- Disseminate information to guide policy and improve public health.
- Foster collaboration among health and environmental programs.

EPHT is a Web-based network of standardized electronic health and environmental data. Oregon is one of 17 grantees funded by the CDC in 2006 to participate in a collaborative network development process and implement state/city networks that are components of the national network.

EPHT Nationally Consistent Data and Measures (NCDM)

As part of the implementation process, content work groups (CWG) were established to identify and recommend core measures to include in the network, examine availability of existing data, identify approaches to obtaining needed data, and develop standards and guidelines to facilitate collection of nationally consistent data.

The network content is conceptually divided into hazard, exposure and health outcome areas. The CWG structure included a steering group made up of the principal investigators for grantee health departments and academic partners. The steering group was, in turn, advised by content-specific teams.

Teams included content experts from the following: grantee states, cities and academic partners; CDC; other government agencies including the U.S. Environmental Protection Agency, the U.S. Geological Survey and the National Institutes of Health; and non-governmental organizations including the American Association of Poison Control Centers, the National Birth Defects Prevention Network, the National Association of Health Data Organizations, the National Association for Public Health Statistics and Information Systems and the North American Association of Central Cancer Registries.

Each content team provided recommendations for indicators and measures as well as for the data sets and methods to create the recommended measures. Content groups focused on developing measures specific to one area; however, in doing so, they considered potential linkages to other areas.

Rationale for tracking asthma and heart attack hospitalizations

Asthma: Asthma is a disease affecting the airways that carry oxygen in and out of the lungs. If you have asthma, the inside of these airways can become irritated and swollen. The airways of people with asthma are sensitive and more likely to react strongly to infections, allergens such as pollen in the air, or irritants such as tobacco smoke and air pollution.

Asthma affects people of all races, genders and ages. Although asthma may develop at any age, it often starts in childhood and is more common in children than among adults. Half of the people with asthma developed it in childhood, usually before age 10. It is the leading chronic health condition among children.

A number of epidemiologic studies have reported associations between breathing polluted air and asthma. The association between fine matter in the air (particulate matter or $PM_{2.5}$) and asthma, including increased hospital admissions, is well-documented.

Most problems associated with asthma, including emergency room visits and hospitalizations, are avoided if asthma is well-managed. Effective management includes avoiding asthma triggers, use of medications according to doctors' recommendations, and education in asthma care.

Heart attack: An acute myocardial infarction (MI), also known as a heart attack, occurs when the blood supply to the heart is severely reduced or completely blocked. During a heart attack, heart muscle cells do not receive enough oxygen and begin to die. The more time that passes without treatment to restore blood flow, the greater the damage to the heart.

Research has shown significant relationships between air pollutants and increased risk of heart attack and other forms of coronary heart disease. A number of studies, usually focused on the elderly, have reported associations between air pollution and hospitalizations for heart attacks and other forms of heart disease.

There is currently no single heart attack surveillance system in place in the United States. Death records are the sole national descriptor for heart attacks and are limited by their nature to capturing fatal outcomes. Estimates of incidence and prevalence of heart attacks have been largely based on survey samples.

The availability of standardized heath outcome measures for heart attack and asthma hospitalization will inform multiple users at the national, state and local levels and allow monitoring of trends over time. The measures may help identify populations or areas with inadequate routine medical care that may be in need of targeted interventions. Standardized measures also support heart attack and asthma prevention, evaluation and program planning efforts.

Overview: Hospitalization indicators and measures

The heart attack and asthma hospitalization measures calculated by EPHT are counts and rates for the years 2000 to 2006. Counts include the monthly (average, maximum, minimum) and annual number of hospitalizations, by state and county. Annual crude, age-specific and age-adjusted hospitalization rates are shown by state and county.

Data used in the calculation of these measures were collected by the Oregon Association of Hospitals and Health Systems for the Hospital Discharge Index (HDI). The HDI provides a central database of all Oregon hospital discharges for public health surveillance and hospital policy analysis. Information on emergency room visits, urgent care, outpatient surgery and clinic visits is not included in this database.

Hospitalization measures

Only hospital admissions with a primary diagnosis of asthma (ICD-9 Code 493) or acute myocardial infarction (ICD-9 Code 410) are included in the calculation of these measures. Rates are calculated using U.S. Census Bureau annual population estimates; age adjustments are based on the standard U.S. population using 2000 census numbers.

Transfers from one hospital to another that occurred on the same day or the day following the initial admission for a particular health event have been excluded from the calculation of these measures. Duplicate records have also been excluded.

Confidentiality is protected through the application of the confidentiality guidelines from the Center for Health Statistics in the Oregon Department of Human Services. These guidelines allow for the release of all the statistics in this report.

A. Asthma

Although the cause of asthma is unknown, it is thought to be an immune response problem that can develop at any age. Once it develops, it doesn't go away, although it may get much better at times. Although asthma has no cure, it can be controlled in order to live a healthy, active life.

Asthma is not contagious; you cannot catch it from someone else. Children are more likely to have asthma if a parent has asthma, if they were born prematurely, or if there is a smoker in the home. Young children under aged 3 may also be more likely to develop asthma if they have eczema, allergies such as hay fever, or severe viral infections.

Asthma episodes and serious asthma attacks are caused by triggers. Triggers are different for each person with asthma. To help keep asthma under control, it is necessary to know which substances are triggers so that they can be eliminated or avoided and to use medications and inhalers according to your medical provider's recommendations.

The most common indoor asthma triggers are tobacco smoke, animals with fur or feathers, dust mites (creatures too small to see that live in dust in beds, pillows, rugs and furniture cushions), and mold or mildew. Strong fragrances, smells and chemicals such as chlorine bleach and perfumes are also indoor triggers. Outdoor triggers include plant pollens and air pollution caused by industrial emissions and automobile exhaust. Other triggers such as exercise, breathing cold air, medications, infections and stress may also cause asthma symptoms.

Most people who receive medical treatment for the management and control of asthma are not hospitalized. However, hospitalizations occur more frequently with inadequate care, persistent exposure to environmental triggers or greater severity of the disease. With effective asthma management, medical care can usually be done at a medical provider's office. Managing asthma can reduce or eliminate the need for emergency room visits or hospitalizations and can significantly improve the quality of life.

In 2004, 20.5 million people in the United States reported having asthma. In 2003, there were more than 574,000 hospitalizations for asthma. In 2002, there were more than 4,200 deaths in which asthma was the underlying cause. Asthma causes a lower quality of life, preventable undesirable health outcomes, and large direct and indirect economic costs. There are also large racial, income and geographic disparities in poor asthma outcomes.

A.1. Annual number of hospitalizations; annual crude, age-specific and age-adjusted asthma hospitalization rates, by state, county and year

Table 1 shows the number of asthma hospitalizations between 2000 and 2006 for Oregon and the 36 Oregon counties. The considerable variation among counties in the number of hospitalizations can largely be explained by their diverse population sizes. Some of the changes over time may also be due to changes in population.

Table 1. Annual number of asthma hospitalizations by state and county, by year

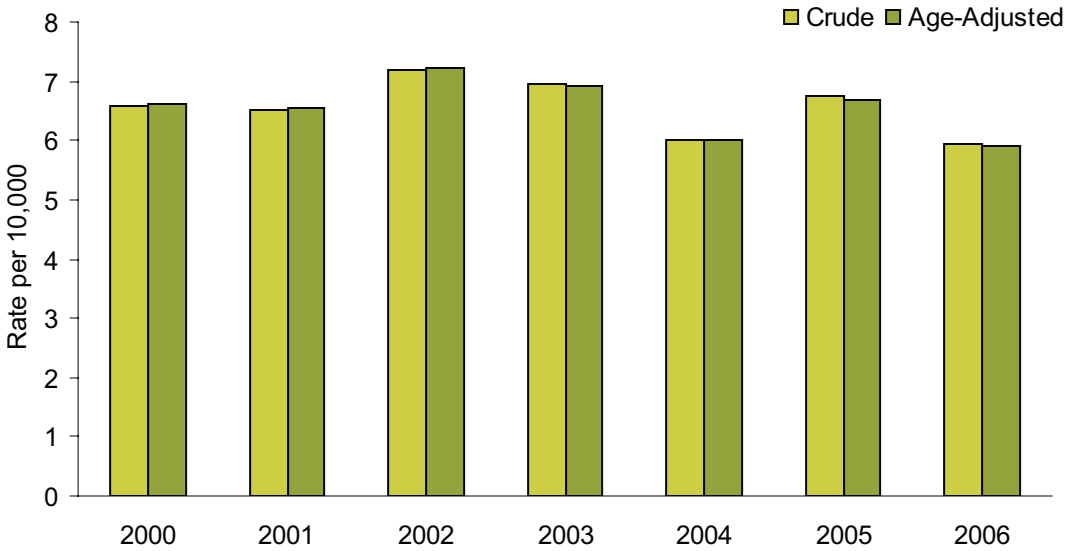
	2000	2001	2002	2003	2004	2005	2006
Oregon	2260	2263	2533	2472	2152	2446	2192
Baker	14	7	7	11	4	9	5
Benton	18	24	20	24	27	17	24
Clackamas	167	158	212	178	148	166	147
Clatsop	36	33	33	28	28	35	30
Columbia	30	32	35	33	33	34	34
Coos	84	75	84	88	78	113	88
Crook	12	10	12	27	16	17	7
Curry	19	14	24	32	26	24	25
Deschutes	92	66	79	62	49	77	61
Douglas	115	114	159	139	104	107	94
Gilliam	2	3	0	2	0	5	1
Grant	1	3	2	5	9	4	2
Harney	5	22	29	22	6	6	6
Hood River	14	4	2	12	5	6	4
Jackson	116	136	139	185	136	197	156
Jefferson	21	26	25	24	23	17	14
Josephine	48	59	78	87	61	81	50
Klamath	45	47	57	53	67	67	45
Lake	6	14	9	12	9	6	6
Lane	150	173	206	174	196	202	194
Lincoln	28	37	23	23	39	38	26
Linn	126	107	92	85	75	84	83
Malheur	10	7	11	18	21	10	10
Marion	120	122	133	162	132	155	153
Morrow	9	10	10	9	8	2	1
Multnomah	532	522	552	501	463	539	527
Polk	16	18	18	34	18	28	33
Sherman	0	3	3	7	7	3	2
Tillamook	31	43	27	18	14	16	9
Umatilla	34	53	65	52	26	20	22
Union	22	18	15	38	26	9	13
Wallowa	4	4	9	7	7	6	7
Wasco	20	21	22	30	26	26	41
Washington	258	224	257	223	205	265	225
Wheeler	1	3	2	3	0	0	0
Yamhill	54	51	82	64	60	55	47

Rates, which take the size of the population into account, are presented in Table 2 as well as in Graph 1 and Graph 2. The crude rates presented here indicate the number of asthma hospitalizations per 10,000 people. Age-adjusted rates represent the number of hospitalizations per 10,000 people that would be expected if the state or county population had the same age structure as the United States had in 2000. As Graph 1 shows, crude and age-adjusted rates for Oregon are very similar.

Between 2000 and 2006, the asthma hospitalization rate was 6 to 7 per 10,000. This is significantly lower than the asthma hospitalization rate for the United States, which was 17 per 10,000 in 2004. It is also slightly lower than the rates in neighboring West Coast states, such as Washington with 9 to 10 per 10,000 between 1995 and 2002, and California with 11 per 10,000 in 2000.

The significantly lower asthma hospitalization rate in Oregon, when compared to the United States, cannot be attributed to differences in asthma prevalence because the percentage of people who ever had asthma was somewhat higher in Oregon than in the United States: 15.3 percent vs. 12.5 percent for adults in 2005, according to the Behavioral Risk Factor Surveillance System (BRFSS), and 13.2 percent vs. 12.7 percent for children in 2005 (BRFSS and National Health Interview Survey, respectively). This suggests that the lower asthma hospitalization rate in Oregon may have been due to less severe forms of asthma or better asthma management in Oregon compared to other parts of the United States.

Table 2, Graph 2, Map 1 and Map 2 show that asthma hospitalization rates varied among counties, with the average annual rate ranging from 3 per 10,000 in Hood River to 17 per 10,000 in Harney County. When comparing counties, it is important to note that rate estimates for many counties can be based on a relatively small number of events (hospitalizations), resulting in unstable estimates. In the tables and graphs, rates based on counts less than 10 are therefore flagged with an asterisk. But instability may also occur with slightly higher counts than 10. Table 1, which lists the number of hospitalizations by year and county, should be consulted to better understand the reliability of the rates for individual counties.

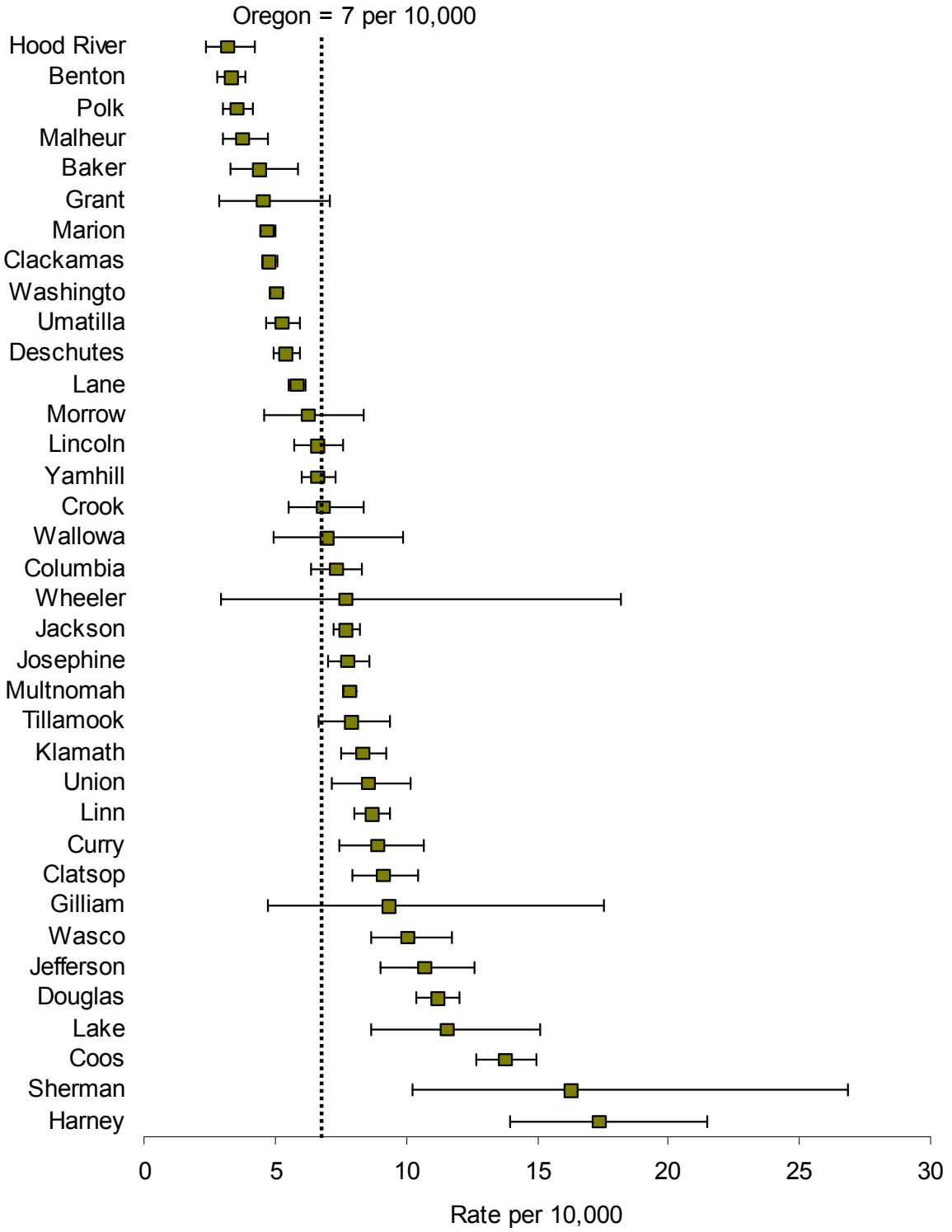


Graph 1. Annual crude and age-adjusted asthma hospitalization rates per 10,000 for Oregon, by year

Table 2. Crude and age-adjusted asthma hospitalization rates per 10,000, by state, county and year

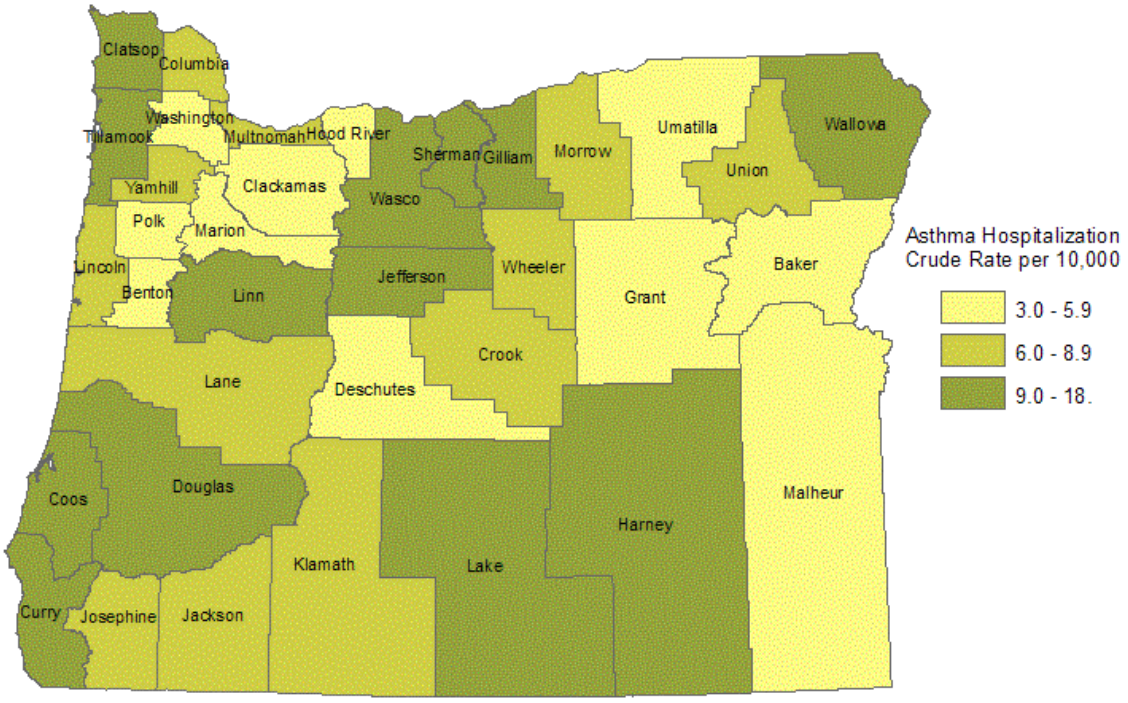
	Crude rate *(age-adjusted rate)*													
	2000		2001		2002		2003		2004		2005		2006	
Oregon	7	*(7)*	7	*(7)*	7	*(7)*	7	*(7)*	6	*(6)*	7	*(7)*	6	*(6)*
Baker	8	*(7)*	4*	*(3)*	4*	*(4)*	7	*(7)*	2*	*(3)*	6*	*(6)*	3*	*(3)*
Benton	2	*(3)*	3	*(4)*	3	*(3)*	3	*(3)*	3	*(4)*	2	*(3)*	3	*(4)*
Clackamas	5	*(5)*	5	*(5)*	6	*(6)*	5	*(5)*	4	*(4)*	5	*(5)*	4	*(4)*
Clatsop	10	*(11)*	9	*(9)*	9	*(10)*	8	*(8)*	8	*(8)*	10	*(10)*	8	*(8)*
Columbia	7	*(7)*	7	*(7)*	8	*(8)*	7	*(8)*	7	*(7)*	7	*(7)*	7	*(7)*
Coos	13	*(15)*	12	*(12)*	13	*(13)*	14	*(13)*	12	*(12)*	18	*(17)*	14	*(14)*
Crook	6	*(7)*	5	*(5)*	6	*(6)*	13	*(12)*	7	*(7)*	8	*(8)*	3*	*(4)*
Curry	9	*(7)*	7	*(5)*	11	*(11)*	15	*(12)*	12	*(12)*	11	*(8)*	11	*(7)*
Deschutes	8	*(8)*	5	*(6)*	6	*(7)*	5	*(5)*	4	*(4)*	5	*(5)*	4	*(4)*
Douglas	11	*(11)*	11	*(11)*	16	*(15)*	14	*(13)*	10	*(10)*	10	*(10)*	9	*(9)*
Gilliam	10*	*(11)*	16*	*(23)*	0*	*(0)*	11*	*(8)*	0*	*(0)*	28*	*(19)*	6*	*(3)*
Grant	1*	*(1)*	4*	*(4)*	3*	*(3)*	7*	*(7)*	12*	*(9)*	5*	*(5)*	3*	*(3)*
Harney	7*	*(6)*	30	*(25)*	40	*(35)*	31	*(30)*	8*	*(7)*	9*	*(9)*	9*	*(8)*
Hood River	7	*(7)*	2*	*(2)*	1*	*(1)*	6	*(6)*	2*	*(2)*	3*	*(3)*	2*	*(2)*
Jackson	6	*(6)*	7	*(7)*	7	*(7)*	10	*(10)*	7	*(7)*	10	*(9)*	8	*(8)*
Jefferson	11	*(11)*	13	*(13)*	13	*(13)*	12	*(12)*	12	*(12)*	8	*(8)*	7	*(6)*
Josephine	6	*(7)*	8	*(7)*	10	*(9)*	11	*(10)*	8	*(7)*	10	*(9)*	6	*(6)*
Klamath	7	*(7)*	7	*(7)*	9	*(9)*	8	*(8)*	10	*(10)*	10	*(10)*	7	*(7)*
Lake	8*	*(11)*	19	*(19)*	12*	*(11)*	16	*(14)*	12*	*(11)*	8*	*(7)*	8*	*(7)*
Lane	5	*(5)*	5	*(5)*	6	*(7)*	5	*(6)*	6	*(6)*	6	*(6)*	6	*(6)*
Lincoln	6	*(6)*	8	*(9)*	5	*(5)*	5	*(5)*	9	*(9)*	8	*(8)*	6	*(5)*
Linn	12	*(12)*	10	*(10)*	9	*(8)*	8	*(8)*	7	*(7)*	8	*(8)*	7	*(7)*
Malheur	3	*(3)*	2*	*(2)*	3	*(3)*	6	*(5)*	7	*(6)*	3	*(3)*	3	*(3)*
Marion	4	*(4)*	4	*(4)*	5	*(5)*	5	*(5)*	4	*(4)*	5	*(5)*	5	*(5)*
Morrow	8*	*(7)*	9	*(9)*	9	*(10)*	8*	*(8)*	7*	*(7)*	2*	*(2)*	1*	*(1)*
Multnomah	8	*(8)*	8	*(8)*	8	*(8)*	7	*(7)*	7	*(7)*	8	*(8)*	8	*(8)*
Polk	3	*(2)*	3	*(3)*	3	*(3)*	5	*(6)*	3	*(2)*	4	*(4)*	5	*(4)*
Sherman	0*	*(0)*	16*	*(15)*	17*	*(15)*	39*	*(28)*	41*	*(35)*	17*	*(12)*	12*	*(8)*
Tillamook	13	*(12)*	18	*(15)*	11	*(10)*	7	*(6)*	6	*(5)*	6	*(5)*	4*	*(3)*
Umatilla	5	*(5)*	8	*(7)*	9	*(9)*	7	*(7)*	4	*(4)*	3	*(3)*	3	*(3)*
Union	9	*(9)*	7	*(8)*	6	*(6)*	16	*(16)*	11	*(12)*	4*	*(4)*	5	*(5)*
Wallowa	6*	*(4)*	6*	*(5)*	13*	*(11)*	10*	*(9)*	10*	*(6)*	9*	*(8)*	10*	*(7)*
Wasco	8	*(8)*	9	*(8)*	9	*(8)*	13	*(11)*	11	*(10)*	11	*(9)*	17	*(17)*
Washington	6	*(6)*	5	*(5)*	5	*(6)*	5	*(5)*	4	*(4)*	5	*(6)*	4	*(4)*
Wheeler	6*	*(9)*	20*	*(9)*	13*	*(7)*	20*	*(25)*	0*	*(0)*	0*	*(0)*	0*	*(0)*
Yamhill	6	*(6)*	6	*(6)*	9	*(10)*	7	*(7)*	7	*(7)*	6	*(6)*	5	*(5)*

Note: Crude rates are in regular font, age-adjusted rates are in parentheses and italics. For rates based on counts of less than 10, the crude rate is marked with an asterisk.



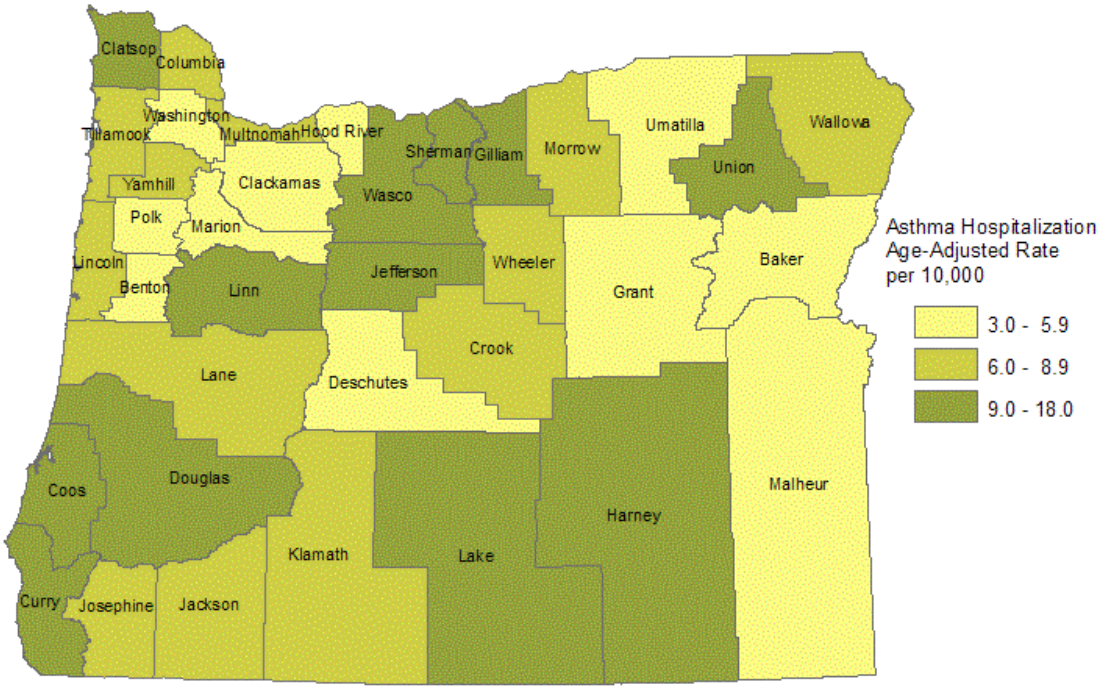
Note: County rates are shown as green squares. The 95% confidence intervals (CI) of the rates are indicated by black horizontal lines. The vertical dotted line indicates the average Oregon average. A county percentage is considered statistically higher (or lower) than the Oregon rate if the entire CI lies above (or below) the Oregon rate. If the CI includes the Oregon rate, the county rate is considered statistically similar to the Oregon rate.

Graph 2. Crude and age-adjusted annual asthma hospitalization rates per 10,000, averaged from 2000 to 2006, by county



Note: The rate in Wheeler County is based on a count of less than 10.

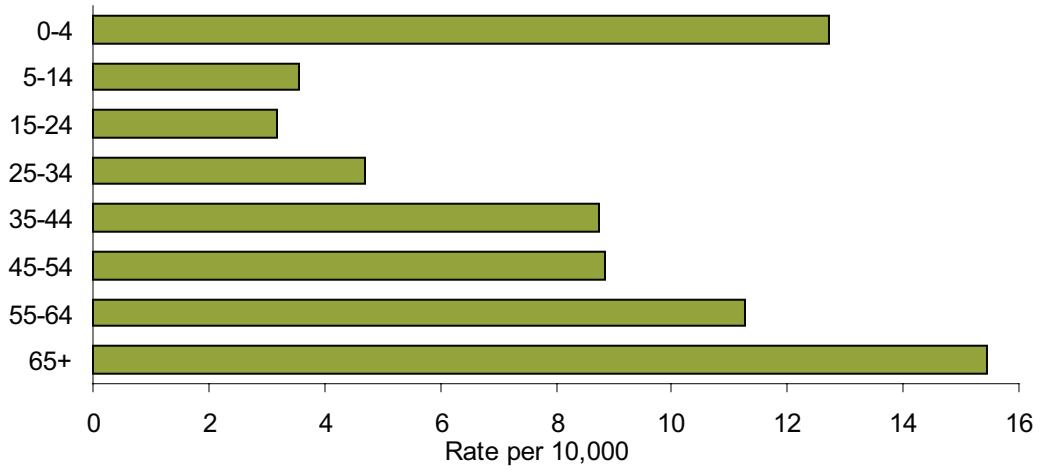
Map 1. Crude annual asthma hospitalization rates per 10,000, averaged from 2000 to 2006, by county



Note: The rate in Wheeler County is based on a count of less than 10.

Map 2. Age-adjusted annual asthma hospitalization rates per 10,000, averaged from 2000 to 2006, by county

Asthma hospitalization rates for specific age groups are presented in Graph 3 and Table 3 for Oregon and in Table 4 for individual counties. Asthma hospitalizations were most frequent in children under the age of 5 with an average annual hospitalization rate of 13 per 10,000 as well as in adults 65 and older with an average rate of 15 per 10,000. Asthma hospitalizations were rarest in people between the ages of 5 and 34 with average annual rates of 3 to 5 per 10,000.



Graph 3. Average annual asthma hospitalization rates for specific age groups (in years) in Oregon, averaged from 2000 to 2006

The Healthy People 2010 initiative has set target asthma hospitalization rates for three age groups. For children under 5 the target is 25 per 10,000. Oregon has been meeting this target with rates between 11 and 15 per 10,000 in the years 2000 to 2006. For people between the ages of 5 and 64, the goal is an age-adjusted rate of 7.7 per 10,000, which Oregon has also met consistently with rates between 4 and 5 per 10,000. The age-adjusted target rate for adults aged 65 and older is 11 per 10,000. Oregon met this goal in 2000, 2004 and 2006 with a rate of 11 per 10,000. In other years asthma hospitalization rates for this age group exceeded the target with rates between 12 and 14 per 10,000.

Table 3. Annual age-specific asthma hospitalization rates for Oregon, by year

Age group	2000	2001	2002	2003	2004	2005	2006
0-4	13	13	14	15	13	12	11
5-14	4	4	5	3	3	4	3
15-24	5	3	4	3	2	3	2
25-34	6	4	5	5	4	4	4
35-44	9	9	9	9	8	9	9
45-54	8	9	9	9	8	9	10
55-64	11	13	12	12	10	12	9
65+	13	15	18	17	13	18	14

Note: All rates are based on counts equal to or greater than 10.

Individual counties show the same overall pattern as the state with the highest rates for the youngest and oldest age groups. Not all counties, however, meet the Healthy People 2010 goals because their age-specific rates exceed the targets. In some cases, these rate estimates may not be reliable. Yet certain counties, such as Harney or Douglas, show rates that are reliably above the rate for the entire state and the Healthy People 2010 target rates.

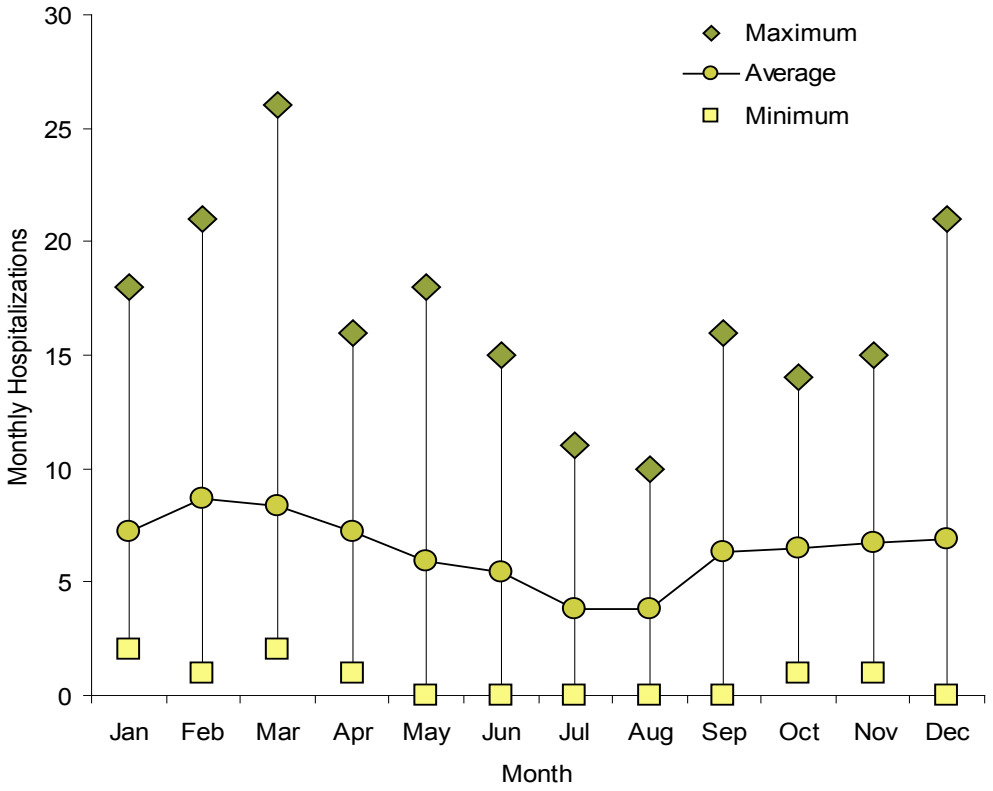
Table 4. Age-specific annual asthma hospitalization rates per 10,000, by state and county, averaged from 2000 to 2006

	<5	5-14	15-24	25-34	35-44	45-54	55-64	65+
Oregon	13	4	3	5	9	9	11	15
Baker	7*	2*	2*	4*	2*	7	3*	10
Benton	14	2	0*	1*	4	3	2	5
Clackamas	12	3	1	3	3	4	5	11
Clatsop	30	10	4	7	9	5	11	8
Columbia	16	8	2	3	6	5	8	14
Coos	39	13	7	7	16	7	13	20
Crook	12	3*	6	6	6	6	8	10
Curry	20	3*	3*	2*	11	11	13	17
Deschutes	16	4	3	2	5	2	6	12
Douglas	28	7	4	6	12	12	13	17
Gilliam	51*	6*	0*	0*	0*	9*	18*	15*
Grant	8*	3*	2*	3*	4*	1*	4*	13
Harney	39	17	5*	2*	8*	20	21	39
Hood River	5*	2*	0*	1*	6	4*	2*	6
Jackson	21	5	2	3	6	7	10	15
Jefferson	36	8	4*	4*	8	11	11	17
Josephine	17	6	4	2	8	8	8	14
Klamath	28	4	3	5	8	4	9	16
Lake	43	6*	4*	2*	12*	5*	12*	25
Lane	19	5	3	2	5	4	6	10
Lincoln	18	8	1*	4	4	8	7	9
Linn	25	9	4	5	8	6	9	12
Malheur	8	3	1*	2*	3*	2*	4*	11
Marion	10	2	1	3	5	4	7	9
Morrow	14*	5*	0*	3*	7*	3*	4*	18
Multnomah	20	5	3	4	6	8	10	15
Polk	9	3	1*	2	4	3	4	6
Sherman	50*	6*	0*	0*	0*	14*	18*	61
Tillamook	16*	4*	3*	2*	6	10	10	19
Umatilla	24*	6	2	2	3	3	4	8
Union	25	6	5	8	9	7	8	9
Wallowa	9*	11*	2*	0*	3*	4*	8*	23
Wasco	25	7	1*	3*	9	9	12	26
Washington	16	4	2	2	3	4	6	10
Wheeler	48*	0*	0*	0*	0*	7*	6*	20*
Yamhill	16	4	3	5	5	8	9	12

* Rates based on counts less than 10

A.2. Monthly average, maximum and minimum number of asthma hospitalizations, by state and county

Graph 4 presents monthly asthma hospitalization statistics, summarized from 2000 to 2006. It shows the average number of daily hospitalizations for a given calendar month along with the maximum and minimum number of daily hospitalizations for that month. All three statistics show a similar trend: Asthma hospitalizations were most frequent in winter and early spring and least frequent in the summer months. This pattern is commonly observed in the United States as well as other parts of the world, and it can be related to factors that exacerbate asthma, such as infections or allergies.



Graph 4. Average, maximum and minimum daily number of asthma hospitalizations in Oregon, by month, from 2000 to 2006

The highest numbers of hospitalizations occurred in the period from November through March, which comprises the flu season in North America. The common cold also occurs most frequently during this period. Both the flu and the common cold can trigger asthma attacks because they irritate the air passages and heighten the body's response to other allergens and pollutants. Respiratory infections can, therefore, at least partly explain the increased asthma hospitalization rate during the cold season.

The relatively sharp increase in September, also known as the September epidemic of asthma hospitalizations, has also been linked to respiratory infections; in September, children return to school, where they are more likely to get an infection and to transmit it to their siblings or parents. As a result, asthma attacks resulting in hospitalizations suddenly increase in frequency.

The high number of hospitalizations in spring is probably due to the beginning of the tree pollen season. Pollen can trigger an allergic reaction that, in the case of asthma, affects the lungs and brings about asthma symptoms. The start of the pollen season can overlap with the end of the flu season, leading to a particularly high susceptibility to asthma attacks and subsequent asthma hospitalizations.

The general seasonal pattern of asthma hospitalizations is quite stable over time. Table 5 presents asthma hospitalization statistics by month for each year from 2000 to 2006. In each of these years, the highest numbers of average daily asthma hospitalizations occurred between December and March, and the lowest numbers were observed in July and August. The maximum and minimum daily hospitalizations also followed a similar pattern in every year.

Table 5. Average, maximum and minimum daily asthma hospitalizations in Oregon, by month and year

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	Average	8.8	7.9	7.2	6.5	4.4	4.2	4.0	3.8	7.0	6.8	7.6	6.1
	Maximum	18	15	14	12	10	9	11	9	12	12	14	11
	Minimum	2	2	2	1	0	1	0	1	3	2	3	2
2001	Average	6.6	8.4	8.9	7.8	6.3	5.1	4.2	4.4	4.8	6.8	5.9	5.4
	Maximum	11	20	21	16	12	13	10	8	13	13	12	10
	Minimum	3	4	2	1	3	0	1	1	1	2	1	3
2002	Average	7.3	9.2	9.7	7.3	5.6	6.3	3.6	4.9	7.8	6.9	7.7	7.4
	Maximum	12	21	18	12	9	15	9	10	16	11	15	12
	Minimum	3	1	4	3	1	1	0	1	1	2	1	2
2003	Average	6.8	8.8	8.8	8.0	7.1	5.5	3.9	4.1	6.1	5.7	6.2	10.4
	Maximum	13	14	17	16	18	12	8	8	12	9	11	21
	Minimum	2	4	4	2	3	2	1	0	2	2	2	3
2004	Average	5.7	8.3	6.9	5.6	5.6	5.9	3.6	3.5	6.2	5.8	6.9	6.8
	Maximum	11	14	12	10	13	13	10	10	13	10	14	14
	Minimum	2	3	2	2	0	1	1	0	2	3	2	2
2005	Average	8.2	10.9	9.0	8.0	7.0	5.8	3.7	3.1	6.1	7.0	6.1	5.9
	Maximum	13	20	26	15	14	11	9	7	15	13	12	14
	Minimum	3	5	3	3	2	2	1	0	0	1	2	2
2006	Average	6.9	7.2	8.2	7.2	5.5	5.0	3.7	3.2	6.3	6.2	6.5	6.4
	Maximum	13	12	14	14	12	12	9	7	13	14	12	14
	Minimum	2	3	4	1	1	1	0	0	3	2	3	0

Table 6 presents daily asthma hospitalizations, averaged from 2000 to 2006, by month for all Oregon counties. It demonstrates that the seasonal pattern holds in every county: Asthma hospitalizations were more frequent December through March and less frequent July and August.

Table 6. Average daily asthma hospitalizations by county and month, averaged from 2000 to 2006

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Baker	0.0*	0.0*	0.0	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0	0.0*
Benton	0.1	0.1	0.1	0.1	0.1	0.0*	0.0*	0.0*	0.1	0.1	0.1	0.1
Clackamas	0.5	0.7	0.6	0.5	0.4	0.4	0.3	0.3	0.5	0.5	0.5	0.5
Clatsop	0.1	0.1	0.1	0.1	0.1	0.0*	0.1	0.1	0.1	0.1	0.1	0.1
Columbia	0.1	0.1	0.2	0.1	0.0*	0.1	0.1	0.0*	0.1	0.1	0.1	0.1
Coos	0.2	0.3	0.3	0.3	0.2	0.2	0.1	0.2	0.2	0.2	0.3	0.2
Crook	0.0	0.1	0.1	0.1	0.0*	0.0*	0.0	0.0*	0.0	0.0*	0.1	0.0
Curry	0.1	0.1	0.1	0.1	0.0*	0.1	0.0*	0.0*	0.0*	0.0*	0.0*	0.1
Deschutes	0.2	0.3	0.3	0.3	0.1	0.1	0.1	0.1	0.2	0.3	0.2	0.2
Douglas	0.4	0.4	0.4	0.4	0.3	0.2	0.3	0.1	0.3	0.3	0.3	0.4
Gilliam	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*
Grant	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*
Harney	0.0*	0.0*	0.1	0.1	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.1	0.0*
Hood River	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*
Jackson	0.5	0.5	0.5	0.4	0.4	0.4	0.2	0.3	0.4	0.4	0.4	0.5
Jefferson	0.1	0.1	0.1	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.1	0.1	0.1
Josephine	0.2	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.2	0.2	0.2	0.2
Klamath	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.1
Lake	0.0*	0.0*	0.1	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0	0.0*	0.0*
Lane	0.5	0.6	0.6	0.6	0.4	0.5	0.3	0.2	0.5	0.4	0.7	0.5
Lincoln	0.1	0.1	0.1	0.1	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.1
Linn	0.3	0.3	0.4	0.4	0.3	0.2	0.1	0.2	0.2	0.2	0.2	0.3
Malheur	0.0*	0.0*	0.1	0.0*	0.0*	0.0*	0.0*	0.0*	0.0	0.0*	0.0*	0.0*
Marion	0.4	0.5	0.6	0.4	0.3	0.4	0.2	0.2	0.3	0.4	0.4	0.4
Morrow	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*
Multnomah	1.6	1.9	1.8	1.5	1.3	1.2	0.9	0.9	1.5	1.5	1.5	1.6
Polk	0.1	0.1	0.1	0.1	0.1	0.1	0.0*	0.0*	0.1	0.1	0.1	0.1
Sherman	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*
Tillamook	0.1	0.1	0.1	0.1	0.1	0.0*	0.1	0.1	0.1	0.1	0.1	0.1
Umatilla	0.1	0.2	0.2	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1
Union	0.1	0.1	0.1	0.0	0.1	0.0*	0.0*	0.0*	0.1	0.0	0.1	0.1
Wallowa	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*
Wasco	0.1	0.1	0.1	0.1	0.1	0.0*	0.1	0.0*	0.1	0.1	0.1	0.1
Washington	0.7	1.0	0.9	0.8	0.7	0.6	0.3	0.3	0.6	0.6	0.6	0.7
Wheeler	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*
Yamhill	0.2	0.2	0.2	0.2	0.1	0.2	0.1	0.1	0.1	0.2	0.2	0.2

* Averages based on less than 10 hospitalizations a month.

B. Acute myocardial infarction (heart attack)

Research has identified several factors that increase the risk of a heart attack. There are two types of risk factors: inherited and acquired. Inherited (or genetic) risk factors are characteristics you are born with that cannot be changed, but can be improved with medical management and lifestyle changes. Acquired risk factors are due to voluntary activities that can be managed through lifestyle changes and appropriate medical care. The more risk factors you have, the greater your chances of having a heart attack.

Inherited (genetic) factors:

- Inherited hypertension (high blood pressure);
- Inherited low levels of HDL (high-density lipoprotein) or high levels of LDL (low-density lipoprotein) blood cholesterol;
- Family history of heart disease (especially with onset before the age of 55);
- Age (men are at greater risk when younger, but women are equally at risk after menopause);
- Diabetes mellitus (type 1 diabetes).

Acquired risk factors:

- Acquired hypertension (high blood pressure);
- Acquired low levels of HDL (high-density lipoprotein) or high levels of LDL (low-density lipoprotein) blood cholesterol;
- Cigarette smoking and secondhand smoke;
- Stress;
- Sedentary lifestyle;
- Poor diet;
- Overweight by 30 percent or more.

Managing the risk for a heart attack involves becoming aware of conditions that may be "silent killers" such as hypertension or abnormal cholesterol levels. You should also identify modifiable risk factors and take steps to reduce or eliminate them medically and through lifestyle changes.

In 2007 the American Heart Association estimated an annual 565,000 new attacks and 300,000 recurrent attacks of myocardial infarction. Among Americans aged 20 and older, new and recurrent MI prevalence for both men and women represented 3.7 percent of the U.S. population or 7,900,000 people (4.9 million men and 3.0 million women). The corresponding prevalence by race and ethnicity is 5.4 percent for white males, 2.5 percent for white females, 3.9 percent for black males and 3.3 percent for black females.

B.1. Annual number of hospitalizations; annual crude, age-specific and age-adjusted acute myocardial infarction (heart attack) hospitalization rates, by state and county

Table 7 presents the number of heart attack hospitalizations in Oregon for the years 2000 to 2006. It shows that, in each of these years, more than 6,000 people were hospitalized because of a heart attack. The numbers varied widely among counties, with more than 1,000 hospitalizations per year in Multnomah County and less than 10 per year in Wheeler and Gilliam counties. These differences among counties were largely due to differences in overall population size.

Table 7. Annual number of heart attack hospitalizations by state and county, by year

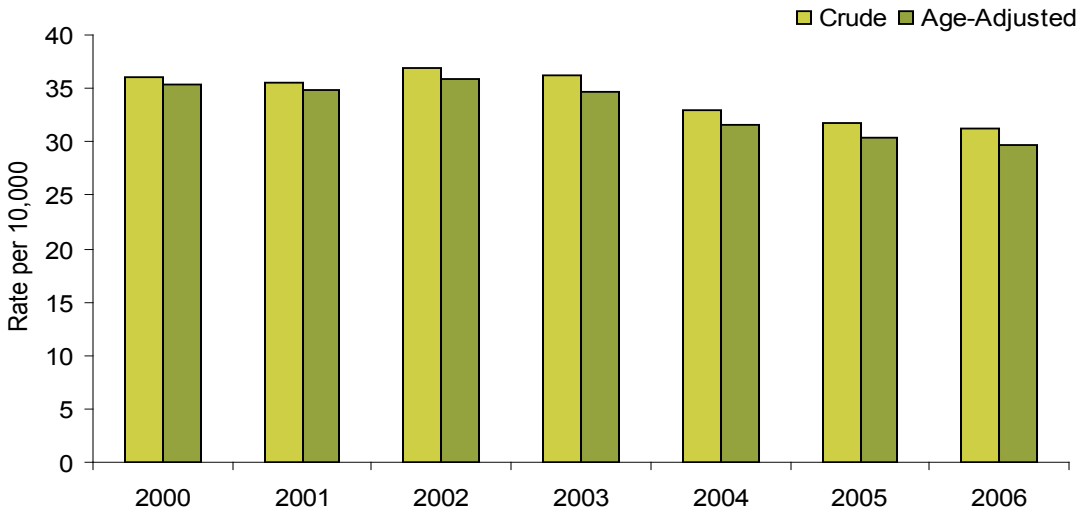
	2000	2001	2002	2003	2004	2005	2006
Oregon	6443	6487	6841	6801	6313	6199	6222
Baker	40	54	32	39	23	20	16
Benton	80	102	94	71	82	78	69
Clackamas	552	587	708	664	573	564	601
Clatsop	109	93	99	102	116	120	102
Columbia	89	94	107	111	101	93	105
Coos	206	233	267	261	222	223	218
Crook	63	46	58	54	40	40	50
Curry	80	66	65	61	44	48	59
Deschutes	288	286	258	253	230	260	274
Douglas	245	232	290	276	294	246	212
Gilliam	4	6	7	5	10	5	5
Grant	14	15	18	16	9	19	18
Harney	25	22	20	23	12	16	14
Hood River	58	48	53	27	47	41	48
Jackson	416	381	409	370	322	330	351
Jefferson	40	41	49	56	58	48	71
Josephine	294	316	280	278	233	234	194
Klamath	167	152	149	150	147	141	137
Lake	22	23	22	15	18	18	22
Lane	534	569	527	581	585	540	556
Lincoln	162	145	127	134	132	103	119
Linn	281	302	271	275	231	245	226
Malheur	50	46	45	44	33	31	14
Marion	519	486	521	478	498	491	516
Morrow	11	22	23	18	8	6	6
Multnomah	1010	1038	1104	1157	1092	1065	1042
Polk	117	102	96	101	87	94	100
Sherman	2	8	7	5	7	10	5
Tillamook	78	78	68	61	43	59	72
Umatilla	97	104	102	90	70	37	40
Union	70	61	35	28	34	31	35
Wallowa	22	14	19	21	20	9	6
Wasco	62	62	65	65	65	79	58
Washington	459	506	630	722	679	660	694
Wheeler	2	1	8	5	4	6	3
Yamhill	175	146	208	184	144	189	164

Graph 5 shows crude and age-adjusted annual heart attack hospitalization rates per 10,000 people aged 35 and older for the years from 2000 to 2006. Crude rates varied between 31 and 37, and age-adjusted rates between 20 and 36. That is, crude hospitalization rates were slightly higher than rates that are adjusted to the age structure of the standard 2000 U.S. population. This is due to the fact that heart attacks are more prevalent among older people and Oregon has a higher proportion of older people than the United States in general. The age adjustment removes this effect and shows the number of heart attack hospitalizations that would be expected if Oregon had the same age structure as the United States in general.

From 2000 to 2006, the crude rate of heart attack hospitalizations significantly decreased. A similar trend can be found in heart attack mortality data, as the number of deaths due to myocardial infarction in Oregon fell from 1,772 in 2000 to 1,409 in 2005. This drop in heart attacks has been observed throughout the United States and was linked to a broader use of preventive medication and declines in risk factors such as smoking.

In the United States, heart attack hospitalization rates per 10,000 people of all ages fell from 28 in 2000 to 23 in 2005. In Oregon, this rate dropped from 19 per 10,000 in 2000 to 17 in 2005 and 2006 (with age-adjusted rates of 18 per 10,000 in 2000, 16 in 2005 and 15 in 2006). Besides the similar decrease in heart attack hospitalizations for Oregon and the United States as a whole, these numbers show that heart attack hospitalization rates were significantly lower in Oregon compared to the rest of the country. In 2004, for example, Oregon's heart attack hospitalization rate was 25 percent lower than that of the United States, and the rate of deaths from a heart attack was 23 percent lower in Oregon than in the United States, with death rates of 4.1 per 10,000 in Oregon and 5.4 in the United States overall. Oregon's 2004 crude heart attack mortality rate of 4.1 per 10,000 was also lower than that of Idaho (5.8), but slightly higher than that of California (4.0) and Washington (3.95). After age adjustment, however, Oregon's rate was lowest with 3.8 per 10,000 compared to 6.1, 4.5, and 4.0 for Idaho, California and Washington, respectively.

The reasons for Oregon's low heart attack rates are not clear. According to the 2004 Behavioral Risk Factor Surveillance System (BRFSS) survey, high blood pressure was less frequent in Oregon (24.0 percent) than in the United States overall (24.8 percent), but it was even rarer in California (23.4 percent), Washington (23.8 percent) and Idaho (23.1 percent). Smoking was less prevalent among Oregonians (20.9 percent) than among Americans in general (22.0 percent), but it was even less frequent in California (16.8 percent), Washington (19.5 percent) and Idaho (19.0 percent). Also, the percentage of people reporting no physical activity in their leisure time was lower in Oregon (18.8 percent) than in the United States (23.1 percent), but it was even lower in Washington (17.7 percent). In sum, none of these factors can explain the lower prevalence of heart attacks in Oregon compared to the United States overall and to neighboring states such as California, Washington and Idaho.



Graph 5. Annual crude and age-adjusted heart attack hospitalization rates for persons aged 35 and older per 10,000 for Oregon, by year

Table 8 presents heart attack hospitalization rates for each of the 36 counties in Oregon. There were significant regional differences: rates varied between counties both in overall value and in their change over time. The overall decline in hospitalizations was observed in almost all counties, but it appeared stronger in counties with higher overall rates.

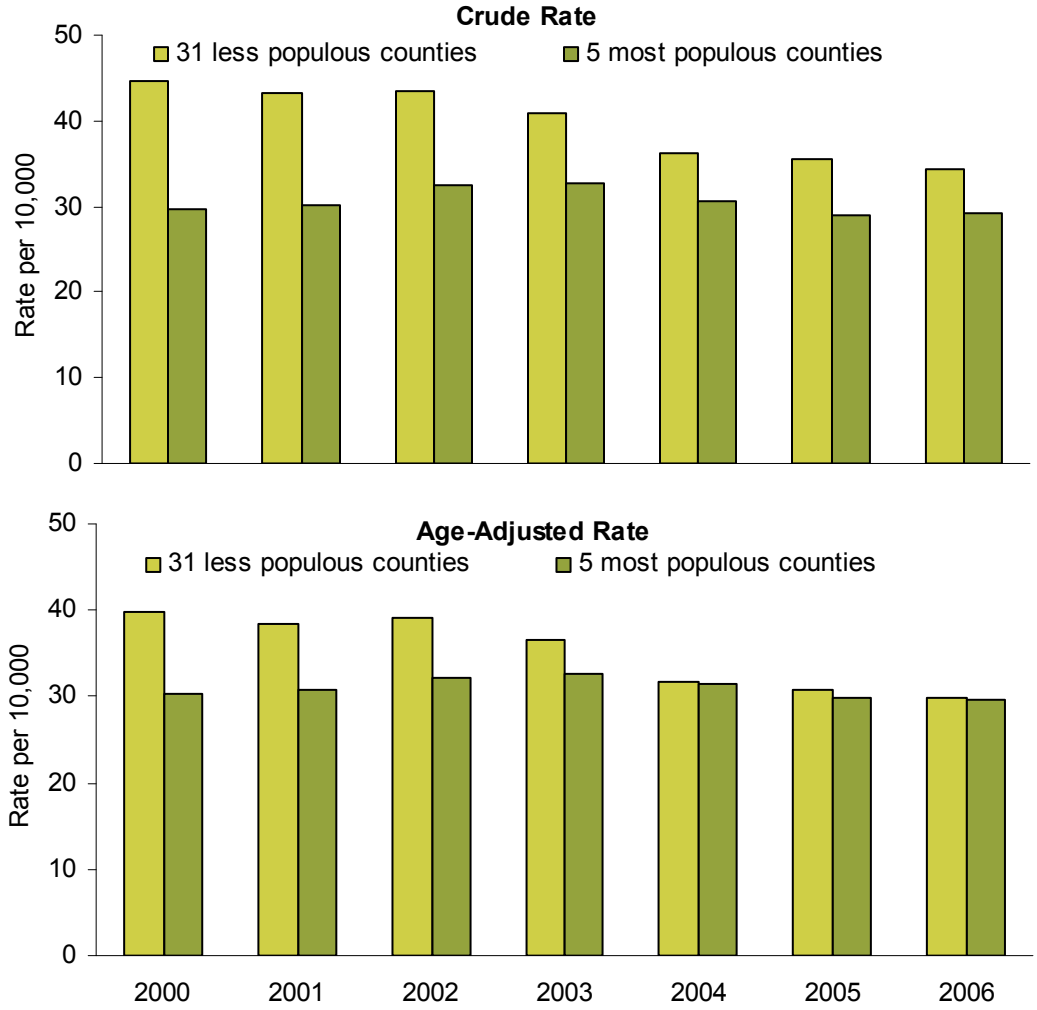
Table 8. Crude and age-adjusted heart attack hospitalization rates for persons aged 35 and older per 10,000, by state and county, by year

	Crude rate (*age-adjusted rate*)						
	2000	2001	2002	2003	2004	2005	2006
Oregon	36 *(35)*	36 *(35)*	37 *(36)*	36 *(35)*	33 *(32)*	32 *(30)*	31 *(30)*
Baker	39 *(33)*	53 *(43)*	31 *(25)*	38 *(29)*	23 *(18)*	20 *(14)*	16 *(11)*
Benton	23 *(23)*	28 *(30)*	26 *(26)*	19 *(18)*	22 *(21)*	20 *(20)*	18 *(18)*
Clackamas	30 *(33)*	31 *(34)*	37 *(39)*	34 *(36)*	29 *(30)*	28 *(28)*	29 *(29)*
Clatsop	54 *(49)*	46 *(41)*	48 *(44)*	50 *(44)*	56 *(48)*	56 *(49)*	48 *(41)*
Columbia	37 *(40)*	39 *(42)*	44 *(46)*	44 *(46)*	39 *(41)*	35 *(37)*	39 *(42)*
Coos	53 *(45)*	60 *(50)*	69 *(58)*	67 *(55)*	56 *(46)*	57 *(46)*	55 *(44)*
Crook	58 *(53)*	42 *(38)*	53 *(47)*	48 *(43)*	34 *(30)*	34 *(29)*	41 *(36)*
Curry	55 *(47)*	45 *(35)*	45 *(33)*	42 *(33)*	30 *(23)*	32 *(26)*	40 *(30)*
Deschutes	45 *(46)*	43 *(43)*	38 *(37)*	36 *(35)*	31 *(31)*	34 *(33)*	34 *(32)*
Douglas	42 *(36)*	39 *(34)*	49 *(41)*	46 *(39)*	49 *(41)*	39 *(32)*	34 *(28)*
Gilliam	34**(32)*	50**(42)*	60**(48)*	43**(34)*	86 *(69)*	43**(32)*	43**(36)*
Grant	30 *(25)*	33 *(29)*	39 *(33)*	35 *(30)*	20**(15)*	41 *(33)*	37 *(28)*
Harney	57 *(54)*	51 *(48)*	46 *(44)*	53 *(49)*	28 *(28)*	38 *(33)*	33 *(30)*
Hood River	56 *(56)*	45 *(45)*	50 *(50)*	25 *(25)*	43 *(42)*	37 *(35)*	42 *(43)*
Jackson	41 *(37)*	37 *(32)*	39 *(34)*	35 *(30)*	30 *(25)*	30 *(25)*	32 *(26)*
Jefferson	42 *(42)*	42 *(44)*	49 *(49)*	55 *(55)*	57 *(53)*	47 *(45)*	68 *(67)*
Josephine	63 *(52)*	68 *(54)*	59 *(46)*	58 *(46)*	49 *(39)*	48 *(38)*	40 *(31)*
Klamath	48 *(45)*	43 *(40)*	42 *(38)*	42 *(38)*	41 *(36)*	39 *(34)*	37 *(32)*
Lake	49 *(42)*	51 *(45)*	49 *(41)*	33 *(28)*	40 *(35)*	40 *(32)*	48 *(41)*
Lane	31 *(30)*	33 *(31)*	30 *(28)*	33 *(30)*	33 *(30)*	30 *(27)*	30 *(28)*
Lincoln	58 *(51)*	52 *(45)*	46 *(40)*	48 *(40)*	47 *(39)*	36 *(30)*	42 *(33)*
Linn	51 *(47)*	54 *(49)*	48 *(44)*	48 *(43)*	40 *(36)*	42 *(36)*	38 *(33)*
Malheur	33 *(29)*	30 *(27)*	29 *(26)*	28 *(23)*	21 *(18)*	20 *(16)*	8 *(6)*
Marion	37 *(36)*	34 *(33)*	37 *(35)*	33 *(31)*	34 *(32)*	33 *(32)*	34 *(32)*
Morrow	21 *(22)*	41 *(44)*	42 *(45)*	32 *(35)*	14**(15)*	11**(12)*	10**(11)*
Multnomah	30 *(32)*	31 *(32)*	32 *(34)*	33 *(35)*	31 *(33)*	30 *(31)*	28 *(31)*
Polk	36 *(32)*	31 *(27)*	28 *(24)*	29 *(25)*	25 *(21)*	26 *(21)*	26 *(23)*
Sherman	17**(15)*	70**(53)*	62**(63)*	44**(42)*	63**(48)*	91 *(66)*	46**(35)*
Tillamook	52 *(44)*	52 *(45)*	45 *(39)*	41 *(32)*	27 *(23)*	37 *(33)*	47 *(40)*
Umatilla	28 *(27)*	29 *(29)*	29 *(28)*	24 *(24)*	19 *(19)*	10 *(10)*	10 *(10)*
Union	54 *(49)*	47 *(40)*	27 *(23)*	21 *(18)*	26 *(22)*	24 *(19)*	26 *(21)*
Wallowa	48 *(42)*	31 *(25)*	40 *(32)*	46 *(36)*	44 *(35)*	20**(15)*	13**(10)*
Wasco	45 *(40)*	46 *(40)*	48 *(42)*	48 *(40)*	48 *(40)*	57 *(49)*	42 *(35)*
Washington	22 *(25)*	23 *(27)*	28 *(33)*	31 *(36)*	28 *(33)*	26 *(31)*	27 *(31)*
Wheeler	20**(12)*	10* *(6)*	78**(74)*	49**(36)*	40**(28)*	62**(41)*	32**(24)*
Yamhill	42 *(42)*	34 *(34)*	48 *(48)*	42 *(41)*	32 *(31)*	41 *(40)*	35 *(34)*

Note: Crude rates are displayed in regular font.
Age-adjusted rates are in parentheses and displayed in italics.

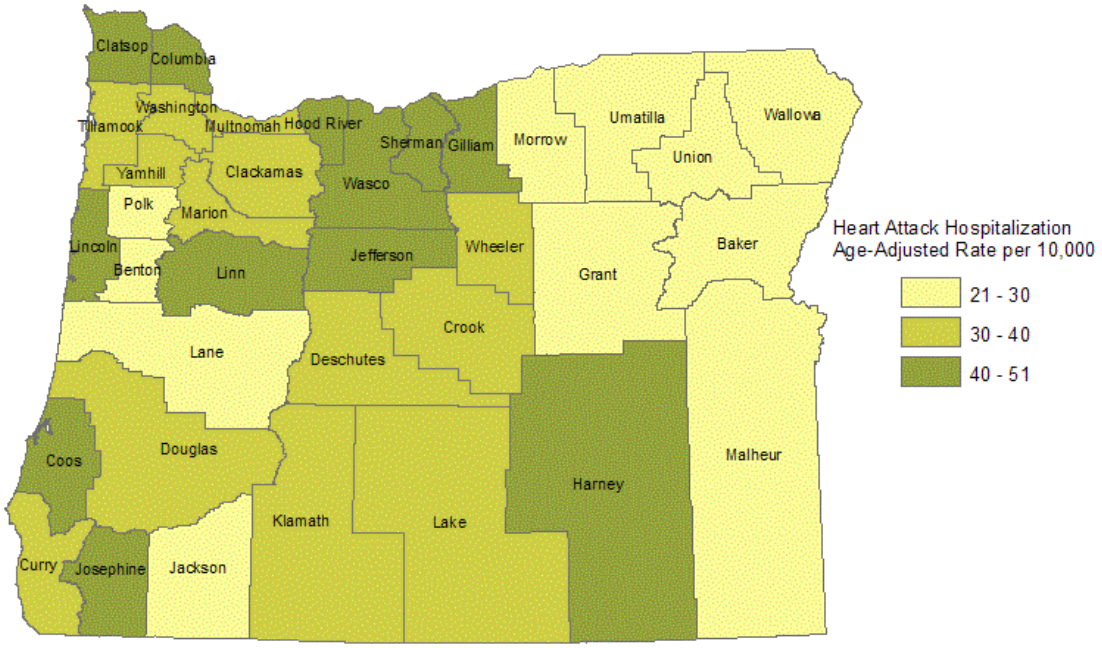
Graph 6 presents crude and age-adjusted rates summarized for the five most populous and overall more urban counties (Multnomah, Washington, Clackamas, Lane and Marion) and for the 31 less populous and generally more rural counties. Crude rates were significantly higher in rural compared to urban counties, but the drop in rates over time was also more pronounced in rural counties. As a result, the difference between the two regions decreased from 15 per 10,000 in 2000 to 5 per 10,000 in 2006. However, crude rates were still significantly higher in urban areas.

An examination of the second panel in Graph 6 suggests that some of the difference between rural and urban counties was due to their different age structures: Age-adjusted rates, which factor out differences in age structure, varied much less than crude rates between urban and rural areas, and they converged over time. In 2000, the difference was 9 per 10,000 and, by 2006, the age-adjusted rates for both groups of counties were virtually identical. In other words, heart attack hospitalization rates have become similar in urban and rural areas as a result of the decreasing rates in the rural counties. As mentioned earlier in this report, this decrease may be due to a broader use of preventive measures and wider availability of appropriate medical care.



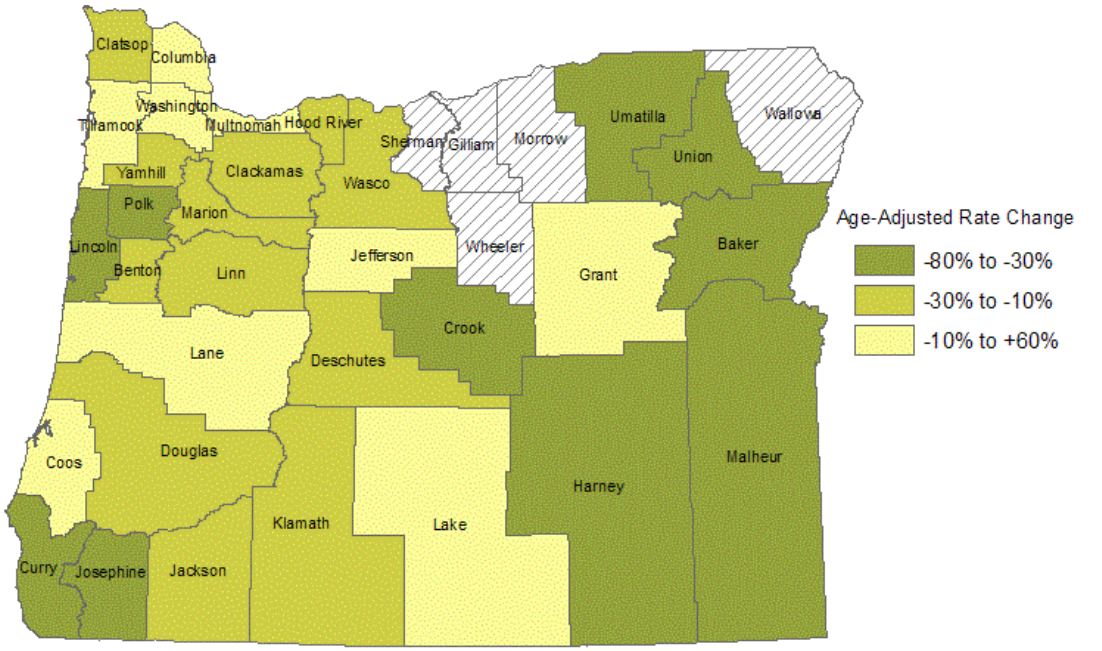
Graph 6. Crude and age-adjusted annual heart attack hospitalization rates for Oregon's five most populous counties and 31 less populous counties, by year

Map 3 presents the distribution of age-adjusted heart attack hospitalization rates across counties, showing that higher rates were observed in Central Oregon as well as scattered counties in rural Western Oregon



Map 3. Age-adjusted annual heart attack hospitalization rates per 10,000 people aged 35 and older, averaged from 2000 to 2006, by county

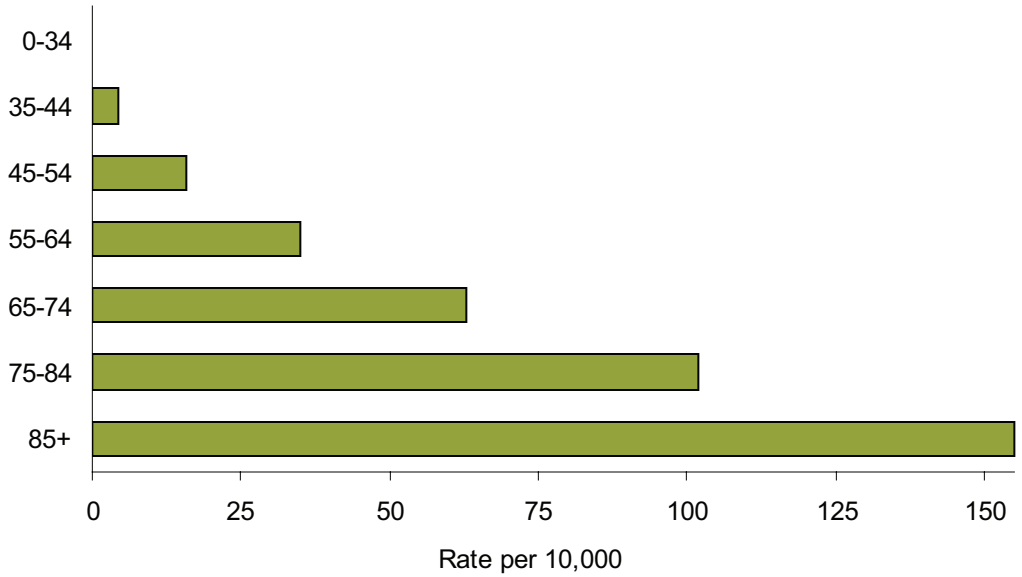
Map 4 shows the change in age-adjusted heart attack hospitalization rates from 2000 to 2006. It demonstrates that the decline in heart attack hospitalization rates was strongest in rural counties.



Note: No change was computed for counties in which the annual rate was based on a count of less than 10

Map 4. Change in age-adjusted heart attack hospitalization rates from 2000 to 2006

The age-specific heart attack hospitalization rates in Graph 7 demonstrate that heart attack frequency increased dramatically with age. Compared to people under 35, heart attack hospitalization rates were approximately 20 times as high in the 35-44 age group, almost 300 times as high in the 65-74 group, and more than 700 times as high in people over the age of 84.



Note: All rates are based on counts equal to or greater than 10.

Graph 7. Age-specific annual heart attack hospitalization rates per 10,000 for Oregon, averaged from 2000 to 2006

Table 9 contains age-specific rates separately for each year from 2000 to 2006. It shows that a similar age-dependent increase in heart attack hospitalization rates was observed in every year. Over the seven years shown here, there was a significant decrease in heart attack hospitalizations in the five groups between the ages of 35 and 74, while there was no observable pattern in the changes in the rates for people under 35 and over 84.

Table 9. Age-specific annual heart attack hospitalization rates per 10,000 for Oregon, by year

	2000	2001	2002	2003	2004	2005	2006
0-34	0	0	0	0	0	0	0
35-44	5	5	4	5	4	4	4
45-54	17	16	16	16	15	15	14
55-64	40	37	39	37	32	29	31
65-74	68	67	70	62	58	58	56
75-84	108	106	111	108	101	90	90
85+	145	159	160	174	152	156	140

Note: All rates are based on counts equal to or greater than 10.

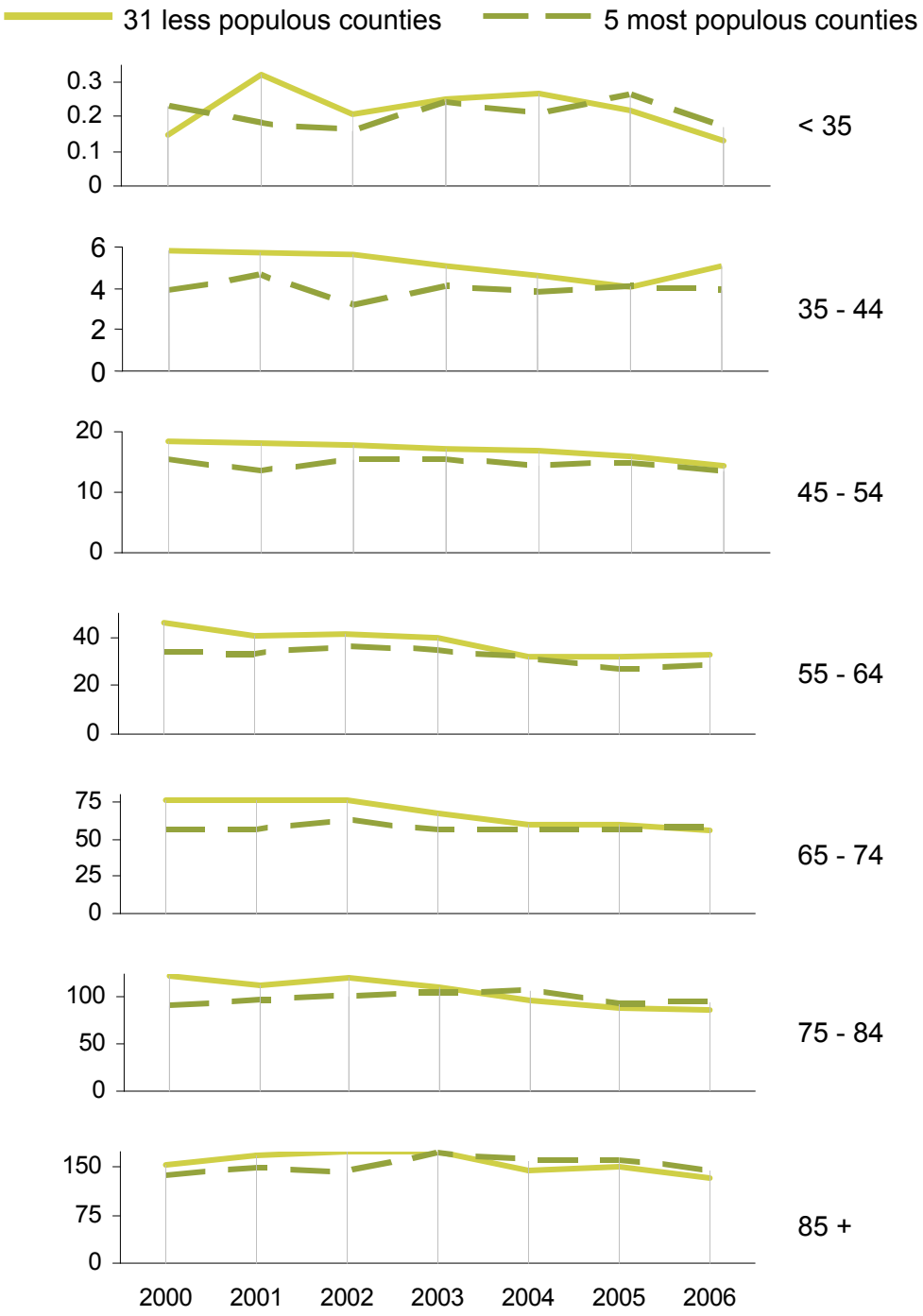
Table 10 lists age-specific rates for each county: All counties showed similar age-dependent increases in heart attack hospitalization rates, but there were considerable differences among counties in every age group. Systematic differences appear when counties are grouped into urban (five most populous counties) and rural (31 less populous counties) areas.

Table 10. Age-specific annual heart attack hospitalization rates for persons aged 35 and older per 10,000, by state and county, averaged from 2000 to 2006

	<35	35-44	45-54	55-64	65-74	75-84	85+
Oregon	0	4	16	35	63	102	155
Baker	0*	1*	13	14	54	89	137
Benton	0*	4	10	18	42	76	116
Clackamas	0	4	14	34	58	104	169
Clatsop	0*	8	21	50	93	133	174
Columbia	0*	6	19	45	83	125	191
Coos	0*	10	23	55	84	145	230
Crook	1*	5	17	50	85	114	123
Curry	0*	10	24	43	60	67	70
Deschutes	0	5	17	39	65	112	193
Douglas	0	6	22	40	67	97	137
Gilliam	0*	0*	21*	31*	101	144	155*
Grant	1*	5*	14	28	68	61	134
Harney	0*	10*	19	42	90	121	94*
Hood River	0*	6	15	54	87	140	110
Jackson	0*	4	15	32	58	84	151
Jefferson	0*	6	28	53	86	155	253
Josephine	0*	7	20	45	81	139	193
Klamath	0*	5	17	42	70	115	171
Lake	0*	3*	17	39	71	143	122
Lane	0	4	14	31	55	87	141
Lincoln	0*	8	23	45	73	110	156
Linn	0*	7	19	44	77	122	183
Malheur	0*	1*	6	25	42	59	133
Marion	0	4	17	36	62	99	148
Morrow	0*	2*	8*	30	59	81	125
Multnomah	0	4	15	35	60	101	150
Polk	0*	3	13	30	52	67	91
Sherman	0*	11*	14*	55*	102	150	116*
Tillamook	1*	7	22	34	75	100	135
Umatilla	0*	2	9	20	48	63	86
Union	0*	5	13	25	48	94	138
Wallowa	1*	2*	9*	23	67	99	131
Wasco	0*	5	20	42	83	125	169
Washington	0	3	13	29	51	109	178
Wheeler	0*	7*	14*	18*	94	82*	115*
Yamhill	0*	5	19	41	77	116	159

* Rates based on counts less than 10

Graph 8 presents age-specific rates for urban and rural counties for every year from 2000 to 2006. It shows that in earlier years (2000 to 2002), rates were higher in rural counties. Over time, however, rates for the groups over age 34 decreased in rural counties while they did not drop in urban areas (except for the 55-64 group), so that by 2005 and 2006 rates in rural and urban areas were statistically indistinguishable for most age groups (except 55-64). Again, the broader availability of medical care in rural areas may be responsible for this convergence in heart attack hospitalization rates.

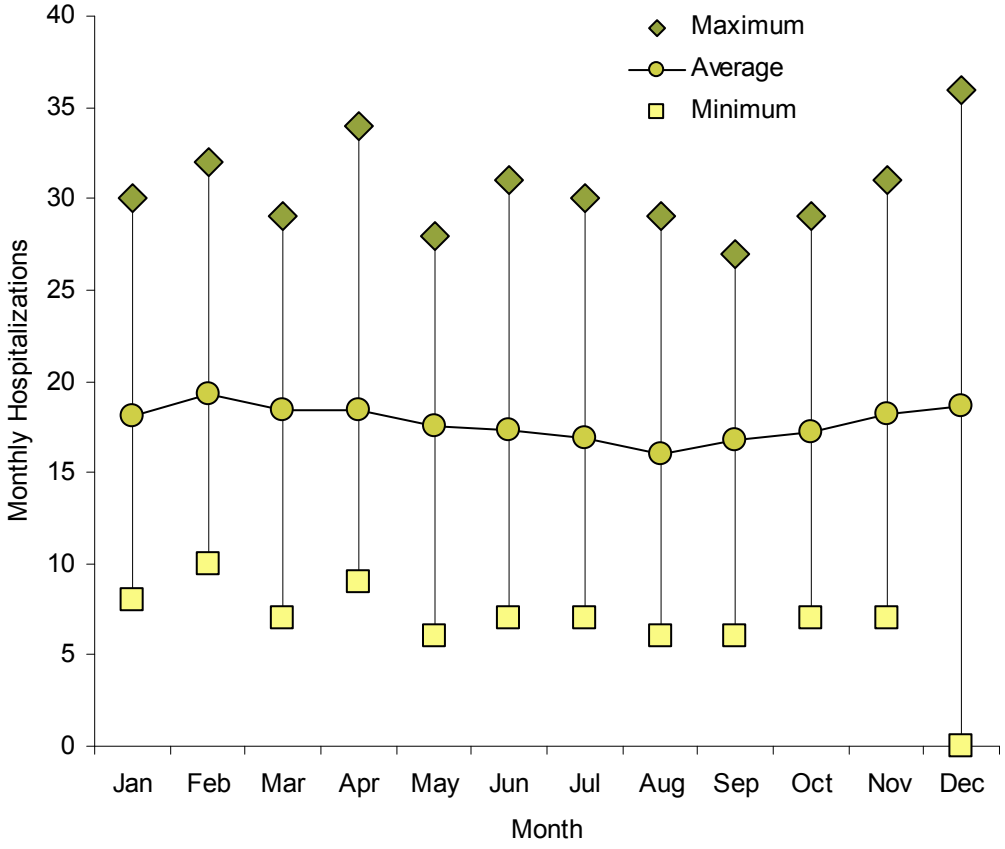


Graph 8. Annual heart attack hospitalization rates by age group, year and geographic area

B.2. Monthly average, maximum and minimum number of acute myocardial infarction (heart attack) hospitalizations, by state and county

Research in various countries has shown that the frequency of heart attacks varies by season. Graph 9 presents monthly heart attack hospitalization statistics for Oregon, summarized from 2000 to 2006. It shows that hospitalizations occurred more often in winter than in summer. The highest numbers of average daily heart attack hospitalizations were observed in December through February, and the lowest numbers occurred in July through September. Over the seven years shown here, heart attack hospitalizations were most frequent in February and rarest in August; there were approximately 20 percent more heart attack hospitalizations in February than in August.

Deaths from heart attack followed the same pattern, but the difference was even more pronounced: From 2000 to 2005, deaths due to heart attack were most frequent in February and rarest in August. The increase from August to February was 38 percent. This is almost twice as much as the increase in hospitalizations, suggesting that heart attacks in winter may not only be more frequent, but also more severe.



Graph 9. Average, maximum and minimum daily number of heart attack hospitalizations in Oregon, by month, from 2000 to 2006

Table 11 demonstrates that the timing of seasonal highs and lows varied somewhat from year to year; the highest number of hospitalizations was recorded between December and March and the lowest number between July and August. Notwithstanding these variations, the general pattern of higher heart hospitalization rates in winter and lower rates in summer was observed every year.

Table 11. Average, maximum and minimum daily heart attack hospitalizations in Oregon, by month and year

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	Average	17.2	19.1	18.1	18.6	16.5	17.7	16.9	16.4	16.8	16.2	18.1	19.8
	Maximum	25	32	27	28	25	29	30	27	26	27	29	30
	Minimum	9	12	9	9	10	11	7	8	9	7	10	9
2001	Average	17.3	18.9	18.0	17.6	17.9	16.4	16.1	16.4	16.3	19.0	18.4	21.0
	Maximum	30	31	29	25	26	24	25	25	25	29	26	31
	Minimum	8	12	8	11	10	10	10	7	6	9	8	11
2002	Average	20.2	20.0	18.9	19.3	18.8	18.9	17.6	17.5	18.6	18.0	17.7	19.5
	Maximum	29	31	27	29	27	31	30	28	27	28	26	31
	Minimum	9	13	10	10	6	9	10	11	9	11	9	13
2003	Average	18.0	20.6	18.9	20.2	19.6	17.4	17.6	17.9	17.4	18.5	18.8	18.8
	Maximum	25	25	26	29	28	26	28	29	26	28	31	36
	Minimum	11	14	7	10	12	7	9	8	12	9	7	10
2004	Average	18.9	18.4	18.2	18.1	16.2	16.0	16.5	14.6	16.0	17.9	18.6	17.7
	Maximum	25	31	25	29	23	26	25	24	22	25	27	27
	Minimum	12	11	12	12	8	8	10	8	7	11	12	8
2005	Average	18.6	19.6	18.6	17.4	16.7	16.1	16.7	14.6	15.6	15.2	16.9	17.8
	Maximum	26	27	27	23	25	26	26	26	23	27	27	30
	Minimum	9	10	10	9	10	7	8	9	10	9	8	9
2006	Average	16.2	18.5	17.9	17.7	17.2	18.4	16.7	14.9	16.7	16.0	18.6	16.2
	Maximum	24	26	27	34	26	25	23	23	24	24	27	26
	Minimum	8	10	8	10	9	9	9	6	8	10	8	0

Several explanations for the higher incidence of heart attacks in the cold season have been suggested. Lower temperatures have been found to be associated with higher levels of heart disease risk factors, such as high blood pressure and high overall cholesterol as well as LDL ("bad") cholesterol. Elevated levels of factors related to the formation of blood clots, which trigger heart attacks, have also been observed in winter.

The lack of sunshine during the cold season leads to reduced levels of vitamin D, which may contribute to an increased risk of a heart attack. Furthermore, respiratory tract infections, which have been linked to heart attacks, also occur more frequently in winter.

Table 12 presents the average number of daily heart attack hospitalizations by county. All counties for which reliable data were available showed a pattern similar to the overall Oregon pattern: Hospitalization rates were higher in winter and lower in summer. The lowest number of hospitalizations occurred in August in 41 percent of all counties, and the highest number of hospitalizations occurred in February in 44 percent of all counties. There were no systematic differences between counties or geographic areas.

Table 12. Average daily heart attack hospitalizations by county and month, averaged from 2000 to 2006

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Baker	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Benton	0.3	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Clackamas	1.7	1.8	1.5	1.7	1.7	1.6	1.6	1.5	1.6	1.7	1.6	1.8
Clatsop	0.3	0.3	0.3	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Columbia	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.3
Coos	0.7	0.8	0.6	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.6
Crook	0.2	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1
Curry	0.1	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.1
Deschutes	0.7	0.9	0.8	0.8	0.8	0.7	0.7	0.6	0.6	0.6	0.7	0.7
Douglas	0.6	0.8	0.7	0.7	0.7	0.7	0.7	0.6	0.7	0.7	0.7	0.7
Gilliam	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*
Grant	0.0*	0.1	0.0*	0.0*	0.0*	0.1	0.1	0.0*	0.0*	0.1	0.0	0.1
Harney	0.1	0.0*	0.1	0.1	0.1	0.0*	0.0*	0.0*	0.1	0.1	0.1	0.0
Hood River	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1
Jackson	1.0	1.1	1.0	1.0	1.1	1.0	0.9	1.0	1.0	1.0	1.0	1.1
Jefferson	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.2	0.1	0.2	0.2
Josephine	0.7	0.8	0.7	0.8	0.8	0.8	0.7	0.7	0.6	0.7	0.6	0.7
Klamath	0.4	0.4	0.4	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Lake	0.1	0.1	0.1	0.1	0.0	0.1	0.0*	0.0	0.0*	0.1	0.1	0.1
Lane	1.5	1.7	1.6	1.6	1.5	1.5	1.6	1.4	1.4	1.5	1.5	1.5
Lincoln	0.4	0.3	0.4	0.5	0.3	0.4	0.4	0.3	0.3	0.3	0.4	0.4
Linn	0.8	0.8	0.6	0.8	0.7	0.7	0.7	0.7	0.7	0.6	0.8	0.8
Malheur	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Marion	1.2	1.4	1.6	1.3	1.2	1.3	1.2	1.2	1.4	1.5	1.6	1.5
Morrow	0.0*	0.1	0.0*	0.0*	0.0*	0.0	0.0*	0.0*	0.0*	0.0*	0.0*	0.1
Multnomah	2.9	3.2	3.1	2.9	2.9	3.0	2.7	2.5	2.9	2.8	3.1	3.2
Polk	0.3	0.2	0.3	0.3	0.2	0.3	0.3	0.2	0.3	0.3	0.3	0.2
Sherman	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*
Tillamook	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Umatilla	0.3	0.2	0.3	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2
Union	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Wallowa	0.1	0.1	0.0*	0.0*	0.1	0.0*	0.0	0.1	0.0*	0.0*	0.1	0.0*
Wasco	0.2	0.2	0.2	0.1	0.2	0.2	0.1	0.1	0.2	0.2	0.2	0.2
Washington	1.9	1.8	1.8	1.8	1.6	1.6	1.5	1.5	1.6	1.6	1.8	1.9
Wheeler	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*	0.0*
Yamhill	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.5	0.4	0.6	0.5

*Averages based on less than 10 hopsitalizations per month

Major limitations

Hospitalization data, by definition, does not include information about individuals who were not hospitalized, including those who did not receive medical care and those who received care at home, in emergency rooms, in alternative care settings and in outpatient settings. Additionally, Veterans Affairs, Indian Health Services and institutionalized (prison) populations are not included in hospitalization data sets. Statewide measures and measures for counties bordering other states may be underestimated because of health care utilization patterns in those areas.

Differences in rates by time or area may reflect differences or changes in diagnostic techniques and criteria, and in coding of asthma and heart attack (acute myocardial infarction). Differences in rates by area may be due to different sociodemographic characteristics and associated behaviors. When comparing rates across geographic areas, a variety of non-environmental factors, such as access to medical care and diet, can also impact the likelihood of persons hospitalized for asthma or heart attack.

Rates at the state and county levels will not reveal the burden of disease at a more local level, i.e. ZIP code or neighborhood. Rates at the state and/or county level will also not be geographically resolved enough to be linked with many types of environmental data. Furthermore, patients may be exposed to environmental triggers in multiple locations, but hospital discharge geographic information is limited to the patient residence ZIP code. Race, ethnicity and street addresses are currently unavailable.

There is usually a two-year lag period before hospitalization data are available from the Oregon Association of Hospitals and Health Systems. Data were available only for discharges that occurred before Jan. 1, 2007. Admissions occurring in 2006 that resulted in discharges in 2007 are not captured in the data. This may have led to an underestimation of the number of hospitalizations for the year 2006, especially for the month of December.

Census data is only available every 10 years. Post-censal estimates, which may not accurately reflect demographic changes, are used when calculating rates for years following the census year. Post-censal estimates by ZIP code are not available from the U.S. Census Bureau. These need to be extrapolated or purchased from a vendor.

Index to tables and graphs

A. Asthma

B. Myocardial infarction (heart attack)

Glossary

Acute myocardial infarction	Irreversible death of heart muscle as a consequence of prolonged loss of blood supply.
Age-adjusted rate	To make comparisons possible, certain rates may take the age composition of the population into account. Age-adjusting is a statistical procedure to remove the effects of age differences when comparing populations. The age-adjusted rates presented here are weighted averages of age-specific rates, where the weights are based on the proportion of the age groups in the U.S. population as determined by the 2000 census.
Age-specific rate	The rate among people of a particular age range in a given time period. Age-specific rates are calculated by dividing the number of people in an age group who have a particular condition by the number of people in that same age group overall.
CDC	Centers for Disease Control and Prevention, U.S. DHHS
Coronary heart disease	Range of cardiovascular disorders featuring reduced blood supply to the heart muscle.
Crude rate	The number of new cases (or deaths) occurring in a specified population per year, usually expressed as the number of cases per 10,000 or 100,000 population at risk (see rate).
DHHS	United States Department of Health and Human Services
DHS	Oregon Department of Human Services
Environmental Public Health Tracking (EPHT)	The national initiative to establish a network to enable the ongoing collection, integration, analysis and interpretation of data about environmental hazards, exposure to environmental hazards and health effects.
EPHT Program	Environmental Public Health Tracking: This national program is in the Division of Environmental Hazards and Health Effects of CDC's National Center for Environmental Health; Oregon's program is in the Toxicology, Assessment and Tracking Section of the Oregon DHS Office of Environmental Public Health.
Hazard	A source that may potentially adversely affect health, from past, current or future exposures.
HDL (high-density lipoprotein)	Lipoproteins are combinations of lipids (fats) and proteins. They are the form in which lipids are transported in the blood. The high-density lipoproteins transport cholesterol from the tissues of the body to the liver so it can dispose of the bile. HDL cholesterol is, therefore, considered the "good" cholesterol. The higher the HDL cholesterol level, the lower the risk of coronary artery disease.
Hospitalization/ hospital admission	Being treated as a patient in a hospital. To be considered a hospitalization, a minimum stay is required (often more than 23 hours). Treatment as an outpatient is not considered to be hospitalization.
ICD-9/ ICD-10	The International Statistical Classification of Diseases and Related Health Problems (ICD) provides codes to classify diseases and a wide variety of signs, symptoms, abnormal findings, complaints, social circumstances and external causes of injury or disease. Every health condition can be assigned to a unique category and given a code, up to six characters long. The ICD-10 is used to code cause of death; the ICD-9 is used for all other conditions.
Incidence	The number of new cases of a particular disease that occur in a population during a defined period of time, usually one year.

LDL (low-density lipoprotein)	Lipoproteins are combinations of lipids (fats) and proteins. They are the form in which lipids are transported in the blood. Low density lipoproteins transport cholesterol from the liver to the tissues of the body. LDL cholesterol is, therefore, considered "bad" cholesterol. Higher LDL cholesterol levels are associated with greater risk of coronary artery disease.
Multiple admissions	Second or subsequent admission for the same person for the same primary diagnosis code but on a different date and related to a separate event within a given year.
Percentage	A way of expressing a number as a fraction of 100 (percent meaning "per hundred").
Prevalence	The total number of cases of the disease in the population at a given time (total number of cases in the population, divided by the number of individuals in the population).
Primary diagnosis	The main condition treated or investigated and diagnosed by the health care provider.
Public health	The art and science dealing with preventing disease, prolonging life and promoting health through organized efforts of society including preventive medicine, sanitary and social services.
Rate	Rate, also called crude rate, is the measure of an event's frequency of occurrence during a defined population in a specified period of time, typically displayed as the number of cases per 10,000 people. For example, if in 2007 there were 50 admissions for heart attacks among men aged 55-65 out of a population that included 40,000 men of that age, the admission rate for that condition and age group for 2007 would be 80/40,000 X 10,000 = 20 per 10,000.
Relationship	A way in which people and things may be associated with each other, either real or suspected, that describes their interaction. Relationship or association does not imply causation.
Reliability	The degree of stability of a measurement. Rates are used to estimate how many cases (such as deaths or hospitalizations) are expected in a population of a certain size. These estimates become unreliable (or unstable) when the computation is based on a small number of cases. In the tables and graphs presented here, rates based on less than ten cases are flagged as potentially unreliable.
Risk factor	An exposure, activity, physical characteristic or genetic predisposition that may increase the chance of developing a particular health outcome.
Spatial	A reference to geographic location; contrasted with temporal, which pertains to time.
Temporal	Referring to time, the passage of time or the measurement of time; contrasted with spatial, which pertains to geographic location.
Transfer	A patient discharged from one facility and readmitted to a second facility on the same day or the next day for the same health episode.

Reference links

General interest:

Oregon Department of Human Services (DHS), Oregon Environmental Public Health Tracking (EPHT): *http://oregon.gov/DHS/ph/epht/index.shtml*

U.S. Census Bureau: *www.census.gov/*

U.S. Department of Health and Human Services (DHHS), Centers for Disease Control and Prevention (CDC), Behavioral Risk Factor Surveillance System (BRFSS): *www.cdc.gov/BRFSS*

U.S. Department of Health and Human Services (DHHS), Centers for Disease Control and Prevention (CDC), National Center for Health Statistics NCHS), National Health Interview Survey (NHIS): *www.cdc.gov/nchs/nhis.htm*

U.S. Department of Health and Human Services (DHHS), Office of Disease Prevention and Health Promotion (ODPHP), Healthy People 2010: *www.healthypeople.gov*

Asthma:

Allergy & Asthma Network Mothers of Asthmatics (AANMA): *www.aanma.org/*

American Academy of Allergy, Asthma, and Immunology (AAAAI): *www.aaaai.org/*

American College of Allergy, Asthma & Immunology (ACAAI): *www.acaai.org/*

American Lung Association: *www.lungusa.org/*

Asthma and Allergy Foundation of America (AAFA): *www.aafa.org/*

Global Initiative for Asthma (GINA): *www.ginasthma.com/*

Oregon Department of Environmental Quality (DEQ). Air Quality Division: *www.oregon.gov/DEQ/AQ/index.shtml*

Oregon Department of Environmental Quality (DEQ), Air Quality Index (AQI): *www.deq.state.or.us/aqi/index.aspx*

Oregon Department of Human Services (DHS), Oregon Asthma Program: *http://oregon.gov/DHS/ph/asthma/index.shtml*

Oregon Department of Human Services (DHS), Oregon Asthma Resource Bank: *http://oregon.gov/DHS/ph/asthma/resourcebank/index.shtml*

Oregon Health & Science University (OHSU). Health topics, allergy and asthma: *www.ohsu.edu/health/health-topics/topic.cfm?id=10160&parent=11973*

U.S. Department of Health and Human Services (DHHS), Centers for Disease Control and Prevention (CDC). National Asthma Control Program (NACP): *www.cdc.gov/asthma/NACP.htm*

U.S. Environmental Protection Agency (EPA): *www.epa.gov/iaq/asthma/*

Heart attack:

American Heart Association (AHA). Diseases & conditions, heart attack: *www.americanheart.org/presenter.jhtml?identifier=1200005*

Mayo Clinic. Heart disease: *www.mayoclinic.com/health/heart-attack/DS00094*

Oregon Health & Science University (OHSU). Health topics, heart attack: *www.ohsu.edu/health/health-topics/topic.cfm?id=8653*

U.S. Department of Health and Human Services (DHHS), Centers for Disease Control and Prevention (CDC), Division for Heart Disease and Stroke Prevention (DHDSP): *www.cdc.gov/DHDSP/index.htm*

U.S. Department of Health and Human Services (DHHS), Centers for Disease Control and Prevention (CDC), National Environmental Public Health Tracking (NEPHT) Program: *www.cdc.gov/nceh/tracking/default.htm;*

U.S. Department of Health and Human Services (DHHS), National Institute of Health (NIH), National Heart, Blood, and Lung Institute (NHLBI). Heart attack signs: *www.nhlbi.nih.gov/actintime/*

U.S. Department of Health and Human Services (DHHS), National Institute of Health (NIH), National Library of Medicine (NLM), MedLine Plus. Heart attack: *www.nlm.nih.gov/medlineplus/ency/article/000195.htm*

World Health Organization (WHO). Cardiovascular diseases: *www.who.int/cardiovascular_diseases/en/*

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Public Health Division
Environmental Public Health Tracking Program
Portland State Office Building
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Portland, OR 97232
Phone: 971-673-0977
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Web site: *www.healthoregon.org/epht*

E-mail: epht.ohd@state.or.us

DHS
Oregon Department
of Human Services

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