Illinois Morbidity and Mortality Bulletin

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Message from Director Ezike

Welcome to the eighth issue of the Illinois Morbidity and Mortality Bulletin (IMMB), an IDPH publication created to present topics of interest to public health communities and professionals in Illinois through scientific analysis and interpretation of data.

In this issue, Anh-Thu Runez and Chinyere Alu from the Division of Patient Safety and Quality examine the most common inpatient diagnoses in Illinois hospitals utilizing data from the Illinois hospital discharge database for 2016 and 2017.

In the second article, Kyle Garner from the Division of Epidemiologic Studies presents the ecological association between smoking prevalence and lung cancer across Illinois counties using data from the Behavioral Risk Factor Surveillance System (BRFSS) and the Illinois State Cancer Registry.

We encourage manuscript contributions from public health professionals at the state and local levels, as well as those in hospitals and academic institutions. Please send your manuscripts to IMMB's editor, Tiefu Shen, M.D., Ph.D. at Tiefu.Shen@illinois.gov (217.785.1873)

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Most Common Inpatient Diagnoses in Illinois Hospitals, 2016-2017

The Illinois hospital discharge data are often used for public health strategic planning for disease prevention and health promotion at the state and local level. Understanding patterns and trends of health conditions allow better focused initiative and program management. In 2017, there were 1.4 million hospitalizations in Illinois, translating to 1,123 hospitalizations per 10,000 population (pop). The 10 most common diagnoses in 2017 accounted for 37% of all hospitalizations in Illinois. Of note, mental health diagnoses accounted for the majority of hospitalizations across all age groups between 5-65 years. Between 2016 and 2017, there was a significant increase …….. read more

Ecological Association between Smoking Prevalence and Lung Cancer Incidence across Illinois Counties

Lung cancer is one of the most commonly diagnosed cancers in Illinois. Marked county level variations in lung cancer incidence and tobacco smoking, a major cause of lung cancer, exist. In this study, county lung cancer incidence rates were correlated with the percentage of current smokers in a direct and ecological manner. Simple linear regression was used to examine the relationship with county level lung cancer rates as a function of percentage of current smokers. Overall, county level smoking rates accounted for …….. read more

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Most Common Inpatient Diagnoses in Illinois Hospitals, 2016-2017

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Abstract

The Illinois hospital discharge data are often used for public health strategic planning for disease prevention and health promotion at the state and local level. Understanding patterns and trends of health conditions allow better focused initiative and program management. In 2017, there were 1.4 million hospitalizations in Illinois, translating to 1,123 hospitalizations per 10,000 population (pop). The 10 most common diagnoses in 2017 accounted for 37% of all hospitalizations in Illinois. Of note, mental health diagnoses accounted for the majority of hospitalizations across all age groups between 5-65 years. Between 2016 and 2017, there was a significant increase in hypertension with complications and secondary hypertension diagnosis in the older age groups, the Medicare insured, and the uninsured patients. Although much of the results of the analysis are consistent with findings nationwide, [1] the change in hospitalizations for certain conditions is noteworthy and warrants further evaluation.

Introduction

Hospital inpatient care accounts for approximately one-third of health care spending in the United States. Thus, understanding the trends in hospitalizations, including who is getting hospitalized, is fundamental to efforts to improve health outcomes and reduce unnecessary health care use. The Illinois Department of Public Health (IDPH) Division of Patient Safety and Quality collects patient level administrative discharge data from all Illinois acute care hospitals, specialty hospitals, and ambulatory surgical treatment centers. Primary diagnoses data from all Illinois acute care and specialty hospital discharges were analyzed by age group and payer type. This report presents results on the most common principal diagnoses for all hospitalizations in 2016 and 2017. Percent change in the overall number of hospitalization and the rate of hospitalization in the population are presented for the most common conditions by sex and age groups.

Methods

On October 1, 2015 the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) was implemented for all inpatient medical coding and billing. Compared to the ICD-9-CM, the ICD-10-CM has improved specificity with more than 70,000 diagnosis codes.[2] For this report, calendar year 2016 and 2017 ICD-10-CM diagnosis codes data are categorized into a manageable number of clinically meaningful groupings using Clinical Classification Software (CCS).[3] Tables and graphs are generated of the most common principal diagnoses by year and patient characteristics (age groups, sex, and payer type).

Population data are obtained from Claritas, a vendor that compiles data from the U.S. Census Bureau, and aligns with the population used in the results in the Illinois Hospital Report Card and Community Map (http://www.healthcarereportcard.illinois.gov/map). Calendar year 2017 population data was used as the denominator for both 2016 and 2017 data.

Results

Overall Number and Rates of Hospitalization in Illinois, 2016-2017

In 2017, there were 1.4 million hospitalizations in Illinois, or 1,123 hospitalizations per 10,000 population. In 2017, 56% of all hospitalizations were women at a rate of 1,238 per 10,000 pop. Men accounted for 44% of all hospitalizations (1,004 hospitalizations per 10,000 pop). These numbers were similar to 2016 results.

Excluding children less than 5 years, the hospitalization rate increased with age in 2016 and 2017. In both years, patients 75 and older had the highest rate of hospitalizations (e.g., 4,024 per 10,000 pop in 2017) and made up of approximately 22% of total cases. Table 1 details the number of cases, hospitalization rates, and percent change between 2016 and 2017. Figure 1 displays hospitalization rates by age groups.

In 2017, the primary payer for 40% of all hospitalized patients was Medicare, followed by commercial insurance (27%), Medicaid (22%), HMO (5%), Self-pay (3%), and Other (2%). The hospitalization rate for HMO patients increased by 39% between 2016 and 2017. In contrast, hospitalizations by commercially insured patients decreased by 12% (Table 1 and Figure 2).

Table 1. Number of hospitalizations, rate of hospitalization (per 10,000 population), and percent change in rate of hospitalization in Illinois hospitals by patient characteristics, 2016 - 2017

Characteristic	2016			2017			Percent Change in Rate
	Number of Cases	Rate per 10,000 pop	Percent of Cases	Number of Cases	Rate per 10,000 pop	Percent of Cases	
Illinois (Total)	1,464,496	1,136	n/a	1,448,298	1,123	n/a	-1.1%
Sex							
Female	826,447	1,259	56.4%	812,620	1,238	56.1%	-1.7%
Male	637,982	1,008	43.6%	635,601	1,004	43.9%	-0.4%
Patient Age (years)							
0-4	172,465	2,117	11.8%	165,060	2,027	11.4%	-4.3%
5-9	10,388	125	0.7%	10,006	120	0.7%	-3.7%
10-14	17,364	203	1.2%	18,309	214	1.3%	5.4%
15-17	20,403	381	1.4%	21,221	396	1.5%	4.0%
18-24	76,301	598	5.2%	73,756	578	5.1%	-3.3%
25-44	282,691	828	19.3%	274,882	805	19.0%	-2.8%
45-64	362,301	1,068	24.7%	351,410	1,036	24.3%	-3.0%
65-74	216,403	2,162	14.8%	220,983	2,208	15.3%	2.1%
75+	306,180	3,940	20.9%	312,671	4,024	21.6%	2.1%
Primary Payer							
Medicare	566,332	n/a	38.7%	578,475	n/a	39.9%	2.1%
Medicaid	308,403	n/a	21.1%	319,937	n/a	22.1%	3.7%
Commercial	449,375	n/a	30.7%	396,753	n/a	27.4%	-11.7%
HMO	51,319	n/a	3.5%	71,351	n/a	4.9%	**39.0%**
Self-Pay	42,240	n/a	2.9%	42,762	n/a	3.0%	1.2%
Other	43,056	n/a	2.9%	35,190	n/a	2.4%	-18.3%

Figure 1. Hospitalization Rate (per 10,000 population) in Illinois Hospitals by Age Group, 2016-2017

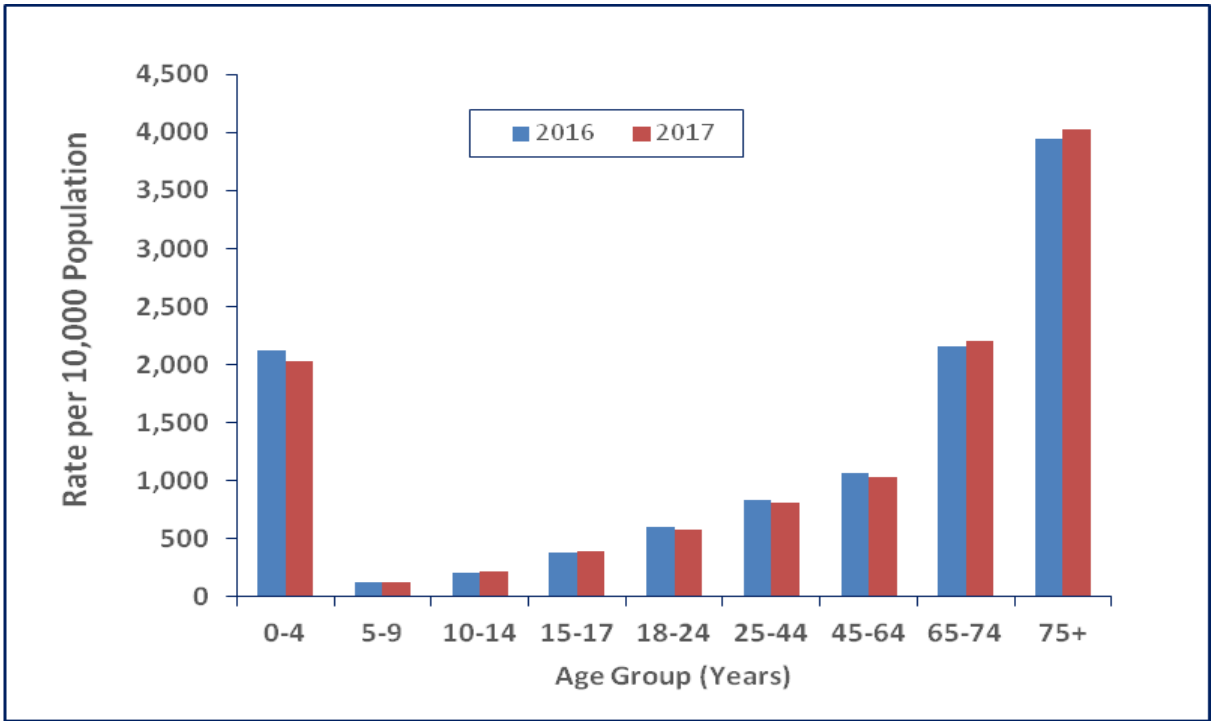
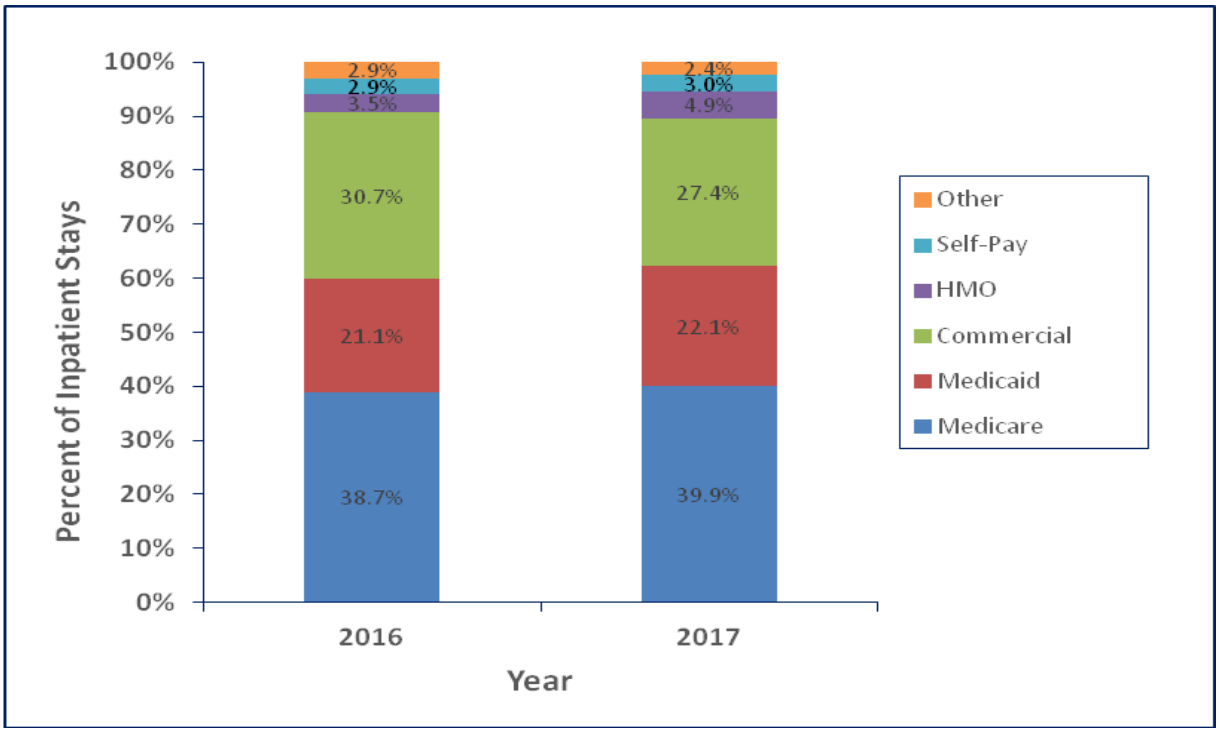


Figure 2. Percent of Hospitalization in Illinois by Payer Type, 2016-2017



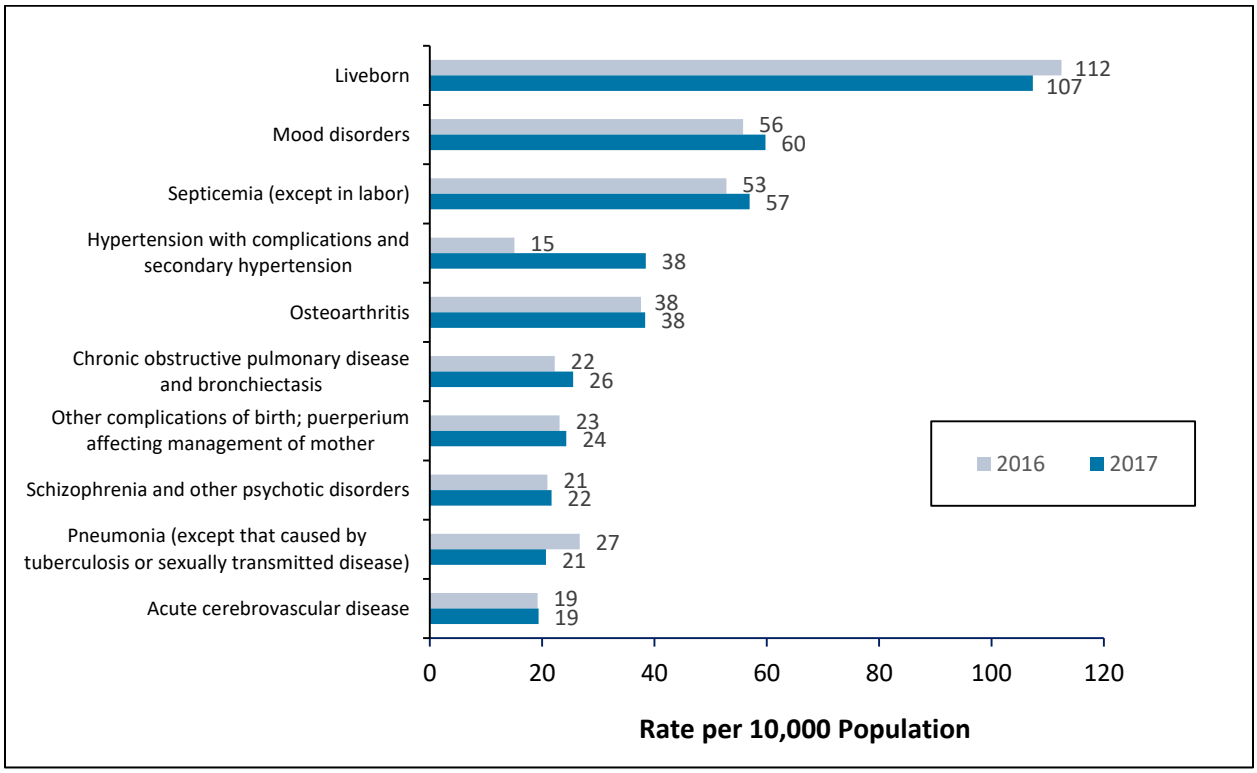
Most Common Principal Diagnoses in Illinois Hospitals, 2016-2017

Table 2 and Figure 3 show the 10 most common diagnoses in 2016 and 2017; these diagnoses accounted for 37% of all hospitalizations in Illinois. In both years, the most common cause of hospitalization was for liveborn/newborn infant, which accounted for 145,035 cases (112 hospitalizations per 10,000 pop) and 138,433 cases (107 hospitalizations per 10,000 pop), respectively. Mood disorders was the second most common diagnosis, with 77,052 cases (60 hospitalizations per 10,000 pop) in 2017; mood disorders increased by 7% between 2016 and 2017. Hospitalizations for septicemia was the third most common diagnosis, and increased by 8% between 2016 and 2017. The largest change in hospitalization rates was due to hypertension with complications: hospitalizations from this condition increased significantly by 155% between 2016 and 2017. Hospitalization rates for pneumonia decreased 23% from 2016.

Table 2. Number of hospitalization, rate of hospitalization (per 10,000 population), and percent change in rate of the 10 most common diagnoses, 2016 - 2017

Principal CCS Diagnosis	2016		2017		Percent Change in Rate
	Number of Cases	Rate per 10,000 pop	Number of Cases	Rate per 10,000 pop	
Illinois (Total)	1,464,496	1,136	1,448,298	1,123	-1.1%
Liveborn	145,035	112	138,433	107	-4.6%
Mood disorders	71,936	56	77,052	60	7.1%
Septicemia (except in labor)	68,102	53	73,436	57	7.8%
Hypertension with complications and secondary hypertension	19,439	15	49,606	38	**155.2%**
Osteoarthritis	48,498	38	49,426	38	1.9%
Chronic obstructive pulmonary disease and bronchiectasis	28,695	22	32,929	26	14.8%
Other complications of birth; puerperium affecting management of mother	29,805	23	31,333	24	5.1%
Schizophrenia and other psychotic disorders	27,004	21	27,954	22	3.5%
Pneumonia (except that caused by tuberculosis or sexually transmitted disease)	34,421	27	26,668	21	-22.5%
Acute cerebrovascular disease	24,773	19	24,980	19	0.8%

Figure 3. Hospitalization rates (per 10,000 population) of the 10 most common diagnoses, 2016-2017



Most Common Principal Diagnoses in Illinois Hospitals by Age Group, 2016-2017

Table 3 shows the number and rates of hospitalization of the five most common diagnoses by age groups in 2016 and 2017, along with the rate percent change between both years.

Among patients 5-44 years, mental health was among the top two reasons for hospitalizations in both 2016 and 2017. Among patients 5-24 years, mood disorders increased between 2016 and 2017. Patients 15-17 years had the highest rate (194 per 10,000 pop) of hospitalization due to mood disorders, with suicide and intentional self-inflicted injury as the second most common reason for hospitalizations among this age group.

The other top diagnoses among adults age 18-44 years were due to pregnancy and childbirth. These included complications of birth; puerperium affecting management of mother, OB-related trauma to perineum and vulva, and other complications of pregnancy or previous C-section.

Among adults ages 45 and older, the three most common reasons for hospitalizations were septicemia (excluding labor), chronic obstructive pulmonary disease and bronchiectasis, and hypertension with complications and secondary hypertension. For age groups 45-64 years, 65-74 years, and 75+ years the hospitalization rates for hypertension with complications and secondary hypertension significantly increased (by 124%, 165%, and 193% respectively) since 2016. In addition, for both years, hospitalizations for these diagnoses increased with age: 45-64 years (36 per 10,000), 65-74 years (108 per 10,000), and 75+ years (300 per 10,000).

Table 3. Number of hospitalizations, rate of hospitalization (per 10,000 population), and percent change in rate of the 5 most common diagnoses by age group, 2016 – 2017

Principal CCS Diagnosis	2016		2017		Percent Change in Rate
	Number of Cases	Rate per 10,000 pop	Number of Cases	Rate per 10,000 pop	
0-4 years					
Liveborn	145,035	1,781	138,433	1,700	-5%
Acute bronchitis	3,381	42	3,789	47	12%
Other perinatal conditions	2,082	26	1,796	22	-14%
Pneumonia (except that caused by tuberculosis or sexually transmitted disease)	1,875	23	1,653	20	-12%
Asthma	1,423	17	1,496	18	5%
5-9 years					
Mood disorders	873	11	1,098	13	26%
Asthma	1,087	13	1,061	13	-2%
Attention-deficit conduct and disruptive behavior disorders	702	8	623	7	-11%
Pneumonia (except that caused by tuberculosis or sexually transmitted disease)	608	7	483	6	-21%
Epilepsy; convulsions	445	5	435	5	-2%
10-14 years					
Mood disorders	6,866	80	8,239	97	20%
Attention-deficit conduct and disruptive behavior disorders	876	10	714	8	-18%
Asthma	543	6	593	7	9%
Appendicitis and other appendiceal conditions	545	6	526	6	-3%
Diabetes mellitus with complications	480	6	475	6	-1%
15-17 years					
Mood disorders	9,184	172	10,405	194	13%
Suicide and intentional self-inflicted injury	462	9	493	9	7%
Other complications of birth; puerperium affecting management of mother	516	10	469	9	-9%
Schizophrenia and other psychotic disorders	321	6	382	7	19%
Maintenance chemotherapy; radiotherapy	357	7	367	7	3%
18-24 years					
Mood disorders	11,233	88	12,327	97	10%
Other complications of birth; puerperium affecting management of mother	7,806	61	7,830	61	0%
OB-related trauma to perineum and vulva	5,169	40	4,144	32	-20%
Other complications of pregnancy	3,737	29	3,432	27	-8%
Schizophrenia and other psychotic disorders	3,173	25	3,369	26	6%
25-44 years					
Other complications of birth; puerperium affecting management of mother	21,411	63	22,968	67	7%
Mood disorders	21,568	63	22,644	66	5%
OB-related trauma to perineum and vulva	19,420	57	15,185	44	-22%
Previous C-section	15,008	44	14,566	43	-3%
Schizophrenia and other psychotic disorders	10,896	32	11,226	33	3%

45-64 years					
Septicemia (except in labor)	18,855	56	19,783	58	5%
Osteoarthritis	19,940	59	19,513	58	-2%
Mood disorders	17,811	53	17,860	53	0%
Hypertension with complications and secondary hypertension	5,514	16	12,369	36	124%
Chronic obstructive pulmonary disease and bronchiectasis	10,471	31	11,049	33	6%
65-74 years					
Osteoarthritis	17,523	175	18,628	186	6%
Septicemia (except in labor)	14,837	148	16,318	163	10%
Hypertension with complications and secondary hypertension	4,087	41	10,821	108	165%
Chronic obstructive pulmonary disease and bronchiectasis	7,942	79	9,218	92	16%
Cardiac dysrhythmias	6,424	64	6,309	63	-2%
75+ years					
Septicemia (except in labor)	26,012	335	28,427	366	9%
Hypertension with complications and secondary hypertension	7,966	103	23,330	300	193%
Chronic obstructive pulmonary disease and bronchiectasis	9,549	123	11,897	153	25%
Pneumonia (except that caused by tuberculosis or sexually transmitted disease)	13,700	176	10,935	141	-20%
Urinary tract infections	10,966	141	10,734	138	-2%

Most Common Principal Diagnoses in Illinois Hospitals by Payer Type, 2016-2017

Table 4 shows the five most common diagnoses for hospitalization in 2016 and 2017 by payer type. Hospitalization for septicemia (except in labor) was among the top five most common diagnoses for all payer types. Septicemia accounted for 5% of the total hospitalizations in Illinois. Mood disorders are also among the top five diagnoses for every payer group except for Medicare insured.

In 2017, 40% of hospitalizations were by Medicare insured patients. Among this group, septicemia (except in labor) was the most common condition (47,448 cases) and hypertension with complications and secondary hypertension was the second most common condition (35,638 cases). This finding aligns with the previous analysis showing association between increasing age and hypertension.

Table 4. Number of hospitalization, percent distribution, and percent change in rate of the five most common diagnoses by principal payer, 2016 – 2017

Principal CCS Diagnosis	2016		2017		Percent Change in Rate
	Number of Cases	Percent of cases	Number of Cases	Percent of cases	
Medicare					
Septicemia (except in labor)	43,338	2.96%	47,448	3.28%	9%
Hypertension with complications and secondary hypertension	13,293	0.91%	35,638	2.46%	168%
Osteoarthritis	25,738	1.76%	27,188	1.88%	6%
Chronic obstructive pulmonary disease and bronchiectasis	19,367	1.32%	22,879	1.58%	18%
Cardiac dysrhythmias	16,322	1.11%	16,456	1.14%	1%
Medicaid					
Liveborn	49,487	3.38%	47,827	3.30%	-3%
Mood disorders	26,771	1.83%	31,284	2.16%	17%
Other complications of birth; puerperium affecting management of mother	11,602	0.79%	12,934	0.89%	11%
Schizophrenia and other psychotic disorders	9,296	0.63%	10,513	0.73%	13%
Septicemia (except in labor)	8,303	0.57%	9,565	0.66%	15%
Commercial					
Liveborn	69,218	4.73%	61,495	4.25%	-11%
Mood disorders	27,450	1.87%	26,434	1.83%	-4%
Osteoarthritis	17,437	1.19%	16,399	1.13%	-6%
Other complications of birth; puerperium affecting management of mother	14,247	0.97%	13,948	0.96%	-2%
Septicemia (except in labor)	11,906	0.81%	10,824	0.75%	-9%
HMO					
Liveborn	9,124	0.62%	12,076	0.83%	32%
Mood disorders	1,999	0.14%	3,624	0.25%	81%
Other complications of birth; puerperium affecting management of mother	1,897	0.13%	2,745	0.19%	45%
Osteoarthritis	2,121	0.14%	2,664	0.18%	26%
Septicemia (except in labor)	1,349	0.09%	2,308	0.16%	71%
Self-Administered					
Liveborn	632	0.04%	592	0.04%	-6%
Septicemia (except in labor)	221	0.02%	247	0.02%	12%
Osteoarthritis	179	0.01%	207	0.01%	16%
Other complications of birth; puerperium affecting management of mother	128	0.01%	136	0.01%	6%
Mood disorders	101	0.01%	117	0.01%	16%
Self-Pay					
Liveborn	11,735	0.80%	12,955	0.89%	10%
Mood disorders	1,216	0.08%	1,586	0.11%	30%
Septicemia (except in labor)	1,375	0.09%	1,500	0.10%	9%
Alcohol-related disorders	1,423	0.10%	1,377	0.10%	-3%
Hypertension with complications and secondary hypertension	395	0.03%	1,001	0.07%	153%

Discussion

Overall, the total number of hospitalizations in Illinois stayed relatively the same between 2016 and 2017. In both years, the top 10 most common primary diagnoses remained the same and accounted for approximately one third of all hospitalizations in Illinois. Between 2016 and 2017, there was a significant increase in hospitalization rates for HMO patients, as well as for patients being treated for hypertension.

Excluding live births, mood disorders accounted for the majority of hospitalizations for both 2016 and 2017, suggesting a significant unmet need for mental health services. The Illinois Public Health Community Map[4] shows distribution of hospitalizations for mood disorders and other mental health indicators by geography and includes additional demographics not included in this report. Further analysis linking these data with other datasets, e.g., prescriptions or treatment, may be instructive.

Among those 45 years and older, septicemia was among the top two primary diagnoses for hospitalizations and increased by 5% to 9% between 2016 and 2017. Reasons for this may include an aging population with more chronic illnesses, increasing antibiotic resistance, and other variables noted in the literature.[5] Patients with septicemia are sicker, have longer inpatient stays, and are more likely to die than those with other diagnoses. As the most expensive condition treated in U.S. hospitals,[6] the economic cost of sepsis is also high. Unrelenting implementation and assessment of evidence-based improvement activities will be needed.

Although much of the results of the analysis are consistent with previous findings, the trends in the specific conditions highlighted are noteworthy and warrant continued attention. Tracking data included in this report over time will help inform and assess efforts to address the leading causes of morbidity in Illinois.

This report has several limitations:

- Discharge data may be affected by the quality of diagnostic coding and decisions of health providers inputting the data
- The unit of analysis in the discharge data is 'cases' versus unique individuals, which can lead to over-estimation of rates
- ICD-10 was implemented at the end on 2015 and therefore 2016 was the first complete year of reporting. Comparison of numbers and rates between 2016 and 2017 may vary widely as health providers become more familiar with ICD-10 reporting.

Author Affiliations

1. Illinois Department of Public Health, Office of Policy, Planning and Statistics, Division of Patient Safety and Quality.

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APPENDIX A

Definitions

The ***principal diagnosis*** is the condition that is primarily responsible for a patient's hospitalization and was used as the unit of analysis in this report. A person may be admitted to a hospital multiple times within a year and is considered a single 'case' count based on each separate time a patient is discharged from the hospital.

Age refers to the age of the patient at admission. Individual patient's age are categorized in smaller age groups for analysis. Discharges missing age are excluded from results reported by age.

Sex refers to the patient's sex and designated as male or female. All non-male, non-female (unknown "U") responses are set to missing. Discharges with missing values for sex are excluded from results reported by sex.

Payer is the expected primary payer type for the hospital stay, categorized into the following groups:

- **Medicare** – All programs, including fee-for-service and managed care Medicare patients
- **Medicaid** – All programs, including fee-for-service, managed care Medicaid patients, and patients covered by the State Children's Health Insurance Program (SCHIP)
- **Commercial** - Private insurance including all identifiable carriers (Preferred Provider Organizations, Point of Service, etc.) but excluding Health Maintenance Organizations (HMOs)
- **HMO** - Private HMO insurance
- **Self-pay** – Includes bills for charges made to the patient, having no identifiable private or public insurance coverage or eligibility
- "**Other**" – Includes declared but un-identifiable carriers (including Worker's Compensation) and government programs such as TRICARE/CHAMPUS, Black Lung, and Title V

The ***rate of hospitalization*** is calculated based on the number of hospitalization in the numerator and the Illinois resident population in the denominator (with a multiplier of 10,000 or 100,000 where specified). Rates of hospitalization for Payer groups are not calculated since population data for payer mix is not available.

APPENDIX B

Most Common Principal Diagnoses in Illinois Hospitals by Sex, 2016-2017

- **For women, four of the top 10 most common reason for hospitalization were related to pregnancy and birth. Complication of birth was the fourth most common diagnosis for women**

For both men and women, liveborn, mood disorders, and septicemia were the top three common reason for hospitalization in 2016 and 2017. Complication of birth was the fourth most common diagnosis for women. The increase in hypertension between 2016 and 2017 that was noted in the overall rate of hospitalization in Illinois is observed in both men (150%) and women (160%). Refer to **Table 5** for the number of cases, rate of hospitalization, and percent change from 2016 by sex.

Table 5. Number of hospitalization, rate of hospitalization (per 10,000 population), and percent change in rate of the 10 most common diagnoses by Sex, 2016 – 2017

Principal CCS Diagnosis	2016		2017		Percent Change in Rate
	Number of Cases	Rate per 10,000 pop	Number of Cases	Rate per 10,000 pop	
Female					
Liveborn	70,921	108	67,818	103	-4%
Mood disorders	38,190	58	40,742	62	7%
Septicemia (except in labor)	34,821	53	37,305	57	7%
Other complications of birth; puerperium affecting management of mother	29,805	45	31,333	48	5%
Osteoarthritis	28,932	44	29,532	45	2%
Hypertension with complications and secondary hypertension	9,669	15	25,137	38	**160%**
OB-related trauma to perineum and vulva	24,994	38	19,638	30	-21%
Chronic obstructive pulmonary disease and bronchiectasis	16,784	26	19,015	29	13%
Previous C-section	17,120	26	16,459	25	-4%
Urinary tract infections	15,856	24	15,460	24	-2%
Male					
Liveborn	74,076	117	70,575	111	-5%
Mood disorders	33,733	53	36,281	57	8%
Septicemia (except in labor)	33,281	53	36,131	57	9%
Hypertension with complications and secondary hypertension	9,770	15	24,469	39	**150%**
Osteoarthritis	19,566	31	19,893	31	2%
Schizophrenia and other psychotic disorders	17,347	27	18,238	29	5%
Alcohol-related disorders	14,786	23	15,325	24	4%
Acute myocardial infarction	13,792	22	13,952	22	1%
Chronic obstructive pulmonary disease and bronchiectasis	11,911	19	13,914	22	17%
Diabetes mellitus with complications	12,102	19	13,820	22	14%

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Ecological Association between Smoking Prevalence and Lung Cancer Incidence across Illinois Counties

Kyle Garner, MPH[1]

Abstract

Lung cancer is one of the most commonly diagnosed cancers in Illinois. Marked county level variations in lung cancer incidence and tobacco smoking, a major cause of lung cancer, exist. In this study, county lung cancer incidence rates were correlated with the percentage of current smokers in a direct and ecological manner. Simple linear regression was used to examine the relationship with county level lung cancer rates as a function of percentage of current smokers. Overall, county level smoking rates accounted for 22%t of lung cancer variation between counties ($F=26.07$, $R^2=0.22$, $p=0.00$). Additional variables, which may include carcinogenic exposures, socioeconomic status, and possibly occupational exposures, could assist in understanding the remaining county variation.

Introduction

Lung cancer was the second most commonly diagnosed cancer in Illinois in both men and women.[1] It is widely understood that cigarette smoking is a major risk factor for cancer, specifically in the lungs and bronchus.[2] Public health efforts to reduce smoking rates in Illinois have coincided with declines in the incidence of lung cancer across the state.[3] However, while these positive changes are encouraging at the state level, at the county level a large amount of variation exists when examining county specific lung cancer incidence rates. This short paper examines county specific smoking prevalence in relation to lung cancer incidence and attempts to quantify how much of the variation between counties is accounted for by differences in smoking prevalence between Illinois counties.

Methods

Variables utilized in this analysis were cancer incidence rate (per 100,000) by county for Illinois residents who were diagnosed with lung cancer in 2006-2015, smoking prevalence as measured by the estimated percent of the population who are 'current smokers' in 2010-2016, and 2010 U.S. census county population totals. Cancer incidence data were provided by the Illinois State Cancer Registry (ISCR) and smoking data were from the Illinois Behavioral Risk Factor Survey (BRFSS). Both data sources are housed at IDPH.

Due to small populations and the design of the Illinois BRFSS, 12 Illinois counties were combined into three multi-county groups. First, Alexander, Hardin, Johnson, Massac, Pope, Pulaski, and Union were combined into one geographic unit. Second, Franklin and Williamson were combined, and third, Gallatin, Saline, and White were combined. These counties are all located in the southern tip of Illinois and are predominantly rural areas. This resulted in a total of 93 observations (n=93).

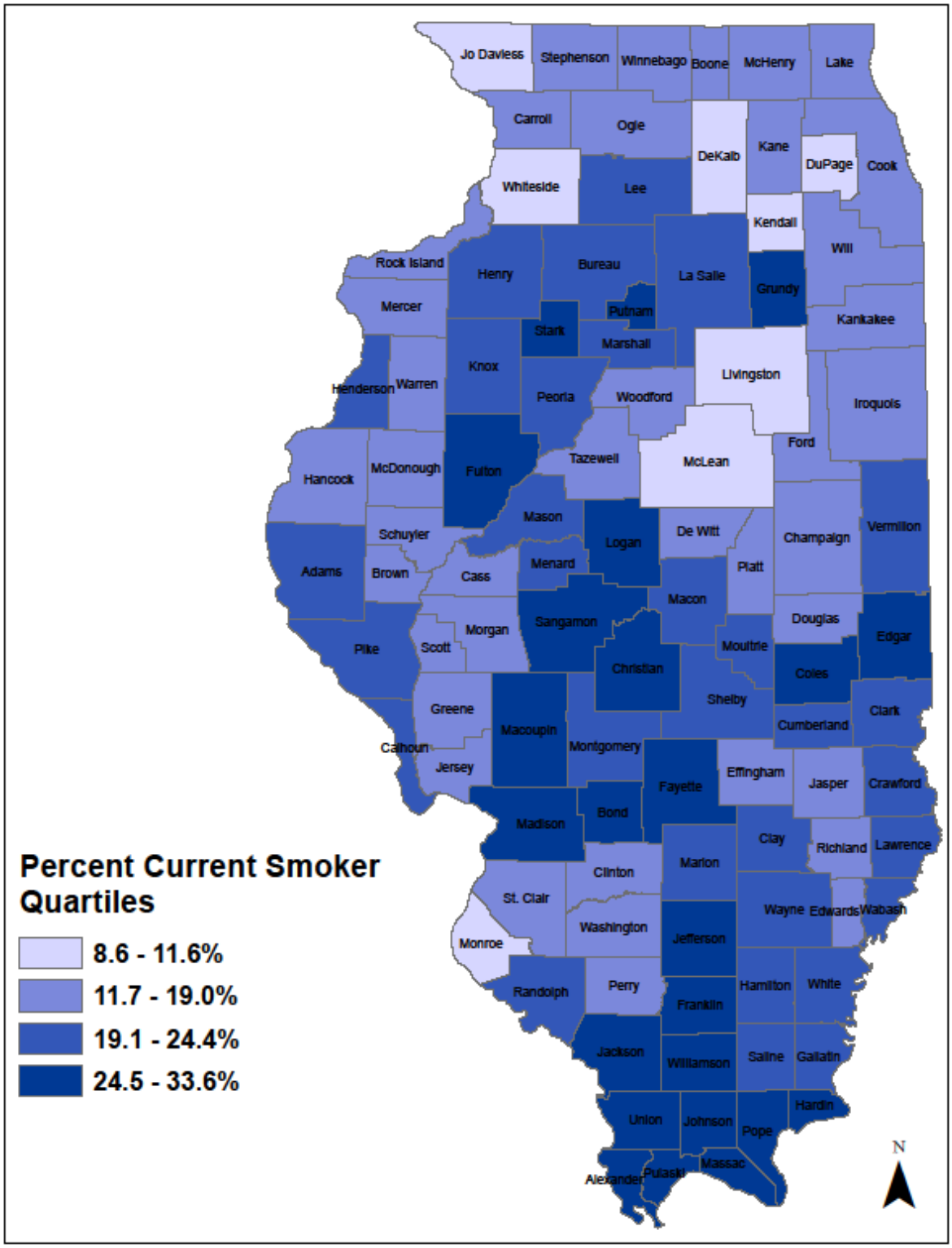
The data were analyzed using Statistical Package for the Social Sciences (SPSS). A simple linear regression analysis allowing for possible variable transformation was carried out to examine the association between lung cancer incidence rates and smoking prevalence among Illinois counties. Correlation coefficient and R squared values were examined and statistical significance was set at the 0.05 level.

Results

Map 1 displays the adult smoking rate for Illinois counties. The rate of residents currently smoking ranged from a low of 8.6% to a high of 33.6%. Map 2 shows the lung cancer incidence rate for Illinois counties. Lung cancer incidence rates ranged from 54.8 per 100,000 to 108 per 100,000.

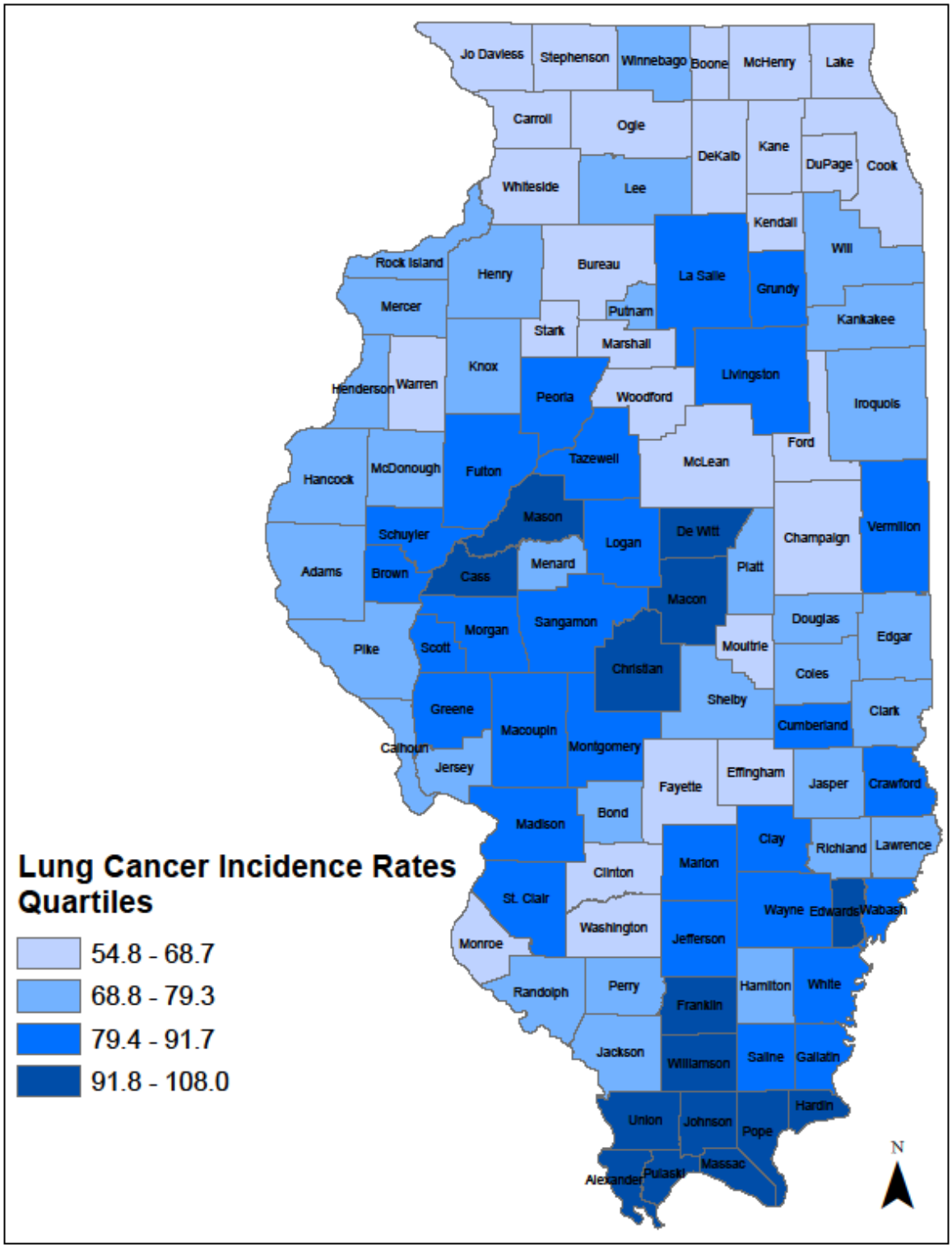
Initially, the regression model included population as well as the percentage of current smokers. However, the population variable was not statistically significant and therefore dropped from the model (t=-0.93, p=0.33). Table 1 shows the results of the simple regression analysis. The slope coefficient, positive and statistically significant, was almost one (B=0.96; p=0.00), meaning that for every 1% change in smoking rate, there would be a change of one case per 100,000 population. The coefficient of correlation was 0.47. The coefficient of determination, which is the square root of the coefficient of correlation, was 0.22, indicating county level smoking prevalence could explain 22% of differences in lung cancer rates across counties (F=26.07, R^2=0.22).

Map 1: Illinois County Percent Current Smokers, 2010-2014



Source: Illinois Behavioral Risk Factor Surveillance System

Map 2: Illinois County Lung Cancer Incidence Rate, Both Genders, 2006-2015



Source: Illinois State Cancer Registry, Illinois Department of Public Health, Rates per 100,000

Table 1: Ordinary Least Squares Regression Results – Lung Cancer Incidence

Model	B Coefficient	Standardized B Coefficient	t	Significance
Constant	57.50		15.04	0.00
Current Smoker Prevalence	0.96	0.47	5.1	0.00
$R^2 = 0.22$; F = 26.07 (0.000, $p<0.05$)				

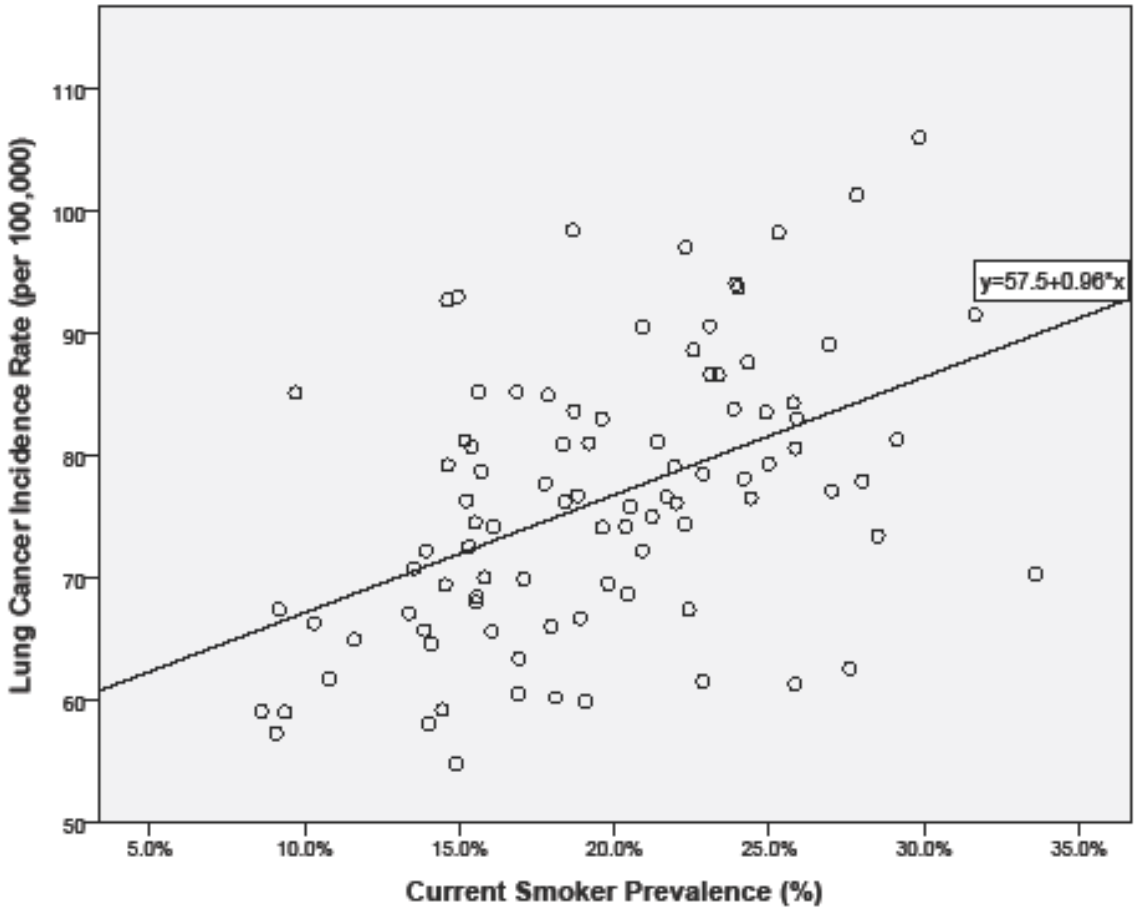
Discussion

This study found a moderate and positive association between lung cancer incidence rates and smoking prevalence rates across counties. About 22% of the county variation in lung cancer incidence could be explained by differences in the percentage of current smokers, as measured by the BRFSS. Figure 1 displays graphically the positive association between the smoking prevalence and lung cancer incidence. One can see that, overall, the higher the percentage of current smokers in a county the higher that county's lung cancer incidence.

It is important to keep in mind that this study is ecological in nature, as it examined the variables in question at the county level. Any associations described at the county level should not be ascribed to individuals residing in Illinois counties. Associations at the county level may not hold true at the individual level.

While this simple model explained a portion of variation in lung cancer incidence between counties, a much larger portion remains unexplained. Other factors not included in this analysis could very well influence the lung cancer incidence rate. Environmental and occupational exposures to radon have been documented as a risk for lung cancer.[4] Study of additional variables is needed to understand what factors account for variation between counties.

Figure 1: Illinois County Lung Cancer Incidence Rate as a Function of the Percentage of Current Smokers



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