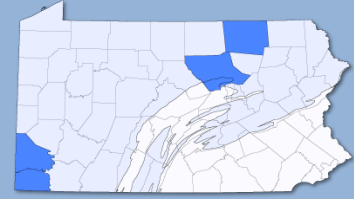


The Impact of Marcellus Shale Development on Health and Health Care

The Marcellus Impacts Project Report #2



Executive Summary

Little is known about the potential human health effects of Marcellus Shale drilling and related development activities. It is likely that different phases of drilling and development may affect human health differently; some aspects of drilling may impact health directly and other health effects may be indirect.

This research examines changes in healthcare services, the use of healthcare services, reported injuries, and emergency medical service complaints in the four study counties before and after the start of Marcellus Shale development; across regions; and across varying degrees of intensity of Marcellus Shale development. The objective was to determine if incidences of certain health status indicators and demand for healthcare services changed in the study counties during the years that Marcellus drilling activity increased. The quantitative data were supplemented with information obtained from regional focus groups held with health, housing, and human service professionals. This research is exploratory and should not be treated as conclusive. However, it provides the basis for additional research to determine the relationship of Marcellus Shale development to health and health services use.

Results indicated that:

- While all counties and regions are served by general acute care hospitals, the level of service by “safety net providers” varies. The numbers of these providers does not seem to be associated with a change in population overall but may reflect an increase in the uninsured population in certain counties.
- Inpatient hospitalizations in the four counties and the two regions increased slightly in the northern tier and decreased slightly in the southwest, but it is not possible to directly connect this to Marcellus Shale drilling.
- Access to primary care providers was and continues to be an issue and the demand for mental and behavioral health services has increased as have the interagency strategies for addressing this need.
- The percentage of uninsured residents was at or above 10 percent, which is consistent with the general level of uninsurance in the state overall at any given time. The overall variation in the southwest region could be explained by changes in population or employment. The spike in Greene County could be associated with the increase in drilling activity and, potentially, with individuals and families accompanying industry workers who were without health insurance. The fluctuations in the uninsured in the northern tier could be a result of drilling activity or other economic issues.
- While the four study counties experienced fluctuations in the percentage of persons enrolled in Medicare, the overall percentage increased from 1999 to 2010 and does not appear to be

dependent on the level of drilling activity during the 11-year timeframe. The same holds true for Medicaid.

- There are no overall trends for injuries in the four study counties or across the two regions; however, there are noticeable increases in injuries associated with falls, motor vehicle accidents, and accidents involving motorcycles. These types of injuries could be related to any type of large-scale construction activity and not necessarily to Marcellus Shale drilling.
- While there are no trends in injuries reported in the two regions, the increase in the number of EMS complaints is substantial, in some cases increasing by more than 3,000 percent. However, since data are not available on the exact nature of the injuries and complaints cannot be tied directly to drilling activity, it cannot be definitively stated that there is a relationship, although that could be inferred due to the timeframe in which the data were reported.
- A challenge with accessing and analyzing these kinds of data is that data are not collected by healthcare delivery systems on the employment status of patients and if those data are collected, it is not done so in a consistent, systematic way and is not reported in any publically available format that is useful for analysis.

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The Center for Rural Pennsylvania is a bipartisan, bicameral legislative agency that serves as a resource for rural policy within the Pennsylvania General Assembly. It was created in 1987 under Act 16, the Rural Revitalization Act, to promote and sustain the vitality of Pennsylvania’s rural and small communities.

Information contained in this report does not necessarily reflect the views of individual board members or the Center for Rural Pennsylvania. For more information, contact the Center for Rural Pennsylvania, 625 Forster St., Room 902, Harrisburg, PA 17120, telephone (717) 787-9555, email: info@rural.palegislature.us, www.rural.palegislature.us.

About This Project:

The Marcellus Shale Impacts Project chronicles the effects of shale-based energy development in Pennsylvania by focusing on the experiences of four counties with significant extraction and production activity – Bradford, Lycoming, Greene, and Washington counties. The project examines social and economic changes in these counties within the context of regional and statewide trends. A series of nine reports describes the research results as follows: (1) population, (2) health, (3) education, (4) youth, (5) housing, (6) crime, (7) local government, (8) local economy, and (9) agriculture.

Study Counties

Bradford, Lycoming, Greene, and Washington counties are studied in this project. They have experienced some of the highest levels of Marcellus Shale development in Pennsylvania, yet they have diverse populations, histories, economic bases, and geographic locations. These differences allow comparisons that facilitate understanding of the potential effects of Marcellus Shale development across the commonwealth and by region. The regional comparisons are defined based on adjacency to the four study counties. The northern tier contains 12 counties: Bradford, Lycoming, and the 10 neighboring counties of Clinton, Columbia, Montour, Northumberland, Potter, Sullivan, Susquehanna, Tioga, Union, and Wyoming. The southwest region consists of six counties: Greene, Washington, and the four neighboring counties of Allegheny, Beaver, Fayette, and Westmoreland.

All four study counties are classified as rural by the Center for Rural Pennsylvania with population densities of less than 284 people per square mile.

Table 1 offers an overview of selected characteristics from 2000 for the four study counties as well as counties in the surrounding region and the state. These data provide important context for understanding differences between the counties and regions prior to Marcellus Shale development. As Table 1 shows how the counties and regions differ across indicators. In the northern tier, Lycoming's population was nearly twice that of Bradford's, and Lycoming County had a slightly higher unemployment rate than Bradford County. The percentage employed in mining was very small in 2000 in both northern tier counties, although a larger percentage of people were employed in the industry in Bradford (0.6 percent) than in Lycoming (just 0.1 percent). The two counties had comparable median household incomes.

In the southwest, the differences between Greene and Washington are more pronounced. Greene had the smallest population of the four counties (40,672) and 6.7 percent of employed individuals in the county were working in mining. The unemployment rate (9.2 percent) was more than 3 points above the state's average (5.7 percent), and the median household income (\$41,972) was well below average for the region (\$52,004) and the state (\$55,460). In contrast, the median household income in Washington County was just over \$10,000 higher than in Greene. Only 1.3 percent of the employed work in mining and the unemployment rate was notably lower (5.3 percent).

The two counties of the southwest had more diversified economies than counties of the northern tier. In Bradford and Lycoming, the same three industries (Manufacturing, Health Care and Social Assistance, and Retail Trade) employed around half the population (52.4 percent and 47.4 percent, respectively (Census 2000). In contrast, just over one-third of the working population in Greene County worked in the same three industries (Health Care and Social Assistance, Retail Trade, and Educational Services). Washington's top three industries (Manufacturing, Health Care and Social Assistance, Retail Trade, and Manufacturing) employed 41.7 percent of the working population.

Table 1. Pre-Marcellus characteristics of study counties in 2000

	Population	People per square mile	% employed in Mining	% Unemployed	Median Household Income (adjusted for inflation to 2012 values)
Northern Tier*	47,968	83	0.6%	6.0%	\$47,071
Bradford	62,761	55	0.6%	5.5%	\$48,451
Lycoming	120,044	97	0.1%	6.3%	\$47,038
Southwest*	370,881	505	1.8%	6.6%	\$47,901
Greene	40,672	71	6.7%	9.2%	\$41,972
Washington	202,897	237	1.3%	5.3%	\$52,004
Pennsylvania	12,281,054	274	0.3%	5.7%	\$55,460

The northern tier region contains 12 counties: Bradford, Lycoming, and the 10 neighboring counties of Clinton, Columbia, Montour, Northumberland, Potter, Sullivan, Susquehanna, Tioga, Union, and Wyoming. The southwest region consists of six counties: Greene, Washington, and the four neighboring counties of Allegheny, Beaver, Fayette, and Westmoreland. Source: Social Explorer Tables (SE), Census 2000, U.S. Census Bureau and Social Explorer. * County average, includes study counties.

Marcellus Shale Activity

Table 2 shows the number of unconventional wells drilled in the Marcellus Shale each year in the six Pennsylvania counties with the highest total number of wells drilled between 2005 and mid-year 2013 (Pennsylvania Department of Environmental Protection).

Table 2. Six counties with the most wells drilled and wells drilled each year, 2005-2013*

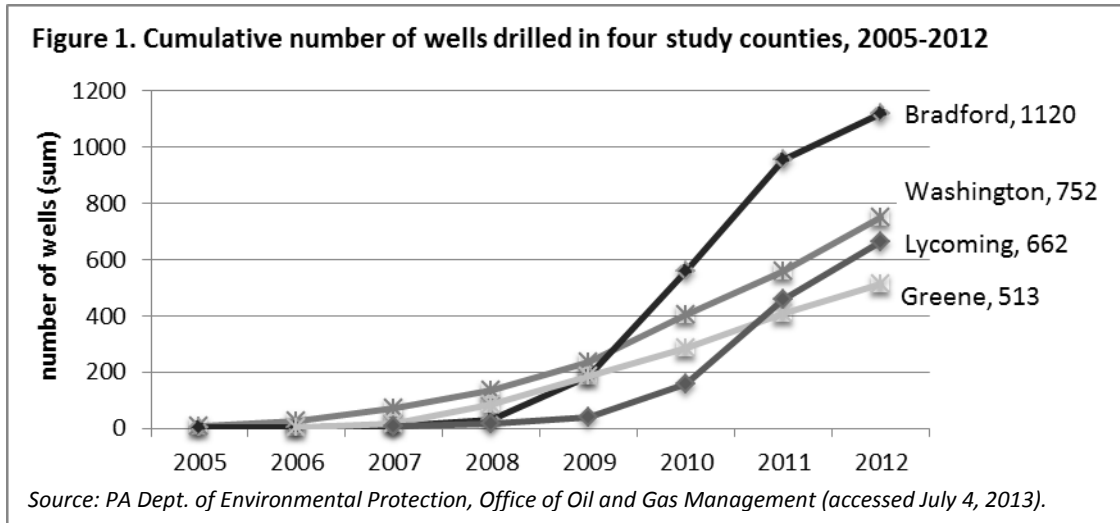
county name	2005	2006	2007	2008	2009	2010	2011	2012	2013* mid-year	Total, by county
Bradford⁺	1	2	2	24	158	373	396	164	66	1186
Washington⁺	5	19	45	66	101	166	155	195	120	872
Tioga	0	1	0	15	124	273	272	122	13	820
Lycoming⁺	0	0	5	12	23	119	301	202	89	751
Susquehanna	0	1	2	33	88	125	205	191	102	747
Greene⁺	0	2	14	67	101	103	121	105	54	567
Total wells drilled in top six counties:										4943

Source: Pennsylvania Department of Environmental Protection, Office of Oil and Gas Management.

*Data through June 30, 2013 (accessed July 4, 2013); ⁺Study counties.

The four study counties have experienced significant Marcellus Shale well drilling and account for half (3,376) of the 6,833 unconventional wells drilled in the commonwealth. The two counties located in the southwest, Washington and Greene, experienced more well development through 2008 than the other counties. Bradford County experienced significant growth starting in 2009. Despite the late start, Bradford County quickly surpassed all other Pennsylvania counties with nearly 400 new wells drilled in 2011, for a total of 1,186 by June 30, 2013. Lycoming similarly experienced more new drilling activity in 2011 than occurred in the southwest and had the highest number of new wells drilled in 2012.

Figure 1 shows the cumulative number of wells drilled from 2005 to 2012 in each of the study counties. Although some wells may no longer be in production by 2012, and some have not yet been put into production, the lines reveal overall trends in the counties and across regions. The northern tier counties (Bradford and Lycoming) had steeper increases in the past 3 years, whereas those in the southwest (Washington and Greene) had more gradual but steady increases in the number of wells drilled.

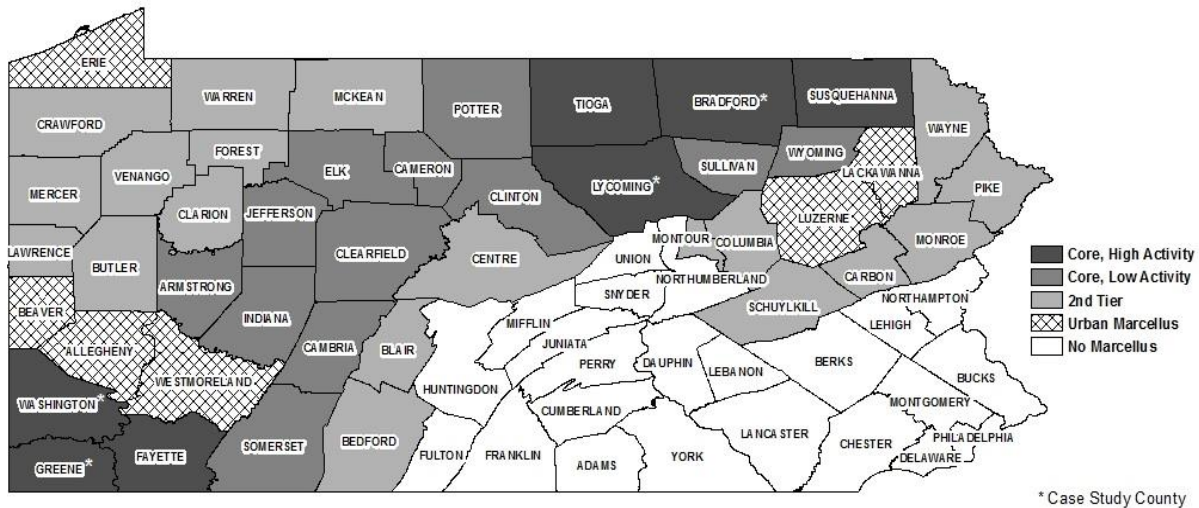


In 2012, the pace of new drilling slowed in Bradford and Lycoming, likely due to the declining price of natural gas. In contrast, drilling in Greene and Washington counties in 2012 was on par with the previous year. This may be because gas in southwestern Pennsylvania tends to be “wet” gas, meaning it contains more marketable compounds (liquid natural gases such as butane and propane) that can generate higher revenues than “dry” natural gas (i.e. methane) alone. Even so, mid-year figures suggest that new drilling activity across all four counties in 2013 may be comparable to 2012. A table listing well counts for all counties in Pennsylvania is in Appendix A.

Classifying Counties by Marcellus Shale Activity

To further understand the effects of Marcellus Shale activity, the analyses compared counties based on their level of Marcellus Shale activity using a five-category county typology. The typology was created by combining several definitions based on estimated shale value and actual development activity, including publicly available maps of the thickness, depth, and thermal maturity of the shale (McLaughlin et al., 2012). This typology also differentiates urban counties because the population and economic dynamics in these counties are fundamentally different from that of rural counties.

Figure 2. Marcellus Shale Typology



Typology based on the number of unconventional wells drilled through September 2012

In Pennsylvania, the number of wells is highly concentrated in a small number of counties. There are 7 counties (including the four study counties) that account for 90 percent of the total number of wells drilled through June 30, 2013. These 7 counties are classified as “core” counties with high drilling activity, and are shaded with the darkest gray in Figure 2. The other four typology categories are: “core” counties with low drilling activity, 2nd tier counties (with lower quality shale and limited drilling activity), urban counties with potential or some Marcellus Shale development, and those counties with no Marcellus Shale. For a full description of the typology, see Appendix B.

Measuring Health and Health Services

Little is known about the potential human health effects of Marcellus Shale drilling and related development activities. Some aspects of drilling may impact health directly if, for example, drinking water is contaminated by drilling activities. Other health effects may be indirect. For example, increased dust levels from heavy truck traffic and site and road excavation may increase asthma attacks or constant noise during the drilling phase may disrupt sleep, leading to mental or emotional distress. The increase in work activity involving heavy manual labor around dangerous equipment for long shifts may increase work-related accidents and calls for emergency services may affect the ability of local first responders to answer these and other calls. Increased truck traffic on two-lane roads may lead to increased traffic accidents resulting in injuries and an increased demand for emergency and hospital services.

This research examined indicators of health status and the use of health services in the four study counties, and determined whether there were differences among the four case study counties. The data are presented and discussed according to the region in which the counties are located and are reported by those regions. Quantitative data on health status indicators relevant to Marcellus Shale drilling are presented and are augmented by input provided during focus groups held with health, housing, and human service professionals in the two regions. These data and input are then analyzed to determine if any relationship in healthcare utilization and health status can be linked to Marcellus Shale drilling activity.

This research used data available from multiple sources to examine if the incidences of certain health status indicators and demand for healthcare services have changed in counties during the years that Marcellus drilling activity has increased. The report focuses on measures for which some changes are expected to occur because of what is known or hypothesized about how Marcellus might affect health and health service demands. Because so little is known about the relationship between health and health service use and Marcellus drilling and development, data on other measures of health and use of health services also are examined to determine if any vary with drilling activity. This aspect of the report is exploratory and should not be treated as conclusive. However, it provides the basis for additional research to determine the relationship of Marcellus Shale development to health and health services use.

Data Sources

This research used data from a combination of publicly available quantitative data sources from 1998 to 2010 and qualitative data gathered through a series of focus groups conducted in 2013 with health, housing, and human service professionals. The quantitative data were from several sources. As a result, the data for each measure were not available for all of the years or for the same years. In counties with small populations, obtaining reliable county-level estimates for some measures (i.e., those that occur infrequently) was not possible and data for these items were not used. The table in Appendix C details the measures and the years for which data are available and the sources for those data. While natural gas drilling began in 2005, the rate of drilling did not increase to more substantial levels in the study counties until 2008 and 2009. Because of this, changes in health status and health services use resulting from Marcellus drilling activity in the four study counties most likely would be observed in 2008 or later.

Focus groups were conducted with health, housing, and human service professionals representing each county in the two regions. Potential participants were identified based on the researcher's experience and contacts in the counties and regions; through recommendations from those contacts; and through web-based searches of health, housing, and human service agencies in the counties and across the regions. Consistency in participation and perspectives across regions were goals for the focus groups to the greatest extent possible.

The focus group in the southwest region included four focus group participants representing county and community-based human service, drug and alcohol, and homeless assistance agencies. The northern tier focus group included six participants representing the offices of elected officials, human services, community development, housing authorities, healthcare delivery systems, and special population advocates.

Measures and Methods of Data Analysis

The health of people can be measured at the population level (people with a particular condition per 1,000 or 100,000 population) or as numbers reporting a condition. Information on the number of individuals with a particular condition is useful for assessing demand for healthcare services in a place (county), but less useful for comparing actual health problems across places when the number of people in the places compared differs dramatically. Washington County, for example, has a much larger population than Greene County, so a report of 1,000 traffic accidents in Washington County is much less serious than the same number of traffic accidents in Greene County. Even within a county, it is

important to be careful to determine whether an increase in accidents over time results from an increase in the population or an actual increase in the rate at which accidents occur.

The quantitative data were analyzed using Microsoft Office Excel 2007 and STATA 12 (StataCorp, 2011). The number of data points, dependent upon the variable, ranged from four to 14. Accordingly, it was difficult to draw any concrete conclusions from these data. For variables with more than four data points, the values were entered into Microsoft Office Excel 2007. Qualitative data were derived from the focus groups. The focus group discussions were recorded and transcribed. Using the NVivo qualitative software program, transcripts were coded to highlight the range of topics and issues raised by focus group participants. The data collected provides contextual information and an in-depth account into the experiences of members of the health, housing, and human service sectors.

The data and results reported here describe the healthcare services available in each of the four counties to provide a snapshot of the types of healthcare services available. Data on the numbers of uninsured and those for whom health care is supported by Medicare (the federal health insurance program for persons over the age of 65 and those with disabilities) and on Medicaid (the state's health insurance program for low-income persons) also are provided as a way to track changes in residents who may be low-income or may not have health insurance since those populations pose a financial burden to the local healthcare systems. To determine if changes in certain health concerns have occurred prior to and during Marcellus expansion, data on specific types of injuries and emergencies were assessed. Finally, these quantitative data were augmented by local stakeholder perspectives provided during the focus groups with health, housing, and human service professionals in the two regions.

It should be noted that it was difficult to definitely state that changes in health status or healthcare use are a direct result of Marcellus Shale drilling activity. The primary issue here is that hospitals and emergency responders do not collect data from patients on their employment status or whether they are employed in an occupation associated with drilling. If that type of information is collected, it is not done on a systematic basis and is not publically available. The same holds true with human and social service agencies but perhaps to a lesser extent. The providers may, due to the more personal nature of the services they provide, have greater knowledge of the employment status of their clients, but, like healthcare delivery systems, they do not collect or report that information in a consistent, quantifiable, publically available manner. As a result of these limitations, the results presented here are based largely on the association between the data and the timeframe of Marcellus drilling activity.

Health and Healthcare Use in Marcellus Shale Counties

To describe the potential impacts of Marcellus Shale drilling activity, the researchers examined data on health and healthcare service use, insurance status, injuries by type, and emergency medical service complaints. Data and information on healthcare services available in the four study counties and injury and trauma data are presented by county and region and compared and contrasted to describe any changes that have occurred from the pre-Marcellus drilling period and during drilling expansion. Input from focus groups held with health, housing, and human service professionals from the regions provide additional context for the data. The data are aggregated by region (southwest and northern tier) and by county within each region: southwest (Greene and Washington) and the northern tier (Bradford and Lycoming).

Access to Healthcare Services in the Southwest Region and the Northern Tier

Access to comprehensive, quality healthcare services plays a vital role in achieving high levels of quality of care and increasing health equity for all individuals. Access to healthcare services affects an individual's physical, social, and mental health status; contributes to preventing disease; assists in detecting health conditions; facilitates treatment for health issues; and improves quality of life and life expectancy.

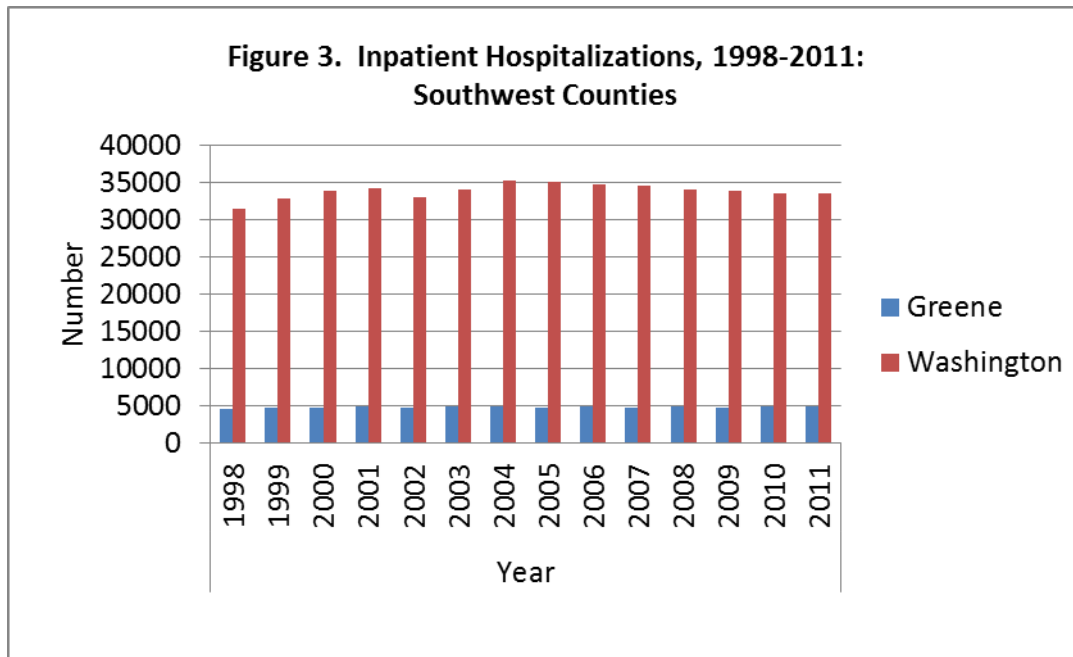
Access to care involves three distinct steps (DHHS, 2012):

1. Gaining entry into the healthcare system.
2. Accessing a healthcare location where needed services are provided.
3. Finding a healthcare provider with whom a patient can fully communicate and trust.

The following analysis measures the first two steps by focusing on use of and access to healthcare providers, including hospital- and community-based care, emergency care, and sources of insurance through Medicare and Medicaid as well as percentages of the population who are uninsured.

Inpatient hospitalization refers to healthcare services provided to an individual who has been admitted to a hospital for a period of more than one day. In the southwest region, from 1998-2010, Greene County had one hospital, Southwest Regional Medical Center, located in the county seat of Waynesburg, and Washington County had one hospital, Washington Hospital, located in Washington, the county seat. In the northern tier, Bradford County had three hospitals: Memorial Hospital in the county seat of Towanda, Troy Community Hospital in Troy, and Robert Packer Hospital in Sayre. These hospitals are part of the Guthrie Health System. Lycoming County had four hospitals: Williamsport Hospital and Divine Providence Hospital in the county seat of Williamsport, Jersey Shore Hospital in Jersey Shore, and Muncy Valley Hospital in Muncy. Two of these hospitals, Jersey Shore and Muncy Valley, are federally-designated Critical Access Hospitals, which by regulation must be located in a rural area, have 25 beds or less, be located at least 15-25 miles (depending on terrain) from the nearest hospital or be designated as a necessary provider by the state, and must provide care for a maximum of 96 hours (four days) before patient discharge. All of the hospitals in Lycoming County, with the exception of Jersey Shore Hospital, are part of the Susquehanna Health system.

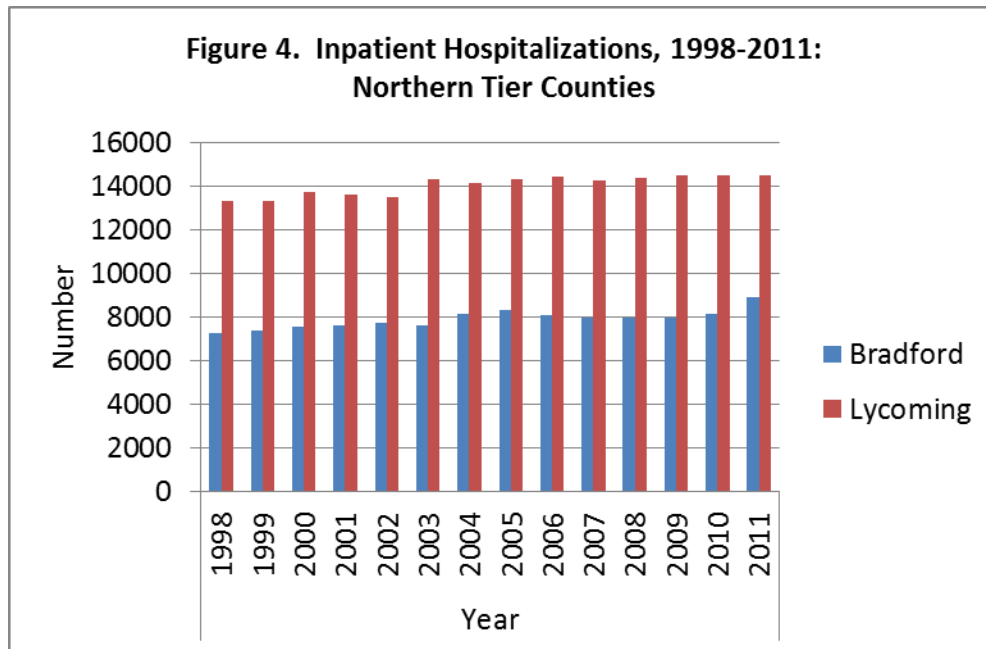
In the southwest region, total inpatient hospitalizations increased for the two counties from 1998 to 2010 (Figure 3). Greene County averaged 4,862 inpatient hospitalizations per year over the 12-year time period, with a minimum of 4,546 hospitalizations in 1998 and a maximum of 5,001 in 2006. Marcellus development began in Washington County in 2005 and in Greene County in 2006. When the data were examined pre-Marcellus development (1998-2005) versus during the expansion of Marcellus drilling (2006-2011), there was no distinguishable change in either time period (i.e.) for Greene County. However, the average number of inpatient hospitalizations during Marcellus drilling expansion in Greene County was higher than the average pre-Marcellus development, 4,934 versus 4,833. The reason for the increased inpatient hospitalizations is unknown.



Source: Pennsylvania Health Care Cost Containment Council

During the 1998-2011 time period, Washington County averaged 33,891 inpatient hospitalizations per year, with a minimum of 31,547 in 1998 and a maximum of 35,214 in 2004. There was no distinguishable trend for inpatient hospitalizations during the pre-Marcellus time period. On the other hand, a decline in hospitalizations was experienced during Marcellus Shale expansion. Contrary to what was observed in Greene County, the average inpatient hospitalizations in Washington County pre-Marcellus development was slightly higher prior to rather than during expansion, 33,938 versus 33,774.

In the northern tier, Marcellus Shale development in Bradford County actively began in 2008 and in Lycoming County in 2007. Bradford County averaged 7,904 inpatient hospitalizations over the 14-year time period of 1998-2011, with a minimum of 7,234 in 1998 and a maximum of 8,881 in 2011 as shown in Figure 4. The increasing trend that was observed for the entire time period of 1998-2011 also was evident when the data points were broken into pre-Marcellus drilling (1998-2007) and during-Marcellus expansion (2008-2011) time periods. The average number of inpatient hospitalizations for Bradford County were 7,769 during pre-Marcellus years and 8,240 during Marcellus expansion.



Source: Pennsylvania Health Care Cost Containment Council

During the 1998-2011 time period, Lycoming County averaged 14,055 inpatient hospitalizations, with a minimum of 13,311 in 1999 and a maximum of 14,515 in 2011 with no discernable difference in hospitalizations between the pre-drilling time period and during expansion. The average number of inpatient hospitalizations for Lycoming County was higher in the period of pre-Marcellus drilling than during expansion: 14,474 vs. 13,888.

In addition to information on hospital-based use of healthcare services, the number of Federally Qualified Health Centers (FQHCs), Rural Health Clinics (RHCs), and Community Mental Health Centers (CMHCs) were examined over the 2000-2008 time period. These types of healthcare providers are considered to be “safety net” providers since they provide healthcare services to those who are uninsured and underinsured (those who may have health insurance that does not cover the full cost of their care). Employer-provided health insurance may be more likely among people working for the large drilling companies than among those working for subcontractors, excavating companies, and trucking companies or other heavy equipment operators managed by independent contractors.

FQHCs provide primary care services to Medicaid, Medicare, privately insured, and uninsured populations in medically underserved areas (CMS, 2013). In the southwest, Greene County began with five FQHCs in 2000 and had eight centers at the end of 2008. Washington County had five FQHCs in 2000 and ended with seven centers in 2008. The increase in FQHCs in Greene County and the establishment of an RHC may reflect the increase in uninsured individuals. The increase in FQHCs in Washington County cannot be tied to the number of uninsured since that number decreased over the time period but may be linked to the increase in the number of persons eligible for Medicaid. In the northern tier, neither Bradford nor Lycoming county had an FQHC in 2000 to 2008, although one was established in Lycoming County in 2012.

RHCs focus on increasing primary care services to the Medicaid, Medicare, privately insured, and uninsured populations in rural areas (CMS, 2013). In the southwest, in 2006, Greene County opened its first RHC. As of 2008, Washington County had no rural health clinics since it is not considered to be a

rural county according to federal criteria for RHCs. During the 2000-2008 time period, neither county in the northern tier had any rural health clinics.

CMHCs provide outpatient services for individuals who are chronically mentally ill or have recently been discharged from a mental health facility. CMHCs also may provide screenings for those being considered for admission to a mental health facility (CMS, 2013). Neither Greene nor Washington counties had a CMHC during the 2000-2008 time period and in the northern tier, Bradford County had one CMHC in 2000, but in 2003 they had none. Lycoming County had no community mental health centers during this time period.

In summary, in the southwest region, both Greene and Washington counties are served by one general acute care hospital each, which provide inpatient and outpatient services in their respective counties. The number of safety net providers increased slightly in the study years, by three FQHCs in Greene and by two in Washington; neither county is served by a CMHC. The increase in FQHCs in Greene County and the establishment of an RHC may reflect the increase in uninsured individuals. The increase in FQHCs in Washington County cannot be tied to the number of uninsured since that number decreased over the time period. However, it may be linked to the increase in the number of persons eligible for Medicaid, which will be demonstrated in the next section.

In the northern tier, Bradford County is served by three general acute care hospitals and Lycoming by four. Bradford County had one safety net provider in the time period before Marcellus Shale drilling that closed; Lycoming County gained one FQHC between the time period prior to and during the expansion of drilling activity and was not served by any other safety net providers. The slight increases in FQHCs may be in response to available federal funding for those types of community-based healthcare providers since those types of grants have increased under federal administrations as a means to address access to healthcare services for the un- and underinsured.

Input obtained from focus groups in the two regions offered additional insight into the need for and use of healthcare services for primary and emergency care services, the lack of some services and strategies the agencies have used to respond to increased demands. One member of the focus group held in the southwest region commented on the need for services in her county based on assessments conducted by her agency.

We've done a number of health assessments...I just completed one here in 2013. In terms of health needs...it's the big three: tobacco, diet, and exercise. However, we have always put an open-ended question very near the beginning of the survey. We ask them, "What do you think's the most important issue in our community?" In the most recent one, a couple of people responded: fracking, which we had never, obviously, had that before. There are some community perceptions that there are some health issues there. After Marcellus Shale, there's a small segment that thinks it's the biggest health concern.

One member of the focus group in the northern tier commented on the lack of access to primary care services: "[F]or a while you couldn't get a dentist appointment within an hour's drive. I mean you had to go to [names of towns in a neighboring state]" and other participants concurred. "When I worked in the ER, prior to here in [name of town], and there was a lot of influx of people just because they didn't have family doctors. So their first stop was the ER. So those numbers went up." "Yeah, because you get more retired doctors in rural areas, older doctors who are coming back to practice or it's hard to get a nice,

young doctor in rural [name of town] and to stay for 20, 30 years.” “We are aging in place predominantly. We have an older population. Access to healthcare has been an ongoing challenge as well. Good and bad with natural gas is it exacerbates the access to healthcare issue.”

Focus group participants also addressed the need for mental and behavioral health services that they perceived to be an increased burden on that sector of county human services. They also acknowledged the impact that drilling has had on access to affordable housing. Several from the southwest region focus group commented:

There would be families, yes, because for instance, we had one camper, there was—he brought his wife and his two children. Our early intervention department actually had to go in, because he’s now become a county resident. Now, we’re having to offer the services to them for a child that’s birth to three who has delays, whether speech delays or whatnot, hearing delays. Our early intervention department was going in and bringing a provider in to get them those services. These are services that we could be offering to our county residents, and because they’ve become county resident. I look at it, you wanna take care of your own first.

One of her colleagues agreed:

We were able to dovetail—’cuz remember, once you cross that [line from town to town}, you’re technically in [section of the county]. I know the district overlaps there, but we decided that our children needed a place to go to get their community mental health. We were able to do that through administration and support that says, this is where we are as a community. This is where we can best service our children and our families. It happened because there’s a coordinated effort between human services, school administration, and community. That’s what we do best. When a hiccup comes along, like the Marcellus Shale industry, we go, okay, we’re accommodating. We’re going to deal with it. We’re going to move forward.

Participants from the focus group in the northern tier also noted experiences with an increased need for mental and behavioral health services. One professional provided the following assessment:

In the last 4 or 5 years, there has been increased funding requests based upon clientele for counseling, mental health issues. I don’t know if that’s related to the gas industry or not, but we’ve seen a spike in that. A couple of the organizations that we fund really have their hands full...That caused, especially the "working poor" a lot of issues. We have seen a spike, but again, I don’t know that that’s related to the gas industry.

Another professional from the northern tier agreed:

Mental health providers in our county have suffered from funding cuts I know. That’s a homeless issue too, because those people that are available to the population are living in the lower cost apartments. Then the prices go up, and

then where do they go? I mean, they have such a limited amount of money to start with and they just have no place to go.

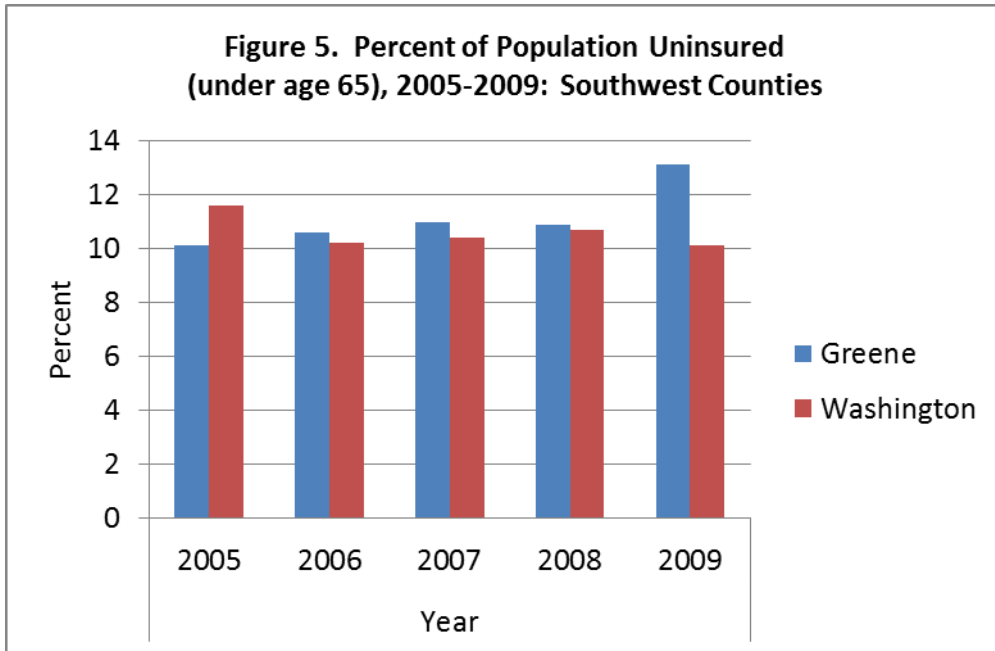
In summary, the data indicate that inpatient hospitalizations in the four counties and the two regions increased slightly with the biggest increase in Bradford and Lycoming counties and decreased slightly in Washington County between the time period prior to and during Marcellus drilling expansion. There was a slight increase overall in the number of safety net providers, mostly in the southwest region. The qualitative data from the focus groups stressed that access to primary care providers was and continues to be an issue both for permanent residents and those moving to the area due to drilling-related employment. And they stressed that the demand for mental and behavioral health services has increased as have the inter-agency strategies for addressing this need.

Insurance Status in the Southwest Region and the Northern Tier

Whether an individual has health insurance plays a significant role in access to care. Uninsured persons are less likely to receive medical care and are more likely to have shorter lifespans and poor health status. In addition, the uninsured are commonly burdened with large medical bills (DHHS, 2013). The health insurance measure used here is a county-level estimate of persons without health insurance under age 65 during the 2005-2009ⁱ period.

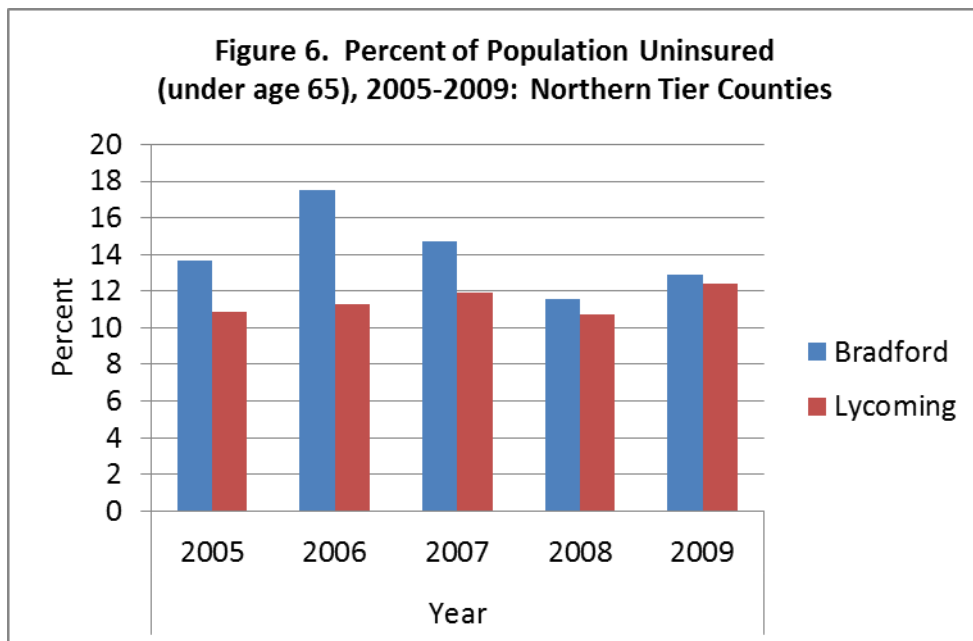
In the southwest region, Greene County had an average percentage of total uninsured population under age 65 of 11.1 percent from 2005 to 2009. There is a steady increase in the percentage of uninsured (see Figure 5) with a spike from 2008-2009. During this same time period, Washington County had an average of 10.6 percent of total population under age 65 who were uninsured, with the highest percentage in 2005, a slight decrease in 2006, and slight increases in 2007 and 2008 before decreasing to the lowest level in 2009.

ⁱ County level data on insurance status were obtained from the U.S. Census Bureau's Small Area Health Insurance Estimate (SAHIE) program. The 2005 Estimates of Persons with and without Health Insurance are carried by age and gender (18 to 64, under 65 years old, under 19 years old with family income to poverty ratio <=200%). The county estimates were produced using models that combine results from a variety of sources, including the Annual Social and Economic Supplement (ASEC) to the Current Population Survey (CPS), demographic population estimates, aggregated federal tax returns, food stamp participation records, the County Business Patterns data set, Medicaid and State Children's Health Insurance Program (SCHIP) participation records, and Census 2000. 2000 data are available for the total population and for children under age 18 but are not available by gender or race. Additional information about SAHIE data and methodologies can be found at <http://www.census.gov/hhes/www/sahie/>.



Source: U.S. Department of Health and Human Services, Office of Women’s Health

In the northern tier, during the time period of 2005-2009, Bradford County had an average percentage of 14.1 of total population under age 65 uninsured. The percentage of uninsured jumped by four percentage points from 2005-2006, decreased three percentage points in 2007, a decline that continued to 2008 before rising again in 2009 (Figure 6). Of these 5 years, 2009 had the highest drilling activity (159 wells). Compared to 2005 where only one well was present, the percentage of the population uninsured is about the same. It is difficult to determine if the introduction of workers in natural gas drilling companies and subcontractors have any effect on the percentage of the population who was uninsured.

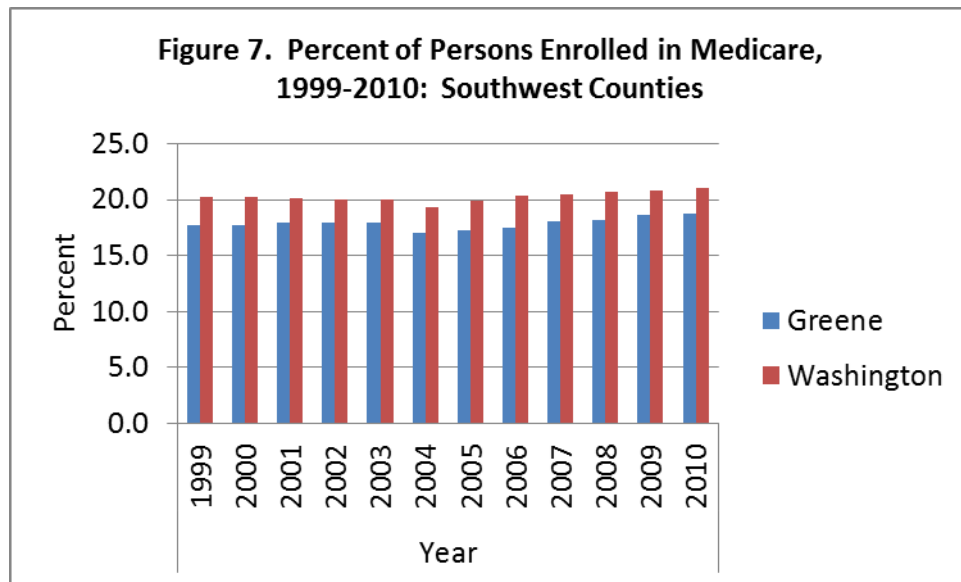


Source: U.S. Department of Health and Human Services, Office of Women’s Health

During 2005-2009, Lycoming County had not yet experienced high drilling activity. By 2009, the county had 23 wells. During this time, the county had an average of 11.4 percentage of the total population under age 65 who was uninsured, with a high of 12.4 percent in 2009 and a low of 10.7 percent in 2008.

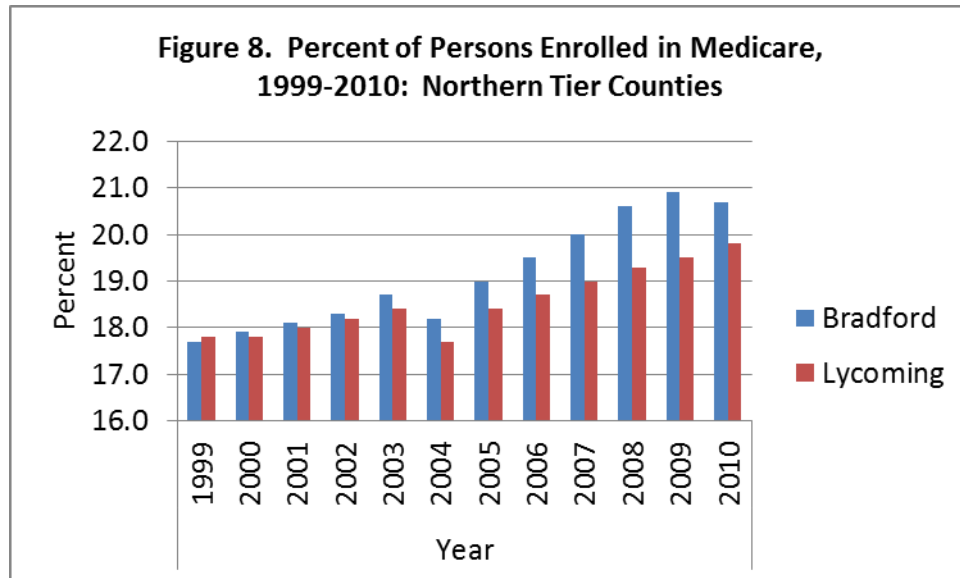
In both regions of the state, the percentage of uninsured residents was at or above 10 percent, which is consistent with the general level of uninsurance in the state overall at any given time. The overall variation in the southwest region could be explained by changes in population or employment. The spike in Greene County in 2009 could be associated with the increase in drilling activity and potentially, with individuals and families accompanying workers who were without health insurance. The fluctuations in the uninsured in Bradford County could be a result of drilling activity or other issues that would increase the percentages of uninsured.

During 1999-2010, the percent of the over age 65 population in Greene County enrolled in Medicare dipped in 2004, potentially due to changes in population. It climbed again over the next 6 years to its highest level in 2010. The same pattern in Medicare coverage held for Washington County through 2004 and then began to climb through 2010 (Figure 7).



Source: U.S. Department of Health and Human Services, Centers for Medicare and Medicaid Services, and the U.S. Census Bureau.

In the northern tier, as shown in Figure 8, the percent of persons enrolled in Medicare rose from 1993-2003, dipped in 2004, rose in 2005, and continued to increase steadily through 2009 before falling slightly in 2010. Figure 8 also shows a similar pattern for the percentage of persons enrolled in Medicare in Lycoming County which saw a steady increase from 1999-2003, a dip in 2004, and then a steady increase from 2005 to 2010. It is hard to determine if the increase in the percent of persons enrolled in Medicare is related to the general aging of the population in these counties. Noted one focus group participant in the northern tier, "We are aging in place predominantly. We have an older population."

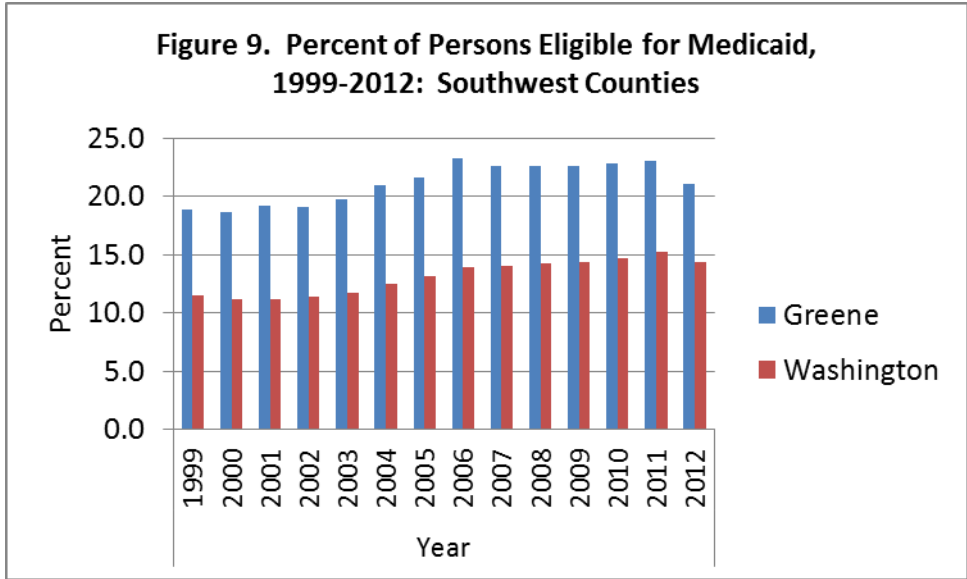


Source: U.S. Department of Health and Human Services, Centers for Medicare and Medicaid Services and the U.S. Census Bureau

In summary, while the four counties in the two regions experienced fluctuations in the percentage of persons enrolled in Medicare, the overall percentage increased during the time period of 1999-2010 and did not appear to be dependent on the level of drilling activity during the 11-year timeframe.

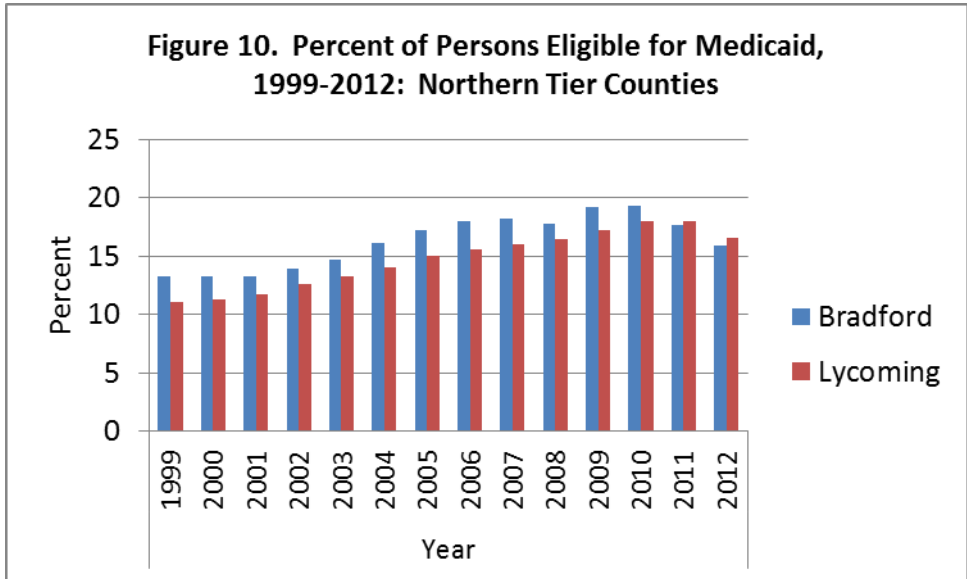
Medicaid is the state’s health insurance program for low-income persons who qualify for benefits. In Pennsylvania, the Medicaid program is known either as Medical Assistance (MA) or as HealthChoices, the name of the mandatory MA managed care program.

In the southwest region, the percentage of persons in Greene County eligible for Medicaid fluctuated in the 14-year period of 1999-2013. It dipped slightly from 1999-2000 and then rose consistently from 2001 to 2011 before decreasing slightly in 2012. Likewise, Washington County saw the same pattern in persons eligible for Medicaid: the percentage remained relatively static until 2003 when it began to rise to a peak in 2011 (Figure 9). These changes may be reflective of Marcellus development, which began in Greene County in 2006 and in Washington County in 2005, if family members or others connected to drilling workers located to the county, established residency, and were eligible for Medicaid benefits. It also may reflect local impacts of the national economic downturn in the late-2000s.



Source: Pennsylvania Department of Public Welfare

In the northern tier, the number of persons eligible for Medicaid increased steadily from 1999-2010 in Bradford County with a decrease in 2008, a jump in 2009 and 2010, and a sharp decrease in 2012 (Figure 10). Figure 10 also shows a similar pattern in the population eligible for Medicaid in Lycoming County, which increased steadily from 1999-2010 and decreased in 2011 and 2012. Since Marcellus development began in Bradford County in 2008 and in Lycoming County in 2009, it is hard to determine if the increase in the numbers of persons eligible for Medicaid is related to drilling activity or to other effects of the local economies. However, the dip in eligibility for Medicaid in 2008 in Bradford County could be a result of the development of drilling activity in that year.



Source: Pennsylvania Department of Public Welfare.

It does not appear that the percentage of persons eligible for Medicaid is dependent on Marcellus Shale drilling activity in any of the regions or the four study counties, with the exception of Bradford County, which saw a decrease in 2008, the year that drilling activity began.

Input offered during the focus group held with health, housing, and human service professionals in the northern tier region emphasized access to health services and payment for healthcare services, which is seen as a benefit for one of the healthcare systems but as a general concern overall. Tracking health insurance was seen as an issue in the northern tier as evidenced by these comments:

We had the same learning curve when this all started to happen. If they have Blue Cross of [a state in the west], well all Blue Crosses have reciprocal agreements, but that's like tracking it down I know, but—

Yeah, and it took a lot of manpower from the hospital that they weren't used to having to deal with that.

Yeah. I would think anybody that uses insurance would probably have that option in their database, but anybody who's doin' a service otherwise, wouldn't necessarily be tracking anything like that. That's been one of the problems is how do you tell if this—the situation is coming from the Marcellus Shale workers or not?

I don't know any information about that other than from the advisory panel, we have the person from the hospital in [name of town]. When the gas workers first came to town, they had a lot of trouble tracking their insurance. They would get these people coming in and they'd say, "Oh, but we have insurance," but it was in [state in the west], and it was here, and it was there. They'd have a lot of issues tracking it down, getting it figured out, and getting payment. They were like months behind on getting payments from these things. I think that now they've worked that out, because they don't seem to have the issue anymore.

Just tracking down health records, that's about it, really, and getting kids their insurance. A lot of them have trouble changing insurances or getting insurance in their private family doctor.

One focus group participant in the northern tier reflected on the benefits that the health system she represented has realized with those associated with drilling activity.

Access to health care has been an ongoing challenge as well. Good and bad with natural gas is it exacerbates the access to healthcare issue. By the same token, from an occupational health perspective, they've been great for business. They've been great for business and they're one of the most—when you speak to our director of occupational health, he will tell you that they are very good payers, that they hold to their standards very tightly, that initially one of the concerns about this developing industry in our areas was these horrendous trauma injuries, but they have not found that to be the case because safety is such a primary concern of the industry.

...I was interviewing people within the health system before today and they said that there is a positive trickledown effect when it comes to our payer mix. With the natural gas industry developing and gaining a foothold here, people who were locally employed here and other industries, they are moving into higher paying jobs, which is opening up their old jobs, which typically—employer based health insurance. We're seeing an improvement in our payer mix. As people then move into their jobs, it's the shell game, but more people are gaining employer based healthcare as a result. We think that's a very positive outcome from a pure business perspective.

The following section reviews injury and emergency service data, which are analyzed to determine differences within and between counties and regions prior to Marcellus Shale drilling activity and during expansion.

Injuries and Emergency Services in the Southwest Region and the Northern Tier

Injuries affect the population by imposing individual, social, and economic costs on society, including lost wages, uncompensated medical expenses, pain and suffering, short- and long-term physical limitations, family stress, depression, fear, and anger (Boden and Speiler, 2001). How and why injuries occur provide important information for policymakers to design and focus intervention efforts to prevent injuries (CDC, 2012). For this analysis, 12 different types of injuries were examined during the period of 2000-2011 and are related to the following mechanisms: motor vehicle accidents, motorcycles, pedestrians, gunshot wounds, stabs, falls, hot/corrosive materials, fire/flames, struck by, caught between, machinery/power tools, and assaults. These are organized into categories that relate to increases in activities that might be associated with Marcellus Shale development. For example, an increase in traffic and pedestrian accidents could occur because of the increase in traffic, especially truck traffic, associated with drilling and pipeline construction. Injuries associated with crime (gunshot wounds and stabbings) might occur with an increase in the number of younger men in the population, especially those living away from their families. This would include those who work in the gas industry and live in temporary housing in areas with drilling activity. Finally, the types of injuries associated with mechanisms, such as being struck by or caught between, and machinery or power tools also might be more frequent at workplaces, such as drilling rigs and other types of large machinery.

Table 3 describes the number of injuries by mechanism for Greene County from 2000-2011. There were no apparent trends for any of the injuries by mechanism during this time period. Table 3 also includes the average number of injuries by mechanism pre-Marcellus development and during Marcellus expansion. When the trends for pre-drilling and during expansion were examined, there were no distinguishable trends. However, during the time period of 2000-2010, the population of Greene County experienced an average annual change of 4.9 percent, with a larger decrease of 6.5 percent during the time period of 2005/2007 through 2010.

Table 3. Number of Injuries by Mechanism, 2000-2011: Greene County

	2000	2001	2002	2003	2004	2005	2006	2007	Pre-Marcellus Average	2008	2009	2010	2011*	Marcellus Expansion Average
Motor vehicle accident	25	20	17	9	4	9	11	10	13	13	3	9	3	7
Motorcycle	2	2	1	0	2	5	4	4	3	3	1	1	4	2
Pedestrian	3	1	1	0	0	1	0	0	1	0	1	1	0	1
Gunshot wound	2	1	0	0	0	1	0	0	1	0	0	0	0	0
Stab	0	2	1	0	1	1	2	0	1	0	0	2	1	1
Fall	5	11	6	8	6	8	9	9	8	10	9	8	13	10
Hot/corrosive material	2	0	1	0	1	1	0	2	1	1	0	0	0	0
Fire/flame	1	1	3	1	1	2	0	1	1	0	1	2	0	1
Struck by	2	2	1	4	3	1	1	3	2	2	3	1	0	2
Caught between	0	1	0	0	0	1	1	0	0	0	0	0	0	0
Machinery/power tool	2	1	0	2	3	4	3	1	2	1	3	1	2	2
Assault	4	1	2	2	1	2	2	4	2	2	0	2	2	2
TOTAL	48	43	33	26	22	36	33	34	35	32	21	27	25	28

Source: Pennsylvania Trauma Systems Foundation

Table 4 describes the number of injuries by mechanism for Washington County during the 2000-2011 time period. Injuries due to falls was the only category that had a discernible trend, increasing over time. Table 4 also includes the average number of injuries in Washington County by mechanism for pre-Marcellus drilling and during expansion. Upon examining trends for each injury by mechanism during this time period, few trend lines were found. There were no distinguishable trends during the full 2000-2011 time period for injuries related to motor vehicle accidents, motorcycles, or assaults. However, prior to Marcellus Shale development, motor vehicle accidents, accidents involving motorcycles, and assaults exhibited upward trends from 2000-2007. The following injuries by mechanism had distinguishable increasing trends during Marcellus expansion: pedestrian, struck by, caught between, and machinery. The population of Washington County increased by 2.4 percent from 2000-2010 and by 3.1 percent from 2005/2007 to 2010.

Table 4. Number of Injuries by Mechanism, 2000-2011: Washington County

	2000	2001	2002	2003	2004	2005	2006	2007	Pre-Marcellus Average	2008	2009	2010	2011	Post-Marcellus Average
Motor vehicle accident	110	128	138	136	155	190	177	221	157	161	162	181	166	168
Motorcycle	14	24	36	24	25	38	41	52	32	42	47	49	39	44
Pedestrian	10	16	10	14	14	7	9	17	12	5	13	11	15	11
Gunshot wound	6	8	8	2	17	8	13	15	10	14	13	5	11	11
Stab	8	9	13	12	9	11	11	16	11	12	11	9	14	12
Fall	87	88	119	151	178	168	166	198	144	210	205	244	265	231
Hot/corrosive material	3	4	0	1	1	1	1	1	2	2	3	2	5	3
Fire/flare	6	1	2	2	5	2	3	4	3	5	5	10	4	6
Struck by	9	15	8	12	15	22	30	17	16	16	19	23	23	20
Caught between	3	0	2	3	0	3	2	3	2	5	6	3	1	4
Machinery/power tool	17	23	18	10	19	15	16	15	17	12	17	20	20	17
Assault	4	18	10	15	26	20	30	39	20	23	19	29	28	25
TOTAL	277	334	364	382	464	485	499	598	426	507	520	586	591	552

Source: Pennsylvania Trauma Systems Foundation

Table 5 describes the number of injuries by mechanism for Bradford County from 2000-2011. There were no apparent trends for any of the injuries by mechanism during this time period for the county.

Table 5 also includes the average number of injuries by mechanism for the pre-Marcellus development period (2000-2007) and during expansion (2008-2011). As previously mentioned, there were no apparent trends for Bradford County during 2000-2011. However, when broken into pre-drilling and expansion periods, some distinguishable trends were observed. Injuries associated with motor vehicle accidents, pedestrians, and assault showed increasing trends in the Marcellus expansion time frame. Gunshot wound injuries also appeared to be declining from the pre-Marcellus period to the period of expansion. Bradford County’s population declined from 2000 to 2005/2007 by 3 percent and then increased by 4 percent from 2005/2007 to 2010.

Table 5. Number of Injuries by Mechanism, 2000-2011: Bradford County

	2000	2001	2002	2003	2004	2005	2006*	2007	Pre-Marcellus Average	2008	2009	2010	2011	Marcellus Expansion Average
Motor vehicle accident	42	54	58	59	55	21	9	14	39	37	49	66	76	57
Motorcycle	4	3	8	4	7	9	4	5	6	17	6	9	6	10
Pedestrian	1	4	3	3	3	0	1	2	2	2	3	3	4	3
Gunshot wound	2	2	3	1	1	0	0	0	1	1	4	1	2	2
Stab	2	4	5	4	4	1	0	3	3	3	1	6	2	3
Fall	46	39	40	50	53	49	3	30	39	81	74	88	122	91
Hot/corrosive material	0	0	0	1	0	0	0	0	0	2	2	3	2	2
Fire/flame	5	0	8	1	2	1	0	0	2	2	0	4	2	2
Struck by	1	9	2	8	5	7	0	2	4	6	6	6	7	6
Caught between	3	0	0	0	1	0	0	1	1	1	0	0	0	0
Machinery/power tool	4	4	4	6	10	8	2	1	5	2	2	15	8	10
Assault	2	3	2	2	2	1	1	2	2	1	5	5	8	5
TOTAL	112	122	133	139	143	97	20	60	104	155	152	206	239	191

Note: In 2006, level II trauma center in this county had a period of non-accreditation.

Source: Pennsylvania Trauma Systems Foundation

Table 6 describes the number of injuries by mechanism for Lycoming County during 2000-2011. There were no apparent trends for any of the injuries by mechanism during this time period for Lycoming County. Table 6 also includes average injuries by mechanism for pre-drilling and during expansion. When the trends were examined separately for these time periods, two distinguishable trends were identified: motorcycle and fire/flame injuries depicted decreasing trends.

Table 6. Number of Injuries by Mechanism, 2000-2011: Lycoming County

	2000	2001	2002	2003	2004	2005	2006	2007	Pre-Marcellus Average	2008	2009	2010	2011	Marcellus Expansion Average
Motor vehicle accident	16	16	25	29	21	25	18	29	22	24	30	35	28	29
Motorcycle	1	0	3	2	4	9	4	8	4	11	9	10	6	9
Pedestrian	1	2	1	2	2	0	3	4	2	1	1	1	4	2
Gunshot wound	1	3	0	1	2	2	3	2	2	1	3	3	2	2
Stab	0	0	0	0	0	0	1	0	0	1	0	1	1	1
Fall	12	8	14	11	10	28	24	26	17	26	18	29	17	23
Hot/corrosive material	3	0	0	1	0	0	0	1	1	2	2	6	5	4
Fire/flame	1	1	2	1	0	2	1	3	2	3	3	2	2	3
Struck by	1	1	2	2	3	2	3	0	2	3	2	3	5	3
Caught between	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Machinery/power tool	4	1	2	2	3	4	3	3	3	1	2	0	2	1
Assault	2	2	0	0	1	1	2	1	1	0	3	2	1	2
TOTAL	42	34	49	51	46	73	62	77	56	74	73	92	73	79

Source: Pennsylvania Trauma Systems Foundation.

In summary, while there were no overall trends for injuries in the four study counties or across the two regions, there were noticeable increases in injuries associated with falls, motor vehicle accidents, and accidents involving motorcycles.

It was not possible to associate the increase in falls with Marcellus Shale drilling activity but the increase in accidents could be associated with the increased vehicle traffic that resulted from an increase in population. This conclusion was reflected in comments made by several focus group participants. One professional from the southwest region reflected:

In our county...we've had a huge increase in DUI charges. Last year alone, we had 25 individuals from out of state that were pulled over for a DUI. The problem with [name of county], especially if you're within the borough, where many of these gentlemen are living, we have a lot of one-way streets. It's very easy to turn onto a one-way street. A lot of times, that's what happens. They turn onto a one-way street, the borough cop sees them, they pull them over, they may have had just a couple of beers or whatever. It might've been three blocks from their place of residence, but that's pretty much.

Emergency Medical Services Complaints in the Southwest Region and the Northern Tier

Emergency Medical Services (EMS) is a component of the healthcare delivery system that provides emergency medical care, often activated by an incident that causes serious illness or injury. EMS is a system of coordinated response and emergency medical care involving several individuals and agencies (NHTSA, 2013). A complaint refers to the type of health issue an individual was experiencing when the EMS service was requested. Analyzing EMS complaints can help in understanding what types of health emergencies were experienced before the highest level of drilling activity and after.

Table 7 provides the total number of emergency medical services (EMS) complaints (of those selected for this analysis) during the period of 2009-2011 in Greene County and Table 8 provides details on those complaints by category.

Table 7. Total Number of Complaints, 2009-2011: Greene County

2009	2010	2011
149	2,418	5,030

Source: Pennsylvania Department of Health, Bureau of Emergency Medical Services.

Table 8. Number of Complaints by Category, 2009-2011: Greene County

Complaint	2009 101 wells	2010 102 wells	2011 121 wells	Total 2009-2011	Average Number of Complaints 2009-2011
Abdominal Pain	2	93	189	284	95
Assault	1	20	71	92	31
Back Pain	3	17	39	59	20
Breathing Problem	21	272	413	706	235
Burns	1	12	12	25	8
CO Poisoning/Hazmat	1	7	7	15	5
Cardiac Arrest	6	40	57	103	34
Chest Pain	23	301	399	723	241
Choking	2	10	6	18	6
Convulsions/Seizure	7	71	126	204	68
Diabetic Problem	4	61	124	189	63
Electrocution	0	5	1	6	2
Eye Problem	0	3	7	10	3
Fall Victim	10	237	398	645	215
Headache	1	13	22	36	12
Heart Problems	0	23	28	51	17
Heat/Cold Exposure	0	9	13	22	7
Hemorrhage/Laceration	3	43	74	120	40
Industrial Accident/Inaccessible Incident/Other	3	14	17	34	11
Stab/Gunshot Wound	0	5	9	14	5
Stroke/CVA	1	61	95	157	52
Traffic Accident	21	252	484	757	252
Traumatic Injury	10	116	268	394	131
Unconscious/Fainting	6	94	136	236	79
Unknown Problem Man Down	11	154	316	481	160
Transfer/Interfacility/Palliative Care	12	485	1,719	2,216	739
MCI (Mass Casualty Incident)	0	0	0	0	0
TOTAL	149	2,418	5,030	7,597	2,531

Source: Pennsylvania Department of Health, Bureau of Emergency Medical Services.

Table 9 provides the total number of emergency medical services (EMS) complaints for Washington County (of those selected for this analysis) during 2009-2011 and Table 10 provides the detail on those complaints by category.

Table 9. Total Number of Complaints, 2009-2011: Washington County

2009	2010	2011
2,732	4,582	33,632

Source: Pennsylvania Department of Health, Bureau of Emergency Medical Services.

Table 10. Number of Complaints by Category, 2009-2011: Washington County

Complaint	2009 101 wells	2010 167 wells	2011 156 wells	Total 2009-2011	Average Number of Complaints 2009-2011
Abdominal Pain	94	325	1,288	1,707	569
Assault	28	136	494	658	219
Back Pain	36	98	439	573	191
Breathing Problem	279	1,076	3,467	4,822	1,607
Burns	3	15	58	76	25
CO Poisoning/Hazmat	0	2	14	16	5
Cardiac Arrest	36	126	324	486	162
Chest Pain	207	830	2,459	3,496	1,165
Choking	6	13	83	102	34
Convulsions/Seizure	58	229	928	1,215	405
Diabetic Problem	60	272	1,044	1,376	459
Electrocution	0	1	6	7	2
Eye Problem	1	8	16	25	8
Fall Victim	293	1,112	3,877	5,282	1,761
Headache	6	48	186	240	80
Heart Problems	16	56	263	335	112
Heat/Cold Exposure	3	9	55	67	22
Hemorrhage/Laceration	46	159	591	796	265
Industrial Accident/Inaccessible Incident/Other	2	3	14	19	6
Stab/Gunshot Wound	1	8	35	44	15
Stroke/CVA	75	8	1,046	1,432	376
Traffic Accident	200	8	2,756	3,588	988
Traumatic Injury	152	8	1,232	1,794	464
Unconscious/Fainting	133	8	1,554	2,129	565
Unknown Problem Man Down	62	8	1,015	1,323	362
Transfer/Interfacility/Palliative Care	935	8	10,388	14,583	3,777
MCI (Mass Casualty Incident)	0	8	0	0	3
TOTAL	2,732	4,582	33,632	46,191	13,647

Source: Pennsylvania Department of Health, Bureau of Emergency Medical Services.

Unlike injuries by mechanism, the number of complaints by category increased substantially in the southwest region, by 3,276 percent in Greene County and by 1,131 percent in Washington County. Increases in specific complaints for breathing problems, cardiac arrest, chest pain, fall victims, headache, hemorrhage/laceration, industrial accident/inaccessible incident/other, stroke/CVA, traffic accident, traumatic injury, unconscious/fainting, and unknown problem man down were the chief complaints for which emergency assistance was requested.

The input offered during the focus group held with health, housing, and human service professionals in the southwest region did not address reported injuries, *per se*. Instead, the participants emphasized issues associated with individual behavior, such as drug use, outcomes associated with alcohol consumption such as DUIs, and sexually transmitted diseases. It is not possible to associate these comments with the data for complaints but it can be hypothesized that behaviors associated with drug use could lead to these types of reported injuries.

I'll tell you, one of the biggest problems that I know of in our business because we deal with some of these oil and gas people, is this dope. They can't pass a drug test. They'll have an application out, there will be 25 people come in, make an application out. Twenty-three of them can't pass the drug test. The drug people come out to take a test, they'll walk around, half of them's gone. They

know they can't pass the test, so they just leave. It's a sad situation, this drug thing. It's sad.

Another participant noted that there is an “influx of cash...and an influx of population” and as a result:

We're right on the tri-axle of drugs coming in from [city in southwest Pennsylvania], drugs coming in from [cities in a neighboring state] via the [city in the Midwest] pipeline. We're right here. Meth has not made it here yet, thank you, God. That's maybe out in the eastern part of our county, but not here in our area yet, but we've had some concerns with heroin and that sort of thing. That's also been a part of the impact as well, as far as I'm concerned.

Table 11 provides the total number of emergency medical services (EMS) complaints for Bradford County (of those selected for this analysis) during the period of 2009-2011 and Table 12 provides the detail on those complaints by category.

Table 11. Total Number of Complaints, 2009-2011: Bradford County

2009	2010	2011
1,646	7,878	8,607

Source: Pennsylvania Department of Health, Bureau of Emergency Medical Services.

Table 12. Number of Complaints by Category, 2009-2011: Bradford County

Complaint	2009	2010	2011	Total 2009-2011	Average Number of Complaints 2009-2011
Abdominal Pain	63	445	479	987	329
Assault	6	80	41	127	42
Back Pain	44	232	173	449	150
Breathing Problem	167	941	1,177	2,285	762
Burns	6	19	24	49	16
CO Poisoning/Hazmat	12	7	3	22	7
Cardiac Arrest	16	80	108	204	68
Chest Pain	140	679	774	1,593	531
Choking	6	41	23	70	23
Convulsions/Seizure	49	147	293	489	163
Diabetic Problem	37	247	289	573	191
Electrocution	0	1	0	1	0
Eye Problem	4	2	11	17	6
Fall Victim	326	1,045	1,049	2,420	807
Headache	5	63	33	101	34
Heart Problems	72	285	57	414	138
Heat/Cold Exposure	0	7	18	25	8
Hemorrhage/Laceration	15	115	183	313	104
Industrial Accident/Inaccessible Incident/Other	0	10	56	66	22
Stab/Gunshot Wound	0	20	9	29	10
Stroke/CVA	44	306	210	560	187
Traffic Accident	379	1,757	1,778	3,914	1,305
Traumatic Injury	31	126	270	427	142
Unconscious/Fainting	20	226	344	590	197
Unknown Problem Man Down	23	168	330	521	174
Transfer/Interfacility/Palliative Care	181	826	875	1,882	627
MCI (Mass Casualty Incident)	0	3	0	3	1
TOTAL	1,646	7,878	8,607	18,131	6,044

Source: Pennsylvania Department of Health, Bureau of Emergency Medical Services.

Table 13 provides the total number of emergency medical services (EMS) complaints for Lycoming County (of those selected for this analysis) during the period of 2009-2011 and Table 14 provides the detail on those complaints by category.

Table 13. Total Number of Complaints, 2009-2011: Lycoming County

2009	2010	2011
4,464	11,671	11,819

Source: Pennsylvania Department of Health, Bureau of Emergency Medical Services.

Table 14. Number of Complaints by Category, 2009-2011: Lycoming County

Complaint	2009	2010	2011	Total 2009-2011	Average Number of Complaints 2009-2011
Abdominal Pain	213	612	609	1,434	478
Assault	104	221	228	553	184
Back Pain	80	305	302	687	229
Breathing Problem	506	1,492	1,308	3,306	1,102
Burns	15	25	13	53	18
CO Poisoning/Hazmat	5	32	39	76	25
Cardiac Arrest	129	247	199	575	192
Chest Pain	590	1,362	1,142	3,094	1,031
Choking	16	62	50	128	43
Convulsions/Seizure	169	427	321	917	306
Diabetic Problem	126	375	297	798	266
Electrocution	0	10	4	14	5
Eye Problem	5	6	17	28	9
Fall Victim	543	1,712	1,546	3,801	1,267
Headache	35	72	73	180	60
Heart Problems	32	108	108	248	83
Heat/Cold Exposure	5	25	32	62	21
Hemorrhage/Laceration	73	235	184	492	164
Industrial Accident/Inaccessible Incident/Other	7	18	14	39	13
Stab/Gunshot Wound	19	50	34	103	34
Stroke/CVA	120	363	336	819	273
Traffic Accident	628	1,530	1,618	3,776	1,259
Traumatic Injury	102	273	222	597	199
Unconscious/Fainting	251	572	567	1,390	463
Unknown Problem Man Down	133	231	361	725	242
Transfer/Interfacility/Palliative Care	553	1,297	2,187	4,037	1,346
MCI (Mass Casualty Incident)	5	9	8	22	7
TOTAL	4,464	11,671	11,819	27,954	9,319

Source: Pennsylvania Department of Health, Bureau of Emergency Medical Services.

Like the southwest region, the number of complaints by category increased substantially in the northern tier between the period prior to and during Marcellus expansion, by 424 percent in Bradford County and by 165 percent in Lycoming County. And consistent with the southwest region, specific complaints were reported for breathing problems, cardiac arrest, chest pain, fall victims, headache, hemorrhage/laceration, industrial accident/inaccessible incident/other, stroke/CVA, traffic accident, traumatic injury, unconscious/fainting, and unknown problem man down. Participants in the northern tier focus group did not comment on injuries or the need for emergency response care.

In summary, while there were no trends in injuries reported in the two regions, the number of EMS complaints was substantial, increasing, in some cases by more than 3,000 percent. As with the data on healthcare use and insurance status, data were not collected by EMS responders on the employment

status of patients and if those data were collected, they are not collected in a consistent, systematic way and are not reported in any publically available format that is useful for analysis. However, given the increase in drilling activity, it can be hypothesized that the increase in these complaints is associated with drilling activity, changes in the number and type of persons in the counties at any given time, and the results of employment-related or leisure time activity.

Summary and Conclusions

All counties and regions are served by general acute care hospitals but the level of service by “safety net providers” varies and does not seem to be associated with a change in population overall but may reflect an increase in the uninsured population in certain counties. Inpatient hospitalizations in the four counties and the two regions increased slightly in the northern tier and decreased slightly in the southwest. The changes in the uninsured population could not be tied directly to Marcellus Shale drilling activity and may reflect the economic changes that occurred in the mid-2000s.

While the four counties experienced fluctuations in the percentage of persons enrolled in Medicare, the overall percentage increased during 1999-2010 and did not appear to be dependent on the level of drilling activity during the 11-year timeframe. The same holds true for Medicaid.

There were no overall trends for injuries in the four study counties or across the two regions; however, there were noticeable increases in injuries associated with falls, motor vehicle accidents, and accidents involving motorcycles, potentially as a result of driving while under the influence of alcohol or drugs.

While there were no trends in injuries reported in the two regions prior to or during the expansion of drilling activity, the increase in the number of EMS complaints was substantial, increasing, in some cases by more than 3,000 percent. This is the most notable finding of the analyses, and while the complaints could not be definitely tied to drilling activity, it is hypothesized that Marcellus Shale expansion is the cause.

Input from the focus groups held with health, housing, and human service professionals in the two regions support, in general, the quantitative data but also provide additional contextual information. Overall, the influx of workers and their families place additional burdens on human service providers who identified associated increases in the need for mental and behavioral health services for the workers and for their families. The agencies responded through collaborative strategies to address these needs. Negative outcomes resulting from behavioral health issues, such as increased DUIs and drug use activity, also were noted. It also was noted that while many of the workers associated with the drilling industry have insurance, that coverage is valid in other states and may not transfer to the local areas. However, it was acknowledged that the drilling industry can be associated with patients who have access to employer-sponsored health insurance, a bonus for hospitals.

As noted earlier, it was difficult to definitely state that changes in health status or healthcare use are a direct result of Marcellus Shale drilling activity. The primary issue here is that the healthcare delivery system, as a general rule, does not collect data from patients on their employment status or whether they are employed in an occupation associated with drilling. If that type of information is collected, it is not done on a systematic basis and is not publically available. The same holds true with human and social service agencies but perhaps to a lesser extent. The providers may, due to the more personal nature of the services they provide, have greater knowledge of the employment status of their clients but, like healthcare delivery systems, they do not collect, or report, that information in a consistent,

quantifiable, publically available manner. As a result of these limitations, the results presented in this report are based largely on the association between the data and the timeframe of Marcellus drilling activity. Policies implemented in the sectors across the healthcare continuum that require this kind of data collection would aid greatly in establishing a clear cause-and-effect relationship between Marcellus Shale drilling activity and healthcare use and health status.

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Appendix A: Unconventional Wells Drilled by County and Year, 2005-2013

county name	2005	2006	2007	2008	2009	2010	2011	2012	2013*	Total, county
Bradford**	1	2	2	24	158	373	396	164	66	1186
Washington**	5	19	45	66	101	166	155	195	120	872
Tioga	0	1	0	15	124	273	272	122	13	820
Lycoming**	0	0	5	12	23	119	301	202	89	751
Susquehanna	0	1	2	33	88	125	205	191	102	747
Greene**	0	2	14	67	101	103	121	105	54	567
Westmoreland	1	0	4	33	39	49	59	42	22	249
Fayette	0	2	6	20	57	44	54	43	12	238
Butler	0	3	12	11	10	35	35	69	44	219
Armstrong	0	3	2	7	19	36	35	44	26	172
Clearfield	0	0	1	6	24	39	58	19	2	149
Wyoming	0	0	0	0	2	24	71	15	25	137
Clinton	0	0	0	4	9	35	39	10	1	98
Sullivan	0	0	0	0	0	22	19	27	5	73
Potter	0	0	8	6	8	36	11	1	0	70
Elk	1	1	6	8	6	16	22	1	3	64
McKean	0	2	1	5	7	22	19	5	3	64
Centre	0	0	1	4	7	41	8	2	0	63
Indiana	0	0	0	5	6	7	21	2	0	41
Jefferson	0	0	0	3	3	7	15	9	0	37
Allegheny	0	0	0	1	3	0	5	13	8	30
Lawrence	0	0	0	0	0	0	2	16	8	26
Beaver	0	0	0	0	1	1	5	17	2	26
Somerset	0	0	1	0	7	4	7	5	1	25
Clarion	0	0	3	1	3	3	10	4	0	24
Forest	0	0	0	0	5	1	0	12	4	22
Cameron	0	0	0	3	2	3	7	0	0	15
Mercer	0	0	0	0	0	0	0	5	3	8
Cambria	0	0	0	0	2	1	3	1	0	7
Blair	0	0	0	0	0	4	2	0	0	6
Venango	0	0	0	0	0	0	2	3	0	5
Warren	0	0	2	0	0	0	1	1	1	5
Wayne	0	0	0	1	0	4	0	0	0	5
Columbia	0	0	0	0	0	1	2	0	0	3
Crawford	0	0	0	0	0	0	0	3	0	3
Lackawanna	0	0	0	0	1	0	1	0	0	2
Luzerne	0	0	0	0	0	2	0	0	0	2
Bedford	0	0	0	0	0	1	0	0	0	1
Huntingdon	0	0	0	0	0	1	0	0	0	1
Total, by year	8	36	115	335	816	1598	1963	1348	614	6833

Source: Pennsylvania Department of Environmental Protection, Office of Oil and Gas Management. *Data through June 30, 2013 (accessed July 4, 2013). **Study counties.

Appendix B. Marcellus Activity County Typology Definitions for Pennsylvania^a

Category	Geological Definition	Activity level	Counties
Core Counties with High Drilling Activity^b (N=7)	More than 50 percent of the land area is in the core Marcellus formation	Annual average 64 or more Marcellus wells 2005 to 2010	Bradford, Fayette, Greene, Lycoming, Susquehanna, Tioga, Washington
Core Counties with Low Drilling Activity (N=12)	More than 50 percent of the land area is in the core Marcellus formation	Annual average less than 64 Marcellus wells 2005 to 2010	Armstrong, Cambria, Cameron ^c , Clearfield, Clinton, Elk, Indiana, Jefferson, Potter ^c , Somerset, Sullivan ^c , Wyoming
Counties in the Marcellus 2nd Tier (N=19)	1 percent-50 percent land area is in the core <u>and</u> 25 percent or more land area is in the less viable areas (2 nd tier or gray areas in Figure 12)	Not applicable	Bedford, Blair, Butler, Carbon, Centre, Clarion, Columbia, Crawford, Forest ^c , Lawrence, McKean, Mercer, Monroe, Montour ^c , Pike, Schuylkill, Venango, Warren, Wayne
Urban Counties in the Marcellus Shale-- Core or 2nd Tier (N=6)	Marcellus Core or 2 nd Tier <u>and</u> identified as urban by the Center for Rural Pennsylvania	Not applicable	Allegheny, Beaver, Erie, Lackawanna, Luzerne, Westmoreland
Counties with No Marcellus Shale (N=23)	25 percent or less viable Marcellus land area or no Marcellus land area	Not applicable	Adams, Berks, Bucks, Chester, Cumberland, Dauphin, Delaware, Franklin, Fulton ^c , Huntingdon, Juniata, Lancaster, Lebanon, Lehigh, Mifflin, Montgomery, Northampton, Northumberland, Perry, Philadelphia, Snyder, Union, York

^aSee McLaughlin, et al. 2012.

^bNote this category includes all four study counties.

^cThese counties are excluded from subsequent analyses as their populations are too small to be included in ACS three-year estimates.

Appendix C: Health-related Variables by Years Available

Variable	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
HEALTH SERVICES														
Number of hospitals	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Number of federally qualified health centers			X	X	X	X	X	X	X	X	X			
Number of rural health centers			X	X	X	X	X	X	X	X	X			
Number of community mental health centers			X	X	X	X	X	X	X	X	X			
GENERAL HEALTH-RELATED CHARACTERISTICS														
Inpatient hospitalizations	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Number of population enrolled in Medicare (over age 65) and disabled		X	X	X	X	X	X	X	X	X	X	X	X	
Number of population eligible for enrollment in Medicaid (under age 65)		X	X	X	X	X	X	X	X	X	X	X	X	
Percentage of total population uninsured (under age 65)								X	X	X	X	X		
VEHICLE AND TRAFFIC RELATED INJURIES AND COMPLAINTS														
Number of motor vehicle accidents			X	X	X	X	X	X	X	X	X	X	X	X
Number of motorcycle injuries			X	X	X	X	X	X	X	X	X	X	X	X
Number of pedestrian injuries			X	X	X	X	X	X	X	X	X	X	X	X
Number of traffic accident complaints												X	X	X
CRIME-RELATED INJURIES AND COMPLAINTS														
Number of gunshot wound injuries			X	X	X	X	X	X	X	X	X	X	X	X
Number of stab-related injuries			X	X	X	X	X	X	X	X	X	X	X	X
Number of assault injuries			X	X	X	X	X	X	X	X	X	X	X	X
Number of stab/gunshot wound complaints												X	X	X
POSSIBLE WORK-RELATED INJURIES AND COMPLAINTS														
Number of fall-related injuries			X	X	X	X	X	X	X	X	X	X	X	X
Number of hot/corrosive material-related injuries			X	X	X	X	X	X	X	X	X	X	X	X
Number of fire/flame injuries			X	X	X	X	X	X	X	X	X	X	X	X
Number of struck by injuries			X	X	X	X	X	X	X	X	X	X	X	X
Number of caught between injuries			X	X	X	X	X	X	X	X	X	X	X	X
Number of machinery/power tool-related injuries			X	X	X	X	X	X	X	X	X	X	X	X
Number of breathing problem complaints												X	X	X
Number of burn complaints												X	X	X
Number of CO poisoning/hazmat complaints												X	X	X
Number of cardiac arrest complaints												X	X	X
Number of chest pain complaints												X	X	X
Number of electrocution complaints												X	X	
Number of eye problem complaints												X	X	X
Number of fall victim complaints												X	X	X
Number of headache complaints												X	X	X
Number of heart problem complaints												X	X	X
Number of heat/cold exposure complaints												X	X	X
Number of hemorrhage/laceration												X	X	X

complaints																				
Number of industrial accident/inaccessible incident/other complaints														X	X	X				
Number of stroke/CVA complaints														X	X	X				
Number of traumatic injury complaints														X	X	X				
Number of unconscious/fainting complaints														X	X	X				
Number of unknown problem man down complaints														X	X	X				
Number of MCI (mass casualty incident) complaints														X	X	X				

Sources of Data Used in This Report

For this analysis, reports, query tools, and information were used from five data sources: the Pennsylvania Health Care Cost Containment Council (PHC4), the federal Office on Women’s Health (OWH), the Centers for Medicare and Medicaid Services (CMS), the Pennsylvania Trauma Systems Foundation (PTSF), the Pennsylvania Emergency Health Services Council (PEHSC) and the Pennsylvania Department of Public Welfare (DPW). Qualitative data from focus groups held in the two regions also were used to augment data reported from these five sources. These focus groups were conducted with health, housing, and human service professionals representing each county in the two regions. Potential participants were identified based on the researcher’s experience and contacts in the counties/regions, through recommendations from those contacts, and through web-based searches of health, housing, and human service agencies in the counties/regions. The focus group in the southwest region included six focus group participants representing county and community-based human service, drug and alcohol, and homeless assistance agencies. The northern tier focus group included nine participants representing the offices of elected officials and human service, community development, housing authorities, healthcare delivery systems, and special population advocates.

PHC4 is an independent state agency that collects, analyzes, and reports healthcare information for Pennsylvania. PHC4 collects information on all inpatient and outpatient records for 509 hospitals and ambulatory surgery centers in Pennsylvania. While a majority of PHC4 data are not publicly available, reports on selected health topics are available at the county-level. The analysis for this report utilizes data on total ambulatory surgery records and inpatient hospitalizations at the county-level for the study four counties.

OWH is a part of the U.S. Department of Health and Human Services (HHS). The office was established in 1991 to improve the health of American women by coordinating a women’s health agenda throughout the HHS. The OWH supports Quick Health Data Online, an interactive system that provides health data compiled from national sources and obtained from each state individually, such as the Annual Social and Economic Supplement (ASEC) of the Current Population Survey (CPS), the Centers for Medicare and Medicaid (CMS), and the National Center for Health Statistics (NCHS). The system provides information on 11 main categories: demographic characteristics, mortality, natality, reproductive health, violence, prevention, disease, and mental health. Each category contains numerous subcategories. For this report, data regarding access to care, infectious and chronic disease, and mortality at the county-level were used.

CMS is an agency within the U.S. Department of Health and Human Services (HHS) responsible for administration of several key federal health care programs. In addition to Medicare (the federal health insurance program for seniors) and Medicaid (the federal needs-based program), CMS oversees the Children's Health Insurance Program (CHIP), the Health Insurance Portability and Accountability Act (HIPAA) and the Clinical Laboratory Improvement Amendments (CLIA), among other services. For this report, data from CMS' registry of Medicaid enrollment were used.

PTSF was organized through the combined efforts of the Pennsylvania Medical Society, the Hospital and Healthsystem Association of Pennsylvania, the Pennsylvania State Nurses Association, the Pennsylvania Emergency Health Services Council, and the Pennsylvania Department of Health. PTSF develops standards for trauma centers in Pennsylvania and issues certificates of accreditation. The Foundation collects statewide trauma registry data, designed specifically to assess injury by mechanism (how the injury occurred) data.

PEHSC is a non-profit organization whose core mission is to serve as an independent advisory body to the Pennsylvania Department of Health and other appropriate agencies on matters pertaining to Emergency Medical Services (EMS). PEHSC fosters improvements in the quality and delivery of emergency health services throughout the Commonwealth. The data acquired from this source contains EMS data categorized by the healthcare issue or complaints.

DPW is the agency in Pennsylvania that administers the Medicaid program, known in the state as Medical Assistance. DPW's mission is to promote, improve and sustain the quality of family life; break the cycle of dependency; promote respect for employees; protect and serve Pennsylvania's most vulnerable citizens; and manage our resources effectively.

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