

Neonatal Abstinence Syndrome and Maternal Substance Abuse in Tennessee 1999-2011

Tennessee Department of Health

Division of Policy, Planning and Assessment

Surveillance, Epidemiology and Evaluation

TENNESSEE DEPARTMENT OF HEALTH ORGANIZATION

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The mission of the Tennessee Department of Health is to protect, promote and improve the health and prosperity of people in Tennessee.

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Executive Summary

Neonatal abstinence syndrome (NAS) is a group of problems that occur in a newborn who was exposed to addictive illegal or prescription drugs while in the mother's womb. These drugs can include amphetamines, barbiturates, benzodiazepines, cocaine, marijuana and opiates/narcotics. These substances pass through the placenta to the baby during pregnancy and the baby becomes addicted along with the mother. At birth, the baby is no longer getting the drug and symptoms of withdrawal occur. Symptoms can begin within 1-3 days of birth or may take 5-10 days to appear, and can last as long as 6 months. These symptoms can include mottled skin, diarrhea/vomiting, excessive sucking, poor feeding, slow weight gain, fever, rapid breathing, hyperactive reflexes, increased muscle tone, sleep problems, irritability, excessive or high-pitched crying, sweating, trembling and seizures. Drug use during pregnancy is also associated with birth defects, low birthweight, prematurity and sudden infant death syndrome.*

NAS is a growing problem in Tennessee – between 1999 and 2011, the inpatient hospitalization rate for infants diagnosed with NAS increased approximately eleven-fold. This report was created in response to heightened awareness of this issue, and is the first comprehensive source of information about NAS in Tennessee. It examines trends in the number and rate of, and billed charges and length of stay associated with, NAS hospitalizations in the state from 1999 to 2011. Both discharge-level and unique patient data are presented, and the report includes both statewide and county-level data. In addition, the report also includes information on hospitalizations for deliveries with maternal substance abuse. Overall maternal substance abuse hospitalizations are examined, as well as hospitalizations by maternal age, type of drug used and dependent versus nondependent drug use. Data on maternal substance abuse are discharge-level and include both statewide and county-level data.

Key findings in this report include the following:

Neonatal Abstinence Syndrome

- In 2011, there were 672 inpatient hospitalizations (discharge-level) with any diagnosis of NAS and the NAS hospitalization rate was 8.5 discharges per 1,000 live births.
- Between 1999 and 2011, the NAS hospitalization rate increased approximately eleven-fold.
- The majority of NAS hospitalizations (96%) were billed to TennCare.
- In 2011, billed charges for NAS hospitalizations totaled \$41.7 million, and mean charges per hospital discharge were approximately \$62,000.
- After accounting for inflation, mean charges for NAS hospitalizations approximately tripled between 1999 and 2011.
- In 2011, the mean length of stay for NAS hospitalizations was 17.5 days.
- Mean charges among newborns with a secondary diagnosis of NAS were 4 times as high as among those without NAS; mean length of stay among those with NAS was over 3 times as long.
- The majority of NAS hospitalizations represent unique patients. Among the 672 discharge-level NAS hospitalizations in 2011, 629 (94%) were unique patients and the remaining 43 (6%) were readmissions.

* National Institutes of Health; National Library of Medicine; A.D.A.M. Medical Encyclopedia. Atlanta (GA): A.D.A.M.; 2013. Accessed April 2013 at <http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0004566/>

Executive Summary *cont.*

Maternal Substance Abuse

- In 2011, there were 1,592 inpatient hospitalizations for deliveries with maternal substance abuse in Tennessee, and the hospitalization rate was 21.3 discharges per 1,000 liveborn deliveries.
- Between 1999 and 2011, the hospitalization rate for deliveries with maternal substance abuse approximately tripled.
- In 2011, the highest hospitalization rate for deliveries with maternal substance abuse occurred among women 20-24 years of age and the lowest among those 40-44 years of age.
- In 2011, the highest hospitalization rates for deliveries with maternal substance abuse were for marijuana and opioids.
- Since 2009, maternal marijuana use has decreased 18%; since 1999 maternal opioid use has increased 38-fold.
- In 1999, opioids represented 2.1% of maternal substance abuse diagnoses; in 2011 they represented 26.5% of these diagnoses.
- In 2011, the majority (83%) of deliveries with maternal substance abuse had a diagnosis of nondependent drug use; about 16% had a diagnosis of dependent use and less than 1% had diagnoses for both nondependent and dependent use.
- Marijuana represented the highest proportion (42%) of maternal substance abuse diagnoses for nondependent drug use; opioids represented the highest proportion (66%) of dependent use.

The above key findings, along with the other information contained within this report, are the most up-to-date data available on NAS and on maternal substance abuse in Tennessee. The purpose of the report is to inform health professionals, policy makers and the general public of the importance of NAS, and its impact on health, the health care system and society. It is hoped this information will help guide efforts to address this issue in Tennessee and improve maternal and child health.

What is Tennessee doing to address neonatal abstinence syndrome?

A subcabinet working group was convened in 2012 to focus mainly on primary prevention strategies for reducing the burden of neonatal abstinence syndrome. The group is comprised of cabinet-level representatives from the Departments of Health, Children's Services, Mental Health and Substance Abuse Services, Human Services, and TennCare, as well as representatives of the Children's Cabinet. Subcabinet activities have thus far focused on identifying state NAS data resources, developing common messages, implementing policy strategies aimed at primary prevention (such as prior authorization requirements for long acting narcotics) and engaging external partners at local, state, and federal levels.

In January 2013, NAS became a reportable disease in Tennessee – all healthcare providers are required to report cases of NAS at the time of diagnosis. This information is for surveillance purposes only, and will be used to inform the development of NAS-related policies and programs aimed at reducing the incidence of babies born to substance-affected women. More information about NAS and reporting requirements can be found at: <http://health.state.tn.us/MCH/NAS/index.shtml>.

**Neonatal Abstinence Syndrome
Inpatient Hospitalizations**

Discharge-Level Data

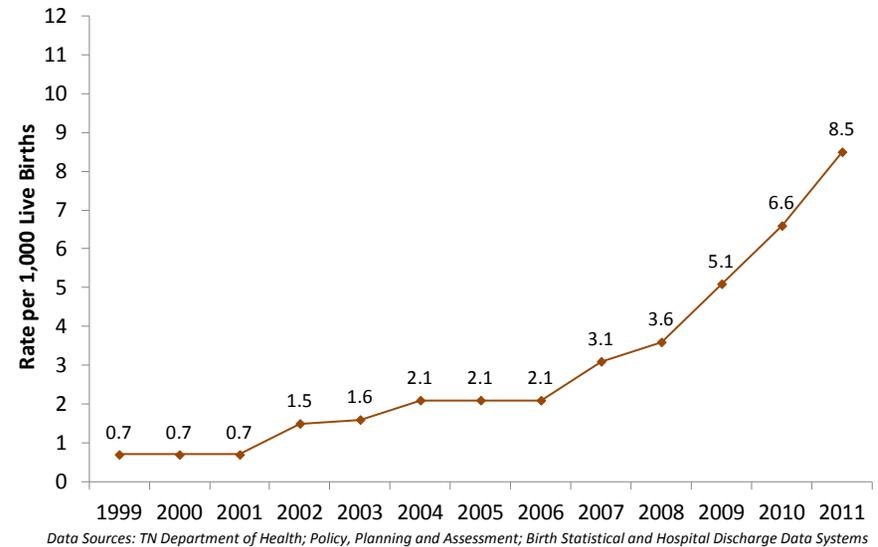
**Neonatal Abstinence Syndrome - Inpatient Hospitalizations
Discharge-Level Data
Tennessee**

Number and Rate of Inpatient Hospitalizations

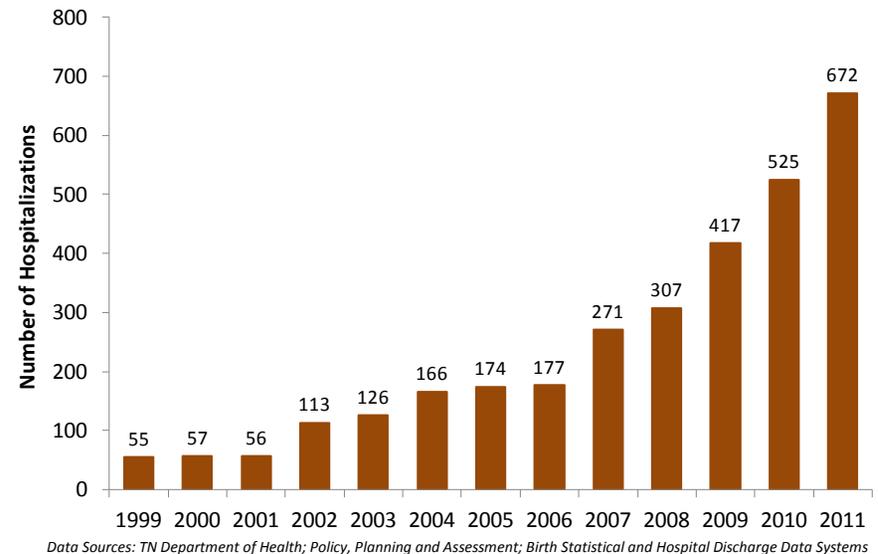
- In 2011, there were 672 inpatient hospitalizations with any diagnosis of NAS in Tennessee, and the inpatient hospitalization rate was 8.5 discharges per 1,000 live births.*
- Between 1999 and 2001, there was no change in the NAS hospitalization rate, which remained stable at 0.7/1,000.
- Between 2001 and 2006, the NAS rate approximately tripled, increasing from 0.7 to 2.1 discharges per 1,000 live births.
- Since 2006 there has been a much steeper rise in the NAS hospitalization rate. During this time period, the rate increased approximately three-fold, from 2.1/1,000 to 8.5/1,000.
- Overall, the NAS hospitalization rate increased approximately eleven-fold between 1999 and 2011.

*See Technical Notes for a detailed description of how NAS hospitalizations were identified.

**Inpatient Hospitalization Rate for Any Diagnosis of Neonatal Abstinence Syndrome
Tennessee, 1999-2011**



**Number of Inpatient Hospitalizations with Any Diagnosis of Neonatal Abstinence Syndrome
Tennessee, 1999-2011**

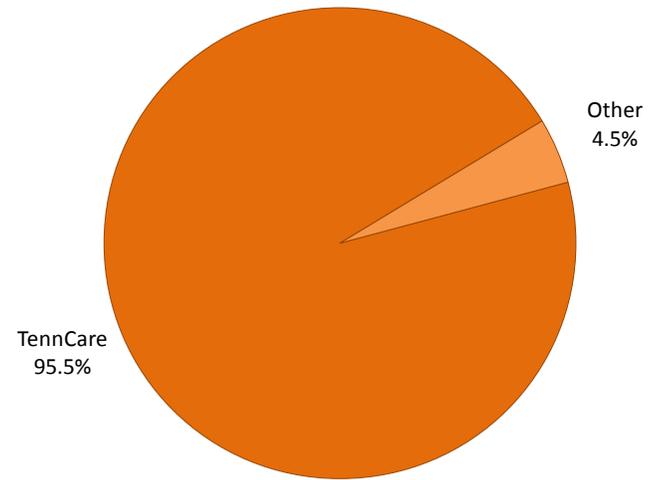


**Neonatal Abstinence Syndrome - Inpatient Hospitalizations
Discharge-Level Data
Tennessee**

Number of Inpatient Hospitalizations by Payer

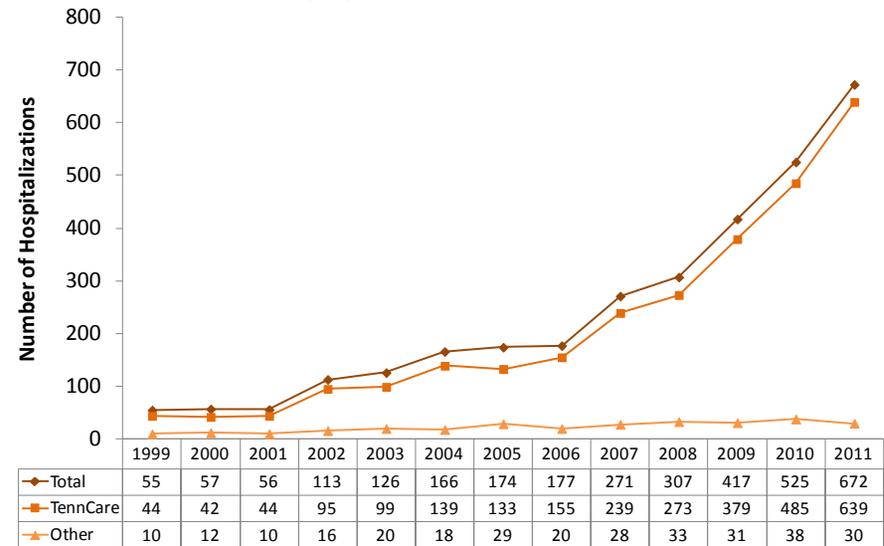
- In 2011, the majority of NAS inpatient hospitalizations (95.5%) were charged to TennCare.
- Between 1999 and 2011, the percentage of NAS hospitalizations charged to TennCare increased from 81.5% to 95.5% – an increase of 17%.

**Inpatient Hospitalizations with Any Diagnosis of Neonatal Abstinence Syndrome
By Payer, Tennessee, 2011**



Data Sources: TN Department of Health; Policy, Planning and Assessment; Birth Statistical and Hospital Discharge Data Systems

**Number of Inpatient Hospitalizations with Any Diagnosis of Neonatal Abstinence Syndrome
By Payer, Tennessee, 1999-2011***



Data Sources: TN Department of Health; Policy, Planning and Assessment; Birth Statistical and Hospital Discharge Data Systems

*The number of 'TennCare' and 'Other Payer' hospitalizations may not sum to the total number of hospitalizations due to missing payer data.

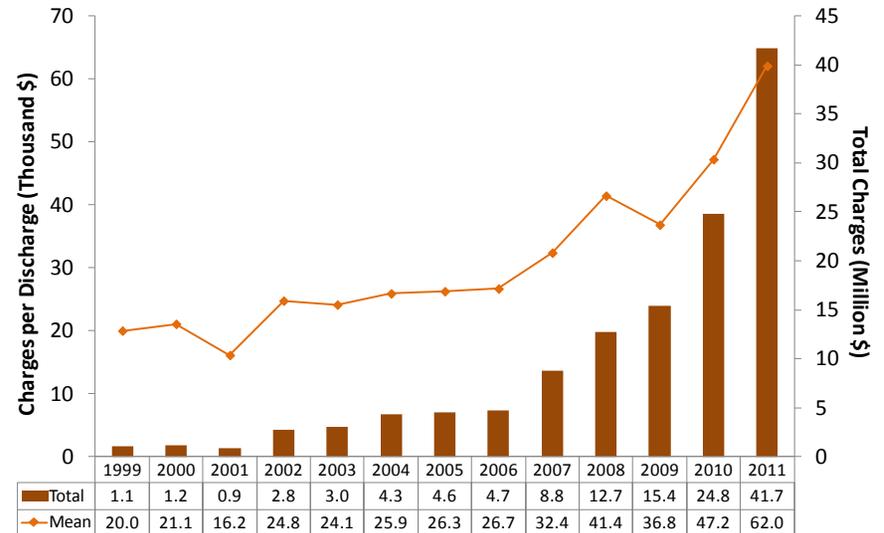
**Neonatal Abstinence Syndrome - Inpatient Hospitalizations
Discharge-Level Data
Tennessee**

Total and Mean Charges

- In 2011, billed charges for inpatient hospitalizations with any diagnosis of NAS totaled \$41.7 million, and mean charges per hospital discharge were approximately \$62,000.
- Between 1999 and 2011, total charges for NAS hospitalizations increased 37-fold, from \$1.1M to \$41.7M.*
- During this same time period, mean charges approximately tripled, from \$20,000 to \$62,000.
- In 2011, \$39.4M in total charges for NAS hospitalizations were billed to TennCare. TennCare patients represented 95.5% of NAS discharges and 94.5% of billed charges for NAS during that year.
- In 2011, mean charges for inpatient hospitalizations with any diagnosis of NAS were approximately \$61,600 per discharge for hospitalizations billed to TennCare, and approximately \$75,300 for those billed to other payers.

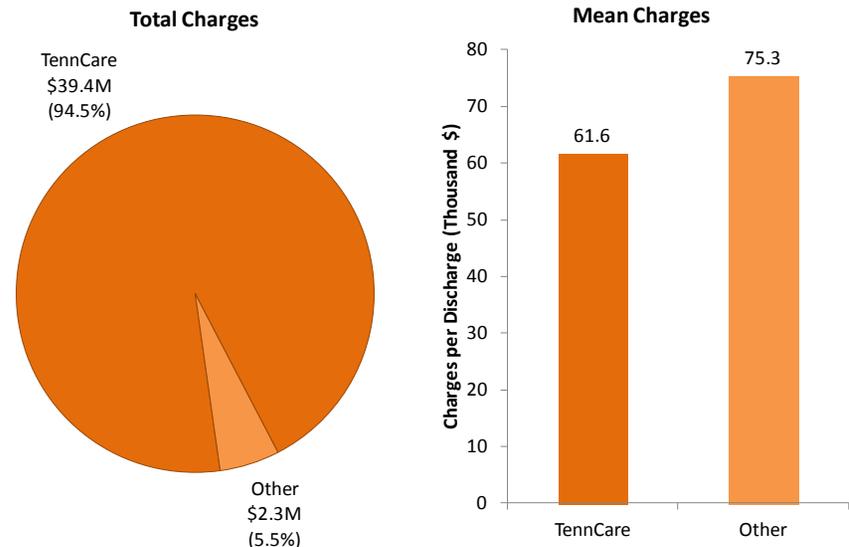
*Hospital charges prior to 2011 were adjusted to 2011 dollars to account for inflation.

**Inpatient Hospital Charges for Any Diagnosis of Neonatal Abstinence Syndrome
Tennessee, 1999-2011***



Data Sources: TN Department of Health; Policy, Planning and Assessment; Birth Statistical and Hospital Discharge Data Systems

**Inpatient Hospital Charges for Any Diagnosis of Neonatal Abstinence Syndrome
By Payer, Tennessee, 2011**

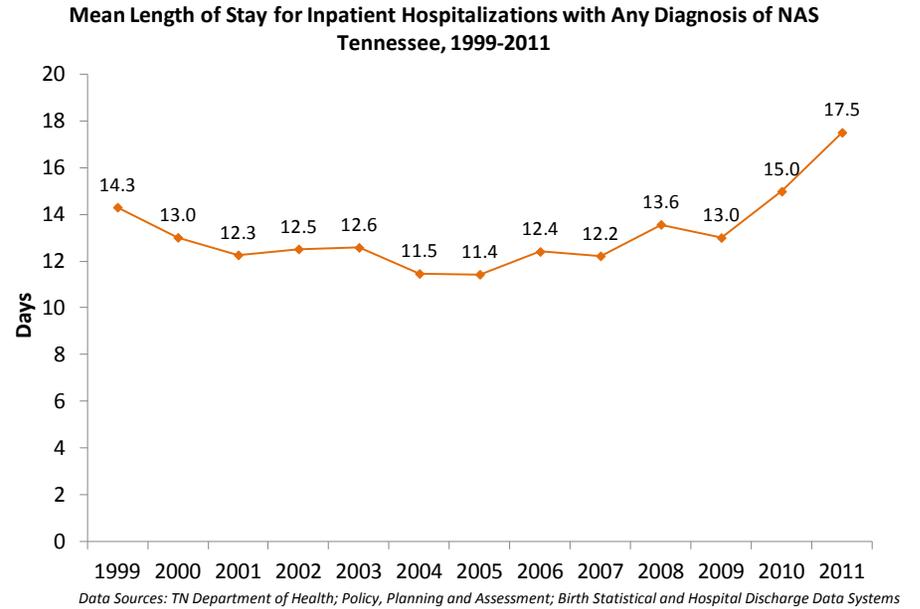


Data Sources: TN Department of Health; Policy, Planning and Assessment; Birth Statistical and Hospital Discharge Data Systems

**Neonatal Abstinence Syndrome - Inpatient Hospitalizations
Discharge-Level Data
Tennessee**

Mean Length of Stay

- In 2011, the mean length of stay for inpatient hospitalizations with any diagnosis of NAS was 17.5 days.
- Between 1999 and 2009, there was not a statistically significant change in the mean length of stay for NAS hospitalizations.
- Between 2009 and 2011, the mean length of stay for NAS hospitalizations increased by approximately 35%, from 13.0 to 17.5 days.



**Neonatal Abstinence Syndrome - Inpatient Hospitalizations
Discharge-Level Data
Tennessee**

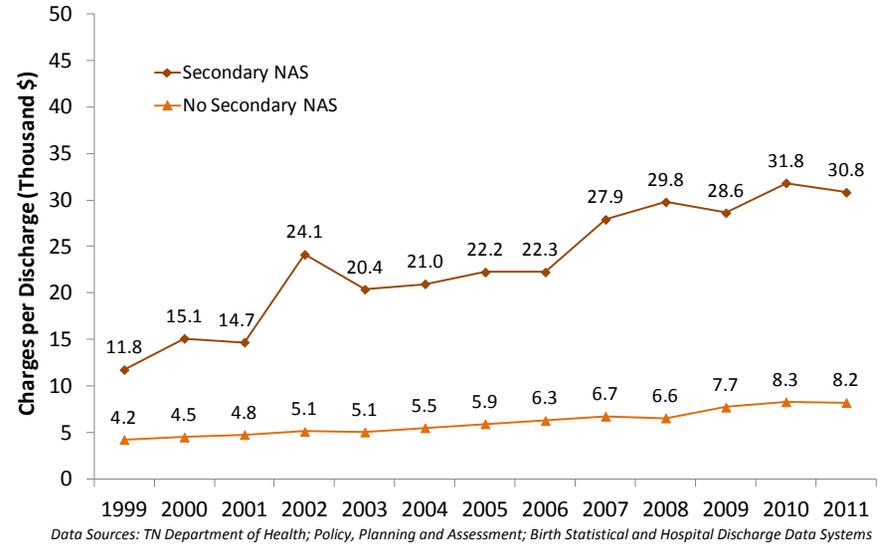
Mean Charges and Length of Stay by NAS Status

- In 2011, there were 74,592 infant hospitalizations with a primary diagnosis of newborn delivery. Among these hospitalizations, there were 437 (0.6%) with a secondary diagnosis of NAS.*
- In 2011, mean charges among newborns with secondary NAS were almost 4 times as high as mean charges among those without NAS (\$30,800 versus \$8,200, respectively).
- Between 1999 and 2011, mean charges among newborns without secondary NAS approximately doubled, while charges among those with NAS increased 1.6-fold.†
- In 2011, mean length of stay among newborns with a secondary diagnosis of NAS was over 3 times as long as mean length of stay among those without NAS (11.5 versus 3.2 days, respectively).
- Between 1999 and 2011, mean length of stay among newborns without a secondary NAS diagnosis remained stable at approximately 3.2 days, while length of stay among those with NAS decreased approximately 11%.

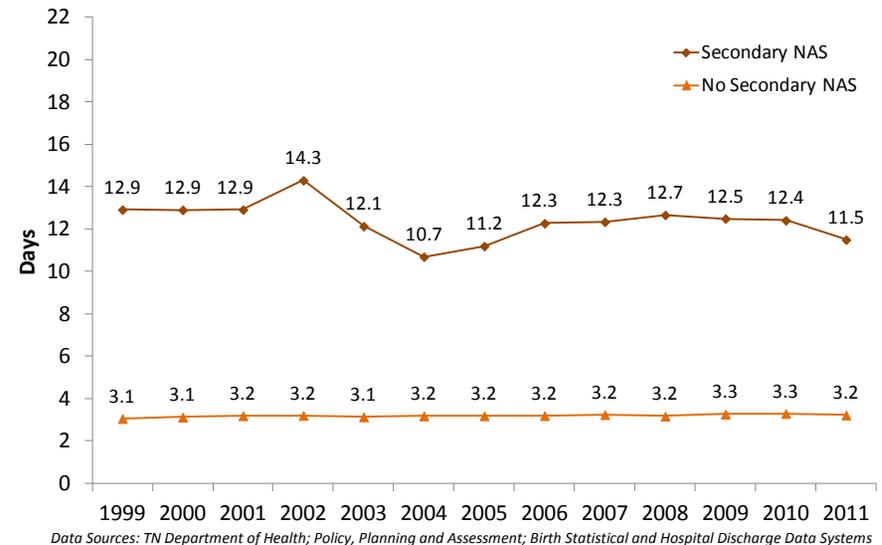
*See Technical Notes for a detailed description of how NAS hospitalizations were identified.

†Hospital charges prior to 2011 were adjusted to 2011 dollars to account for inflation.

**Mean Charges for Inpatient Hospitalizations for Newborn Delivery
By NAS Status, Tennessee, 1999-2011†**



**Mean Length of Stay for Inpatient Hospitalizations for Newborn Delivery
By NAS Status, Tennessee, 1999-2011**



Neonatal Abstinence Syndrome - Inpatient Hospitalizations

Discharge-Level Data

Tennessee

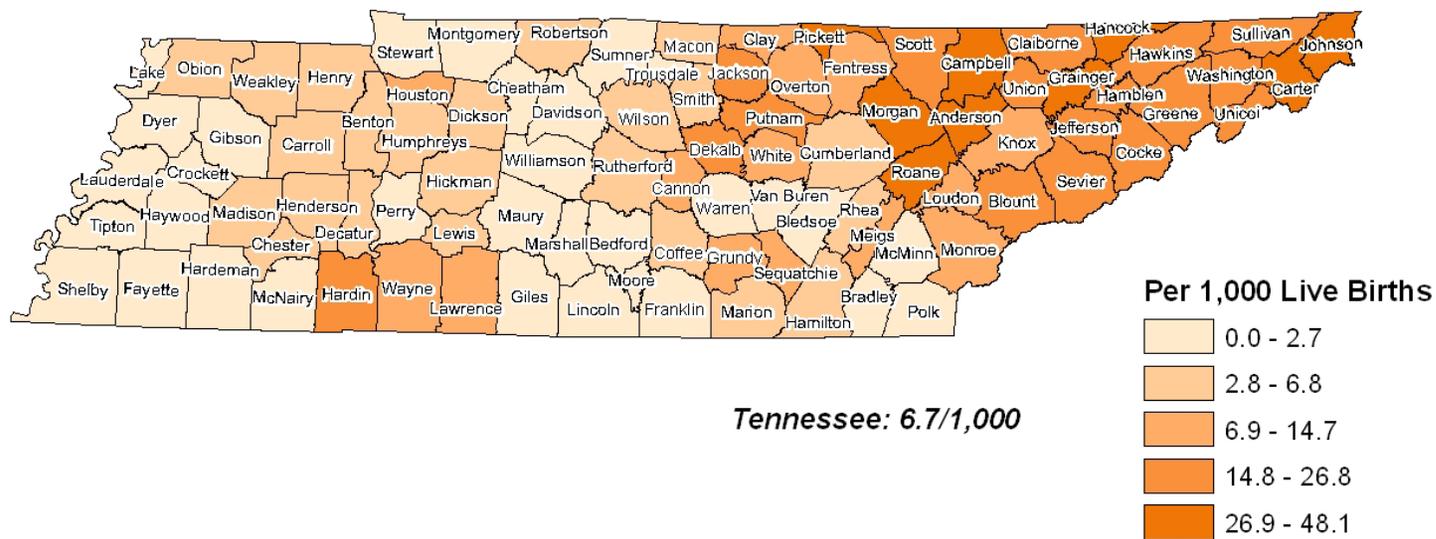
County-Level Data

- Between 2009 and 2011, the average, annual inpatient hospitalization rate for any diagnosis of NAS among Tennessee counties ranged from 0.0 to 48.1 discharges per 1,000 live births.
- During this time period, 10 counties had no NAS hospitalizations: Bedford, Fayette, Lake, Lauderdale, Moore, Perry, Polk, Stewart, Trousdale and Van Buren.
- The 10 counties with the lowest NAS hospitalization rates (not including those with zero hospitalizations) were: Williamson, Warren, Cheatham, Montgomery, Lincoln, Franklin, Madison, Haywood, Maury and Gibson.
- The 10 counties with the highest NAS hospitalization rates were: Hawkins, Anderson, Pickett, Carter, Grainger, Roane, Johnson, Campbell, Morgan and Hancock.
- There were 32 counties with a statistically significant increase in the annual, average inpatient hospitalization rate for any diagnosis of NAS when comparing 2000-2002 to 2009-2011. Among the remaining 63 counties, there were no counties with a statistically significant change (increase or decrease) in the NAS hospitalization rate between these two time periods.

See following map and table for additional regional and county discharge-level NAS hospitalization data.

Neonatal Abstinence Syndrome - Inpatient Hospitalizations
 Discharge-Level Data
 Tennessee
 County-Level Data cont.

Inpatient Hospitalization Rate for Any Diagnosis of Neonatal Abstinence Syndrome Tennessee Counties, 2009-2011 Annual Average



Data Sources: TN Department of Health; Policy, Planning and Assessment; Birth Statistical and Hospital Discharge Data Systems

**Neonatal Abstinence Syndrome Discharge-Level Inpatient Hospitalizations by Region and County
Tennessee, 2000-2002 and 2009-2011**

Region/County	2000-2002		2009-2011		Change in Rate from 2000-2002 to 2009-2011
	Number of NAS Hospitalizations	NAS Rate per 1,000 Live Births (95% Confidence Interval)	Number of NAS Hospitalizations	NAS Rate per 1,000 Live Births (95% Confidence Interval)	
Metropolitan Regions/Counties					
Davidson	21	0.8 (0.5-1.2)	55	1.9 (1.4-2.5)	increase
Hamilton	0	0.0 (0.0-0.3)	44	3.6 (2.6-4.8)	increase
Knox	30	2.1 (1.4-3.0)	173	11.1 (9.5-12.9)	increase
Madison	1	0.2 (0.0-1.4)	4	1.0 (0.3-2.6)	
Shelby	13	0.3 (0.2-0.5)	70	1.7 (1.3-2.1)	increase
Sullivan	8	1.6 (0.7-3.1)	84	17.8 (14.2-22.0)	increase
East Region					
Anderson	10	4.2 (2.0-7.8)	72	29.6 (23.1-37.3)	increase
Blount	7	1.8 (0.7-3.7)	63	16.6 (12.8-21.3)	increase
Campbell	3	2.1 (0.4-6.2)	52	40.7 (30.4-53.3)	increase
Claiborne	1	0.9 (0.0-5.3)	25	25.5 (16.5-37.6)	increase
Cocke	5	4.1 (1.3-9.5)	27	23.2 (15.3-33.7)	increase
Grainger	2	2.6 (0.3-9.3)	23	32.0 (20.3-48.1)	increase
Hamblen	3	1.2 (0.2-3.5)	58	24.5 (18.6-31.6)	increase
Jefferson	6	3.8 (1.4-8.2)	30	18.6 (12.6-26.6)	increase
Loudon	4	2.8 (0.8-7.1)	19	12.1 (7.3-18.8)	increase
Monroe	3	1.9 (0.4-5.5)	17	11.5 (6.7-18.4)	increase
Morgan	5	7.5 (2.4-17.5)	26	45.2 (29.5-66.3)	increase
Roane	9	5.2 (2.4-9.8)	56	37.3 (28.1-48.4)	increase
Scott	7	7.4 (3.0-15.2)	17	21.9 (12.8-35.1)	
Sevier	3	1.1 (0.2-3.2)	53	16.6 (12.4-21.7)	increase
Union	3	4.3 (0.9-12.5)	16	24.7 (14.1-40.2)	increase
Region Total	71	2.9 (2.2-3.6)	554	23.0 (21.1-25.0)	increase

**Neonatal Abstinence Syndrome Discharge-Level Inpatient Hospitalizations by Region and County
Tennessee, 2000-2002 and 2009-2011, cont.**

Region/County	2000-2002		2009-2011		Change in Rate from 2000-2002 to 2009-2011
	Number of NAS Hospitalizations	NAS Rate per 1,000 Live Births (95% Confidence Interval)	Number of NAS Hospitalizations	NAS Rate per 1,000 Live Births (95% Confidence Interval)	
Mid-Cumberland Region					
Cheatham	1	0.7 (0.0-3.8)	1	0.8 (0.0-4.3)	
Dickson	1	0.5 (0.0-2.9)	7	3.8 (1.5-7.9)	
Houston	0	0.0 (0.0-12.3)	3	10.5 (2.2-30.8)	
Humphreys	0	0.0 (0.0-5.6)	3	4.8 (1.0-14.0)	
Montgomery	2	0.3 (0.0-1.0)	7	0.8 (0.3-1.6)	
Robertson	1	0.4 (0.0-2.2)	9	3.2 (1.5-6.1)	
Rutherford	1	0.1 (0.0-0.6)	41	3.7 (2.6-5.0)	increase
Stewart	0	0.0 (0.0-8.1)	0	0.0 (0.0-9.2)	
Sumner	3	0.6 (0.1-1.6)	11	1.9 (0.9-3.4)	
Trousdale	0	0.0 (0.0-13.8)	0	0.0 (0.0-13.5)	
Williamson	0	0.0 (0.0-0.7)	3	0.5 (0.1-1.4)	
Wilson	3	0.8 (0.2-2.3)	19	4.7 (2.9-7.4)	increase
Region Total	12	0.3 (0.2-0.6)	104	2.4 (1.9-2.9)	increase
Northeast Region					
Carter	12	6.9 (3.6-12.0)	54	31.3 (23.5-40.9)	increase
Greene	1	0.5 (0.0-2.5)	39	20.1 (14.3-27.4)	increase
Hancock	0	0.0 (0.0-16.9)	10	48.1 (23.1-88.4)	increase
Hawkins	3	1.6 (0.3-4.5)	45	26.8 (19.5-35.9)	increase
Johnson	1	2.2 (0.1-12.3)	18	37.7 (22.4-59.6)	increase
Unicoi	2	3.8 (0.5-13.8)	12	24.3 (12.6-42.5)	
Washington	15	3.9 (2.2-6.4)	75	18.7 (14.7-23.5)	increase
Region Total	34	3.1 (2.1-4.3)	253	24.0 (21.2-27.2)	increase

**Neonatal Abstinence Syndrome Discharge-Level Inpatient Hospitalizations by Region and County
Tennessee, 2000-2002 and 2009-2011, cont.**

Region/County	2000-2002		2009-2011		Change in Rate from 2000-2002 to 2009-2011
	Number of NAS Hospitalizations	NAS Rate per 1,000 Live Births (95% Confidence Interval)	Number of NAS Hospitalizations	NAS Rate per 1,000 Live Births (95% Confidence Interval)	
Northwest Region					
Benton	0	0.0 (0.0-7.4)	2	4.0 (0.5-14.3)	
Carroll	1	0.9 (0.0-5.1)	3	3.1 (0.6-9.0)	
Crockett	0	0.0 (0.0-6.3)	1	1.9 (0.0-10.3)	
Dyer	0	0.0 (0.0-2.4)	3	2.0 (0.4-6.0)	
Gibson	2	1.1 (0.1-3.8)	3	1.6 (0.3-4.7)	
Henry	0	0.0 (0.0-3.3)	3	2.9 (0.6-8.4)	
Lake	0	0.0 (0.0-16.3)	0	0.0 (0.0-17.2)	
Obion	1	0.8 (0.0-4.5)	4	3.8 (1.0-9.7)	
Weakley	0	0.0 (0.0-3.2)	6	5.2 (1.9-11.4)	
Region Total	4	0.4 (0.1-1.1)	25	2.8 (1.8-4.2)	increase
South Central Region					
Bedford	0	0.0 (0.0-2.1)	0	0.0 (0.0-1.9)	
Coffee	0	0.0 (0.0-1.9)	9	4.7 (2.1-8.8)	increase
Giles	1	1.0 (0.0-5.4)	2	2.2 (0.3-7.8)	
Hickman	0	0.0 (0.0-4.3)	4	5.2 (1.4-13.3)	
Lawrence	2	1.1 (0.1-4.0)	19	11.3 (6.8-17.7)	increase
Lewis	0	0.0 (0.0-9.3)	2	5.4 (0.7-19.6)	
Lincoln	4	3.5 (0.9-8.9)	1	0.9 (0.0-5.1)	
Marshall	0	0.0 (0.0-3.3)	2	1.8 (0.2-6.6)	
Maury	1	0.3 (0.0-1.9)	5	1.5 (0.5-3.4)	
Moore	0	0.0 (0.0-20.4)	0	0.0 (0.0-26.4)	
Perry	0	0.0 (0.0-13.3)	0	0.0 (0.0-12.4)	
Wayne	0	0.0 (0.0-7.3)	5	12.0 (3.9-28.0)	
Region Total	8	0.6 (0.2-1.1)	49	3.5 (2.6-4.6)	increase

**Neonatal Abstinence Syndrome Discharge-Level Inpatient Hospitalizations by Region and County
Tennessee, 2000-2002 and 2009-2011, cont.**

Region/County	2000-2002		2009-2011		Change in Rate from 2000-2002 to 2009-2011
	Number of NAS Hospitalizations	NAS Rate per 1,000 Live Births (95% Confidence Interval)	Number of NAS Hospitalizations	NAS Rate per 1,000 Live Births (95% Confidence Interval)	
<i>Southeast Region</i>					
Bledsoe	0	0.0 (0.0-9.5)	1	2.7 (0.1-15.0)	
Bradley	1	0.3 (0.0-1.6)	7	2.0 (0.8-4.2)	
Franklin	0	0.0 (0.0-2.7)	1	0.9 (0.0-4.8)	
Grundy	1	1.7 (0.0-9.5)	4	8.3 (2.3-21.2)	
McMinn	1	0.5 (0.0-3.0)	7	4.1 (1.7-8.5)	
Marion	1	1.0 (0.0-5.4)	2	2.2 (0.3-7.8)	
Meigs	0	0.0 (0.0-8.1)	3	8.7 (1.8-25.5)	
Polk	0	0.0 (0.0-5.9)	0	0.0 (0.0-7.8)	
Rhea	2	1.7 (0.2-6.1)	8	6.8 (2.9-13.4)	
Sequatchie	0	0.0 (0.0-8.6)	4	8.1 (2.2-20.9)	
<i>Region Total</i>	6	0.5 (0.2-1.1)	37	3.5 (2.5-4.8)	<i>increase</i>
<i>Southwest Region</i>					
Chester	1	1.8 (0.0-10.3)	2	3.6 (0.4-13.0)	
Decatur	0	0.0 (0.0-9.3)	2	5.9 (0.7-21.4)	
Fayette	0	0.0 (0.0-3.1)	0	0.0 (0.0-2.6)	
Hardeman	0	0.0 (0.0-3.6)	2	2.3 (0.3-8.3)	
Hardin	2	2.4 (0.3-8.7)	19	22.0 (13.2-34.3)	increase
Haywood	0	0.0 (0.0-4.3)	1	1.4 (0.0-8.0)	
Henderson	1	0.9 (0.0-5.3)	6	6.0 (2.2-13.1)	
Lauderdale	1	0.8 (0.0-4.5)	0	0.0 (0.0-3.6)	
McNairy	0	0.0 (0.0-3.6)	5	5.7 (1.9-13.4)	
Tipton	0	0.0 (0.0-1.7)	6	2.6 (1.0-5.7)	
<i>Region Total</i>	5	0.5 (0.2-1.1)	43	4.3 (3.1-5.8)	<i>increase</i>

**Neonatal Abstinence Syndrome Discharge-Level Inpatient Hospitalizations by Region and County
Tennessee, 2000-2002 and 2009-2011, cont.**

Region/County	2000-2002		2009-2011		Change in Rate from 2000-2002 to 2009-2011
	Number of NAS Hospitalizations	NAS Rate per 1,000 Live Births (95% Confidence Interval)	Number of NAS Hospitalizations	NAS Rate per 1,000 Live Births (95% Confidence Interval)	
Upper Cumberland Region					
Cannon	0	0.0 (0.0-8.3)	4	9.8 (2.7-25.0)	
Clay	0	0.0 (0.0-14.2)	3	11.2 (2.3-32.8)	
Cumberland	2	1.3 (0.2-4.8)	10	5.8 (2.8-10.7)	
DeKalb	0	0.0 (0.0-5.9)	12	18.3 (9.5-32.1)	increase
Fentress	1	1.6 (0.0-9.0)	7	12.1 (4.9-24.9)	
Jackson	0	0.0 (0.0-11.6)	5	16.1 (5.2-37.6)	
Macon	0	0.0 (0.0-4.7)	3	3.2 (0.7-9.4)	
Overton	1	1.4 (0.0-8.0)	11	14.7 (7.3-26.3)	
Pickett	0	0.0 (0.0-23.9)	4	30.8 (8.4-78.8)	
Putnam	3	1.2 (0.2-3.5)	46	16.8 (12.3-22.4)	increase
Smith	0	0.0 (0.0-5.7)	4	6.3 (1.7-16.1)	
Van Buren	0	0.0 (0.0-21.9)	0	0.0 (0.0-23.0)	
Warren	0	0.0 (0.0-2.2)	1	0.7 (0.0-3.8)	
White	5	5.7 (1.8-13.2)	8	9.4 (4.0-18.5)	
Region Total	12	1.1 (0.5-1.8)	118	10.2 (8.4-12.2)	increase
Tennessee	226	1.0 (0.8-1.1)	1,614	6.7 (6.4-7.0)	increase

Data Sources: TN Department of Health; Policy, Planning and Assessment; Birth Statistical and Hospital Discharge Data Systems

**Neonatal Abstinence Syndrome
Inpatient Hospitalizations**

Unique Patient Data

Neonatal Abstinence Syndrome - Inpatient Hospitalizations

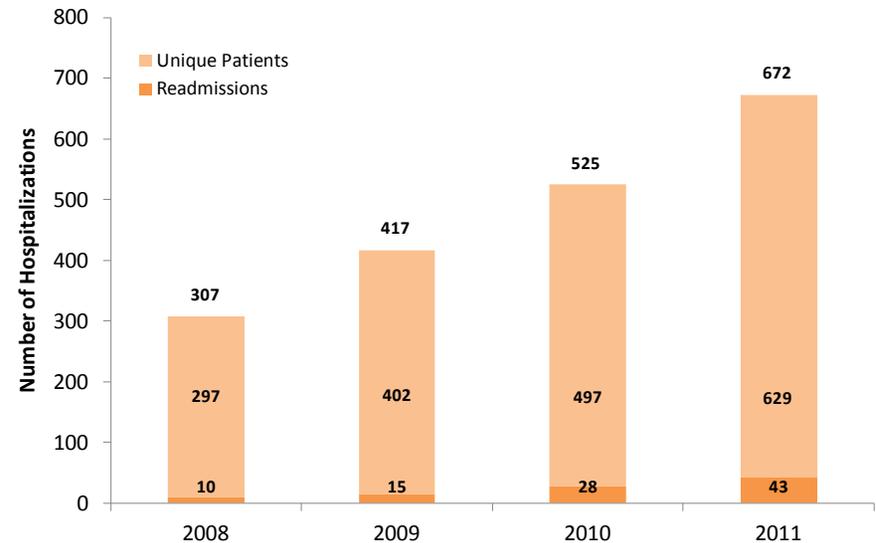
Unique Patient Data

Tennessee

Number and Rate of Inpatient Hospitalizations

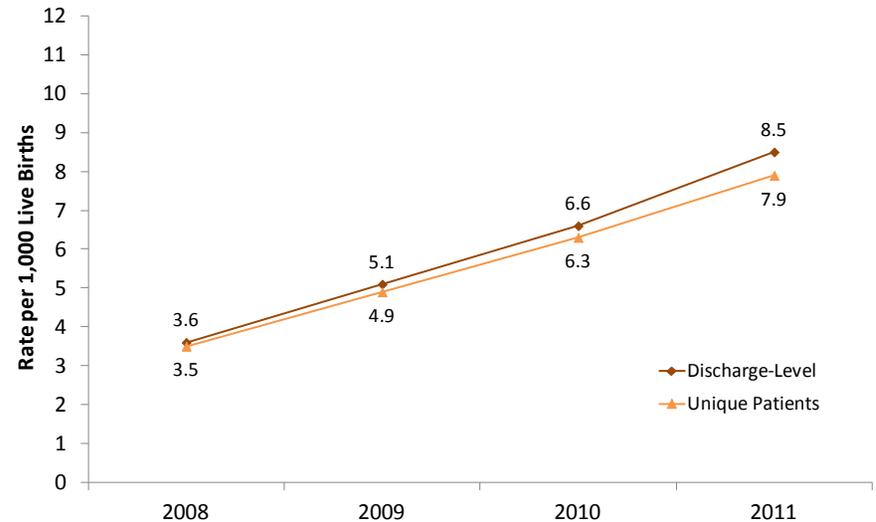
- Since 2008, the majority of inpatient hospitalizations with any diagnosis of NAS have represented unique patients.
- In 2011, there were a total of 672 discharge-level inpatient hospitalizations with any diagnosis of NAS. Among these 672 discharges, 629 (94%) represented unique patients. There were 43 readmissions with an NAS diagnosis.
- In 2011, the inpatient hospitalization rate for unique patients with any diagnosis of NAS was 7.9 discharges per 1,000 live births. This was slightly lower than the discharge-level rate of 8.5/1,000.
- Between 2008 and 2011, the unique patient NAS hospitalization rate approximately doubled, from 3.5 to 7.9/1,000.

Number of Inpatient Hospitalizations with Any Diagnosis of Neonatal Abstinence Syndrome
Unique Patients and Readmissions, Tennessee, 2008-2011



Data Sources: TN Department of Health; Policy, Planning and Assessment; Birth Statistical and Hospital Discharge Data Systems

Inpatient Hospitalization Rate for Any Diagnosis of Neonatal Abstinence Syndrome
Discharge-Level vs. Unique Patients, Tennessee, 2008-2011



Data Sources: TN Department of Health; Policy, Planning and Assessment; Birth Statistical and Hospital Discharge Data Systems

Neonatal Abstinence Syndrome - Inpatient Hospitalizations

Unique Patient Data

Tennessee

County-Level Data

- Between 2009 and 2011, the average, annual inpatient hospitalization rate for unique patients with any diagnosis of NAS among Tennessee counties ranged from 0.0 to 48.1 discharges per 1,000 live births.
- During this time period, 10 counties had no unique NAS patients: Bedford, Fayette, Lake, Lauderdale, Moore, Perry, Polk, Stewart, Trousdale and Van Buren.
- The 10 counties with the lowest unique patient NAS hospitalization rates (not including those with zero patients) were: Williamson, Montgomery, Warren, Cheatham, Franklin, Lincoln, Madison, Giles, Haywood and Maury.
- The 10 counties with the highest unique patient NAS hospitalization rates were: Hawkins, Anderson, Grainger, Carter, Pickett, Roane, Johnson, Campbell, Hancock and Morgan.

See following map and table for additional regional and county unique patient NAS hospitalization data.

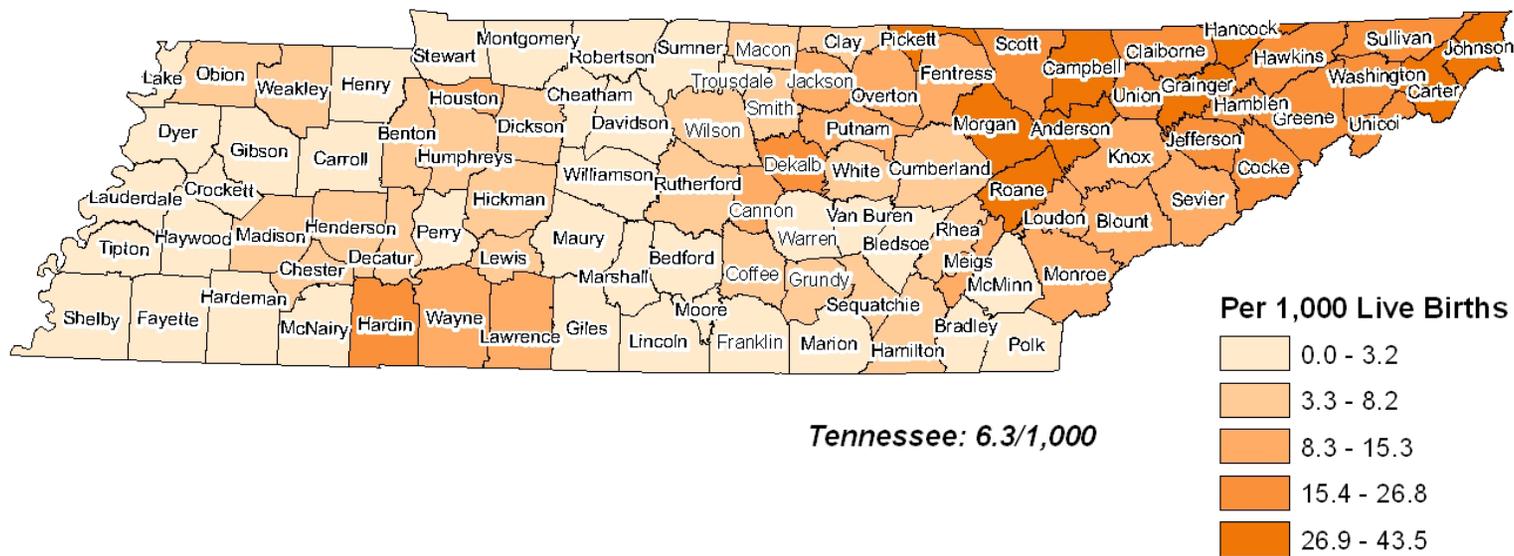
Neonatal Abstinence Syndrome - Inpatient Hospitalizations

Unique Patient Data

Tennessee

County-Level Data cont.

Inpatient Hospitalization Rate for Any Diagnosis of Neonatal Abstinence Syndrome Unique Patients, Tennessee Counties, 2009-2011 Annual Average



Data Sources: TN Department of Health; Policy, Planning and Assessment; Birth Statistical and Hospital Discharge Data Systems

**Neonatal Abstinence Syndrome Unique Inpatient Hospitalizations by Region and County
Tennessee, 2009-2011**

Region/County	Number of Unique NAS Patients	NAS Rate per 1,000 Live Births (95% Confidence Interval)
<i>Metropolitan Regions/Counties</i>		
Davidson	54	1.9 (1.4-2.4)
Hamilton	43	3.5 (2.5-4.7)
Knox	159	10.2 (8.7-11.9)
Madison	4	1.0 (0.3-2.6)
Shelby	70	1.7 (1.3-2.1)
Sullivan	82	17.4 (13.8-21.6)
<i>East Region</i>		
Anderson	71	29.2 (22.8-36.8)
Blount	58	15.3 (11.6-19.8)
Campbell	48	37.5 (27.7-49.8)
Claiborne	23	23.4 (14.8-35.1)
Cocke	26	22.3 (14.6-32.7)
Grainger	22	30.6 (19.2-46.4)
Hamblen	50	21.1 (15.6-27.8)
Jefferson	29	18.0 (12.1-25.9)
Loudon	18	11.4 (6.8-18.1)
Monroe	13	8.8 (4.7-15.1)
Morgan	25	43.5 (28.1-64.2)
Roane	52	34.6 (25.8-45.4)
Scott	17	21.9 (12.8-35.1)
Sevier	44	13.8 (10.0-18.5)
Union	15	23.2 (13.0-38.2)
<i>Region Total</i>	511	21.2 (19.4-23.1)

**Neonatal Abstinence Syndrome Unique Inpatient Hospitalizations by Region and County
Tennessee, 2009-2011, cont.**

Region/County	Number of Unique NAS Patients	NAS Rate per 1,000 Live Births (95% Confidence Interval)
<i>Mid-Cumberland Region</i>		
Cheatham	1	0.8 (0.0-4.3)
Dickson	7	3.8 (1.5-7.9)
Houston	3	10.5 (2.2-30.8)
Humphreys	3	4.8 (1.0-14.0)
Montgomery	6	0.6 (0.2-1.4)
Robertson	8	2.9 (1.2-5.7)
Rutherford	41	3.7 (2.6-5.0)
Stewart	0	0.0 (0.0-9.2)
Sumner	10	1.7 (0.8-3.2)
Trousdale	0	0.0 (0.0-13.5)
Williamson	3	0.5 (0.1-1.4)
Wilson	19	4.7 (2.9-7.4)
<i>Region Total</i>	101	2.3 (1.9-2.8)
<i>Northeast Region</i>		
Carter	53	30.7 (23.0-40.2)
Greene	37	19.0 (13.4-26.2)
Hancock	8	38.5 (16.6-75.8)
Hawkins	45	26.8 (19.5-35.9)
Johnson	17	35.6 (20.8-57.1)
Unicoi	12	24.3 (12.6-42.5)
Washington	75	18.7 (14.7-23.5)
<i>Region Total</i>	247	23.5 (20.6-26.6)

**Neonatal Abstinence Syndrome Unique Inpatient Hospitalizations by Region and County
Tennessee, 2009-2011, cont.**

Region/County	Number of Unique NAS Patients	NAS Rate per 1,000 Live Births (95% Confidence Interval)
<i>Northwest Region</i>		
Benton	2	4.0 (0.5-14.3)
Carroll	3	3.1 (0.6-9.0)
Crockett	1	1.9 (0.0-10.3)
Dyer	3	2.0 (0.4-6.0)
Gibson	3	1.6 (0.3-4.7)
Henry	3	2.9 (0.6-8.4)
Lake	0	0.0 (0.0-17.2)
Obion	4	3.8 (1.0-9.7)
Weakley	5	4.4 (1.4-10.2)
<i>Region Total</i>	24	2.7 (1.7-4.1)
<i>South Central Region</i>		
Bedford	0	0.0 (0.0-1.9)
Coffee	8	4.1 (1.8-8.2)
Giles	1	1.1 (0.0-6.0)
Hickman	4	5.2 (1.4-13.3)
Lawrence	19	11.3 (6.8-17.7)
Lewis	2	5.4 (0.7-19.6)
Lincoln	1	0.9 (0.0-5.1)
Marshall	2	1.8 (0.2-6.6)
Maury	5	1.5 (0.5-3.4)
Moore	0	0.0 (0.0-26.4)
Perry	0	0.0 (0.0-12.4)
Wayne	5	12.0 (3.9-28.0)
<i>Region Total</i>	47	3.3 (2.5-4.4)

**Neonatal Abstinence Syndrome Unique Inpatient Hospitalizations by Region and County
Tennessee, 2009-2011, cont.**

Region/County	Number of Unique NAS Patients	NAS Rate per 1,000 Live Births (95% Confidence Interval)
<i>Southeast Region</i>		
Bledsoe	1	2.7 (0.1-15.0)
Bradley	7	2.0 (0.8-4.2)
Franklin	1	0.9 (0.0-4.8)
Grundy	3	6.2 (1.3-18.1)
McMinn	6	3.6 (1.3-7.7)
Marion	2	2.2 (0.3-7.8)
Meigs	3	8.7 (1.8-25.5)
Polk	0	0.0 (0.0-7.8)
Rhea	8	6.8 (2.9-13.4)
Sequatchie	4	8.1 (2.2-20.9)
<i>Region Total</i>	35	3.3 (2.3-4.6)
<i>Southwest Region</i>		
Chester	2	3.6 (0.4-13.0)
Decatur	2	5.9 (0.7-21.4)
Fayette	0	0.0 (0.0-2.6)
Hardeman	2	2.3 (0.3-8.3)
Hardin	19	22.0 (13.2-34.3)
Haywood	1	1.4 (0.0-8.0)
Henderson	6	6.0 (2.2-13.1)
Lauderdale	0	0.0 (0.0-3.6)
McNairy	5	5.7 (1.9-13.4)
Tipton	6	2.6 (1.0-5.7)
<i>Region Total</i>	43	4.3 (3.1-5.8)

**Neonatal Abstinence Syndrome Unique Inpatient Hospitalizations by Region and County
Tennessee, 2009-2011, cont.**

Region/County	Number of Unique NAS Patients	NAS Rate per 1,000 Live Births (95% Confidence Interval)
<i>Upper Cumberland Region</i>		
Cannon	4	9.8 (2.7-25.0)
Clay	2	7.5 (0.9-27.1)
Cumberland	10	5.8 (2.8-10.7)
DeKalb	11	16.8 (8.4-30.1)
Fentress	6	10.3 (3.8-22.5)
Jackson	4	12.9 (3.5-33.0)
Macon	3	3.2 (0.7-9.4)
Overton	11	14.7 (7.3-26.3)
Pickett	4	30.8 (8.4-78.8)
Putnam	40	14.6 (10.4-19.9)
Smith	4	6.3 (1.7-16.1)
Van Buren	0	0.0 (0.0-23.0)
Warren	1	0.7 (0.0-3.8)
White	7	8.2 (3.3-16.9)
<i>Region Total</i>	107	9.2 (7.6-11.2)
Tennessee	1,528	6.3 (6.0-6.7)

Data Sources: TN Department of Health; Policy, Planning and Assessment; Birth Statistical and Hospital Discharge Data Systems

Maternal Substance Abuse Inpatient Hospitalizations

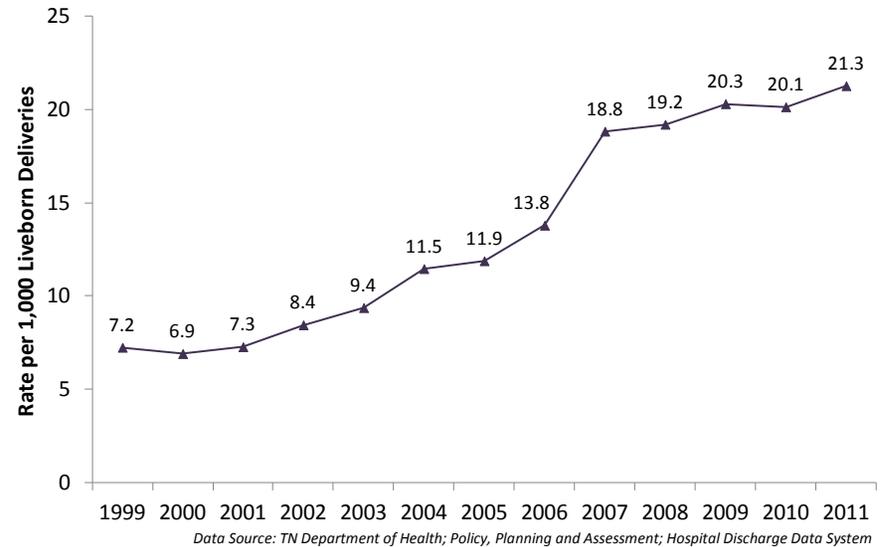
Discharge-Level Data

**Maternal Substance Abuse - Inpatient Hospitalizations
Discharge-Level Data
Tennessee**

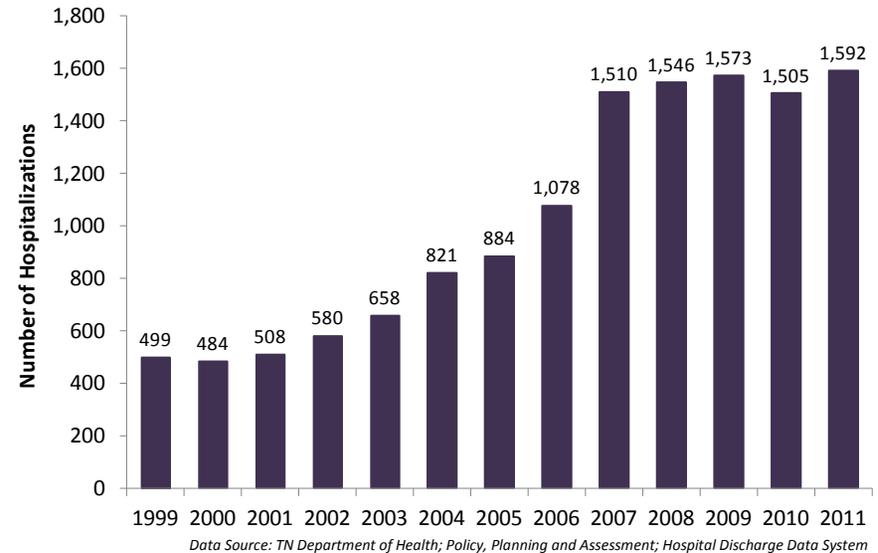
Number and Rate of Inpatient Hospitalizations – Any Use

- In 2011, there were 74,846 inpatient hospitalizations in Tennessee for liveborn delivery.*
- 1,592 (2%) of these hospitalizations for delivery also had a diagnosis of substance abuse, and the inpatient hospitalization rate for maternal substance abuse was 21.3 discharges per 1,000 liveborn deliveries.
- Between 1999 and 2011, the hospitalization rate for deliveries with maternal substance abuse approximately tripled, from 7.2/1,000 to 21.3/1,000.

**Inpatient Hospitalization Rate for Deliveries with Any Maternal Substance Abuse
Tennessee, 1999-2011**



**Number of Inpatient Hospitalization with Any Maternal Substance Abuse
Tennessee, 1999-2011**

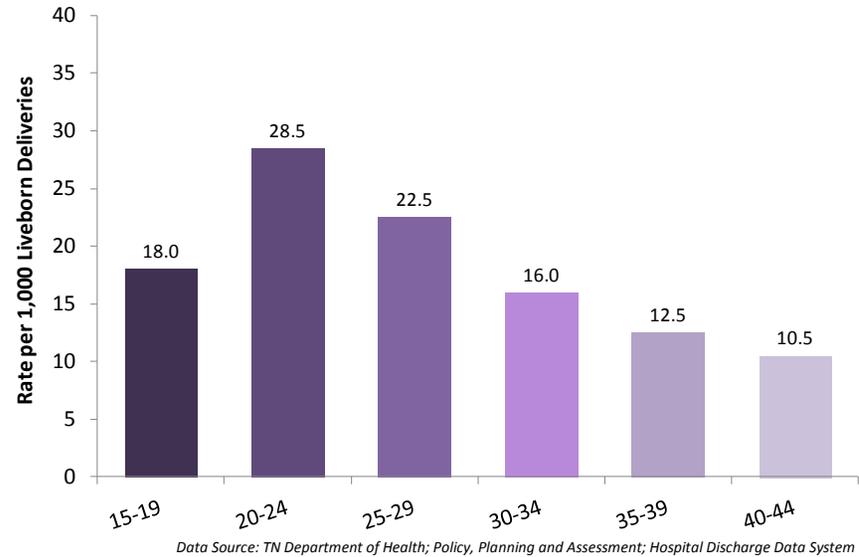


*These are hospitalizations of **women** giving birth. Based on birth certificate data, there were a total of 79,462 **infants** born to TN resident women in 2011. The majority of these infants (98%) were born at in-state hospitals. The remaining 2% were home births or were delivered at birthing centers, clinics/doctor's offices, or out-of-state.

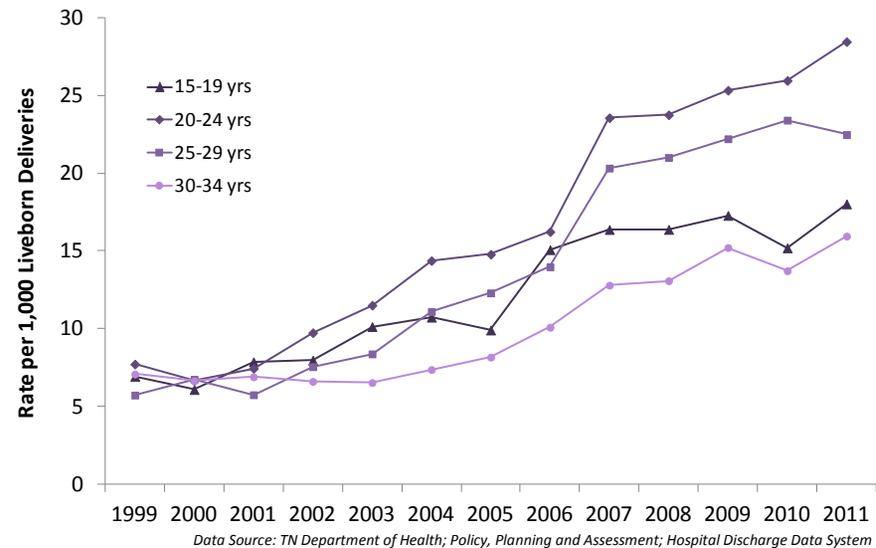
Maternal Substance Abuse - Inpatient Hospitalizations
Discharge-Level Data
Tennessee
Maternal Age

- In 2011, the highest inpatient hospitalization rate for deliveries with maternal substance abuse occurred among women 20-24 years of age (28.5 per 1,000 liveborn deliveries), and the lowest among those 40-44 years of age (10.5/1,000).
- Between 1999 and 2011, the hospitalization rate for deliveries with maternal substance abuse increased among younger women aged 15-19, 20-24, 25-29 and 30-34 years of age. There was not a statistically significant increase or decrease in the rate among older women aged 35-39 or 40-44 years of age during this time period.
- The largest increase in the inpatient hospitalization rate for deliveries with maternal substance abuse between 1999 and 2011 occurred among women aged 25-29 years of age (2.9-fold increase), followed by 20-24 year olds (2.7-fold increase), 15-19 year olds (1.6-fold increase) and 30-34 year olds (1.3-fold increase).

Inpatient Hospitalization Rate for Deliveries with Maternal Substance Abuse
By Maternal Age, Tennessee, 2011



Inpatient Hospitalization Rate for Deliveries with Maternal Substance Abuse
By Maternal Age, Tennessee, 1999-2011

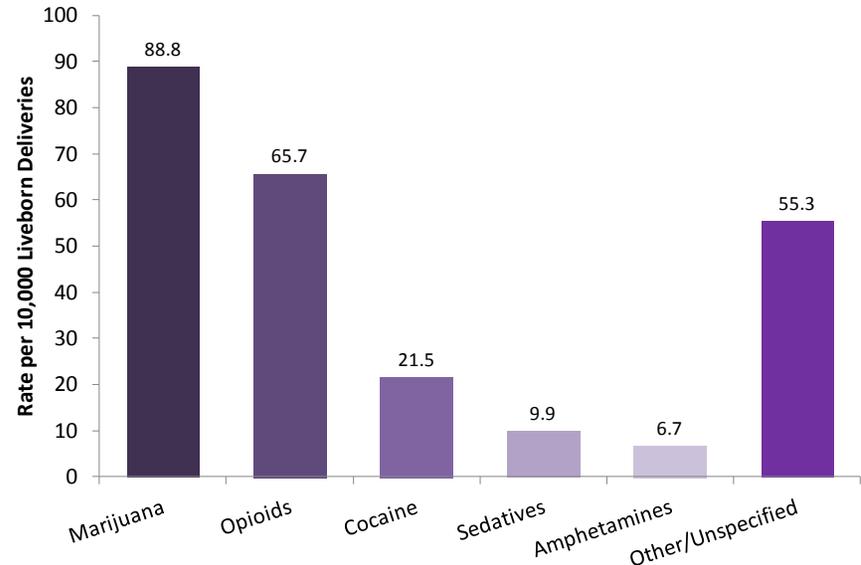


Maternal Substance Abuse - Inpatient Hospitalizations
Discharge-Level Data
Tennessee
Type of Drug Used

- The majority of the 1,592 inpatient hospitalizations with maternal substance abuse (86%) involved the use of a single type of drug; 12% involved two drug types and 2% involved three or more drug types.
- In 2011, the highest inpatient hospitalization rate for deliveries with maternal substance abuse was for marijuana use (88.8 per 10,000 liveborn deliveries), followed by opioids (65.7/10,000) and cocaine (21.5/10,000).*
- Between 1999 and 2009, maternal marijuana use approximately tripled, but since 2009 has decreased 18%.
- Between 1999 and 2007, maternal cocaine use increased approximately 39%, but since 2007 has decreased 55%.
- Between 1999 and 2011, maternal opioid use increased approximately 38-fold, from 1.7/10,000 to 65.7/10,000.

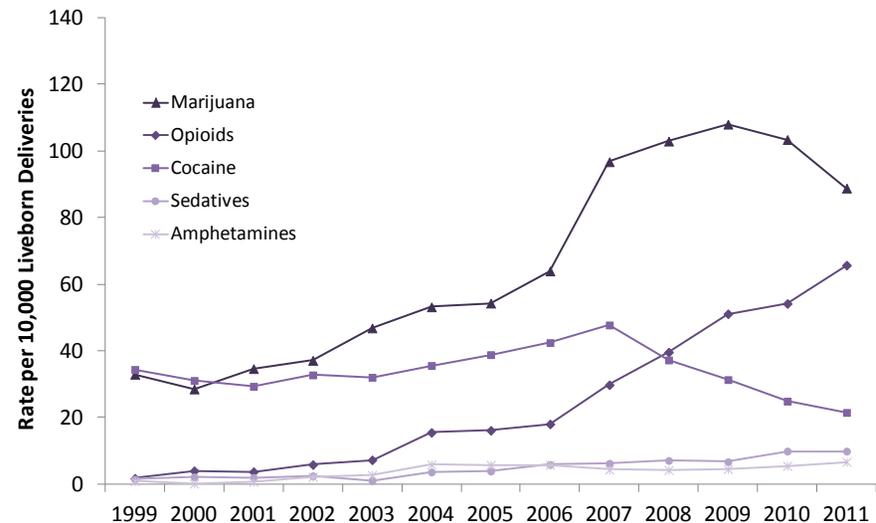
* Drug type categories are not mutually exclusive – some women had multiple substance abuse diagnoses.

Inpatient Hospitalization Rate for Deliveries with Maternal Substance Abuse By Drug Type, Tennessee, 2011



Data Source: TN Department of Health; Policy, Planning and Assessment; Hospital Discharge Data System

Inpatient Hospitalization Rate for Deliveries with Maternal Substance Abuse By Drug Type, Tennessee, 1999-2011



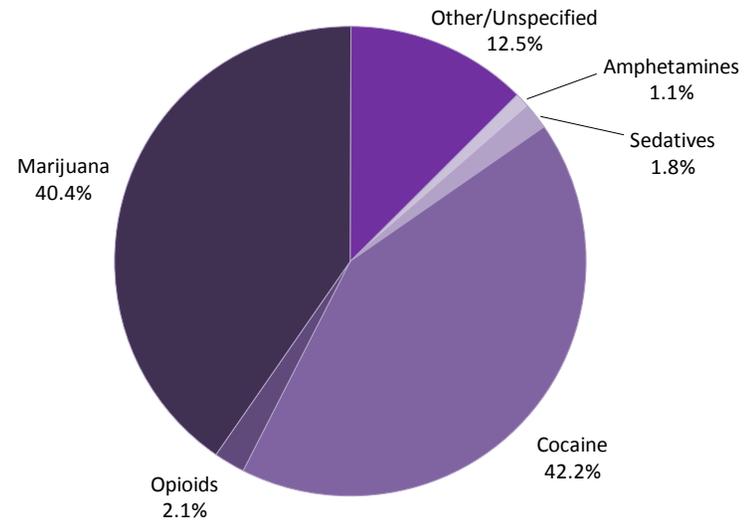
Data Source: TN Department of Health; Policy, Planning and Assessment; Hospital Discharge Data System

**Maternal Substance Abuse - Inpatient Hospitalizations
Discharge-Level Data
Tennessee**

Type of Drug Used cont.

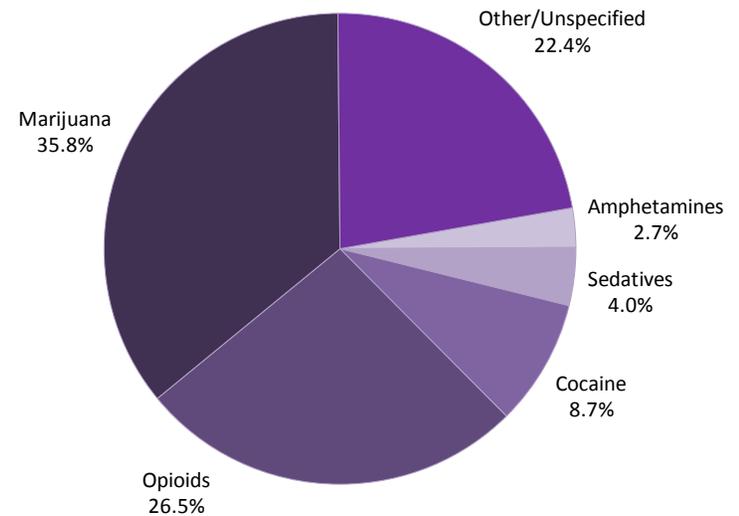
- In 1999, cocaine and marijuana each represented approximately two-fifths of maternal substance abuse diagnoses. Combined, these two drugs were responsible for over 80% of maternal substance abuse diagnoses.*
- In 2011, marijuana still represented almost two-fifths of maternal substance abuse diagnoses, but the proportion of cocaine diagnoses had decreased to less than 10%.
- In 1999, opioids represented just 2% of maternal substance abuse diagnoses, but in 2011 this had increased to 27%.

**Maternal Substance Abuse Diagnoses by Drug Type
Tennessee, 1999**



Data Source: TN Department of Health; Policy, Planning and Assessment; Hospital Discharge Data System

**Maternal Substance Abuse Diagnoses by Drug Type
Tennessee, 2011**



Data Source: TN Department of Health; Policy, Planning and Assessment; Hospital Discharge Data System

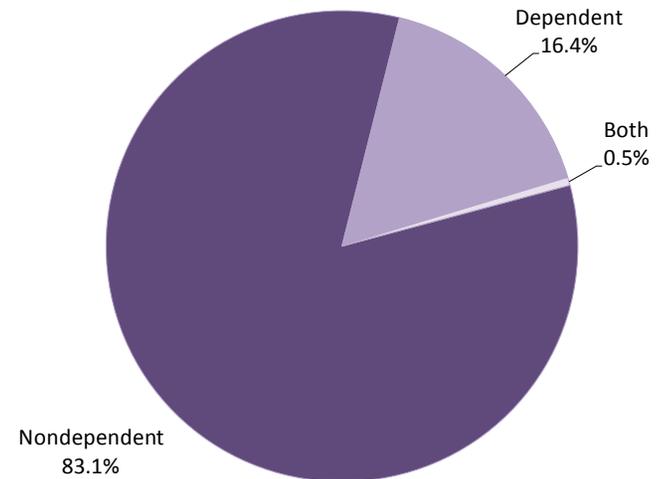
**In 1999 and 2011, there were 562 and 1,861 diagnoses of maternal substance abuse, respectively. The number of substance abuse diagnoses is greater than the number of inpatient hospitalizations with maternal substance abuse because some women had multiple substance abuse diagnoses.*

**Maternal Substance Abuse - Inpatient Hospitalizations
Discharge-Level Data
Tennessee**

Dependent vs. Nondependent Use

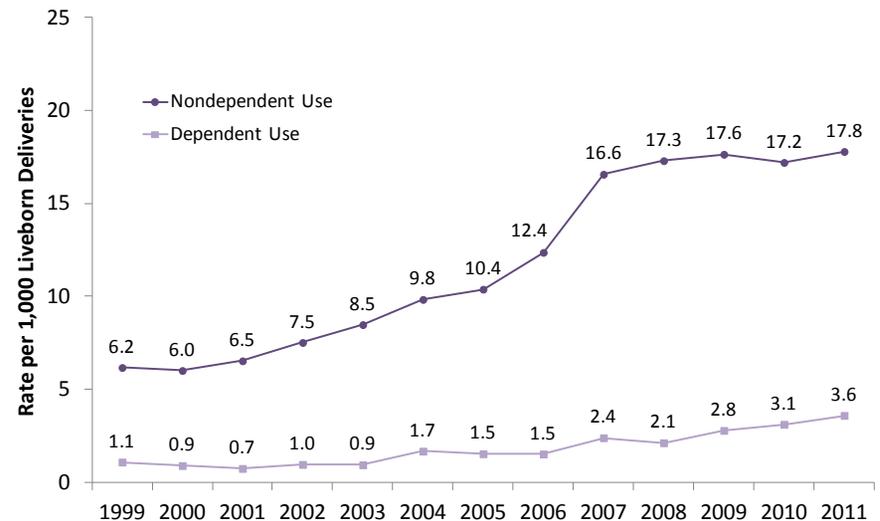
- Among the 1,592 inpatient hospitalizations identified in 2011 with maternal substance abuse, the majority (83%) had a diagnosis for nondependent drug use. Approximately 16% had a diagnosis for dependent drug use, and less than 1% had diagnoses for both nondependent and dependent use.
- The proportion of maternal substance abuse hospitalizations with nondependent drug use was similar in 1999 compared to 2011 (85% versus 83%, respectively).
- Between 1999 and 2011, the hospitalization rates for deliveries with nondependent and dependent maternal substance abuse both approximately tripled.*

**Inpatient Hospitalizations for Deliveries with Maternal Substance Abuse
Dependent vs. Nondependent Drug Use, Tennessee, 2011**



Data Source: TN Department of Health; Policy, Planning and Assessment; Hospital Discharge Data System

**Inpatient Hospitalization Rate for Deliveries with Maternal Substance Abuse
Dependent vs. Nondependent Drug Use, Tennessee, 1999-2011***



Data Source: TN Department of Health; Policy, Planning and Assessment; Hospital Discharge Data System

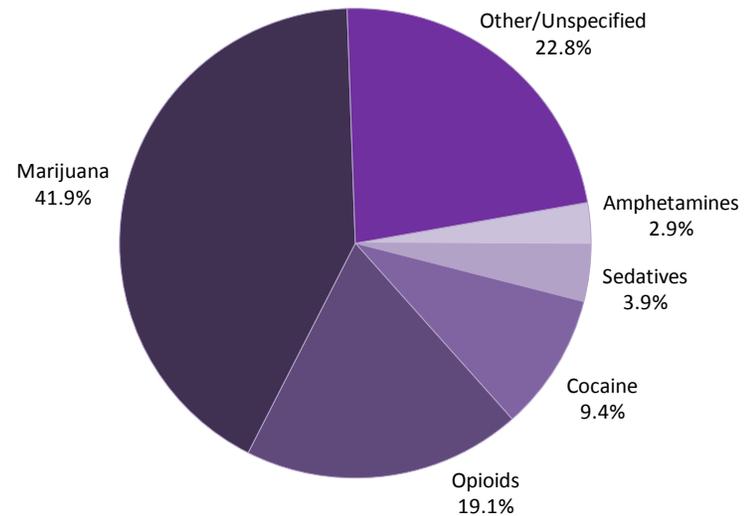
*Rates were calculated separately for nondependent and dependent use – a small number of hospitalizations may be included in both categories due to multiple drug use diagnoses.

**Maternal Substance Abuse - Inpatient Hospitalizations
Discharge-Level Data
Tennessee**

Dependent vs. Nondependent Use cont.

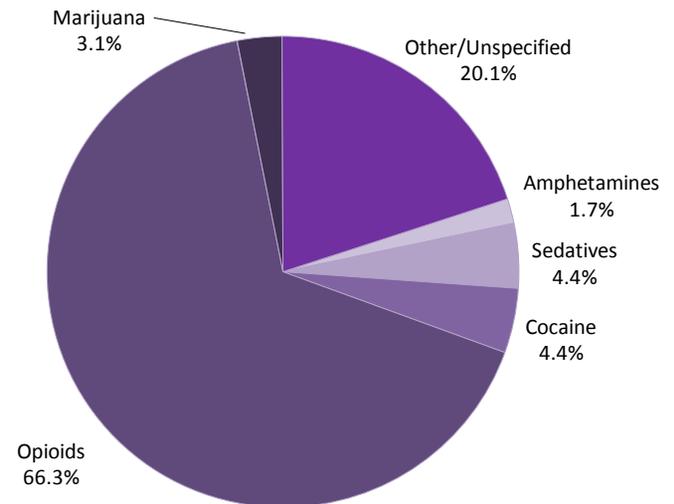
- In 2011, marijuana represented the highest proportion (42%) of maternal substance abuse diagnoses for nondependent drug use, followed by opioids (19%) and cocaine (9.4%).
- Opioids represented the majority (66%) of maternal substance abuse diagnoses for dependent drug use, followed by cocaine and sedatives (4% each) and marijuana (3%).

**Nondependent Maternal Substance Abuse Diagnoses by Drug Type
Tennessee, 2011**



Data Source: TN Department of Health; Policy, Planning and Assessment; Hospital Discharge Data System

**Dependent Maternal Substance Abuse Diagnoses by Drug Type
Tennessee, 2011**



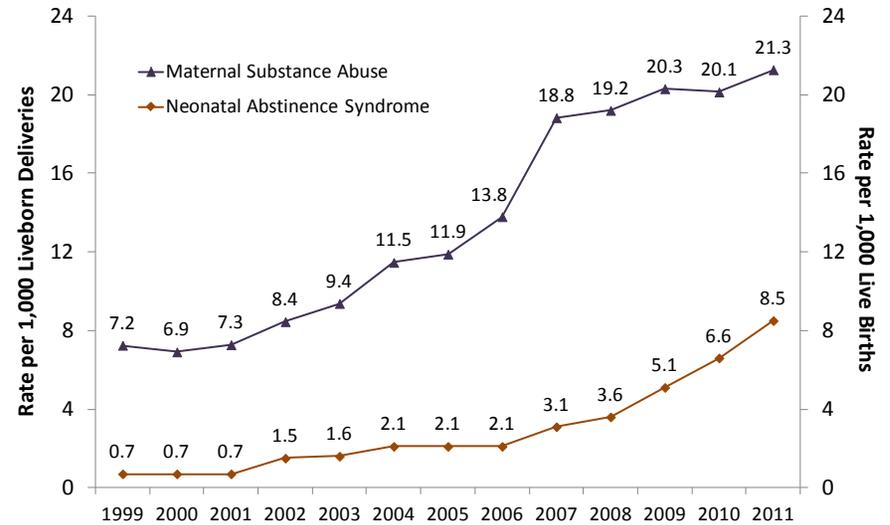
Data Source: TN Department of Health; Policy, Planning and Assessment; Hospital Discharge Data System

**Maternal Substance Abuse - Inpatient Hospitalizations
Discharge-Level Data
Tennessee**

Maternal Substance Abuse vs. NAS Hospitalizations

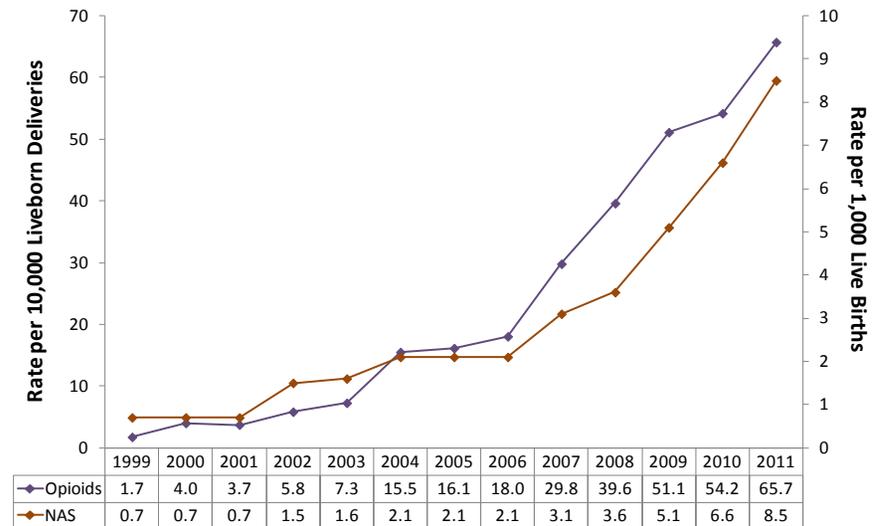
- The inpatient hospitalization rates for both deliveries with any maternal substance abuse and for neonatal abstinence syndrome (NAS) increased between 1999 and 2011. The maternal substance abuse rate approximately tripled during this time period, while the NAS rate increased approximately 11-fold.
- Neonatal abstinence syndrome is most commonly associated with opioid use.* Between 1999 and 2011, the inpatient hospitalization rate for deliveries with maternal opioid use increased approximately 38-fold, compared to an 11-fold increase in NAS hospitalizations.

**Deliveries with Any Maternal Substance Abuse and Infants with Any Diagnosis of NAS
Inpatient Hospitalization Rates, Tennessee, 1999-2011**



Data Sources: TN Department of Health; Policy, Planning and Assessment; Birth Statistical and Hospital Discharge Data Systems

**Deliveries with Maternal Opioid Use and Infants with Any Diagnosis of NAS
Inpatient Hospitalization Rates, Tennessee, 1999-2011**



Data Sources: TN Department of Health; Policy, Planning and Assessment; Birth Statistical and Hospital Discharge Data Systems

*Patrick SW, Schumacher RE, Benneyworth BD, et al. Neonatal Abstinence Syndrome and Associated Health Care Expenditures, United States, 2000-2009. JAMA. 2012; 307(18):1934-1940.

Maternal Substance Abuse - Inpatient Hospitalizations

Discharge-Level Data

Tennessee

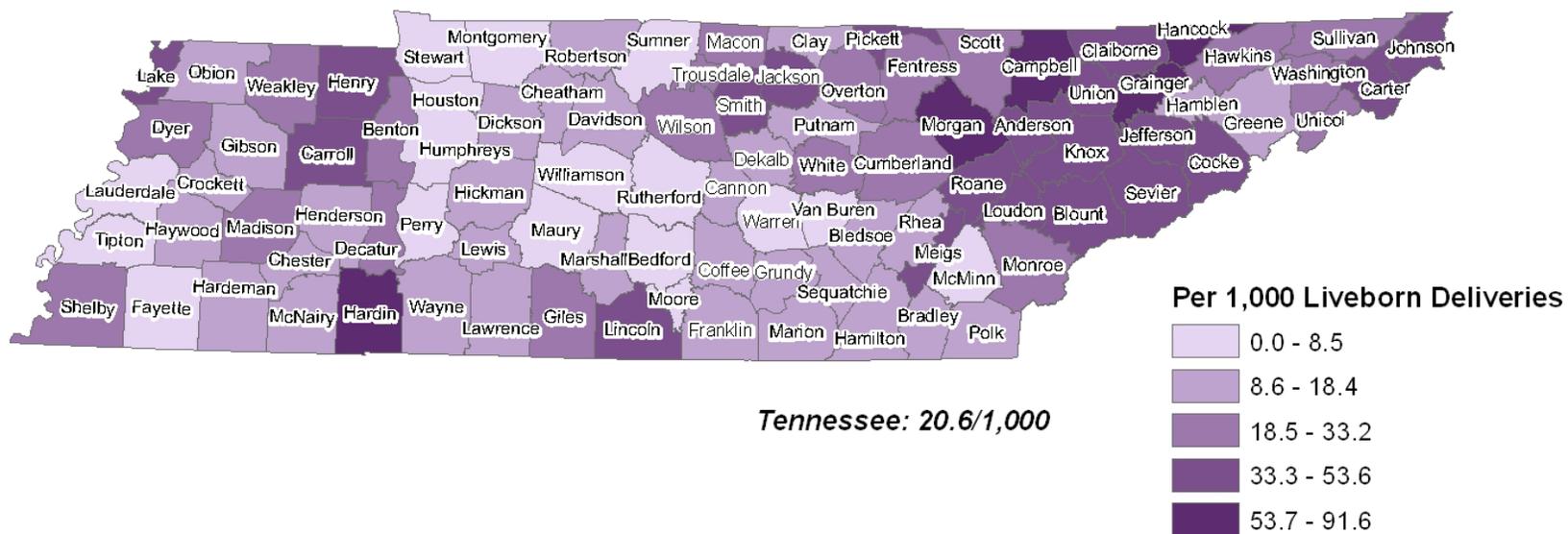
County-Level Data

- Between 2009 and 2011, the average, annual inpatient hospitalization rate for deliveries with any maternal substance abuse among Tennessee counties ranged from 0.0 to 91.6 discharges per 1,000 liveborn deliveries.
- During this time period, 2 counties had no deliveries with maternal substance abuse: Moore and Van Buren.
- The 10 counties with the lowest hospitalization rates (not including those with zero hospitalizations) were: Williamson, Fayette, Bedford, Stewart, Houston, Montgomery, Tipton, Perry, Warren, Humphreys.
- The 10 counties with the highest hospitalization rates were: Anderson, Roane, Union, Knox, Claiborne, Grainger, Morgan, Hancock, Hardin and Campbell.
- There were 46 counties with a statistically significant increase in the annual, average inpatient hospitalization rate for deliveries with any maternal substance abuse when comparing 2000-2002 to 2009-2011. Among the remaining 49 counties, there were no counties with a statistically significant change (increase or decrease) in the hospitalization rate between these two time periods.
- Between 2000-2002 and 2009-2011, there were 27 counties with a statistically significant increase in both hospitalizations for deliveries with maternal substance abuse and for those with any diagnosis of NAS (discharge-level data). There were 19 counties with an increase in maternal substance abuse deliveries alone, and 5 counties with an increase in NAS alone.

See following maps and table for additional regional and county discharge-level maternal substance abuse hospitalization data.

Maternal Substance Abuse - Inpatient Hospitalizations
 Discharge-Level Data
 Tennessee
 County-Level Data cont.

Inpatient Hospitalization Rate for Deliveries with Any Maternal Substance Abuse Tennessee Counties, 2009-2011 Annual Average



Data Source: TN Department of Health; Policy, Planning and Assessment; Hospital Discharge Data System

**Inpatient Hospitalizations for Deliveries with Any Maternal Substance Abuse by Region and County
Tennessee, 2000-2002 and 2009-2011**

Region/County	2000-2002		2009-2011		Change in Rate from 2000-2002 to 2009-2011
	Number of Hospitalizations	Rate per 1,000 Liveborn Deliveries (95% Confidence Interval)	Number of Hospitalizations	Rate per 1,000 Liveborn Deliveries (95% Confidence Interval)	
Metropolitan Regions/Counties					
Davidson*	185	8.5 (7.3-9.8)	364	12.9 (11.6-14.3)	increase
Hamilton*	38	3.4 (2.4-4.6)	166	13.8 (11.8-16.1)	increase
Knox*	298	21.9 (19.5-24.5)	757	51.6 (48.0-55.4)	increase
Madison	18	4.7 (2.8-7.5)	43	11.5 (8.3-15.4)	increase
Shelby*	394	9.5 (8.6-10.5)	796	19.6 (18.3-21.0)	increase
Sullivan*	29	6.1 (4.1-8.7)	125	27.3 (22.7-32.5)	increase
East Region					
Anderson*	22	11.0 (6.9-16.6)	108	48.8 (40.0-58.9)	increase
Blount*	37	10.6 (7.5-14.6)	164	46.7 (39.8-54.4)	increase
Campbell*	33	23.7 (16.3-33.3)	113	91.6 (75.5-110.2)	increase
Claiborne*	8	9.4 (4.0-18.5)	42	53.6 (38.7-72.5)	increase
Cocke*	14	12.1 (6.6-20.3)	51	45.2 (33.6-59.4)	increase
Grainger*	5	6.7 (2.2-15.6)	39	56.4 (40.1-77.2)	increase
Hamblen*	13	5.4 (2.9-9.3)	35	14.6 (10.2-20.4)	increase
Jefferson*	19	12.0 (7.2-18.8)	58	36.2 (27.5-46.7)	increase
Loudon*	15	10.0 (5.6-16.4)	67	42.3 (32.8-53.7)	increase
Monroe*	4	2.9 (0.8-7.4)	43	31.5 (22.8-42.5)	increase
Morgan*	9	10.1 (4.6-19.1)	33	57.3 (39.4-80.5)	increase
Roane*	20	14.1 (8.6-21.7)	71	49.0 (38.3-61.9)	increase
Scott	5	6.0 (2.0-14.1)	20	26.4 (16.1-40.8)	increase
Sevier*	22	8.0 (5.0-12.1)	126	40.5 (33.7-48.2)	increase
Union*	6	10.8 (4.0-23.5)	29	49.7 (33.3-71.4)	increase
Region Total*	232	10.1 (8.8-11.5)	999	43.5 (40.8-46.3)	increase

**Inpatient Hospitalizations for Deliveries with Any Maternal Substance Abuse by Region and County
Tennessee, 2000-2002 and 2009-2011**

Region/County	2000-2002		2009-2011		Change in Rate from 2000-2002 to 2009-2011
	Number of Hospitalizations	Rate per 1,000 Liveborn Deliveries (95% Confidence Interval)	Number of Hospitalizations	Rate per 1,000 Liveborn Deliveries (95% Confidence Interval)	
Mid-Cumberland Region					
Cheatham	4	3.3 (0.9-8.3)	13	10.7 (5.7-18.3)	
Dickson	9	5.2 (2.4-9.9)	18	10.1 (6.0-16.0)	
Houston	1	3.6 (0.1-19.9)	1	3.7 (0.1-20.6)	
Humphreys	4	6.8 (1.9-17.5)	3	5.0 (1.0-14.6)	
Montgomery	11	2.8 (1.4-5.0)	22	3.9 (2.5-5.9)	
Robertson	0	0.0 (0.0-1.5)	24	8.8 (5.6-13.1)	increase
Rutherford*	11	1.4 (0.7-2.4)	54	5.1 (3.8-6.6)	increase
Stewart	0	0.0 (0.0-9.6)	1	2.8 (0.1-15.7)	
Sumner	9	2.0 (0.9-3.9)	45	8.5 (6.2-11.3)	increase
Trousdale	1	5.0 (0.1-27.7)	6	24.4 (9.0-53.1)	
Williamson	7	1.6 (0.7-3.3)	13	2.2 (1.1-3.7)	
Wilson*	12	3.8 (2.0-6.6)	77	20.9 (16.5-26.1)	increase
Region Total*	69	2.3 (1.8-2.8)	277	7.2 (6.4-8.1)	increase
Northeast Region					
Carter*	20	14.8 (9.1-22.9)	52	35.2 (26.3-46.2)	increase
Greene*	5	2.5 (0.8-5.9)	31	16.9 (11.5-24.0)	increase
Hancock	1	6.0 (0.2-33.4)	10	61.0 (29.2-112.1)	
Hawkins*	2	1.1 (0.1-4.1)	45	28.5 (20.8-38.1)	increase
Johnson	3	7.7 (1.6-22.4)	15	37.9 (21.2-62.5)	
Unicoi	3	5.7 (1.2-16.8)	15	33.2 (18.6-54.7)	increase
Washington*	40	10.4 (7.4-14.1)	107	27.1 (22.2-32.7)	increase
Region Total*	74	7.4 (5.8-9.3)	275	27.9 (24.7-31.4)	increase

**Inpatient Hospitalizations for Deliveries with Any Maternal Substance Abuse by Region and County
Tennessee, 2000-2002 and 2009-2011**

Region/County	2000-2002		2009-2011		Change in Rate from 2000-2002 to 2009-2011
	Number of Hospitalizations	Rate per 1,000 Liveborn Deliveries (95% Confidence Interval)	Number of Hospitalizations	Rate per 1,000 Liveborn Deliveries (95% Confidence Interval)	
Northwest Region					
Benton	2	4.4 (0.5-15.8)	13	26.3 (14.0-45.0)	increase
Carroll	3	2.7 (0.6-8.0)	40	40.7 (29.1-55.4)	
Crockett	4	6.8 (1.9-17.5)	9	16.9 (7.7-32.0)	
Dyer	17	11.8 (6.9-18.9)	31	21.7 (14.8-30.8)	
Gibson	11	5.5 (2.8-9.9)	27	14.3 (9.4-20.8)	
Henry	5	5.2 (1.7-12.2)	44	46.3 (33.6-62.1)	
Lake	0	0.0 (0.0-16.0)	10	47.2 (22.6-86.7)	
Obion	6	6.0 (2.2-13.0)	17	17.3 (10.1-27.7)	
Weakley	1	0.9 (0.0-5.2)	24	22.4 (14.4-33.4)	
Region Total*	49	5.6 (4.1-7.3)	215	25.2 (21.9-28.8)	increase
South Central Region					
Bedford	1	0.6 (0.0-3.6)	5	2.7 (0.9-6.4)	increase
Coffee	7	3.7 (1.5-7.6)	19	10.3 (6.2-16.1)	
Giles	2	2.3 (0.3-8.4)	22	26.4 (16.6-40.0)	
Hickman	3	3.7 (0.8-10.9)	9	12.0 (5.5-22.8)	
Lawrence	7	4.4 (1.8-9.2)	13	9.3 (4.9-15.9)	
Lewis	0	0.0 (0.0-10.9)	3	9.3 (1.9-27.3)	
Lincoln	11	15.1 (7.5-27.0)	30	34.7 (23.4-49.6)	
Marshall	7	7.0 (2.8-14.5)	6	5.6 (2.1-12.3)	
Maury	17	5.6 (3.3-8.9)	35	10.7 (7.5-14.9)	
Moore	1	9.5 (0.2-53.1)	0	0.0 (0.0-38.5)	
Perry	2	9.4 (1.1-34.1)	1	4.6 (0.1-25.6)	
Wayne	1	2.9 (0.1-16.4)	4	12.0 (3.3-30.7)	
Region Total*	59	4.7 (3.6-6.1)	147	11.5 (9.7-13.5)	

**Inpatient Hospitalizations for Deliveries with Any Maternal Substance Abuse by Region and County
Tennessee, 2000-2002 and 2009-2011**

Region/County	2000-2002		2009-2011		Change in Rate from 2000-2002 to 2009-2011
	Number of Hospitalizations	Rate per 1,000 Liveborn Deliveries (95% Confidence Interval)	Number of Hospitalizations	Rate per 1,000 Liveborn Deliveries (95% Confidence Interval)	
<i>Southeast Region</i>					
Bledsoe	0	0.0 (0.0-12.5)	6	18.4 (6.8-40.1)	
Bradley	2	1.6 (0.2-5.8)	47	14.3 (10.5-19.1)	increase
Franklin	5	4.2 (1.4-9.9)	13	11.9 (6.4-20.4)	
Grundy	7	12.3 (4.9-25.3)	6	12.3 (4.5-26.8)	
McMinn	7	5.2 (2.1-10.6)	33	21.5 (14.8-30.2)	increase
Marion	3	3.2 (0.7-9.3)	7	8.0 (3.2-16.4)	
Meigs	1	2.8 (0.1-15.7)	13	34.9 (18.6-59.8)	increase
Polk	0	0.0 (0.0-21.4)	5	11.0 (3.6-25.7)	
Rhea	2	1.8 (0.2-6.4)	17	14.3 (8.4-23.0)	increase
Sequatchie	0	0.0 (0.0-10.2)	7	17.7 (7.1-36.4)	
<i>Region Total*</i>	27	3.5 (2.3-5.2)	154	15.4 (13.1-18.0)	<i>increase</i>
<i>Southwest Region</i>					
Chester	2	4.1 (0.5-15.0)	9	17.2 (7.9-32.7)	
Decatur	1	2.4 (0.1-13.6)	9	28.8 (13.2-54.8)	
Fayette	5	5.4 (1.8-12.6)	3	2.4 (0.5-7.0)	
Hardeman	5	5.0 (1.6-11.7)	8	9.8 (4.2-19.4)	
Hardin*	1	1.7 (0.0-9.3)	49	66.0 (48.9-87.3)	increase
Haywood	5	6.2 (2.0-14.4)	6	9.4 (3.4-20.4)	
Henderson	2	2.2 (0.3-7.9)	16	17.2 (9.9-28.0)	increase
Lauderdale	9	7.3 (3.4-13.9)	8	8.0 (3.5-15.8)	
McNairy	3	3.5 (0.7-10.1)	22	26.2 (16.4-39.7)	increase
Tipton	15	7.2 (4.0-11.9)	10	4.5 (2.2-8.3)	
<i>Region Total*</i>	48	5.2 (3.8-6.8)	140	15.1 (12.7-17.8)	<i>increase</i>

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Tennessee, 2000-2002 and 2009-2011**

Region/County	2000-2002		2009-2011		Change in Rate from 2000-2002 to 2009-2011
	Number of Hospitalizations	Rate per 1,000 Liveborn Deliveries (95% Confidence Interval)	Number of Hospitalizations	Rate per 1,000 Liveborn Deliveries (95% Confidence Interval)	
Upper Cumberland Region					
Cannon	0	0.0 (0.0-8.7)	4	9.6 (2.6-24.6)	
Clay	0	0.0 (0.0-21.6)	2	10.2 (1.2-36.7)	
Cumberland	4	3.6 (1.0-9.2)	44	27.9 (20.2-37.4)	increase
DeKalb	3	5.5 (1.1-16.0)	11	17.7 (8.8-31.6)	
Fentress	3	5.4 (1.1-15.8)	12	22.6 (11.7-39.4)	
Jackson	1	4.3 (0.1-23.7)	12	47.1 (24.3-82.2)	increase
Macon	1	1.7 (0.0-9.4)	12	15.3 (7.9-26.7)	
Overton	5	8.6 (2.8-20.1)	15	23.3 (13.1-38.5)	
Pickett	1	8.9 (0.2-49.7)	5	40.7 (13.2-94.9)	
Putnam*	7	2.9 (1.2-5.9)	41	14.7 (10.5-19.9)	increase
Smith	2	3.5 (0.4-12.6)	24	41.2 (26.4-61.3)	increase
Van Buren	2	14.7 (1.8-53.1)	0	0.0 (0.0-27.4)	
Warren	6	3.7 (1.4-8.1)	7	4.8 (1.9-9.9)	
White	14	17.8 (9.8-29.9)	20	24.5 (15.0-37.9)	
Region Total*	49	5.0 (3.7-6.6)	209	19.1 (16.6-21.9)	increase
Tennessee *	1,572	7.5 (7.2-7.9)	4,670	20.6 (20.0-21.2)	increase

Data Source: TN Department of Health; Policy, Planning and Assessment; Hospital Discharge Data System

*These counties/regions also had a statistically significant increase in the discharge-level NAS inpatient hospitalization rate from 2000-2002 to 2009-2011.

Technical Notes

Data Sources:

Tennessee Department of Health; Division of Policy, Planning and Assessment; Office of Health Statistics; Birth Statistical System (BSS)

Tennessee Department of Health; Division of Policy, Planning and Assessment; Office of Health Statistics; Hospital Discharge Data System (HDDS)

Methodology:

Neonatal Abstinence Syndrome: Analyses were limited to the records of Tennessee residents and include inpatient hospitalizations with age less than 1 year and any diagnosis of drug withdrawal syndrome of newborn [International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) 779.5]. HDDS records contain up to 18 diagnoses – infants were included if any of these diagnosis fields were coded 779.5. Discharge-level analyses include all records with an NAS diagnosis – infants with multiple NAS discharges could therefore be counted more than once. For unique-patient analyses, infants with multiple NAS discharges were counted only once. Unique patients were identified using date of birth, gender, first and last two letters of the last name and first two letters of the first name. When comparing mean charges and length of stay among infants with and without NAS (page 8), the analysis was restricted to records with a first listed diagnosis of newborn delivery (ICD-9-CM codes 765.20, 765.29, and those beginning with V3) – the number of infants with NAS was therefore limited to those with a secondary diagnosis only, rather than any diagnoses as in the rest of the report. For a given data year, hospitalization rates were calculated by dividing the number of discharge-level hospitalizations or unique patients with NAS from the HDDS (i.e. the numerator) by the number of live births from the BSS (i.e. the denominator).

Maternal Substance Abuse: Analyses were limited to the records of Tennessee residents and included inpatient hospitalizations for liveborn delivery (identified using ICD-9-CM codes V270, V272, V273, V275, and V276) among females aged 15-44 years. Maternal substance abuse was defined using ICD-9-CM codes beginning with 304 (drug dependence) and codes beginning with 305.2-305.9 (nondependent drug abuse). HDDS records contain up to 18 diagnoses – women were classified as substance abusers if any of these diagnosis fields were coded with one of the above listed diagnoses. All analyses were discharge-level. For a given data year, hospitalization rates were calculated by dividing the number of hospitalizations with maternal substance abuse (i.e. the numerator) by the number of hospitalizations for liveborn delivery (i.e. the denominator).

HDDS records include up to 3 payer fields. Hospitalizations were included in the ‘TennCare’ payer group if any of these fields included TennCare, Cover TN, Cover Kids, or Access TN. ‘Other Payer’ includes Medicare, self-pay, other insurance, and free care. The number of ‘TennCare’ and ‘Other Payer’ hospitalizations may not sum to the total number of hospitalizations due to missing payer data.

Technical Notes *cont.*

Billed charges are the amount the hospital billed for the entire inpatient stay. These billed charges are not necessarily the same as reimbursements or costs, and do not include most professional (physician) fees. Hospital charges prior to 2011 were adjusted to 2011 dollars to account for inflation.

Because of the small number of annual hospitalizations at the county level, county data are presented for 3-yr time periods. The number of county-level NAS hospitalizations or hospitalizations with maternal substance abuse is the total number of hospitalizations over a specified 3-yr time period (note: county-level counts may not sum to the Tennessee total for the same time period due to missing data on county of residence). County-level rates are annual averages over the same 3-yr time period. Statistical significance of changes in county-level rates between time periods (specifically 2000-2002 vs. 2009-2011) was based on non-overlapping 95% confidence intervals.

Statistical significance of state-level time trends was determined using linear regression with a significance level of 0.05.

Definitions:

Dependent drug use: state in which there is a compulsive need to take a drug continuously or episodically, and there are emotional and physical symptoms of withdrawal upon discontinuance of use.

Nondependent drug abuse: excessive use of a drug without physical dependence.