



# The Chartis Center for Rural Health

*Insight and Solutions to Address Today's Most Complex Challenges*



**THE CHARTIS GROUP**

CHARTIS CENTER FOR RURAL HEALTH

*The Rural Health Safety Net Under Pressure:  
Rural Hospital Vulnerability*

February 2020

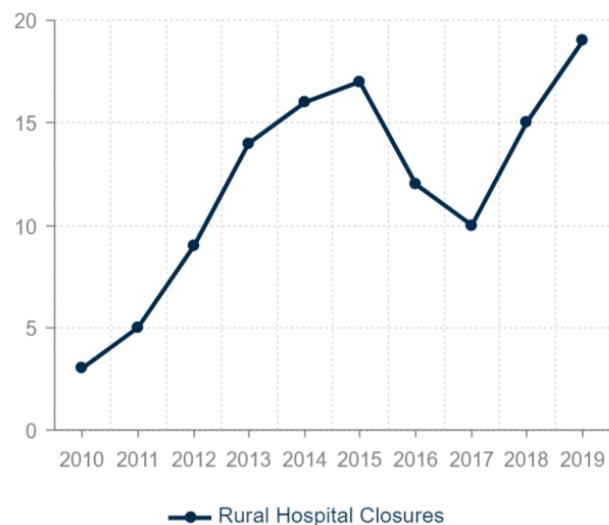
Since 2010, The Chartis Center for Rural Health and iVantage Health Analytics have been tracking the loss of rural hospitals across America. Over the course of the past decade, The Chartis Center for Rural Health has been a leading participant in the national conversation surrounding rural healthcare through research into the stability of the rural health safety net.

As of January 1, 2020, the rural hospital closure crisis has claimed 120 facilities across the nation. Although the number of rural hospital closures slowed somewhat in 2016 (12) and 2017 (10), there have been 34 closure announcements in the last 24 months. In fact, calendar year 2019 was the single worst year of the closure crisis as 19 rural hospitals closed (see Figure 1).<sup>1</sup>

The accelerated rate at which rural hospitals are closing continues to unsettle the rural healthcare community and demands a more nuanced investigation into rural hospital performance. Building upon its existing research into the stability of the rural health safety net, The Chartis Center for Rural Health developed a multilevel logistic regression model designed to identify the probability of closure for the nation's 1,844 open rural hospitals. Specifically, this research aimed to:

- Expand our understanding of the downward trajectory of key performance indicators in the 36 months prior to closure;
- Determine which rural hospitals are performing at levels similar to those facilities that have closed since 2010, and therefore vulnerable to closure; and
- Identify which performance variables have the greatest impact on increasing or decreasing a rural hospital's likelihood of closing.

Our analysis of a series of financial and operational metrics for closed hospitals revealed a rapid decline in performance in the 12 months prior to closure. Informed by the findings of this analysis, our regression model assessed the impact of 16 variables of which nine were shown to be statistically significant. The model identified 453 open rural facilities which can be considered 'vulnerable' to closure based on performance levels. Within this group, two distinct cohorts emerged; a group of 216 which can be considered 'most vulnerable' and a second group of 237 which are defined as 'at risk.'



*Figure 1: With 19 closures, 2019 was the single worst year of the rural hospital closure crisis.*

## Uncovering the Path Toward Closure

Rural hospital closures are tracked by the Cecil G. Sheps Center for Health Services Research at the University of North Carolina. In September 2019 when the data analysis for this study was conducted, the number of rural hospital closures at the time was 113.<sup>2</sup> Among this group of 113 hospitals were 39 Critical Access Hospitals and 74 Rural & Community Hospitals (aka Rural PPS).

States in the Southeast and lower Great Plains have borne the brunt of the closure crisis. States experiencing the highest number of rural hospital closures since 2010 include Texas (20), Tennessee (12), Oklahoma (7), Georgia (7), Alabama (6) and Missouri (6).<sup>3</sup> Our analysis shows that hospitals located in states that have not adopted Medicaid expansion have lower median operating margin and have a higher percentage of rural hospitals operating with a negative operating margin (see Figure 2). Of the eight states with the highest levels of closures since 2010, none are Medicaid expansion states.



**Figure 2:** Rural hospitals in states that have not expanded Medicaid face greater financial pressures than those in expansion states.

In an effort to determine when rural hospitals reach a tipping point toward closure, The Chartis Center for Rural Health examined financial and operational data for the three years prior to closure for closed hospitals and found that between three years and one year prior to closure, operating margin and revenue decline steadily (see Figure 3). Once the timeline eclipses 12 months (e.g. the final 12 months the hospital is operational), however, the decrease in operating margin and revenue is much more precipitous. When considered through the lens of magnitude of change, the decline in operating margin median during the last 12 months of operation is -12.5% and total revenue is -\$2.1 million.



**Figure 3:** The three years prior to a rural hospital's closure show a steady decline in key metrics between month 36 and 12. The decline accelerates once the timeline passes 12 months.

# Understanding the Likelihood of Hospital Closure

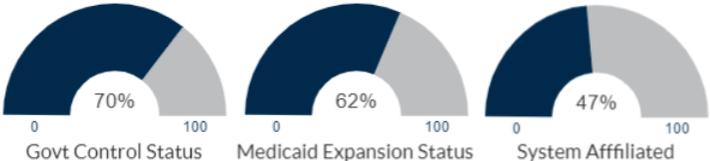
Our exploration into the three years preceding closure enabled us to not only better understand factors influencing closure but provided the framework for the regression model used to identify hospitals at high risk for closure. Informed by this initial analysis, The Chartis Center for Rural Health developed a rigorous statistical model that (A) identifies key indicators most likely to impact a hospital’s ability to sustain operations during the critical tipping point window (e.g. two years prior to closure), (B) identifies the number of open rural hospitals vulnerable to closure that are quantitatively similar across selected covariates to rural hospitals that closed since January, 2010, and (C) explores the performance levels of these open hospitals that are vulnerable to closure.

Utilizing data from Medicare Hospital Cost Report Information System<sup>4</sup>, Medicaid Expansion Status according to Kaiser Family foundation<sup>5</sup>, and the Area Deprivation Index, The Chartis Center for Rural Health analyzed financial and operational data from closed hospitals as well as 1,844 open rural hospitals. Our multilevel logistic regression model produced the probability of closure for each facility based on these metrics for the two most recent financial reporting years available. The model explored 16 indicators, determined to be important predictors of hospital closure, nine of which were determined to be statistically relevant (bolded below).

1. Area Deprivation Index	9. Operating Margin (Positive/Negative)
<b>2. Average Age of Plant</b>	<b>10. Percentage Capital Efficiency</b>
3. Average Length of Stay	<b>11. Percentage Change Total Revenue</b>
<b>4. Case Mix Index</b>	12. Percentage Net Days in AR
5. Critical Access Hospital	<b>13. Percentage Occupancy</b>
<b>6. Government Control Status</b>	<b>14. Percentage Outpatient Revenue</b>
7. Medicare/Medicaid Discharges	<b>15. System Affiliation</b>
8. Number of Beds	<b>16. State-level Medicaid Expansion Status</b>

Through the model, the nine bolded indicators emerged as having a real impact on decreasing a hospital’s likelihood of closure. According to this model, for example, a one percent increase in the percent change in total revenue can decrease the likelihood of closure by three percent on average. Similarly, a one percentage increase in the proportion of outpatient revenue decreases the likelihood of closure by five percent on average.

**Figure 4:** Government Control Status, Medicaid Expansion Status and System Affiliation can significantly decrease the likelihood of closure on average.

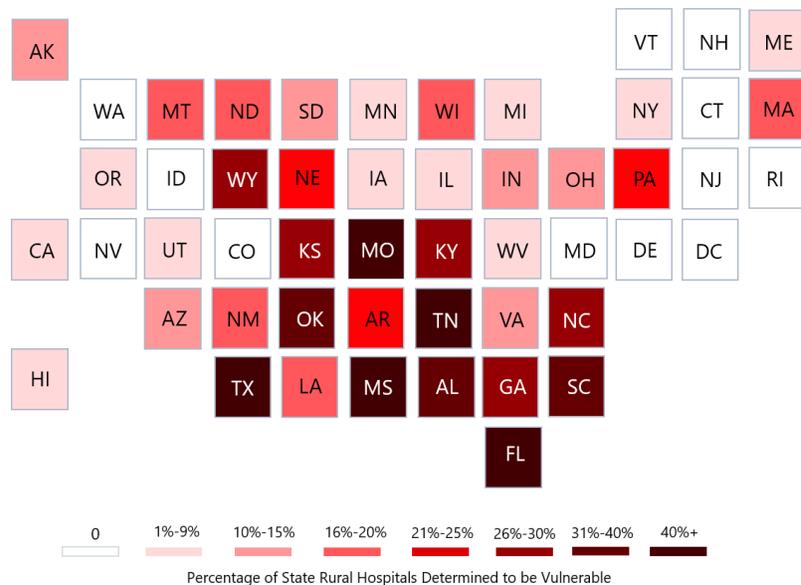


As noted earlier, the closure crisis has affected rural hospitals located in non-Medicaid expansion states much more so than in states that have expanded Medicaid. Our regression model showed that being located in a Medicaid expansion state decreases the likelihood of closure by 62 percent on average. Likewise, Government Control Status was shown to decrease the likelihood of closure 70 percent on average, and System Affiliation was shown to decrease the likelihood of closure by nearly 50 percent on average (see Figure 4).

## Rural Hospital ‘Vulnerability’

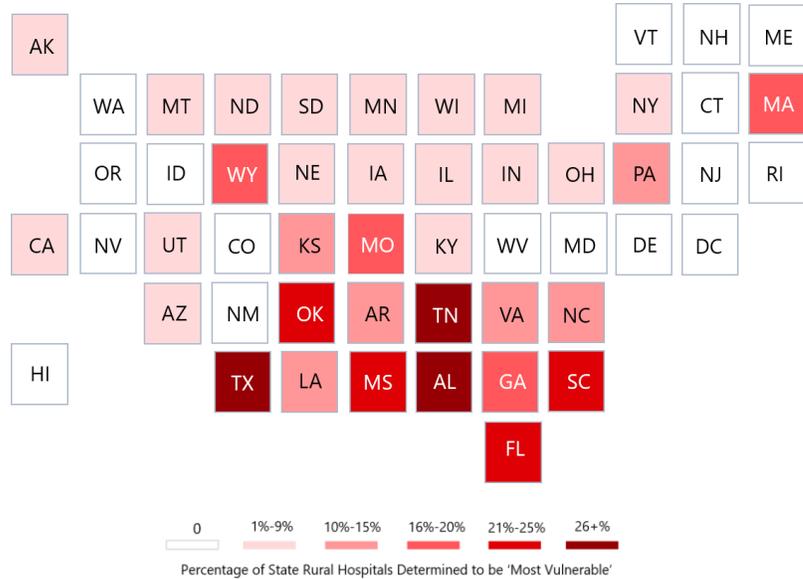
Utilizing this new analysis and model, The Chartis Center for Rural Health has determined that 453 rural hospitals (i.e. Critical Access Hospitals and Rural & Community Hospitals) are vulnerable to closure based on performance levels which are similar to rural hospitals at the time of their closure. Within this group of 453 vulnerable hospitals (see Figure 5). The statistical analysis reveals that this group of vulnerable rural providers falls into two categories ‘most vulnerable’ and ‘at risk.’

**Figure 5:** States with the highest percentage of rural hospitals identified as ‘Vulnerable’ by the analysis.



The first cohort are hospitals identified by the model to be greater than the selected probability threshold that optimizes model accuracy. This cohort is comprised of 216 hospitals which we consider to be ‘**most vulnerable**’ to closure (see Figure 6). Among this group of 216 hospitals are 97 Critical Access Hospitals and 119 Rural & Community Hospitals. Seventy five percent (or 162) are located in states that have not expanded Medicaid, and seventy six percent (or 165) do not have government control status.

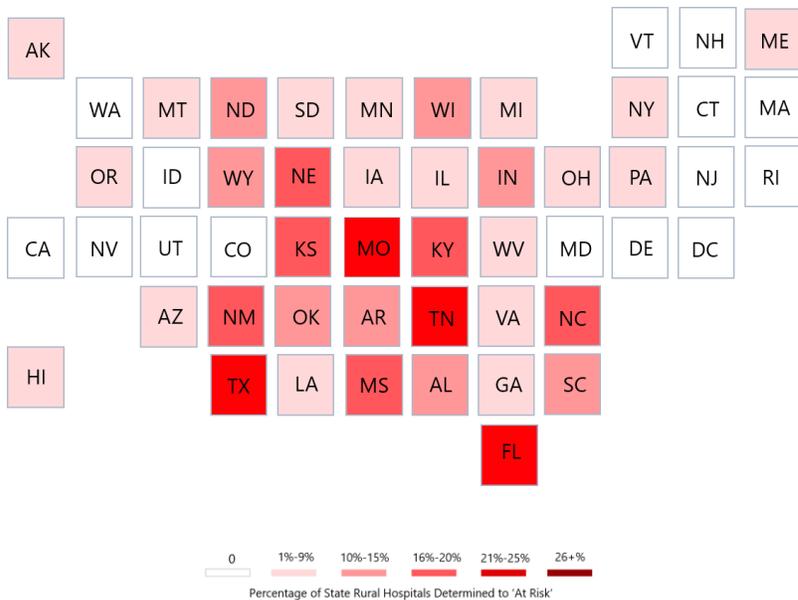
**Figure 6:** States with the highest percentage of rural hospitals identified as 'most vulnerable' by the analysis.



Our analysis revealed that this group’s median Percentage Change in Total Revenue is -1.4 percent, the median Occupancy is 20.7 percent, the median Capital Efficiency is -6.3 percent, the median Percentage of Outpatient Revenue is 75.9 percent, and the median Operating Margin in -8.6 percent.

The second cohort is identified by the model as having a lower likelihood of closure, compared to the most vulnerable group but is still identified as **‘at risk’** given sufficient similarity to the underlying characteristics of those hospitals that have closed. There are 237 hospitals ‘at risk’ in this cohort of which 92 are classified as Rural & Community Hospitals and 145 are Critical Access Hospitals (see Figure 7). Sixty two percent (or 146) are located in states that have not expanded Medicaid, and 68 percent (or 160) do not have government control status.

**Figure 7:** States with the highest percentage of rural hospitals identified as 'At Risk' by the analysis.

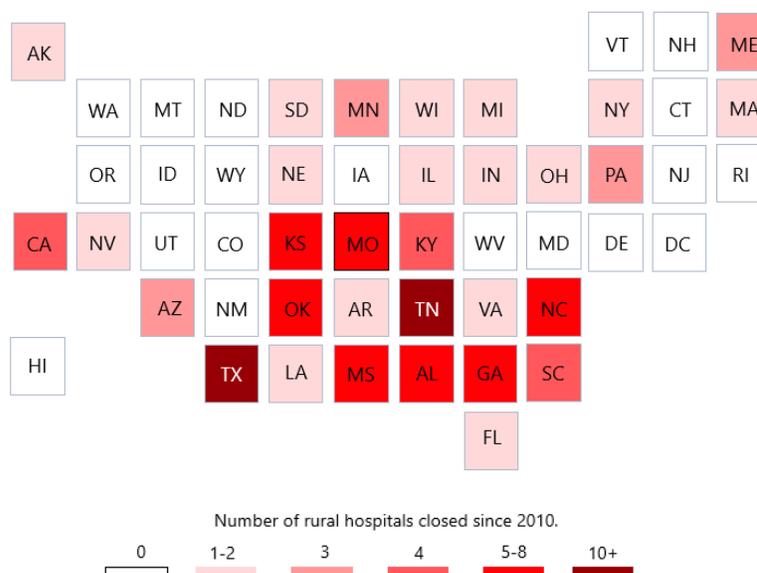


The analysis showed that this group’s median Percentage Change in Total Revenue is 1.7 percent, the median Occupancy is 26.9 percent, the median Capital Efficiency is -1.1 percent, the median Percentage of Outpatient Revenue is 77.6 percent, and the median Operating Margin is -2.6 percent.

## Vulnerability by the Numbers

When mapping rural hospital vulnerability, there is visible overlap between the areas of greatest vulnerability and the areas which have experienced the most rural hospital closures (see Figure 8). As is the case with closures, states in the Southeast and lower Great Plains are prevalent across multiple slices of the data (e.g. states with highest number of ‘most vulnerable’ hospitals, states with highest percentage of ‘at risk’ hospitals).

**Figure 9:** States with the highest number of rural hospital closures since 2010.



The highest levels of rural hospitals identified as ‘most vulnerable’ exist in states such as Texas, Oklahoma, Tennessee, Mississippi and Georgia. Each of these states have seen four or more rural hospital closures since 2010. Texas leads the nation in closures with 20 during this period, while Tennessee (12), Oklahoma (7) and Georgia (7) each rank in the top 5 among states experiencing the most closures.

Similarly, states with the highest number of ‘at risk’ facilities are Texas (36), Kansas (19), Missouri (15), Nebraska (14) and Mississippi (13). While Nebraska has seen only one rural hospital close since 2010, Missouri has lost six and Kansas and Mississippi have each lost five.

Looking at vulnerability through the lens of a percentage of a state’s rural hospitals, the Southeast and lower Great Plains again emerge with the highest percentage levels. For example, 52 percent of the rural hospitals in Tennessee are performing at a level similar to the rural hospitals that have closed since 2010. Thirty one percent of Tennessee rural facilities are among the ‘most vulnerable’.

In Texas, 51 percent of the state’s rural hospitals are among the 453 vulnerable hospitals with 27 percent among the ‘most vulnerable.’ In Alabama and Oklahoma, 38 percent and 37 percent respectively of each state’s rural hospitals are among the group of 453 vulnerable hospitals, and 27 percent and 22 percent are among the ‘most vulnerable.’ The table below offers a state-by-state breakdown of the analysis across each category of vulnerability alongside closure numbers since 2010.

State	Medicaid Expansion	Total Rural Hospitals	Closed Hospitals (Since 2010)	Count Vulnerable	Count 'Most Vulnerable'	Count 'At Risk'	% Vulnerable	% 'Most Vulnerable'	% 'At Risk'
AK	Y	17	1	2	1	1	12%	6%	6%
AL	N	45	6	17	12	5	38%	27%	11%
AR	Y	48	1	11	5	6	23%	10%	13%
AZ	Y	22	3	3	1	2	14%	5%	9%
CA	Y	56	4	2	2	0	4%	4%	0%
CO	Y	40	0	0	0	0	0%	0%	0%
CT	Y	3	0	0	0	0	0%	0%	0%
DE	Y	2	0	0	0	0	0%	0%	0%
FL	N	23	2	10	5	5	43%	22%	22%
GA	N	67	7	18	13	5	27%	19%	7%
HI	Y	13	0	1	0	1	8%	0%	8%
IA	Y	94	0	4	1	3	4%	1%	3%
ID	Y	28	0	0	0	0	0%	0%	0%
IL	Y	74	1	6	1	5	8%	1%	7%
IN	Y	55	1	7	1	6	13%	2%	11%
KS	N	105	5	31	12	19	30%	11%	18%
KY	Y	64	4	18	6	12	28%	9%	19%
LA	Y	57	0	9	6	3	16%	11%	5%
MA	Y	5	1	1	1	0	20%	20%	0%
MD	Y	5	0	0	0	0	0%	0%	0%
ME	Y	23	3	1	0	1	4%	0%	4%
MI	Y	64	1	4	2	2	6%	3%	3%
MN	Y	95	3	9	2	7	9%	2%	7%
MO	N	61	6	26	11	15	43%	18%	25%
MS	N	64	5	27	14	13	42%	22%	20%
MT	Y	55	0	9	5	4	16%	9%	7%
NC	N	50	5	15	6	9	30%	12%	18%
ND	Y	36	0	7	2	5	19%	6%	14%
NE	Y	72	1	16	2	14	22%	3%	19%
NH	Y	15	0	0	0	0	0%	0%	0%
NJ	Y	0	0		0	0	NA	NA	NA
NM	Y	24	0	4	0	4	17%	0%	17%
NV	Y	14	1	0	0	0	0%	0%	0%
NY	Y	53	1	5	3	2	9%	6%	4%
OH	Y	58	2	8	3	5	14%	5%	9%
OK	N	76	7	28	17	11	37%	22%	14%
OR	Y	33	0	1	0	1	3%	0%	3%
PA	Y	46	2	10	6	4	22%	13%	9%
RI	Y	0	0	0	0	0	NA	NA	NA
SC	N	22	4	8	5	3	36%	23%	14%
SD	N	46	1	7	4	3	15%	9%	7%
TN	N	48	12	25	15	10	52%	31%	21%
TX	N	152	20	77	41	36	51%	27%	24%
UT	Y	20	0	1	1	0	5%	5%	0%
VA	Y	26	2	4	3	1	15%	12%	4%
VT	Y	12	0	0	0	0	0%	0%	0%
WA	Y	45	0	0	0	0	0%	0%	0%
WI	N	76	1	12	3	9	16%	4%	12%
WV	Y	28	0	2	0	2	7%	0%	7%
WY	N	23	0	7	4	3	30%	17%	13%
		<b>2160</b>	<b>113</b>	<b>453</b>	<b>216</b>	<b>237</b>	<b>21%</b>	<b>10%</b>	<b>11%</b>

\*The Total Rural Hospitals (2,160) reflects the total number of providers before outliers were removed for the vulnerability analysis.

## Considerations in Reducing Vulnerability

As noted, nine variables emerged from our model to be statistically relevant in determining the probability of closure. As various stakeholders seek solutions to the rural closure crisis, and more broadly the stabilization of the rural health safety net, these indicators may present a roadmap for action. Our initial hypothesis, confirmed by the model, as to how each of these indicators should be protective of closure are stated below:

- **Average Age of Plant:** While older facilities may present challenges, avoiding the financial stress of large capital expenditure projects during a period of general instability would be beneficial.
- **Case Mix Index:** The ability to handle a broader array of service lines has the potential to create opportunities for hospitals to treat – or retain – more patients.
- **Government Control Status:** Having – or securing – government control status opens doors for additional funding and access to resources.
- **Percentage of Capital Efficiency:** A higher percentage of capital efficiency (e.g. Net Patient Income/Total Patient Revenue) means hospitals are extracting greater financial value from the services they provide.
- **Percentage Change Total Revenue:** Nearly 50 percent of rural hospitals operate in the red. A positive change in total revenue can signify momentum.
- **Percentage Occupancy:** Higher occupancy rates helps to reduce risk.
- **Percentage Outpatient Revenue:** As more and more care transfers to outpatient settings, the ability to secure a larger portion of patients particularly for financially beneficial service lines will counter the loss of inpatient-related revenue.
- **System Affiliation:** System affiliation often opens doors for rural providers to deliver services typically not supported locally, while creating opportunities for health systems to coordinate care across a larger continuum of service providers and develop upstream interventions. The Chartis Center for Rural Health's data also indicates that system-affiliated hospitals outperform independent rural hospitals.
- **State-level Medicare Expansion Status:** Rural populations are shown to be older, less healthy and less affluent than urban counterparts. Medicaid expansion creates

opportunities for individual in rural communities to move from the ranks of the medically uninsured.

## **Informing Tomorrow's New Ideas**

Over the course of the last five years, rural hospital operating margins have descended deeper into the red, moving from 39 percent to 47 percent. This in conjunction with the closure crisis underscores the pressure rural providers face. As policy makers and rural health advocates work to stabilize the rural health safety net, questions inevitability arise with regard to how many hospitals may be forced to confront difficult decisions about maintaining operations. This research suggests that a sizeable portion of the country's rural hospitals are vulnerable to closure. As the vulnerability heat map indicates, many of the states hit hardest by the closure crisis also see the highest levels of vulnerability which threatens to further erode the delivery of healthcare services at the local level. The regression model's ability to identify indicators with the greatest impact on predicting closure has the potential to better inform rural health stakeholders in their efforts to devise new policies and guidelines aimed at reducing downward pressure on rural provider revenues and improving care.

Research Citations: [1,2,3] Cecil G. Sheps Center for Health Services Research, University of North Carolina, September 2019, [4] Medicare Hospital Cost Report Information System, Q2 2019, [5] Kaiser Family Foundation, September 2019.

## **Analysis Methodology**

This analysis was developed by The Chartis Center for Rural Health and designed to model the probability of closure for all rural hospitals as a function of various indicators of closure and provide new insight into the underlying characteristics of hospitals that are more vulnerable to closure. To learn more about the methodology please visit [www.iVantageINDEX.com](http://www.iVantageINDEX.com).

## Research Team



### **Michael Topchik, MA, National Leader, The Chartis Center for Rural Health**

Michael has led the development and program operations of more than 20 rural health network initiatives around the country including the development and management of the OH CAH Network since 2009. He is a frequent presenter at state, regional and national rural health events and brings a wealth of experience utilizing “big data” for hospital benchmarking and performance improvement. Michael offers his expertise and knowledge as a key resource on matters impacting rural healthcare for media outlets such as *CNN*, *The Washington Post*, *Forbes*, *Reuters*, *The Boston Globe* and *FiveThirtyEight*.



### **Ken Gross, PhD, Chief Data Scientist, The Chartis Group**

Ken Gross is the Chief Data Scientist of The Chartis Group. He has over 15 years of experience as a thought leader for advanced analytic techniques and solution development across the healthcare provider industry. At Chartis, he serves as a senior advisor and industry expert to healthcare providers, aiming to advance their analytic capabilities and methods, and leads the development of new analytic methodologies and algorithms that support the firm’s consulting practices.

Prior to joining The Chartis Group, Dr. Gross was founder and Principal of Quantitative Innovations, a data strategy consulting practice, where he advised hospital systems and ACOs on implementation of population health data analytic strategies. He also served as the Director of Research and Evaluation for the Camden Coalition of Healthcare Providers, where he developed innovative quantitative and spatial analytic methods for understanding and addressing the needs of high utilization patients. Prior to his work with the Camden Coalition, Dr. Gross held positions as a Senior Associate at The Reinvestment Fund, and an Epidemiologist for the City of Philadelphia, Division of Maternal and Child Health.



### **Melanie Pinette, MEM, Data Analysis, The Chartis Center for Rural Health**

Melanie possesses extensive experience working with analyzing healthcare data. She works closely with CCRH’s state networks, providing insight into performance improvement opportunities. Prior to joining CCRH, Melanie served as a manager of Business Development for GNS Healthcare’s managed care team and led several program analyses and research efforts related to population health at Onpoint Health Data. She also worked with state health entities to implement and evaluate ACO networks designed to improve patient outcomes and lower total cost of care.



**Troy Brown, Client Services Manager, The Chartis Center for Rural Health**

Troy spent 10 years at Charles A. Dean Memorial Hospital, a critical access hospital in Maine, serving in a variety of roles including: Director of Business Services, Registration, Patient Accounts, HIM, IT, Materials Management, Performance Improvement and Community Relations and Development. Troy has built upon this foundation at The Chartis Center for Rural Health, facilitating a variety of strategic performance improvement-related projects with independent rural hospitals, system affiliated facilities and state-wide networks of rural and Critical Access Hospitals nationally.



**Billy Balfour, Director, Communications, The Chartis Center for Rural Health**

Billy leads The Chartis Center for Rural Health’s marketing initiatives. In his role, he works closely with state networks to promote and coordinate various network initiatives designed to educate and help participating hospitals optimize the use of INDEX-related benchmarks. Billy oversees development and marketing of CCRH’s thought leadership activities, including executive-level presentations at national rural health conferences and ongoing research into the rural health safety net.



**Hayleigh Kein, Analyst, The Chartis Center for Rural Health**

In her role, Hayleigh works closely with The Chartis Center for Rural Health’s clients to better understand and assess performance metrics, including the Hospital Strength INDEX. She’s actively involved in the development of market and population health assessments for The Chartis Center for Rural Health’s state network clients that provide hospital leadership teams with a new lens into dynamic factors impacting market share, patient volumes, as well as the quality and the delivery of care.