NC RHRP

Findings Brief
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Prediction of Financial Distress among Rural Hospitals

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BACKGROUND

From 2005 through 2015, more than 100 rural hospitals have closed their doors to patients in need of inpatient services.[1] Though a handful of these closed hospitals have since reopened, the remaining closures leave millions of rural residents at greater risk of negative health and economic hardship due to the loss of local acute care services.[2] Policymakers, hospital managers, researchers, and rural residents are concerned and interested in identifying hospitals experiencing financial distress and forecasting potential closures. However, the ability of existing risk prediction models to forecast imminent closures is limited because a high proportion of rural hospitals fall into the highest risk category. This broad definition of financial distress makes identification of the highest risk among the "high risk" hospitals more challenging.[3,4]

KEY FINDINGS

- The Financial Distress Index (FDI) is a new algorithm developed by the North Carolina Rural Health Research Program to predict whether a rural hospital is at high, medium-high, medium-low, or low risk of financial distress. The FDI has high face validity and predictive value as a tool to identify rural hospitals at high risk of closure.
- Among rural hospitals identified by the FDI as being at high risk of financial distress, the closure rate (between 2006 and 2014) was approximately 60 times higher than the rate among hospitals identified by the FDI as being at low risk.
- Two out of three hospitals that closed are identified by the FDI as being at high risk of financial distress in the year prior to closure.
- Financial indicators are the strongest drivers of financial distress, particularly total margin, benchmark performance and retained earnings, while hospital size and market poverty rates are the most influential non-financial factors.

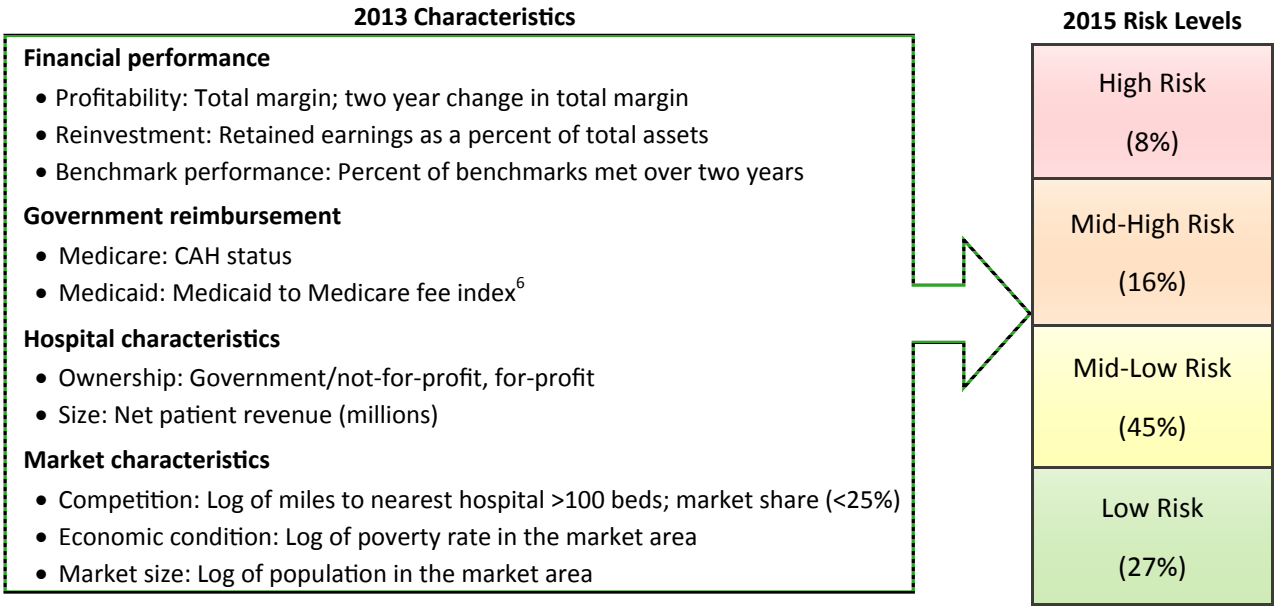
To better understand factors affecting rural hospital financial distress and to develop an early warning system to identify hospitals at risk of distress, we developed the Financial Distress Index (FDI). The FDI model forecasts the risk of distress in two years using the most currently available hospital financial performance, government reimbursement, organizational characteristics and market characteristics. The objective of this brief is to: 1) describe the ability of the FDI model to identify a group of rural hospitals facing an increased closure rate and 2) evaluate the potential impact drivers of the FDI model may have on the percent of hospitals at high risk of financial distress and closure.

RESULTS

FDI Model and Hospital Closure

The FDI model conceptualizes financial distress as four financial events of increasing signal strength: 1) unprofitability, 2) equity decline, 3) insolvency and 4) closure. Unprofitability was measured by negative cash flow margin. We defined equity decline as a greater than 20% decline in equity over two years. Insolvency was measured by negative equity (total liabilities > total assets), and closure was measured by cessation of inpatient care. The final FDI model includes 12 predictors composed of four measures of financial performance, two measures of hospital characteristics, two measures of government reimbursement, two measures of community characteristics, and two measures of local competition (Figure 1 on the next page). All drivers were statistically significant predictors of FDI. Finally, hospitals are assigned to high, mid-high, mid-low or low risk levels using the FDI score generated by the model. (See Appendix I on the last page for more detail.) Of 2,264 rural hospitals with available data in 2013, eight percent were identified as high risk of financial distress in 2015. Another 16% were categorized as mid-high risk, and the majority were categorized as low (27%) or mid-low (45%) risk.

Figure 1: FDI Model for Forecasting Financial Distress in Rural Hospitals



Rates of rural hospital closure increase significantly for hospitals identified as high risk by the FDI ($p<.0001$). For each FDI risk level, Figure 2 shows the two-year rate of rural hospital closure estimated using the Kaplan Meier method.[5] Over the period 2006 to 2014, one tenth of a percent of hospitals assigned to the low and mid-low risk categories for each two year period ceased inpatient services (CI 0.02-0.33 and 0.06-0.31, respectively), compared to 1.1% of hospitals assigned to mid-high risk (CI 0.7-1.9) and 5.9% of hospitals assigned to high risk (CI 4.2-8.1).

Figure 2: Two Year Closure Rates for Rural Hospitals by FDI Risk Level (2006-2014)

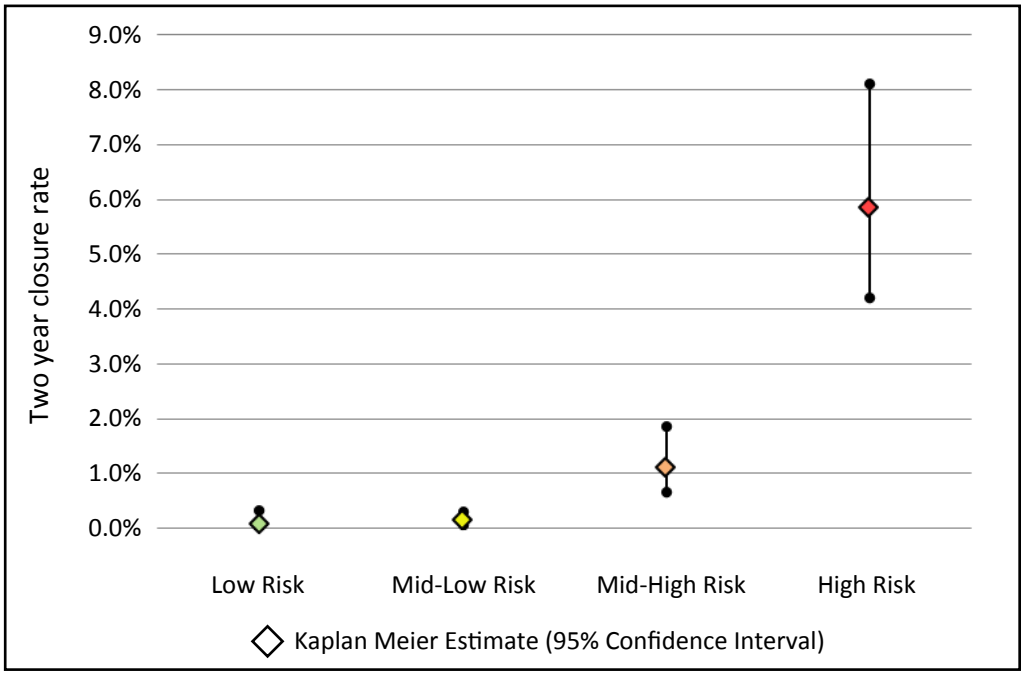
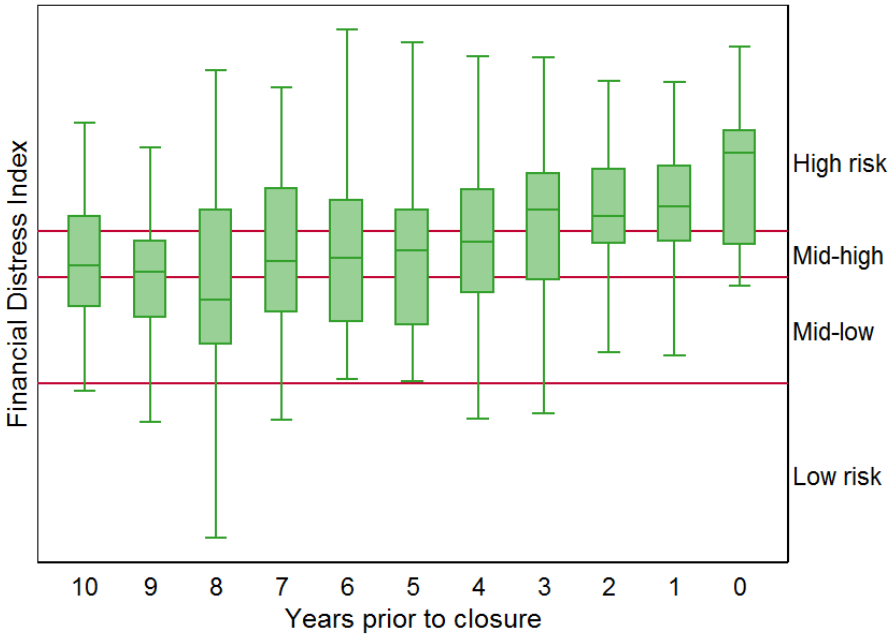


Figure 3 (next page) shows the trends in the distribution of FDI scores among closing hospitals, calculated using their data in the years prior to the closure. Most hospitals that close are classified as high risk two years prior to the closure, and we see a steady increase in risk beginning roughly five years prior to the closure. This trend suggests that the FDI is sensitive enough to capture a secular increase in risk occurring prior to the closure. Of hospitals that have closed since 2005, one third were identified by the FDI as high risk five years prior to closure, and more than two thirds were high risk one year prior.

Figure 3: Trend in FDI for Hospitals that Closed from 2005 to 2015



Note: Excludes outliers. Observations per year vary from 15 to 65.

Key Drivers in the FDI Model

To assess relative importance of predictors, we compared standardized coefficients – the change in FDI resulting from a one standard deviation change in the driver. Negative signs indicate a decrease (improvement) in the distress score. Financial performance measures are the most important drivers of the FDI score (see Table 1). A one standard deviation increase in total margin, percent benchmarks met and retained earnings results in a 0.25, 0.23 and 0.16 standard deviation decrease in the FDI score respectively, indicating a decreased risk of distress. Hospital size, measured by net patient revenue, is also a strong factor with larger hospitals less likely to experience distress (-0.18). The poverty rate in the market is the most influential market factor, with higher poverty rates associated with increasing risk (0.14). Contrary to expectations, for-profit hospitals are more likely than non-profit or government owned hospitals to experience distress (0.13). Medicare cost based reimbursement, measured by Critical Access Hospital status, was associated with a reduced risk of financial distress (-0.06) as was Medicaid generosity, measured by the Medicaid to Medicare Fee Index (-0.05).[6] Among measures of competition, the hospital's share of Medicare discharges (-0.08) has a larger impact on risk than the number of miles to the nearest 100 bed hospital (-0.05).

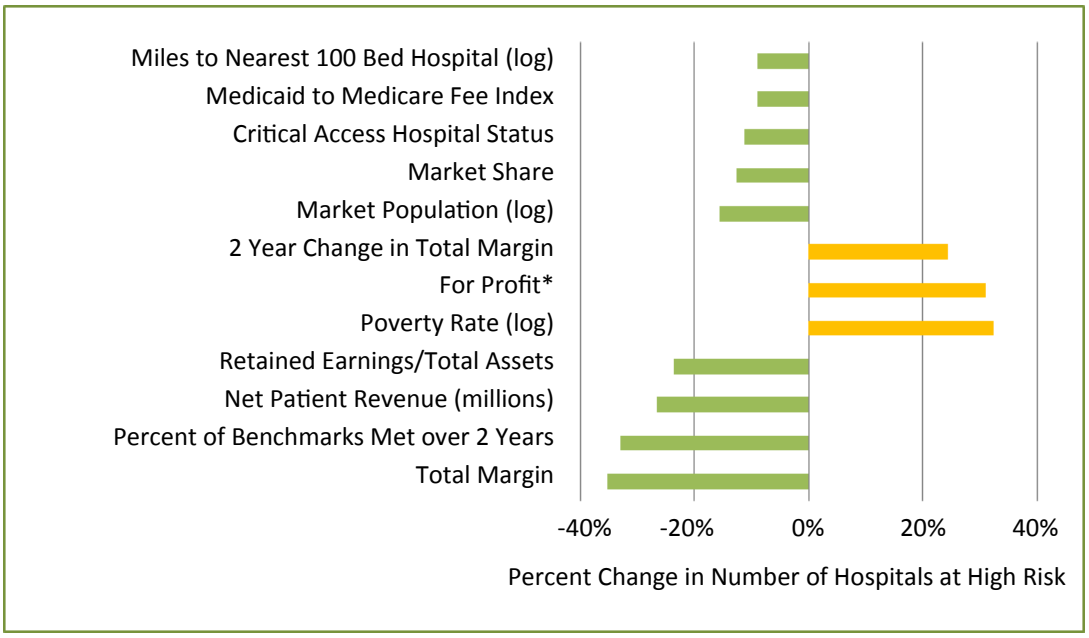
Table 1: Predictors of the FDI Score in Order of Standardized Effect Size

Variable	Standardized Coefficient	Standard Deviation
Total Margin	-0.25	0.11
Percent of Benchmarks Met over 2 Years	-0.23	0.25
Net Patient Revenue (millions)	-0.18	3.44
Retained Earnings/Total Assets	-0.16	0.70
Poverty Rate (Log)	0.14	0.43
For Profit (relative to non-profit/government owned)	0.13	0.28
2 Year Change in Total Margin	0.10	0.11
Market Population (Log)	-0.10	1.07
Market Share	-0.08	6.21
Critical Access Hospital Status	-0.06	0.50
Medicaid to Medicare Fee Index	-0.05	0.15
Miles to Nearest 100 Bed Hospital (Log)	-0.05	0.59

Note: Negative coefficients indicate a reduced risk of financial distress

Of course, it is difficult to interpret the practical effect of a change in the FDI; a change in the probability of being in each risk level is far more interpretable. The impact these drivers have on the FDI score is most relevant for the eight percent of rural hospitals identified as high risk for 2015. The percent change in the proportion of hospitals identified as high risk due to one standard deviation increase in each predictor ranges from a decrease of 35% to an increase of 32% (Figure 4). Increasing total margins by one standard deviation (for example, a hospital with a loss of five percent to a profit of six percent) would cut the proportion of hospitals considered high risk by one third.

Figure 4: Impact of One Standard Deviation Increase in each Predictor on Proportion of Rural Hospitals at High Risk of Financial Distress in 2015



**Relative to not for profit/government owned hospitals*
Note: Excludes outliers

CONCLUSION

The FDI risk levels successfully discriminate rural hospitals facing an increased rate of closure. Key drivers in the FDI model include financial indicators as well as community factors. Policies and interventions targeting these factors may reduce the proportion of rural hospitals at high risk of closure. Despite the predictive power demonstrated currently, we note the FDI model was developed using data from a time period prior to the implementation of the Affordable Care Act. The introduction of health care reform warrants future monitoring to ensure that the model is calibrated appropriately.

APPENDIX I

Financial and market data for rural hospitals were drawn from Healthcare Cost Report Information System (HCRIS) from 2000-2014, the Online Survey, Certification and Reporting (OSCAR), Medicaid to Medicare Fee Index, Nielsen-Claritas Population Facts, and Centers for Medicare and Medicaid Services (CMS) Hospital Service Area File. Rural hospitals were defined using the Federal Office of Rural Health Policy definition.[7] Cost reports for periods less than 360 days and observations with missing FDI score due to missing data were excluded for a final sample of N=25,235. The predictive logistic model was developed using a 50% random sample of rural hospitals and validated in the combined sample. The model posits financial distress in time *t* is the predicted risk of a financial distress event in time *t*+2. Further details about the model are available from the authors, but briefly, the statistical approach is as follows. The statistical model "stacks" each hospital-year into four observations measuring whether a hospital has each of the four signals (unprofitability, equity decline, insolvency, closure). The underlying coefficients are specified as identical for each outcome with the exception of a constant "shifting" the index to allow for differing rates of the signal occurring. That is, $Pr(SIGNAL_{ht+2}=1) = f(X_{ht}b+d_s)$ where *h* designates hospitals, *t* designates year, and *s* designates which of the four signals.

After developing the model, risk levels were determined by the association between the predicted score and the probability of the distress events. Coefficients of the predictors in the FDI model were standardized by dividing the product of the coefficient and the standard deviation of the variable by the standard deviation of the logistic function. The probability of closure within two years was calculated using the Kaplan Meier[5] method for observations within three distinct time periods: 2007-2008; 2009-2010; 2011-2012; 2013-2014. Hospitals were assigned to FDI risk level using data from the cost report ending the year prior to the period. Observations were censored in the middle of the year of closure (N=56) or the end of the time period (two years).

REFERENCES AND NOTES

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