MT47

Does the use of new technology by Care Managers have an impact on Neonatal Intensive Care Unit (NICU) Admissions and Length of Stay?

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INTRODUCTION

- Neonatal intensive care units (NICU) provide essential medical care to neonates, however, are associated with hospital-acquired infections, less maternal-newborn bonding, and high costs.
- This study uses causal-inference methods to evaluate the impact of care managers using new technology to identify and risk stratify pregnancies on NICU admissions and NICU Length of Stay (LOS).
- The new technology provides data analytics tools that care managers at CareFirst did previously not have, including pregnancy identification, risk stratification, to better track and manage patients throughout their pregnancy.

METHODS

Study Population

- Claims data of 4,917 deliveries whose maternal comorbidities were matched with their neonate's outcomes from the CareFirst BlueCross BlueShield Community Health Plan District of Columbia from 2013 to 2022.

Data Collection and Variables

- **Maternal data included:** age, socioeconomic status, zip code, and maternal comorbidities such as sickle cell disease, pre-existing diabetes mellitus, and hypertension.
- **Obstetrical data included:** a history of preterm delivery, pre-eclampsia, placenta previa, fetal abnormality, gestational hypertension, cesarean section delivery, as well as other prior and current obstetrical conditions.

Technological Intervention

Care Management Workflow Pre and Post Intervention

Causal Inference Models

Generalized Linear Models (GLM)

- Three patient-level GLM models: Logit, Poisson, and Negative Binomial

$$\text{logit}(P(\text{NICU Admission}_i=1)) = \beta_0 + \beta_1 \text{Technological Intervention}_i + \gamma' \boldsymbol{X} + \varepsilon_i$$

$$\text{NICU LOS}_i = \exp\left(\beta_0 + \beta_1 \text{Technological Intervention}_i + \gamma' \boldsymbol{X} + \varepsilon_i\right)$$

$$\text{NICU LOS}_i = \exp\left(\beta_0 + \beta_1 \text{Technological Intervention}_i + \gamma' \boldsymbol{X} + \nu_j + \varepsilon_i\right)$$

Where the Technological Intervention is 1 after the new technology was implemented and 0 prior to the new technology, X is a vector of maternal and obstetrical characteristics, $\nu_j \sim \Gamma\left(\frac{1}{\alpha}, \alpha\right)$, where α is the overdispersion parameter and ε_i is the error term.

Bayesian Structural Time-Series (BSTS)

- BSTS models provide a way to test the couterfactuals of not having the new technology.

$$\text{NICU Outcome}_t = \mu_t + \tau_t + \beta' \mathbf{x}_t + \varepsilon_t,$$

$$\mu_{t+1} = \rho \mu_t + \eta_{\mu,t},$$

$$\tau_{t+1} = -\sum_{s=1}^{S-1} \tau_t + \eta_{\tau,t},$$

Where μ_t denotes the trend in NICU Outcome, $\eta_{\mu,t} \sim N\left(0, \sigma_\mu^2\right)$ $\eta_{\tau,t} \sim N\left(0, \sigma_\tau^2\right)$, and $|\rho| < 1$ for the stationarity condition. The $\mathbf{x}_t$ vector denotes the comorbidities, and τ_t denotes the seasonal component where we set S=12 since we use monthly NICU data for these models.

RESULTS

NICU Admissions and NICU Length of Stay Models

	NICU Admissions	NICU Length of Stay (Days)	
	Logit (OR)	Poisson (IRR)	Negative Binomial (IRR)
Technological Intervention	0.708*** (0.001)	0.925*** (0.001)	0.766*** (0.006)
Maternal Comorbidities	Yes	Yes	Yes
ZIP Code Dummies	Yes	Yes	Yes
Month Dummies	Yes	Yes	Yes
N	4,917	4,917	4,917

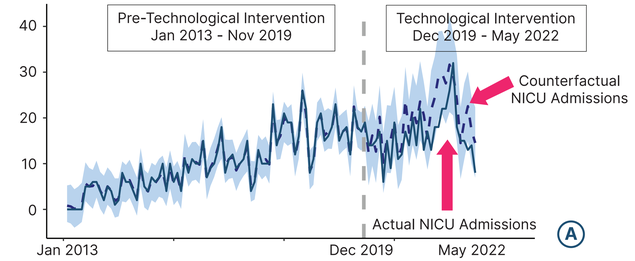
*,**, and *** denote statistical significance at the 10%, 5% and 1% levels. p-values are given in parentheses.

Impact of technological intervention on NICU admissions (# of NICU admissions) and NICU length of stay days. (Dec 2019 - May 2022)

Average Impact: Month/Year/%	NICU Admissions (#/%)	NICU Length of Stay (Days)
Month	-4	-44
Year	-48	-528
Overall%	-19%	-24%
Probability of Causal Effect	98%	93%

Maternal data NICU admissions count counterfactuals (BSTS model)

Technological Start Date: Dec 2019 (5-month buffer)



Maternal data NICU days counterfactuals (BSTS model)

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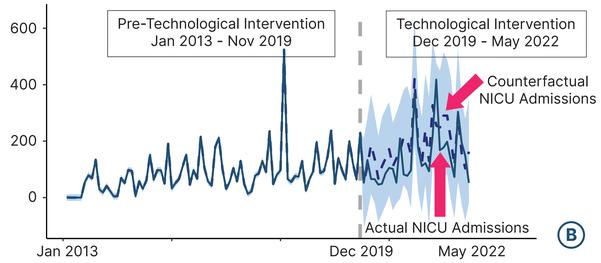

CONCLUSION

- Technology which equips care managers with better tools for pregnancy identification and risk stratification can lead to significant improvements in neonatal health outcomes as indicated by a reduction in NICU admissions and NICU LOS.