

Online Supplemental Material

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Supplemental Table 1. Adjusted associations of continuous UNGD metrics with heart failure hospitalization status

UNGD Metric	Odds ratio (95% CI) per 1 unit increase in natural log of each metric*
Pad preparation**, 1/m ²	
Mean-centered	1.33 (1.20, 1.47)
Mean-centered-squared	0.95 (0.91, 0.98)
Spud (drilling), 1/m ²	
Mean-centered	1.13 (0.94, 1.37)
Stimulation, m/m ²	
Mean-centered	1.14 (1.05, 1.24)
Production**, m ³ /m ²	
Mean-centered	1.21 (1.11, 1.31)
Mean-centered-squared	1.02 (1.01, 1.03)

*Models adjusted for: sex, race/ethnicity, receipt of Medical Assistance, smoking status, BMI (centered and centered-squared), age category, season, contact time, distance to hospital or clinic, year, and region.

**Results are reported for both the mean-centered metric and the mean-centered-squared metric separately only if quadratic term was statistically significant.

Supplemental Table 2. Adjusted associations of annual peak (for 16-day period each year) normalized difference vegetation index (NDVI) and sensitivity analyses of primary UNGD models after inclusion of NDVI with heart failure hospitalization status

UNGD Metric	Odds ratio (95% CI)
Model 1a	
NDVI*, unitless	0.94 (0.89, 0.99)
Model 1b	
NDVI*, unitless	(ref)
Q1 (0.14, 0.60)	(ref)
Q2 (0.60, 0.70)	0.82 (0.70, 0.98)
Q3 (0.70, 0.79)	0.91 (0.75, 1.09)
Q4 (0.79, 0.94)	0.84 (0.69, 1.02)
Models 2a-d	
Sensitivity analyses for UNGD associations with NDVI adjustment	
Pad preparation**, 1/m ²	(ref)
Q1 (4.0 X 10 ⁻⁹ , 3.3 X 10 ⁻⁸)	(ref)
Q2 (3.3 X 10 ⁻⁸ , 6.2 X 10 ⁻⁸)	1.18 (1.00, 1.39)
Q3 (6.2 X 10 ⁻⁸ , 1.2 X 10 ⁻⁷)	1.60 (1.33, 1.93)
Q4 (1.2 X 10 ⁻⁷ , 2.5 X 10 ⁻⁵)	1.66 (1.32, 2.08)
Spud (drilling)**, 1/m ²	(ref)
Q1 (1.9 X 10 ⁻¹⁰ , 2.6 X 10 ⁻⁹)	(ref)
Q2 (2.6 X 10 ⁻⁹ , 3.8 X 10 ⁻⁹)	1.00 (0.81, 1.24)
Q3 (3.8 X 10 ⁻⁹ , 4.7 X 10 ⁻⁸)	1.08 (0.85, 1.36)
Q4 (4.7 X 10 ⁻⁹ , 1.7 X 10 ⁻⁸)	0.96 (0.74, 1.25)
Stimulation**, m/m ²	(ref)
Q1 (2.5 X 10 ⁻⁶ , 2.7 X 10 ⁻⁴)	(ref)
Q2 (2.7 X 10 ⁻⁴ , 5.6 X 10 ⁻⁴)	1.02 (0.80, 1.30)
Q3 (5.6 X 10 ⁻⁴ , 9.7 X 10 ⁻⁴)	1.54 (1.18, 2.01)
Q4 (9.7 X 10 ⁻⁴ , 0.2)	1.76 (1.32, 2.35)
Production**, m ³ /m ²	(ref)
Q1 (2.2 X 10 ⁻⁶ , 0.002)	(ref)
Q2 (0.002, 0.02)	0.88 (0.65, 1.20)
Q3 (0.02, 0.03)	1.11 (0.76, 1.62)
Q4 (0.03, 16.5)	1.62 (1.07, 2.45)

*Models adjusted for: sex, race/ethnicity, receipt of Medical Assistance, smoking status, BMI (centered and centered-squared), age category, season, contact time, distance to hospital or clinic, year, and region.

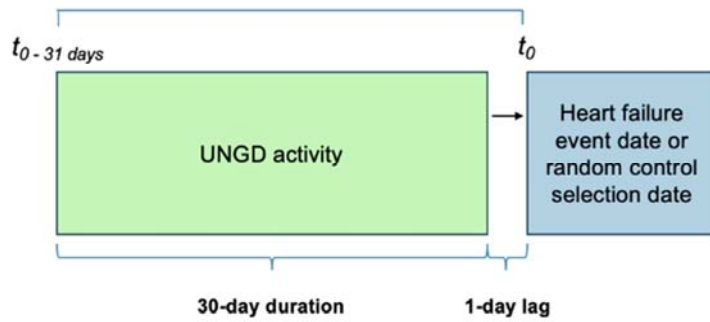
**Models included one UNGD metric in separate models and adjusted for: sex, race/ethnicity, receipt of Medical Assistance, smoking status, BMI (centered and centered-squared), age category, season, contact time, distance to hospital or clinic, year, region, and NDVI (centered).

Supplemental Table 3. Adjusted associations of a 30-day composite UNGD metric (z-score sum of pad preparation, spud, stimulation, and production phases) with heart failure hospitalization status

UNGD Metric	Odds ratio (95% CI)
Composite z-score sum*	
Q1 (-6.93, -6.82)	(ref)
Q2 (-6.82, -6.69)	0.89 (0.68, 1.18)
Q3 (-6.69, -6.52)	1.41 (1.04, 1.91)
Q4 (-6.52, 59.22)	1.49 (1.08, 2.06)

*Models adjusted for: sex, race/ethnicity, receipt of Medical Assistance, smoking status, BMI (centered and centered-squared), age category, season, contact time, distance to hospital or clinic, year, and region.

Supplemental Figure 1. Schematic of UNGD activity assignment in relation to events (hospitalizations or control encounters), showing the 30-day duration and the 1-day lag in relation to the date of hospitalization or control encounter



Supplemental Figure 2. Plot of linear and quadratic associations between the production metric and predicted probability of hospitalization, with 95 % confidence intervals

