How is the Doctor Feeling?

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The judgment of intensive care unit (ICU) providers is difficult to measure using conventional structured electronic medical record (EMR) data. However, provider sentiment may be a proxy for such judgment. Building on 10 years of EMR data, this study evaluates the association between provider sentiment and diagnostic imaging utilization. We extracted daily positive / negative sentiment scores of written provider notes, and used a Poisson regression to estimate sentiment association with the total number of daily imaging reports. After adjusting for confounding factors, we found that (1) negative sentiment was associated with increased imaging utilization (p < 0.01), (2) sentiment’s association was most pronounced at the beginning of the ICU stay (p < 0.01), and (3) the presence of any form of sentiment increased diagnostic imaging utilization up to a critical threshold (p < 0.01). Our results indicate that provider sentiment may clarify currently unexplained variance in resource utilization and clinical practice.

(1) What is the relationship between ICU provider sentiment and diagnostic imaging utilization?

(2) Is this relationship consistent over the course of ICU length of stay, or does it change over time?

Confounding Factors: We extracted a set of continuous and categorical features that were suspected to confound the relationship between provider sentiment and the number of daily imaging exams. The features included: patient age, the Sequential Organ Failure Assessment Score (SOFA), the Elixhauser comorbidity index and the Oxford Acute Severity of Illness Score (OASIS) gender (with female being the reference group) and ethnicity (white, black, Hispanic and other, with white as the reference group). We also included dichotomous indicators for the following conditions: obesity, human immunodeficiency virus infection (HIV), metabolic cancer diagnosis, diabetes and ICU type (with surgical coded as one).

Data Source: All data for this study were extracted from the publicly available Medical Information Mart for Intensive Care (MIMIC-III) database (mimic.physionet.org).

Sentiment in Medical Notes. Each point represents a patient’s day in the ICU. Colors represent the number of radiological exams received (see legend), while the size of each point indicates the number of provider notes used to compute the sentiment. The average number of notes for each radiological exam level is shown in the figure legend.

RESULTS

Imaging Utilization over Time: Changes in image utilization as a function of daily sentiment over the first 5 days of ICU stay. Curves represent the value of the relative rate of image utilization per unit increase in daily sentiment (y-axis) by ICU day (x-axis).

Imaging Utilization as a Function of Sentiment: The association between negative sentiment and imaging utilization over time is shown with linear and quadratic sentiment terms. Curves represent the estimated relative rate of image utilization per unit increase in negative sentiment.

TABLE I: SUMMARY STATISTICS. EXTRACTED FEATURES FOR THE PATIENT POPULATION, PARTITIONED BY THE NUMBER OF DAILY IMAGING EXAMS. OASIS: OXFORD ACUTE SEVERITY OF ILLNESS SCORE. SOFA: SEQUENTIAL ORGAN FAILURE ASSESSMENT.

For questions, or collaboration interests, please email ghassemi@mit.edu