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Identifying heat-related diagnoses through linked electronic health record and environmental data: a heat-wide association study conducted in Chicago

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Extreme heat is an escalating public health concern, yet prior studies capture only a limited spectrum of heat-related illness and often misclassify or miss heat-related conditions. To comprehensively identify heat-sensitive health outcomes, we conducted a heat-wide association study using multi-institutional electronic health record (EHR) data from the Chicago Area Patient-Centered Outcomes Research Network (CAPriCORN). The analytic cohort included 916,904 emergency department (ED) visits among 372,140 adults across five healthcare systems during the warm-season (May–September) from 2011–2023. Patient residential data in CAPriCORN enabled precise linkage of environmental exposure to clinical outcomes. For exposure assessment, 1 km²–resolution daily maximum temperature data from Daymet were linked to census tract of each patient’s residence on the date of their ED encounter(s), providing a robust platform for studying acute-care risk during extreme heat events. We employed a two-

stage analytic framework—quasi-Poisson regression screening followed by time-stratified case-crossover distributed lag non-linear models—to systematically identify and quantify associations between extreme heat and ICD-10–coded diagnoses. The first stage screened 1,803 diagnostic categories, of which 38 met statistical significance and predefined frequency criteria. The second stage identified 11 diagnoses with elevated same-day risks of ED visits during extreme heat, including heat illness, volume depletion, hypotension, edema, acute kidney failure, and injury-related conditions. By integrating citywide EHR and environmental data, this study provides a population-scale characterization of heat-associated morbidity and its heterogeneity across demographic/geographic subgroups. Findings refine the definition of heat-related health outcomes and inform targeted public-health and clinical responses to future extreme heat events.

