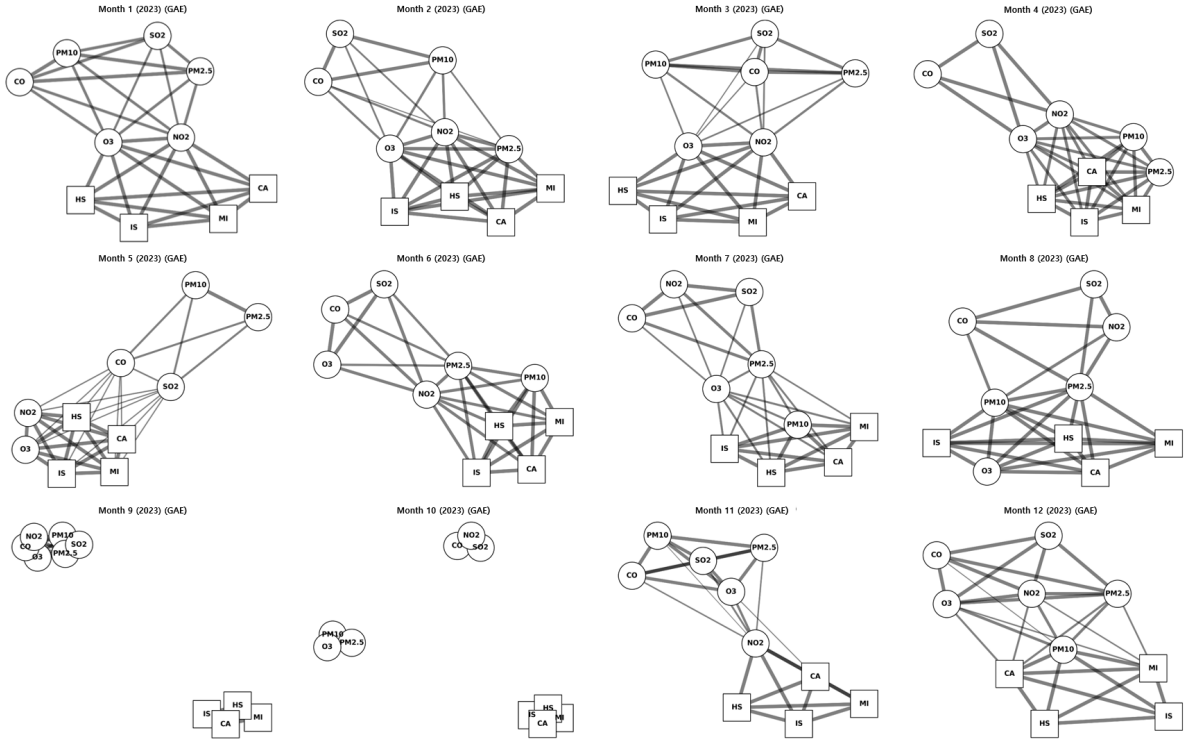
Supplement 9. Monthly Graph Autoencoder (GAE) Networks Depicting Lagged Pollutant–Disease Associations in 2023



This figure shows the monthly network visualizations generated by the Graph Autoencoder (GAE) model for each month of 2023 using lagged associations (t-1 month pollutant concentrations with t month emergency room visits).

Graph Construction:
Nodes: Circles indicate air pollutants (SO_2, NO_2, O_3, CO, PM_{10}, $PM_{2.5}$), squares indicate disease categories (CA, MI, IS, HS).
Edges: Black lines represent predicted structural associations between nodes based on lagged relationships. Thicker edges indicate stronger learned connections (higher adj_pred values).

Interpretation:
Each panel (Month 1–12) corresponds to a specific month in 2023 with pollutant data from the previous month (t-1) used to predict associations with current month (t) disease outcomes.
Seasonal variation in lagged effects is visible in the network density and clustering patterns. Winter months may show persistent strong connections between previous month's NO_2, O_3 concentrations and current month's disease nodes, suggesting delayed health impacts from cold-season pollutant exposure.
From Summer to Autumn, graphs display more fragmented networks in the lagged analysis, indicating weaker temporal carryover effects during warmer periods when pollutant concentrations are generally lower and atmospheric dispersion is enhanced.
These month-by-month lagged visualizations help illustrate how pollutant exposure effects may persist across monthly boundaries, supporting the identification of temporal lag patterns in pollutant–disease associations.