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Social Media-Based Respiratory Disease Surveillance: Multi-Assessor Labelling and Cross-Model Accuracy Assessment

Timely health surveillance reporting is of foremost importance within the context of respiratory infection outbreaks. Traditional public health surveillance is often marred by reporting delays and low ascertainment rates. Recognizing the surveillance potential of Twitter reports of health symptoms, our Computational Epidemiology and Public Health Informatics Laboratory collected a repository of hundreds of millions of Canadian tweets during 2016-2022.

As a central part of their COVID-19 pandemic work under contract with SHA, PHAC, and FNIHB, the applicants employed Particle Filtering and PMCMC of compartmental models with diverse empirical data for regular reporting and projections. That work further investigated the potential for augmenting such data with time series gathered from tweets automatically classified as plausible COVID-19 or Influenza cases. Substantially expanding on the results shared in Tian et al. 2025, we describe here an end-to-end project using multi-assessor tweet labeling, training and testing of language embedding with 24 diverse machine learning models while navigating class imbalances, and comparisons of model accuracy across multiple accuracy measures. 16 models and model variants were assessed for accuracy in identifying tweets reporting plausible COVID-19 cases, with an additional 8 models being assessed for classifying plausible influenza cases. Models were compared using recall, F1, area under the ROC Curve and accuracy. Among models, transformer-based tweets performed most favourably, followed by an ensemble method involving a diverse set of classical techniques. In closing, we discuss our efforts to shift data collection platforms, and to augment our methods to detect spread of health disinformation via sheaf-based deep learning.