Our new implementation of spatial scan statistics has several advantages over standard spatial scan approaches (e.g. SaTScan). First, we use novel spatial statistical methods to adjust for spatial and temporal variation in the baseline counts, allowing us to account correctly for day of week, seasonality, and other trends. This improves detection power, allowing more timely detection of emerging clusters with fewer false positives. Second, we have developed a new computational method, the “fast spatial scan.” This fast multi-resolution search approach allows us to compute the spatial scan hundreds to thousands of times faster than the standard approach. Thus we can obtain results in minutes rather than hours or days, even for massive datasets containing millions of records.

Spatial Scan can find anomalous spatial clusters in spatial or space-time data sets. In particular, given a large set of spatial locations (e.g. zip codes), where each location has an associated time series of counts, it can detect any spatial regions where the most recent counts are significantly higher than expected, given the historical baseline data. For example, if we are given the number of emergency department visits in each zip code on each day, it can find areas where the recent number of cases is abnormally high, which may be indicative of an emerging outbreak of disease.

We are currently using Fast Spatial Scan to perform daily monitoring of over-the-counter medication sales from the National Retail Data Monitor (NRDM). Our system receives daily counts of the number of units sold in 18 different product categories (cough remedies, nasal decongestants, etc.) from over 20,000 retail stores and pharmacies nationwide. It then uses our new spatial cluster detection methods to find areas where the sales are significantly higher than expected, and makes these results available to state and local public health officials via a web-based graphical interface.

In May 2000, an outbreak of gastroenteritis in Walkerton, Ontario resulted from contamination of the water supply with E. coli bacteria. Over 2000 individuals were affected by severe gastrointestinal symptoms, including 65 hospitalizations and 6 deaths. We used the Fast Spatial Scan software to perform a retrospective analysis of emergency department visits in Walkerton and the surrounding Grey-Bruce region of Ontario between 1999 and 2001. At a rate of only two false positives per year, fast spatial scan was able to detect the outbreak on May 19, 2000, two days before the first public health response and one day before the other surveillance methods tested.