Improving Public Health Inspectors' Efficiency Using Geographical Information Systems Optimal Routing Technology

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Abstract

Geographical Information Systems (GIS) are quickly becoming a common tool in public health, and there are many examples of GIS being used to map disease. This project used GIS software to find optimal routing of Public Health Inspectors' (PHIs) inspections from a quality improvement perspective in order to increase the number of restaurant inspection completed in the Calgary Health Region (the Region), Calgary and surrounding area, Alberta, Canada. The goals of project were as follows:

1. Assess the value of optimal routing technology
2. Increase the number of inspection performed by PHIs
3. Decrease time spent driving by PHIs
4. Develop a process for using optimal routing technology

Background and Relevance

There is potential for the optimal routing technology to be adopted into practice for PHIs to plan their inspections for the day or the month. In order for the Environmental Health Department to use this technology routinely this project must prove that optimal routing technology increases efficiency; meaning the optimal route shown by GIS must take less time than the actual route PHIs are taking. This difference must be enough to allow for at least one more inspection every day; about 45 minutes. The question must then be asked if the difference the software is reporting is valid.

GIS optimal routing technology has rarely been assessed as a tool to increase efficiency within public health from a quality improvement perspective. There are many examples of its use to assess health care outcomes, accessibility and planning of health care service delivery (Christie & Fone, 2003, Lovett et al., 2002, Patel, Waters & Ghali, 2007, Walsh, Page & Gesler, 1997).

A study in Greece (Hadjichristodoulou, 2005) used GIS software to develop an efficient plan to complete public health inspections before the 2004 Olympic Games held in Athens. Road network analysis was used to estimate the time needed to travel to inspections in order to establish hours of work time needed to complete all inspections.

In Israel GIS software (Peleg, 2004) was used to establish better response time for ambulances. GIS road network analysis was used to determine the time needed to travel to a call. Polygons of eight minute response times were generated for each ambulance deployment center depending on the day and time to account for traffic load and call volume.

A study in New Zealand (Beere, 2006) used GIS software to determine travel time to maternity units. Road analysis was used to calculate the travel time from different locations to the maternity units. There are a number of examples of analysis of populations access to services. Brabyn and Skelly (2002) discuss analyzing travel time and distance to the closest hospital to estimate geographical accessibility to hospitals. Schuuman et al (2006) discuss using GIS to determine catchments areas for non-urban hospitals.

Lopez Alvarez et al. (2008) documented using GIS road networking as a method to determine the optimal placement of recycling bins and an optimal route for collection in Spain. Gose, Dikshit and Sharma (2006) also have examined a similar problem; solid waste disposal in India. Their analysis also included using GIS to find optimal placement of waste containers and optimal routing for collection of the contents of the bins and transportation to the landfill.

Methods and Data

PHIs in the Region enter all inspection into a program, Caseworks, as they go through their day. This software collects information on the inspection as well as time tracking of the PHIs. Administration time, onsite time and travel time are all entered into the program for all inspections, meetings and office time. All entries into Caseworks in 2006 were pulled into a Microsoft Excel spreadsheet and then imported into Microsoft Access.

A descriptive analysis was done which produced insight into:

1. Number of minutes spent inspecting by risk group and inspection type
2. Number of minutes spent doing office work
3. Spatial representation of high risk premises, risk 4 and 5 for June 2007

It was decided that three days per month for four months would be analyzed for optimal routing from eight PHIs. Data for all inspections completed in 2006 by all PHIs in Caseworks was collected and the data was cleaned. Unfortunately rural areas could not be used as most towns have only one postal code and travel time could not be calculated without more than one postal code.

Tables were created with inspections for each PHI for each month. A network dataset was created in ARCGIS and a turn penalties restriction was added. The one way street restrictions were not used, and there was no consideration for traffic lights, construction or accidents.

The tables with the inspection data were then imported into ARCGIS version 9.1, joined with the postal code file and saved as a shape file. The road network data used was from 2005. The network analysis was run with the stops in the order specified (the order the PHIS's took); the minutes of travel time for the day and the number of KM were recorded. The network analysis was then run again, preserving only the first stop, minutes of travel time and KM were recorded.

Two "ride alongs" with PHIs were done to validate the process; however it also provided an opportunity to validate ARCGIS network analysis.

Results

The difference of ARCGIS optimal from actual route, on average per day ranges from five minutes to 11 minutes. The average difference from ARCGIS optimal from actual route for distance ranges from six KM to 13 KM. The average difference of time spent driving per day ranges from 21 minutes to 35 minutes. The average driving distance per day ranges from 21 KM to 38 KM.

Conclusions

PHIs work is dynamic and requires flexibility in order to change plans on a moments notice. This project has demonstrated that PHIs generally are planning their inspections in an efficient manner and using optimal routing technology to suggest a route for the day is not recommended at this time as only five to 11 minutes could be saved per day. This does not meet the prespecified number of minutes saved (45 minutes) needed to justify change.

Although ARCGIS is a very sophisticated program that has the potential to account for many different variables such as rush hour traffic, traffic lights, collisions, time needed to find parking or weather, one must have the data to support these parameters. It would be extremely time consuming to have a person constantly updating GIS parameters based on a rapidly changing variable such as weather. Although this project did not support the use of GIS technology for optimal routing of PHI inspections there is much potential for its use in other areas of public health.

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