

A dynamic GIS space-time diffusion model to tackle COVID-19 emergency

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Background:

Surveillance and containment of the spread of COVID-19 requires the use of advanced geographic information science and technology (GIS&T) to map the spread and eventually to guide interventions. A dynamic space-time diffusion model in a GIS environment was developed and successfully tested in Rome, Italy.

Methods:

Information on cases of SARS-CoV-2 infection confirmed by molecular diagnostics from Feb 25 to Sep 26 2020 (collected by a large Local Health Unit of Rome, Italy) was used to test a GIS simulator model able to monitor the spatial diffusion and temporal evolution of the spread of the disease. Data included information on: sex, date and place of birth, healthcare facility of hospitalization, date of notification, start date and end date of isolation, date of recovery (both clinical and laboratory confirmed), residence address.

Results:

Globally, 3,056 cases were geocoded and analysed. The spatio-temporal analysis of the first 45 days since 25 Feb 2020 shows that the spread of COVID-19 was very fast (1,230 cases recorded on 11 Apr) and spatially widespread. Number of cases was highest in the city centre with clusters, thickets and axes in different sub-municipal areas. A slowdown occurred the following month, confirming the positive effect of the lockdown. This effect continued until 11 Jun with a small increase in the number of cases (+10.9%). The period up to 26 Sep is paradigmatic of the second wave, with a continuous increase in cases that spread from the city centre to the suburbs.

Conclusions:

Using geocoding process and a detailed GIS mapping it is possible to identify streets, buildings and census sections where the number of cases is high and tends to increase rapidly and, at the same time, it is possible to distinguish clusters and axes that should be kept immediately under special observation as potential pools of super-diffusion. Development of its use in near-real time could bring significant advantages in controlling the spread of COVID-19.

Key messages:

- The use of GIS technology is fundamental for mapping the spread of COVID-19.
- A greater effort should be made by institutions to increase the digitisation of health data and the possibility of using them for both research and surveillance purposes.