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Polesat-Web-2018: A Simulation IT Tool with Immediate Prospective and Strategic Views of Hospital Spatial Planning

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Abstract

Medical geo-informatics allows the Health world to address major challenges thanks to attractive concepts, methods and user-friendly IT. PoleSat-web-2018 presents a decision support system – a modelling "variable geometry" IT tool for simulation of hospital spatial planning. The outputs enable quasi-instantaneous analytic visualization at several geographic levels. PoleSat-web-2018 provides prospective views of hospital catchments (by grouping, closing) and proves to be relevant for the French planners of the Ministry of Health.

Keywords:

Health Services Accessibility, Hospital Planning, Expert Systems

Introduction

Geo-informatics has become an important science and faces deep challenges to assist the medical policy makers through attractive concepts and methods. Among them, 1-spatial accessibility is paramount within the framework of a gravity model in order to provide the most valid measures [1-3]. 2- Decision Support Systems (DSS) as management tools through geospatial applications [3]. The main objective is to deliver a user-friendly Information Technology (IT) simulation environment that enables studies and test assumptions [4] and provides immediate strategic spatial views. PoleSat-web-2018 is based on a Graphical User Interface (GUI) with an embedded optimized geometric algorithm (an article was submitted to JOMS on March 2019) for simulation modelling hospital spatial planning. The algorithm, related to a refined gravity model [2; 5], has evolved in order to be completely automated inside a spatial DSS and is intended for the non-geomatician, i.e. non-Geographic Information System (GIS) specialists. An online demonstration (alpha version) is currently available for both specialties: traumatology – total hip prosthesis (PTH)) and Clinical Onco-Hematology (COH) on four geographical scales/levels including 1- former regions, 2- new regions, 3- Territory Hospital Grouping (GHT), 4- France.

This article presents the modelling results (by specialty) through the Advanced 1st Order Simulation **(A1OS)** and the Advanced 2nd Order Simulation **(A2OS)** examples, which are based firstly on "a grouping of hospitals" and secondly on "a suppression of hospitals followed by a conditional-based grouping of the remaining hospitals".

Materials and methods

PoleSat-web-2018 uses sources from the French Diagnosis-Related Group "DRG"-based information system (PMSI). This database (DB) is derived from aggregated data retrievals and represents private-public sectors in 2014. The specialties concern "rare and onerous diseases – OH", and "common and less expensive illnesses" – traumatology-PTH. Patient identification is rendered impossible. More details on the geographic DBs can be found inside the GUI aid.

Software access, architecture and algorithm process

An online PoleSat-web-2018 access is given by https://thymine.univ-lille2.fr/polesat2018/ with a log-in (ID: demo3/PW: polesat4). As of now, no scalability management has been made. Clients and server machines communicate in a request-response messaging pattern. All human-computer exchanges are made in a secured environment. The client can check the progress of the process. The calculation takes 2-3 min (per region) and 45 min (for France coverage). The algorithm workflow can be depicted through the succession of four main steps. 1- Keep all or delete hospital services (P5, default setting: keep all services = 0). 2- Group the hospitals with an expert distance (P8, default setting: 15,000 m). 3- Create referring hospital poles after relocating hospitals in "hospital and hospital-basket poles". 4- Deliver outputs detailing hospital catchment areas (CAs) in maps (.pdf, .shp) and spreadsheets (.csv).

Results

The modelling results derive first in "the A1OS" by grouping hospitals for the region: "Hauts-de-France". Next, the A2OS represents a removal of hospitals followed by grouping of the remaining hospitals. The GUI is intended either for a basic user (with a video guide and a pre-recorded default setup) or for a more advanced user (knowledge of the planner and setting adjustment).

The A1OS: grouping hospitals – COH DB

The A1OS represents (Figure 1) with 53 hospital services, a grouping of 12 services and a final number of 41 referring poles.

*Figure 1– The A1OS: Grouping Hospitals (a CA map with black administrative census (IRIS) & white PMSI limits). The main settings: D5: COH, P1: New regions, P2: 32, **P5: 0**, P8: 15,000 m, checked boxes of CHUs, label, ID, IRIS & PMSI*

The A2OS: removal & grouping hospitals – COH DB

The A2OS (Figure 2), with 53 hospital services, is based on A: removal of 26 hospitals (mass < 2) followed by B: grouping of the 3 remaining hospitals (inside a radius <= 15,000 m), into simple or basket poles, which are 24 final referring poles.

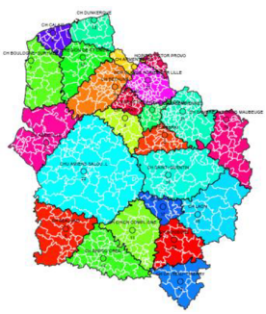

*Figure 2– The A2OS by Closing & Grouping (a CA map with black IRIS & white PMSI limits). The main settings: D5: COH, P1: New regions, P2: 32, **P5: 2**, P8: 15,000 m, checked boxes of CHUs, label, ID, IRIS & PMSI*

Discussion

The results provide both a quasi-instantaneous visualization thanks to ready-to-use maps and spreadsheets, and other format files suitable for geomatic use. To note that the related symbology, used in hospital CA maps, is distinguished by random and contrasting automatic colors. Also, a non-administrative numbered circle is assigned for each referring pole.

The advanced simulations: A1OS & A2OS

After launching the A1OS, maps and spreadsheets are available for verifications and adjusting the settings (Figure 1) and before launching A2OS if hospital closing is desired. This time, there are removals of services followed by a grouping of remaining hospital poles (Figure 2). However, the hospital closing insight (even by specialty) may be terrifying (for citizens), but that should not lead planners to give up this idea. It is why a tailored-made version could be focused to specifically start on hospital supply view and grouping modelling. Only after deeper simulation analyses, a new option proposal of service closing could be adopted by planners & public because of the objective, detailed and clearly analyzed proofs.

Besides, catchment area differences for specific border hospital pole could appear if we use a former or a new region. In consequence, the geographical analysis level choice must take place according to the initial problem of the planner and with full background knowledge.

Obviously, future versions should allow the processing of all PMSI and other health DBs over long periods. A tailored-made version has just begun for the French Health Ministry. The future updates are not yet specified since we are in a preliminary test period.

Conclusions

PoleSat-web-2018 is an effective and easy-to-use web-based GUI (alpha version), with an embedded optimized and automatized algorithm for prospective hospital spatial planning. PoleSat offers practical simulations for studying different scenario effects. It aims at helping planners in predicting the hospital provision reorganization. It proves to be a modelling "variable geometry" IT tool and appears to be relevant for planners with a productive and impartial foundation for strategic decisions. It can therefore be generalized.

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