

LOCATION INTELLIGENCE – GIS FOR HEALTHCARE

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What is GIS?

A **Geographic Information System (GIS)** is a computer-based information system that captures, integrates, analyzes, manages and displays data that is referenced to an accurate cartographic (*practice of making geographical maps*) representation of objects in space.

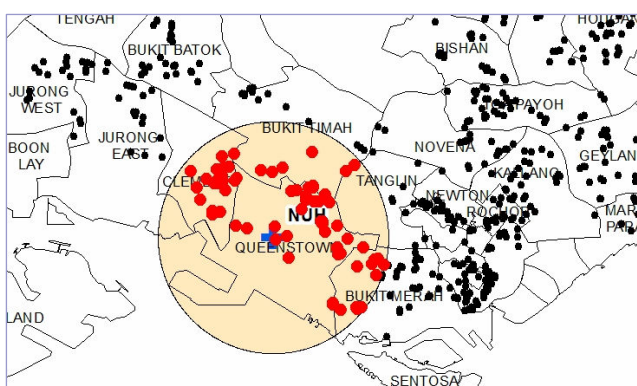
Applications of GIS in healthcare

This **Location Intelligence** solution provides powerful tools for geographical and spatial analysis

by linking databases with environmental, demographic and temporal factors. It enables one to understand the population served to better allocate resources, ensure access to services and make better-informed decisions. Traditionally, GIS has been used to track infectious diseases and identify gaps in child immunization. Nowadays, the use of the GIS has moved to new and innovative applications: **see (a-d)**

(a) Data visualization

Integrating demographic, clinical or financial information with the location of patients' residence will provide geo-clinical information of every known ailment, treatment and procedure in NHG institutions. One can visualize the geo-demographic drivers of a specific discipline/product and issues such as market penetration.



GP clinics within 4 km radius of National University Hospital

(b) Proximity analysis

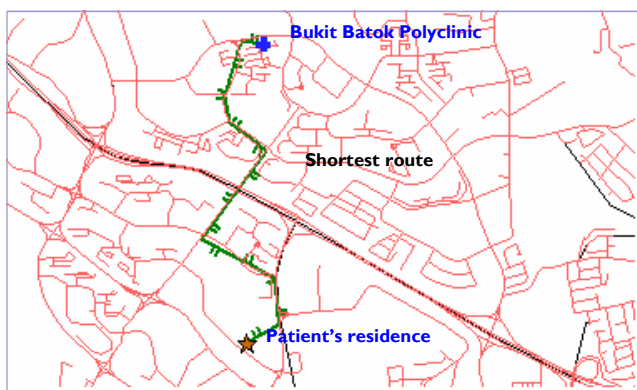
By linking patients' and providers' data, we can analyze geographical referral patterns between polyclinics and hospitals, know the number of patients staying within a given distance of a hospital and distances between GPs and public hospitals.

(c) Site selection

Identifying a new service location is a critical planning function. GIS enables us to quickly assess the geo-demographic dynamics of existing markets in relation to the likely demand for services at a new location.

(d) Network analysis

A common function of network analyses is routing, which determines the optimal path along a network; e.g. shortest distance and shortest time to a hospital or clinic.



Shortest route using network analysis

HOW GIS WORKS?

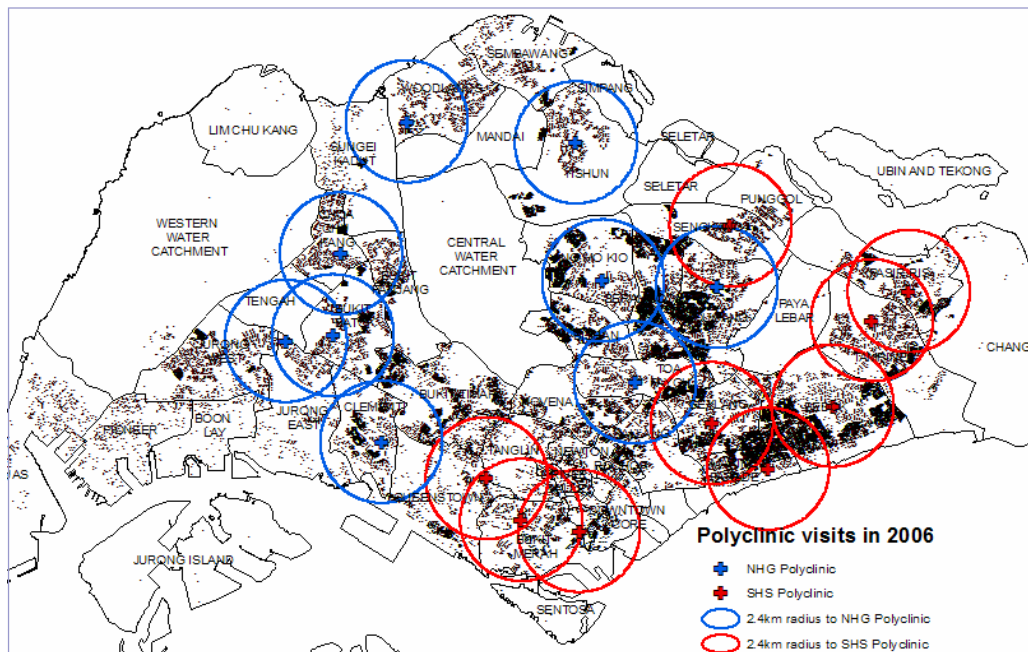
A geographic coordinate system is used to assign geographic locations to objects. With this we can integrate datasets within maps as well as perform various integrated analytical operations, such as overlaying data layers from disparate sources and coordinate systems. For example, patients' 6-digit postal code can be referenced with computerized Singapore maps containing x-y coordinates for further analysis.

CASE STUDY: MEASURING GEOGRAPHICAL ACCESS

Let's examine how far patients travel to polyclinics, to gain an insight into service gaps.

How it was done: A database containing 3 million polyclinic consultations was geo-analysed using ArcGIS and MapInfo DriveTime applications. The residential postal code of each patient and the 18 polyclinics were mapped by geographical zones. The shortest road distances between patients' residence and their choice of polyclinics were computed to measure their access to polyclinic services.

What was found: Catchment areas of the polyclinics were highly localized. On average, a patient stayed 2.4km away from a polyclinic, but they actually travelled an average of 3.9km (i.e. another clinic further away) for treatment.



Location of NHG and SingHealth Polyclinics in relation to distribution of patients

Patients from the following polyclinics travelled the least:

- Sengkang (2.6km)
- Pasir Ris (2.8km)
- Hougang (3km)
- Tampines (3.6km)
- Bedok (3.6km) Polyclinics.

Patients from the following polyclinics travelled further:

- Outram (8.7km)
- Jurong (5km)
- Woodlands (4.9km)
- Clementi (4.7km).

Shorter distance too for:

- the young (age<15) and the elderly (age 65+); 3.2km and 3.5km, respectively.
- patients with chronic conditions vs those with acute ailments (3.7km vs 4.2km).

The longer distances travelled to some polyclinics indicate potential service gaps (e.g. Jurong, Woodlands), or other factors e.g. high attendances, long waiting time.

So What:

When planning services for targeted population groups; e.g. young, elderly, those with chronic conditions, travel distance should be a consideration.

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