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Spatial Data Application on Health (COVID-19) in Health Region 6 of Thailand

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Abstract

Purpose: A geographic information system (GIS) in a combination with health data is very useful for disease monitoring, prevention and control. The new sciences of the combination of GIS and classical health data, namely *spatial epidemiology*. **Methods:** Using the secondary health database (including COVID-19 data); data source is the 43 standard data folders of Thailand health statistic collected by Ministry of Public Health Thailand, collected between 2013 and 2022. The data of the Heath Region 6 of Thailand was used as an example. Twodata sets health data with spatial data Combined to new database and developed dashboard to present the information via web base system. **Results:** The dash board provides new perspective of disease distribution view. For example, the map on our dashboard reports the density of COVID-19 cases in each area. Based on the records, the densest areas shown are the urban area in each province. It can also be used for resource distribution and access time to health center of the area. **Conclusion:** The project reports the use of GIS and public health data to develop a dashboard for monitoring health resources and disease distributions in the health region 6 of Thailand. The major limitation of spatial epidemiology is the lack of or incomplete raw data input in the system.

Keywords

GIS, COVID-19, Epidemiology, Spatial Data, Thailand

1. Introduction

A geographic information system (GIS) represents data in a map data format that integrates location data with its descriptive information [1] [2]. The benefits

of GIS include improvement in communication and efficiency, which leads to better management and decision making. GIS also helps reveal patterns, relationships, and geographic context [3]. Many industries use GIS to improve their policy planning and management [4]. Public health section is one of the area where GIS will help for better understanding of disease distribution and control [5]. This technology will be very beneficial especially in the COVID-19 pandemic era [6] [7]. This paper shows the usage of GIS in public health by using recorded health data of the Heath Region 6 of Thailand for a study case.

2. Method

This descriptive study uses secondary data, including COVID-19 data, from the Health Data Center of the Ministry of Public Health Thailand. The study site is in the health region 6 of Thailand. All the health data of heath region 6 of Thailand are stored in a new data server and coordinated with GIS data over all 8 provinces in the health region 6 (Samut Prakarn, Chonburi, Trad, Rayong, Chachoengsao, Prachinburi and Sakaeo). The data are from 2013 to 2022. All maps are created using R packages from the Comprehensive R Archive Network (CRAN). Our procedure is as follows. First, we connect with the source databases; data source is the 43 standard data folders of Thailand health statistic collected by Ministry of Public Health Thailand, and query relevant data. Then we clean and merge data with spatial information that represents administrative boundary (Tambon). Next, we publish the spatial data via GeoServer as a web map service (WMS). Lastly, we build a dashboard website to present the processed health data in the health region 6 of Thailand, namely "http://www.r6-health.info/home/", that pulls the published spatial data upon requests.

Ethics Approval

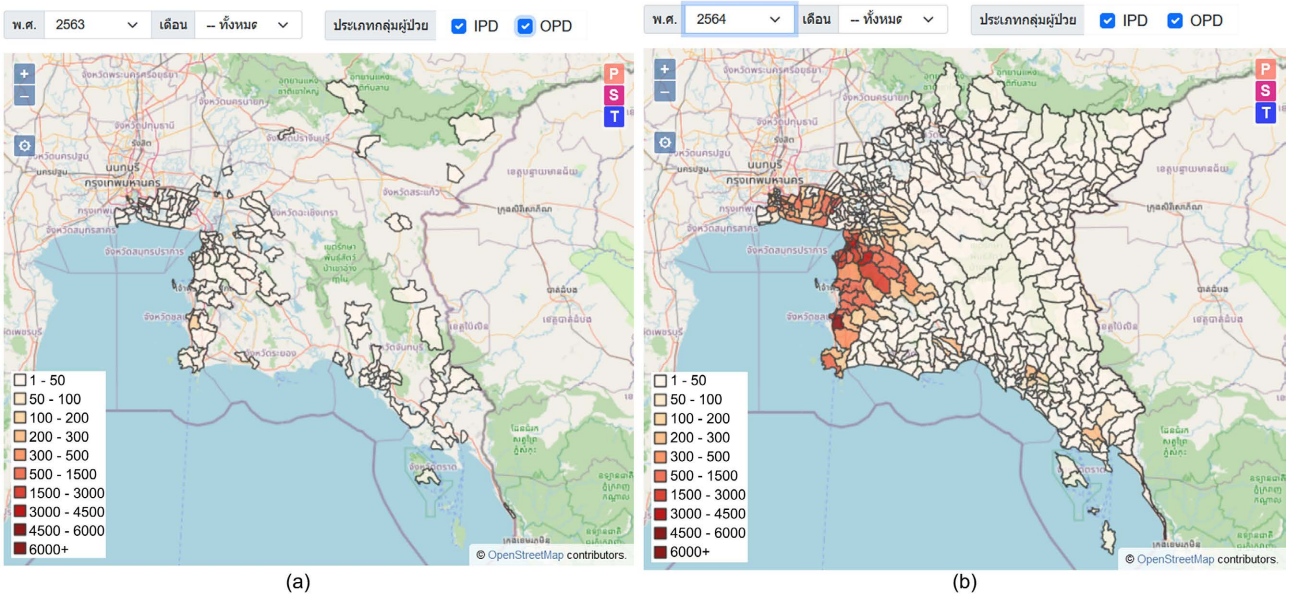
This study was approved by Chonburi Hospital Research Ethics Committee. All data present in this paper has been asked for permission for research by Ministry of Public Health Thailand.

3. Result

COVID-19 distribution in the health region 6 of Thailand data by GIS.

As shown in **Figure 1**, the map on our dashboard reports the density of COVID-19 cases in each area. Based on the records, the densest areas shown are the urban area in each province. In addition, the map reveals the reported case number and the location detail when selecting or clicking on the area of interest (**Figure 2**).

Spatial data is not only used for the distribution of diseases, but it can also be used for resource distribution. For example, there are 13 tertiary healthcare centers in the health region 6 of Thailand (blue pentagon symbols in **Figure 3**). The shaded colors demonstrate the approximated time required to access the healthcare centers by car. Our findings show that more than 80% of the area in the



(a) (b)

Figure 1. COVID-19 distribution in Thailand (a) 2020 (b) 2021. (a) COVID-19 distribution in 2020; (b) COVID-19 distribution in 2021.

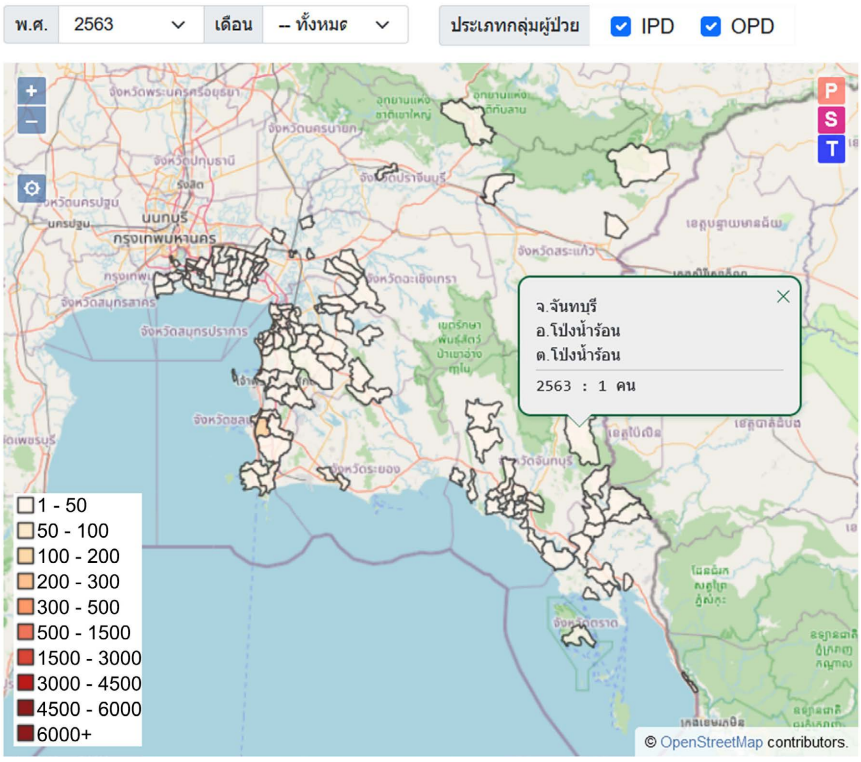


Figure 2. The map showed density of COVID-19 in 2021and a prevalence at pointed area and name of the location.

health region 6 has an access time of more than 30 minutes to reach a tertiary healthcare center (**Figure 3**). On the other hand, primary healthcare centers help cover a near 100% of the area in the health region 6 including the areas outside the 30-minute access time of the tertiary health care center (**Figure 4**).

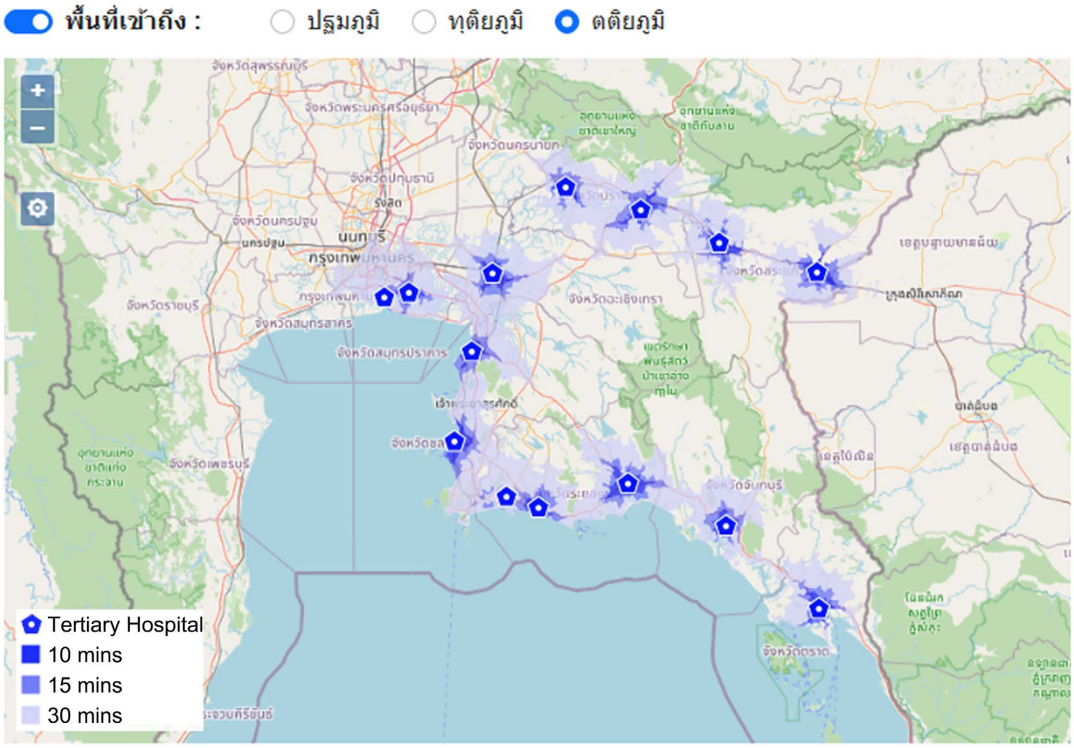


Figure 3. Tertiary healthcare center in Heath Region 6.

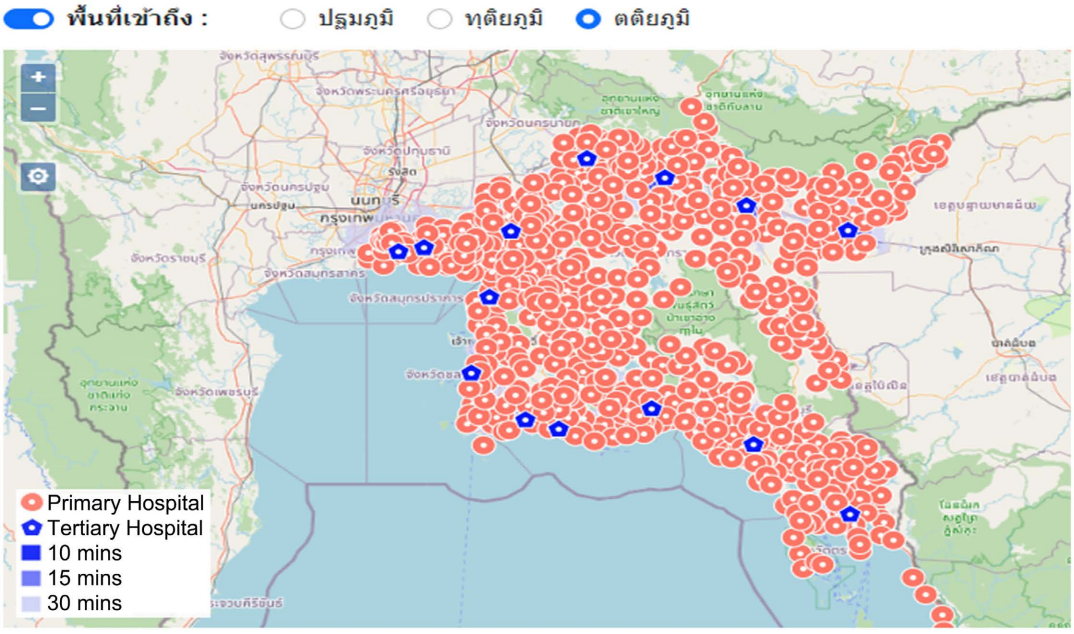


Figure 4. Primary healthcare center (red) and Tertiary healthcare center (blue).

When adding both spatial data with classic epidemiology data, we develop a dashboard for a public purpose (Figure 5). The dashboard also presents health-related statistics according to the International Classification of Diseases (ICD) and health resource utilization (Figure 5).

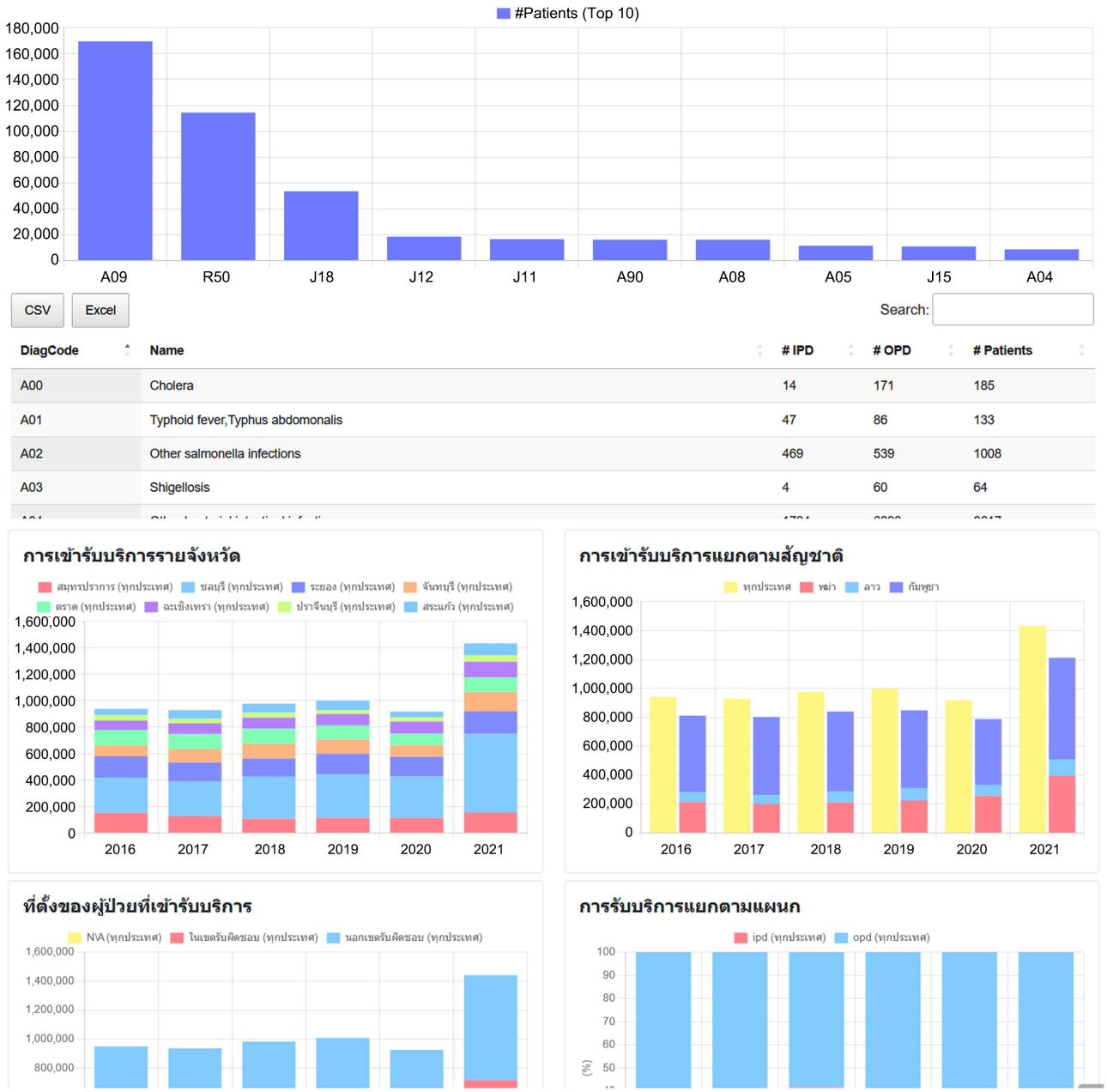


Figure 5. Dashboard of health data of heath region 6th of Thailand.

4. Conclusion

Thailand's public health measurements during the first and the second wave of COVID-19 spreading are effective [8]. The measure consists of two main strategies. The first strategy is the high restriction on both inbound and outbound travel. The second strategy is high precaution behaviors (Distancing, masking, and hand washing). COVID-19 is heavily spread during the 4th (Omicron) and 5th (Omicron variances) waves in Thailand. Thailand still believes in the effectiveness of COVID-19 vaccination that reduces morbidity and mortality from infection [9] [10]. The precaution measurements are proved to be effective for

COVID-19 prevention. With the proposed spatial data including disease density, spreading area, high prevalence area, and resource distribution, all of the information can then be used for the prevention and control of diseases and resource allocation. For example, COVID-19 distribution pattern was very high in urban area, same as high admission rate in these areas. Nevertheless, the major limitation of spatial epidemiology is the lack or incompletion of raw data input to the system.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Melin, P., Monica, J.C., Sanchez, D. and Castillo, O. (2020) Analysis of Spatial Spread Relationships of Coronavirus (COVID-19) Pandemic in the World Using Self Organizing Maps. *Chaos, Solitons and Fractals*, **138**, Article ID: 109917. https://doi.org/10.1016/j.chaos.2020.109917

[2] Franch-Pardo, I., Napoletano, B.M., Rosete-Verges, F. and Billa, L. (2020) Spatial Analysis and GIS in the Study of COVID-19: A Review. *Science of the Total Environment*, **739**, Article ID: 140033. https://doi.org/10.1016/j.scitotenv.2020.140033

[3] Scholten, H. and Lepper, M.J.C. (1991) The Benefits of the Application of Geographical Information Systems in Public and Environmental Health. *World Health Statistics Quarterly*, **44**, 160-170.

[4] Sherrouse, B., Clement, J. and Semmens, D. (2011) A GIS Application for Assessing, Mapping, and Quantifying the Social Values of Ecosystem Services. *Applied Geography*, **31**, 748-760. https://doi.org/10.1016/j.apgeog.2010.08.002

[5] da Silva, P.P., da Silva, F.A., Rodrigues, C.A.S., Souza, L.P., de Lima, E.M., Pereira, M.H.B., *et al.* (2021) Geographical Information System and Spatial-Temporal Statistics for Monitoring Infectious Agents in Hospital: A Model Using *Klebsiella pneumoniae* Complex. *Antimicrobial Resistance & Infection Control*, **10**, Article No. 92. https://doi.org/10.1186/s13756-021-00944-5

[6] Kanga, S., Meraj, G., Sudhanshu, M.F., Nathawat, M.S. and Singh, S.K. (2021) Analyzing the Risk to COVID-19 Infection Using Remote Sensing and GIS. *Risk Analysis*, **41**, 801-813. https://doi.org/10.1111/risa.13724

[7] Irwansyah, E., Budiharto, W., Widhyatmoko, D., Istamar, A. and Panghurian, F.P. (2020) Monitoring Coronavirus COVID-19/SARS-CoV-2 Pandemic Using GIS Dashboard: International and Indonesia Context. *Preprints*, **2020**, 1-16. https://doi.org/10.20944/preprints202008.0415.v1

[8] Punyoo, J., Jongaramraung, J., Daramas, T., Buadong, D., Singhasai, L., Tunksakool, J., *et al.* (2021) Factors Related to Perceived Self-Efficacy for COVID-19 Prevention in Pediatric Nursing Staff. *Ramathibodi Nursing Journal*, **27**, 415-429. https://he02.tci-thaijo.org/index.php/RNJ/article/view/250702

[9] Watson, O.J., Barnsley, G., Toor, J., Hogan, A.B., Winskill, P. and Ghani, A.C. (2022) Global Impact of the First Year of COVID-19 Vaccination: A Mathematical Modelling Study. *The Lancet Infectious Diseases*. https://doi.org/10.1016/S1473-3099(22)00320-6

[10] Kittikraisak, W., Piyaraj, P., Vachiraphan, A., Wongrapee, T., Punjasamanvong, S., Hunsawong, T., *et al.* (2021) Sero-Surveillance for SARS-CoV-2 Infection among Healthcare Providers in Four Hospitals in Thailand One Year after the First Community Outbreak. *PLOS ONE*, **16**, e0254563. https://doi.org/10.1371/journal.pone.0254563