AIDING DECISION MAKING IN PUBLIC HEALTH DOMAIN USING WEB GIS

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TO MY REASON, MOTHER

TO MY DEAREST, SISTER and BROTHER.

TO MY BELOVED FRIENDS

TO MY LOVELY FAMILY

ROMA

ABSTRACT

The importance of new technologies such as web-GIS is increasingly noted in supporting decision making in public health planning and management. Most of literatures point to examples of web-GIS use especially in the developing world in areas of such as geography of disease, urban planning as well as public health care. This project was exemplified this need in the types of information of interest to local epidemiologists. It includes TB/ HIV distribution in population, rural/urban variations, delivery of health services, and dissemination of National Tuberculosis Program and general health services. The contribution of web-GIS in aiding the decision making process in last years is being agreed upon it by most of new applications have been developed. Is become no doubt that spatial analysis breaks down all awkward details of setting policies and taking proper decisions This project takes in hand the task of implementing a prototype web-GIS application using ArcGIS, MapGuide Open Source tools, and scripting language “PHP, ArcXML”. The scope of the project is to connect treatment centers with central unit of disease management allowing them to access a centralized database, also to create an easy-to-use interface of basic layers of information, which include general health facilities, population data; Directly Observed Treatment Short Course centers (DOTs), Antiretroviral Therapy centers’ locations (ARTs), and mapping important health indicators.

ABSTRAK

Kepentingan teknologi-teknologi baru seperti web-GIS semakin mendapat perhatian di dalam sektor penyelidikan kesihatan dan penilaian. Kebanyakan daripada literatur menunjukkan contoh-contoh bagi penggunaan web-GIS dalam dunia yang membangun di kawasan seperti konflik, perancangan bandar serta kesihatan awam. Projek ini telah dijadikan contoh keperluan dalam jenis-jenis maklumat menarik untuk ahli-ahli epidemiologi tempatan. Ia termasuk taburan TB/ HIV dalam populasi (pada masa, jantina, taraf sosioekonomi, tempat atau satu kombinasi ini), luar bandar / variasi bandar, populasi tidak dapat dicapai, dan taburan *National Tuberculosis Programme* dan perkhidmatan kesihatan umum. Sumbangan web-GIS dalam menambah proses pembuatan keputusan pada tahun lepas telah dipersetujui dan ia adalah kebanyakannya di kalangan pemohon baru yang telah dimajukan. Oleh itu, tidak diragui lagi bahawa analisis ruang itu rosak semua butir-butir kekok menetapkan dasar-dasar dan mengambil keputusan sesuai. Projek ini dijalankan untuk melaksanakan sebuah prototaip aplikasi web-GIS menggunakan ArcGIS, alat- alat MapGuide, dan bahasa penskripan “PHP, ArcXML”. Skop projek ini adalah untuk mewujudkan satu kemudahan untuk penggunaan tindihan lapisan-lapisan asas maklumat. Ini adalah termasuk kemudahan kesihatan umum, data populasi; pusat-pusat *Directly Observed Treatment Short Course* dan pusat-pusat lokasi *Antiretroviral Therapy* pemetaan data dalam kesihatan.

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TB	Tuberculosis
HIV	Human Immunodeficiency Virus
AIDS	Acquired Immunodeficiency Syndrome
SNAP	Sudanese National HIV/AIDS control Program
NTP	National tuberculosis program
CU	Central Unit
TBMU	TB Management Unit
DOTs	Direct Observation Center
ART	Antiretroviral therapy
VCT	Voluntary Counseling and Testing
WHO	World Health Organization
UNAIDS	United Nation AIDS program
RDBMS	Relational Database Management Systems
UML	Unified Modeling Language
CMap	Conceptual Mapping.

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CHAPTER 1

PROJECT OVERVIEW

1.1 Introduction

Geographical Information Systems (GIS) can be described as general-purpose computer-based technologies for handling geographical data in digital form in order to capture, store, manipulate, analyze and display diverse sets of spatial or geo-referenced data **[1]**, it is technology combines a powerful database with the unique ability to display the database information on a map. This ability to visualize information on a map allows quick analysis of the information and makes GIS invaluable to public safety. By referencing all the data in a GIS to a location on the earth's surface, maps can be generated and displayed, information can be visualized, and decisions can be quickly made.

The synergy of Geographical Information Systems and Web Technology allows access to dynamic geospatial information without burdening the users with complicated and expensive software. The World Wide Web provides GIS users easy access to spatial data in a distributed environment through a simple browser interface or sometimes by a lightweight client side application, these powerful characteristics will help “Decision makers” to better understand, represent, manage and evaluate spatial data by creating graphic displays using information stored in the database.

1.2 Background of Problem

At first glance, it may seem like GIS is a mapping program, while it is a complex mix of database management, display technology, and analysis tools, therefore the absence care about keeping the location dimension and all relevant spatial data alongside the tabular data could affect the decision making process and designing of policies.

As decision makers in public health domain need to understand and evaluate data and dynamically analyze and update information linked to the locations, Web GIS can participate on this, by provide the ability to display the data, and also enables them and all users in the medical community to study epidemiology, map health care facilities, dynamically analyze, update and share information to make maximum use of these valuable assets. So it can support them in setting policies and producing meticulous decisions.

1.3 Statement of the Problem

In a developing country like Sudan with 2.5 million km² area and over 37 million of population 64% reside in rural areas and 36% in urban areas **[2]**, we need a very structured planning procedure such that the development activities and infrastructure facilities are available at both urban and rural area. However, in such a condition where majority of people leave in rural area and are provided with the least infrastructure facilities, creates a regional imbalance in development, causing shift in population from rural to urban areas.

Moreover there is no computer-based system for collecting, analyzing and reporting data in each health center all over the country (including Khartoum state Capital of Sudan), also the distribution of HIV/TB treatment services (ART centers and Dot Centers) done by the NTP “National tuberculosis program” and SNAP “Sudanese's national aids program” is not based on the disease dissemination, patient locations or any other specific policies it is based only on the available facilities **[3].** Although the central unite for NTP collects quarter reports from health centers all over the country using database management system, it doesn’t help in decision making process. In addition there is no collaboration between two programs regarding that the diseases’ treatment required, Hence administrators or decision-makers require an efficient GIS based tool which will assist them to get the updated scenario of the region. This project is about to provide an easy to use application helps them better understand, represent, manage and communicate to arrive to common understanding of problem which is an indispensable first step to developing shared solutions.

1.4 Project Objectives

The main idea of this project is to create a web-GIS application (Server GIS) controlling the distribution of TB and HIV/AIDS diseases in Khartoum state - Sudan, and provide users with the capabilities that enable them to add or query accurate, up-to-date data without a lot of training, using a shared server in a secure environment with stable power and good data backup. The project will use Khartoum state as a case study and this is selection is made according to the reports produced by the Sudanese National AIDS Programme (SNAP) reports and the surveillance made by WHO and UNAIDS **[4]** which indicate that there is large number of cases in this area,. That in addition to its good infrastructure for establishing this kind of application allows and justifies the development and use of the proposed system.

The main objectives of this project can be stated as follow:

1. To study the relevant literature reviews about web_ based GIS applications in public health domain.
2. To develop a prototype Web_ based GIS system for existing TB/HIV health system in Sudan in order to support decision making process.

1.5 Scope

This project will cover two to three Tuberculosis Management Units [TBMU], and at the same time they are working as Antiretroviral Treatment Centers [ART], which will be located in Khartoum state-Sudan. The developed system will Connect 2-3 PC each one is representing TB/HIV centers using simple connection techniques to illustrate how the system will work and test its functionality in a client/server environment.

It will establish secure access features in the system such as, use of passwords and limiting access of users to only the parts of the system they need. In addition, investigate and implement techniques to maintain the privacy of patients, impose privilege levels to ensure protection for their data and control the databases by creating an access list used to explicitly grant privileges to users or groups and to states how they can interact with some objects and to what extent.

The project will intend to use ArcGIS (GIS software produced by ESRI co.), ArcIMS (Internet Map Server) to update and distribute the geodatabase layers, GIS data, interactive maps and meta data catalogs to multiple users, or in case of facing problems in obtaining a licensed copy of ArcIMS, the will use MapGuide Open Source which is a web-based platform that enables users to quickly develop and deploy web mapping applications and geospatial web services. In addition ArcSDE (Spatial Database Engine) which is an advanced spatial data server for managing geographic information in numerous RDBMS, enable geodatabases to be shared by many users across the network and to scale in size to any level necessary. Scripting for web-GIS can be done using AJAX, JavaScript HTML or PHP.

The proposed information that will be assessed to be incorporated in the Web-GIS maps of the developed application will include the following:

- Disease distribution, the rate of its spread and its drugs availability.
- Basic information about health facilities itself (hospitals, health centers) such as their distribution, number of doctors, numbers of beds on each one and any other essential data. To help mangers to determine which ones can be used as DOTs centers.
- Centers catchment areas in addition to the number of HIV cases among TB patients in each center.
- Data collected from service center.
- NTP, SNAP reports and TB and HIV data in the Epidemiological laboratory.

1.5.1 Potential users of developed system:

The main source of data for the system are doctors themselves (center's coordinators) who they will be the able to add, update the information on the system. There will be two types of potential users of the generated reports of the system:

1. Public health researchers:

Because they need to use a technical assistance for establishing and evaluating system for treatment plans, enhancing drug distribution mechanisms like quantify the need for providing ART to TB patients, and improve their reporting system. And

2. Policy makers: (those people responsible for TB/HIV Surveillance and public health decision-makers at national level like NTP and SNAP).

Because maps are a concise way to describe information and it is much more effective way for importing key information than serials tables so it can help them to provide a skeleton for the methods to be used for controlling HIV prevalence among tuberculosis patients and promote better policies.

1.6 Importance of Project

In consequence of the growth of medical informatics in public health, the internet access and use of georeferenced public health information for GIS application will be an important and exciting development for the Health services and all health agencies in this new millennium.

This project will produce an easy-to-use Web-based mapping application that provides new opportunities for the visualization, exploration, and understanding of

the health indicators, Policy makers and healthcare providers (at government level - ministry of health, program manager) often lack the resources or information to make effective healthcare decisions that impact their communities, therefore Information must be delivered to in a way that maximizes healthcare decision making, therefore project will support decision making on:

- Distribution of services.
- Evaluation on performance.

They will be able to access recent data on TB and HIV health problems and track individual patients status, monitor the care of an entire group (for patients with TB or HIV this includes tracking critical laboratory results, drug supplies, etc.).

The most important benefit of this project it can contribute to collaborative activities between HIV/AIDS and TB programs (SNAP, NTP) that aim at the formulation and implementation of a joint TB/HIV strategy.

1.7 Chapter Summary

In this chapter, short ideas about the project have been given. The main purpose of this project was to develop a web based GIA application that manage TB and HIV disease information and help a top management to view the current situation to take proper decisions and setting new policies if required. It demonstrates the importance of this project and the stakeholders who will serve.

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