Electronic Medical Records (EMRs) as Data Inputs to Geospatial Mapping of Fever Patterns in Rural Health Units in the Philippines

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The eHealth TABLET (Technology-Assisted Boards for LGU Efficiency and Transparency) for Informed Decision-Making of Local Government Units or eHATID LGU project is providing Rural Health Units in the Philippines with a cloud-based solution for migrating patient medical records into EMRs using a customized software installed in computer tablets. EMR data is stored in and analyzed using the GovCloud platform of the National Government Data Center (NGDC). For geospatial mapping of fever patterns, the EMR and demographic data are filtered and mapped by the eHATID LGU application and visualized in geographic maps with recorded fever cases identified up to the village level. These geospatial maps with identified fever cases provide the Rural Health Units with real time information on the monitoring of fever cases in specific population groups and can alert the health authorities on unusual fever patterns indicative of possible disease outbreaks that may affect their health service areas.

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The eHATID LGU Project

The eHealth TABLET (Technology-Assisted Boards for LGU Efficiency and Transparency) for Informed Decision-Making of Local Government Units or eHATID LGU project is providing Rural Health Units (RHUs) in the Philippines with a cloud-based solution for migrating patient medical records into Electronic Medical Records (EMRs) using a customized software installed in computer tablets. The geospatial mapping feature of eHATID LGU called eHATID LGU Morbidity Boards in Geospatial Graphs (eHaMBinGG) is the data analytics component of the eHATID LGU project of the Philippine Council for Health Research and Development, Department of Science and Technology (PCHRD-DOST) and the Ateneo De Manila University (AdMU).

The main focus of eHATID LGU include software design and development, system usage, and real-time visualization with five program components namely institutional development and partnership, integration of the system to currently existing communication channels, capacity building, systems integration, and sustainability. The eHATID LGU Program aims to deploy the tablet-based EMR
system up to 450 cities and municipalities. As of 25 April 2016, 365 cities and municipalities have been introduced to the system and have been formally trained on how to use the mobile and web components of the system.

The eHATID LGU System

The eHATID LGU system parts include both web and mobile components. The web components were developed with MySQL and PHP using the Laravel framework, while the mobile components were developed with Android Studio. Both the web and mobile components of eHATID share a similar cloud based backend in the form of a government provided remote server infrastructure. The government partner utilized in the infrastructure is a branch of the same funding body, DOST. All clients of the eHATID environment (i.e. every user, both web and mobile) across the different program-deployed cities and municipalities transmit data into this cloud, referred to as the “DOST eGov Cloud Facility,” also known as the National Government Data Center. This is a guaranteed secure backend foundation for government funded services as this program. Figure 1 illustrates the simple yet effective IT infrastructure of the program.

![Figure 1: Clients (users) of the eHATID LGU Program connect to the secure National Government Data Center, also known as the eGov Cloud Service.](image)

This secure cloud facility is connected to the Philippine Health Information Exchange [PHIE] which allows the eHATID system to interconnect and at a limited capacity, operate with other public health based systems connected to PHIE. The PHIE infrastructure is explained in the next section.

eHATID LGU System Development

The tablet utilizes an Android operating system with four services: Electronic Medical Record System [EMR], Graphs and Reports, Doctor Requests, and Local Chief Executives [LCE] instructions.

The EMR System is the heart of the application, providing the main point of entry for all users input. The Graphs and Reports provide visualization of data entered on the patient record system (i.e., maps, bar, graphs, chart) thus gives the user a quick analysis of the local health system. The last two services (Doctor Request and LCE Instruction) provide communication and documentation log service which will increased transparency on the decision making activities on local health system.

To facilitate interoperability with other EMRs, as well as maintain protocol with health related entities (i.e. Philippine Health Insurance Corporation or Philhealth), the eHATID LGU products and services implement the ICD10 standard for diagnosis identification.

It is the mandate from DOST that the eHATID LGU Program web components be able to generate reports consistent with the reporting requirements of the national Department of Health [DOH] to the municipalities. The web component of the program incorporates a report-generation facility that is compatible with the DOH Field Health Information System [FHSIS] reports.

The development process for the integration of Primary Care Benefit 1 (PCB 1) system in eHealth TABLET included joint architectural design by the project team and PhilHealth technical and software

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personnel. Existing health data standards, security and privacy protocols and framework of PhilHealth will be adopted by the system.

The existing eHealth.ph website is currently used as online support platform for eHealth TABLET deployment where documentation, training materials, updated application and other related instructional and educational materials can be downloaded.

The project currently utilizes cloud computing technology on data storage and management and is directed to be incorporated in the Philippine Health Information Exchange [PHIE] infrastructure on data reporting.

eHATID LGU Capacity Building Process

Capacity Building for eHATID included development of instructional and training materials, including short learning videos, powerpoint materials, user manuals, an online forum and paper assessment. The content of the presentation materials, manuals as well as the assessment were designed by an instructional designer. The design of the materials were for intended users as well as for future trainors. With the objective of deploying eHATID in over 450 municipalities in the entire country, there was a need to select universities, agencies and institutions that can serve as extensions of eHATID in the province or region. Regional Technical Assistance Partners [RTAPs] were selected based on a set of qualifications to assist the core team in deploying and monitoring the system. Specifically, the RTAPs serve as the help desk of the LGU end users whenever they encounter technical and non-technical difficulties with the system, provide echo training to the users (as needed), and monitor the system utilization. A total of 22 RTAPs were trained last February 2015 and April 2015.

Deployment plan includes selection of sites, submission of letter of intent and ICT survey. Monitoring of sites through field visits were done by the RTAPs. RTAPs also collected surveys on technology acceptance from the various users of the system.

Given the dispersed geographical locations of the LGUs interested to be part of the project, the team has employed a dynamic deployment strategy, constantly changing depending mainly on the following factors: 1) responsiveness and availability of the LGUs for either a provincial or regional training; 2) responsiveness of the partner regional and provincial government agencies tapped by the project team to support the training and deployment activities; and 3) number of requests received by the team from partner government agencies regarding their preferred LGUs for eHATID implementation.

Figure 2: Deployment sites of the eHATID LGU system. The map shows details of deployment sites at the regional level.
The deployment activities, which started in April 2015, were conducted through partnership arrangements with the DOST Regional Offices, Provincial Governments (through the League of Provinces of the Philippines or LPP), and PhilHealth. The project's partnership with these government agencies are formalized through a Memorandum of Understanding for a more effective implementation and sustainability of the project.

The implementation process of the technology is as follows: First, the LGU will send an accomplished and signed (by their Mayor) Letter of Intent (LOI) and ICT survey to the central eHATID LGU team via email, fax, or courier. Second, the team acknowledges the receipt of the accomplished forms and schedules the training and deployment activity either at the provincial or regional level. Except for highly-urbanized cities, the project accepts LGUs from all levels of municipal and city income classification as long as they have submitted the duly signed LOI and accomplished ICT survey form. Lastly, the team conducts the training through the help of the regional and/or provincial agency partners. The post-training support includes an SMS-based and online help desk, Regional Technical Assistance Partners (RTAPs) follow up visits, and facilitated access to instructional materials.

Specifically on the training and deployment activity, the project deploys two units of Lenovo tablet devices with the pre-installed eHATID LGU mobile application and hard copies of the instructional materials. To formalize the partnership between the IPC and LGU and more significantly, to ensure the seamless and sustainable implementation of the project, a conforme letter and MOU between the LGU and IPC ADMU, which stipulate the accountabilities of each of the parties involved in the project as well as the best practice guidelines for technology utilization, are given to the LGU representatives during the training.

The social mobilization strategy for the deployment included the Training of Trainers where trainers will be coming from local universities, DOST and PhilHealth Regional Offices. Technical support and services can be provided by regional partners. Training modules and protocols will be standardized based on the pilot testing result and PhilHealth standard protocols on PCB packages.

Selection of provinces were based on the DOST Community Empowerment through Science and Technology (CEST) sites, municipal LGU sites of eHealth TABLET project and preferred sites of the project partners. Assistance from the League of Municipalities of the Philippines (LMP), League of Cities of the Philippines (LCP), and League of Provinces of the Philippines (LPP) and PhilHealth, as well as DOST and DOH, on the engagement process of provincial, city and municipal local chief executives. Selection criteria includes: a) local chief executive support for innovations, b) presence of development–oriented programs in the LGU, c) responsive health sector, and d) no electronic health information systems at the local level.

eHATID LGU Geospatial Mapping

The geospatial mapping feature of eHATID LGU called eHATID LGU Morbidity Boards in Geospatial Graphs (eHaMBinGG) is an expansion of the existing eHATID LGU municipal and city real-time morbidity dashboard and local surveillance system to include provincial, regional and national government level users through the creation of two new portals. These eHaMBinGG portals called eHATID LGU Geospatial Morbidity Dashboard (GMD) and eHATID LGU Comparative Morbidity Data (CMD) allows for real-time visualization of selected morbidity cases either at the national, regional, provincial or city/municipal levels and comparison of morbidity cases in several LGUs. The aggregate reports of morbidity data from Electronic Medical Records (EMRs) can now be visualized in support of disease surveillance, LGU-specific morbidity studies and decision making processes on health service delivery issues.

The eHATID LGU geospatial mapping feature brings us closer to ‘real time’ detection and notification of outbreaks. Figure 3 below shows a sample geospatial map for cases of unspecified fever in a municipality. Real-time data as in the fever patterns for possible infectious diseases outbreak provides for a more responsive system with very early warnings of potential problems. The sample geospatial map below include suggested measures to help reduce the...
impact of a Dengue outbreak. Identifying a potential or a real outbreak earlier can result in a reduction of mortality and morbidity and thus, the subsequent economic consequences.

A separate eHaMBinGG surveillance system portal currently being developed will focus on disease surveillance. Disease surveillance is the cornerstone of public health security and will enhance the current management of emerging infectious diseases. It also helps in controlling and managing diseases and its spread. The eHaMBinGG surveillance system being developed will include ongoing systematic collection and assessment of data which can be utilized in planning, implementation and evaluation of the disease and its spread.

The goal of eHaMBinGG surveillance system being developed is to detect disease outbreaks a few days earlier before traditional surveillance methods can. eHaMBinGG will be implemented to introduce compatible or interoperable tracking systems to improve the timeliness of data collected and LGU decision-making processes to address the alerts. Regular trials and consultations with the eHaMBinGG partner institutions will be done as the systems are enhanced and integrated into the Philippine Health Information Exchange. In a later phase of the eHaMBinGG development of the surveillance system, there will be selected pilot sites to include veterinary healthcare providers in this surveillance system as there are known emerging diseases affecting both humans and animals.

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