

Short Paper

A Feasibility Study on Infectious Disease Surveillance System for Barangay Health Centers of Makati City

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Abstract

Purpose – An Infectious Disease Surveillance System will allow for the easier transition of the latest medical reports from all public medical facilities in the City and detect any epidemic or outbreak, based number of reports per disease and its corresponding geolocation, as well as existing predictive or seasonal models and historical data from the local health department.



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Method – The researchers utilized the descriptive developmental approach, where a feasibility study was conducted first before creating a prototype and used surveys, questionnaires, and interviews to gather data. In system development, the waterfall model was used, developed the different module or units individually, tested it then integrated the modules into singular system and finally tested it again.

Results – The developed Infectious Disease Surveillance System was evaluated by randomly-selected personnel from the IT and non-IT group in terms of functional suitability, compatibility, usability, reliability, and security of the ISO 25010 software quality model and obtained an overall evaluation of Very Acceptable with an overall composite mean rating of 4.33.

Conclusion –The developed system is feasible according to the results of the product, organizational, financial, technical, and market feasibility analysis. Most respondents believed that the system was interesting and expressed various degrees of desire to procure the system for their professional needs. The developed system has a moderate to high potential attractiveness to the industry given its timeliness and relevance. However, factors that may affect marketability include the reduction of budget allotment for healthcare by the national government and minimal number of potential customers (public and private health institutions).

Recommendations – Based on the conclusions derived from the conduct of this study, the following suggestions are recommended, maximize the rollout of the Makatizen Cards to include children to ensure every citizen can be detected in the system database; utilize the location data of confirmed cases of an infectious disease to track the spread of the disease from one person to another which will be useful in identifying the patient zero of a new previously undiscovered infection and; the developed system can be integrated with the existing disaster and risk management system of Makati City.

Keywords – public health surveillance, infectious disease surveillance, health monitoring

INTRODUCTION

There is a plethora of things humans cannot see that could potentially wipe out the whole human race in a short while. Microorganisms–bacteria, viruses, and fungi, have been at war since life began on this planet roughly 3.5 billion years ago and human bodies are either casualties or mere factories for weapons of biological destruction. While not every pathogen has a cure, public health surveillance and monitoring systems can help policymakers keep track of known diseases, efficiently coordinate action of concerned agencies, and decrease possible mortality rates.

Leading the way in terms of human development, Makati City is at the forefront of utilizing modern technology to further standards of living. According to a progress report analyzing the implementation of state-wide resiliency policies in Makati City by Progress Web in 2013 (Bendimerad et al.,2013), the city allocates 5 percent of total annual revenue, which in 2018 amounts to 17.8 billion pesos, for risk reduction and management. Makati city is equipped with both private and public medical facilities, not to mention twenty seven locally funded and operated barangay health centers spread across the city with the exception of posh and high income barangays such as: Forbes Park, Magallanes, San Lorenzo and, Urdaneta; and Barangay Post Proper Northside and Post Proper Southside which are in disputed locations, all listed in the National Health Facility Registry of the Department of Health (2013).

With that being said, the current system in place used to monitor the spread and prevalence of infectious diseases in Makati City where a confirmed instance of a disease is consolidated in disease reporting units that has testing capabilities, and directly transferred to the city health department every Friday of the week, prioritizing the Individual Case Investigation Form and the Case Report Form. In turn, the data received and processed is sent to specialized medical institutions such as the Research Institute for Tropical Medicine (RITM) in accordance with the PIDSR framework of the national health department. In this existing system, there is limited checks and balances for duplicating cases especially when patients seek treatment in multiple medical centers. Additionally, when a patient seeks treatment in a barangay health center, when the case is referred to a hospital, the data gathering process from the patient becomes redundant.

Infectious disease monitoring equates to efficient intervention and control programs particularly to allow the proper allocation of resources as well as to influence and give evidence to future policymaking. Moreover, early detection of any public health risks ensures rapid detection and in turn, rapid implementation of appropriate response and control events.

Objectives of the Study

The general objective of this study is to design a web-based application for an infectious disease surveillance system for barangay health centers of Makati City.

Specifically, the study aims to

1. determine the feasibility of the project;
2. design a web-based application of infectious disease surveillance that could be used to influence policymaking which includes the following features:
 - a. User Accounts Module, for management of barangay and hospital users account.
 - b. Dashboard Module, provides a quick overview of system processes by consolidating and visualizing data through graphs and heatmaps.

- c. Makatizen Module, patient information database modeled after the Makatizen card.
- d. Patient Creation Module, for patients without the Makatizen card.
- e. Case Creation Module that will record any instance of infectious disease which includes patient information, suspected diagnosis, and steps that had been taken.
- f. Case Confirmation Module that will allow bona fide medical and health officers in tertiary medical institutions e.g. Ospital ng Makati to confirm or close a case after patient testing.
- g. Reports Module, for generating reports.
- 3. develop the application as designed;
- 4. test the functionality and reliability of the prototype;
- 5. evaluate the accessibility of the prototype using the ISO 25010 software quality model in terms of functional suitability, compatibility, usability, reliability, and security; and
- 6. document the result.

LITERATURE REVIEW

What is Public Health Surveillance?

The Centers for Disease Control of the United States of America defines public health surveillance as “the ongoing systematic collection, analysis, and interpretation of data essential to the planning, implementation, and evaluation of public health practice, closely integrated with the timely dissemination of these data to those who need to know” (Choi, 2012). The World Health Organization (WHO, 2012) redefined it in 2012 as “the continuous, systematic collection, analysis, and interpretation of health-related data needed for the planning, implementation, and evaluation of public health practice”. The WHO coordinates the global public health surveillance program.

On the other hand, the World Bank described six categories of uses of public health surveillance and monitoring. These are—Recognize cases or clusters of cases to trigger interventions to prevent transmission or reduce morbidity and mortality; Assess the public health impact of health events or determine and measure trends; Demonstrate the need for public health intervention programs and resources, and allocate resources during public health planning; Monitor effectiveness of prevention and control measures and intervention strategies; Identify high-risk population groups or geographic areas to target interventions and guide analytic studies; and Develop hypotheses that lead to analytic studies about risk factors for disease causation, propagation, or progression.

Visualization of Public Health Dashboards

The Somalia Polio Room dashboard (Kamadjeu & Gathenji, 2017) and the Medi+board Pilot Project (Kostkova et al., 2014) demonstrated that it is possible to develop an online electronic dashboard for outbreak response using existing open-source and free tools. The development of such dashboard requires technical expertise but should also be carefully examined in light of the considerations identified. The Somalia Polio Room Dashboard clearly demonstrates the usefulness of electronic dashboards in outbreak response through their ability to improve information sharing and minimize the time spent on multiple information requests; their use should, therefore, be encouraged. Moreover, the Medi+board project visualized multiple data sources, detecting patterns in them and presented results on an interactive dashboard.

Philippine Systems for Disease Surveillance

Surveillance in Post Extreme Emergencies and Disasters

The Philippines has an early warning surveillance system called SPEED that is activated after disasters and in extreme emergency situations. It is very vulnerable to disruption particularly when during Typhoon Yolanda hit in 2013 (World Health Organization Philippines, 2014b). Speed has 430 trained personnel in health surveillance with automated report generation enabled by Early Warning Alert and Response Network which in turn automates the Department of Health's Philippine Integrated Disease Surveillance Response. In the year 2013, SPEED was activated due to natural disasters – Luzon Flood in August, Bohol Earthquake in October, and Typhoon Yolanda in November. These disasters were compared using syndrome consultation per 10,000 population and syndrome percent of 21 syndromes and three syndrome groups (communicable, injuries, and non-communicable).

Philippine Integrated Disease Surveillance and Response

The Philippine Integrated Disease Surveillance and Response (PIDSR) is an enhanced surveillance system that monitors notifiable diseases and other health-related events of public health importance utilizing integrated approach (World Health Organization Philippines, 2014a). The researchers identified two categories of diseases and public health related events. Category 1 is defined as “Immediately reportable diseases/syndromes/events” and includes global pandemics such as Anthrax, Human Avian Influenza, SARS, HIV/AIDS and more. Category 2 on the other hand, is defined as weekly reportable diseases/syndromes/events and includes more common local epidemics such as but not limited to Diarrhea, Viral Hepatitis, Meningitis, Cholera, Dengue, Diphtheria, Influenza, Leptospirosis, Malaria, Tetanus, Rabies and Typhoid Fever. They also identified barangay health centers as the first institution to make a case about patients with these diseases.

PIDSR expects to see cases from Disease Reporting Units (DRU) which are tasked with primary case detection. These are Barangay Health Stations, Rural Health Units, and, Local Hospitals among others. PIDSR defines the role and responsibilities of a Municipal/City Health Office as: a. Set up and maintain a functional disease surveillance system equipped with necessary resources and adequate local financial support; b. Collect, organize, analyze and interpret surveillance data in their respective areas; c. Report all available essential information (e.g. clinical description, laboratory results, numbers of human cases and deaths, sources and type of risk) immediately to the next higher level; d. Implement appropriate epidemic control measures immediately; e. Establish, operate and maintain an epidemic preparedness and response plan, including the creation of multidisciplinary/multisectoral teams to respond to events that may constitute a public health emergency; and f. Facilitate submission of weekly notifiable disease surveillance reports from public and private hospitals.

PIDSR utilizes a 3-tiered system to define a standard case definition for surveillance. The first level, 'suspected case' is an indicative clinical picture without being a confirmed or probable case. Second is a 'probable case' which has a clear clinical picture or can be linked epidemiologically to a confirmed case. Lastly, a 'confirmed case' is verified by laboratory analysis. However, PIDSR also suggests that case definitions are "not sufficient for establishing medical diagnosis and should not be relied upon to initiate therapy".

METHODOLOGY

The developers applied the descriptive developmental approach in conducting the study. Given the scale, the developers of the Infectious Disease Surveillance System analyzed the current process of infectious disease reporting and tracking in Makati City as well as conducted interviews with concerned groups and individuals such as the Makati Health Department and actual health workers in barangay health centers. On the other hand, the developers also utilized multiple survey instruments and questionnaires in different processes along the project development to gather data. Moreover, the developers aim to provide a solution to properly monitor and provide assistance to the local health officers in keeping their communities safer from outbreaks.

Finally, the process of developing the system utilized the Waterfall model comprised of five phases namely, requirements definition, system and software design, implementation and unit testing, integration of system testing, and operation and maintenance phase. Steps in system development follow each other and does not overlap and the developers must complete every phase before the next phase begin. Project Development relies on gathering and thorough analysis of data as well as the evaluation of the final prototype.

System Design

City Health Officials and/or Doctors

A major actor of this system will be the Makati Health Department and the doctors at the Ospital ng Makati. City Health Officers can create cases as well as add patients. Members of this user type can also view and modify cases created by the barangay health officials and add, edit and delete user accounts for each barangay. Finally, they can also issue alerts and announcements on the dashboard, view all reports and add and edit diseases and treatments.

Barangay Health Centers

The users from this group are going to be the barangay health officers. They are mainly the ones who are going to be entering the patient information on the system, as well as create the cases. Their main responsibility is close all created cases in their vicinity which may mean that the patient recovered or was cured or passed away. On the other hand, they can also create reports from the system.

Administrator

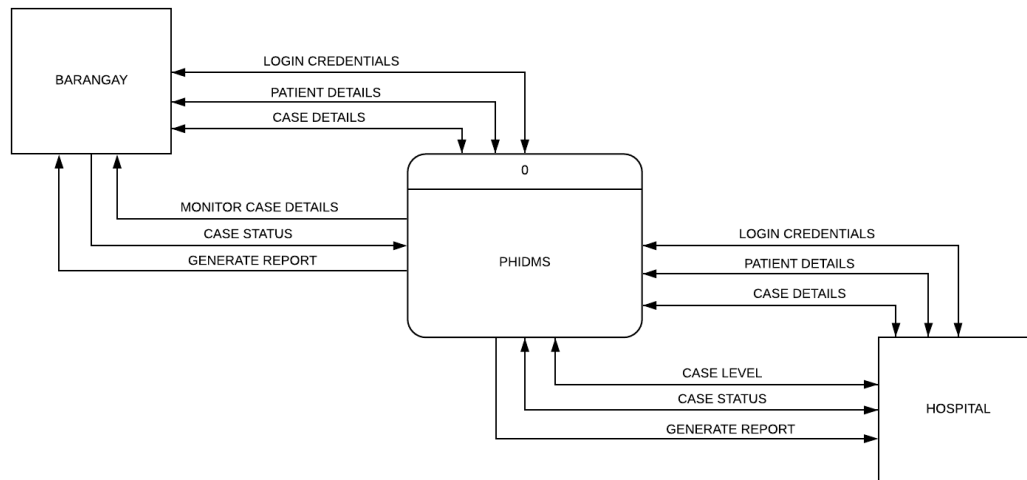
Administrator accounts can do all functions in the system. They can add, edit and, revoke access to all user types; generate reports; modify patient information; modify case information and issue alerts (Table 1). There are currently 5 case monitoring levels in the system that can be used to identify the current state of the case, as seen in the table above (Table 1). Moreover, these are accompanied by 10 status identifications (seen in the table below), that further describes the actions already accomplished by the users to resolve the case. Naturally, each level only has 2 possible partner Status ID e.g. Level 2 diagnosis has two states; which are Status ID 3 which happens when a diagnosis is confirmed true by the attending doctor and, Status ID 4 when the diagnosis is false or is not infectious (Table 2).

Table 1. Case Monitoring Levels

Levels	Definition
Level 1	Case Created
Level 2	Diagnosis
Level 3	Confirmed Case
Level 4	Monitoring
Level 5	Case Closed

Table 2. Case Monitoring Status

Status ID	Definition
1	Case Information Created
2	Patient Notified
3	Confirmed Case
4	Declined Case
5	In Treatment
6	In Quarantine
7	In Monitoring
8	Cured
9	Case Closed
10	Not Infectious



IDSS

Figure 1. Context Level Diagram

The Context Level Diagram illustrates the interactions and requirements of the system from the Barangay Health Officials and the Hospital/City Health Officials (Figure 1). Initial information needed by the System will be coming from the barangay health officials, but the users from the other group can also enter the same type of information in the System as well as others such closing a case and confirming a case.

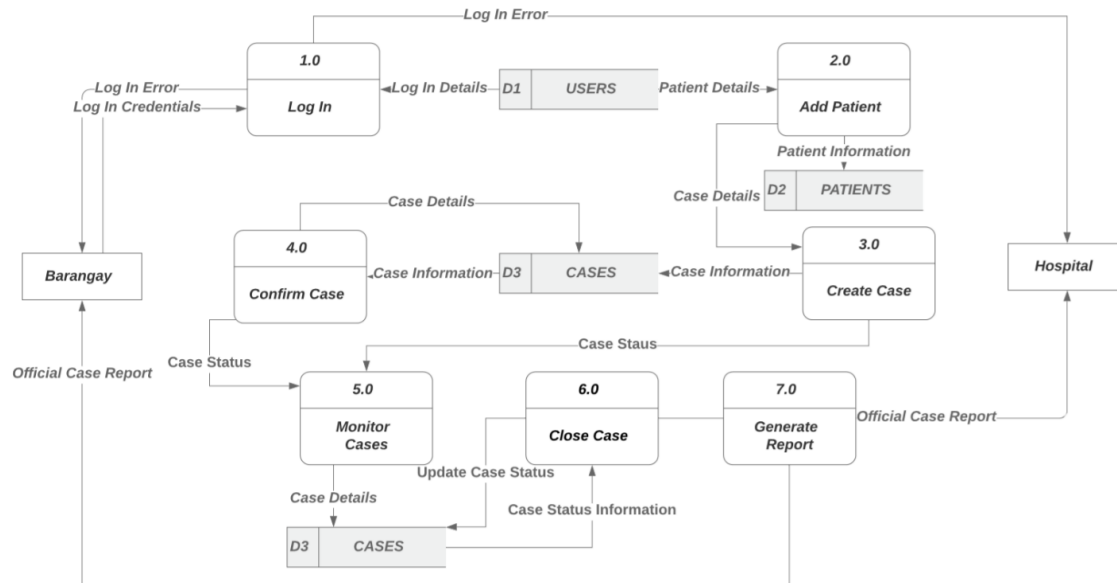


Figure 2. Data Flow Diagram for the System

Figure 2 illustrates the Data Flow Diagram for both Barangay users and Hospital users. The work flow for Barangay users initially the same with Hospital users in the beginning. Activity starts with the user login. The login derives its data from the users table. After logging in, the users can add patients. The system doesn't permit entering a patient that has the same email and contact number in any patient in the system. The user can make any change to the patient's details any time.

After adding a patient, the user can now create a case under the patient's ID. If the user creates a case, it automatically creates a new instance in the 'cases' table with the patient's symptoms, generated possible diagnosis, attending physician's remarks and a levelID and statusID of 1. Once the system successfully notifies the patient of what to do next thru SMS, the system changes the case's statusID to 2. This is where the work flow diverges for both users. Barangay users would have to wait for input from Hospital users before they can go to the next process.

This is necessary because the testing and detection capabilities of barangay health centers are insufficient to properly confirm an instance of a disease. Barangay health centers may serve as referral centers for medical institution. Once the patient proceeds to a secondary or tertiary medical facility like OsMak, the work flow continues. Hospital users (doctors and health officials) retrieves the case information from the 'cases' table, which includes the generated primary diagnosis, symptoms and remarks, and combined with actual testing (e.g. blood tests) in the medical institution, decides to either close or confirm the case. A case is closed when the diseases is non-contagious or is not supported by the system. The case will be updated to reflect this change (levelID = 10, statusID = 4 or 10). However, when the case is supported in the system and is confirmed

by the testing, the user can confirm this instance of the case and its details will be updated to levelID 3 and statusID 3. The user/health official can now enter a prescription, as well as a treatment plan to the case. He/she will also need to decide if the patient can leave the medical facility or is to be quarantined. Either choice will update the levelID to 4 and statusID to 5 or 6. After this is done, the workflow is once again unified for both Barangay and Hospital users.

The case information initially created by a barangay user will only appear in his view again once the hospital has confirmed the case. This time, the barangay health official is tasked in monitoring the progress of an outpatient case. At the same time, if the patient is in quarantine, the responsibility lies with the Hospital. Either way, once they started to monitor the case, the case statusID will once again change to 7. If the patient is cured, either user can update the statusID again to reflect the change (8 or 10).

The barangay user can generate a report called “Official Prescription” that will help in monitoring the patient while the hospital user can generate the “Official Case Report” for other purposes.

Operating Procedure

The process starts when a barangay health official creates a case for a patient suspected of having an infectious disease (Figure 3). A case ID will be created along with the details of the case as well as the patient’s information. The system will send a notification to the patient, along with his case ID for reference when the patient proceeds to the hospital. When the patient proceeds to the hospital and his/her identity is confirmed, the consulting physician can update the status of the case whether it is infectious or not, depending on the tests performed. The physician will also decide the proper treatment or if the patient is necessary to be quarantined. A case will remain open until its case status is updated for the final time.

Testing Procedure

The main purpose of this stage in software development before implementation and deployment takes place is to ensure accuracy of the program, meeting the expected results in accordance with the ISO 25010 standard. Once a fully functional prototype is completed and approved for evaluation, the system will be evaluated by the expected users and testers as defined, using the prepared System Evaluation Instrument that tests the system according on five indicators, namely Functional Suitability, Compatibility, Usability, Reliability, and Security including their respective sub-characteristics.

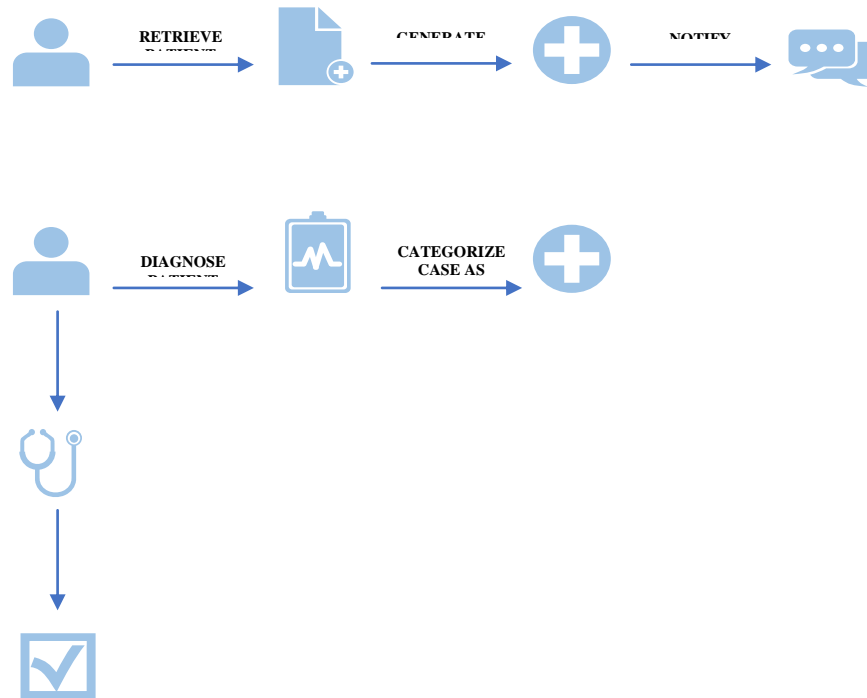


Figure 3. Operating Procedure

Treatment of the Data

A five-point scale will quantify the evaluator's responses, with each numerical rating given an equivalent verbal interpretation (Table 3). The data gathered will be computed to determine the weighted mean and the composite mean which will be used for the interpretation of results for the overall technical feasibility of the system. The formula the mean and weighted mean is:

$$\bar{x} = \frac{\sum fx}{n} \text{ where } \bar{x} = \text{weighted mean, } f = \text{frequency, } x = \text{score, } n = \text{total frequency}$$

Equation 1

$$\bar{x} = \frac{\sum x}{n} \text{ where } \bar{x} = \text{mean, } x = \text{score, } n = \text{total frequency}$$

Equation 2

Table 3. Five – Point Likert Scale

SCALE	RANGE	VERBAL INTERPRETATION
1	1.00 – 2.49	Not Acceptable
2	2.50 – 3.24	Moderately Acceptable
3	3.25 – 3.99	Acceptable
4	4.00 – 4.74	Very Acceptable
5	4.75 – 5.00	Highly Acceptable

Feasibility Study Instruments

The feasibility of the developed Infectious Disease Surveillance System will be measured on different aspects using several tools. The product feasibility will be determined using the Concept Statement Instrument and Buying Intentions Survey. The organizational feasibility will be determined using the Management Prowess Assessment Tool and the Resource Sufficiency Assessment Tool. The financial feasibility will be determined using the Total Budgetary Requirements, and Cost Benefit Analysis. The technical feasibility will be determined by the Hardware and Software Requirements. Lastly, the Market Timeliness Tool will determine the market feasibility of the system.

RESULTS

Profile of the Respondents

The developed system was evaluated by thirty respondents divided into two categories namely the IT and Non-IT Professionals. Non-IT professionals were further broken down into school nurses, nurses working in public health facilities, and workers from the city health department. The figure below illustrates the breakdown of respondents (Figure 4).

Project Evaluation

The respondents evaluated the system in accordance with the ISO/IEC 25010 software quality model and their responses and its equivalent interpretation is shown in Table 4. In summary, the software received a “very acceptable” rating on all six metrics as shown in the figure below with Compatibility having the lowest score of 4.27 and Reliability having the highest score of 4.42. Responses from the non-IT experts are marginally higher than the IT experts giving the system a score of 4.49 and 4.17 respectively. The overall rating of the Infectious Disease Surveillance System in accordance with the ISO 25010 standard is 4.33 (Figure 5).

Product Feasibility

The figure above (Figure 6) shows the answers of the respondents when asked about buying the software application for personal use and over 80 percent or 24 out of 30 people interview says that they are positive that they will buy the software for themselves, with 27 percent saying they “will definitely buy” and 53 percent saying they “probably would buy”. The remaining 20 percent or 6 persons answered that they might or might not but the application for themselves.

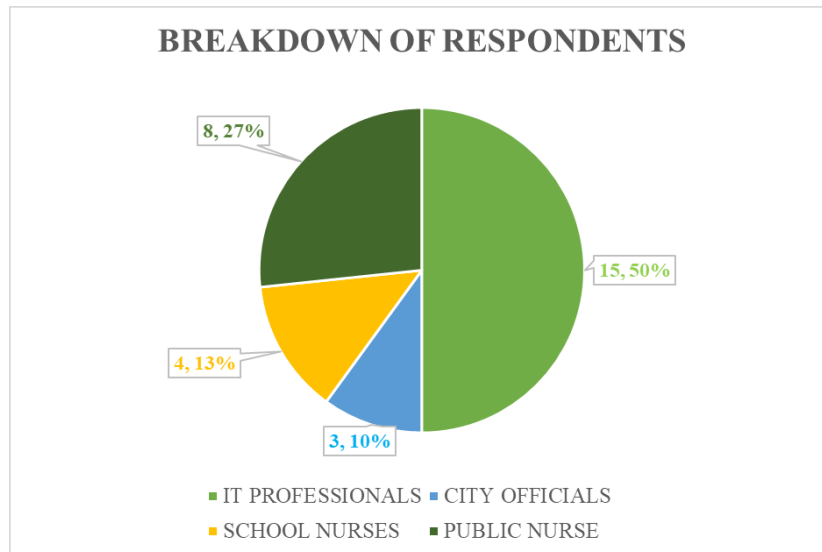


Figure 4. Breakdown of Respondents

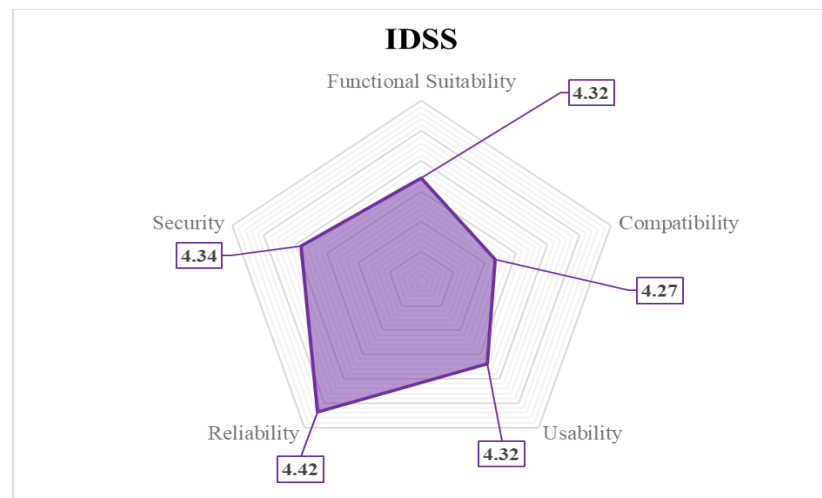


Figure 5. Summary of Ratings

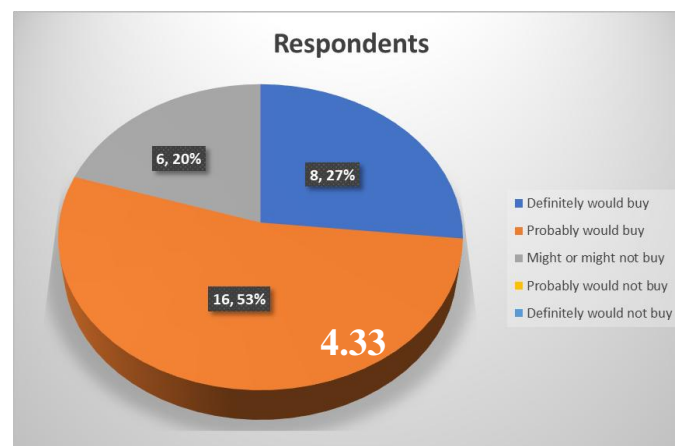


Figure 6. Responses for Buying Intentions Survey

Table 4. Results of the Project Evaluation for Non-IT and IT Experts

Indicators	Weighted Mean		Verbal Interpretation	
	Non-IT Experts	IT Experts	Non-IT Experts	IT Experts
Functional Suitability				
Functional Completeness- The set of functions covers all the specified tasks and user objectives.	4.23	4.50	Very Acceptable	Very Acceptable
Functional Correctness- Product or system provides the correct results with the needed degree of precision.	4.30	4.33	Very Acceptable	Very Acceptable
Functional Appropriateness - The functions facilitate the accomplishment of specified tasks and objectives.	4.40	4.17	Very Acceptable	Very Acceptable
Compatibility				
Interoperability- Degree to which two or more systems, products or components can exchange information and use the information that has been exchanged.	4.53	4.00	Very Acceptable	Very Acceptable
Usability				
Operability- The product or system has attributes that make it easy to operate and control with effective and efficiency.	4.63	3.83	Very Acceptable	Acceptable
User interface aesthetics- User interface enables pleasing and satisfying interaction for the user.	4.50	4.17	Very Acceptable	Very Acceptable
Appropriateness recognizability- Users can recognize whether a product or system is appropriate for their needs.	4.53	3.83	Very Acceptable	Acceptable
Learnability- The product or system can be used by specified users to achieve specified goals of learning to use the product or system with effectiveness, efficiency, in a specified context of use.	4.70	4.33	Very Acceptable	Very Acceptable

Table 4. Results of the Project Evaluation for Non-IT and IT Experts (continuation)

Indicators	Weighted Mean		Verbal Interpretation	
	Non-IT Experts	IT Experts	Non-IT Experts	IT Experts
Usability				
User error protection- Degree to which a system protects users against making errors.	4.27	4.17	Very Acceptable	Very Acceptable
Accessibility – The product or system can be used by people with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use.	4.70	4.17	Very Acceptable	Very Acceptable
Reliability				
Availability- The system, product or component is operational and accessible when required for use.	4.57	4.57	Very Acceptable	Very Acceptable
Fault Tolerance- The system, product or component operates as intended despite the presence of hardware or software faults.	4.37	4.17	Very Acceptable	Very Acceptable
Security				
Confidentiality- The product or system ensures that data are accessible only to those authorized to have access.	4.57	4.17	Very Acceptable	Very Acceptable
Integrity – The system, product or component prevents unauthorized access to, or modification of, computer programs or data.	4.63	4.17	Very Acceptable	Very Acceptable
Accountability- Degree to which the actions of an entity can be traced uniquely to the entity.	4.67	4.00	Very Acceptable	Very Acceptable
Authenticity- Degree to which the identity of a subject or resource can be proved to be the one claimed.	4.53	4.0	Very Acceptable	Very Acceptable
Composite Mean	4.49	4.17	Very Acceptable	Very Acceptable
Overall Composite Mean	4.33		Very Acceptable	

Most of the respondents (53%) believe that the features of the system would be useful in a real time situation and see themselves utilizing system in monitoring epidemics in the city. Moreover, respondents also see the system to be feasible and also said that they are likely to buy it not only for themselves and for their colleagues but also said that they see themselves recommending the system to other professionals in the medical field. Most respondents see that the system can influence policy making of the health official in the city because of certain features that are presented in the proposed system.

Organizational Feasibility

A thorough examination of the processes and functions of the different actors in the system, interviews with employees from the City Health Department and nurses in the barangay health centers of West Rembo, Dasmarinas, the University Clinic, using the Management Prowess Assessment tool and Resource Sufficiency Assessment tool comprised the Organizational Feasibility analysis.

The overall management prowess lies between moderate to high potential. Passion for the Business Idea, Relevant Industry Experience, Depth of Professional and Social Networks, and Creativity Among Management Team Members exhibit high potential. Meanwhile, Prior Entrepreneurial Experience, and Experience and Expertise on Cash Flow Management fall on Moderate Potential. Finally, current members of the organization under vital positions, as well as future employees are required to have college degree or medical or civil service license.

On the other hand, in terms of resource sufficiency, office space, key equipment necessary for operation, ability to obtain intellectual property protection and the support of the local and state government is already readily available. Any manufacturers or outsource providers, management and support employees and ability to form favorable business partnerships is likely to be available and within the organization's budget if they implemented the system. Finally, the system integration in terms of analysis of the overall organization is feasible.

Market Feasibility

The Infectious Disease Surveillance System has a moderate to high potential attractiveness based on market timeliness assessment tool. Given the multiple outbreaks and re-emergence of previously defeated diseases in the country e.g. Dengue, Chikungunya, African Swine Flu Virus, Malaria, Poliomyelitis and, Diptheria, disease surveillance will ever be more relevant in tackling today's public health issues. With the recent reduction of budget allotment for the Department of Health, medical professionals and various health groups are warning of an upcoming public health crisis in the Philippines. There is going to be pressure for local governments to address these issues which in turn will increase demand for solutions. Although IT exists in the medical

field, integration in public health monitoring is quite underdeveloped. This will be driving growth for specialized systems for disease surveillance in the long term.

The target market has a medium potential for attractiveness. The majority of organization involved in public health surveillance is government owned and operated making the number of potential customers between the government and the remaining private medical institutions willing and capable to purchase the system. Majority of patients catered by public health institutions are dissatisfied with their services and the lack of accessible healthcare remains a problem for all. This presents an opportunity as the application can bridge some gaps in the current public health situations and potentially mitigate the spread onset of outbreaks in its early stage.

Buying mood of potential customer, momentum of the market and, needs of the new firms exhibits medium potential. Business and environmental trends are also moving in favor of the target market. It can be concluded that the system is marketable.

DISCUSSION

Based on the gathered data, the findings may be summarized as follows:

1. The developed Infectious Disease Monitoring System works on several of the major web browsers for Windows 10 and Linux platforms (e.g. Google Chrome, Microsoft Edge) and is design and performance compatible based on the result of the portability test conducted by the developers using different browsers and operating systems for personal computers that assured the compatibility of the system.
2. Professionals from the field of Information Technology gave the developed system an overall computed score of 4.17 which indicates that the system is “very acceptable” in terms of Functional Suitability, Compatibility, Usability, Reliability, and Security.
3. Professionals involved in public health as well as medical professionals, both intended users of the Infectious Disease Surveillance System, rated the system 4.49 which also indicates that the system is “very acceptable” in terms of Functional Suitability, Compatibility, Usability, Reliability, and Security.
4. The weighted ratings from both IT and non-IT professionals yielded a 4.33 rating for the Infectious Disease Surveillance System.
5. The feasibility of the developed system in different areas are as follows:
 - a. Product Feasibility. Most respondents believed that the system was interesting and expressed various degrees of desire to procure the system for their professional needs.
 - b. Organizational Feasibility. The organization has a moderate to high potential in terms of management prowess and resources necessary for vital functions such as office space, suppliers, computers, machineries, intellectual property protection, government support, business

partnerships, funds, among others are readily available and any other resources they may require is likely to be available.

- c. Technical Feasibility. Technical requirements are achievable, doable and personnel needed for further development is available. The system can be deployed and is feasible for the organization.
- d. Financial Feasibility. The cost and benefit analysis show that there is a discernable return of investment upon development and implementation of the system.
- e. Market Feasibility. The developed system has a moderate to high potential attractiveness to the industry given its timeliness and relevance. However, factors that may affect marketability include the reduction of budget allotment for healthcare by the national government and minimal number of potential customers (public and private health institutions).

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions were achieved or drawn:

1. Developed a web-based application of infectious disease surveillance which includes the following features:
 - a. User log-in module
 - b. Primary dashboard consolidating infectious disease reports from barangay health centers.
 - c. Patient information database modeled after the Makatizen card.
 - d. Patient creation module for patients without the Makatizen card.
 - e. Case creation module that will record any instance of infectious disease which includes patient information, suspected diagnosis, and steps that had been taken.
 - f. Case confirmation module that will allow bona fide medical and health officers in tertiary medical institutions e.g. Ospital ng Makati to confirm or close a case after patient testing.
 - g. Pinpoint high-risk areas for closer monitoring via geotagging.
2. Developed the system as designed utilizing the following open source web technologies:
 - a. Bootstrap for web development and designing
 - b. PHP for web programming;
 - c. HTML, CSS and JavaScript for web development and design;
 - d. MySQL as database management system;
3. Tested the functionality and reliability of the prototype;
4. The developed Infectious Disease Surveillance System was evaluated by randomly-selected personnel from the IT and non-IT group in terms of functional suitability, compatibility, usability, reliability, and security of the ISO 25010 software quality model and obtained an overall evaluation of Very Acceptable with an overall composite mean rating of 4.33.

5. The developed system is feasible according to the results of the product, organizational, financial, technical, and market feasibility analysis.

Based on the conclusions derived from the conduct of this study, the following suggestions are recommended:

1. Maximize the rollout of the Makatizen Cards to include children to ensure every citizen can be detected in the system database.
2. Utilize the location data of confirmed cases of an infectious disease to track the spread of the disease from one person to another which will be useful in identifying the patient zero of a new previously undiscovered infection.
3. The developed system can be integrated with the existing disaster and risk management system of Makati City.

IMPLICATIONS

The developed Infectious Disease Surveillance system was evaluated both by IT professionals and by its intended users, and was determined feasible based on the market, technical, product, organizational and, financial feasibility studies. The respondents' sentiment with the project may or may not have been affected with the current state of infectious disease surveillance in the Philippines given the multiple infectious diseases simultaneously affecting the country. With that being said, Makati City is in a unique position to adapt the developed system in improving epidemic detection and surveillance in its vicinity, while also being compliant with the PIDSR framework of the Department of Health. The result of the study can serve as a baseline for creating the equivalent web application of the PIDSR framework, integrating every disease reporting unit in the country as defined by the framework itself.

However, since the study is limited to the specific case of the Makati City Health department, future researchers may take in consideration in their studies, the comparative analysis of the capabilities of the other organizations or cities in implementing an infectious disease surveillance system.

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