ANIMAL BITE MAPPING (ABMAP)USING MOBILE APPS

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ABSTRACT

This study on "Animal Bite Mapping (ABMap) Using Mobile Apps" utilized the descriptive research design for the qualitative approach and developmental research design for the system development. In the interview, most of the participants were bitten by dogs than cats. The highest incident of bites happened in Tuguegarao City. The immediate response of the animal bite victims was to wash the bitten area with soap and water, while the Animal Bite Treatment Center was to attend to their health-care needs and conduct an interview with the patient for health-care interventions. Along the post-exposure prophylaxis, the Tissue Cultured Vaccine (TCV) and Equine Rabies Immune Globulin (ERIG) were administered to the animal bite victims.

The developed Animal Bite Mapping System using Mobile Apps quickly provides information to both the animal bite victims and Animal Bite Treatment Centers regarding immediate health-care interventions.

The Animal Bite Mapping System was created using My Structured Query Language (Mysql) which is an open source relational database management system (RDBMS) with a client-server model; Sequential Query Language(SQLite) which is an embedded SQL database engine; Basic4Android (B4a) which is one of the very best options to make an Android application quickly; and Microsoft Visual Studio which is an integrated development environment (IDE) from Microsoft that includes a code editor supporting intelliSense (the code completion component) as well as code refactoring; and google map application (google map API).

KEYWORDS: Animal bite, Animal Bite Treatment Center, Mapping, Mobile Apps

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INTRODUCTION

With the birth of information technology, the technological advancements and innovations are making it possible to automate the work currently being performed by human beings. The Smart Health Monitoring Systems that have rapidly evolved recently have been proposed to monitor patient current health conditions (Tarapiah, et al. 2017), and data mapping is their problem. So, the data mapping in this study will be used to address the gap regarding animal bite and deaths of rabies cases, delay of health-care services to the victims and prompt information dissemination to victims and clinical staff of Animal Bite Treatment Center (ABTC) through the developed system with mobile application.

Animal bites are a significant cause of morbidity and mortality worldwide. Dog bites account for tens of millions of injuries annually; the highest risk is among children (WHO Global 2018). Animal bites, even when these are minors, can cause bacterial infections and spread bacteria to the different parts of the body (Johns Hopkins Medicines 2019). Millions of animal bites occur in United States each year and dogs cause most animal bites (Standford Children's Health 2019). Dogs are the source of the vast majority of human rabies deaths (WHO Western Pacific Region 2019). The rabies in dogs is rare but a potentially fatal infection. Rabies attacks the nervous system and, once symptoms develop, it is 100 percent fatal (Standford Children's Health 2019). "Rabies is something you die from, and once you're infected, there's no chance of surviving (Ido Efrati, 2018). It remains one of the greatest global zoonotic threats to human health (Palmer, S. 2011).

Rabies infection causes tens of thousands of deaths every year mainly in Africa and Asia. The 40% of people bitten by suspect rabid animals are children under 15 years of age (WHO Global May 2019). The World Health Organization Survey on Rabies in 2017 reported that South East Asia region accounts approximately for 60% of human rabies deaths in the world. An estimated 20,000 rabies deaths and 17.4 million exposure to animal bite occurs every year in India. In China, the second highest number of reported rabies cases in the world, with over 2,000 deaths on average reported each year for the past 10 years. Epidemiological investigations in Beijing showed that most of the rabies deaths occurred in persons exposed to rabies-suspected dogs (85-95%) and cats (5%) (WHO WPRO 2019). The Health Ministry of Indonesia reported that from January to February this year, 628 people were infected with rabies nationwide, with at least 12 cases that turned fatal. These incidents in Indonesia prompt

the government to declare a rabies outbreak (Cahya, G.H. et. al, 2019). In Ghana, 4,821 dog bites were reported over the three-year period. This translated into an annual incidence of 172 cases per a population of 100,000. Most of cases were in children aged less than 10 yrs.

In the Philippines, rabies is considered to be a neglected disease, which is 100% fatal though 100% preventable. It is not among the leading causes of mortality and morbidity in the country but it is regarded as a significant public health problem because (1) it is one of the most acutely fatal infection and (2) it is responsible for the death of 200-300 Filipinos annually (DOH 2018.

The RA No. 9482 which is the Anti Rabies Act of 2007 mandates the implementation of a program to control and prevent human and animal rabies (Sengson, R. F. 2011). The Batas Pambansa Bilang 97: An Act Providing for the Compulsory Immunization of Livestock, Poultry and other Animals against Dangerous Communicable Diseases. The Act required the Secretary of Agriculture to make compulsory the vaccination of susceptible animals and poultry should there be a threat or existence of a highly communicable animal or avian disease in a certain locality. Under the Republic Act No. 7305 – The Magna Carta of Public Health Care, indicated that the state should shall instill health consciousness among our people to carry out the health programs and projects to the government essential for the growth and health of the nation [Chan robles, 2005].

Hence, this study on animal bite mapping using mobile phones is of great help to the Animal Bite treatment Centers and to the animal bite victims as there is an interactive geographical information system that can provide easy access for the users in line with the features of the Animal Bite Mapping.

Review of Related Literature

This part of the study presents the related literature and studies that are relevant in understanding this research endeavor. It discusses about the animal bites, data mapping, and use of mobile applications.

Animal Bites

Animal bites are common worldwide and may be associated with significant morbidity (Baddour, L. et.al., (2019). Dog bites account for approximately 90 percent of animal bites (rate of 103 to 118 per 100,000 population). Most dog bite victims are children, with the highest number in boys between five and nine years of age. Fatalities are rare but disproportionately affect children younger than 10 years of age. In resource-poor regions of the world, stray dog bites are an important cause of rabies transmission.

The American Pet Association estimates that there are 77 million cats in the United States (www.apapets.org). The most common route of infection related to cat contact is through bites and scratches, especially among children (Kotton, C., 2018). The infection caused by Bartonella sp. is typically self-limiting and characterized by lymphadenopathy and fever. It is commonly termed cat scratch disease (CSD) because domestic cats may act as a natural reservoir and vector for Bartonella henselae (B. henselae) which is responsible for human disease (Ameilia, A. et.al., 2015). Cat scratch disease is caused by the small intracellular bacillus *B henselae*. It is typically transmitted by the scratch of a kitten, resulting in a papule or pustule at the inoculation site. Regional lymphadenopathy is the most common presentation in immunocompetent patients, and usually develops 1–2 weeks after the initial skin finding. Simonton, K. et.al., (2015). Cats co-occupy one third of all residences in the United States. As common household pets, they serve as sources of joy and companionship for their owners. However, feline ownership also comes with its own inherent risks, as cats can transmit an array of diseases to their owners, ranging from trivial to fatal ailments (Kravetz, J. et.al., 2002).

The Republic Act No. 9482

The Republic Act No. 9482 known as the "Anti-Rabies Act of 2007" has a declaration of policy pointing out that the State shall protect and promote the right to health of the people. Towards this end, a system for the control, prevention of the spread, and eventual eradication of human and animal Rabies shall be provided and the need for responsible pet ownership established. This refers to an act by which a dog seizes, cuts or grips with its teeth so that the skin of a person has been wounded, pierced or scratched. Rabies refers to a highly fatal disease caused by a lyssa virus, transmitted mainly through the bite of an infected animal and is characterized by muscle paralysis, hydrophobia and aerophobia, and other neurological manifestations.

The Local Government Units, in their respective localities, shall: (1) Ensure that all Dogs are properly immunized, registered and issued a corresponding Dog tag for every immunized and registered Dog. (2) Strictly enforce Dog Impounding activities and field control to eliminate Stray Dogs. (3) Ensure that Dogs are leashed or confined within the premises of the Owner's house or Owner's fenced surroundings. (4) Allocate funds to augment the implementation of the National Rabies Prevention and Control Program, particularly on the financing of supplies and human and Dog vaccines needed for immunization. (5) Ensure the enforcement of Section 6 of Republic Act No. 8485 or "The Animal Welfare

Act of 1998". (6) Enact additional local ordinances that will support the National Rabies Prevention and Control Program that should include the regulation of treatment locally known as "tandok." (7) Prohibit the trade of Dogs for meat. (8) With respect to cities and first class municipalities, establish and maintain a Dog Pound where Impounded Dogs shall be kept, in accordance with Section 9 herein: Provided, That the other municipalities, shall, on their own, establish a Dog Pound or opt to share the expense of establishing and maintaining a Dog Pound with other adjoining municipalities and/or with private animal shelters and control facilities. (9) Prohibit the use of electrocution as a euthanasia procedure. (10) Appoint a veterinarian and establish a veterinary office in every province, city and first-class municipality: Provided, That the other municipalities shall, on their own, opt to share the expense of having a veterinary office. (11) Require pet shops to post information regarding Rabies and responsible pet ownership. (12) For purposes of ensuring the administrative feasibility of implementing the provisions of this Act and subject to paragraph 8 of this Section, the LGU shall collect the fines imposed under Section 11 subparagraphs (1). (3), (4), (5) and (6) hereof. Any and all fines collected pursuant to this Act shall be used for the enhancement of the National Rabies Prevention and Control Program within the locality concerned, as well as the achievement of the objectives envisioned in this Act. The DILG shall ensure compliance of these responsibilities by the LGUs.

Animal bites or scratches of animals with rabies when not properly treated can be reasons of morbidity since infections can be led to simple fever to fatal ailments. This is true from the global perspective to the local areas like the Cagayan province.

Data Mapping

Data mapping is a visual feature that figures out incidence of animal bites in a certain location as provided for by the data from documents retrieved from data warehouse or in the Animal Bite Treatment Center. The mapping tools are programming softwares to code the data according to the classifications and categories of exposure. The Mapping techniques are symbols to represent the classified and categorized data in order to have a better picture of the desired information or report.

According to Arez (2018), mapping the epidemiological distribution and incidence of selected zoonotic diseases helps identify vulnerable communities where zoonoses pose significant health threats and allocate the limited resources for their control and prevention. The various functionalities of geographical information system were used to map the distribution and incidence proportion of four major zoonotic diseases namely; rabies, tuberculosis, schistosomiasis and helminthiasis (Arez, 2018). The mapping of disease incidence and prevalence has long been a part of public health, epidemiology, and the study of disease in human populations (Koch, 2005). It has mapping models that provide a rich framework for the definition and application of hierarchical spatial models for a real data that simultaneously address twin but competing goals of accurate small area estimation and fine-scale geographic resolution (Waller, A. et. al., 2014).

The data mapping shall be useful for the healthcare providers and those who need the healthcare services.

Google Maps

Google Maps is a Web-based service that provides detailed information about geographical regions and sites around the world. In addition to conventional road maps, Google Maps offers aerial and satellite views of many places. In some cities, Google Maps offers street views comprising photographs taken from vehicles.

Google Maps offers several services as part of the larger Web application, as follows: 1) A route planner offers directions for drivers, bikers, walkers, and users of public transportation who want to take a trip from one specific location to another; 2) The Google Maps application program interface (API) makes it possible for Web site administrators to embed Google Maps into a proprietary site such as a real estate guide or community service page; 2) Google Maps for Mobile offers a location service for motorists that utilizes the Global Positioning System (GPS) location of the mobile device (if available) along with data from wireless and cellular networks; 3) Google Street View enables users to view and navigate through horizontal and vertical panoramic street level images of various cities around the world; and 4) Supplemental services offer images of the moon, Mars, and the heavens for hobby astronomers (TechTarget Contributor 2013).

The Google map creates real-world, real-time experiences with the latest Maps, Routes, and Places features from Google Maps Platform which imbedded by the Google team for developers everywhere. Maps SDKs bring the real world to your users with static and dynamic maps for the web and mobile. Embedded maps can add an interactive map to your site with a simple HTTP request. Routes provides directions for multiple transportation modes, featuring real-time traffic information. The distance matrix calculates travel times and distances for multiple origins and destinations. The roads Identifies nearby roads using coordinates. The Places API & SDKs integrates Google's Place details, search, and

autocomplete into your apps. The Geocoding converts coordinates into addresses and addresses into coordinates. The Geolocation gets an approximate device location using nearby cell towers and WiFi nodes, and Time zones determines the time zone for a set of coordinates. https://developers.google.com/maps.

The Use of Mobile Applications

In the study conducted by Ventola (2014) *on Mobile Devices and Apps for Health Care Professionals: Uses and Benefits,* the use of mobile devices by Health Care Professionals (HCPs) has important tasks such as information and time management; health record maintenance and access; communications and consulting; reference and information gathering; patient management and monitoring; clinical decision-making; and medical education and training. The result of the study reveals that a frequent reliance on mobile devices was also reported in the survey of medical school HCPs and students, with 85% reporting the use of a mobile device at least once daily for clinical purposes, often for information and time management or communication relating to education and patient care.https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4029126/

In the study on the Use of Mobile Phone Text Message Reminders in Health Care Services: A Narrative Literature Review by Kanisto, K.A. et al., (2014), it reveals that mobile phone text message reminders were used to remind patients about their medication or treatment in 63% of the studies, and both to increase the attendance to clinical appointments and to decrease the non-attendance to clinical appointments with patients from different patient groups in 37%.The mobile telephone text message reminders were used as the only intervention in 73% of the studies. In 27% of the studies, the approach was multifaceted, indicating that text message reminders were connected to another comprehensive health intervention system, such as educational text messages (7%), informational text messages about patients' disease and healthy living (12%) along with supportive text messages.

The Research and Development of Mobile Application for Android Platform by Li Ma. et al., (2014) reveals that as the developing of hardware of mobile is getting better, the performance index is much higher than the actual requirements of the software configuration. Phone's features more depend on software. As the Android operating system is getting more popular, the application based on Android SDK attracts much more attention. The users' data is collected through the Sina open platform called by Sina client and the data will be returned under the format of JSON by the Sina server. The system uses the OAuth authentication method for user authorization to complete the login process. The specific functions of this system are developed based on Android Weibo SDK. The interfaces of these Android apps are pretty and the operation is smooth.

Text Message Notification for Web Surveys by*Kyley McGeeney and H. Yanna Yan (2016) stressed on* sending texts to survey panel members that shortens response time. It further indicates *on text* messaging for interview and as a means of alerting people to complete a survey, such as by sending them a link to a web survey. The Text messages are now standard American Trends Panel protocol, and based on the results of these experiments, consensual text message invitations and reminders are now standard protocol for the American Trends Panel. The panelists received reminders via email and all web panelists with mailing addresses on file (96% of web panelists) also received a pre-notification postcard. Sending notifications via text to consenting survey panel members improves response time (people take the survey sooner, on average) and boosts the share of respondents completing the survey on a mobile device.

In the study conducted by Schwebel, F.J. et al., (2017) on using text message reminders in health care services, it shows that SMS messages are relatively inexpensive, easily customized, automatically sent directly to individuals, and a part of many individuals' daily life. Given these attributes, it is not surprising many studies utilize SMS as a reminder to help improve health care services. SMS can function as a reminder both for recurring (e.g., daily medication adherence) and distal, one-time (e.g., to complete a follow-up vaccination two months after initial vaccination) behaviors. Clinics report major financial savings after implementing an automated, SMS-reminder system, and attribute the savings to the relative inexpensiveness of SMS reminders and the decreased rate of missed appointments (e.g., Pratap et al., 2015; SMS messages may also help individuals who need additional support or structure to remember things or to engage in a behavior (e.g., individuals with schizophrenia or a TBI) (Hart and Vaccaro, 2017).

Medical professionals can use technology to help guide their treatment. With technology, they can receive more accurate information about treatment adherence when they are treating patients whose recall and self-report may not be accurate (Boker et al.,2012).

Objectives of the Study

This study aimed to create an animal bite mapping system using mobile apps. It provides data and information on the issues and concerns encountered by the victims of bites and animal bite treatment centers, best practices, the incidence of animal bites as data source for the developed mapping system to be used primarily by the Animal Bite Teatment Centers and victims of bites.

METHODOLOGY

Research Design

The study utilized the descriptive and developmental research designs. For the descriptive research design, the qualitative approach was utilized to analyze the results of the structured interview and to generate data sets, issues, and concerns, best practices of both the Animal Bite Treatment Center staff and animal bite victims. For the developmental research design, the mobile application for mapping was developed. The mobile application part uses the Android Smart Phones and early Phones for registration, log-in, schedule of appointment, and to locate the nearest Animal Bite Treatment Center.

Software Development Methodology

The researcher used the popular Agile software development methodology in designing and developing the proposed Animal Bite Mapping System using Mobile Phones.Each value is optimized throughout the development process through the use of iterative planning and feedback. As the Agile continues, developers revise, extend and merge earlier versions into the final product with continuous feedback from the users.

In the **Animal Bite Mapping (ABMap)** System, all factors identified in the iteration process contribute for the development of the Animal Bite System. The study provides a very informative report to be delivered to the community about the bite occurrences. A systematic report is in place and stored in the ABTC database server for future retrievals by the top-level management in support for the quality decision making. The reviewed and authenticated reports from the top- level management can be used for the Geographical User Interface to finalize the result for public viewing. Further, it will be used to reach out and disseminate the information to the community, country and the world.

Participants of the Study

The study was conducted in the in the Province of Cagayan. There were 102 participants from public health practitioners of the Animal Bite Centers and Animal Bite Victims.

Instrumentation

The proposed system utilized the useful mechanisms and techniques in gathering data to obtain sufficient information about the study. An interview was conducted to gather pertinent data. To further understand the real situation in the site of the study, the researcher interviewed the participants with regard to issues and concerns together with their best practices. Interview was also done inside the ABTC Clinic to patients who were assessed and treated, and also to patients who received Post Exposure Prophylaxis and those who were not given any treatment. Through interview, the researcher was able to generate data needed for data analysis.

Data Gathering Procedure

In gathering the data for this study, the researcher undertook the following:

First, the researcher sought the approval of the Governor for the conduct of the study. The Governor endorsed the researcher to the Animal Bite Treatment Centers, but before going to the Animal Bite Centers of Cagayan, the researcher sought first the approval of the Municipal Mayors. After the approval of the Municipal Mayors, the researcher coordinated with the ABTC Health Workers to request for the data needed for the study and to conduct an interview.

All information solicited from all the participants of the study were treated with high confidentiality. .

Ethical Considerations

The participation of the respondents of the study is solely voluntary and free of coercion. The data and information gathered were kept confidential. To access the data and information, communications through channel shall be observed addressed to the Animal Bite treatment Center of the Province of Cagayan.

Data Analysis

The data were collated from the results of the interview in accordance to the structured questionnaire. Data mapping techniques were utilized to classify the data sets.

RESULTS AND DISCUSSION.

I. Issues and concerns encountered by the victims of bite and the animal bite treatment centers

A. Animal Bite Victims

As a result of the **interview** with the animal bite victims conducted by the researcher, around 87.78% were bitten by dog while 2.22% were bitten by cat. All the animal bite victims were bitten by rabid animals. The interview likewise reveals that the participants opted to observe the biting animal for almost a week or go to “tandok” immediately when

the Health Center is far from their house. The difficulties encountered by the animal bite victims was to avail immediate medical intervention when the vaccination is expensive, long waiting time to be given the shot or injection especially when these animal bite victims suddenly come in huge number on a set ABTC schedule. Along quick response or the best they did when bitten by rabid animals was to wash the bitten part with soap and water only, or apply disinfectant such as alcohol and betadine, or producing extract from garlic to be placed at the bitten area

B. Animal Bite Treatment Center Health-Care Workers

The result of the interview conducted by the researcher with the health-care workers of the Animal Bite Treatment Centers revealed that animal bite victims come respectively to the Animal Bite Centers for health-care treatment. Their problems and concerns include the coming only of the animal bite victims when their condition is already at mid-risk.

The immediate action of the ABTC health-care workers when animal bite victims submit themselves for health treatment, is to interview the patient using the patient's information data followed by providing health care advisory through health education, then prescribing the dosage, and provide them their vaccination schedule.

III. Best practices of the victims of bites and animal bite treatment centers vis-à-vis occurrences of animal bites particularly on dog and cat

As per interview, one of the best practices of the animal bite victims was to wash the bitten part with soap and water only, while the Animal Bite Treatment Center is usually to attend to the health-care needs of the victims and conduct an interview with the patient using the patient's information data followed by providing health care advisory through health education, then prescribing the dosage, and provide them their vaccination schedule.

III. Rate of incidence of animal bite victims across towns and city as per record of the Provincial Health office

The 2019 annual report of the Provincial Health Office on the incidence of animal bite across towns and city reveals that that there were 14,293 cases of animal bite victims. The highest case of animal bites happened in Tuguegarao City, while the lowest number of cases is in Calayan. Most of them were bitten by dogs.

Along the post-exposure prophylaxis, only the two types were administered which are Tissue Cultured Vaccine (TCV) and Equine Rabies Immune Globulin (ERIG) were administered.

IV. The Mapping Techniques, Mapping Tools and Developed System

The Mapping Techniques

The mapping techniques include codes, symbols, and pinning for animal bite victim cases. For the category of exposure, the color varies. Green for low risk, yellow for moderate risk, and red for the high risk. For gender, it is obvious in the system their GAD male and Gad female symbols and the feature of the biting animal as to whether it is dog or cat or others. For the occurrence of bite per town and the province of Cagayan, the pinning symbol evidently appears identifying their location, while the age of the animal bite victims is identified through symbols of either 15 and below or greater than 15. For the distance in kilometer signifying the shortest way and nearest Animal Bite Treatment Center where the animal bite victims will be directed to go for treatment, the technique used is either home or office symbol.

The Mapping Tools

Geographical information system database is designed to store data using *My Structured Query Language (Mysql) which is* an open source Relational Database Management System (RDBMS) with a client-server model and Sequential Query Language(*SQLite) which is an* embedded SQL database engine. The Microsoft Visual Studio which is an Integrated Development Environment (IDE) provides a graphical user interface of the system; the *Basic4Android (B4a) used to develop the mobile application using the* Smart Phone and early phones and Google Map Api for the mapping.

The Developed System

The developed Animal Bite Mapping (ABMap) using Mobile Apps contains the A) Login, B) Main form/Dash board, C) Mapping, D) Data entry (for Adding, Editing and Deleting of Records), E) Searching of records, F) Patient assessment, G) Viewing of appointment, H) Manage notifications via SMS, I) Medicine inventory and J) Reports.

The Main Form/Dashboard of the ABMap system contains all the main menu such as (Set-up, Transactions, Reports and Settings). Each menu has its own feature in the system to function based on the user management.

The use of a mobile smart phones has the features of (1) Main menu or the dashboard, (2) ABV Registration (3)Login username and password, (4)Locate the nearest animal bite treatment center, (5) Set an Appointment / Schedule (6)send SMS notifications.

The system administrator in the ABTC can perform all transactions while client/user and Animal Bite Victims has limited transactions to navigate.

CONCLUSION:

The developed Animal Bite Mapping System that provides quick access to data and information which is intended for use by the Animal Bite Treatment Centers in the province of Cagayan is secured with strong password for confidentiality of data.

Recommendations

The developer may provide training for the users of the developed system for them to be adept with its features for easy use, and the developer to monitor the implementation of the developed system in the Animal Bite Treatment Center in the province of Cagayan to keep track most probably of the functionality.

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