

RESEARCH ARTICLE

BIO INFORMATICS

## DEVELOPMENT OF AN INTEGRATED DECISION SUPPORT SYSTEM (IDS ONLINE) FOR AN EFFECTIVE DISEASE SURVEILLANCE AND DISASTER MANAGEMENT

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### ABSTRACT

Emerging infectious diseases are a significant burden on global economies and public health. Their emergence is thought to be driven largely by socio-economic, environmental and ecological factor. These diseases have caused devastating effects internationally, with millions infected and billions spent. Some diseases have become pandemic, spreading from one continent to another causing massive mortality rates and affecting global economies and livelihoods. Presently there is no integrated Information System available in the Public Space for recording, analyzing and reporting on Emerging Diseases. IDS ONLINE will meet the need for effectively managing the emerging infectious disease by providing a detailed demographic profile on the incidence of infectious diseases. This initiative will bridge the gap between the actual scenarios at the field level and the decision making process at the management level. Also the Research data so available will be useful for healthcare professionals and researchers for further research and effective management of future outbreaks. The IDS ONLINE System will act as an Effective Reporting Mechanism which will aid in Disaster management.



## KEY WORDS

Disease surveillance system, Decision support system, Public health system, Emerging diseases, Integrated Disease surveillance system, Disaster Management

## INTRODUCTION

Emerging infectious diseases are one of the most significant health challenges facing the global public health community<sup>1</sup>. Their emergence is thought to be driven largely by socio-economic, environmental and ecological factors. In an analysis of emerging infectious diseases between 1940 and 2004, it has been observed that a majority (about 60%) is caused by zoonotic pathogens and vector borne diseases are responsible for 23% of them. The predicted emerging disease hotspots due to zoonotic diseases and vector borne pathogens are more concentrated in lower latitude developing countries<sup>2</sup>. It is also feared that in all probabilities the next flu pandemic too would raise its head from Asia. A large number of factors are thought to be playing a role in this, with varying degrees of contribution in emergence of each infection. Changes in land use or agricultural practices and changes in human demographics and society are the most common drivers. Followed by poor population health (e.g. HIV, malnutrition), hospital and medical procedures, pathogen evolution (e.g. antimicrobial drug resistance, increased virulence), contaminating food sources or water supplies, international travel and failure of public health system. To mount an effective public health response to a disease outbreak a vibrant public health system is necessary<sup>3</sup>.

### ***Disease Surveillance and Disaster Management:***

Disease surveillance has long been recognized as an important tool for measuring the disease burden, studying morbidity and mortality trends and early detection of outbreaks for instituting effective control measures in a timely manner<sup>4</sup>.

In simple terms, public health surveillance can be defined quite succinctly as generation of information for action. This includes an on-going systematic collection, analysis, interpretation, and dissemination of health data. Data collected through this process are used to assist in detection and tracking of diseases and hence help health teams to promptly respond to outbreaks, set priorities, plan interventions and, mobilize and allocate resources. The surveillance of infectious diseases has recently assumed greater importance in most countries because of emerging and re-emerging of infectious diseases and also because strains of pathogens causing Influenza, Chikungunya, Tuberculosis (TB), Malaria, and pneumonia have developed resistance to common and cheap antimicrobial drugs<sup>5</sup>.

Information systems play a central role in developing an effective comprehensive approach to prevent, detect, respond to, and manage infectious disease outbreaks of plants, animals, and humans<sup>6</sup>. In the past, information systems for disease control were designed for use centrally with little or no feedback to the source of information and with no impact on local activities<sup>7</sup>.

The main role of disease surveillance is to predict, observe, and minimize the impact caused by sudden outbreak, epidemic, endemic and pandemic situations, as well as knowledge empowerment as to what factors might contribute to such circumstances. Also Strengthening of Health Surveillance system in India has become essential in the context of



growing population, climatic, environmental and ecological interactions, rapid urbanization and changing socio-economic profiles.

At present there are some basic systems available to manage disease surveillance, but there remains a huge gap in availability of an Integrated and alert system at the field level. Capturing outbreak data from the field on a timely basis is a highly critical requirement for effective surveillance. More importantly, the systems available presently are not providing appropriate data on a timely basis to the decision makers or health authorities. This has caused lacunae in the efforts of Public Health Administration departments while managing sudden outbreaks of highly infectious vector borne diseases. Effective surveillance system is necessary for management of any Public health hazards. Hence the present investigation is focused on developing a new integrated web based Decision Support System (IDS) with real-time analysis using open source technologies such as LAMP (Linux, Apache, MySQL, Php).

## MATERIALS AND METHODS

We reviewed the standard practice guidelines for each specific disease involved in the IDS ONLINE strategy to identify the surveillance requirements (for example, standard case definitions, data elements for reporting, thresholds and response actions) for emerging and Vector-borne diseases. We consulted disease experts to confirm and modify our understanding of surveillance and response requirements for each disease.

### ***Design and Development of an Integrated Decision Support System (IDS ONLINE):***

The IDS ONLINE has been developed by using open source technologies i.e., PHP, MySQL, AJAX, etc. Today open source technologies are gaining greater momentum in the Integrated IT solution space. Open source is a development

method for software that harnesses the power of distributed peer review and transparency of process. The promise of open source is better quality, interactive, higher reliability, more flexibility and the lower cost or free.

### ***(i) Software Development Methodology***

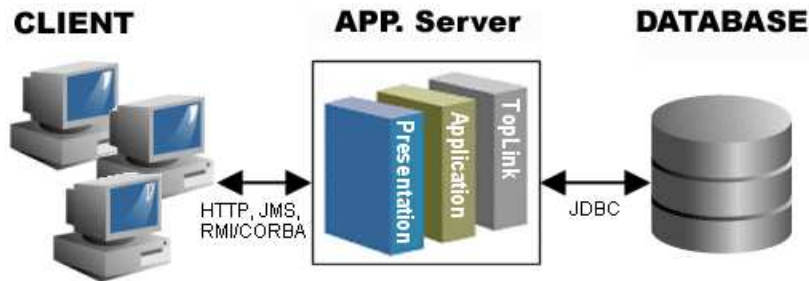
Agile-Prototype methodology had been used to develop the IDS ONLINE application development. Traditional approaches to software development projects assume that all requirements are specified in advance, documented in detail, and formally signed-off by all parties before development work begins. Unexpected changes in the business cannot be easily addressed, with efforts to do so being penalized with higher costs for development services and with schedule delays. The software developers typically drive the process, even though they may know very little about the customer's business processes.

The agile approach allows people to rapidly develop and test new process, learning and correcting as they go. This methodology promotes a disciplined project management process that encourages frequent reviews and adaptation, and a leadership philosophy that encourages teamwork and accountability. Experienced agile developers can deliver business software that conforms precisely to the way people work, and in a fraction of the time compared to traditional methods.

### ***(ii) Application Environment - Technical Architecture***

Architecture depicts the overall structure of a System and also it considers the overall functioning of the system. It may consist of one or more subsystems, which interfaces with other subsystem to provide a final version of System. Issues related to scalability, security, portability of the System will also be analysed under Architecture.

## System Architecture-Web:



This architecture is ideally suited for distributed Web applications and helps in hiding all the business rules inside the application framework and thus business logic will not be exposed to outside world. The maintenance becomes easy since any changes to the middle tier or the front

end does not involve any changes in the back end database design. Also the scalability of Database server increases as the MySQL server acts only as a data store and does not have any load to do any computation and it can be within the same box with the web server.

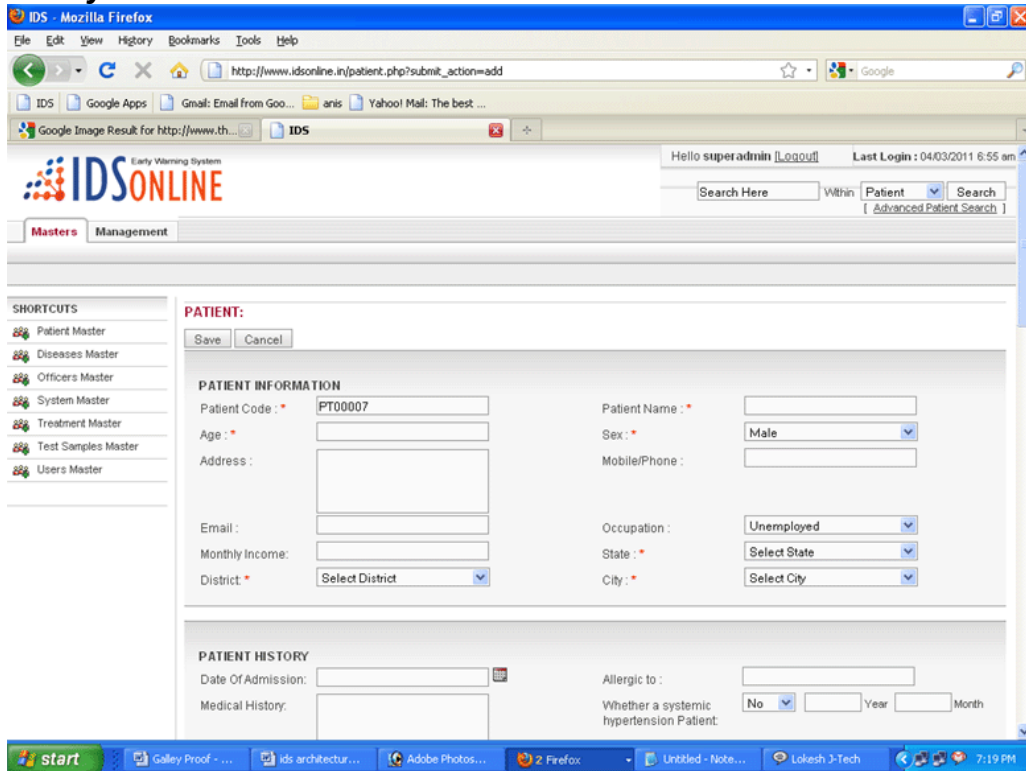
## Screen shots of www.IDSONline.In

### (i) Home Page – Login Page

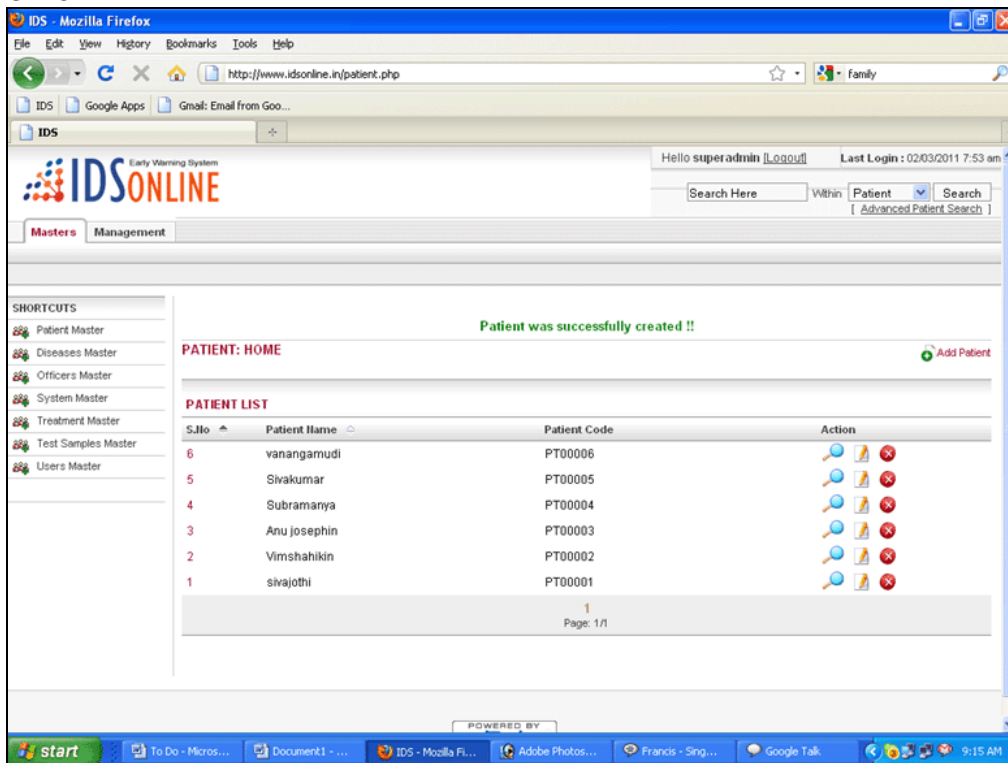




(ii) Data Entry screenshot



(iii) Patient Home







## RESULTS AND DISCUSSION

### ***Integrated Decision Support System (IDS):***

IDS ONLINE is a web based Information system to collect, manage and analyze the clinical data pertaining to infectious diseases and it contains many features that facilitate various aspects of the operation of Public Health Authorities. The application is currently available online and the URL is [www.IDSONline.In](http://www.IDSONline.In). IDS ONLINE is Highly Secured, Just-in-time and Highly Configurable. The system can be customized as per the user requirement. The Administrator has all the privileges to create new users, block specific users, customise access rights to specific users, etc., The Application source is dedicated to open source community initiative. Hence anyone can download the source of this application and further develop and contribute to the community.

### ***Early Warning system***

IDS ONLINE has advanced alert system to send the alert messages to the health authorities. The system has configurable threshold limits and if it attains the particular limit, it will send the alert through mail and SMS. This will result in several advantages and ensure timely reporting, early detection, warning and alerting the Health Department. The system developed for this purpose will provide a fully integrated solution which is highly user friendly and supports the Surveillance and Disaster Management efforts of local governing bodies.

### ***Analyses that facilitate Public Health Decision Making***

IDS ONLINE provides many kind of analysis based on the user search parameters like disease wise report, area or location wise report, Disease incident report with Geographical Information System (GIS). Most surveillance systems routinely analyze the data by calculating rates of cases over time. Few included reports described the methods for calculating the expected rate of disease or for setting thresholds to determine when the observed rate differs

significantly from expected. Some of the surveillance systems designed specifically for bioterrorism routinely performs both temporal and spatial analyses. We need evaluations of surveillance systems that specifically evaluate various methods of presenting surveillance data to public health officials to determine which methods best facilitate decision making.

### ***Effective Data Management***

IDS ONLINE provides simple interface to collect and store the data from the field level. Any primary health centres or field staff can use this system to manage disease outbreaks. Since we are collecting all the basic clinical data from the patients, we can get much number of reports as per the user requirement. The current version is fully web based system on a relational database model and the system allows the health authorities to analyze the disease spread based on the data available in the database. The system can accommodate any kind of diseases for other public health needs.

A very important step in effective management of disasters is bridging the information gap. Developing an efficient decision support system to manage the disaster is an important stage in planning for disaster preparedness. IDS ONLINE can assist Public health authorities to improve the quality of their decision-making and increase efficiency and effectiveness in all levels of disease outbreak management activities.

## CONCLUSION

The Information System "Integrated Decision Support System" IDS ONLINE developed under this research will manage the emerging infectious disease by providing a detailed demographic profile on the incidence of infectious diseases and many more features. The IDS ONLINE can be utilized by Public Health Administration authorities for the



purpose of effectively managing and controlling the outbreaks of highly infectious diseases. This research will bridge the gap between the actual scenarios at the field level and the decision making process at the management level.

Any country or state can use this application 'IDS ONLINE' that can be adapted for any disease

type. Successful implementation of this reporting system at the field level will provide adequate and valid data for decision making and in turn help to manage the large scale damages caused by the Emerging diseases.

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