Abstract

Public health epidemiology is the main methods in medicine to study the cause of disease and make it possibly to be prevented in population. The disease will occur if there is interaction among human, epidemic agent (e.g. virus, bacteria, fire, bomb etc) and environment. Therefore we need the update information of the disease to disaggregate it. However the conventional epidemiology sometimes has problems to complete the data due to lack of information and communication. In this study, we propose the medical social informatics framework for epidemic based problems, to prevent the emerging disease and save as many as people alive by satisfying the completeness of information. We merged two theories of epidemiology and social informatics. By using the social informatics framework (Ohta & Yamamoto, 1995), the health problem emergence can be resolved based on three main theory, that, information systems theory, social systems theory and semantics of social information. Those theories can be employed in the epidemiology triangle to disaggregate the interaction among human, epidemic agent and environment, so that the disease can be prevented or treated and disappear gradually. For example, the gene characteristics in the bacteria which living in their environment can be simulated by computer agent based modeling by using bioinformatics (information systems theory). Meanwhile the human interaction with epidemic agent can be analyzed by using social systems theory as well as the interaction between human and environment which will able to be employed by using semantic of social information theory. In conclusion, the medical social informatics framework is a new system thinking methodology to assist public health problem solving and it will be a prompt epidemiology information system to satisfy the completeness information and communication exchange in which the conventional used can not be done.

Keywords: Medical social informatics, social informatics, epidemiology, social welfare.

Introduction

Public health is primarily concerned with the prevention of disease in human population. It differs from clinical medicine both in its emphasis on prevention rather than treatment, and in its focus on populations rather than individual patients. Epidemiology is the branch of the public health which attempts to discover the causes of disease in order to make disease prevention possible. Epidemiology methods can be used in other contexts, for instance in clinical research as well. The epidemiology of disease has been developed well by previous studies since World War II. It has been traced from Hippocrates through John Graunt, William Farr, Jon Snow and others [1]. In our evidence base study, there are many cases in epidemiology that can be analyzed, for instance, the case that describes the predictors of typhoid fever with complications on disaster affected area [2], the revised recommendation for tetanus referral systems after earthquake [3] and the extensive critically ill patients transport monitoring strategies being implemented in a city recently affected by a massive disaster [4]. All those cases can be analyzed in epidemiology study. In other words, the epidemiology focuses in public health practice for the purpose of social welfare. In the general context, epidemiology has been defined by Last (1988) as, “the study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to control of health problems”.

Medical Social Informatics Framework for Preventive and Curative Strategy on Clinical Epidemic Based Problems in Public Health

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Nowadays, the information and communication technology has been developed very well and more sophisticated. There are many researchers have been worked hard to develop such a systems which might help for the human activities. One of the information branch studies is the theory of social informatics (SI) [5]. Social informatics is an interdisciplinary study to explore a function of information in social systems, and to design a system for information exchange in society. The social informatics aims to promote welfare of human beings in a society. Focusing on information, SI researchers observe various aspects of human behaviour and social systems, and examine various information systems, an administrative information system, and a life information system and so on [5].

The two typical science and knowledge as described above, in general, epidemiology and social informatics are having the same purpose that is to reach and promote welfare for human being in society. The integration of those two methodologies between epidemiology and SI can be possibly to afford a new framework, here and after we propose as medical social informatics framework which focus on the utilization of SI for prevention and curative strategy on clinical epidemic based problems in public health.

Social behavioral and epidemiology

**Health and social behavior**

Health can be achieved by considering the relation between individual behavior and health condition. This also implies that from individual behavior is likely to become social behavior and might influence the health achievement. For instance, the common problems of social behavior in public health is sanitation, which is vital for human health, generate economic benefits, contribute to dignity and social development, and helps the environment. But worldwide, has billion people have no access to basic sanitation and hygiene. This lack has been identified as a fundamental component of poverty; it contributes to two million child deaths a year, reduces school attendance, and is a fundamental deprivation of human dignity. The concrete situation which tightly related to the sanitation is the complex emergency disaster situation. It might trigger the wide spread of infectious disease among people. Poor habits in hygiene and sanitation will make more complicated situation, afterwards, uncontrolled disease may appear as well as the health behavior in society is also minus.

**Epidemiology**

Epidemiology in this paper refers to social epidemiology which means a branch of epidemiology that focuses particularly on the effects of social-structural factors on states of health. Social epidemiology assumes that the distribution of advantages and disadvantages in a society reflects the distribution of health and disease. Basically the emerging disease occurs due to the interaction among three components, that, human, environment and epidemic agent as shown on figure 1. But this paper is proposed to identify societal characteristics that affect the pattern of disease and health distribution in a society and to understand its mechanisms. The central and initial question of social epidemiology to be answered is what effect do social factors have on individual and population health. However, the new focus on this theme using current epidemiological methods is a relatively recent phenomenon. There are several significant concepts in the field of social epidemiology: 1) the bio-psychosocial paradigm, 2) the population perspective, 3) use of new statistical approaches such as multilevel analysis, and 4) other significance theory of information systems as focused on our framework. The relationship between social class and health has been a major research field since the beginning of public health history. Many studies have identified the disparities in health among social classes and developed several theories, such as social selection theory and socio-biological translation theory. However, despite the long history of this research field, the effect of social class on health based on the information systems theory is not yet fully understood. Socio-economic information distribution and health/medicine is a relatively new field within social epidemiology. Three possible mechanisms for the consequences of socio-economic informations distribution on health are 1) mis-information of human capital, 2) mis-information of social capital, and 3) lack
Refining theories of socio-economic information distribution is a major challenge in research among medicine and socio-economic information distribution.

**Cyber community and information technology**

*Cyber community*

The exchanged information is becoming important among people who use information systems technology [7]. The communications occurs on the virtual world due to the exchanged information among people who mixed up with information network which become popular since internet connection was established as well. This will emerge a new characterization in accordance to the technology information tools link to community of information network users. Recently the number of cyber community is tended to increase as well as the information networks in internet are also more sophisticated, inexpensive, faster due to broadband access network and so on.

*Social informatics*

One of the cyber community analysis framework is social informatics. Social Informatics (SI) is an interdisciplinary study to explore a function of information in a social system, and to design a system for information exchange in a society. The social informatics aims to promote welfare of human beings in a society. Focusing on information, SI researchers observe various aspects of human behavior and social systems, and examine various information networks in the society, including an economic information system, a management information system, a political information system, an administrative information system, a life information system, and so on. SI consists of three major theories; i.e. a theory of social system, a theory of information system, and a theory of semantics of social information, as is illustrated in the Figure 2.

In order to provide a basis for social information systems, SI refines these theories and also integrates them into SI. SI discusses the theory of social system derived from the auto-genesis or self-genesis aspect of organizing entity in a society, and on a property of society as a complex evolutional system, referring the theory of information system. For SI, the theory of social system contributes to explore necessity of information systems in promoting social welfare based on the social situation. SI discusses the theory of information system with respect to distribution and cooperation, or integration and coordination of actors in a society, referring the theory of social system. SI examines the theory of semantics of social information, referring the theory of social system and the theory of information system. In order to integrate a concept of information in humanistic and social sciences with that of natural sciences, SI attaches an importance on a social theoretic semantics of information and on a information theoretic semantics of information [8]. Of the promising approaches are a development of cyber commons, a computational organization theory [9], and an engineering of organizational intelligence [10].

**Figure 1.** Triad epidemiology

**Figure 2.** Framework of social information systems (Ohta & Yamamoto, 1995)
Integration framework between social informatics and epidemiology

As has been described above that both of epidemiology and social informatics are having the same purpose on that is to reach and promote welfare for human being in society. Here and after the explanation of how to solve epidemic based problem in public health by implementing the theory of social informatics will be described in more details.

Medical social informatics (MSI)

Medical problems are mostly related with the disease on human being which can be classified into two actions, that, preventive and curative. In the last decade there has been increasing concern expressed about the limitations of the risk factor approach for the diseases, and considerable debate about the future direction of epidemiology. Medical social informatics theory is an integrated and multidisciplinary approach specifically to analyze and to prevent emergence of disease, with main goal to save more people alive by using information from the society and develop the systems supported by information technology. This theory is established by fusion of two theory, that, social informatics and epidemiology. The framework can be represented by extending the triad epidemiology (figure. 1) into the reform of three dimension of cube which is overlaid with three circle of social informatics theory (Figure 2) as shown on figure 3.

There are three planes of cube and represents the point of epidemic agent, human and environment on its axis. Note, there are two kind of agent terminology in medical social informatics, that, agent in medical social informatics means epidemic agent which may come from the animate or inanimate. It differs from the agent in social informatics that means agent created in computer agent based modeling. We emphasize health problem in the cube (figure 3) whereas the disease will appear if the interaction between agent, human and environment are occurred and may cause health problems which located on the cube space (cavity).

As long as one of the three components can be controlled, the disease will not emerge. On each plane has own color, blue is representing the interaction between human–environment, which means the human need environment to live. Yellow is a warning color which means the epidemic agent imbalance might occur. It also represents the interaction between agent–environment which means the agent is also need environment to live or media. Red is danger interaction as long as the agent is sustained by environment and might suffer human being. For instance, the epidemic agent in the cube plane of epidemiology refers to the animate or inanimate things such as, bacteria, thermal energy, parasite and etc. for example, malaria might attack human being due to the parasite is living in mosquito and the environment is not protected by net in order to human is not bitten by mosquito. In this case, parasite inside the mosquito is epidemic agent; lack of mosquito net is environment problem. The concrete action for that case is that, we can prevent malaria by cutting the chain between 1) epidemic agent and environment or 2) epidemic agent and human. If we will focus on prevention, the yellow framework can be done in order to disconnect the chain between epidemic agent and environment or human. Agent based computer model as part of theory information systems can be used to analyze the malaria mosquito in the environment, how the
mosquitoes behave, peak time of infection can be achieved as long as the previous data are available.

On the other side, self organizing as part of social systems theory can be done in human being, how to protect human being from mosquito bite can be done by implementing the distribution intelligence of knowledge and information about the necessity of using net or fogging in society. On this medical social informatics framework, health problem solving can be derived from social informatics approaches.

Social informatics for prevention framework

In human site, the purpose on this concept is that how human being can take apart on the prevention of emergence disease. The interaction with agent, SI can be proposed by using the theory of social systems, that, autonomous behaviour model, distributed intelligence, self organizing and complexity. Furthermore, the interaction with environment can be solving by using social information through the reality, economic organization/information, and social organization/information. To control the agent on the environment, it needs the theory of information systems, by using an agent base modeling, distribution/cooperation, integration/coordination of all information.

Social informatics for curative framework

In case of the outbreak/disease has occurred, the SI is still very useful how to stop a widespread of diseases as well. On the human site, the designing an organization can be performed as well as to disaggregate one of the agent or environment chain. The communication system is needed to blockade the agent that will attack the human being who lives on that environment. For the completely integrated action, the security environment should be obtained through intellectual property.

The medical social informatics may integrate all aspects of prevention diseases to avoid the morbidity and mortality rate since it believes as multidisciplinary approach by collecting information from the society through community to save more human population. Nowadays, the epidemic cases that suffered human being have became more complicated. Implementing the epidemiology approach only is more difficult to solve health problems while the real data can not be obtained and observed. Digitalization model in human, epidemic agent and specific environment can be achieved through social informatics and will beshorted as medical social informatics. The advantages of using a medical social informatics framework that it will be able to organize mechanisms or factors of particular relevance to health problems across multiple levels of influence spanning individual, interpersonal, organizational, neighborhood, and societal levels. Afterwards the analysis result that has been done by medical social informatics can be used to the next certain planning and policy based on the classification of target analysis. Data exchanged, information transmission are able to obtain and provide in term of increasing survival rate such as in complex emergencies situation. Each of plane in medical social informatics figure has own characteristic as a guidelines to analyze and search the health problem solving as long as the roles are well followed by users or epidemiologist.

Conclusion

The medical social informatics framework will provide a guidelines to solve the health problems based on the social informatics theory which implementing the theory of information systems, theory of social systems and semantics of social information. Although the medical social informatics framework is possibly to be used however the future evidence based study will be needed by researching in the epidemic disease whether in normal or complex disaster situation in order to save as many people as alive.

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