

DEVELOPMENT OF APPROPRIATE TELEMEDICINE TO IMPROVE THE MANAGEMENT INFORMATION SYSTEM FOR COMMUNITY HEALTH CARE IN INDONESIA

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ABSTRACT

In addition to its large size, the primary health care in Indonesia is uniquely characterized by the dispersed / isolated population over many islands of the world's largest archipelago. The geographic size creates a diverse health-statistics which is accentuated by some developing-countries' leading cause-of-death, i.e. : infant/children and mother mortalities and malnutrition.

The resulting inefficiency of the primary health services needs to be significantly reduced by making timely policy and operational decisions on the basis of appropriate information with rapid implementation and adequate impact monitoring while optimizing the utilization of its scarce resources. Telemedicine even in its elementary level, offers the opportunity of alleviating this inefficiency.

This paper discusses the development of a proposed appropriate starting telemedicine module of a computer- based national health Management Information System (MIS) which is initially targeted for the quantity of coverage rather than the comprehensiveness of services. It is expected that such system will be flexibly expandable in-line with the development of personnel and funds. To optimize the usage of the computer , it is proposed to include some physiological measurement modules to the proposed telemedicine system.

1.0. Introduction

1.1. Background

In Indonesia, the primary health care level represents the basis of a very large health care pyramid, and is formed by over 6,900 units of Puskesmas (community primary health centers) and their constituents spread over the predominantly non-urban area which roughly covers 80% of the 200 million population . In addition to its large size, even by the world's standard, the primary health-care level in Indonesia is uniquely characterized by the dispersed and isolated population over the 13,000 islands of the world's largest archipelago country.

Furthermore, infrastructure-development, especially for the communication and sanitary area, is one of the most important national problems to be immediately resolved. This kind of geographical background represents a major *communication and coordination* problem, a subject which will be of the *primary priority* to be discussed in this paper.

In Indonesia, the population distribution consists of 45.6% children under 15 years and 11.3 % of them are below 5 years[1]. Based on this demographic characteristics, the *health-care delivery support* which will be the *second priority* discussion in this paper is mainly related to *children health problems*.

1.2. Problem identifications

1.2.1. Health-care coordination system and its Management Information System in Indonesia

At the highest level of the government hierarchy, two government Ministries, namely the Ministry of Health and Ministry of Interior Affairs join forces to coordinate the health- care system. The medical part is taken care by the Ministry of Health, while the bureaucracy is maintained by the Ministry of Interior; the structure of which comprises of its Governors (head of provinces) down to village heads in the rural area.

The above coordination structure, i.e. the bureaucracy and policy level, has created its own classical coordination and communication problems because of its dual ministries nature. But , the "actual and real" coordination is actually being done at the level of more than 6,900 Puskesmas (Community Primary Health Centers) spread around the country.

It is not surprising that a Puskesmas which is located in the subdistrict has actually become the core of the currently operating national Health MIS. Every general practitioner, midwife, private clinic is required to report to the Puskesmas, which in turn reports to the offices of both ministries. The report includes administrative, sociodemographic statistics and health-operational data which are important in controlling epidemiology.

The reports are to be submitted to the related health government offices on a monthly, quarterly, and annual bases; all of which will be annually feedback to the Puskesmas level, roughly on the 5th month of the following year, in the form of evaluation and stratification feedbacks[2]. More importantly, these reports are eventually utilized as a basis governments decisions and policies. Currently, the indirect flow of reported information, together with delays in its processing, sometimes diminished its usefulness, and in many instance information arrived too late to be of service in the implementation of strategies and operational measures.

The core problem with the inefficiency of the current Health MIS mostly originate in the Puskesmas level. Each Puskesmas has to conduct about 18 types of activities, serves approximately 30,000 population in rural and urban area, inspite of and its limited human resources in number as well as in education level. Statistically, each paramedic in an average Puskesmas is responsible for at least 4 types of activities which include the writing and processing of reports. Moreover, recording and reporting system is still mainly being done manually which is time and labour consuming.

1.2.2. Maternal and Children related Health problems

The children-related problems actually start as early as in the prenatal stages whereas the health of mother-to be is a primary determining factor. Based on a Household Health Survey conducted in 1992, the ten leading causes of death of all age, which includes the mothers-to-be category, is the circulatory diseases [1]. Normally, in the case of expecting mothers, this type of diseases materialize in the forms of *high-blood pressure* problems. Thus it will affect *fetal and infant mortality*.

Data for *Infant Mortality Rate (IMR)* was in the range of 71 per 1,000 live birth in 1986 [1] and the *pre-school mortality rate* (1 to 4 years) was 81 per 1,000 pre-school age in 1993, while estimated *Maternal Mortality Rates* was 390 per 100,000 live births in 1994. All the mortality rates shown above are already in their declining trends but they are still high by the world's standard. As a comparison, the infant and *perinatal mortality* indices are approximately 6-10 times greater than in developed countries.[8]

Furthermore, children in the pre-school age (about 11.3 %) are in their vulnerable conditions, contributing to the high prevalence of protein-calorie malnutrition (PCM), communicable disease, and to the high post-natal mortality rate. The prevalence of Children under 5 years with *real PCM* (bad and below normal condition of nutrient status has decreased from 18.95% in 1978 to 13.05 % in 1992 [1]. Typical traits such as ignorance, cultural fantasies and taboos on foods are the main cause of the exceedingly high prevalency of PCM, anaemia, and vitamin deficiencies.[4]

2. Method and Materials

2.1. Proposed Application of Telemedicine

2.1.1. Health-Management Instrumentation System

The currently operating health MIS in Indonesia is still predominantly done manually with all the generally described deficiency. It is proposed that an elementary application of telemedicine using a simple and economical PC-based system will be used for a starting module to alleviate the deficiency of the current Health MIS. At present, the author under the auspices of the Biomedical engineering laboratory of Institut Teknologi Bandung is developing a user friendly software to complement this proposed telemedicine system. The development of the combined hardware and software system has been guided by the following criteria and procedure of teledata application:

- Compliance to the data forming which had been established and used in the currently operating Health MIS - a complete research of the existing format had been completed.
- Establishment of an efficient but simple and economical computerized information network - options of general system of network had been proposed after researching the current time-period of interaction.
- Improved validity, accuracy and reliability of data-information collecting and recording by reducing the rate of data acquisition errors by computerization - a user-friendly, easily operable and understood standard operating procedure had been researched and proposed.
- Improved capability to compile, convert, and analyze raw data into useful information - an appropriate software is currently in the halfway process of writing.
- Achievement of manpower efficiency - schemes had been proposed based on the survey of current Puskesmas manpower in Indonesia.

2.1.2. Community Health-Education (Tele-education)

The current community health-education system information in Indonesia had not been connected nor attached to an operating health MIS. They are normally in the form of posters, flyers, circulars or other similar media being produced centrally in the upper-hierarchy offices. Educational materials produced by the Puskesmas, are only in a very limited fashion, while interactive tele-education is virtually unknown. Our laboratory is presently at an early development stage for a suitable tele-education system with the following requirement:

- An appropriate *interactive* tele-education system with simple *desktop publishing* capability.
- Appropriate educational materials.

2.1.3. Teleconsultation/Telediagnosis

The necessity of performing more complicated medical feats, usually required by remotely located

Puskesmas, had been mainly handled by consultation to some referral parties through the existing telecommunication means (i.e. radio, phone, etc). In conjunction with this Health MIS project, our laboratory also plans to establish a teleconsultation/telediagnosis module in accordance with the following criteria and procedures:

- Establishment of "direct" communication (i.e. through e-mail) for consultation and/or referral diagnosis to decrease the required time and cost.
- Establishment of a *data-bank* on standard therapies which can be easily accessed by each Puskesmas for handy reference.

Puskesmas can also use the same facilities to perform consultations on community health services to the related health offices.

2.2. Proposed applications of Physiological measurements

To optimize the computer application of this proposed Health MIS telemedicine system and to improve the early detection/diagnosis of selected leading maternal-children health-related problems, our research aims to attach a number of expandable PC based modular clinical measurement systems. These simple, appropriate and economical measurement module will perform measurement record, data analysis and display the results in real time on the computer monitor. The three selected systems which will be included in the starting telemedicine module are as follows:

2.2.1. PC-based Ultrasonic heart rate fetal monitor

Anoxia is a term used to indicate the end result of oxygen deficiency from a number of primary causes and is the leading cause of *perinatal* death or of permanent damage to central nervous system cells. One of its clinical manifestation is heart rate disturbance. Usually, Puskesmas uses monoaural stethoscope; because of noisy environments, inaccurate analysis may result.

Our current laboratory developments aim to produce a PC-based ultrasonic heart rate fetal monitor system to detect and analyse fetal heart sound in a non

invasive way. The proposed system consists of an ultrasonic transducer, its hardware interface and a custom-made software to analyse fetal heart-rate. The result will be displayed on the monitor or as a printed report.

2.2.2. PC-based Sphygmomanometer

Toxemia gravidarum is a condition of increasing blood pressure in expecting mother. This condition is associated with high rates of maternal morbidity/ mortality, prematurity as well as morbidity in *neonatal* and *infancy* period.

Our laboratory is in its development stage of a PC-based Electronic *sphygmomanometer* to measure blood pressure indirectly and non invasively. The proposed system consists of a *sphygmomanometer* module, its hardware interface and a custom-made software. The target are the expecting-mothers because routine examination of their blood pressure is very important especially in the third semester of pregnancy.

2.2.3. PC-based electronic scale

At present, the plotting of children's weight on the standard of growth chart and its analysis are conducted manually. With this current manual system, though, measurement should be made accurately, plotted carefully and analyzed correctly to obtain valid results.

Recent development in our laboratory has successfully produced a PC-based electronic scale prototype to measure bodyweight in a more practical way. The system consists of a hardware for measuring bodyweight, PC interface and a custom-made software to analyse and evaluate nutritional assessment status. The result will be displayed on the monitor or as a hard copy from printer.

2.3. Proposed Overall System

The proposed overall system combines the addressed Telemedicine systems with the physiological measurement modules, as shown in figure 1. The development of the proposed overall system guided by the following criteria and procedures :

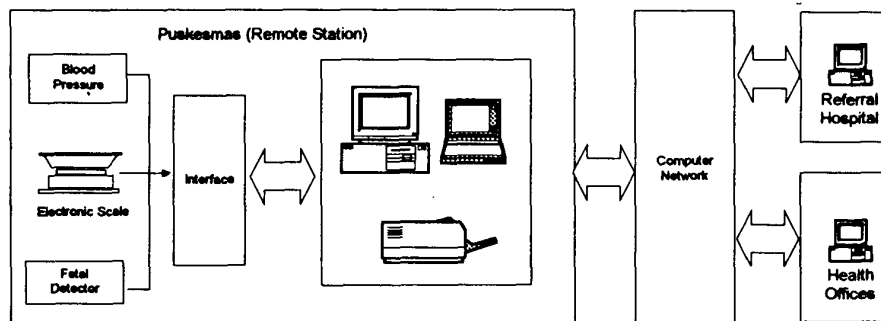


Figure 1. Proposed overall system of telemedicine including Puskesmas (remote station), referral hospital & health offices

- Developing architecture of the system according to the hierarchy of health system in Indonesia.
- Searching for specific requirements and characteristic in all levels of health care providers and offices.
- Determining appropriate communication technology, network protocol that meet requirements and the current situation.
- Developing custom-made software in order to achieve total network transparency & data integration.

3. Expected Result

The expected result of the project is the development of an *Appropriate Telemedicine system prototype* of a computer-based Health Management Informations System (MIS) which is initially planned to be targetted to the quantity of its coverage rather than the comprehensiveness and depth of its services. It is expected that such a system will be flexibly expandable in-line with the future development of manpower and financial resources in Indonesia. To optimize the usage of the computer novelty, it is also proposed to include some early-diagnosis/physiological modules.

It is assumed that the proposed overall system will fulfill the following criteria of "*Appropriateness*", i.e. :

- Lowest possible cost with measurable performance impacts.
- Time-efficiency, i.e. : improving the full-cycle from data-collecting to feedback by some appreciable time-units.
- Manpower-efficiency, i.e. improving the current manpower requirement by some appreciable reductions to suit the Human resource scarcity.

4. Discussion

The authors perfectly understand of the many theoretical and practical difficulties in introducing computerization to developing countries, which if not addressed seriously may constitute assumptive and theoretical errors, which will possibly lead into unworkable and unpracticable project. There are two main concerns which would like to discuss within the context of this paper, i.e. :

- *Cost* - One of the most serious difficulty faced by developing countries like Indonesia is the relatively high cost of computer system, for which one of the solutions will be system and facility sharing with others. Our laboratory is currently discussing for potential cooperation with the state-owned Postal company which is concurrently planning to develop a similar MIS/teledata system for their network of sub-district post-offices where our 6,900 or more Puskesmas are also located. The second cost related difficulty will be the potential financial waste due to

inappropriate investment in the computerization. To address this issue, our research will also address specific areas of concern which will include support equipment and staff, consumables, spare parts, maintenance information and training.

- *Culture* - A major obstacle in the way of computerized MIS networks becoming an effective tool in improving primary health care in Indonesia seems likely to be the *weakness of the computer culture* in Indonesia. It is to be expected that some significant time will elapse before this situation changes and computers become naturally accepted in everyday work.

5. Conclusion

Medical informatics technology holds great promise for the Indonesian primary health care sector and the general idea has been initially embraced by the government and its agencies. While admittedly there are many constraints to its application in the day-today health-activities, the authors believe that it is important to start the development even in its most elementary level. It is believed that an appropriate starting module will positively expand to catch up with our more developed peers.

When technology capability is still low and resources are scarce, as is the pattern in developing countries, the educational institutions should take the lead and initiative in the appropriate technology to maximize their contribution to the national objectives and social welfare.

6. Acknowledgment

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