

Defining problems for health care

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Abstract. The cost of health services increases, the growth of the elderly population will always increase with increasing population, and there will be a shortage of clinical staff, limited access to health information and treatment, this reflects the life expectancy of humans wanting to live longer, advancing living standards in developing countries and capabilities appropriate to provide high-quality medical care, and technological advancements that create new possibilities for curing diseases and providing services.

In fact, the main problem with intelligent health services is the need to provide quality care to patients by reducing health care costs and, how to deal with the problem of lack of nursing staff resources. Development Health facilities for medical equipment are highly incompetent and inappropriate, reducing the capacity of hospitals and clinics, results that are not optimal for patients, and wasting money on investors. The resulting Smart healthcare Health Service System model can overcome the problem of health services in generating maximum service to patients, namely by optimizing limited human resources to be better, optimizing limited health facilities to be better, empowering patients to be more responsible for their health , and ensure that every Indonesian benefits from this research globally.

1. Introduction

Health care costs increase, the growth of the elderly population will always increase with increasing population, and there will be a shortage of clinical staff, limited access to information and health care, this reflects the life expectancy of people who want to live longer, advance living standards in developing countries and capabilities appropriate to provide high-quality medical care, and technological advancements that create new things to cure diseases and provide services [1]. To provide quality care services to patients can be done by performing services as quickly as possible [2], reducing health care costs, and overcoming the problem of shortage of nursing staff [3].

Increasing the number of medical equipment facility services is very incompetent and inappropriate, reducing the capacity of hospitals and clinics, results that are not optimal for patients, and wasting money on investors. The problem that arises is that the operational problem is directly not in accordance with the local resources owned [4].

To provide health services to patients, it must be ensured that the actions that must be taken or the actions of the doctor as the management of the decision, so that the need to provide quality health care can be maximized for patients, and it is possible to reduce health care costs and overcome the problem of staff shortages limited nursing can be done [5].

In order for this study to be focused on solving problems that need to be resolved, the problems that will be discussed in this study will be solved using linear integer programming, so that it can overcome health service problems in minimizing costs and maximizing patient

services, and this study is not discussed service schedule because the nature of the recipient's service needs is to be immediately served which is considered to be in an emergency, so it does not discuss the schedule.

The purpose of this study is to obtain a Smart Health model in public health services using linear integer programming, so that the resulting model can solve the problem to provide services as early as possible by minimizing travel costs, minimum service costs, and minimizing costs due to timeliness service delivery, and maximizing service to patient requests.

The model in this study can be used as an alternative approach to address the issue of decision making about providing health services to patients that occur in hospitals in Indonesia. The solution method developed to solve the problem with the new Smart Health model using linear integer programming is expected to be:

1. Optimizing limited human resources for the better
2. Optimizing limited health facilities for the better
3. Minimize costs arising from health services
4. Empower patients to be more responsible for their health
5. Ensure that every Indonesian benefit from health research globally

2. State of The Art

The sustainability of a smart city is related to city infrastructure and governance, energy and climate change, pollution and waste, and social, economic and health issues. Quality of life (Quality of Life / QoL) can be measured in terms of people's emotional and financial well-being. The smart urbanization aspect includes many aspects and indicators, such as technology, infrastructure, government, and the economy. The uniqueness of smart cities compared to cities that have not applied smart concepts is conceptualized as ambitions to improve the economy of the people, social and environmental standards of the city and its inhabitants[6].

Effective Smart HealthCare requires collaboration among many people, including patients, doctors, and health care professionals, and management of existing facilities in hospitals [7]. Collaboration is very important for health management at home, where patient family members may also be involved. The effectiveness of collaboration, in turn, depends on communication and various information among different people in this arrangement [8]. Poor efficiency in doctor and nurse communication to patients and the inability to monitor the health of patients at home is the main contributing factor.

The determinants of success in the process of providing health services to the community are the differences in health care workers [9], [10], [11], and include data security issues, cost constraints, health provider privacy, and other technical technical barriers [12]. For further sustainability of smart health research that focuses on research topics such as citizen privacy protection using proposals from Fran Casino regarding Smart Healthcare in the IoT Era [13] and the security of population data submitted by Mart'nez [14], as well as anonymous approach techniques for maintaining collaborative filtering privacy [15].

The occurrence of queues in patients is a big problem for hospital services [16], service satisfaction for patients is difficult because the queue takes a long time to wait and each patient may need to undergo various other types of services [17]. The capacity plan is also proposed for work in terms of statistical data, and performance evaluation of the plan carried out through the patient model. Static scheduling policies can reduce the waiting queue length to be lower and more stable. However, there are several potential problems that cause patients

to be scheduled too late. This situation really makes use of the consultation process at a low level before the queue length becomes a stable level [18].

3. Research Methodology

The stages used in this study incorporate the model built by Fatunde & Timothy W Kotin [19] with the method developed by X. Chen [18] becoming the Decision Support System model for Smart HelatCare and conducting the simulation process. Research block diagrams are generally carried out as in Figure 1.

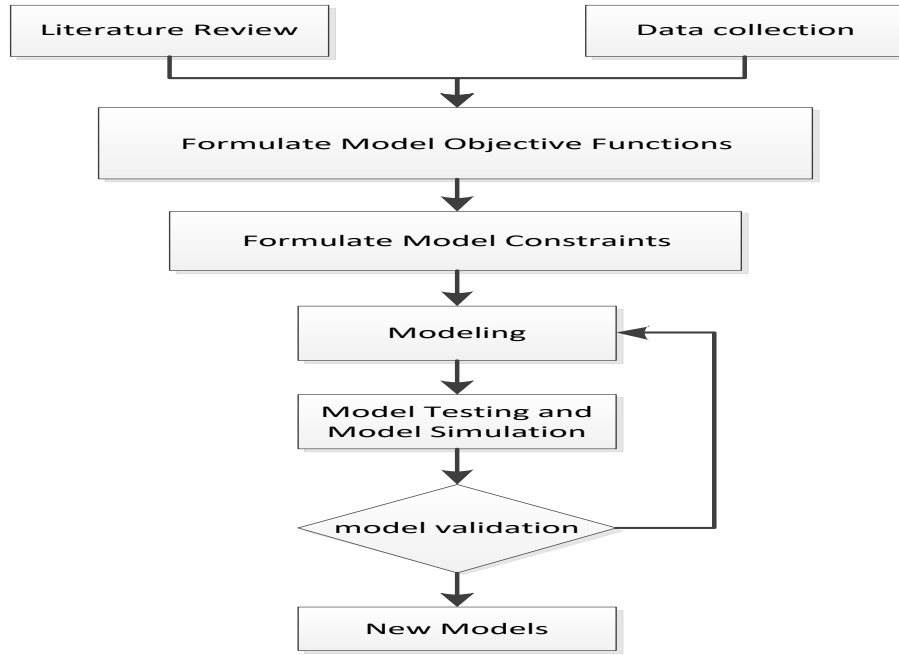


Figure 1. Research Methodology

3.1 Literature Review

Study the theories and concepts of Smart City and Smart HealthCare, hospitals and available resource facilities in hospitals, the cost of service to patients and the cost of travel from the service center to the place of request for services, time of service to patients and various studies related to smart healthcare.

3.2 Data collection

Data sources for benchmarking (a process commonly used in management or generally strategic management) in this study are medical data in health in hospitals and health services, so that numerical data obtained in the form of matrices can support the modeling process and provide clarity objective function of the model mathematically. Data is taken from the set of minimum function matrices, and is explained in detail as in the points below:

1. The function states the travel costs of medical staff h from a place i to place j for providing health services to patients.

$$\sum_{i \in N} \sum_{j \in N} \alpha_{ij} \sum_{h \in H} x_{ij}^h \quad (1)$$

2. The function states the travel cost of the type of medical service from place i to place j for the provision of health services to patients.

$$\sum_{i \in N} \sum_{j \in N} \alpha_{ij} \sum_{k \in K} x_{ij}^k \quad (2)$$

3. The function states the honorarium of medical staff h from place i to place j for providing health services to patients.

$$\sum_{i \in N} \sum_{j \in N} \beta_{ij} \sum_{h \in H} x_{ij}^h \quad (3)$$

4. The function states the fee for the type of service to k from place i to place j for the provision of health services to patients.

$$\sum_{i \in N} \sum_{j \in N} \beta_{ij} \sum_{k \in K} x_{ij}^k \quad (4)$$

5. The function states the cost of the time needed by medical staff to arrive at the place of patient i who needs service.

$$\sum_{i \in N} \sum_{j \in N} t_{ij} \sum_{h \in H} S_{ij}^h \quad (5)$$

3.3 Formulate Model Objective Functions

The objective function of the model built is to minimize travel costs and minimize the cost of services for patients, and minimize costs caused by inaccurate time, so that the maximum demand for patients is served optimally. The objective of the Objective Function model above is to minimize costs, namely the minimum cost of travel for medical staff from place i to place j when providing health services to patients, minimizing travel costs for types of medical services from place i to place j when providing health services to patients, minimize the cost of medical staff from place to place for providing health services to patients, minimize the cost of type of service to place to place when providing health services to patients, minimize the time required for medical staff to arrive at place of patient i who needs service.

When going to do health care services, medical staff depart from place to place to provide health care services, where place j is a place that is in accordance with the demand for health care by patients. The variables calculated when performing health care services are travel costs, medical staff honorarium fees, travel time, service time, and waiting time.

3.4 Formulate Model Constraints

Formulating model constraints is done by determining the actions or determining the initial value of the problem and emphasizing the limitations of the model to be built. The following describes the limitations or constraints that need to be met in the model[20]:

1. That each patient is only served once by the medical staff to completion so that the service is carried out only once and cannot be done repeatedly or cannot perform services partially, which means that medical staff go and return only once in each service to one patient.
2. The medical staff departs immediately after the patient's service is completed, which means the medical staff and the type of service provided for the place of service i to the destination of the next service is zero.
3. Medical staff can only go and return to the patient's place where it is needed, which means that medical staff leaves and return only once in each service to one patient.
4. Elimination of sub-tour.

5. Determine the waiting time needed, namely the total waiting time after the initial time the patient receives service - the time needed by the medical staff to arrive at the patient's place - the time of travel from the service center to the service request.
6. Determine the time of service delivery that arrives at each patient's place, namely the length of time at the start of providing services to the patient until the completion of providing services.
7. Determine the value of punishment if medical staff arrive faster or slower in the place of patients who require services, namely punishments of inaccurate medical staff arrive at the patient's place, where the time needed by medical staff to arrive at the patient's place will decrease if it arrives faster and will increase if it arrives longer than the time specified by b_i (the time at the latest the patient receives service).
8. That medical staff can provide services only if the medical staff is qualified to carry out the type of health service, ie medical staff departing from place i to place j must qualify according to the type of service request that will be given to the patient.
9. The time limit, that medical staff must immediately go to the location of patients who need a higher priority to carry out services, which means that the time needed by medical staff to leave patient i receiving services must be limited if there is a request for health care services from r priority patients, so medical staff must leave immediately.
10. Range of decision variable values, giving decision value ranges using binary integer numbers, namely 0 and 1

3.5 Modeling

Each type of health service can meet health care for each patient according to the type of demand for care services k . In this modeling stage, it is expected to maximize smart health services and minimize costs, namely:

1. Travel costs for medical staff h from place i to place j when giving health services to patients.
2. Travel costs for types of medical services from place i to place j at the time of providing health services to patients.
3. The cost of medical staff h from place i to place j for providing health services to patients.
4. Cost of type of service to k from place i to place j when giving health services to patients.
5. The time needed by medical staff to arrive at the place of patient i who needs service.

3.6 Model Testing and Model Simulation

Model testing is done to find out whether the model has been running properly as desired. This is very important because it can provide information if there is an error in the model and of course a solution can be immediately found on the part where the model must be repaired. Model simulation using the Linear Interactive and Discrete Optimizer (LINDO) application.

3.7 New Models

The results of the model testing that became the new model in solving the problem of this research are minimizing travel costs, service fees and fees charged because they are not on time so that all requests for patients are served, the following are given new models as Optimization models.

4. Future Research Plans

The next research plan will be to create a new model and to test the model to find out whether the model is running as desired. Model simulation is done to find out that the model has been able to solve the problem that it wants to solve.

5. Conclusion

The model of optimizing smart health services is optimizing the provision of health services based on the Smart Health concept, by providing quality care services as quickly as possible to patients by reducing health care costs and, overcoming the problem of limited nursing staff resources with maximum use of resources.

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