



THE DEVELOPMENT OF A LOGICAL MODEL BASED ON PATIENTS' SOCIOECONOMIC STATUS TO IDENTIFY THE MOST FINANCIALLY CONSTRAINED PATIENTS IN A MULTI-SPECIALTY TERTIARY CARE HOSPITAL

Public Health

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ABSTRACT

Background: Multispecialty tertiary care hospitals face the challenge of allocating limited funds effectively to deserving patients, considering their medical needs and socioeconomic circumstances. **Objective:** This study aims to develop a logical model to enhance the efficiency of fund allocation processes in such hospitals, ensuring equitable access to healthcare services. **Methods:** The proposed model integrates factors such as severity of illness, treatment costs, available resources, and patient eligibility criteria into a structured framework for equitable and effective fund allocation. **Results:** Based on the newly developed fund allocation model, a linear graph was plotted with the total score of 195 patients against the subsidy percentage provided. The equation obtained from the trend line analysis is represented as $y = 1.7787x - 42.262$, where 'y' represents the subsidy percentage and 'x' represents the total score of the patients. **Conclusion:** The logical model presented in this study provides a systematic approach to optimize fund allocation in multispecialty tertiary care hospitals, ultimately improving the quality of care provided to patients and promoting equity in healthcare delivery

KEYWORDS

Logical model, Financial constraints, Socio-economic status, Multispecialty, Tertiary care

INTRODUCTION

In the realm of healthcare, ensuring equitable access to quality services is a fundamental imperative. However, in the context of multispecialty tertiary care hospitals, where resources are often limited and patient needs diverse, effective fund allocation becomes a critical challenge.[1] The equitable distribution of financial resources to deserving patients, considering their medical requirements and socioeconomic circumstances, is paramount for upholding the principles of fairness and justice in healthcare delivery.[2,3] Amrita Institute of Medical Sciences (AIMS) is a Kerala-based multispecialty tertiary hospital founded in 1998 by Sri Sri Mata Amritanandamayi Devi. The hospital aims to provide affordable, high-quality healthcare to all, regardless of their background or financial situation. AIMS promotes value-based quality education and research, creating a supportive environment where patients feel heard and treated with compassion. The institute's mission is to ensure exceptional healthcare is accessible to everyone.[4]

This article proposes a logical model tailored to address this challenge by optimizing fund allocation within multispecialty tertiary care hospitals. By leveraging a structured approach grounded in data-driven decision-making, the model aims to streamline the process of distributing funds to patients in need, thereby enhancing both the efficiency and equity of healthcare service delivery. Through an exploration of various factors including patients' socioeconomic status, medical needs, and eligibility criteria, this model seeks to establish a systematic framework for allocating funds in a manner that prioritizes those most in need while ensuring transparency and accountability in resource utilization.[5,6] By doing so, it aspires to not only improve the overall quality of care provided to patients but also to foster a healthcare system that is responsive to the diverse needs of its constituents.[7,8] Here we delineate the rationale for developing such a logical model, elucidating the challenges inherent in current fund allocation practices within multispecialty tertiary care hospitals. Subsequently, our objective is to develop a logical model, setting the stage for a detailed exploration of its components and potential implications for equitable healthcare delivery. Ultimately, this endeavour seeks to contribute to the ongoing discourse on healthcare resource allocation, offering insights and strategies to facilitate more effective and equitable patient care within the context of multispecialty tertiary care settings

METHODOLOGY

Study Design

This study is a prospective cross-sectional study where quantitative

analysis of efficacy of current existing pattern of fund allocation by analysing correlation of governing factors for receiving funds was done and to develop a new model based on these data for effective distribution of funds.

Ethical Consideration

Institutional Research Ethical Committee clearance was obtained. Informed written consent was collected from all participants. Participants were assured confidentiality of all the information. They provided with the option to discontinue their participation at any time during the study.

Sample Size Estimation

Since there is no specific sample size estimation for the regression model, as per the guidelines, 15 subjects would be included for every 13 variables making it a total of 195 samples. Thus, 195 samples were selected from patients who received treatment through Patient Services from January 2019 to January 2023. Five departments from Amrita Hospital namely Cardiology, Paediatric Cardiology, Gastro-Intestinal Surgery, Neurosurgery, Nephrology and were selected by simple random method as huge expense treatments were in these departments.

Data Collection

When a patient arrives at the Outpatient (OP) Department, the attending doctor conducts a diagnosis and recommends a specific procedure or surgery based on the medical assessment. Subsequently, a designated individual, often a family member or caregiver, proceeded to the Financial Information Counter (FIC) with details regarding the recommended procedure or surgery. At the FIC, the approximate cost of the proposed medical intervention was provided to the patient or their representative, enabling them to make informed decisions regarding their healthcare options. When patients expressed difficulty affording medical expenses, they were referred to the Patient Services Department of AIMS for assistance. Here, basic socio-economic information was gathered through direct interviews, and patients were asked to provide documents such as ration cards, income certificates, and unique identification cards. A trained social worker conducted a thorough inquiry to assess the patient's socio-economic status, submitting a report to the Patient Services Department. If deemed deserving based on predefined criteria, the patient was selected for financial assistance. Drawing from extensive literature reviews, key factors influencing fund allocation were identified, leading to the development of structured questionnaires. These questionnaires aimed to collect essential information about respondents and assess their

socio-economic status (SES). Patients were provided with questionnaires to evaluate their financial background, with responses recorded in assessment sheets. The questionnaire consists of 13 questions which are used to assess the patient's socio-economic condition. Answers to each question carry a score and these scores are categorised into a scale. The total score of a patient was calculated after summing up the scores obtained from each question. It focusses on the respondent's socio-economic condition concerning the measure of financial assistance needed for them. Governing factors included in the questions were categorised age, categorised annual income, help, ration card, job, land, house, house pattern, liability, SES, and cause for seeking financial aid. Based on the existing system, patients receive financial assistance. Subsidy for each patient was noted. Then the data were sent to the statistical department for finding out the association between patient scores and discount percentage

This structured approach ensured that financial assistance was allocated equitably based on patients' genuine needs, optimizing resource utilization and promoting fairness in healthcare delivery.

Model Development

The objective of the model is to identify the most financially constrained patients in facilitating for subsidy for their treatment.

Developed a logical model that integrates the identified variables to determine the subsidy amount for each individual. Considered factors such as categorised age, categorised annual income, help, ration card, job, land, house, house pattern, liability, SES, and cause for seeking financial aid to calculate the appropriate level of financial assistance. Incorporated algorithms or decision rules to prioritize subsidy allocation based on the severity of the individual's financial situation and medical needs.

Validation and Calibration

Validated the model in some patients using historical data or simulations to ensure its accuracy and reliability in predicting subsidy requirements.

Statistical Analysis

- IBM SPSS version 20.0 software was used to conduct the statistical analysis. Categorical variables were displayed as percentages and frequencies.
- The chi-square test was employed to examine the statistical significance of the relationship between the regulating factors and the subsidy percentage.

RESULTS

Sociodemographic Data

Sociodemographic data were comparable in terms of age, gender and place. (Table 1)

Table 1: Socio Demographic Data

n=195

DEMOGRAPHIC DETAILS	n (%)
GENDER	
Male	94(48)
Female	101(51)
AGE	
CATEGORISED AGE	FREQUENCY(n)
ABOVE 50	48(25)
40-50	32(16)
25-40	43(22)
15-25	18(9)
0-15	54(28)
PLACE	
Northern Kerala	35 (18)
Central Kerala	104 (53)
Southern Kerala	56 (29)

Model Description

The holistic model developed for patient categorisation necessary for providing financial supports to most deserving patients was developed by giving appropriate scores to the levels of 12 attributes considered listed under five main variables. In the first stage the five main variables considered are economic variables, social variables, asset variables, liability variables and demographic variables. With proper reasoning the weights assigned to these main variables in 100 scales are 30, 20, 20, 20 and 10 respectively. Each of the main variables has

different attributes under it and the attributes have different levels for assigning scores so that the total score under an attribute is 100. For example one attribute under the economic variable is annual income which has four levels namely high, medium, low and very low with assigned scores 5, 20, 35 and 40 (total 100). These scores are then brought down to unit scale (between 0 and 1) by dividing with the maximum scores which is 40 (Table 6.39). Finally the unit scale is converted in to weighted scale by multiplying each unit scale score with the weight assigned to the variable under which the attribute comes. In the example the main variable is economic variable with weight 30 and hence the unit scale scores are multiplied with 30. Through this process the maximum score that can be attained by a patient for an attribute will be restricted to the initial weight assigned to the main variable under which the attribute comes. There are 12 attributes under the 5 main variables. Under economic variable there are 4 attributes with weight 30 so that maximum patient score is 120; under social variable there are 3 attributes with weight 20 so that maximum patient score is 60; under asset variable there are 3 attributes with weight 20 so that maximum patient score is 60; under liability variable there is only 1 attribute with weight 20 so that maximum patient score is 20; and under demographic variable there is only 1 attribute with weight 10 so that the maximum patient score is 10. Considering all the 12 attributes the maximum patient score possible is 270 and this is then brought down to a scale of 100 by multiplying the weighted scale patient score with the fraction 0.3704. The final score obtained for the patients according to this model formed the criteria for subsidy categorization (Table 2).

Table 2 Comprehensive Chart For Effective Allocation

Economic Variables (4 variables)						
No.	Variable name	Weightage	Levels	Scores	Scale	Weighted Scale
1	Annual Income	30	High	5	0.125	3.75
			Medium	20	0.5	15
			Low	85	0.875	26.25
			Very Low	40	1	30
2	Job category		Government	5	0.1	3
			Private (High Level)	15	0.3	9
			Private (Low Level)	30	0.6	18
			Labour	50	1	30
3	Ration card		APL	5	0.588	16.14
			BPL	85	1	30
4	Bill category		High	5	0.083	2.49
			Medium	35	0.583	17.49
			Low	60	1	30
Social Variables (3 variables)						
5	Socio-economic status	20	High	10	0.166	3.32
			Medium	30	0.5	10
			Low	60	1	20
6	Cause for financial aid		Pandemic/Natural calamities	10	0.333	6.66
			Loss of employment	15	0.5	10
			Continuous medical treatment	20	0.66	13.2
			Earning member sick	25	0.833	20
7	Support from external sources		More than one member sick	30	1	16.66
			No support	80	1	1.24
			Partial support	15	0.187	3.74
Asset Variables (3 variables)						
8	House owned	20	Yes	25	0.833	6.66
			No	75	1	20
9	House style		Luxurious	5	0.09	1.8
			Good	10	0.181	3.62
			Medium	30	0.54	10.8
			Thatched	55	1	20
10	Land owned		High	5	0.1	2
			Medium	15	0.5	6
			Low	30	0.6	12
			Nil	50	1	20
Liability Variables (1 variables)						
11	Liability class	20	High	60	1	20
			Medium	30	0.5	10
			Low	10	0.166	3.32
Demographic Variables (1 variables)						
12	Age category	10	Infant	30	0.6	6
			Young Child	50	1	10
			Adult	15	0.3	3
			Aged	5	0.1	1

Socio economic variables are mainly classified into five as shown in table 2. These are:

- Economic
- Social
- Assets
- Liabilities
- Demographic

For each variable, corresponding attributes will be added. Levels of attributes and their scores will be fixed based on their need of financial aid.

- Attributes that come under economic variable are Income group, Ration card and Job category
- Attributes that come under social variable are SES, cause for financial aid and help from external sources
- Attributes that come under assets variable are house, house pattern

- and land
- Attributes that come under liabilities variable are the various levels of liabilities of individuals
- Attributes that come under demographic variable are age group of individuals

1. Annual Income

Annual income of patients is mainly categorised into four: high (above 60000), medium (40000-60000), low (20000-40000) and very low (below 20000).

The number of levels of income is: (i) high with score of weightage 05, (ii) medium with score of weightage 20, (iii) low with score of weightage 35 and (iv) very low with score of weightage 40.

Highest score of weightage is given to the economically weaker sections and lowest score is given to the patients with better economic background. According to this model, patients with highest scores would be benefitted by more percentage of subsidy and patients with lowest scores would be benefitted by less percentage of subsidy.

2. Job Category

Job category of patients is mainly categorised into four: government job, private high, private low and labour.

The number of levels for job is: (i) Government job with score of weightage 05, (ii) private high with score of weightage 15, (iii) private low with score of weightage 30 and (iv) labour with score of weightage 50.

Patients with government jobs receive the highest weightage score, while those with labour jobs receive the lowest. According to this model, patients with the greatest score would receive a higher proportion of the subsidy, while patients with the lowest score would receive a lower percentage of the subsidy. Government personnel receive the highest score in this category because they receive allowances, medical insurance, and other benefits. Labour employees receive no benefits and must rely solely on their daily wage. As a result, they require further financial assistance.

3. Ration Card

The ration cards of people are mainly classified into two: APL (above poverty line) and BPL (below poverty line).

The number of levels of ration card is: (i) APL with score of weightage of 35 and (ii) BPL with score of weightage of 65.

Patients in the BPL category receive the highest weightage score, while those in the APL category receive the lowest.

Bill Amount

Bill category of patients is mainly divided into three: High (above 8 lakhs), medium (3-8 lakhs) and low (below 3 lakhs).

The number of levels of bill category is: (i) high with score of weightage 05, (ii) medium with score of weightage 35 and (iii) low with score of weightage 60.

Patients with modest bills receive the highest weightage score, while patients with higher bills receive the lowest. According to this, patients with the greatest score would receive a higher proportion of the subsidy, while patients with the lowest score would receive a lower percentage of the subsidy. A significant percentage of consumers will have lower bills. As a result, a greater number of patients will benefit from financial assistance. Consequently, patients with lower bills are given higher priority. Furthermore, patients with large medical bills would receive financial assistance from other entities (crowd funding).

4. Socio-economic Status

Socio-economic status is mainly classified into three levels: higher, medium and lower class.

The number of levels of SES are: (i) higher with score of weightage 10, (ii) medium with score of weightage 30 and (iii) lower with score of weightage 60.

The patient with the lowest SES receives the highest score. Lower socio-economic groups often have limited access to financial,

educational, social and health resources. As a result, they require additional financial assistance to cover medical expenses. The patient with the lowest score is from the higher socio-economic class. They are individuals who dwell on the highest rungs of the social ladder, above the middle and lower classes. They are typically the most powerful and rich persons in society. As a result, they require less financial assistance to cover medical expenses than the lower classes.

5. Cause For Financial Aid

Cause for providing financial aid in this model are classified into five levels: Pandemic or natural calamities, Loss of employment, Continuous medical treatment, Earning member sick in the family and more than one-member sick in the family.

Number of levels of cause for providing financial aid include: (i) more than one-member sick in the family with score of weightage 30, (ii) earning member sick in the family with score of weightage 25, (iii) continuous medical treatment with score of weightage 20, (iv) loss of employment with score of weightage 15 and (v) pandemic or natural calamities with score of weightage 10.

Patients face financial strain as a result of high medical costs. Natural calamities such as pandemic viruses, losing a job or being retrenched, being unemployed or unable to find suitable work, ongoing follow-up and expense, and so on all contribute to a financial crisis. Hence, the patient with more than one sick family member receives the highest score. The financial situation of such patients was discovered to be sick, as they had to pay medical expenses for more than one person. Consequently, they demand greater financial assistance. Pandemics and natural disasters receive the lowest rating. The financial situation of such patients was discovered to be significantly better than that of others.

6. Support From External Sources

Financial support from external resources is divided into three. They are No support, Partial support and Full support.

The number of levels of financial support is: (i) full support with score of weightage 05, (ii) partial support with score of weightage 15, and (iii) no support with score of weightage 80.

Highest score is given to the patient who did not receive any support from external sources. External sources of finance are financing options that come from outside the family. Thus persons who are unsupported demand additional financial aid. The patient with the lowest score receives the most help from outside sources. These people already receive financial assistance from outside sources to cover their bills. Hence, less financial support is needed from the hospital.

7. House

Based on the ownership of house, it classified into two: owned and rented.

The number of levels based on the ownership of house is: (i) owned with score of weightage 25 and (ii) rented with score of weightage 75.

The patient with the highest score is the one who lives in his or her own home. Intangible benefits of home ownership include a sense of security and ownership pride. So they face less financial trouble than others. The patient who lives in a rented residence receives the lowest score. Renting a house affords regular monthly expenses. Hence, renters must pay both their rent and their medical bills. As a result, they demand more financial assistance than others.

8. House Style

The style of house is classified as Luxurious, Good, Medium and Thatched.

The number of levels of house style is (i) luxurious with score of weightage 05, (ii) good with score of weightage 10, (iii) medium with score of weightage 30 and (iv) thatched with score of weightage 55.

The highest score is given to the patients who lives in thatched houses. It is because of their high financial struggle. The lowest score is given to people who live in luxurious houses such as a villa, flat, etc. These people have higher access to all basic needs so they do not require further financial aid.

9. Land

Land is divided into four categories namely high (above 20 cent), medium (5-20 cent), low (1-5 cent) and Nil.

The number of levels of land is: (i) high with score of weightage 05, (ii) medium with score of weightage 15, (iii) low with score of weightage 30 and (iv) nil with score of weightage 50.

The patients with no land receive the highest score. People who cannot afford to acquire land suffer the most. The patient with acres of land receives the lowest score. People who own lots of land can fulfil expenses by pledging land, selling and so on, and they are more financially secure than others.

10. Liabilities

Liabilities are divided into three classes namely high (above 3 lakhs), medium (1-3 lakhs) and low (below 1 lakhs). The number of levels is: (i) high with score of weightage 60, (ii) medium with score of weightage 30 and (iii) low with score of weightage 10.

Persons who have considerable liability receive the highest score. These people face a greater financial strain than others. As a result, they demand substantial financial aid. People with the lowest liability receive the lowest score. In this case, their liabilities are minimal, and they bear the least financial burden in comparison to others.

11. Age Category

Age group is categorised into four namely infant (0-1yrs), young child (1-15yrs), adult (16-50yrs) and aged (above 50yrs).

The number of levels is: infant with score of weightage 30, young child with score of weightage 50 adult with score of weightage 15 and aged with score of weightage 5.

Age is important in influencing the prognosis of a disease. Individuals in the young child category obtain the highest score. They are afflicted with a range of diseases. The importance of protecting and improving children's health cannot be emphasised. More than half of all child deaths could be avoided or mitigated if children had access to healthcare and improved their QoL. They require more financial aid due to their high expenses in healthcare. Persons in the elderly class receive the lowest score. Palliative care is usually used for the elderly. Patients who receive palliative care in the hospital spend less money on healthcare than others. It does not focus on treating the diseases. As a result, they require less financial assistance than others.

A scale of scores is then made by dividing each score with the highest score. The weighted score is obtained by multiplying with the corresponding weightage that was given (economic-30, social-20, liability-20, asset-20 and demographic-10). The overall score for each patient (on a scale of 100) is then computed. Subsidy percentage is determined based on a patient's total score. Patients with the highest scores will receive the most subsidies, but those with the lowest scores would receive the least.

Thus five categories of scale were made in the new model according to the total patient score and the subsidy percentage.

Table 3 Subsidy Categorisation Against Patient Score

Category	Patient score	Subsidy percentage
A+	<10	0 (No subsidy)
A	10 to 40	<25
B	40 to 60	25 to 50
C	60 to 80	50 to 75
D	80 to 100	75 to 100

- Category A+ includes patients with lowest score (<10). They will not get any percentage of subsidy as these patients could afford the hospital expenses by themselves.
- Category A includes patients with low score (10-40). They will get the lowest percentage of subsidy (less than 25%). These patients have minimum financial insecurity.
- Category B includes patients with score 40-60. These patients will get 25-50% percentage of subsidy.
- Category C includes patients with score 60-80. These patients will get 50-75% percentage of subsidy.
- Category D includes patients with highest score (80-100). They will get the highest percentage of subsidy (75-100%). These patients would have maximum financial struggles.

Some disparities were found in patients with high medical bill amount (above 25 lakhs). Even though their patient scores were found to be high they somehow managed to find alternative sources of funding along with the financial assistance they received from the hospital. This model can also be used to determine the percentage of subsidy which needs to be given to the patients who already paid the bill, but are no longer able to pay further. In such circumstances, their total score can be assessed to decide the percentage of subsidy and take the decision whether or not to pay the pending bills from Patient Services Department.

Model Validation

Based on the newly developed fund allocation model, a linear graph was plotted with the total score of 195 patients against the subsidy percentage provided. The equation obtained from the trend line analysis is represented as $y = 1.7787x - 42.262$, where 'y' represents the subsidy percentage and 'x' represents the total score of the patients. (Figure:1)

The coefficient of determination (R^2) value on the chart is 0.7991, indicating the reliability of the linear regression model. This value suggests that approximately 79.91% of the variability in the subsidy percentage can be explained by the total score of the patients as per the model. The high R^2 value indicates a strong correlation between the total score of patients and the subsidy percentage provided, affirming the effectiveness of the developed fund allocation model.

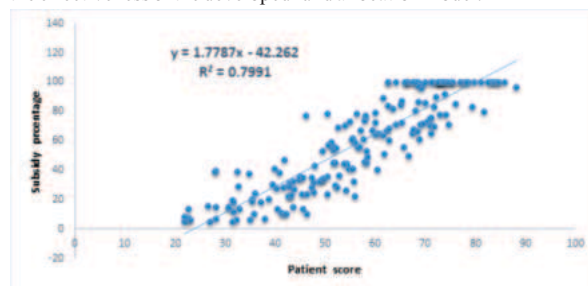


Figure:1 Patient Score Versus Subsidy Percentage

DISCUSSION

Almost every hospital has its own administration, which presents a distinct management challenge. Finding two hospitals that provide the same services to the same kind of patients using the same management techniques would be difficult. Consequently, it is challenging to create a universal model that can be used by various hospitals. However, all forms of medical institutions perform the same fundamental duties as hospitals. As a result, once an aggregative resource allocation model is created for a hospital, it may be quickly changed to meet the particulars of the hospital for use. Over the previous 35 years, numerous models have been developed and enhanced. They can help increase an organisation's decision-making process' efficiency. There are different forms of models in hospital resource allocation such as multiple objective nurse scheduling model, linear programming models, etc.. [9] Here in the newly developed model, linear equation and pattern were found:

Based on findings related with the governing factors for fund allocation, this model was developed and the newly developed model was tested on some patients for checking its reliability. This model is highly suitable to assess the SES of patients coming to the hospital and thereby deciding the deserving financial aid to them. [10]

However, some disparities were found in patients with high medical bill amount (above 25 lakhs). Even though their patient score was found to be high, they had somehow managed to find alternate sources of funding along with the financial assistance they received from the hospital. This model can also be used to determine the percentage of subsidy which needs to be given to the patients who already paid the bill, but are no longer able to pay further. In such circumstances their total score can be assessed to decide the percentage of subsidy and thus can take the decision of paying the pending bills from the Patient Services Department or not.

The healthcare sector's fund allocation models are concerned with financial effectiveness, equitable distribution, and resource efficiency. This study develops a socioeconomic logical model to address the challenges of determining effective medical treatment programs,

identifying economically backward individuals, recognizing areas where these groups live, distributing funds based on an area's group, and ensuring resources are spent effectively on poor groups and appropriate interventions. Proportional funding is becoming more important in less-developed healthcare systems, particularly those following a decentralisation program. [6,11] Locals must trust that national funds are being allocated equitably for decentralization policies to be successful. Access to finances and the manner in which funds arrive at hospitals can influence the quantity, availability, and efficacy of offerings, leading to versatility or limits for medical providers. Budgeting is the ability of administrators to create a document that describes expected revenue and anticipated expenditures for an institution (government or health facility) for a specified time period.[12] This finance and fund allocation program investigates the accessibility and administration of resources at the institution level, as well as a variety of Governmental finances. Regulations and laws are put in place to ensure public finances are managed in an open, effective, and responsible manner. [13] Personal finance management (PFM) encompasses the entire budget cycle, from budget planning to budget implementation, internal supervision and examination, purchasing, evaluation and communication plans, and a third-party audit. This model can be used not only by private not-for-profit NFP hospitals but also by government healthcare sectors. There is currently no universal standard for the selection of requirement measurements, and modelling and criteria vary greatly. [14] Demographic characteristics, extra need variables, and questionnaire information are increasingly being employed as primary data sources due to their adaptability and the variety of factors available.[15] As an illustration, when we use various requirement measures, we get varied outcomes. Different types of models determine allocations based on disparities in medical condition and death rates in local populations. Considering the deep policy consequences of this subject, there is little in the way of allocations resulting from different criterion indices. One explanation for the scarcity of such studies is a lack of easily comparable data[16]

Recommendations

- **Implementation and Monitoring:** Implement the fund allocation model within the multispecialty tertiary care hospital's administrative system, integrating it with patient intake and financial assistance processes. Establish monitoring mechanisms to track the distribution of subsidies and assess the model's impact on improving access to healthcare services for deserving patients. Periodically review and update the model to accommodate changes in socioeconomic conditions, healthcare policies, and patient needs.
- **Stakeholder Engagement and integration with public organisations:** Foster collaboration and communication among various stakeholders including hospital administrators, healthcare providers, patient advocates, and community organizations. Engaging stakeholders in the fund allocation process can promote transparency, accountability, and buy-in, ultimately leading to greater acceptance and effectiveness of the model.

Ethics Statement

The studies involving humans were approved by the Institutional Ethics Committee (AIMS) approval number ECASM-AIMS-2023-046. The participants provided their written informed consent to participate in this study.

Author Contributions

Rahana C Mukundan Conceptualised and conducted the study, Sathianandan analysed and interpreted the data, Rahana Chathoth wrote the first draft, and Sanjeev K Singh ,N Ajith Kumar and Sreekumar reviewed drafts. All authors contributed to the article and approved the submitted version.

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