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Research Article

An Evaluation of the Effectiveness of Pharmacognosy Research and a Pharmaceutical Resource Management in Hospitals

Suresh Chandra Akula[1]*, Pritpal Singh1[,]*, Prikshat Kumar Angra[2], Gagandeep Singh Cheema[1], Anup Sharma[1], Mohd Farhan[1]

ABSTRACT

Objective: This research paper aims to evaluate the relative efficacy of pharmacognosy research on the top 40 tertiary hospitals and its pharmacy in India according to Newsweek's 2021 ranking. **Purpose:** India's pharmaceutical market is now estimated to be worth $50 billion. India is a significant pharmaceutical exporter, reaching more than 200 nations with its exports. This study will help to identify whether the pharma industry is working efficiently in selected Indian hospitals or not. Thus, to create a bench marking for the hospital pharmacies in India. **Design/methodology/approach:** Data for the study came from public and private hospitals' official websites, financial records, and government notifications. Cross-sectional data analyses were done using a Slack-Based model and data envelopment analysis (DEA). STATA was the software used to scrutinize the results effectively. **Results:** Thirteen hospital pharmacies out of a total of 40 are judged to be relatively technically efficient overall, according to the research. The findings of the slack analysis demonstrate that government hospitals and pharmacies are better able to handle slack and effectively manage input and output. **Conclusion:** The researchers also set upped a benchmarking hospital both for private and government healthcare settings for pharmacognosy research. Thus, it can be utilized for the betterment of the pharmacies.

Key words: Pharmacognosy research, Data envelopment analysis (DEA), Hospitals, Pharmacy, Efficiency, SBM model, India.

Suresh Chandra Akula[1]*, Pritpal Singh[1], Prikshat Kumar Angra[2], Gagandeep Singh Cheema[1], Anup Sharma[1], Mohd Farhan[1]

[1]Mittal School of Business, Lovely Professional University, Phagwara, Punjab 144001, INDIA.

[2]School of computer applications, Lovely Professional University, Phagwara, Punjab 144001, INDIA.

Correspondence

Suresh Chandra Akula

Mittal School of Business, Lovely Professional University, Phagwara, Punjab 144001, INDIA.

E-mail: akulasureshchandra@gmail.com

Pritpal Singh

Mittal School of Business, Lovely Professional University, Phagwara, Punjab 144001, INDIA.

E-mail: pritpal.16741@lpu.co.in

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INTRODUCTION

Our nation is an emerging country that has created great strides in recent decades to enhance the health and well-being of its citizens. The general population still needs to be provided with high-quality healthcare services, and there is still considerable work to be done to increase literacy and public awareness. The Government of India is nevertheless coming underneath growing tension to make the healthcare delivery system more effective. Additionally, private hospitals are crucial to this. Starting from the pre COVID – 19, Rs. 2.73 lakh crore in 2019–20 to COVID era of Rs. 4.72 lakh crore in 2021–22, India's health expenditure would increase by over 73% (Economic Survey 21-22). At 4.2% of GDP, India is among the top 20 nations in the world for private expenditure. Employers provide 9% of the cost of private treatment; health care insurance covers a percentage of 5–10, and the remaining 82 percent is wrapped by individual money. As a result, 25 percentage of agriculturalists are pushed lower to the poverty mark by the charge of their medicinal care, and more than 40 percentage of all patients committed to hospitals are forced to plagiarize money or vend assets, such as hereditary stuff and farms, to pay for charges[1].

Pharmacogenetic investigations and Data Envelopment Analysis (DEA) are two distinct areas, and combining them requires a careful and structured approach. Pharmacognostic investigations involve the identification, authentication, and quality assessment of plant-based drugs or natural products, while DEA is a precise practice which is used to gauge the comparative efficacy of the decision-making units (DMUs), such as firms or organizations[1]. Here, we will discuss how DEA can be applied in the context of pharmacognostic investigations.

Incorporating DEA into pharmacogenetic investigations can provide a data-driven approach to evaluate and improve the efficiency of herbal drug production units. This is especially important in the context of herbal medicines, where product quality and consistency are critical for safety and efficacy[2-3.] DEA helps identify areas for improvement and sets benchmarks for best practices, contributing to the overall quality and standardization of herbal drug production.

NEED FOR THE STUDY

In the current landscape of hospital and healthcare systems, the task of ensuring enhanced efficiency in service delivery has become a formidable challenge for hospitals in the state of Kerala. Data envelopment analysis (DEA), when employed effectively, has the potential to provide authorities with the means to enhance their decision-making capabilities regarding the optimal allocation of inputs and outputs. By utilizing DEA, authorities can determine the most appropriate combination of inputs necessary to generate desired outputs. In light of this circumstance, it becomes imperative for hospitals and their affiliated pharmacies, regardless of whether they are privately owned or government-run, to effectively harness their current resources. To this end, the utilization of Data Envelopment Analysis (DEA) emerges as a pertinent technique. DEA is designed to ascertain the operational efficiency of an

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organization, specifically in terms of logical and scale efficiency. This assessment aids in determining a benchmark for the organization, which subsequently informs their operational practices. In cases where a benchmark does not exist, DEA can assist in establishing a benchmark for the organization to adhere to. In the current context, it is imperative to exert efforts towards cost containment and ensuring the efficacy of healthcare services. In this regard, the utilization of the Data Envelopment Analysis (DEA) methodology can offer valuable insights into the operational dynamics of healthcare organizations[4]. Considering the prevailing circumstances, it is imperative to ascertain the optimal allocation of resources and its subsequent utilization. In a similar vein, it is of utmost significance to acknowledge the origins of relative cost inefficiency - namely, the concentrated core - and duly allocate both accordingly. The primary focus of this assessment pertains to the examination of medical hospital facilities, particularly in terms of the optimal allocation of resources for achieving desired outcomes, encompassing the pharmacy sector as well. The primary impetus behind this investigation pertains to the exploration of strategies aimed at effectively navigating the process of benchmarking within the dynamic context of medical hospitals. The escalating trends in healthcare expenditures and rapidly expanding demands have compelled healthcare providers to prioritize efficiency and quality. In this manner, healthcare institutions are often compelled to enhance their operations in terms of the resources they utilize, as well as the quantity and quality of their outcomes[5-7]. The scarcity of resources in the healthcare sector poses a particularly precarious situation.

In the context of developing nations, it is widely acknowledged that the presence of unforeseen shortcomings poses a significant obstacle to both economic development and overall societal well-being.

As per the report published in The Hindu Business Line in the year 2018, it has been observed that... In the context of India, it has been observed that the construction expenditure per bed can reach a remarkably low figure of approximately $43,000. In this emerging phenomenon, experts in the field are forging collaborative partnerships with investors, pharmaceutical supply companies, and providers of clinical equipment with the aim of establishing specialized hospitals at reduced expenses. The establishment cost of a high-quality hospital is estimated to be approximately Rs. 95 lakh (equivalent to $152,000) per bed. It is noteworthy that the investment in this particular model necessitates a waiting period of approximately five years to attain a return on investment. Conversely, the speculative investment required for this model is estimated to be around Rs. 20-25 lakh (equivalent to $43,000 to $54,000) per bed, with a return on investment projected to be achieved in less than three years. This model has pulled in light of a legitimate concern for the Businessmen particularly investors.

MATERIALS AND METHODS

This study assesses Slack Based Measure (SBM) model- Data Envelopment Analysis (DEA), which are indicators of a DMU's capacity to enlarge outputs from a set of inputs while also identifying input slacks. A linear non - parametric programming model called DEA determines the extent of each DMU's divergence from efficiency boundaries. DEA is preferred to other approaches since it can handle numerous outputs and numerous inputs, doesn't necessitate previous weights' evidence, doesn't entail any expectations about the miniscule form between outputs and inputs, accentuates specific explanations over statistical guesstimates, is a lively diagnostic decision-making tool that can suggest ways to increase relative efficiencies, and uses benchmarking and help strategy creators to change policies. The BCC model and the radial CCR model both have this flaw: they fail to include inefficiencies when evaluating efficiency. Efficacy scores can be calculated by means of Tone's "SBM," a non-radial and non-oriented model, to address this flaw

Selection of homogeneous hospitals and its pharmacies

Using data gathered from hospital websites, government records, and financial statements for the year 2021, the researcher assesses the input-oriented CRS efficiency and slacks of both private and public sector hospitals and its pharmacies in India, ranked as the Top 40 hospitals in India by News Week. The Appendix contains a detailed list of the hospitals that were chosen. Tertiary care hospitals and reference centers are present in every hospital. As a result, the study's chosen hospitals are all the same.

VARIABLES SELECTION OF OUTPUT AND INPUT

The model selection

Subsequently the fundamental CCR and BCC models test efficacy both by altering outputs or by changing inputs, the measurement is done using either an input-oriented model or an output-oriented model. A non-oriented SBM demonstration is treated while inputs and outputs may both be adjusted at the same time, indicating the business can decline inputs while fueling outputs[12-13]. It is grounded on output and input slacks and is referred to as the Additive Model or an SBM. To maximize efficacy, executives can utilize this attempt to succeed on both input and outcomes. In general, while evaluating efficiency in public hospitals, it might be challenging to decide whether to focus on input or output. Lowering input points or obtaining output stages for government hospitals is not commendable. Consequently, the SBM-DEA model, a non-oriented and non-radial model, has been adopted in this investigation

The SBM-DEA model

The Slacks-Based Measure (SBM) models, developed by do away with the notion of proportional modifications in inputs and outputs in favor of a more direct approach to slacks. There are three different types of it: input-, output-, and non-oriented. The SBM models are made to comply with the subsequent two requirements:

1. Measure should be independent of the units of the data in which it is used.

2. The metric should be monotonically lowering for each input and output slack.

Underneath the persistent returns-to-scale hypothesis, there lies the SBM models output, input and non-oriented situations; nevertheless, these models are generalizable to the variable returns-to-scale (VRS) setting. In this study the researchers are using input oriented slack based data envelopment analysis.

These can also be related to the hospital pharmacies.

Efficacy measurements in a hospital pharmacy are crucial for ensuring the safe and timely delivery of medications to patients while minimizing costs and waste. Here are some key efficiency measurements and considerations for hospital pharmacies:

Turnaround Time:

Prescription Processing Time: Measure the time it takes to receive, process, and dispense medications for inpatient and outpatient prescriptions[8-9].

Medication Delivery Time: Track the time it takes to deliver medications to patient units or clinics.

Medication Inventory Management:

Inventory Turnover Rate: Calculate how often the pharmacy's inventory is replenished or used up within a specific period.

Drug Expiry Rate: Monitor the percentage of medications that expire before use.

Table 1: Variables used in the prior studies.

Sl no	Inputs	Outputs
1	Number of doctors, beds, other technical staff and subordinate staff	Number of mother and child care, deliveries and patients discharged
2	Number of medical workforce and hospitals beds	Number of OPD visit and IPD days
3	Number of beds, doctors, and pharmacists	Number of OPDs, IPDs, major and minor surgeries
4	Number of nursing staff, bed, and doctors	Number of OPD, IPD, and surgeries undertaken, emergency cases handled, deliveries and medico legal cases
5	Number of full-time equivalent people employed and beds	Number of deaths and discharges, day cases and outpatient attendance
6	Number of paramedics, doctors and no of bed	Number of OPDs, IPDs, major and minor surgeries
7	Number of nurses, specialist, allied health members and no of beds	Number of OPD, IPD, laboratory tests, and no of recipients of radiological imagery

Table 2: Variable definitions of output and input.

Sl no	Variables	Definition
A	Input	
1	Sum of beds	The entire number of hospital beds truly utilized by the clinic within a calendar year.
2	Sum of special equipment's used	The total number of special devices like ventilators, ECMO machine etc. used in the hospital within a year.
3	Figure of physicians	The entire sum of full-time clinicians working in the infirmary in a calendar year.
4	Figure of nurses	The entire sum of registered nurses working in the infirmary in a calendar year.
5	Figure of paramedics	The entire sum of allied -health personnel hired by the infirmary in a calendar year.
6	Figure of pharmacists	The entire figure of permanent pharmacy staffs working in the infirmary in a calendar year.

Staff Productivity:

Prescription Fill Rate: Measure the number of prescriptions filled per pharmacist or pharmacy technician per hour.

Workload Balance: Ensure staff workload is evenly distributed to prevent bottlenecks.

Medication Dispensing Accuracy:

Medication Error Rate: Track the number of medication errors or discrepancies in prescription orders.

Adherence to Safety Protocols: Ensure compliance with safety standards and protocols to prevent medication errors.

Cost Control:

Cost per Prescription: Calculate the cost associated with dispensing each prescription, including labor, inventory, and overhead costs.

Drug Utilization Review: Regularly evaluate the usage and cost-effectiveness of medications in the formulary.

Space Utilization:

Space Efficiency: Measure the effective utilization of pharmacy space, considering storage, workstations, and equipment layout.

Technology Integration:

Electronic Health Record (EHR) Integration: Ensure seamless integration with EHR systems for efficient prescription processing and communication with healthcare providers.

Automation Usage: Evaluate the use of automation and technology, such as robotic dispensing systems, to streamline processes.

Patient and Clinician Satisfaction:

Patient Wait Time: Measure the time patients spend waiting for medications in the pharmacy.

Clinician Feedback: Gather input from healthcare providers who rely on the pharmacy's services.

RESULTS AND DISCUSSIONS

The proficiency score of efficient hospitals by SBM-DEA Model is graphically represented in the figure 1 and 2

For the year 2021, the efficiency ratings of 40 hospitals and the pharmacies in India have been calculated. The efficacy counts from the SBM-CRS model, input and output slacks, indication suites, and friend influences of the model clinics are presented in figure 1 and 2. The hospitals that make up the efficiency frontier are evaluated by the DEA. The efficiency frontier is made up of hospitals with a competence score of 1, and ineffective sickbays have a score below that. figure 1 and 2 shows that, among the 40 hospitals, thirteen sickbays (H1, H2, H3, H4, H6, H7, H8, H23, H27, H29, H31, H32, and H33) have a score of 1, indicating that they are relatively efficient. The remaining 27 hospitals have efficiency scores under 1, which indicates that they are ineffective[10]. These hospitals serve as "reference sets" for the remaining 27 inefficient hospitals since they are at the cutting edge of best practises and may serve as role models for efficient operations. The most technically inefficient hospitals are H19 and H28, whose efficiency is judged to be 0.1%, followed by H8 and H11 at 0.2%. Only one inefficient hospital, H18, has an efficiency rating that is higher than the industry standard. The hospitals with high efficiency scores are having zero slack scoring.

Only a limited government hospitals were listed as a top 40 hospitals by Newsweek in 2021and the results of the efficiency score suggests that majority of the government owned hospitals are technically efficient and can be set as a benchmark to other hospitals[11]. The interpretation of the data also suggests that the output variables of the government hospitals are more when compared to private hospitals. The inpatient and outpatient units are handled on a massive scale by the government hospitals. The hospitals like AIIMS- New Delhi, JIPMER Puducherry, Safdarjung Hospital- Delhi, PGIMER- Chandigarh are the benchmarking hospitals in Government healthcare settings where as Apollo Hospital International, Medanta The Medicity-Delhi, The Christian Medical College- Chennai, King Edward Memorial Hospital-Mumbai are benchmarking hospitals in private healthcare settings. These hospitals are technically efficient with zero slack values.

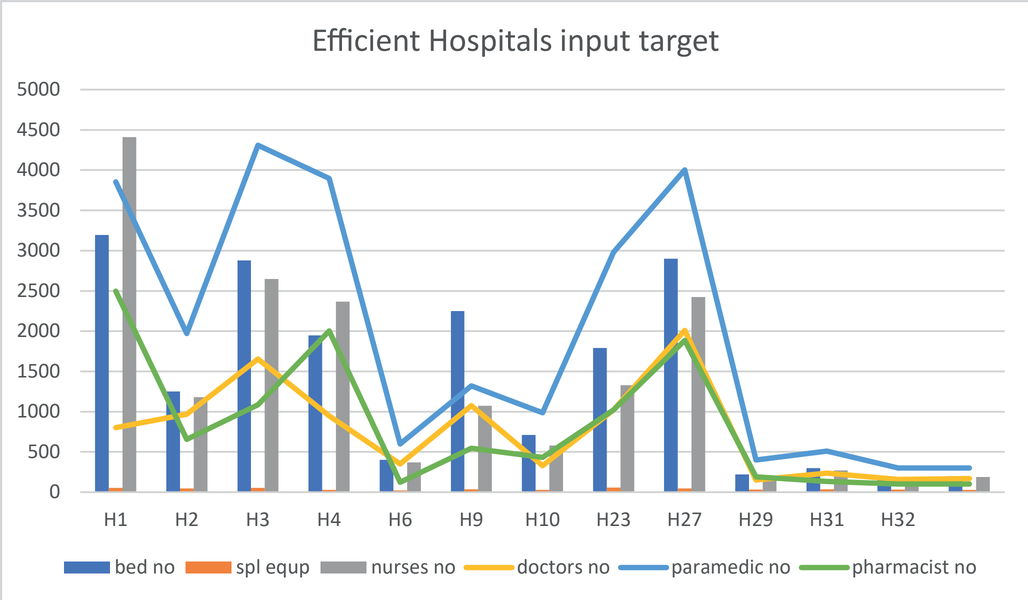

Figure 1: Input target of efficient hospitals.

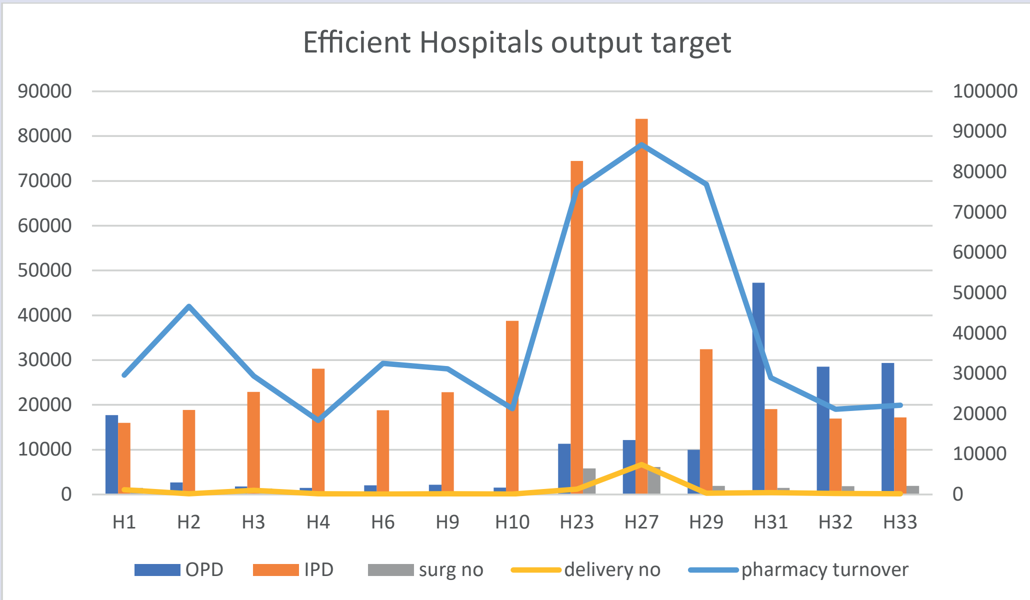

Figure 2: Output target of efficient hospitals.

Importance of impact and efficiency of pharmacognosy research and the management of pharmaceutical resources within hospital setting

CONCLUSION

While evaluating the research it was found that the pharmacy plays a pivot role in the efficacy of a hospital. Thus, some benchmarking can be made according to the pharmacognosy. Benchmarking in pharmacognosy, the study of natural products and their medicinal properties, can be a valuable tool for assessing the efficiency and effectiveness of research and development processes. Here are some key benchmarks and indicators to consider for efficient benchmarking in pharmacognosy:

1. Extraction Efficiency: Evaluate the efficiency of extraction methods used to isolate bioactive compounds from natural sources. The yield of target compounds per unit of starting material can be a critical benchmark.

2. Purity of Isolated Compounds: Assess the purity of isolated compounds, ensuring that they meet quality standards for pharmaceutical or research purposes.

3. Bioactivity Testing: Benchmark the effectiveness of bioassays used to assess the biological activity of isolated compounds. This can include evaluating the IC50 values or other relevant parameters.

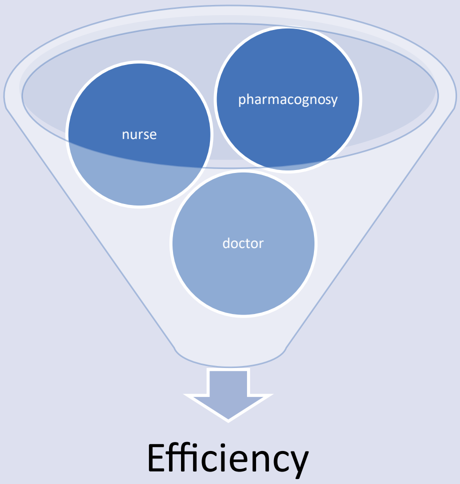

Figure 3: Efficiency Indicators of a hospital.

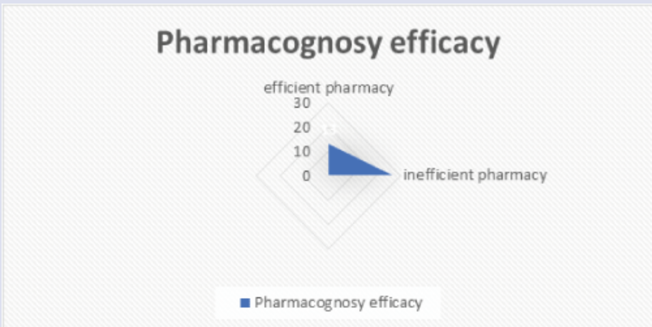

Figure 4: Pharmaceutical resource management in hospitals.

Figure 5: Impact and efficiency of pharmacognosy research.

4. Quantitative Analysis: Determine the accuracy and precision of analytical techniques used for quantifying specific compounds in natural products.

5. Pharmacological Assays: Benchmark the results of pharmacological tests to assess the therapeutic potential and safety of natural products.

Efficient benchmarking in pharmacognosy should aim to improve the overall research process, increase the discovery of valuable bioactive compounds, and enhance the quality and consistency of natural product-based medicines or supplements. It's important to adapt these benchmarks to the specific goals and context of your pharmacognosy research projects.

This learning used the SBM-DEA model to evaluate the efficacy of 40 hospitals and the pharmacies that Newsweek identified as the top hospitals in India in 2021. According to the survey, 13 (32.5%) hospitals and its pharmacies are effective. The average efficiency of hospitals shows that, on average, 45.90% of their technological capacity is not being used, meaning that these hospitals and pharmacies can produce more outputs with fewer inputs than they now do. According to the SBM-CRS model's findings, 13 (32.5%) out of 40 hospitals and its pharmacies are wholly technical efficient, meaning they effectively transform their inputs into outputs. However, due to the scale-size effect, twenty-seven of those hospitals and its pharmacies are technically inefficient. The least efficient hospitals are H19 and H28. According to the research, hospitals may increase their size of operation and concentrate more on cutting down on slack to increase their efficiency score. All inputs have a large amount of room for discount, and all outputs have a noteworthy amount of room for extension, according to the outcomes of target setting. Thus, if a hospital in efficiently working, majority of its pharmacy also work well.

LIMITATIONS OF THE STUDY

The current research only forecasts efficiency for one almanack year, and News Week will feature it as one of the top 40 studies in 2021, which can be protracted for efficiency time sequences analysis. The study also focused on the pharmacies of these selected hospitals. It could have extended to other hospital pharmacies as well. Additionally, the study may be expanded to classify the influences that contribute to incompetence and to compare the efficiencies of PHCs, CHCs, secondary and tertiary level hospitals. It may also be used to evaluate the effectiveness of a health ministry by doing an efficiency study of the entire state of India.

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