CONTENTS

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OPTIMIZATION OF HEALTH-CARE RESOURCES THROUGH GOAL PROGRAMMING

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ABSTRACT

In the complex financial environment, todays health-care industry requires administrators who are familiar with efficient method of allocating scare resources. Many health-care facilities have become similar to large business enterprises, which intend to achieve multiple and conflicting goals through integration and use of limited resources. The objective of this study was to develop the goal programming approach in the health-care field, and to determine the optimum sequence for treatment of surgical patients that maximizes the total contribution to profit.

Keywords: Optimization, Health-Care Resources, Goal Programming, Strategic, Categorical

1. INTRODUCTION

The India spends over a millions of rupees annually on health expenditures. Both as a percentage of national productivity and per capita, health care spending by the India exceeds that of any other nation in the world. However, this tremendous expenditure has not secured the India a rank among the 'healthiest' nations. In fact, for many health indicators, such as infant mortality and measles immunizations, the India ranks below some countries characterized as underdeveloped [23,29]. Prolonged public debates on health care policy in the India have focused on insurance coverage and medical care financing programs without any serious examination of the true health status of the nation. The need to assess the health status of Indian communities in a comprehensive and systematic manner has been widely recognized within the health professions. The Institute of Medicine (IOM) of the National Academy of Sciences has acknowledged the importance of a population-based perspective in two influential reports, emphasizing the need for a regular and systematic collection, assemblage, and analysis of the health status of our nation's communities [16,18]. A community health profile is comprised of socio-

demographic characteristics, health status and quality of life indicators, health risk factors, and health resource measures. The intent of such a comprehensive health profile is to assist a community in developing, refining, and monitoring a long-term strategic view of its overall health status. Although there are many sources of health data, there are no standard data definitions, formats, or reports across the health care industry. Thus, health care data are widely used (and misused) in an ad-hoc manner to justify managerial objectives of health institutions and agencies, a maze of mandated categorical funding, and a variety of political agendas. Sound information and accepted analytic techniques are even more important as funding is consolidated in block grants and local community decision-making is emphasized. As part of the ongoing clarification of the public health role at the community level and the transition from a disease to a health focus and from a treatment to a prevention strategy, there has been recognition that partnerships and collaboration are necessary to support effective action [17,21]. Health organizations, public sector agencies, medical care providers, businesses, the religious community, educational institutions, and other community organizations are interdependent components of a multi-sectoral community health environment. The overall community must be empowered to make the necessary, and sometimes difficult, resource allocation choices to improve health through information, education, behavior change, and social support [7]. Such collaborative action at the community level must be informed by unbiased data describing the community's health status, needs, and resources. The ability is also needed to track progress over time to meet the community's health care goals [24].

2. DATA OF THE PROBLEM

The data collected from Govt. Hospital, Hyderabad, which is specialized in performing six types of surgery: *tonsillectomies, appendectomies, hemias, cholecystectomies, hystroctomies* and *l.s.c.s (Lower Sigment Ciserian Surgery)*. The performance of these surgeries is constrained by three resources: *Operating room hours, recovery room-bed hours and surgical service bed-days.*

The required information is given in Table I.

Table 1

	Types of Surgical Patients						
	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Capacity/Year
Operating Room	2	2	3	2	2	2	1960 hours
Recovery Room	6	4	8	6	6	7	2205 bed hours

Surgical Service	3	4	7	4	5	6	2541 bed days
Average Contribution to profit (Rs.)	2500	2700	2300	3500	3700	3900	
Average contribution to profit is taken hypothetical, because hospital is being run by the Government on no profit basis.							

Where

Y_1 = number of tonsillectomy patients.

Y_2 = number of appendectomy patients.

Y_3 = number of hernia patients.

Y_4 = number of cholecystectomy patients

Y_5 = number of hystroctomy patients.

Y_6 = number of 1.s.c.s. (Lower Sigments Ciserian Surgery) patients.

I_1 = idle hours of the operating room.

I_2 = idle hours of the recovery room.

I_3 = idle days of the surgical service beds.

3. GOAL PROGRAMMING MODEL

The goal programming model developed is as follows:-

$$\text{Minimize } Z = P_1(d_1^-) + P_2(d_2^-) + P_3(d_3^-) + P_4(d_4^-)$$

Subject to the constraints :

(i) Target profit

$$2500Y_1 + 2700Y_2 + 2300Y_3 + 3500Y_4 + 3700Y_5 + 3900Y_6 + d_1^- - d_1^+ = 12,12,000$$

(ii) Operating room hours

$$2Y_1 + 2Y_2 + 3Y_3 + 2Y_4 + 2Y_5 + 2Y_6 + d_2^- - d_2^+ = 1960$$

(iii) Recovery room bed-hours

$6Y_1+4Y_2+8Y_3+6Y_4+6Y_5+7\ Y_6+d_3^- - d_3^+ =2205$

(iv) Surgical service bed-days

$3\ Y_1+4\ Y_2+7\ Y_3+4\ Y_4+5\ Y_5+6\ Y_6+d_4^- - d_4^+ =2541$

And, $Y_1, Y_2, Y_3, Y_4, Y_5, Y_6 \quad d_1^-, d_1^+, d_2^-, d_2^+, d_3^-, d_3^+, d_4^-, d_4^+ \geq 0.$

The equations above however, require two slack variables, to allow the possible deviation above and below the goal achievement. Note that the d_1^- appears in the objective function with a P_1 coefficient. The reason is that, since first goal requires making at least Rs.12,12000, there is no need to put any restriction on d1. The objective of the second, a third and fourth goal is to minimize the idle capacities of all the scare resources. Thais is done by including under-achievement variables d_2^-, d_3^-, d_4^- in the objective function with priority coefficients P_2, P3 and P_4 respectively.

4. RESULT AND ANALYSIS

The solution values of decision variables (Y_i's) and deviational variables (d_i's) obtained by using modified simplex method for goal programming are as under.

Table 2

$Y_1=0;\ Y_2=373;\ Y_3=89;\ Y_4= Y_5= Y_6=0$

$d_1^- = d_1^+ =0;\ d_2^+ =0;\ d_2^- =946$

$d_3^+ = d_3^- =0;\ d_4^+ =0;\ d_4^- =425.$

The solution values in accordance with priorities (P_i's) so obtained may be interpretated as follows:

The first priority goal for target profit is fully achieved (since $d_1^-=0$).Treat only *apendecetomy* and *hernia* patients. The best combination of these patients will be 373 apendectomy patients (Y_2) and 89 hernia patients (Y_3).Decrease the *operating room hours* by 946 hrs (since $d_2^-=946$). Decrease the *surgical service bed-days* by 425 days(since d_4^- =425).

5. CONCLUSION

In this paper we developed a goal programming model to determine the optimal solution for treatment of surgical patients that maximizes the total contribution of profit. The proposed method is used for the limited resources and is extendable for large scale for large scale hospitals.

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