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Total Service Quality in Healthcare with Special Reference to Yeshasvini Project in Karnataka

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1.0 Introduction

Awareness for service quality in health sector is a recent phenomenon in developing countries like India. The awareness has become strong enough to deserve serious evaluation of the quality level. Entitlement for a reasonable quality level at affordable cost is now considered almost a *right* of the people.

2.0 Motivation

2.1 Need for the Study

It has been reported that the inequality in access to health service is even more than in economic status in the developing countries. The poor stand highly disadvantaged. Thus, it is a pressing need that service quality in health sector is properly evaluated, taking into consideration all the stakeholders. The Indian case is less investigated. Hence, the need for this study.

2.2 The Research Gap

Service quality in healthcare has been researched and discussed to some extent. There is a body of literature on TQM in service quality, in general, and in healthcare. Some isolated work on service quality along with TQM in sectors like banking is noted.

A unified approach of fusing together service quality considerations with TQM principles in healthcare is not seen in the literature. Clearly, such an effort provides a holistic framework for more effective measurement. This shows a gap in research efforts. Such a consideration is the basic motivation for the work in the thesis. Developing a *(Service Quality + TQM) = Total Service Quality (TSQ)* framework in the context of healthcare is an objective of the work. On the application side, the PPP model of Yeshasvini scheme of the Karnataka Government is evaluated from the TSQ perspective.

3.0 Objectives and Scope

3.1 Objectives

The specific objectives of the study are:

1) To assess the levels of service quality as perceived and expected by service providers and end users together with a ground level evaluation.

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2) To develop an appropriate classification of determinants of service quality in health sector and indicators of quality level, along with the necessary theoretical framework (TSQ).

3) To evaluate the quality aspects of Yeshasvini scheme for healthcare in Karnataka &

4) To draw policy conclusions based on the results of the study.

3.2 Research Questions

Keeping in view the stated objectives, research questions (RQs) are formulated as below:

RQ 1. a) What are the determinants of service quality in healthcare?

b) How to quantitatively model service quality delivery in hospitals?

c) How to fit healthcare service into TSQ framework?

RQ 2. What does the patient-centered empirical evidence on healthcare quality in India suggest?

RQ 3. How is the performance of Yeshasvini healthcare project as a PPP model in Karnataka?

3.3 Scope of the Work

The present study is theoretical in part, by synthesizing the service quality and TQM concepts in healthcare. It provides a Total Service Quality (TSQ) framework. On the application side, the quality aspects of a statewide healthcare scheme are evaluated. This refers to the Yeshasvini scheme, right from its inception in the year 2003 and covers geographically the entire Karnataka State. Input data are gathered from a sample of patients, family members, physicians and administrative staff of the network hospitals including those under the PPP model.

4.0 Description of the work

4.1.1 Statement of the Problem

No studies done from a holistic perspective by integrating quality of service & total quality by management practices in an institutional setting. The present study aims to develop a theoretical framework from TSQ perspective and evaluate a *Public-Private-Partnership* (PPP) model from service provider and end user angles in the backdrop of *Total Service Quality.*

4.1.2 Methodology

The theoretical aspects are investigated and quality indices are developed. These methods have been tested before finalization. The data for chosen field studies were collected from secondary and primary sources.

The focus group procedure was used as the method of collecting qualitative data about the Yeshasvini scheme. The participants were either *providers* or recent *beneficiaries* of healthcare.

A field study was conducted in a hospital at Valasad town in Gujarat State. A similar study was conducted covering a few hospitals in Bengaluru and Mangaluru cities. A questionnaire to measure service quality was developed and tested using focus group inputs. The research design is based on the juxtaposing of *Input (service provider) - The Process-Output-Outcome (end-user)* paradigm. The paradigm of design is shown in Figure 1.

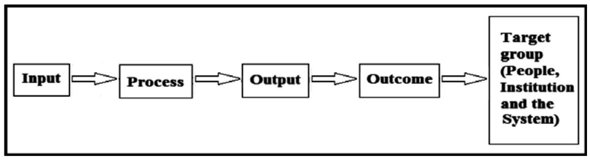

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Figure 1: Basic Research Design

A matrix of total quality v/s service quality is developed; cost, time & value creation was included.

4.1.3 Instrument Development

All the instruments: a. *Checklist* b. *Schedule* c. *Questionnaire* and d. *Interview schedules* are developed keeping in view the work by Parasuraman and his associates. The *fourteen basic principles* are confounded with quality dimensions.

There are three parts in the instrument: Part I - Demographic items (eleven), Part II - Topics (sixty-three) and Part III - Yeshasvini scheme specific (seven).

4.1.4 The Size of the Sample (n)

The sample size was worked out using a standard rule (Cochran's sample size formula, Chap. 4) as 400. The precision of estimation depends primarily on the *actual size* of n and not that much on the *relative size n/N.* In other words, the role of N, after a certain threshold level, N_0, virtually disappears in the determination of precision.

4.2.1 Positive and Negative Attributes

The former ones are desirable, while the latter are not. Examples for positive attributes include compassion for patients, uniform treatment protocol, while absence of fire safety measures and medical negligence are instances of negative attributes.

Classification of Negative Attributes

1) Class *A* Defects: *Very Serious*

Will cause severe health damage to the patient which will be irreversible or will even cause death. Non-testing for allergy or overdose of anesthesia are cases in point.

2) Class *B* Defects: *Serious*

The patient may possibly suffer a Class *A* damage or somewhat less serious health consequences, may end up with reduced balance life span. Absence of fire and radiation safety measures provides examples.

3) Class *C* Defects: *Moderately Serious*

Will cause trouble that is less serious than permanent health damage, but not insignificant in its impact. Certain cases of medical negligence are examples.

4) Class *D* Defects: *Minor*

No impact on health status or longevity. Has minor effect on service quality level. Absence of a pharmacy in hospital premises is an example.

A System of Weights

A suggested method of weighting to arrive at a composite demerit index for the hospital is the following:

Let X_A, X_B, X_C, X_D be respectively the number of Class *A*, Class *B*, Class *C* and Class *D* defects in an inspection unit. Assuming each Class of defect to be independent and occurrence of defects in each Class to be well modeled, one may define the overall number of *demerits* in the inspection unit as

$$X = 100 X_A + 50 X_B + 10 X_C + X_D \quad \ldots (1)$$

The demerit weights (100, 50, 10, 1), though arbitrary, have been widely used in manufacturing industries. Other system of weights may be designed.

The expression (1) has a form $\sum W_i X_i$, which may be converted to a weighted average as

$$I = X / \sum W_i$$

or $I = X/161$ for the choice (100, 50, 10, 1) of weights.

Generalization of *I*

The generalization of I to k Classes is straightforward. This is given by the weighted average

$$I(k) = \sum_{1}^{k} W_i X_i / \sum_{1}^{k} W_i \quad \ldots (2)$$

where the W_i are weights and X_i is the number of demerits in Class *i*.

The Index *I* and *g* Ratio

The index I focus on the negative qualities or deficiencies in a hospital. It is the weighted mean of the number of defects in the four Classes *A, B, C* and *D.* Clearly, larger values of I put the hospital in bad light. This negative indicator of quality is helpful in accreditation processes and points to the scope for quality up-gradation.

A similar index I' may be worked out for the positive qualities after a suitable classification into Classes A', B', C' and D'. Finally, the balance of positive and negative qualities may be judged through a comparison of I' and I and computing a percentage:

$$g = (I'/I)\,100 \quad \ldots (3)$$

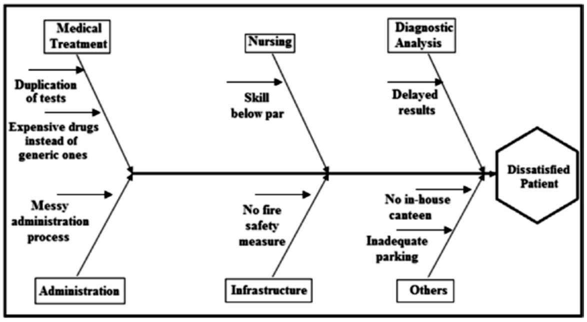
which shows the percentage dominance or otherwise of negative attributes over positive attributes.

4.2.2 Cause and Effect Analysis of Demerits

One may classify the demerits by ***source,*** leading to a cause and *effect* analysis.

1) Administration 2) Infrastructure 3) Medical treatment 4) Nursing 5) Diagnostic analysis and 6) Others.

The above classification is handy for fixing responsibility for demerits and initiating corrective actions. The direction of the arrow in the diagram is indicative of the deficiencies all combine to result in a *dissatisfied* patient.



Source: Author

Figure 2: Ishikawa Diagram

4.2.3 De jure and De facto Quality Levels

A human component easily allows for *de jure and de facto* quality levels to be different. The latter reflects the ground realities with all its harsh aspects. De facto situation is what matters to the patients, as it corresponds to the *attained level* of service quality. A hospital may satisfy the norms as per the book (guidelines). But when it comes to practice, there may be a significant gap between what is *'claimed' (de jure),* say L, and what is actually *'delivered' (de facto), say* $L^{\prime}$.

Assessment of the Two Levels

Assessment of the gap between L and $L^{\prime}$ is a necessary step for a realistic quality evaluation of health service that is provided to the public. This is a tricky step, as human respondents are involved, many with vested interests.

An investigative indirect survey will be needed to throw light on the situation.

i) Two methods are proposed:

1) A survey of patients with a few probing questions may be conducted, as a fact-finding exercise,

2) As a better alternative, one may plan a *Delphi method* based evaluation. The focus may be made more pointed by a suitable stratification of the frame.

For instance, the health service providers may be pre-stratified for a specified geographical area.

ii) The *de jure* health service quality level L may be accessed through a direct survey of hospital administration and medical personnel, employing the very same stratification.

The gap may be expressed as a ratio:

$$H = L^{\prime}/L \qquad \text{... (4)}$$

4.2.4 A General Hybrid Model

The development of a *Service Quality Score (SQS) in a generalized framework is attempted here.* In the setup of a hospital, the service quality variables can be bifurcated:

a) Binary Variables:

These are *present/absent* or *yes/no* type characteristics. Availability of a lift system, fire safety measures and an in-house pharmacy are three such examples. When there are p such desirable variables, define

X_i = 1 if variable i is present; 0 Otherwise.

for $i = 1, 2, \ldots, p$.

Then, in a vector form, one may write

$$X = (X_1, X_2, \ldots, X_p)$$

which will consist entirely of ones and zeros, depending on availability or otherwise of the factors. These are in fact *indicator variables.*

b) Rated Variables:

These are not amenable for direct measurement but can be *rated* in an interval, say 0 to 10. Nursing skill, medical care and simplicity of patient admission are three good examples. In the presence of q such variables, the vector Y is defined as

$$Y = (Y_1, Y_2, \ldots, Y_q)$$

Where Y_j is the *rating* for characteristic j, $j = 1, 2 \ldots q$.

With the above notation, a general service quality score model can be formulated:

$$SQS = f(X, Y) \qquad \text{... (5)}$$

Where, X and Y are vector variables. This is a *hybrid model* in the sense that it has both binary and rated variables as *independent* factors. *SQS* is the *dependent variable* to be evaluated.

If the two components in (5) are segregated, possibly with different functional forms, one may write the service score as

$$SQS = f_1(X) + f_2(Y) \quad \text{... (6)}$$

assuming an additive structure for the components, where f_1 and f_2 stand for the two functional forms.

Linear Structure for f_1 and f_2

When f_1 and f_2 are both linear in the variables, which is the simplest form to consider, the model (6) can be rewritten as

$$SQS = \sum_{1}^{p} a_i X_i + \sum_{1}^{q} b_j Y_j \quad \text{... (7)}$$

where the coefficients a_i and b_j are to be estimated using empirical evidence.

The Relative Score

Under the above model, the maximum score occurs when each $X_i = 1$ and $Y_j = 10$ (assuming rating between zero and ten). This works out to be

$$SQS_{Max} = [\sum a_i + 10 \sum b_j] \quad \text{... (8)}$$

Thus, the relative score, relative to the maximum, is

$$SQS_{Rel} = [SQS / SQS_{Max}] \quad \text{... (9)}$$

The relative score lies between zero and one, and a value closer to one points to a good service quality level.

Choice of Weights

The coefficients a_i, b_j are non-negative. Parity between the two sets of weights may be ensured by making their averages mutually proportional. Thus take

$$\sum b_j / q = \alpha \sum a_i / p$$

where α is the constant of proportionality. A choice $\alpha = 1$ keeps the two sets of variables *on par;* $\alpha > 1$ implies greater role for the rated variables and $\alpha < 1$ is for the reverse situation.

The researcher has another lever in the choice of *W,* to account for the relative contributions of $f_1(X)$ and $f_2(Y)$ in the SQS. One may make weights proportional to the *number of* variables in the sets. Thus use

$$W = 2p / (p + q);$$

$$(2 - W) = 2q / (p + q);$$

where the sum of weights is two and not one, since the sum $(f_1 + f_2)$ is being estimated and not the average $(f_1 + f_2)/2$. This two-level choice of weights imbibes near proportionality between as well as consideration for the number of factors in each set.

Complementary Roles of *Demerit Index* and *SQS*

While constructing a demerit index *I,* the possible deficiencies in an institution are first classified. The number of deficiencies in each group is counted; then these counts are converted into a weighted average, the weights reflecting the impact of the Classes on quality level. While constructing a *SQS,* there is a bifurcation of quality factors as:

a) Binary variable (with values 0 or 1) and

b) Rated variables, which are rated in a specified range, e.g. 0 to 10.

A score is constructed for each group as $f_1(X)$ and $f_2(Y)$. There is two-level flexibility for choosing weights.

Structure-wise, the demerit index is the weighted average of scores from *negative* quality aspects while *SQS* from *positive* quality aspects. The complementary nature of focuses (negative *versus* positive) accounts for the complementary nature of the two measures as outcomes. A generalization to a multivariate setup (*n* patients and *p* questions) is also discussed.

4.3.1 Empirical Studies on Total Service Quality Evaluation

Table 1: Split of the Surveyed Sample by Hospital Type & City

Respondents: Patient / Attendant			
Hospital	**Type**	**City**	**Sample Size**
Bowring & Lady Curzon Hospitals	Govern-ment	Bengaluru	Thirty-four
Jayadeva Institute of Cardiovascular Sciences & Research		Bengaluru	Thirty-two
K. C. General Hospital		Bengaluru	Thirty-six
The Lady Goschen Govt. Hospital		Mangaluru	Twenty-nine

Wenlock District Hospital	Government	Mangaluru	Thirty-three
M S Ramaiah Memorial Hospital	Private	Bengaluru	Forty
Narayana Institute of Cardiac Sciences		Bengaluru	Thirty-five
RMD Cancer Hospital		Surat	Thirty-five
Sir Shankara Cancer Hospital & Research Centre		Bengaluru	Forty
Vikram Hospital		Bengaluru	Forty-two
Respindents-Doctor / Support Staff			
Common			Thirty-five
Total Sample Size			**391**

Source: Author

Table 2: Demographic Characteristics of Respondents

Characteristics	Frequency	Percentage (%)
Gender:		
Male	169	47.5
Female	187	52.5
Age:		
Under 20 years	2	0.09
(20-29) years	23	6.5
(30-39) years	32	8.98
(40-49) years	59	16.57
(50-59) years	87	24.4
60 years & above	153	43.37
Location in India:		
South India	289	81.2
North India	67	18.8
Family Size:		
1	1	0.28
2	54	15.16
3	82	23.03
4	116	32.58
5	82	23.03
6 and above	21	5.92
Annual Income (Rs.):		
Below 5 lakhs	21	5.89
(5-10) lakhs	44	12.36
(10-15) lakhs	90	25.28
(15-20) lakhs	106	29.78
20 lakhs & above	95	26.69
Type of Hospital:		
Public	164	46.07
Private	192	53.93
Total	**356**	**100**

Source: Author

4.3.2 Validity and Reliability of the Instrument

In order to judge the validity of the instrument, the standard Cronbach's Alpha was used as a measure, Bartlett's Test of Sphericity to verify the factorability of variables and KMO (Kaiser-Meyer-Olkin) test for sampling adequacy.

Table 3: Cronbach's Alpha for Grouped Responses

Features	Perceptions	Expectations	P - E	P & E
Reliability (Q1 - Q5)	0.75	0.73	0.74	0.75
Responsiveness (Q6 - Q9)	0.71	0.72	0.72	0.71
Assurance (Q10 - Q13)	0.79	0.77	0.79	0.79
Empathy (Q14 - Q18)	0.68	0.69	0.69	0.68
Tangibles (Q19 - Q22)	0.76	0.74	0.72	0.76
Other Factors (Q23 - Q63)	0.94	0.92	0.9	0.9
Total	**0.97**	**0.93**	**0.94**	**0.94**

Source: Author

Table 4: KMO and Bartlett's Test / Results

Kaiser-Meyer-Olkin Measure of Sampling		**0.87**
Bartlett's Test of Sphericity	Approx. Chi-Square	9039.46
	df	1953
	Sig.	0.000

Source: Author

The values of Cronbach's Alpha was greater than 0.68 (acceptable if > 0.6), testifying the reliability of the instrument. The Bartlett's test of sphericity showed that the variables could be grouped into certain factors/dimensions (Chi square 9039.46; df =1953 and p < 0.000) (acceptable if Sig. < 0.05). KMO value was 0.87 (acceptable if > 0.6) which indicates that the degree of common variance among the sixty-three variables is high and sampling adequacy is established.

4.3.3 Statistical Analysis of Responses

The summary of the analysis is in the tables below:

Table 5: The Five Largest / Smallest Average Quality Scores

The Five Highest Perceptions	
Statements	**Mean Scores**
SP2 (Problem Solving Capabilities)	3.1461
SP12 (Courteous Staff)	3.0758
SP7 (Timely Service)	3.0590
SP11 (Less Burden on Bills)	3.0140
SP10 (Feeling of Getting Cured)	3.0112

The Five Lowest Perceptions	
Statements	**Mean Scores**
SP29 (First Impression)	2.2640
SP34 (Authenticity)	2.3090
SP46 (Parking)	2.3624
SP49 (Interior Design)	2.3933
SP62 (Wi-Fi Connectivity)	2.4326

The Five Highest Expectations	
Statements	**Mean Scores**
SE9 (Readiness to Respond)	4.4129
SE23 (Timeliness)	4.3680
SE5 (Record Documentation)	4.3287
SE1 (Service Provided)	4.3258
SE18 (Convenient Transaction Hours)	4.3146

The Five Lowest Expectations	
Statements	**Mean Scores**
SE63 (Website Updation)	2.3736
SE49 (Vaastu Signs)	2.4803
SE60 (Uniform)	2.5478
SE58 (Report Availability)	2.5562
SE34 (Authenticity)	2.5590

Source: Author

The Five Largest Differences	
(SP-SE)4 (Timely Cure)	-1.63
(SP-SE)21 (Professionalism)	-1.54
(SP-SE)13 (Domain Knowledge)	-1.54
(SP-SE)5 (Record Documentation)	-1.54
(SP-SE)20 (Hospital Facilities)	-1.52

The Five Smallest Differences	
(SP-SE)51 (Signage)	.00
(SP-SE)53 (Air Quality)	-.02
(SP-SE)25 (Hospital Location)	-.03
(SP-SE)27 (Efficiency)	-.03
(SP-SE)39 (Promptness)	-.03

Source: Author

4.3.4 Data Analysis in Hypotheses Testing Framework

A few hypotheses are formulated and tested using Standard tests. The alternative hypotheses are negations of the null hypotheses and are essentially two-sided. Therefore, these are not explicitly stated. The null hypotheses are indexed H_{01} etc. Only statistically significant test results are enumerated.

H_0 *: The demographic character (Family Income) of respondent significantly affects the response patterns.*

Against

H_1*: The demographic character (Family Income) of respondent does not significantly affect the response patterns.*

Method of Test: Regression Analysis (Table 8).

4.3.5 Perceived versus Expected Responses: Paired *t*- Test

In order to check the significance of the differences between the perceptions and expectations of the patient, the standard paired *t*- Test was applied for all items. It is noted that twenty-five of the differences between perceptions and expectations are significant. The negative signs in column two of the table imply expectation exceeding the perception value. This is true of majority of the cases, pointing to perceptions often *not* meeting the expectations. The level of significance is indicated in the last column of the table.

Table 6: Paired Samples *t*- Test

Paired Samples Test									
		Paired Differences							
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	SP1 - SE1	-1.35	1.15	0.06	-1.47	-1.24	-22.31	355.00	0.00
Pair 2	SP2 - SE2	-1.12	1.02	0.05	-1.23	-1.01	-20.72	355.00	0.00
Pair 3	SP3 - SE3	-1.25	1.05	0.06	-1.36	-1.14	-22.42	355.00	0.00
Pair 4	SP4 - SE4	-1.63	1.26	0.07	-1.76	-1.50	-24.45	355.00	0.00
Pair 5	SP5 - SE5	-1.54	1.10	0.06	-1.66	-1.43	-26.37	355.00	0.00
Pair 6	SP6 - SE6	-1.33	1.06	0.06	-1.44	-1.22	-23.68	355.00	0.00
Pair 7	SP7 - SE7	-1.24	1.28	0.07	-1.37	-1.11	-18.21	355.00	0.00
Pair 8	SP8 - SE8	-1.29	1.44	0.08	-1.44	-1.14	-16.94	355.00	0.00
Pair 9	SP9 - SE9	-1.48	1.20	0.06	-1.60	-1.35	-23.24	355.00	0.00
Pair 10	SP10 - SE10	-1.28	1.29	0.07	-1.42	-1.15	-18.72	355.00	0.00
Pair 11	SP11 - SE11	-1.24	1.39	0.07	-1.39	-1.10	-16.89	355.00	0.00
Pair 12	SP12 - SE12	-1.17	1.40	0.07	-1.31	-1.02	-15.74	355.00	0.00
Pair 13	SP13 - SE13	-1.54	1.42	0.08	-1.69	-1.39	-20.45	355.00	0.00
Pair 14	SP14 - SE14	-1.09	1.05	0.06	-1.20	-0.98	-19.56	355.00	0.00
Pair 15	SP15 - SE15	-1.19	1.30	0.07	-1.33	-1.06	-17.36	355.00	0.00
Pair 16	SP16 - SE16	-1.44	1.53	0.08	-1.60	-1.28	-17.79	355.00	0.00
Pair 17	SP17 - SE17	-1.35	1.05	0.06	-1.46	-1.24	-24.29	355.00	0.00
Pair 18	SP18 - SE18	-1.39	1.01	0.05	-1.50	-1.29	-25.88	355.00	0.00
Pair 19	SP19 - SE19	-1.47	1.16	0.06	-1.59	-1.35	-23.87	355.00	0.00
Pair 20	SP20 - SE20	-1.52	1.07	0.06	-1.63	-1.41	-26.87	355.00	0.00
Pair 21	SP21 - SE21	-1.54	1.32	0.07	-1.67	-1.40	-21.96	355.00	0.00
Pair 22	SP22 - SE22	-1.26	1.28	0.07	-1.40	-1.13	-18.61	355.00	0.00
Pair 23	SP23 - SE23	-1.50	1.33	0.07	-1.64	-1.36	-21.19	355.00	0.00
Pair 24	SP24 - SE24	-0.29	1.20	0.06	-0.41	-0.16	-4.52	355.00	0.00
Pair 25	SP25 - SE25	-0.03	1.18	0.06	-0.16	0.09	-0.54	355.00	0.59
Pair 26	SP26 - SE26	-0.24	1.17	0.06	-0.36	-0.12	-3.85	355.00	0.00
Pair 27	SP27 - SE27	-0.03	1.13	0.06	-0.15	0.08	-0.57	355.00	0.57
Pair 28	SP28 - SE28	0.20	1.11	0.06	0.09	0.32	3.43	355.00	0.00
Pair 29	SP29 - SE29	-0.58	1.09	0.06	-0.70	-0.47	-10.08	355.00	0.00
Pair 30	SP30 - SE30	-0.07	1.19	0.06	-0.20	0.05	-1.15	355.00	0.25
Pair 31	SP31 - SE31	-1.34	1.28	0.07	-1.48	-1.21	-19.75	355.00	0.00
Pair 32	SP32 - SE32	-0.09	1.16	0.06	-0.21	0.03	-1.51	355.00	0.13
Pair 33	SP33 - SE33	-0.14	1.26	0.07	-0.28	-0.01	-2.14	355.00	0.03
Pair 34	SP34 - SE34	-0.25	1.35	0.07	-0.39	-0.11	-3.50	355.00	0.00
Pair 35	SP35 - SE35	0.12	1.25	0.07	-0.01	0.25	1.78	355.00	0.08
Pair 36	SP36 - SE36	0.16	1.01	0.05	0.05	0.26	2.93	355.00	0.00
Pair 37	SP37 - SE37	0.08	0.97	0.05	-0.02	0.18	1.58	355.00	0.11
Pair 38	SP38 - SE38	-0.10	1.20	0.06	-0.22	0.03	-1.54	355.00	0.12
Pair 39	SP39 - SE39	-0.03	1.08	0.06	-0.15	0.08	-0.59	355.00	0.56
Pair 40	SP40 - SE40	0.23	1.09	0.06	0.11	0.34	3.88	355.00	0.00
Pair 41	SP41 - SE41	-0.24	1.11	0.06	-0.35	-0.12	-4.03	355.00	0.00
Pair 42	SP42 - SE42	0.13	1.09	0.06	0.02	0.24	2.24	355.00	0.03
Pair 43	SP43 - SE43	0.13	1.29	0.07	0.00	0.27	1.92	355.00	0.06
Pair 44	SP44 - SE44	0.07	1.23	0.07	-0.06	0.20	1.08	355.00	0.28
Pair 45	SP45 - SE45	-0.26	1.08	0.06	-0.37	-0.15	-4.50	355.00	0.00
Pair 46	SP46 - SE46	-0.27	1.43	0.08	-0.42	-0.12	-3.59	355.00	0.00
Pair 47	SP47 - SE47	-0.15	1.04	0.06	-0.26	-0.05	-2.82	355.00	0.01
Pair 48	SP48 - SE48	0.04	1.01	0.05	-0.07	0.15	0.74	355.00	0.46
Pair 49	SP49 - SE49	-0.09	1.10	0.06	-0.20	0.03	-1.49	355.00	0.14
Pair 50	SP50 - SE50	-0.32	1.43	0.08	-0.47	-0.17	-4.23	355.00	0.00
Pair 51	SP51 - SE51	0.00	1.19	0.06	-0.13	0.12	-0.04	355.00	0.97
Pair 52	SP52 - SE52	0.15	1.29	0.07	0.01	0.28	2.13	355.00	0.03
Pair 53	SP53 - SE53	-0.02	1.20	0.06	-0.14	0.11	-0.26	355.00	0.79
Pair 54	SP54 - SE54	-0.08	0.93	0.05	-0.18	0.01	-1.71	355.00	0.09
Pair 55	SP55 - SE55	-0.16	1.33	0.07	-0.30	-0.02	-2.26	355.00	0.02
Pair 56	SP56 - SE56	-0.17	1.26	0.07	-0.30	-0.03	-2.48	355.00	0.01
Pair 57	SP57 - SE57	-0.19	1.00	0.05	-0.29	-0.08	-3.49	355.00	0.00
Pair 58	SP58 - SE58	0.07	1.17	0.06	-0.06	0.19	1.04	355.00	0.03
Pair 59	SP59 - SE59	0.14	1.12	0.06	0.02	0.25	2.32	355.00	0.02
Pair 60	SP60 - SE60	0.17	1.22	0.07	0.04	0.29	2.57	355.00	0.01
Pair 61	SP61 - SE61	-0.36	1.02	0.05	-0.46	-0.25	-6.61	355.00	0.00
Pair 62	SP62 - SE62	-0.17	1.17	0.06	-0.29	-0.05	-2.77	355.00	0.01
Pair 63	SP63 - SE63	0.45	1.07	0.06	0.34	0.56	7.91	355.00	0.00

Source: Author

H_2: *The perceptions / expectations significantly differ with reference to Hospital location* (Q25);

H_3: *The perceptions / expectations significantly differ with reference to System efficiency* (Q27);

H_4: *The perceptions / expectations significantly differ with reference to Timely response by the staff* (Q39);

H_5: *The perceptions / expectations significantly differ with reference to Sign boards* (Q51) and

H_6: *The perceptions / expectations significantly differ with reference to Air quality* (Q53).

4.3.6 Correlation Analysis: Probable Error Criterion

Table 7 provides an *extract* for both the cases of the top five positively correlated pairs and top five negatively correlated pairs to reveal the positive and negative associations between the characteristics. Probable Error Criterion was used to decide significance of *r*. The probable error (PE) is given by PE $(r) = 0.6745\,(1-r^2)/\sqrt{n}$, where *r* is the correlation in a sample of *n* pairs of observations. The role of *n* in addition to that of *r* may be noted in this decision rule.

Table 7: Observed High Correlations

The Five Highest Positive Correlation (Perception)	
Pair	**Correlation**
SP(38-40) (Personalization-Adaptability)	0.9996
SP(19-25) (Latest Equipments-Hospital Location)	0.9904
SP(19-37) (Latest Equipments-Friendliness)	0.9838
SP(24-18) (Effectiveness-Convinient Transaction Hours)	0.9814
SP(30-62) (Staff Diversity-Wifi Connectivity)	0.9759

Source: Author

The Five Lowest Negative Correlation (Perception)	
Pair	**Correlation**
SP(11-63) (Less Burden on Bills-Website Updation)	-0.2091
SP(27-63) (Efficiency-Website Updation)	-0.2347
SP(63-09) (Website Updation-Staff Readiness)	-0.2532
SP(63-10) (Website Updation-Cure)	-0.2771
SP(63-24) (Website Updation-Effectiveness)	-0.3392

Source: Author

The Five Highest Positive Correlation (Expectation)	
Pair	**Correlation**
SE(7-10) (Timely Service-Cure)	0.9967
SE(13-32) (Expertise-Timeliness)	0.9858
SE(6-16) (Treatment Information-Patients Interests)	0.9718
SE(7-8) (Timely Service-Willingness to Help)	0.9572
SE(10-39) (Timely Cure-Promptness)	0.9485

Source: Author

The Five Lowest Negative Correlation (Expectation)	
Pair	**Correlation**
SE(54-3) (Temperature-Problem Identification)	-0.4522
SE(47-62) (Landscape-Wifi Connectivity)	-0.4568
SE(3-40) (Problem Identification-Adaptability)	-0.4637
SE(51-62) (Signage-Wifi Connectivity)	-0.4735
SE(34-62) (Authenticity-Wifi Connectivity)	-0.5590

Source: Author

All high correlations for both perceived and expected scores are statistically significant, while the negative correlations for the *expectations* are significant, but none of them is significant for *perceptions.*

Formally as statistical hypotheses, we can state the following:

<u>Positive Correlations</u> (Perceptions)

$H_{7\ (1)}^{(7)}$: *The perceptions on Personalization and Adaptability are significantly Correlated* (SP (38-40)).

$H_{7\ (2)}^{(7)}$: *The perceptions on Latest equipment and Hospital location are significantly Correlated* (SP (19-25)).

$H_{9\ (3)}^{(7)}$: *The perceptions on Latest equipment and Friendliness are significantly Correlated* (SP (19-37)).

$H_{9\ (4)}^{(7)}$: *The perceptions on Effectiveness and Convenient transaction hours are significantly Correlated* (SP (24-18)) and

$H_{10\ (5)}^{(7)}$: *The perceptions on Staff diversity and Wifi connectivity are significantly Correlated* (SP (30-62)).

<u>Negative Correlations</u> (Perceptions)

$H_{8\ (1)}^{(8)}$: *The perceptions on less burden on bills and Website update are significantly Correlated* (SP (11-63)).

$H_{8\ (2)}^{(8)}$: *The perceptions on Efficiency and Website update are significantly correlated* (SP (27-63)).

$H_{8\ (3)}^{(8)}$: *The perceptions on Website update and Staff readiness are significantly Correlated* (SP (63-9)).

$H_{8\ (4)}^{(8)}$: *The perceptions on Website update and Cure transaction hours are significantly Correlated* (SP (63-10)) and

$H_{8\ (5)}^{(8)}$: *The perceptions on Website update and Effectiveness are significantly Correlated* (SP (63-24)).

<u>Positive Correlations</u> (Expectations)

$H_{9\ (1)}^{(9)}$: *The expectations on Timely service and Cure are significantly correlated* (SE (7-10)).

$H_{9\ (2)}^{(9)}$: *The expectations on Expertise and Timeliness are significantly Correlated* (SE (13-32)).

$H_{9\ (3)}^{(9)}$: *The expectations on Treatment information and Patients interests are significantly Correlated* (SE (6-16)).

$H_{9\ (4)}^{(9)}$: *The expectations on Timely service and Willingness to help are significantly Correlated* (SE (7-8)) and

$H_{9\ (5)}^{(9)}$: *The expectations on Timely cure and Promptness are significantly correlated* (SE (10-39)).

4.3.7 Regression Analysis

Regression was run for responses on the important six demographic variables. The value of R^2 (Coefficient of determination) represents the proportion of variation in the response explained by the individual demographic variable. The results are summarized in the next table, separately for perceptions and expectations.

An examination of table below shows a significant dependence of responses on the family income as reflected by 49.9% for perceptions and 45.8% for expectations. None of the other R^2 values is impressive, implying the weak dependence on the other five demographic variables. This implies that the responses, perceptions or expectations, do not get affected significantly by the age, gender, geographic location, family size or whether the respondent is patient himself/herself.

Table 8: Summary of Regression Analysis

Variable	Perceptions		Expectations	
	R	R^2	R	R^2
Respondent	0.45	0.199	0.49	0.237
SE_Age	0.47	0.221	0.44	0.193
Gender	0.46	0.207	0.44	0.193
Location	0.43	0.184	0.45	0.205
Family Size	0.43	0.184	0.45	0.205
Income	0.71	0.499	0.68	0.458

Source: Author

4.3.8 Results of Factor Analysis

In the initial solution of Factor Analysis, each variable is standardized to have a mean of 0.0 and a Standard Deviation of 1.0. As a result, the total variance equals the total number of variables, being sixty-three in the present case. Also, a factor to be meaningful for interpretation it must have at least unit variance, which suggests a minimum cut-off of one for the eigenvalues, i.e. to have an eigenvalue 1.0; otherwise the factor extracted explains no more variance than a single variable. The analysis shows that there are twelve such components with eigenvalue more than 1 and these collectively account for a total variance of 64.31%. As shown in the table below, variables are loaded into twelve factors and eigenvalue is between 1.02 and 20.99 for these factors/dimensions, which are extracted after Factor Analysis. After varimax rotation, eigenvalue ranged from 1.467 to 10.472, which indicates only a moderate change in the factor pattern. The cumulative variance explained by these components exceeds 60%, which is accepted as the threshold to support the solution in social science investigations (Hair *et al.,* 1995).

Table 9: Factor Analysis

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	20.99	33.32	33.32	10.47	16.62	16.62
2	4.59	7.28	40.60	8.08	12.83	29.45
3	2.41	3.82	44.43	4.56	7.24	36.69
4	2.03	3.22	47.65	3.61	5.73	42.43
5	1.67	2.65	50.30	2.25	3.57	46.00
6	1.48	2.35	52.65	1.95	3.09	49.09
7	1.43	2.27	54.92	1.80	2.86	51.95
8	1.36	2.16	57.08	1.68	2.67	54.62
9	1.22	1.93	59.01	1.60	2.53	57.16
10	1.19	1.90	60.90	1.56	2.47	59.63
11	1.13	1.79	62.69	1.48	2.35	61.98
12	1.02	1.61	64.31	1.47	2.33	64.31

Source: Author

4.4.1 The Working Model of Yeshasvini Scheme

The scheme runs on Public Private Participation (PPP) model. The entities involved are a) the Government (Yeshasvini Trust), b) the Beneficiaries, c) the Network hospitals, and d) the Management Services Provider (MSP).

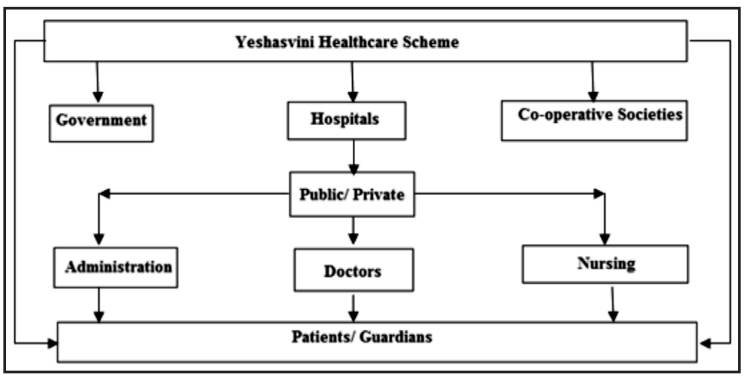


Figure 4: Components of the Scheme

Source: Author

4.4.2 Network Hospitals

There are 730 Network Hospitals across the State at present. Major hospitals like Jayadeva Institute of Cardiovascular Sciences, Kidwai Institute of Oncology, NIMHANS, Government and Private Medical College Hospitals function as network hospitals. The network hospitals treat the outpatient beneficiaries free of cost. Clinical investigations are provided at 25% discount to the beneficiaries. In the case of surgeries, the doctor obtains pre-authorization from Management Services Provider (MSP), performs it, and discharges the patient. The claims are submitted through MSP and the Yeshasvini Trust pays for the same.

4.4.3 Survey Responses from Yeshasvini Beneficiaries

The 118 responses from the beneficiaries of the Yeshasvini scheme were seperately analyzed. The general trend is very much like that observed in the total sample pool.

Table 10: The Five Largest/Smallest Average Quality Scores for Responses from Yeshasvini Beneficiaries

The Five Largest Differences for Yeshasvini Beneficiaries	
(SP-SE)4 - (Timely Cure)	-1.19
(SP-SE)18 - (Convenient Transaction Hours)	-1.19
(SP-SE)9 - (Readiness to Respond)	-1.08
(SP-SE)17 - (Understanding Needs)	-1.06
(SP-SE)5 - (Record Documentation)	1.02

The Five Smallest Differences for Yeshasvini Beneficiaries	
(SP-SE)57 - (Billing Statement)	0
(SP-SE)16 - (Brochures & Handouts)	0
(SP-SE)8 - (Willingness to Help)	0.03
(SP-SE)56 - (Stationery)	0.04
(SP-SE)25 - (Appropriateness of Location)	0.08

Source: Author

The Five Highest Yeshasvini Beneficiaries Perceptions	
Statement	**Mean Scores**
SP12 - (Courteous)	4.15
SP7 - (Timely Service)	3.92
SP16 - (Patient's Interest)	3.9
SP8 - (Willingness to Help)	3.85
SP11 - (Less Burden on Bills)	3.75

The Five Lowest Yeshasvini Beneficiaries Perceptions	
Statement	**Mean Scores**
SP63 - (Website Updation)	2.61
SP49 - (Interior Design)	2.74
SP26 - (Information)	2.81
SP62 - (Wifi Connectivity)	2.81
SP55 - (Business Cards)	2.92

The Five Highest Yeshasvini Beneficiaries Expectations	
Statement	**Mean Scores**
SE9 - (Readiness to Respond)	4.46
SE17 - (Understanding Needs)	4.43
SE23 - (Caring)	4.31
SE10 - (Cured Feeling)	4.25
SE21 - (Professional)	4.25

The Five Lowest Yeshasvini Beneficiaries Expectations	
Statement	**Mean Scores**
SE62 - (Wifi Connectivity)	2.13
SE49 - (Interior Design)	2.21
SE63 - (Website Updation)	2.4
SE36 - (Formality)	2.57
SE46 - (Parking)	2.61

Source: Author

Table 11: Responses to Specific Questions on the Scheme

Statement	Percentage Breakup		
Source of Information	Peers (38%)	Media or Co-operatives (40%)	Others (22%)
Number of Times Scheme Used	One-Two (70%)	Three-Four (16%)	More than Four (8%)
As Insurance Cover	Okay (20%)	Fair (25%)	Good (55%)
Scheme Utility	Low (8%)	Average (20%)	High (55%)
Quality Level of Service	Low (16%)	Average (29%)	High (55%)
Recommendation for Scaling Up	Yes (70%)	No (12%)	Undecided (18%)
Operating Procedure	Simple (51%)	Key (38%)	Messy (11%)

Source: Author

4.5.1. A New Geometric Model: Concept of Coverage

Growth studies often consider coverage of a target population from several standpoints. The progress on each of these fronts is measured in terms of a coverage parameter. The columns of the table identify respectively the problem base, parameters to be addressed, the concerned program implemented and the number of parameters as noted in the contemporary programs. The last column determines the dimensions (number of axes) in the geometric model.

The table below illustrates the typical thrust areas being presently covered in India to improve the overall healthcare scenario. It enumerates the key parameters (dimensions) of the model, which need steps for strengthening and development.

Table 12: Programs and Parameters

Sl. No.	Base	Parameter	Program	No. of Parameters
1.	Child health	Proportion of children covered	Immunization	One
2.	Primary education	Proportions of enrollment & dropout	Universal child education	Two
3.	Human development	Per capita income, Literacy rate & quality of life	Programs related income generation, healthcare & Universal education	Three
4.	Public healthcare	Proportions of population, costs & covered ailments	Public sector & PPP healthcare models	Three
5.	Maternal health	Proportion of women covered in child-bearing group, maternity & infant mortality rates	Maternal healthcare packages & related schemes	Three
6.	Nutrition for school children	Proportion of school children covered, Quality & Nutrition value of food	Mid-day meal schemes	Three

Source: Author

In each of the above situations, it is convenient to visualize that a geometric figure is created, which is desired to be *covered optimally.* Thus, with a single parameter, there will be a *line segment* and optimization implies a push in just one direction. With two parameters, a rectangle will be created in two dimensions, with the parameters as occupants of the axes. The optimum *coverage* occurs when the *covered area* of the rectangle is *maximized,* for a given perimeter. This occurs when the rectangle turns into a *square,* calling for equal paced push in both the directions. In the three-parameter case, a cube is formed, with the parameters along the three directions. This case is analyzed mathematically at some length now and fit the *Yeshasvini scheme* into this framework, with the following three parameters *viz.* Proportion of 1) Population covered (p_1), 2) health package covered (p_2) and 3) medical expenses covered (p_3).

The first parameter is to be improved through awareness drives / campaigns, while the other two are fallouts of policy decisions.

Working with proportions has a specific in-built advantage that they lie in the interval [0, 1], and hence finally create a geometric figure with each side of length unity. As a result, the figure has length/ area/ volume of magnitude one unit.

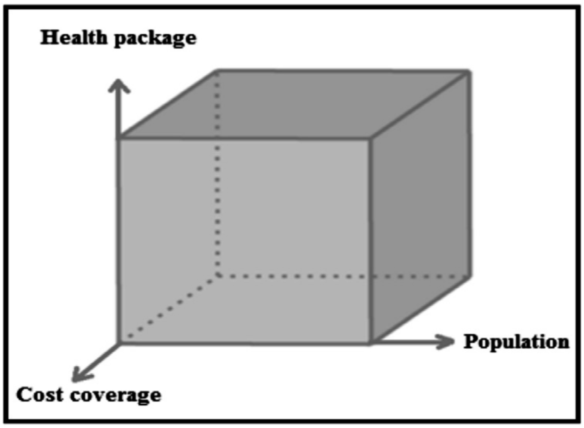
A cube model for three-factor coverage situation of Yeshsvini scheme, starting with the definition of Universal Health Coverage of the WHO, as the base is enumerated here.

4.5.2 The UHC Cube for Yeshasvini Scheme

(Srinivas *et al, 2017*)

Consider this as a hollow standardized unit cube, i.e. the maximum in each of the three dimensions (population, health package and cost coverage) is *unity.* As the rates move along the axes, the hollow of the cube gets filled up. Denote the currently reached proportions by (p_1, p_2, p_3), so that the filled-up volume is

$$V_3 = p_1, p_2, p_3 \qquad \dots (10)$$



Source: Author

Figure 5: Cube Model for Yeshasvini Scheme

This is a good indicator *(impact factor)* of the level (proportion) of health coverage accomplished in the target population, the maximum being clearly unity. This occurs when $p_1 = p_2 = p_3 = 1$ clearly. V_{max} has 1 as its value. In general, the volume gets maximized, for given $\sum p_i = q$, when $p_1 = p_2 = p_3 = q/3$. This represents equal values for the three proportions. This is the point where the geometric mean of the p_i equals the arithmetic and harmonic means. The above result shows the importance of balanced progresses in each of the three aspects. Alternatively, even if one of the progress directions is *unsatisfactory,* the entire coverage picture becomes murky.

Moving on with this scenario, the correct average progress is *NOT* the arithmetic mean

$$A_3 = (p_1 + p_2 + p_3)/ 3 \qquad \dots (11)$$

but rather the geometric mean

$$G_3 = (p_1\, p_2\, p_3)^{1/3} \qquad \dots (12)$$

which is nearly zero when *any one* of the proportions is near zero. *Optimum* effectiveness occurs with *equitable coverage* in the three directions. The rate G_3 represents the rate at which the cube gets occupied. For *continuously varying proportions,* the rates of change in the occupied portion of the cube are given by the *partial derivatives of* V_3 with respect to the parameters p_1, p_2 and p_3. These are respectively given by $p_2 p_3$, $p_1 p_3$ and $p_2 p_2$. The overall penetration of the program can be measured in terms of the filled-up content of the cube *viz.* V_3, which may be, therefore, termed as *Total Impact Factor* (TIF). Eventually, the hollow cube gets filled up to signal 100% coverage by the scheme. A generalization of the cube model to k- dimensions is also considered and its mathematical properties are investigated.

4.5.3 Budget Allocation for Optimum Coverage

The filled-up volume of the cube is $V_3 = p_1 p_2 p_3$ which is maximized, for given $p_1 + p_2 + p_3 = C$, $(0 \leq C \leq 3)$ when $p_1 = p_2 = p_3 = (C/3)$. This is geometrically akin to a rectangle of given perimeter reducing to a square when the area of the figure is to be maximized. This calls for equal paced increases in the pi for optimum coverage, as mentioned earlier.

Let us now consider the situation with a fixed and given budget C_0 that is to be optimally allocated to the three components to maximize the resulting coverage. Let X_i

denote the allocation to dimension i for $i = 1, 2, 3$. Then the constraint is

$$X_1 + X_2 + X_3 = C_0 \qquad \dots (13)$$

and the objective is to work out the allocation in order to achieve optimal coverage.

The coverage, measured by p_i in direction i, clearly depends on the allocation X_i. Thus

$$p_i = f(X_i) \qquad \dots (14)$$

which represents the functional form of dependence. Next examined are two particular choices for $f(X_i)$.

(a) Proportionality with X_i or $p_i = K_i X_i$

Then

$$V_3 = p_1 p_2 p_3 = (K_1 X_1)(K_2 X_2)(K_3 X_3) \qquad \dots (15)$$

where the K_i are the constants of proportionality. To have optimal coverage, the condition is

$$(K_1 X_1) = (K_2 X_2) = (K_3 X_3) \qquad \dots (16)$$

subject to the constraint (13).

Substituting for X_2 and X_3 in (13) in terms of X_1 from (16) leads to

$$X_1 + (K_1/K_2) X_1 + (K_1/K_3) X_1 = C_0$$

or $X_1 [1 + (K_1/K_2) + (K_1/K_3)] = C_0$

or $X_{1\,opt} = [(K_2 K_3) / (K_1 K_2 + K_1 K_3 + K_2 K_3)] C_0 \quad \dots (17)$

It may be noted that the constants of proportionality (K_i) can be different for the three directions. This allows flexible relations between improvement and cost implication.

The expressions for optimum X_2 and X_3 are similarly written down. It is easily verified that the budget constraint (13) is satisfied. Also for $K_1 = K_2 = K_3 = 1$, one gets equal allocation of the budget.

(b) Proportionality with $\sqrt{Xi}$

The improvement is often much *slower* than the increase in the budget provision. Thus, one may take

$$p_i = f(X_i) = K_i X_i^{\,p} \text{ for } i = 1, 2, 3 \qquad \dots (18)$$

Though any $p > 0$ may be considered, a choice of p as a fraction is quite realistic. A good choice is, therefore, $p = ½$, so that the coverage improvement is taken to be proportional to square root of the allocation, and

$$p_i = K_i \sqrt{X_i} \qquad \dots (19)$$

Model (19) incorporates a damping effect on the improvement. For example, in order to double the coverage rate, one has to raise the budget allocation four-fold.

For optimal growth the condition is

$$K_1 \sqrt{X_1} = K_2 \sqrt{X_2} = K_3 \sqrt{X_3} \qquad \dots (20)$$

subject to the constraint (13).

A straight forward recasting leads to

$$X_{1\,opt} = [(K_2^{\,2} K_3^{\,2}) / (K_1^{\,2} K_2^{\,2} + K_1^{\,2} K_3^{\,2} + K_2^{\,2} K_3^{\,2})] C_0 \qquad \dots (21)$$

The expressions for X_2 and X_3 are similarly written, noting the cyclic pattern.

A generalization to cuboid model to accommodate more than three factors is elaborately examined.

5.0 Conclusions / Limitations

5.1 Discussion, Suggestions and Frontiers

Finally, a retrospective view of the dissertation is given along with a summary. Three new directions for future work are outlined, together with some minor gaps in the existing work. The new directions include generalization of the models proposed to other fields, formation of a National Medical Data Base and development of a unified terminology for healthcare system with the terms uniquely reflecting their meaning. Relevant supplementary material is appended.

5.2 Contribution of the Study

The thesis makes a *five-fold* contribution on a modest scale to health sector service quality domain as follows:

1) Theoretical contribution in the form of a few novel ideas and quality measurement methods (classification and measurement indices/growth models) in the TSQ framework.
2) Some empirical evidence on healthcare service quality in Indian context together with discussion of policy issues and anomalies.
3) Examining a PPP model for providing satisfactory healthcare at affordable cost with the potential for countrywide expansion.
4) An effective summary of the work together with

clear outlining of three potential open areas for further work.

5) A brief review of relevant literature precedes the above contributions.

5.3 Limitations of the Work

These primarily concern the following:

1) The empirical evidence is only on a moderate scale due to the limited sample sizes. However, the reliability of the data personally collected by the candidate compensates, at least in part, this limitation.

2) Only two major medicine systems are covered. The alternative systems like *Yunani* and Homeopathy have not been included.

3) The geographical coverage for empirical evidence is not wide spread and limited to three cities, one in Gujarat and two in Karnataka.

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