Chapter 6

Yeshasvini Scheme in Karnataka State: A PPP Model

PPP models have been tipped as a win-win situation in public healthcare and have been strongly commended as an efficient way to deliver quality health services at affordable cost to the large mass of people. The case of Yeshasvini scheme of the Karnataka Government, introduced in the year 2003, is examined as an example for emulation. The genesis of the scheme, the procedural steps and the growth trend are outlined. An analysis of the beneficiary responses on the questionnaire used for the empirical study is provided. The working of this experiment can be improved upon by plugging the loopholes and the model can be extended for wider geographical implementation. A new geometric (cube) model as a mathematical framework for evaluating such schemes is proposed. A new cuboid model is developed and analyzed for a general coverage process. Geometrically, it emphasizes the role of equal thrust in all the coverage parameters for achieving optimum results.

6.1 The Yeshasvini Scheme of Karnataka Government (2003)

A large population segment (particularly rural) is given very little financial security against healthcare expenditure. Thus, the poor cannot afford good healthcare; if they do, the attempt becomes expensive and they get impoverished. Yeshasvini scheme, Rashtriya Swasthya Bima Yojana (RSBY) and the Vajpayee Arogyashree scheme in the context of Karnataka State are the major schemes being implemented. Some other free healthcare schemes for BPL card holders in Karnataka are Rajiv Arogya Bhagya, Jyothi Sanjeevini, Rashtriya Bala Swasthya Karyakrama and Mukhyamantri Santhwana Harish Yojana. In this setting, Yeshasvini Cooperative Farmers' Healthcare Scheme (YCFHCS, referred to as the scheme henceforth in this dissertation for brevity) assumes special significance due to its novelty. With the launch of the scheme, it is expected to reach large masses in the rural & urban areas. This initiative by the State Government of

Total Service Quality in Healthcare: With Special Reference to Yeshasvini Project in Karnataka
Karnataka is creating awareness among the masses. The table below shows the growth (outreach) and trend of the scheme, right from its inception in the year 2003.

The first of the two tables show more than double growth in membership size in the rural scheme. The out-patient department (OPD) services exhibit about a five-fold expansion. The surgeries registered a tremendous upward trend from about 1000 to more than 1.7 lakhs annually. The financial component will have to be adjusted for monetary inflation and other factors (e.g. cost escalation) before concluding on the trend. It happens to be a less important parameter.

Beginning June 1, 2014, the Government of Karnataka (GOK) has launched ‘Nagara Yeshasvini’ scheme to cover urban poor in the State. It intends to cover members of cooperative societies, without any income tag, up to the age of seventy-five years, against an annual membership fee of Rs. 710. The nominal membership fee in the scheme is to inculcate a sense of seriousness, involvement and participation by the beneficiaries. It is well known that anything given as gratis is liable to be taken lightly and misused. The membership makes the patient to feel as a stakeholder, in a sense. This is a characteristic of a PPP model. The urban Yeshasvini scheme appears to be getting popular.

### Table 6.1a: Growth of Urban Yeshasvini (2014-17)

<table>
<thead>
<tr>
<th>Year</th>
<th>Membership (In lakhs)</th>
<th>Members Contribution (Rs. in Crores)</th>
<th>Govt. Contribution (Rs. in Crores)</th>
<th>No. of OPD cases</th>
<th>No. of Surgeries</th>
<th>Amount Reimbursed (Rs. in Crores)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014-15</td>
<td>1.72</td>
<td>12.22</td>
<td>10</td>
<td>16844</td>
<td>6129</td>
<td>9.1</td>
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<tr>
<td>2015-16</td>
<td>1.85</td>
<td>11.86</td>
<td>8.41</td>
<td>19895</td>
<td>11142</td>
<td>20.21</td>
</tr>
<tr>
<td>2016-17</td>
<td>2.25</td>
<td>14.44</td>
<td>-</td>
<td>28458</td>
<td>17084</td>
<td>32.21</td>
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<tr>
<td>Total</td>
<td>5.82</td>
<td>38.52</td>
<td>18.41</td>
<td>65197</td>
<td>34355</td>
<td>61.52</td>
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</table>

*Source: Website of The Trust drawn on July, 2017*

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**Total Service Quality in Healthcare: With Special Reference to Yeshasvini Project in Karnataka**
Table 6.1b: Growth of Rural Scheme during (2003-17)

<table>
<thead>
<tr>
<th>Year</th>
<th>Membership (In lakhs)</th>
<th>Members Contribution (Rs. in Crores)</th>
<th>Govt. Contribution (Rs. in Crores)</th>
<th>No. of OPD cases</th>
<th>No. of Surgeries</th>
<th>Amount Reimbursed (Rs. in Crores)</th>
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</thead>
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<tr>
<td>2003-04</td>
<td>16.01</td>
<td>9.49</td>
<td>4.5</td>
<td>35814</td>
<td>9047</td>
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<td>2004-05</td>
<td>21.05</td>
<td>12.87</td>
<td>3.57</td>
<td>50174</td>
<td>15236</td>
<td>18.47</td>
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<td>2005-06</td>
<td>14.73</td>
<td>16.94</td>
<td>11</td>
<td>52892</td>
<td>19677</td>
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<td>2006-07</td>
<td>18.54</td>
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<td>19.85</td>
<td>206977</td>
<td>39602</td>
<td>38.51</td>
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<td>2007-08</td>
<td>23.18</td>
<td>27.75</td>
<td>25</td>
<td>155572</td>
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<td>2010-11</td>
<td>30.47</td>
<td>41.68</td>
<td>30</td>
<td>157480</td>
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<td>2011-12</td>
<td>30.7</td>
<td>45.08</td>
<td>30</td>
<td>116690</td>
<td>77619</td>
<td>60.09</td>
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<tr>
<td>2012-13</td>
<td>30.36</td>
<td>58.88</td>
<td>35</td>
<td>110842</td>
<td>80401</td>
<td>74.12</td>
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<tr>
<td>2013-14</td>
<td>37.97</td>
<td>52.33</td>
<td>45</td>
<td>123205</td>
<td>95715</td>
<td>95.89</td>
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<tr>
<td>2014-15</td>
<td>38.72</td>
<td>69.4</td>
<td>61.95</td>
<td>172442</td>
<td>134792</td>
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</tr>
<tr>
<td>2015-16</td>
<td>39.43</td>
<td>70.42</td>
<td>101.15</td>
<td>199549</td>
<td>168591</td>
<td>264.41</td>
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<tr>
<td>2016-17</td>
<td>41.47</td>
<td>91.83</td>
<td>170.43</td>
<td>243318</td>
<td>177045</td>
<td>285.6</td>
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<tr>
<td>Total</td>
<td>403.79</td>
<td>595.69</td>
<td>597.45</td>
<td>1950598</td>
<td>1094205</td>
<td>1254.97</td>
</tr>
</tbody>
</table>

Source: Website of The Trust drawn on July, 2017

Graph 6.1a: Reach of Yeshasvini Scheme

Source: Author

Total Service Quality in Healthcare: With Special Reference to Yeshasvini Project in Karnataka
The above two graphs display the numerical growth in the outreach of the scheme. The *bar chart* shows the increase in the membership over the years. The fall in membership during the year (2005-06) is due to non-renewal by a sub-group of members. The *trend chart* shows numerical expansion of the number of medical cases handled. It is to be particularly noted that the number of surgical cases have surpassed the number of OPD cases in the year (2015-16). The monetary aspect has not been graphed since it is subject to the inflation factor.

6.2.1 Highlights of the Scheme

This scheme is the brain-child of Dr. Devi Shetty of Narayana Hrudayalaya, Bengaluru. He has taken a lead in spread of tele-medicine facility along with low-cost heart surgeries in the country. Patients from other Asian countries are noted to be using this mode of doctor-contact. The highlights of the scheme *at a glance* are:

- Started in 2003 to help the rural masses to overcome high cost burden of medical treatment. A trust called Yeshasvini Cooperative Farmers' Healthcare Trust was formed.
- A Government sponsored contributory healthcare scheme for enrolled members, who pay a nominal annual fee (Rs. 300 for Rural and Rs. 710 for Urban).
— Membership to any member of a rural/urban cooperative society and his family.

— Provides facility for surgeries from a list of 823 in fourteen medical disciplines.

— Surgeries are facilitated in 730 paneled hospitals across Karnataka State.

— Provides concessional OPD treatment and clinical investigations at 25% discount in network hospitals.

— Maximum benefit per person in Rural Schemes is Rs. 1.25 lakhs for single admission for a year. It is Rs. 2.00 lakhs for multiple admissions in the same year.

— A Management Support Service Agency appointed by the Trust coordinates among members, network hospitals and the Trust (which settles the bills from the hospitals).

— FHPL is the agency as of now, monitoring through Yeshasvini Service centers established by them and District coordinators. It conducts medical audit of hospitals.

— The budget provision for year (2016-17) was Rs. 169 crores, for (2017-18), it was 184 crores.

— Total enrollment during (2016-17) was 43.7 lakhs and close to 1.8 lakhs surgeries were supported.

— During the fourteen years (2003-17), a total of 11.28 lakhs surgeries were performed with a support of Rs. 1316.49 crores.

— An urban component of the scheme was introduced in the year 2014.

— The scheme has eliminated going to money lenders or pledging jewelry for meeting the treatment expenses.

— The people in left margin of horizontal income axis are mainly under the focus.

6.2.2 The Working Model

The scheme runs on Public Private Participation (PPP) model. The entities involved are (Figure 6.2a)
a) the Government (Yeshasvini Trust), b) the Beneficiaries, 
c) the Network hospitals, and d) the Management Services Provider (MSP).

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**Figure 6.2a: Components of the Scheme**

<table>
<thead>
<tr>
<th>Constraints</th>
<th>Strategies/Mechanisms</th>
<th>Outcomes</th>
<th>Strategies/Mechanisms Principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispersed Rural Farmers &amp; Peasants</td>
<td>Mobilization through Co-operatives</td>
<td>Large Population Low Premium</td>
<td>Free Choice</td>
</tr>
<tr>
<td>Inadequate Health Infrastructure</td>
<td>Networking Hospitals</td>
<td>Comprehensive Benefits Sustainable</td>
<td>Needs a Massive Education Effort</td>
</tr>
<tr>
<td>Weak Administration</td>
<td>Professionalization</td>
<td>Third Party Administration</td>
<td>Self-Sustainable</td>
</tr>
</tbody>
</table>

*Source: Kuruvilla S. et al., (2007)*

**Figure 6.2b: A General Model of the Scheme**

**Total Service Quality in Healthcare: With Special Reference to Yeshasvini Project in Karnataka**
6.2.3 Lessons from Similar Schemes

Studies of similar schemes in India and abroad meant for the poor in informal sector have revealed the following main drawbacks, blocking from the goal of health insurance for the masses. A few other program specific issues may exist, under a scheme.

a) **Restriction in Scope**

Many schemes cover at best a small percentage of target population, e.g. only a geographical area or a subset of a population.

b) **Restriction in Benefits**

The scope of benefits is limited mainly because the premiums for health insurance schemes for poor people have to be limited. Thus, financing of health insurance is a serious constraint.

c) **Administrative Issues**

Generally, the administration is rather weak, paying relatively little attention to quality of healthcare or efficient delivery.

d) **Accessibility and Healthcare Infrastructure**

Many schemes are limited due to the problem of providing access. In order to overcome this bottleneck, an extensive network of hospitals, dispensaries and healthcare providers must be established which may be beyond the financial ability of local governments. Novel and innovative methods to overcome the above four critical problems are needed, coupled with a political will and commitment. This will be an effective step towards achieving health for all. The rules and regulations should effectively circumscribe the functioning of private hospitals.

The operational aspect of Yeshasvini scheme, above stated four constraints is effectively tackled as per the strategies/mechanisms above (Figure 6.2b).

The Yeshasvini scheme may be expanded in scope by incorporating tele-medicine facility as a networking dimension. This will allow consultation with highest level of medical expertise, without the necessity of traveling long distances. This will turn out to be a boon especially for the rural populace.

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**Total Service Quality in Healthcare: With Special Reference to Yeshasvini Project in Karnataka**
6.2.4 The Benefits under the Scheme

The beneficiaries are entitled for any of the 823 surgical procedures identified in fourteen specialties in the medical field like general surgery, gynecology, cardiology, vascular, gastro-, neuro-, ortho-, ophtho- pediatric surgery etc. the medical emergencies like drowning, bull-gore, snake bite, accident by agriculture equipment, etc. normal delivery and neonatal services are also included. The Trust has included from 01-10-2013 the implants in CVS and Orthopedic surgeries and radiation oncology treatment in the scheme. An unexpected medical shock without insurance cover, can bowl over the household lock, stock and barrel. The scheme comes as a financial savior.

The Surgery Packages

This includes cost of medicines, consumables during hospital stay, ICU stay, cost of operation theater, anesthesia, surgeon's fee, professional charges, consultation fee, nursing fee, accommodation etc. are included in the package and the trust reimburses this expenditure to the hospital directly. The beneficiaries are entitled only to general ward facilities.

Typical Surgical Procedures and Approved Rates (as in 2017)

Table 6.2: Surgical Procedures and Approved Rates

<table>
<thead>
<tr>
<th>Main Specialty</th>
<th>Procedure Name</th>
<th>Approved Rates (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gynecology and Obstetrics surgery</td>
<td>Normal Delivery</td>
<td>3000</td>
</tr>
<tr>
<td>General surgery</td>
<td>Fistulectomy</td>
<td>4000</td>
</tr>
<tr>
<td>General surgery</td>
<td>Appendicectomy</td>
<td>8000</td>
</tr>
<tr>
<td>Cardiology</td>
<td>Aorta Balloon Valvotomy (ABV)</td>
<td>15000</td>
</tr>
<tr>
<td>Cardiac Surgery</td>
<td>Ventricular Septal Defect Closure</td>
<td>60000</td>
</tr>
</tbody>
</table>

Source: Website of The Trust, January, 2017

Total Service Quality in Healthcare: With Special Reference to Yeshasvini Project in Karnataka
6.2.5 Procedural Steps- A Hassle Free Process

Each principal member is given ID card with a Unique Health Identification (UHID) number and the details of family members. The data entry of all beneficiaries is done every year and their photographs are scanned and hosted in the website, so that network hospitals and MSP can verify while processing pre-authorization. Operational steps are as under:

a) Member approaches Network Hospitals with UHID card,

b) Network hospitals intimates MSP through 'First Admission Report' and extends cashless treatment,

c) Network hospitals are paid by the Yeshasvini Trust.

This hassle-free administration enables the issue of pre-authorization for surgeries within three to four hours and settlement of hospital bills within a month. This exhibits the inbuilt good governance in the operation of scheme.

6.2.6 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 criteria for paneling are fixed by the Yeshasvini Trust. The district coordination committee in each district receives application, verifies the details, the district surgeon and DHO visit the applicant hospital, make verification and recommend the application, which is placed in district coordination committee meeting for approval and sent to the Trust for final approval. 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 MSP and performs it and discharges the patient. The claims are submitted through MSP and the Yeshasvini Trust pays for the same. The Figure 6.4 displays the sequential steps as a flow chart showing the precedence and relations. They are apt for understanding the mechanism clearly. Figure 6.1b displays how the scheme attempts to solve the four major obstacles for
growth of health insurance scheme as mentioned above. Figure 6.3 indicates the process of enrollment of new hospitals. Figure 6.4 shows the process of availing treatment. The remaining two figures (Figure 6.5 & 6.6) display the pre-authorization and claim settlement respectively.

**Third Party Administrators**

The Government's Insurance Development Regulatory Authority (IDRA) makes it mandatory that any insurance scheme should have a Third-Party Administrator (TPA). This administrator will take care of the working of the schemes and process the monetary claims. However, he will not be an integral part of the organization which provides medical assistance. An established firm Family Health Plan Limited (FHPL), a division of Appolo Hospital has been appointed as TPA. FHPL devises procedures and systems for managing the scheme.

**Table 6.3: District-wise Number of Hospitals**

<table>
<thead>
<tr>
<th>District Name</th>
<th>No. of Network Hospitals</th>
<th>District Name</th>
<th>No. of Network Hospitals</th>
<th>District Name</th>
<th>No. of Network Hospitals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bagalkote</td>
<td>58</td>
<td>Dmkshina Kannada</td>
<td>31</td>
<td>Mandya</td>
<td>24</td>
</tr>
<tr>
<td>Bangalore Urban</td>
<td>92</td>
<td>Davanagere</td>
<td>26</td>
<td>Mysore</td>
<td>41</td>
</tr>
<tr>
<td>Belgaum</td>
<td>59</td>
<td>Dharwad</td>
<td>33</td>
<td>Raichur</td>
<td>14</td>
</tr>
<tr>
<td>Bellary</td>
<td>10</td>
<td>Gadag</td>
<td>13</td>
<td>Ramanagaram</td>
<td>14</td>
</tr>
<tr>
<td>Bidar</td>
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<td>Gulbarga</td>
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<td>Shimoga</td>
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<td>26</td>
<td>Tumkur</td>
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<td>Uttara Kannada</td>
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<td>Kolar</td>
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<td>Yadgir</td>
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<td>12</td>
<td>Koppal</td>
<td>12</td>
<td></td>
<td></td>
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</table>

*Source: Website of The Trust, February, 2018*

**Pre-authorization**

When a doctor at a network hospital determines that the scheme patient requires surgery, he requests FHPL to authorize the surgery, through a pre-authorization form along with a
copy of the ID card of the patient and Society membership card. In cases of emergency, they can call and send the documents later. This process is displayed in Figure 6.5. It may be noted that the process is simple and from the patient's view-point there is no hassle for admission. Finally, the process of claims settlement is shown in Figure 6.6.


Figure 6.3: Enrollment of New Hospitals

Total Service Quality in Healthcare: With Special Reference to Yeshasvini Project in Karnataka
Beneficiary approaches Society for referral letter

Secretary explains scheme & gives letter

Beneficiary goes to NWH with ID card, receipt & letter

IP admission
Free OPD consultation
Admission for surgery

Patient pays for treatment
Investigation under special rate

Normal
Beneficiary leaves hospital

Gets operated under scheme for free


Figure 6.4: Process of Availing Treatment

**Total Service Quality in Healthcare:** With Special Reference to Yeshasvini Project in Karnataka
Total Service Quality in Healthcare: With Special Reference to Yeshasvini Project in Karnataka

Figure 6.5: Process of Pre-authorization

6.3 Cases under Yeshasvini Scheme

The profile report of three typical patient cases are presented to give a feel for the working of the scheme. However, profiling of participating hospitals is not attempted.

(1) K. Puttaiah of Channapatna, near Bengaluru

Mr. Puttaiah is a farmer aged about fifty-eight years and has three acres of agricultural land. He is able to take care of his family of five under normal circumstances. But his savings are negligible. Mr. Puttaiah never knew about the scheme. The secretary


Figure 6.6: Process of Claim Settlement

Total Service Quality in Healthcare: With Special Reference to Yeshasvini Project in Karnataka
of his village cooperative society, a friend of his, told Puttaiah about the scheme and possible health coverage of the same. After dilly-dallying for about a year, Puttaiah signed up for the scheme after paying the nominal annual membership fee in the year 2011.

In March, 2013, a throat problem showed up for Puttaiah and it needed an urgent surgery. He was referred to Vikram hospital in Bengaluru for the surgical treatment. This was promptly carried out with only a minor cost impact on Puttaiah in April, 2013, thanks to the coverage provided by the scheme. Now Puttaiah has fully recovered and is leading a normal life. The surgery as such would have costed about Rs. 1.4 lakhs, which would have turned Puttaiah’s economy upside down. These days Puttaiah is happily canvassing for the scheme among his friends and relatives.

(2) B. Thyampanna Shetty, Brahmavara, Udupi District

Mr. Shetty is a graduate and a progressive farmer aged about sixty-two years. He grows mainly areca and coconuts on the land of about five acres. This is a medium sized holding and is self-sustaining as Mr. Shetty's family members to provide labor for the farming. No major savings is on hand to cover unforeseen shock expenses like a large medical bill. However, Mr. Shetty has been a member under the scheme in his village for long [since the year 2005]. He has been an active advocate of the scheme.

In the year 2008, Mr. Shetty was diagnosed to have a couple of acute blockages in his arteries. He was referred to a leading hospital at Manipal, which estimated the cost of surgery to be about Rs. 2 lakhs. Mr. Shetty was relieved to know that the scheme would provide coverage for the treatment, which was carried out in January, 2009 and was a success. The family members too felt happy as their main-stay was restored, without a financial crisis.

(3) M. Ganesh Shastry, Malooru, Kolara District

Aged about thirty-eight years, Mr. Shastry is an Archaka (Priest) by profession. He is engaged in dairying as a supplementary source of income. His wife is just a housewife. In view of his involvement in dairying, Mr. Shastry is a member of local
cooperative society. He was coaxed to become a member of the scheme, as he initially felt the membership fee to be an avoidable expense. He became a member in the October, 2010.

In the year 2013, his little daughter, Meghana, aged three, was noted to be experiencing frequent breathing problems. The doctors diagnosed Meghana to be having a hole in the heart, which was to be fixed in two stages over a span of a year. The treatment was estimated to cost about Rs. 1.8 lakhs. Mr. Shastry's monthly income of about Rs. 15000 was barely able to meet the routine living expenses, despite a rent free ancestral home to live in. The scheme came to his rescue and his daughter underwent the required surgical treatment without any overturn of the family economy. Today, Meghana is a diligent and active student in 3rd standard studying in Government Primary School at Malooru.

The above three cases amply demonstrate how the scheme has been rescuing families from high costs associated with medical exigencies. This accounts for the growing awareness and popularity of the scheme.

6.4 Survey Responses from Yeshasvini Beneficiaries

To get a cross sectional view, the 118 responses (seventy-nine from government and thirty-nine from private hospitals) from the beneficiaries of the Yeshasvini scheme included in the field survey were focused upon again in isolation. This will help to get the feel for their feedback on the functioning of the scheme. The general trend is very much like that observed in the total sample pool. The largest perceptions concerned Courtesy, Timely service, Patient's interest, Willingness to help and Burden on bills in that order. On the lower side, Website update, Interior design, Information, Wifi connectivity and Business cards were seen in that order. As for expectations, Readiness to respond, Understanding needs, Caring, Cured feeling and Professionalism were on the top, while Wifi connectivity, Interior design, Website update, Formality and Parking were at the bottom. The difference in the perceived and expected average scores ranged from -1.19 to 1. The highest difference was recorded in the case of two items viz. Q4 and Q18.

**Total Service Quality in Healthcare: With Special Reference to Yeshasvini Project in Karnataka**
pertaining to timely cure of the ailment as well as convenient transaction hours. The difference of one was noted for Q44 concerning the structure of the hospital.

Table 6.4: The Five Largest/Smallest Average Quality Scores for Responses from Yeshasvini Beneficiaries

<table>
<thead>
<tr>
<th>The five highest Yeshasvini beneficiaries Expectations</th>
<th>The five lowest Yeshasvini beneficiaries Expectations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statements</td>
<td>Statements</td>
</tr>
<tr>
<td>Mean scores</td>
<td>Mean scores</td>
</tr>
<tr>
<td>SE9 (Readiness to respond)</td>
<td>SE62 (Wifi connectivity)</td>
</tr>
<tr>
<td>4.46</td>
<td>2.13</td>
</tr>
<tr>
<td>SE17 (Understanding needs)</td>
<td>SE49 (Interior design)</td>
</tr>
<tr>
<td>4.43</td>
<td>2.21</td>
</tr>
<tr>
<td>SE23 (Caring)</td>
<td>SE63 (Website updating)</td>
</tr>
<tr>
<td>4.31</td>
<td>2.4</td>
</tr>
<tr>
<td>SE10 (Cured feeling)</td>
<td>SE36 (Formality)</td>
</tr>
<tr>
<td>4.25</td>
<td>2.57</td>
</tr>
<tr>
<td>SE21 (Professional)</td>
<td>SE46 (Parking)</td>
</tr>
<tr>
<td>4.25</td>
<td>2.61</td>
</tr>
</tbody>
</table>

The five largest differences for Yeshasvini beneficiaries

<table>
<thead>
<tr>
<th>(SP-SE)4 (Timely cure)</th>
<th>-1.19</th>
</tr>
</thead>
<tbody>
<tr>
<td>(SP-SE)18 (Convenient transaction hours)</td>
<td>-1.19</td>
</tr>
<tr>
<td>(SP-SE)9 (Readiness to respond)</td>
<td>-1.08</td>
</tr>
<tr>
<td>(SP-SE)17 (Understanding needs)</td>
<td>-1.06</td>
</tr>
<tr>
<td>(SP-SE)5 (Record documentation)</td>
<td>1.02</td>
</tr>
</tbody>
</table>

The five smallest differences for Yeshasvini beneficiaries

<table>
<thead>
<tr>
<th>(SP-SE)57 (Billing statements)</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>(SP-SE)61 (Brochures &amp; handouts)</td>
<td>0</td>
</tr>
<tr>
<td>(SP-SE)8 (Willingness to help)</td>
<td>0.03</td>
</tr>
<tr>
<td>(SP-SE)56 (Stationery)</td>
<td>0.04</td>
</tr>
<tr>
<td>(SP-SE)25 ( Appropriateness of location)</td>
<td>0.08</td>
</tr>
</tbody>
</table>

Source: Author

Total Service Quality in Healthcare: With Special Reference to Yeshasvini Project in Karnataka
The five highest Yeshasvini beneficiaries Perceptions

<table>
<thead>
<tr>
<th>Statements</th>
<th>Mean scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP12 (Courteous)</td>
<td>4.15</td>
</tr>
<tr>
<td>SP7 (Timely service)</td>
<td>3.92</td>
</tr>
<tr>
<td>SP16 (Patient's interest)</td>
<td>3.9</td>
</tr>
<tr>
<td>SP8 (Willingness to help)</td>
<td>3.85</td>
</tr>
<tr>
<td>SP11 (Less burden on bills)</td>
<td>3.75</td>
</tr>
</tbody>
</table>

The five lowest Yeshasvini beneficiaries Perceptions

<table>
<thead>
<tr>
<th>Statements</th>
<th>Mean scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP63 (Website updating)</td>
<td>2.61</td>
</tr>
<tr>
<td>SP49 (Interior design)</td>
<td>2.74</td>
</tr>
<tr>
<td>SP26 (Information)</td>
<td>2.81</td>
</tr>
<tr>
<td>SP62 (Wifi connectivity)</td>
<td>2.81</td>
</tr>
<tr>
<td>SP55 (Business cards)</td>
<td>2.92</td>
</tr>
</tbody>
</table>

Source: Author

For higher perceptions, three of the top five are common, while on the lower side two are common between the General and the Yeshasvini response scenarios. As far as expectations are concerned, two are common on the higher side an equal number on the lower side. On the differences front, there are two common on the higher side and one on the lower side. Thus, understandably, the responses in the General and Yeshasvini scenarios are quite parallel.

A glance at the below table reveals that the sources of information regarding the scheme are evenly distributed among the three options provided. The usage has been once or twice and very rarely more than four times. The other five parameters embody the level of appreciation of the scheme. This averages about 61.8% on the higher side and about 14.6% on the lower side. It appears fair enough to conclude that the Yeshasvini scheme displays a success story as opined by the respondents.

Total Service Quality in Healthcare: With Special Reference to Yeshasvini Project in Karnataka
Table 6.5: Responses to Specific Questions on the Scheme

<table>
<thead>
<tr>
<th>Statement</th>
<th>Percentage Breakup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source of Information</td>
<td>Peers (38%)</td>
</tr>
<tr>
<td></td>
<td>Media or Co-operatives (40%)</td>
</tr>
<tr>
<td></td>
<td>Others (22%)</td>
</tr>
<tr>
<td>Number of Times Scheme Used</td>
<td>One-Two (70%)</td>
</tr>
<tr>
<td></td>
<td>Three-Four (16%)</td>
</tr>
<tr>
<td></td>
<td>More than Four (8%)</td>
</tr>
<tr>
<td>As Insurance Cover</td>
<td>Okay (20%)</td>
</tr>
<tr>
<td></td>
<td>Fair (25%)</td>
</tr>
<tr>
<td></td>
<td>Good (55%)</td>
</tr>
<tr>
<td>Scheme Utility</td>
<td>Low (8%)</td>
</tr>
<tr>
<td></td>
<td>Average (20%)</td>
</tr>
<tr>
<td></td>
<td>High (72%)</td>
</tr>
<tr>
<td>Quality Level of Service</td>
<td>Low (16%)</td>
</tr>
<tr>
<td></td>
<td>Average (29%)</td>
</tr>
<tr>
<td></td>
<td>High (55%)</td>
</tr>
<tr>
<td>Recommendation for Scaling Up</td>
<td>Yes (70%)</td>
</tr>
<tr>
<td></td>
<td>No (12%)</td>
</tr>
<tr>
<td></td>
<td>Undecided (18%)</td>
</tr>
<tr>
<td>Operating Procedure</td>
<td>Simple (51%)</td>
</tr>
<tr>
<td></td>
<td>Okay (38%)</td>
</tr>
<tr>
<td></td>
<td>Messy (11%)</td>
</tr>
</tbody>
</table>

Source: Author

6.5.1 Functioning of the Scheme

From the perspective of covering lifesaving surgeries for the poor, the scheme has worked as a boon. There is good awareness about the scheme and it is noted that the prospective patients often ask the question “Do you have Yeshasvini Scheme?” before getting admitted to a hospital for OPD or surgery. The number of beneficiaries testifies to this. Early after commencement of the scheme, Kuruvilla et al (2005) carried out an evaluation of the working of the project. They put it as a success story in the making and projected the scheme to grow statewide and to be replicated in other States. Established institutions like NABARD consultancy service, Institute for Social and Economic Change, Cologne University (Germany) have examined the scheme subsequently and listed its merits, strengths and shortcomings, with an overall appreciative tone. The ILO comments thus on the scheme. It is successful in providing surgical and OPD coverage to the targeted population. The scheme is considered to be one of the most cost-effective.
All have lauded it as an example of social concern of the cooperation department, nurturing it right from its inception in the year 2003 to make it a flagship program of the Karnataka Government. It is projected to take deeper roots and witness growth both intensive and extensive and is expected to shuffle across in space and time.

**6.5.2 Service Quality in the Scheme**

The above-mentioned studies focus on the functioning (working) of the scheme. They do not delve deep into service quality aspects. But the scheme is embedded into the healthcare sector and is delivered as a PPP model. As a rule, the quality of 'a part' can be no better that the quality of 'the whole'. But the following aspects are in its favor and make the service quality higher than the overall 'average quality' in the sector. The mix of hospitals in the State is very heterogeneous and the 'better hospitals' are generally the participants.

- Joining the scheme is voluntary for the hospitals,
- A screening takes place before final admission as a participating hospital,
- The hospitals would not like their brand image to be lowered,
- They may include the scheme as part of Corporate Social Responsibility (CSR),
- The membership for the individual is easy through the membership of a cooperative society,
- The admission into the concerned hospital, when the need arises, is hassle-free,
- The scheme gives surgical cost-cushion and cover and
- Generally, only the leading hospitals with good establishment and facilities participate in the scheme (E.g: Narayana Hrudayalaya & Jayadeva Cardiovascular Institute, Bengaluru)

**6.5.3 Problems with the Scheme**

The perceived shortcomings of the scheme include the following:

1) The public awareness about the Scheme needs to be further improved,
2) The doctors bestow very little attention to the patient's (and guardian's) narration of the problems,
3) The reimbursement of expenses to the hospital by the State Government is slow, and often it is evasive,
4) Because of remark (3), the hospitals (doctors) show disinterest and reluctance in taking up the cases,
5) The post-treatment care is poor and unsatisfactory,
6) All health-related matters are not included in the package,
7) The items not covered like diagnostic tests and medicines continue to be a burden,
8) Some major exclusion from the coverage are medical line of treatment, chemotherapy, cosmetic/dental surgeries, treatment for burns and road accidents,
9) Tendency to overbill in view of insurance coverage,
10) Lack of education among members about what is covered and what is not covered and
11) More diseases to be included along with higher budget allotment.

In the Yeshasvini model, the Total Service Quality should be the overall thrust and the stages/components of the model are to be geared for this purpose. The model should be able to ensure a smooth and efficient passage from the 'problem' to 'solution'. These are the two logical ends of the model. In between are 'diagnosis', 'cure' and 'management' of the problem to ensure an efficient delivery. This logically includes follow up contact and care for cases like TB, cancer and heart related ailments. The cause and effect process should be integrated and be merged in order to ensure Total Service Quality, without having any disconnect.

Karnataka State has been in the forefront of State-sponsored health schemes in the country. For instance, the Yeshasvini Scheme has facilitated the poor to get surgeries carried out in state-of-the art hospitals at minimal costs. But over a period, a plethora of government backed insurance schemes has deteriorated in quality and are mainly

**Total Service Quality in Healthcare: With Special Reference to Yeshasvini Project in Karnataka**
benefiting private hospitals. This calls for a basic streamlining of the working of the various government schemes.

6.6.1 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.

In each of the below 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 \((p_2)\)
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 Yeshasvini scheme, starting with the definition of Universal Health Coverage of the WHO, as the base is enumerated next.

Table 6.6: Programs and Parameters

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Base</th>
<th>Parameter</th>
<th>Program</th>
<th>Number of Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Child Health</td>
<td>Proportion of children covered.</td>
<td>Immunization.</td>
<td>One</td>
</tr>
<tr>
<td>2</td>
<td>Primary Education</td>
<td>Proportions of enrollment and dropout.</td>
<td>Universal child education.</td>
<td>Two</td>
</tr>
<tr>
<td>3</td>
<td>Human Development</td>
<td>Per capita income, Literacy rate and Quality of life.</td>
<td>Programs related income generation, healthcare and Universal education.</td>
<td>Three</td>
</tr>
<tr>
<td>4</td>
<td>Public Healthcare</td>
<td>Proportions of population, costs and covered ailments.</td>
<td>Public sector and PPP healthcare models.</td>
<td>Three</td>
</tr>
<tr>
<td>5</td>
<td>Maternal Health</td>
<td>Proportion of women covered in child-bearing group, maternity and infant mortality rates.</td>
<td>Maternal healthcare packages and related schemes.</td>
<td>Three</td>
</tr>
<tr>
<td>6</td>
<td>Nutrition for School Children</td>
<td>Proportion of school children covered, Quality and Nutrition value of food.</td>
<td>Mid-day meal schemes.</td>
<td>Three</td>
</tr>
</tbody>
</table>

Source: Author

6.6.2 Universal Health Coverage: WHO View

The WHO describes Universal Health Coverage (UHC), aimed to be achieved by the year 2030, as a state where the health needs of all the citizens are met without any of them experiencing financial hardship. It displays UHC as a cube with three dimensions –

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population coverage, service coverage (health package, availability) and cost coverage. It is hoped that this cube is filled up step by step in a phased manner through commitment, consensus and participatory leadership. Each of the three axes must show progressive increments by overcoming electoral populism, personal preferences of medical personnel and hindered flow of public finance. The costs may be covered via tax-funding or social insurance. Relevant factors must be integrated into the package design. The healthcare divide must be bridged. The next phase of Indian Economic Revolution (started in 1991) is expected to occur from the services sector (and not manufacturing), which includes health services.

6.6.3 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

\[ V_3 = p_1 p_2 p_3 \]  

... (6.1)

Source: Author

Figure 6.7: 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. \( V_{\text{max}} \) 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

\[
A_3 = (p_1 + p_2 + p_3)/3 \quad \ldots \quad (6.2)
\]

but rather the geometric mean

\[
G_3 = (p_1 p_2 p_3)^{1/3} \quad \ldots \quad (6.3)
\]

which is nearly zero when any one of the proportions is near zero. For instance, with 10 \%, 20 \% and 40 \% coverage in the three directions the overall coverage is 20 \%. But if the 10 \% coverage is reduced to just 1 \%, the coverage percentage is now 100 \((0.0008)^{1/3}\) or less than 10 \%. Coverage of even 40 \% in one of the directions is hardly able to lift the overall coverage percentage. Thus, what matters most for optimum effectiveness is an equitable coverage in the three directions. For instance, 10 \% coverage in each of the three fronts results in an overall coverage of 10 \%, which is better than the percentage triplet (1, 20 & 40). This shows the collective role of the three realized directional proportions. 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 \( p_1 p_2 \). 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). This is maximized, as already mentioned, when the parameters progress at equal pace. Eventually, the hollow cube gets filled up to signal 100 \% coverage by the scheme. A generalization of the cube model to

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$k$-dimensions will be considered later in the chapter. The mathematical properties of this model will be investigated in that context. The corresponding features of the cube model will follow by taking $k = 3$.

Effective healthcare concerns three inter-connected issues: *access*, *quality* and *cost*. There are to be addressed in an integrated manner and *not* in isolation. A rational way is to fit in these angles into single system architecture, for example as a UHC, now built into the sustainable Development Goals. The three issues may be envisioned as the three axes of the UHC Cube, discussed above, and need uniform improvements for maximized effect.

### 6.6.4 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 $p_i$ for optimum coverage, as mentioned earlier.

Let us now consider the situation with a fixed and given budget $C_0$ which 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

$$X_1 + X_2 + X_3 = C_0 \quad \ldots (6.4)$$

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

$$p_i = f(X_i) \quad \ldots (6.5)$$

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

$$V_3 = p_1 p_2 p_3 = (K_1 X_1)(K_2 X_2)(K_3 X_3) \quad \ldots (6.6)$$
where the $K_i$ are the constants of proportionality. To have optimal coverage, the condition is

$$(K_1 X_1) = (K_2 X_2) = (K_3 X_3) \quad \ldots \ (6.7)$$

subject to the constraint (6.4).

Substituting for $X_2$ and $X_3$ in (6.4) in terms of $X_1$ from (6.7) leads to

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

or

$$X_1 \left[1 + (K_1/K_2) + (K_1/K_3)\right] = C_0$$

or

$$X_{1,\text{opt}} = [(K_2 K_3)/ (K_1 K_2 + K_1 K_3 + K_2 K_3)] C_0 \quad \ldots \ (6.8)$$

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 (6.4) is satisfied. Also for $K_1 = K_2 = K_3 = 1$, one gets equal allocation of the budget.

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

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

$$p_i = f(X_i) = K_i X_i^p \text{ for } i = 1, 2, 3 \quad \ldots \ (6.9)$$

Though any $p > 0$ may be considered, a choice of $p$ as a fraction is quite realistic. A good choice is, therefore, $p = \frac{1}{2}$, so that the coverage improvement is taken to be proportional to square root of the allocation, and

$$p_i = K_i \sqrt{X_i} \quad \ldots \ (6.10)$$

Model (6.10) 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

$$K_1 \sqrt{X_1} = K_2 \sqrt{X_2} = K_3 \sqrt{X_3} \quad \ldots \ (6.11)$$

subject to the constraint (6.4).

A straightforward recasting leads to

$$X_{1,\text{opt}} = [((K_2^2 K_3^2)/(K_1^2 K_2^2 + K_1^2 K_3^2 + K_2^2 K_3^2))] C_0 \quad \ldots \ (6.12)$$
The expressions for $X_2$ and $X_3$ are similarly written, noting the cyclic pattern.

**Remarks**

1) In practice, the constants $K_i$ are to be assessed or estimated empirically.
2) In the model (6.5) for $p_i$, no provision for an intercept (constant) term is made since $p_i = 0$ for $X_i = 0$ or without a budget provision there is no growth!
3) Other choices for $p$, including different values of $p$ for the different directions can be made. The budget allocations may be worked out algebraically in such cases. Here we get the optimal condition as

$$K_1 X_1 p = K_2 X_2 q = K_3 X_3 r,$$ subject to the constraint $X_1 + X_2 + X_3 = C_0$.

However, this entails the need for assessing three constants of proportionality and an equal number of indices $p, q$ and $r$.
4) Generalization to more than three dimensions can be obtained to provide a cuboid model (discussed later in the chapter) with optimal budget allocation. For instance, under square root cost function and with $s$ dimensions the optimum cost allocation works out to be

$$X_{i, opt} = \left(\prod K_i + \prod K_i^2 + \ldots + \prod K_i^2\right)/\prod K_i^2 C_0$$

etc. which has a cyclic pattern.
5) The square root cost function is especially convenient since it bypasses assessing the indices $p, q$ etc. and at the same time allows coverage to be adequately slower than the budget enhancement. In fact, such a function is known to be robust as a cost model.
6) Typically, the $K_i$ are quite small as $p_i$ are just proportions. Also, the $X_i$ may be expressed in larger monetary units like crores of rupees or any other valid currency.

**6.7 Areas of Application**

These typically include situations where 'coverage' is dependent upon or measured in terms of several factors like the proportion of

1) target population reached,
2) geographical area covered,
3) facilities provided from a master-list &
4) claims/ court cases cleared within a stipulated time etc.

Such examples are plenty in the problems in universal education programs, insurance schemes, healthcare facilities, mass drives of cleanliness, immunization, literacy and so on. It may be noted that India has launched a Universal healthcare project in the year 2010, with the aim of providing affordable, easily accessible healthcare for all its citizens, which has three clear dimensions.

6.8.1 A Generalization: Cuboid Model

This concept of measuring net resultant effectiveness can be generalized to any multi-parameter program (for instance the Yeshasvini scheme) in a straightforward manner. With k measuring parameters, one can conceptualize the achieved coverage as a subset of k-dimensional cuboid. Again, the scenario of optimum penetration will call for equal progress rate in each of the directions. This is a position where the three mean rates (arithmetic, geometric and harmonic) coincide. This geometric argument establishes the following result:

In a coverage model with k rate parameters $p_1, p_2, p_3...p_k$, the optimum (maximum) coverage level is attained, for a given $\sum p_i$, when the parameters move at equal pace.

... (6.13)

The content of the above cuboid is given by the product

$$V_k = (p_1 p_2 p_3 ...p_k)$$

… (6.14)

In general, average coverage rate will be the geometric mean of the component rates given by

$$G_k = \left( \prod_{i=1}^{k} p_i \right)^{1/k}$$

... (6.15)

where the $p_i$ is the coverage parameters (rates). This is the rate at which the cuboid gets filled up. Goal is to reach the roof of the cuboid that is filling it up to the brim, when the hollow cuboid would have become solid. The average rate $G_k$ is, as to be expected,
sensitive to smallness of the $p_i$. As a property of geometric means, when each component rate increases uniformly by a factor of $r$, $G_k$ goes up by this factor.

The cuboid model is apt for coverage processes over a span of time.

6.8.2 A New Service Quality Model

The cuboid model can be envisioned to provide an abstract framework for tracing the coverage of service quality. In the health sector setup, the dimensions could be empathy for the patient, warmth of doctor-patient relation, adherence to ethical practices, nursing skill and so on. This will pave way for a multiplicative effect of the factors, unlike the SQS model of Chapter 4, which considers an additive model. A consequence of the former is the suitability of a geometric average as a summary. Sensitivity to low values of factors is a disadvantage with this measure. However, the applicability of this model has to be supported by empirical evidence, unlike in the earlier case of measurable physical coverage rates. This provides a promising opening for further work.

At any given stage, the quantity $V_3 = p_1 p_2 p_3$ represents the covered proportion of the cube and $(1 - V_3)$ is the portion yet to be covered. A similar physical interpretation can be given to the quantities $V_k$ and $(1 - V_k)$ in the context of a cuboid model. As the $p_i$ individually increase towards unity the quantity $V_k$ tends to 1 (full capacity), the pace of this phenomenon being the fastest when the proportions $p_i$ increase at a common pace. The limiting value 1 of $V_k$ signals complete coverage of the target population by the scheme.

6.8.3 Effect of Change in Parameters

It is of interest to examine the effect of parameter variations on the content $V_k$ of the cuboid. Let us consider three types of change - incremental, geometric and continuous, separately.

a) Linear Change

Assume that there is an incremental change $d_1$ in $p_1$, so that $p_1$ is to be replaced by $(p_1 + d_1)$, other parameters remaining unchanged. Then the consequent change in the cuboid content is given by
$C_{k,1} = (V_{k,1} - V_k)$

$$= \frac{k}{(p_1 + d_1)^{\prod p_i} - \prod p_i}$$

$$= d_1 \prod p_i$$

... (6.16)

This is simply the product of $d_1$, the incremental change in $p_1$, and the other rates. Also, the change relative to $V_k$ is

$$RC_k = \text{Change in content/ Initial content}$$

$$= C_{k,1} / V_k$$

$$= d_1 / p_1$$

... (6.17)

The new geometric mean becomes

$$G_{k,1} = (p_1 + d_1)^{\frac{1}{k}} \left(\prod p_i\right)^{\frac{1}{k}}$$

... (6.18)

The generic expressions are obtained by replacing 1 with $j$ in the above results.

Similarly, when two parameters $p_1$ and $p_2$ get incremental changes of $d_1$ and $d_2$ respectively, the content will change by

$$C_{k,2} = (p_2 d_1 + p_1 d_2 + d_1 d_2) \prod p_i$$

... (6.19)

so that the change relative to $V_k$ is now

$$RC_{k,2} = C_{k,2} / V_k$$

$$= \frac{(p_2 d_1 + p_1 d_2 + d_1 d_2)}{(p_1 p_2)}$$

$$= \frac{(d_1 / p_1) + (d_2 / p_2) + (d_1 d_2 / p_1 p_2)}{... (6.20)$$

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Likewise, the new geometric mean relative to $G_k$ is

$$ RG_{k 2} = G_{k 2} / G_k $$

$$ = [(1 + (d_1 l p_1)) (1 + (d_2 l p_2))]^{1/k} \ldots \ (6.21) $$

The generalization of (6.20) involves higher order terms in the $d_i$, while (6.21) can be generalized in the obvious manner.

b) **Multiplicative Change**

In this case evaluating the expressions for the change in cuboid content etc. is straightforward since $V_k$ itself has a multiplicative structure. Thus, when $p_i$ changes to $r_i$ $p_j$, the change in $V_k$ is

$$ C_k^* = r_i V_k - V_k $$

$$ = (r_i - 1) V_k \ldots \ (6.22) $$

The change relative to $V_k$ is $(r_i - 1)$. When multiplicative changes occur in both $p_i$ and $p_j$, the change in $V_k$ works out to be

$$ C_k^{**} = (r_i r_j - 1) V_k \ldots \ (6.23) $$

and the factor of change is $(r_i r_j - 1)$, and so on. Thus, a simultaneous multiplicative change in all the parameters will lead to the content change of

$$(r_1 r_2 \ldots r_k - 1) V_k \ldots \ (6.24)$$

relative change factor being $(r_1 r_2 \ldots r_k - 1)$. Also, the changed geometric average is

$$ G_{k k} = (\prod_{i=1}^{k} r_i)^{1/k} G_k \ldots \ (6.25) $$

so that the change relative to $G_k$ is

$$ R G_{k k} = (\prod_{i=1}^{k} r_i)^{1/k} \ldots \ (6.26) $$

which is nothing but the geometric mean of the change factors.

c) **Continuous Change**

Since the $p_i$ are proportions which lie in the interval $[0, 1]$, it makes sense to take...
that these are continuous parameters. Then the rate of change of $V_k$ are simply the *partial derivatives* of $V_k$ with respect to the $p_i$. Thus, the rate of change with respect to $p_1$ is

$$\frac{\partial V_k}{\partial p_1} = \frac{\partial}{\partial p_1} \left( \prod_{i=1}^{k} p_i \right) = \prod_{i=2}^{k} p_i$$

and the change relative to $V_k$ becomes $1/p_1$. Likewise, the rate for simultaneous changes in both $p_1$ and $p_2$ becomes

$$\frac{\partial^2 V_k}{\partial p_1 \partial p_2} = \prod_{i=3}^{k} p_i$$

with a relative change of $1/(p_1 p_2)$. These changes are positive. The expressions lend themselves to straightforward generalization. In the passing, one may note that these results can be obtained for a change in $p_1$ from (6.16) and (6.17) by taking $d_1 = 1$. However, this does not carry forward. This is true for change in one parameter at a time. This does not generalize for cases of simultaneous changes in the parameters.

For a comparability with the geometric change case, one must choose $r_1 = (1 + 1/p_1), r_1 r_2 = (1 + 1/(p_1 p_2))$ etc. in the continuous case.

**The Direction of Change**

A change can be an *increase* or a *decrease*. In the case of cuboid content, this will depend on the *sign* of the first factors in (6.16), (6.19), (6.23) and (6.24), since the $p_i$'s are positive. In brief, a *sufficient* condition for the changes to be positive is that $d_i > 0$ for the linear case, though this condition may not be always *necessary*. The case $d_i = 0$ implies a situation of *no change*. Thus, if the first factors in the expressions are positive, the growth thrust will be positive even if some of the $d_i$ slip down marginally. For geometric changes in the factors, a sufficient condition for positive changes is $r_i > 1$. Again, this is not *necessary* to keep all the first factors in the expressions positive.

Thus, a dip below 1 in some $r_i$ can still maintain a positive thrust in $V_k$. The case of every $r_i$ being 1 corresponds to the scenario of no change.

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Finally, every $d_i$ being positive or every $r_i$ exceeding unity ensures increase in the average change, though these conditions may not be necessary.

Table 6.7: Change Pattern in Volume of Cuboid

<table>
<thead>
<tr>
<th>Change in parameter</th>
<th>Change in $V_k$</th>
<th>Change relative to $V_k$</th>
<th>Geometric mean (G.M)</th>
<th>Relative G.M</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Linear</strong></td>
<td>$C_{kl} = d_i \prod p_i \quad i=2$</td>
<td>$RC_k = d_i/p_i$</td>
<td>$G_{k,l} = (p_{1}+d_{1})^{1/k}(\prod p_{i})^{1/k} \quad i=2$</td>
<td>$RG_{k,1} = (1+d_{1}/p_{1})^{1/k}$</td>
</tr>
<tr>
<td><strong>Multiplicative</strong></td>
<td>$C_k = (r_i-1) V_k$</td>
<td>$(r_i-1)$</td>
<td>$G_{k,k} = (\prod r_{i})^{1/k} G_k$</td>
<td></td>
</tr>
<tr>
<td><strong>Continuous</strong></td>
<td>$\frac{\partial V_k}{\partial p_j} = \prod p_i \quad i=2$</td>
<td>$1/p_j$</td>
<td>$RG_{k,k} = (\prod r_{i})^{1/k} \quad i=1$</td>
<td></td>
</tr>
</tbody>
</table>

*Source: Author*

Remarks

1) The case of a cube obtains when $k=3$

2) The linear and multiplicative cases are algebraically equivalent in the sense that $(p_i + d_i) = p_i (1 + d_i/p_i)$, which may be taken as $p_i r_i$ with $r_i = (1 + d_i/p_i)$. However, the two cases have been treated above separately in order to get explicit forms for clarity of presentation.

3) In practice, nobody has a direct control over the changes in the parameters, since they are to be induced through proactive measures like stepping up the awareness drive, streamlining the delivery systems or realigning the policies.

4) A positive thrust in each of the $k$ dimensions, with equal importance given, is a safe policy for practice.

5) The allocation of a given (fixed) budget $C_0$ for optimum growth under a cuboid model has been discussed earlier in the chapter.

6.8.4 Necessary and Sufficient Conditions for Growth

a) With incremental changes $d_i$ in $p_i$, a necessary and sufficient condition for overall
positive increase in the cuboid content is

\[ k \prod (1 + \frac{d_i}{p_i}) > 1 \quad \text{… (6.27)} \]

\[ i = 1 \]

This ensures an increase in the geometric mean coverage.

b) With geometric coverage rates in \( p_i \) the necessary and sufficient condition can be expressed as

\[ k \prod r_i > 1 \quad \text{… (6.28)} \]

\[ i = 1 \]

It can be easily verified that every \( d_i \) being positive implies condition (6.27), but not conversely. A similar statement can be made about each \( r_i \) exceeding 1 in the condition (6.28).

**Implementation Aspect**

Under the cuboid model the *organizational structure* includes the institutions (like Hospitals and Government in healthcare setup) responsible for the satisfactory coverage in the different parameters. The *delivery mechanism* is in formulating the rules/regulations, their implementation and monitoring. This is the critical aspect for the success of the model. The *solution* consists of noting that for optimum coverage, the thrust must be on *all* the parameters and not on an *isolated parameter*. On the practical side, the implementation steps may need different strategies for ensuring coverage, since it heavily depends on the awareness level of the target population. This is all the truer of the health sector.

*Universal Health Care (UHC) in Karnataka*

Karnataka State has rolled out UHC from November 1, 2017, bringing all Government health schemes under one bracket and thus creating a sustainable health model for all. Under this proposal all 1.4 crore households in the State will be eligible for cashless treatment for up to Rs. 1.5 lakh. Priority and deprived households (classified category A) do not have to make any contribution. The others can enroll against payment.
of annual premium of Rs. 300 and Rs. 700 per person respectively in rural and urban areas (Category B). The scheme is named *Arogya Bhagya*, which merges the seven existing schemes: *Vajpayee Arogyasri, Rajive Sanjeevini, Yeshsvini, Jyothi Sanjeevini, Mukhayamantri Santwana Harish Scheme, Janani-Sishu Suraksha Karyakram* and *Rastriya Swasthya Bima Yojana*. A suitably designed health card will be rolled out for the households under this amalgamated scheme.

### 6.9 Concluding Remarks

The basis of the success of the Yeshasvini model is the *law of large numbers* being effectively used to provide a high degree of health security, without a high cost burden, using a well-established system. The innovative aspect is mobilization of large numbers, who are geographically scattered. The existing institutions must be roped in into this mega movement. The scaling up and transfer-ability of this scheme depends solely on such institutions. However, there needs to be a process by which the subscriptions can be periodically collected and new enrollments made. The *use of post offices* which have a most dispersed but well-established network in the country, can be made. With diminishing letter transactions and postal communication, the Department may easily come forward to shoulder the responsibilities. This is parallel to post offices being empowered as payment banks and to receive electricity/water bills - another recent development. Providing health security to large masses depends less on the resources, and more on *mobilizing capacity* and *organization*. In this scenario, a healthcare infrastructure is *necessary* but NOT *sufficient*. Also given a large enough subscriber base, the necessary infrastructure can be built. The large population, generally considered to be a *liability*, can be cleverly converted into an *asset* for ensuring social health. The scheme seems to be working satisfactorily as a PPP model which can be scaled up or replicated to have more success stories. This can break new ground where it is badly needed. Periodical studies and evaluation of this (and similar) schemes will help to innovate and move up on the efficiency scale. This portends well for public health insurance and security in India.

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