Chapter 7
QUALITY ASSESSMENT AND IMPEMENTATION FOR DIABETES CARE

Healthcare industry in India is facing a challenge of maintaining the quality as customers become more informed and demanding. The service quality assessment models like SERVQUAL has been generally robust as a measure of service quality there is no guarantee that it will include all dimensions in case of healthcare services. This study uses focus group discussion and expert interview to identify the variables which patients consider important for the quality of diabetes care. The Interpretative Structural Modeling was used to find out whether and how factors are related, and then finally the Analytical Hierarchy Process (AHP) was used to find out the priority weights of the factors.

Identification of Attributes

This study uses secondary research and unstructured interview of a medical professional to finalize eighteen quality attributes from customer's perspective in case of diabetes care. The detailed description of the quality indicators is listed as below:

1. **Quality of Clinical Care (QOC):** It is the quality of the care provided by the doctor, nurses and hospital staffs. It is a measure of the gap between perceived service level and expected service level by the patients. A healthcare provider is required to meet or exceed the expectation to be labeled as a good quality provider (Donabedian, 1980).
2. **Quality of Investigation (QOI):** It is the quality of the lab investigations carried out in the hospital. It includes whether the investigation is capable of identifying the sign of complications at an earlier stage of diabetes (Donabedian, 1980). The quality of

investigation is judged by the certification of the pathology and the positive word-of-mouth (WOM) about the pathology.

3. **Cost of Medicine (COM):** It is the cost of the medicine prescribed by the doctors in the hospital. Considering the chronic nature of diabetes illness this factor becomes very important.
4. **Length of Stay (LOS):** It indicates the number of days a patient stays in the in-patient-department (IPD) of a diabetes care unit for blood sugar control, infection control, diabetes foot treatment or other medical emergencies.
5. **Professional Flexibility (PRF):** The ability of a hospital to increase the number of professional or launch and provide new services (Chan, 2003).
6. **Practitioner's Attitude (PRA):** The attitude of the practitioner towards patients and their attendant.
7. **Administrative Staff's Attitude (ASA):** The administrative staff's behavior towards patients, attendants, practitioners, and visitors.
8. **Waiting Time (WT):** This attribute indicates the total time spent by a patient for fixing an appointment as well as taking consultation with the doctor (Bij & Vissers, 1999).
9. **Facility Availability (FA):** Availability of specialized departments and facilities in the hospital like Diabetes Education, Medical Nutrition Therapy, Physiotherapy, Neuropathy examination, eye examination and Cardiac Risk Profiling.
10. **Access (ACS):** Ability of a hospital to admit patients for whom it can provide services with its available resources (Aagja & Garg, 2010).

11. **Grievance Handling Time (GHT):** Time-taken by hospital administration to solve any grievance of the customer (Gangolli et al, 2005).
12. **Medical Record Keeping (MRD):** The capacity of a hospital to maintain a proper and detailed record of the patient's case history, and records of the lab investigation done.
13. **Hospital Infection Control (HIC):** Ability to reduce or eliminate the infection risk to the patients and visitors in Out-Patient-Department (OPD) and In-Patient-Department (IPD).
14. **Privacy (PRI):** The extent to which a hospital is able to maintain the records of the patient confidential or doesn't disclose the information about patients without their consent.
15. **Waste Disposal Policy (WDP):** The policy of a hospital related to handling, storage, transportation and disposal of hazardous materials.
16. **Process Flexibility (PFL):** The process flexibility is a measure of time taken in refereeing the complicated cases to a specialized hospital (Chan, 2003). For example, the time is taken in identifying and refereeing a serious nephropathy patient to a nephrology center having dialysis facilities.
17. **Cost of Consultancy (COC):** It is the consultancy and registration fee charged by a hospital at the time of visiting the diabetes center. Since chronic disease like diabetes requires a frequent follow-up visit to the hospital this cost component becomes very important

18. **Cost of Investigation (COI):** It indicates the cost incurred by a patient for a pathology investigation or other special diabetes investigations like body fat analyzer, neurology assessment, eye examination and foot examination.

7.1 Methodology

Using secondary research and unstructured interview of the healthcare professionals the study finalizes eighteen attributes. The names of the eighteen quality attributes along with their notation are listed in Table 7.1 below:

Table 7. 1: Quality Attributes and Symbols

S.N	Name of the Quality Attribute	Notation	Symbol
1	Quality of Clinical Care	QOC	V1
2	Quality of Investigation	QOI	V2
3	Cost of Medicine	COM	V3
4	Length of Stay	LOS	V4
5	Professional Flexibility	PRF	V5
6	Practitioner's Attitude	PRA	V6
7	Administrative Staff's Attitude	ASA	V7
8	Waiting Time	WT	V8
9	Facility Availability	FA	V9
10	Access	ACS	V10
11	Grievance Handling Time	GHT	V11
12	Medical Record Keeping	MRD	V12
13	Hospital Infection Control	HIC	V13
14	Privacy	PRI	V14
15	Waste Disposal Policy	WDP	V15
16	Process Flexibility	PFL	V16
17	Cost of Consultancy	COC	V17
18	Cost of Investigation	COI	V18

First of all this study uses factor analysis to compress the list of the attributes to a small manageable list. The factor analysis was used to identify the unique factors that affect the quality of a diabetes care provider. The Interpretive Structural Modelling (ISM) was then used to establish the order and direction of relationship among these factors. The research design for the study is summarized in figure 7.1 below:

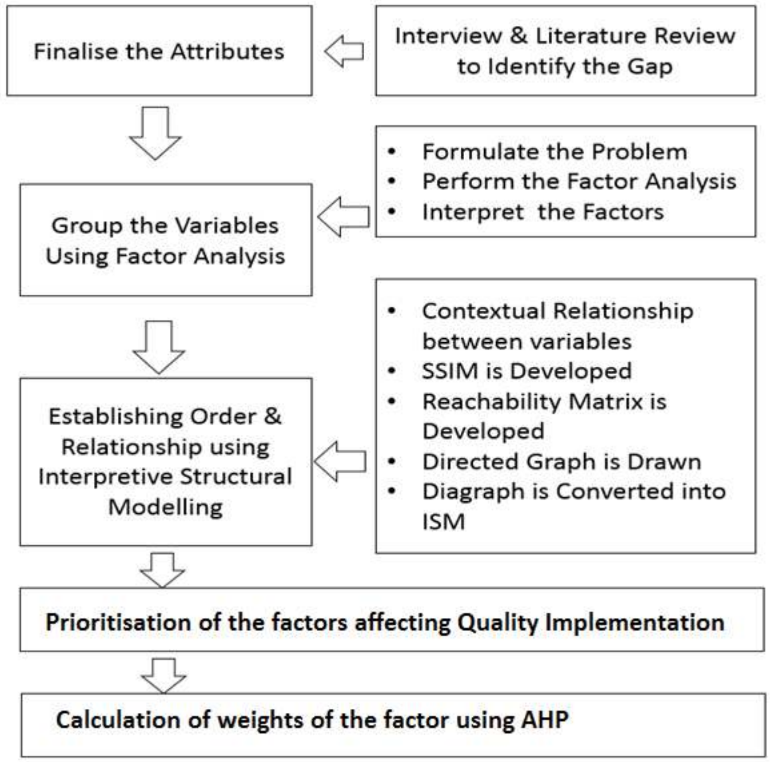

Figure 7. 1: Research Design for the Quality Assessment and Implementation

7.1.1 Factor Analysis

Factor Analysis is a statistical method to determine the minimum number of unobservable common factors by studying the covariance among a set of observable variable (Malhotra, 2007). A factor can be expressed as linear combination of the original variables represented as below:

$$F_i = W_{i1} X_1 + W_{i2} X_2 + \cdots + W_{ik} X_k$$

Where,

F_i = *estimate of the i^{th} factor*

W_{ij} = *weight or factor score coefficient*

K= number of variables

This study uses exploratory factor analysis method to find out the factors. The approach used for calculating the weight or factor score coefficient in the study is Principal Component Analysis (PCA). The method of PCA is used to determine the minimum number of factors that will account for the maximum variance of the collected data.These factors are called principal components.

A questionnaire was constructed incorporating eighteen attributes of the quality for assessing the influence of each attribute on the quality of the diabetes care unit. The respondents were asked to rate the degree of influence of each attribute on the quality of the diabetes care unit on a scale of 1 to 7. A sample size of more than fifty is considered good for the exploratory factor analysis (Winter et al, 2009). Basilevesky (2009) concludes that there should be at least four to five times as many observations as there are variables. Two hundred ten patients were recruited from a private diabetes specialty clinic out of which one fifty-eight patients answered the questionnaire completely (75.24%). The survey responses have been collected between January 2017 and December 2017, while the sampling method used for the study is judgmental sampling. The statistical tool used for the study is SPSS 20.

7.1.2 Interpretive Structural Modelling

Interpretive structural modeling (ISM) is an interactive learning process that transforms unclear and poorly articulated mental models of systems into visible, well-defined models (Sushil, 2012). The ISM method is imperative and a group's judgment decides whether and how items are related. On the basis of the relationship, an overall structure is extracted from the complex set of items to portray the specific relationship and overall structure in a diagraph model (Sage, 1977). The various steps involved in ISM methodology are as following:

Step 1: Variable affecting the system under the consideration are listed using literature review or focus group discussion.

Step 2: From the variable identified in step 1, a contextual relationship is established among variables.

Step 3: Pairwise relationship among variables of the system under consideration is listed in form of a Structural Self –Interaction Matrix (SSIM).

Step 4: Using the SSIM a Reachability Matrix is developed and checked from transitivity. The transitivity of the contextual relationship is a basic assumption in ISM. For example, if A is related to B and B is related to C then A is related to C.

Step 5: The Reachability matrix achieved in Step 4 is partitioned into different levels.

Step 6: Based on the relationship given in reachability matrix, a directed graph is drawn and transitive links are removed.

Step 7: The variable nodes are replaced with relationship statement to convert directed graph into ISM Model.

Step 8: The ISM Model is checked for conceptual consistency and necessary modifications are made.

The procedure to develop ISM model is depicted in figure 2.

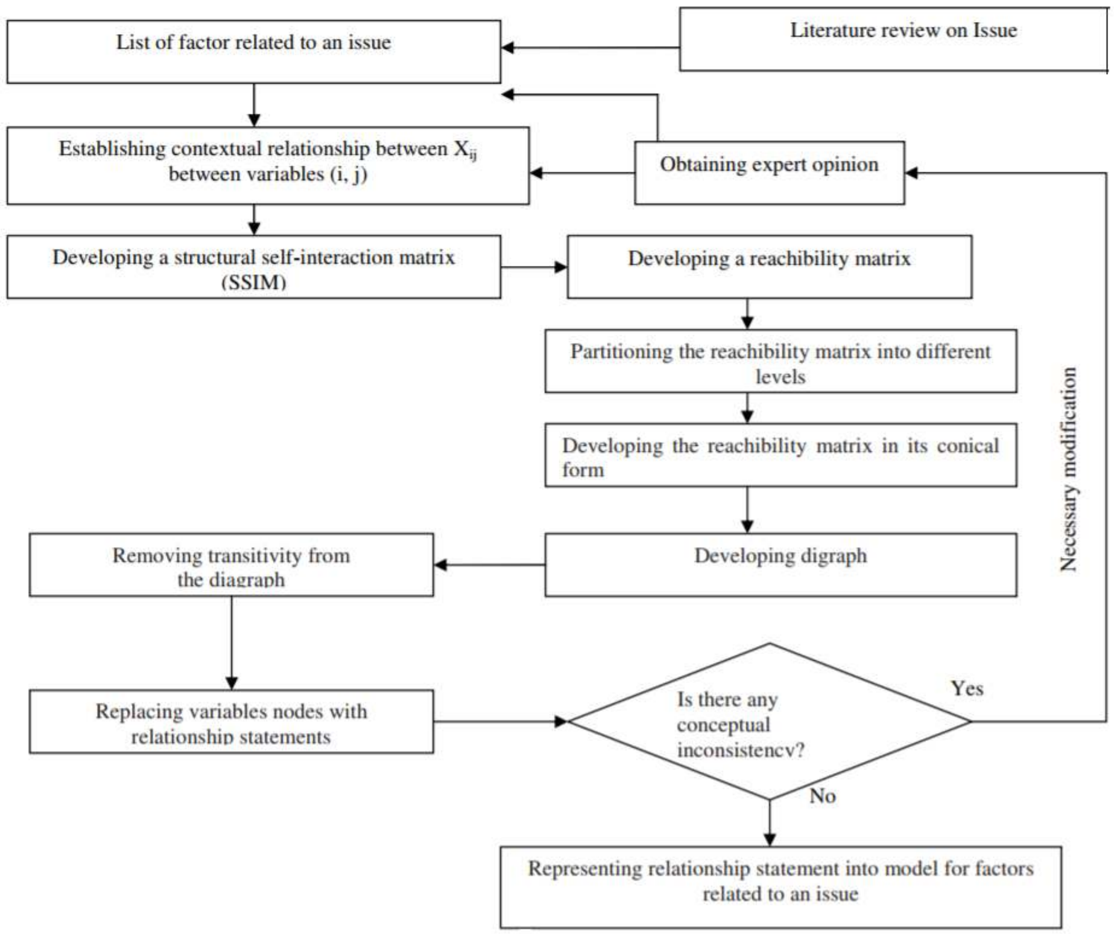

Figure 7. 2: Procedure for Model Development Using ISM

7.1.3 Weight of the Factors

To calculate the weight of the different quality factors Analytic Hierarchy Process (AHP) method was used. AHP was developed in the year 1970 by Thomas L. Saaty and has been extensively used in ranking the choices (Forman, 2001). The analytic hierarchy process (AHP) is a structured technique for organizing and analyzing complex decisions, based on mathematics and psychology. A focus group containing five healthcare experts was asked to rate the quality factor for their relative importance. The detail of the intensity of importance scale is listed in Table 7.2.

Table 7. 2: Scale and its Description

Intensity of Importance	Definition	Explanation
1	Equal Importance	Two factors contribute equally to the objective
3	Weak Importance	Experience and judgment slightly favor one activity over another
5	Essential or Strong Importance	Experience and judgment strongly favor one factor over another
7	Demonstrated Importance	A factor is strongly favored and its dominance is demonstrated in practice
9	Absolute Importance	The evidence favoring one factor over another is of highest possible order of affirmation
2,4,6,8	Intermediate Values between the two adjacent judgments	When compromise is needed between the two factors

7.2 Results & Discussion

The response of the patients was used to achieve the correlation matrix as depicted in figure 7.3.It can be inferred that there exists high correlation among few set of variables. This made us think that we can reduce the number of variables using factor analysis and find out the group of variables representing a single underlying construct. An exploratory study was conducted on the selected eighteen variables in order to identify the key factors determining the quality of a Diabetes Care Unit.

The communality measures the percent of the variance in a given variable explained by all the factors jointly and may be interpreted as the reliability of the indicator. The high value of the communalities (Table 7.3) denotes that common factors explain the variables well.

	QOC	QOI	COM	LOS	PRF	PRA	ASA	WT	FA	ACS	GHT	MRD	HIC	PRI	WDP	PFL	COC	COI
QOC		.000	.005	.112	.337	.149	.281	.310	.147	.000	.101	.001	.012	.098	.000	.102	.451	.234
QOI	.000		.011	.111	.327	.164	.324	.252	.071	.000	.144	.003	.003	.154	.000	.152	.204	.294
COM	.005	.011		.032	.216	.406	.234	.395	.375	.231	.115	.254	.089	.466	.250	.328	.000	.000
LOS	.112	.111	.032		.000	.001	.000	.002	.005	.008	.006	.000	.010	.000	.014	.048	.414	.407
PRF	.337	.327	.216	.000		.001	.000	.002	.005	.093	.087	.023	.389	.000	.373	.048	.414	.407
PRA	.149	.164	.406	.001	.001		.000	.004	.391	.049	.224	.451	.401	.098	.386	.128	.423	.417
ASA	.281	.324	.234	.000	.000	.000		.003	.199	.057	.303	.353	.222	.153	.188	.030	.276	.261
WT	.310	.252	.395	.002	.002	.004	.003		.111	.395	.442	.254	.353	.174	.250	.083	.447	.137
FA	.147	.071	.375	.005	.005	.391	.199	.111		.375	.081	.220	.435	.025	.406	.044	.112	.095
ACS	.000	.000	.231	.008	.093	.049	.057	.395	.375		.183	.002	.005	.466	.002	.078	.447	.131
GHT	.101	.144	.115	.006	.087	.224	.303	.442	.081	.183		.001	.038	.063	.099	.269	.163	.459
MRD	.001	.003	.254	.000	.023	.451	.353	.254	.220	.002	.001		.003	.200	.012	.231	.294	.280
HIC	.012	.003	.089	.010	.389	.401	.222	.353	.435	.005	.038	.003		.000	.000	.275	.489	.452
PRI	.098	.154	.466	.000	.000	.098	.153	.174	.025	.466	.063	.200	.000		.000	.015	.092	.313
WDP	.000	.000	.250	.014	.373	.386	.188	.250	.406	.002	.099	.012	.000	.000		.181	.403	.344
PFL	.102	.152	.328	.048	.048	.128	.030	.083	.044	.078	.269	.231	.275	.015	.181		.123	.106
COC	.451	.204	.000	.414	.414	.423	.276	.447	.112	.447	.163	.294	.489	.092	.403	.123		.000
COI	.234	.294	.000	.407	.407	.417	.261	.137	.095	.131	.459	.280	.452	.313	.344	.106	.000	

Figure 7. 3: Correlation Coefficient between Various Variables

Table 7. 3: Communalities (Using PCA Extraction Method)

Variable	Initial	Extraction	Variable	Initial	Extraction
QOC	1.000	.856	ACS	1.000	.600
QOI	1.000	.910	GHT	1.000	.675
COM	1.000	.823	MRD	1.000	.591
LOS	1.000	.885	HIC	1.000	.928
PRF	1.000	.687	PRI	1.000	.716
PRA	1.000	.830	WDP	1.000	.872
ASA	1.000	.908	PFL	1.000	.746
WT	1.000	.480	COC	1.000	.856
FA	1.000	.467	COI	1.000	.866

The Statistical Tool used for the study is SPSS 20.

Extraction of Factors

The number of factors retained for the model is factored having eigenvalue greater than 1.0. The factors with variance less than 1.0 are no better than a single variable because due to standardization, each variable has a variance of 1.0. The sixth factor has the eigenvalue 1.155 and is taken as a cut-off point (Table 7.4). The cumulative percentage variance explained by the model is 76.1 percent which is higher than the minimum recommended value of 60 percent for a good model (Malhotra, 2007).

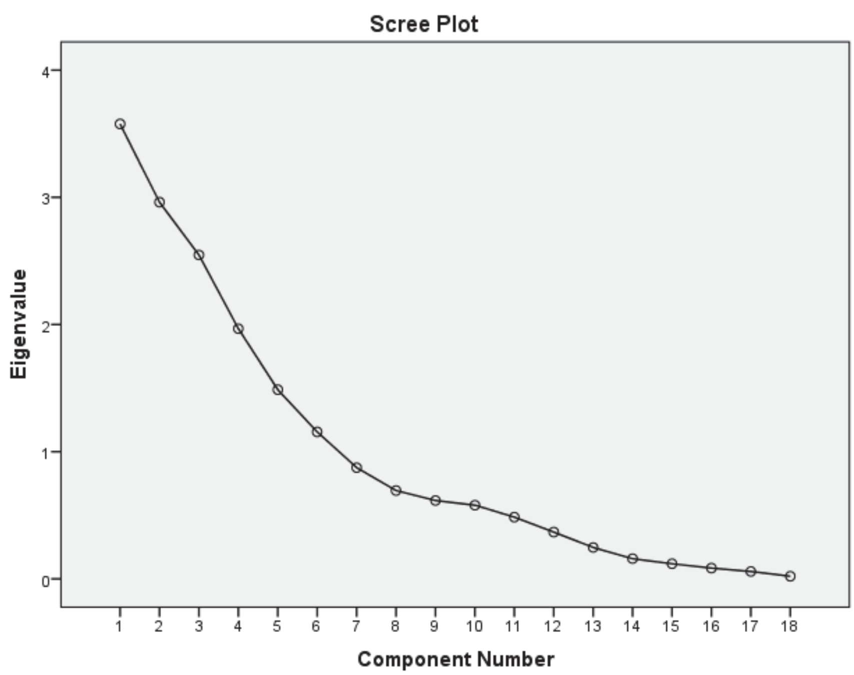

Figure 7. 4: Scree Plot for the Factor Analysis

The Scree Plot (Figure 7.4) is a plot of the eigenvalues against the number of factors in order of extraction. The plot has a distinct break between steep slope of factors with large eigenvalue and a long tail associated with the rest of the factors referred as Scree. From Figure 3, we can conclude that the number of factors to be extracted for the study is six.

Table 7. 4: Total Variance Explained by the Extracted Factors

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.58	19.872	19.872	3.58	19.872	19.872	2.644	14.69	14.69
2	2.96	16.453	36.325	2.96	16.453	36.325	2.588	14.375	29.066
3	2.55	14.148	50.473	2.55	14.148	50.473	2.465	13.692	42.758
4	1.97	10.928	61.401	1.97	10.928	61.401	2.198	12.212	54.97
5	1.49	8.264	69.665	1.49	8.264	69.665	2.095	11.639	66.609
6	1.16	6.417	76.083	1.16	6.417	76.083	1.705	9.474	76.083
7	0.88	4.858	80.941						
8	0.69	3.858	84.799						
9	0.62	3.42	88.219						
10	0.58	3.219	91.438						
11	0.49	2.697	94.135						
12	0.37	2.042	96.178						
13	0.25	1.372	97.549						
14	0.16	0.883	98.432						
15	0.12	0.662	99.094						
16	0.09	0.47	99.564						
17	0.06	0.322	99.886						
18	0.02	0.114	100						

Extraction Method: Principal Component Analysis.

After conducting the Principal Component Analysis (PCA), a component matrix was obtained, as depicted in the Table-7.5. The component matrix contains the coefficients used to express the standardized variables in terms of the factors. These coefficients, known as factor loading, represent the correlation between the factors and the variables. A coefficient with a large absolute value indicates that the factor and variables are closely related.

Although the initial components matrix indicates the relationship between the factors and individual variables, it doesn't provide the results which can be interpreted clearly, as the factors are correlated with many variables. The factor matrix is rotated to increase the interpretability of factors. In a Cartesian coordinate system, if axes represent the factor and variable are represented by the points, the factor rotation is the process of rotating the axes while keeping the points constant. The rotation is done in such a fashion that the points are highly correlated with the axes and provide a meaningful interpretation of the factor solutions. The rotation is called orthogonal if the axes are maintained at right angles.

Table 7. 5: Component Matrix for Factor Analysis

	1	2	3	4	5	6
QOC	.622	.481	-.227	-.072	.425	-.034
QOI	.657	.492	-.237	-.071	.403	-.116
COM	.004	-.138	.879	.121	-.121	.045
LOS	-.732	.560	-.076	-.160	.000	-.068
PRF	-.493	.644	.007	-.116	-.077	.100
PRA	-.179	.621	.044	.640	-.016	-.008
ASA	-.253	.595	.090	.691	-.031	-.060
WT	-.314	.399	-.021	.140	-.033	.448
FA	-.121	.342	.086	-.459	.312	-.142
ACS	.558	.298	-.007	.266	.155	-.324
GHT	.369	-.038	.151	.304	.079	.645
MRD	.667	-.049	.114	.237	.122	.243
HIC	.635	.323	.161	-.222	-.580	.090
PRI	-.005	.610	.142	-.441	-.360	.003
WDP	.679	.345	.116	-.217	-.480	-.024
PFL	-.116	.175	.080	-.518	.412	.507
COC	-.023	.066	.891	-.063	.226	-.042
COI	-.003	.051	.864	-.056	.250	-.227

This study used an orthogonal rotation called Varimax Rotation. It redistributes the variance accounted within the pattern of the factor loading. The rotation converges in eight iterations. The communalities and the total variance accounted for the model is same before and after the rotation. The six factors that are extracted from the Varimax rotated factor matrix (Table 6) are analyzed and interpreted on the basis of their factor loading. As a rule of the thumb, a loading of more than 0.71 (50 percent overlap) is considered excellent, 0.63 (40 percent of overlap) as very good, 0.55 (30 percent overlap) as good, 0.45 (20 percent overlap) as fair and below 0.32 (less than 10 percent overlap) as poor (Bhaduri, 2002). This study uses a factor loading of 0.55 (30 percent overlap) as the cut-off for the interpretation of the factor. Thus the results so obtained can be considered fairly robust.

Table 7. 6: Varimax Rotated Component Matrix

	1	2	3	4	5	6
QOC	.019	**.878**	-.122	.150	.109	.189
QOI	.002	**.919**	-.123	.177	.067	.124
COM	.027	-.284	**.816**	.128	.221	-.101
LOS	**.552**	-.182	-.063	-.048	**-.652**	.341
PRF	**.587**	-.100	-.024	.154	-.414	.369
PRA	**.875**	.170	.045	-.030	.024	-.180
ASA	**.907**	.114	.096	-.076	-.015	-.239
WT	**.554**	-.163	-.102	.032	.092	.355
FA	-.028	.257	.170	.029	-.442	.419
ACS	.092	**.671**	.085	.133	.103	-.326
GHT	.126	.049	.054	.053	**.786**	.182
MRD	-.103	.378	.096	.133	**.636**	-.077
HIC	-.067	.159	.030	**.923**	.198	-.076
PRI	.207	.028	.068	**.676**	-.360	.285
WDP	-.094	.294	.026	**.863**	.136	-.116
PFL	-.078	.047	.072	-.039	.019	**.855**
COC	.031	-.004	**.913**	.014	.019	.149
COI	-.018	.075	**.922**	-.021	-.092	.029

The Component Plot in rotated Space gives one a visual representation of the loadings plotted in a 3-dimensional space. The plot shows how closely related the items are to each other and to the three components (Figure 7.5).

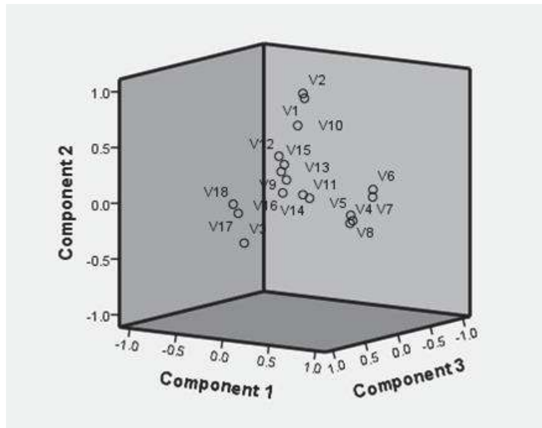

Figure 7. 5: Component Plot in Rotated Space

Interpretation of Factors

Once the factors are extracted out of the initial variables the next step is the interpretation of factors.

Factor 1: This factor includes the variable like professional flexibility, practitioner's attitude, administrative staff attitude, waiting time. This factor can be recognized as ***Employee Attitude Factor***.

Factor 2: This factor includes Quality of care, Quality of investigation and Access. All these factors are related to the delivery of the care hence this factor can be termed as ***Care Delivery Factor.***

Factor 3: This factor includes Cost of Medicine, Cost of Consultancy and Cost of Investigation. Since of these factors are related to the cost of the treatment this factor is recognized as ***Cost of Care Factor.***

Factor 4: This factor includes Hospital Infection Control, Waste Disposal Policy and Privacy. Since most of this factor includes variables related to cleanliness hence this factor is recognized as ***Cleanliness and Privacy Policy Factor.***

Factor 5: This factor includes Length of Stay, Grievance Handling Time and Medical Record Keeping. The Length of Stay is negatively loaded for the factor while other two variables are positively loaded for the factor. This factor is recognized as ***Customer Relationship Factor.***

Factor 6: The only variable loaded for this factor is Process Flexibility hence the factor is recognized as ***Process Flexibility Factor*.**

One variable used in the factor analysis namely "Facility availability" was not incorporated in any factor affecting the quality of the diabetes care unit. This suggests that patients don't find this variable important in explaining the quality of the diabetes care unit. The factor analysis compresses the list of quality attributes from eighteen to a small manageable list of six as follows:

1. Employee Attitude
2. Care Delivery
3. Cost of Care
4. Cleanliness & Privacy
5. Customer Relationship
6. Process Flexibility

These six factors affect the quality perception of a diabetes care unit for patients. Next, the study uses Interpretive Structural Modeling (ISM) to establish the order and direction of complex relationship among various elements of the system.

Structural Self- Interaction Matrix (SSIM)

The earlier identified six components of the Diabetes Care Quality were presented in front of a focus group containing five experts involved in providing diabetes care (Table-7.7). The exercise aims to establish a contextual relationship between components of the diabetes care quality.

Following four symbols were used to denote the direction of the contextual relationship between identified components of the quality of diabetes care (*i* and *j*):

V: component i influence the component j

A: component i is influenced by the component j

X: component i and j influence each other

O: component i and j don't influence each other as they are unrelated

Table 7. 7: Structural Self-Interaction Matrix for Quality Components

SN	**Quality Factors**	**6**	**5**	**4**	**3**	**2**	**1**
1	Employee Attitude	V	V	V	O	O	
2	Clinical Care Delivery	O	O	O	V		
3	Cost of Care	A	A	A			
4	Cleanliness & Privacy	O	O				
5	Customer Relationship	O					
6	Process Flexibility						

The next step is to develop the initial reachability matrix from the Structural Self-Interaction Matrix given in Table 7.7. This transformation is done by substituting V, A, X, O by 1 and 0 as per the following rules (Table 7.8).

Table 7. 8: Rules of Transformation

If the *(i,j)* entry in the SSIM is	Entry in the Initial Reachability Matrix	
	(i,j)	*(j,i)*
V	1	0
A	0	1
X	1	1
O	0	0

Using the rule given in the Table -7.8 initial reachability matrix is prepared as shown in Table-7.9.

Table 7. 9: Initial Reachability Matrix for Quality Components

SN	Quality Factors	6	5	4	3	2	1
1	Employee Attitude	1	1	1	0	0	1
2	Care Delivery	0	0	0	1	1	0
3	Cost of Care	0	0	0	1	0	0
4	Cleanliness & Privacy	0	0	1	1	0	0
5	Customer Relationship	0	1	0	1	0	0
6	Process Flexibility	1	0	0	1	0	0

To get final reachability matrix from the initial reachability matrix concept of transitivity is applied. The final reachability matrix is developed after incorporating the transitivity concept in Table-7.10.

Table 7. 10: Final Reachability Matrix for Quality Components

SN	Quality Factors	6	5	4	3	2	1	Driver Power
1	Employee Attitude	1	1	1	1*	0	1	5
2	Care Delivery	0	0	0	1	1	0	2
3	Cost of Care	0	0	0	1	0	0	1
4	Cleanliness & Privacy	0	0	1	1	0	0	2
5	Customer Relationship	0	1	0	1	0	0	2
6	Process Flexibility	1	0	0	1	0	0	2
	Dependence	2	2	2	5	1	1	

Once the final reachability matrix is developed the next step includes level partitioning. The level partitioning of the quality factor involves the reachability set, antecedent set and intersection set (Table 7.11-Table 7.13). The reachability set consists of the factor itself and the other factor, which it influences. The antecedent set consists of the factor itself and other factors, which may influence it. Thereafter, the intersection of these two sets is derived from all factors. The enablers having the same reachability set and intersection set are eliminated during consecutive iteration. The diagraph is examined to eliminate transitivity of the relationships and the final model was achieved as represented by figure 7.5.

Table 7. 11: Level Partition –Iteration 1

Quality Factors	Reachability Set	Antecedent Set	Interaction Set	Level
1	1,3,4,5,6	1	1	
2	2,3	2	2	
3	3	1,2,3,4,5,6	3	1
4	3,4	1,4	4	
5	3,5	1,5	5	
6	3,6	1,6	6	

Table 7. 12: Level Partition –Iteration 2

Quality Factors	Reachability Set	Antecedent Set	Interaction Set	Level
1	1,4,5,6	1	1	
2	2	2	2	2
4	4	1,4	4	2
5	5	1,5	5	2
6	6	1,6	6	2

Table 7. 13: Level Partition –Iteration 3

Quality Factors	Reachability Set	Antecedent Set	Interaction Set	Level
1	1	1	1	3

Formation of ISM Model

The structural model is developed with the help of final reachability matrix (Table 7.10). The relationship between factors was presented by using an initial directed graph, or initial diagraph. The final digraph is formed after removing the transitivity in the graph. This final diagraph is converted into the ISM-based model for quality assessment in a healthcare unit (Figure 7.6)

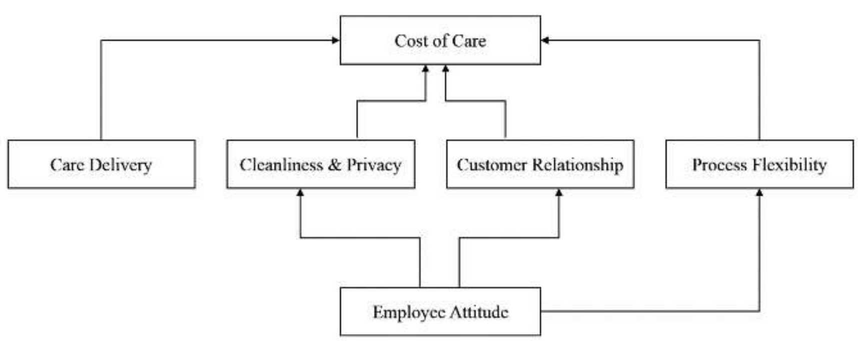

Figure 7. 6: Interpretive Structural Model of Quality Factors

MICMAC Analysis

The MICMAC (Matriced'Impacts Croises-Multiplication Applique' and Classment) is cross-impact matrix multiplication applied for classification and works on the principle of multiplication properties of matrices (Diabat and Goninan, 2011; Kannan et al., 2009). The use of MICMAC analysis is beneficial to calculate the drive and dependence power of factor. A plot was developed by plotting dependence values along the horizontal axis and driving power values along a vertical axis. The driving power and dependence values for the six factors were plotted as shown in Figure 7.7. The entire plot was divided into four quadrants namely Linkage, Independent, Autonomous and Dependent.

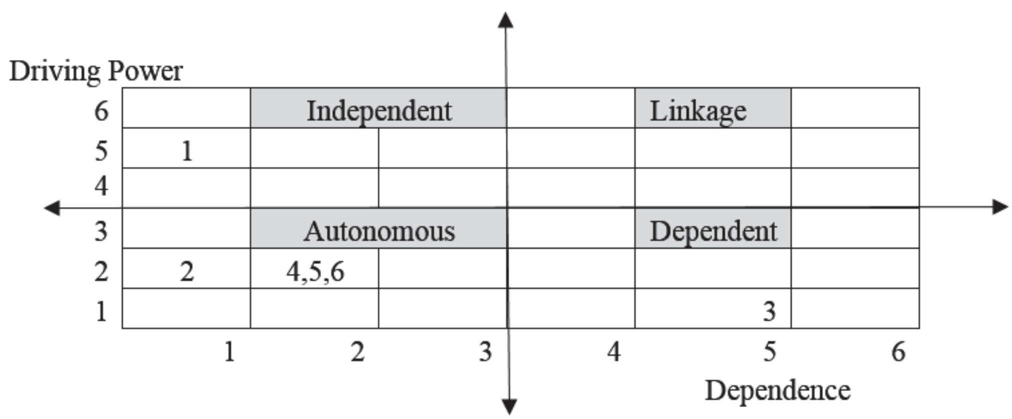

Figure 7. 7: Driving Power Dependence Plot

The factor which is lying in Autonomous Quadrant has very low driving power as well as dependence on other factors. This suggests that the factor falling in this quadrant doesn't have a substantial effect on other factors affecting the quality of the diabetes care. Cleanliness & Privacy, Customer Relationship, and Process Flexibility fall under this quadrant. The factor lying in the dependent quadrant has a very high dependence on other but very low power to drive others. The cost of care factor falls under this quadrant. The Linkage quadrant of the plot consists factors which have high driving capabilities as well as dependence on the other, none of the factors falls in this quadrant. The factor having the high driving capability but low dependence on others fall in Independent Quadrant. The factor falling under this category is the employee attitude.

Outcome of ISM Model

The ISM emphasizes that employee attitude is the most important enabler due to its high driving power and low dependence among all the quality factors. It is basic enablers, which help to develop an organization where quality practices can be implemented; hence top management must pay its full attention to develop a positive employee attitude towards healthcare delivery in the organization. This enabler is positioned at the lowest level in the hierarchy of the ISM-based model. The factors like Care Delivery, Cleanliness & Privacy, Customer Relationship, and Process Flexibility form the middle level in the ISM model and have low driving power and dependence. The cost of care factor has a very high dependence on other but very low power to drive others. The successful implementation of the other factors will affect the cost of the care.

The MICMAC Analysis of the results suggested that the factors like Cleanliness & Privacy, Customer Relationship, and Process Flexibility don't have a direct effect on the quality of the care. They fall under autonomous quadrant. The factor lying in the dependent quadrant has a very high dependence on other but very low power to drive others. The cost of care factor falls under dependent quadrant and hence has a very high dependence on other factors. The factor having the high driving capability but low dependence on others fall in Independent Quadrant. The factor falling under this category is the employee attitude.

Priority Weights

Pairwise comparison matrix [A] was constructed using the relative importance of each factor given by experts. The pairwise importance score is listed in Table 7.14.

Table 7. 14: Pairwise Comparison Matrix for Quality Factor

SN	Quality Factors	1	2	3	4	5	6
1	Employee Attitude	1	1	3	7	5	7
2	Care Delivery	1	1	3	7	5	7
3	Cost of Care	0.33	0.33	1	5	3	5
4	Cleanliness & Privacy	0.14	0.14	0.2	1	0.33	1
5	Customer Relationship	0.2	0.2	0.33	3	1	3
6	Process Flexibility	0.14	0.14	0.2	1	0.33	1
	Sum	2.81	2.81	7.73	24	14.66	24

The entries in each column are divided by the column sum to get the normalized matrix. The average value of the row is assigned as the weight for the corresponding factor forming vector [B] (Table 7.15).

Table 7. 15: Derived Normalized Matrix for Quality Factor

SN	Quality Components	1	2	3	4	5	6	Factor Weight
1	Employee Attitude	0.36	0.36	0.39	0.29	0.34	0.29	0.337
2	Care Delivery	0.36	0.36	0.39	0.29	0.34	0.29	0.337
3	Cost of Care	0.12	0.12	0.13	0.21	0.20	0.21	0.164
4	Cleanliness & Privacy	0.05	0.05	0.03	0.04	0.02	0.04	0.039
5	Customer Relationship	0.07	0.07	0.04	0.13	0.07	0.13	0.084
6	Process Flexibility	0.05	0.05	0.03	0.04	0.02	0.04	0.039

The next step after calculation of the priority weights of the factor is to determine the consistency of the decision making. The Consistency Ration (CR) is an approximate mathematical indicator of the consistency in case of the pairwise comparison. It is a function of ‘maximum eigenvalue” and size of the matrix (consistency index) compared against similar values if the pairwise comparison had been merely random (random index). The ratio of consistency index and the random index is called consistency ratio (CR). According to Saaty, if CR is no greater than 0.1 (10 percent), consistency is generally acceptable for pragmatic purposes (Zahedi, 1986).

To calculate CR, first pairwise comparison matrix [A] was multiplied with priority weight or principal vector [B] to get a new vector [C]. Next, each element in the vector [C] was divided by the corresponding element in vector [B] to find a new vector [D].

$$D=[6.33,6.33,6.27,5.97,6.03,5.97]$$

Now, the approximate value of the maximum eigenvalue is denoted by λ_{max} is calculated as:

$$\lambda_{max}=\frac{6.33+6.33+6.27+5.97+6.03+5.97}{6}=6.15$$

$$\text{Consistency Index (CI)} = \frac{\lambda_{max}-N}{N-1}$$

$$CI=\frac{6.15-6}{6-1}=0.03$$

Using Random Index (RI) for the Matrix of Order 6 as 1.24, the Consistency Ratio (CR) can be calculated as:

$$CR=\frac{CI}{RI}=\frac{0.03}{1.24}=0.02 <10\%$$

Since the consistency ratio is less than 0.1, it is under permissible range. Hence, we conclude that the opinion of experts is consistent.

7.3 Conclusion

The literature review suggests that there is a need for quality assessment framework for the healthcare in India. Considering the inherent complexity of the diabetes care there is a need for a customized quality assessment framework for the diabetes care. The literature review and unstructured interview of the experts helped us finalize eighteen variables critical for the quality of the diabetes care in India. One hundred fifty-eight patients were recruited from a private diabetes clinic to rate these variables for their importance to the quality of the healthcare. Using the response a correlation matrix for the eighteen variable were constituted. The high correlation value of the elements of the matrix suggested us to reduce the variables using factor analysis and find out the group of variables representing a single underlying construct. The factors extracted from this exercise were recognized as (1) Employee Attitude (2) Care Delivery (3) Cost of Care (4) Cleanliness & Privacy Policy (5) Customer Relationship and (6) Process Flexibility.

The study then uses Interpretive Structural Modeling (ISM) to establish the order and direction of complex relationship among the various elements of the system. The ISM emphasizes that employee attitude is the most important enabler due to its high driving power and low dependence among all the quality factors. The factors like Care Delivery, Cleanliness & Privacy, Customer Relationship, and Process Flexibility form the middle level in the ISM model and have low driving power and dependence. The cost of care factor has a very high dependence on other but very low power to drive others. The successful implementation of the other factors will affect the cost of the care. The MICMAC Analysis of the results suggested that the cost of care factor falls under dependent quadrant and hence has a very high dependence on other factors.

To find out the priority weight of the factors Analytic Hierarchy Process was used. The study found the weights for the factors as Employee Attitude (0.337), Care Delivery (0.337), Cost of Care (0.164), Cleanliness & Privacy Policy (0.039), Customer Relationship (0.084) and Process Flexibility (0.039).

Existing tools for assessing the quality of a healthcare unit have their limitation. The chronic disease like diabetes has its own complexity. This study provides a framework for assessment and implementation of quality practices in healthcare. The study identified Employee Attitude, Care Delivery, Cost of Care, Cleanliness & Privacy, Customer Relationship, and Process Flexibility as six factors critical in the implementation of quality practices in an organization. An instrument can be prepared using the factors of the quality identified in the study. The questions of the instrument should include the assessment of the variables included in the corresponding factor. The weighted sum of the score obtained for each factor can help us in getting the quality score for the healthcare unit being studied. The study identified employee attitude as the most important factor for the implementation of the quality practices in an organization. A healthcare organization needs to work on training and development of its human resources because this factor drives customer satisfaction, which eventually drives the cost of the care. The cost of care has high dependence and affected by various factors like Cleanliness & Privacy, Customer Relationship, and Process Flexibility. There is a trade-off between these factors and the cost of care. More than sixty-five percent of the Indians is not covered any insurance and majority of the healthcare spending is out-of-pocket (OOP) (Jayakrishnan et al.,2016) .There is a need to check the cost of care as with increased price, healthcare becomes out of reach of the majority of the population.

7.4 Managerial Implications

The method proposed in this study provides us an alternative to the earlier existing methods, which has limitations in case of assessing the quality of a healthcare unit. This study proposes a customized method for assessing and implementing the quality in case of diabetes care. The study provides the set of factors an organization thinking about implementing the quality practices should work upon.The study further provides the priority weights of these factors. The study also identifies the interrelationships among various elements related to the quality of a healthcare organization. Thus, this study contributes to the existing literature on assessment and implementation of quality practices in healthcare. The method proposed in the study is easy to use and can be easily adapted for other chronic diseases.

7.5 Limitations of the Research

The patients participating in the study are recruited from a private health care provider. The patients recruited from a government hospital (providing care at a subsidized rate), may have a different perception of quality.

This study identifies eighteen attributes using interview and secondary research. It is difficult to manage the complexity of the ISM methodology in case of eighteen variables hence this study uses factor analysis for reducing the number of variables to a manageable list of six. The ISM model is not statistically validated. Structural equation modeling (SEM), also commonly known as linear structural relationship approach has the capability of testing the validity of such hypothetical model.

7.6 Future Directions

This chapter of the study proposes a framework for implementation of the quality of diabetes care and find out employee attitude as a most important factor in implementing the quality in a diabetes care organization. The cost of care has high dependence and increases when we improve other factors of quality. The future direction may include further study of the enabler of the cost of care and employee attitude. The future direction may also include the factor affecting the adaptation of medical insurance in India.