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CUSTOMIZED QUALITY ASSESSMENT FRAMEWORK FOR DIABETES CARE

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Abstract: *Purpose of this study is to develop a customized service quality assessment model for diabetes care. The research identifies factors important for the quality of diabetes care. The study further uses factor analysis to identify the factors representing a single underlying construct. The Interpretative Structural Modelling was used to find out whether and how factors are related. In the end, research finds the priority weight of the factors using Analytic Hierarchy Process (AHP). The six factors identified from the study were (1) Employee Attitude (2) Care Delivery (3) Cost of Care (4) Cleanliness & Privacy (5) Customer Relationship and (6) Process Flexibility. The factors having the highest importance for the implementation of quality practices was employee attitude while the factor at lowest level was the cost of care. The weight calculated using AHP concurs with earlier findings using ISM Model.*

Keyword: *Quality Assessment; Diabetes Care; Factor Analysis; ISM; AHP.*

1. Introduction

Healthcare industry is facing the dual challenge of health care quality and patient satisfaction. The issue of health care quality management has drawn considerable attention from both industry and academia in recent years. The measurement of service quality is very important in evaluating the effectiveness of a healthcare provider (Porter et al., 2016). Quality improvement is a major goal of the healthcare systems in most of the economically developed countries but effective methods to achieve this goal remains elusive (Pope et al., 2002). Healthcare services are difficult to evaluate as the credence values are high. The patients don't possess the medical knowledge adequate to assess the performance of healthcare services (Ramsaran-Fowdar, 2005). There is an ongoing debate about how health care quality should be evaluated. While some authors feel patient perceptions are valuable healthcare quality indicators, others contend that health service quality should be evaluated by experts (Naidu, 2009; Emilsson et al., 2015).

Considering the intangible nature of the service, measuring its quality is an uphill task. The only way to measure it is by measuring the consumer's perception of quality which is very subjective in nature. The consumer's judgment about service quality is the perceived quality. The perceived quality is the degree of variation between the customer's expectation and perception about the services (Parsuraman et al., 1985). The service quality has two components namely technical quality and functional quality (Abbas et al., 2015). Parsuraman et al. (1988) developed a service quality measurement scale SERVQUAL with five dimensions (1) Reliability (2) Responsiveness (3) Assurance (4) Empathy and (5) Tangibility. According

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to the proposer of the model, SERVQUAL is a generic instrument with good reliability & validity and have broad applicability across various service sectors (Parsuraman et al., 1991).

Although 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. The healthcare delivery in case of a chronic disease like diabetes is complex and more involving. Babakus and Mangold (1992) inspected the usefulness of SERVQUAL for assessing the patient's perception of health care service quality and concluded that SERVQUAL is designed to measure the functional quality only and couldn't measure technical quality. They further observe that functional quality in a healthcare setting cannot be sustained without technical quality like accurate diagnoses and good medical procedures. Bowers et al. (1994) observe that the two important dimensions namely caring and patient outcomes are not captured in SERVQUAL. They defined 'caring dimension' as personal involvement and love for patients in the service situation while 'patient outcome' include relief from the pain, saving of life or disappointment with life after the medical intervention. Oermann and Templin (2000) observed that the most important indicator of health care quality to the consumer is the expertise in healthcare, being able to communicate and spend enough time with the patients. The research done by Haywood-Farmer and Stuart (1990) suggested SERVQUAL is inappropriate for measuring professional service quality as it excluded the dimension of 'core service', 'service customization' and 'knowledge of the professional'. Another research was done by Brown and Swartz (1989) identified 'professional credibility', 'professional competence' and 'communication' as factors significant in evaluating the service quality in case of healthcare.

Diabetes is a physiological state of persistent high glucose level in blood. The progression of the disease involves various complications like retinopathy, nephropathy, neuropathy, cardiac problem and diabetic foot. The study shows that physician's communication skill and participatory decision-making style are strongly associated with good outcome in diabetes management (Heisler et al., 2002). This is the reason why diabetes specialty clinic delivers a better quality of diabetes care than a general medical clinic. The knowledge of diabetes care and system resources becomes necessary to deliver a good quality of diabetes care (Ho et al., 1997). According to U.S. data collected during 1988–1995, a gap exists between recommended diabetes care and the care patients actually receive (Saaddine et al., 2002). In best of our knowledge there is a complete absence of any study on identification and prioritization of the quality attributes in diabetes care. This study attempts to fill this gap.

1.1. 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 (Van der 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 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 analysis, neurology assessment, eye examination, and foot examination.

2. Method

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 1 below.

Table 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 summarised in figure 1.

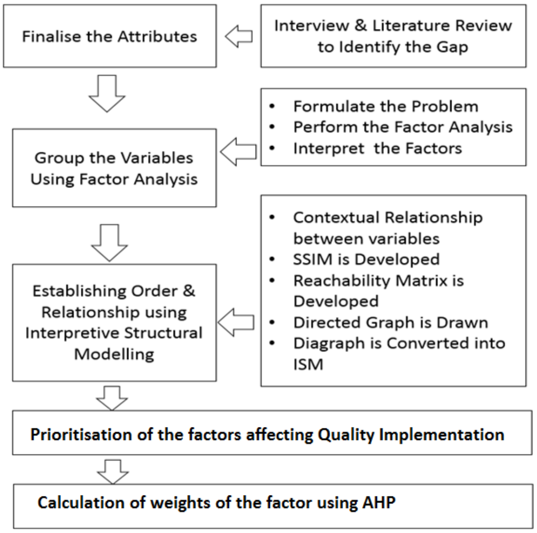

Figure 1. Research Design for the Quality Assessment and Implementation

2.1. 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 (De Winter et al., 2009). Basilevesky (2009) concludes that there should be at least four to five times as many observations as there are variables. Hair et al. (1998) suggest a subject-to-variable (STV) of 20:1 as good sample size. 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%). Considering eighteen variables included in the study has STV close to 20:1. The survey responses have been collected between January 2017 and December 2017, while the sampling method used for the study is judgemental sampling. The statistical tool used for the study is IBM SPSS 20.

2.2. Interpretive Structural Modelling

Interpretive structural modelling (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.

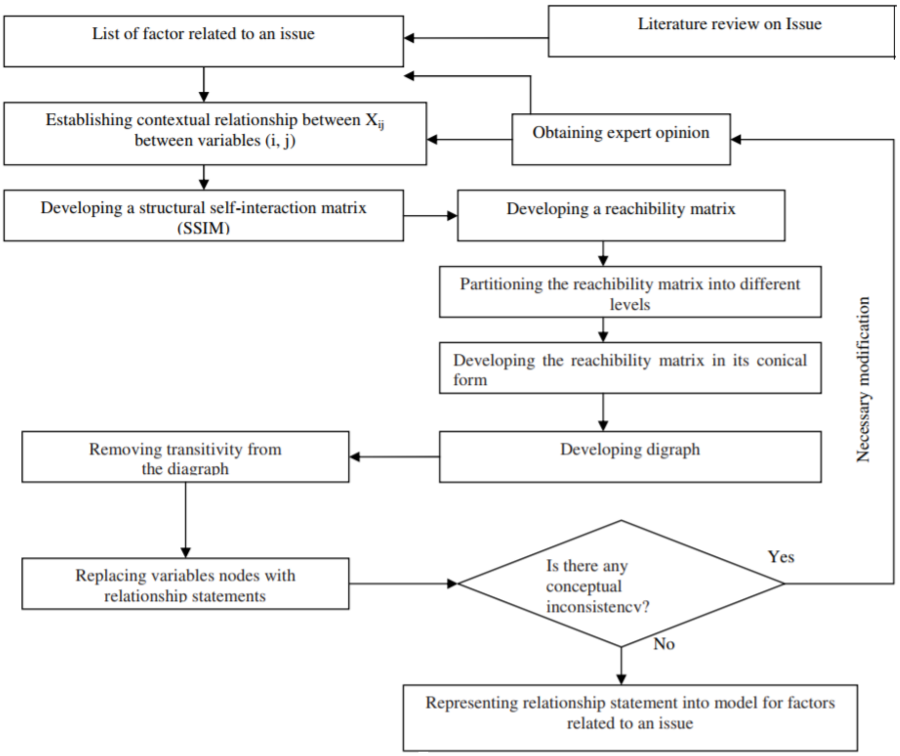

Figure 2. Procedure for Model Development Using ISM

2.3. Weight of the Factors

To calculate the weight of the different quality factors Analytic Hierarchy Process (AHP) method was used. 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 2.

Table 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

3. Results

The response of the patients was used to achieve the correlation matrix as depicted in the Figure 3. It can be understood 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.

	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 3. Correlation Coefficient between Various Variables

The Table 3 gives the results of KMO and Bartlett's test for the study. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy is a statistic that indicates the proportion of variance in variables that might be caused by underlying factors. The value higher than 0.5 is acceptable. Bartlett's test of sphericity tests the hypothesis that the correlation matrix is an identity matrix, which would indicate that your variables are unrelated and therefore unsuitable for structure detection. Small values (less than 0.05) of the significance level indicate that a factor analysis may be useful with the data

Table 3. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.548
Bartlett's Test of Sphericity	Approx. Chi-Square	947.31
	df	153
	Sig.	.000

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 4) denotes that common factors explain the variables well.

Table 4. 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

3.1. 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 1.16 and is taken as a cut-off point (Table 5). 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).

Table 5. 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.

The Scree Plot (Figure 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 4, we can conclude that the number of factors to be extracted for the study is six.

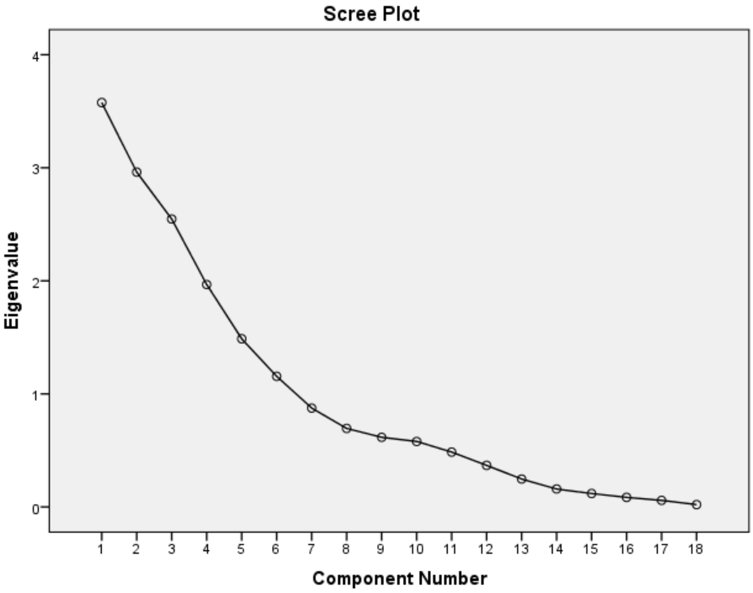

Figure 4. Scree Plot for the Factor Analysis

After conducting the Principal Component Analysis (PCA), a component matrix was obtained, as depicted in the Table-6. The component matrix contains the coefficients used to express the standardized variables in terms of the factors. These coefficients, known as factor loading, represents the correlation between the factors and the variables. A coefficient with a large absolute value indicates that the factor and variables are closely related.

Table 6. 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

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.

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 7) 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. 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 5).

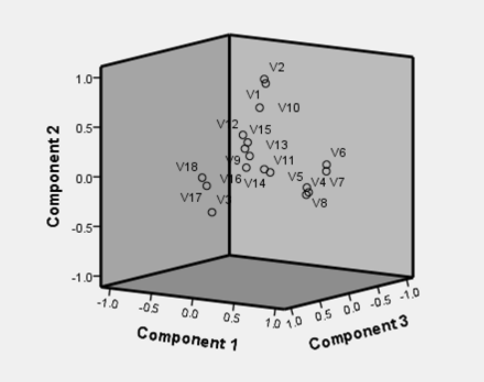

Figure 5. Component Plot in Rotated Space

3.2. 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 include variables related to cleanliness hence this factor is recognized as *Cleanliness and Privacy 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 factor affects the quality perception of a diabetes care unit for patients. Next, the study uses Interpretive Structural Modelling (ISM) to establish the order and direction of complex relationship among various factors identified.

3.3. Result of ISM Model

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-8). 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 8. 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 8. This transformation is done by substituting V, A, X, O by 1 and 0 as per the following rules (Table 9).

Table 9. 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 -9 initial reachability matrix is prepared as shown in Table 10.

Table 10. 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, the concept of transitivity is applied. The final reachability matrix is developed after incorporating the transitivity concept in Table 11.

Table 11. 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 12-Table 14). 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 5.

Table 12. 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 13. 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 14. Level Partition –Iteration 3

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

3.4. Formation of ISM Model

The structural model is developed with the help of final reachability matrix (Table 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 6).

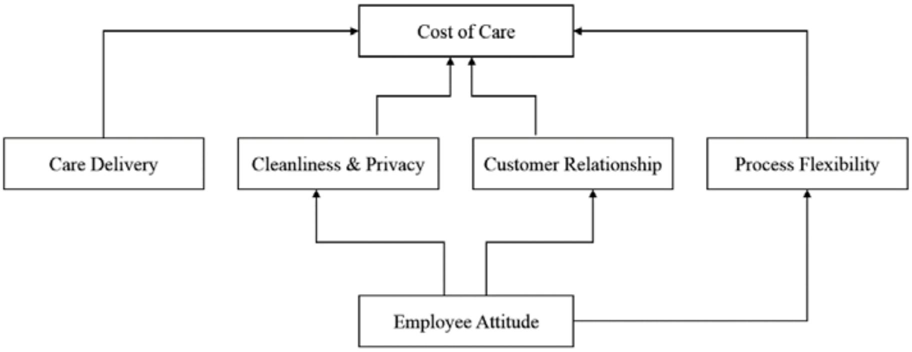

Figure 6. Interpretive Structural Model of Quality Factors

3.5. 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 & 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. The entire plot was divided into four quadrants namely Linkage, Independent, Autonomous and Dependent.

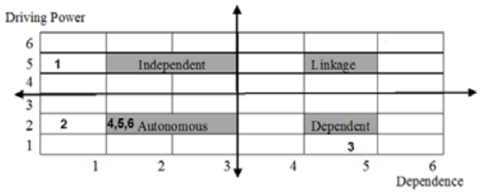

Figure 7. Driving Power Dependence Plot

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 have 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.

3.6. Priority Weights

To calculate the priority weight a pairwise comparison matrix [A] was constructed using the relative importance of each factor. The pairwise importance score is listed in Table 15.

Table 15. 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 16). 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 Satty, 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 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

Table 16. Derived Normalised Matrix for Quality Factor

N	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	0.04S	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

4. Discussions

Considering the inherent complexity of the diabetes care there is a need of 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. Although the variables are identified for diabetes care in India, most of them are relevant for international population as well. 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. The factors extracted from in this study were recognized as (1) Employee Attitude (2) Care Delivery (3) Cost of Care (4) Cleanliness & Privacy (5) Customer Relationship and (6) Process Flexibility.

Once the factors affecting the quality of diabetes care were identified, it is important to know which factor is more important and should be addressed first. The factor employee attitude is positioned at the lowest level in the hierarchy of the ISM-based model and has highest importance. 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. It suggests that successful implementation of the other factors will affect the cost of the care. The research concludes that employee attitude is the most important factor 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.

The research also concludes that factors like Cleanliness & Privacy, Customer Relationship, and Process Flexibility don’t have a direct effect on the quality of the care. The cost of care factor has a very high dependence on other factors. The factor employee attitude is having the high driving capability but low dependence on others. The study found the weights for the factors as Employee Attitude (0.337), Care Delivery (0.337), Cost of Care (0.164), Cleanliness & Privacy (0.039), Customer Relationship (0.084) and Process Flexibility (0.039). The weights of the factor suggest that Employee attitude and Care Delivery are most important factors for quality of diabetes care while Customer Relationship and Process Flexibility is least important factors. This finding concur the finding of the ISM model developed earlier.

5. Conclusions

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 while process flexibility is the least important factor. 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). There is a need to check the cost of care as with increased price, healthcare becomes out of reach of the majority of population.

6. Implication

The method proposed in this study provides us an alternative to the earlier existing methods for measurement of service quality, 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 adopted for other chronic diseases.

7. Limitation and Future Research

The study uses diabetic patients from a private clinic for the study. A more inclusive study can be designed which includes patients from the government hospital. The comparative analysis of the factors affecting quality in case of private and government hospitals can also be included in the future research. The factors identified in the study can be used for scale development to measure the service quality for a diabetes clinic.

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