

Chapter 2

LITERATURE REVIEW

For the present study literature review can be classified into to five sections as follows:

1. Prevalence, Prevention, and Control of Diabetes
2. Facility Planning, Logistic Strategies, and Resource Allocation
3. Lean, Agile and Leagile Strategy implementation
4. Patient's Utility for Service Attributes in Diabetes Care
5. Healthcare Quality Assessment for Diabetes Care

2.1 Prevalence, Prevention, and Control of Diabetes

Diabetes is rising as an epidemic in many parts of the world. The rate of growth of diabetes has earned a tag of world's diabetes capital for India. In the year 2014, there were 387 million individuals with diabetes in the world, and this number is estimated to become 592 million by 2035 (IDF, 2015). The regional prevalence of diabetes is estimated to become 10.1% by the year 2035 in India. Moreover, the South Asian population is genetically at high risk of developing diabetes (Decode-Decoda Study Group and European Diabetes Epidemiology Group, 2003; Mohan et al, 2007). The major reasons for this increasing prevalence of diabetes are a sedentary lifestyle, increased urbanization and increased life expectancy. Multiple complications like retinopathy, nephropathy, neuropathy, cardiac risk and diabetes foot occur with the progression of the disease. The cost of diabetes management increases

many folds with these multiple complications (Kumpatla et al., 2013). Thus we can say that the close monitoring and awareness are critical in diabetes management.

2.1.1 Diabetes Mellitus

Diabetes mellitus (DM), commonly known to as diabetes, is a group of metabolic disorders in which there is a persistent increased level of glucose in the blood. It is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. According to International Diabetes Federation estimated by the year 2040, one person out of every ten people will be diabetic in this world. It further adds that the disease is instrumental in a death every six seconds (IDF, 2015).

The disease is becoming a pandemic in South East Asian (SEA) countries due to the genetically high risk of developing diabetes and high carbohydrate food intake (Chaudhary et al., 2014). The SEA countries host 72 million diabetic patients out of which 69.2 million reside in India (Ramachandran et al., 2014). This is the reason why the country has notoriously been declared the diabetes capital of the world. The Diabetes Atlas further reports that 1 in 3 young people in India suffer from lifestyle diseases and have a high risk of developing the metabolic disorder. The diabetes is not completely curable after its onset and develops multiple complications with the progression. Diabetes and associated complications pose a major health-care burden worldwide and present a major challenge to patients, health-care systems, and national economies (Ramachandran et al., 2010). The lifetime cost of diabetes becomes very high in case of living with diabetes (Zhuo et al., 2013). Hence, the early diagnosis is the solitary way to reduce the healthcare burden of diabetes. India needs to pull its sock for managing the surge in the number of diabetic patients.

2.1.2 Dynamic Complexity of Diabetes

Chronic diseases like diabetes are a growing problem in South-east Asian countries. Even in developed countries like the US, the chronic disease causes more, illness, disability and death than acute or accidental disease (Bodenheimer et al., 2009). The government and healthcare providers still use conventional methods of evaluating and managing each aspect of the disease separately. The tools presently used are diagrammatic logic models and epidemiological forecasting models. These tools are not capable of addressing the dynamic complexity of diabetes. The silo approach to management is not appropriate for managing the disease involving a long delay between causes and the health events (Homer et al., 2004). It is time to adopt an integrated system-wide approach to prevention and management of diabetes.

2.1.3 Growth of Diabetes in India

There is a sudden surge in the prevalence of diabetes in India. The researcher has sited frugal genotype and phenotype as two possible reasons behind the growth of the disease in the Indian subcontinent. The Indian babies are among the smallest in the world. The low weight results in a low beta cells hence higher chance of developing diabetes. India has witnessed significant economic growth and hence per head calorie consumption has increased in recent years. This situation has exposed them at risk of obesity and Diabetes. The prevalence of diabetes in India ranges from 5–17%, with a higher percentage, is reported in the southern part of the country and in urban areas (Anjana et al, 2011; Little et al., 2016; Ramchandran et al., 2001, Barik et al., 2016; Ajay et al., 2008; Mohan et al., 2006, Ravikumar et al., 2011, Mendenhall et al., 2012). As per INDIAB study done by Indian Council of Medical Research diabetes, some of the northern regions report a higher prevalence of diabetes than southern

regions. The Table 2.1 below summarizes the result of INDIAB study Phase-I completed in the year 2011(Anjana et al., 2011).

Table2. 1: Prevalence of Diabetes in the Year 2011

| Region | Prevalence | Confidence Interval |
|---------------|-------------------|----------------------------|
| Tamil Nadu | 10.4% | (95% CI: 9.0-11.0%) |
| Jharkhand | 5.3% | (95% CI: 4.5-6.1%) |
| Chandigarh | 13.6% | (95% CI: 12.8- 15.2%) |
| Maharashtra | 8.4% | (95% CI: 7.5-9.3%) |

The second phase of the INDIAB study completed in July 2013 is more comprehensive and includes fifteen states of the country. The overall prevalence of diabetes in all 15 states of India was estimated as 7.3% (95% CI 7.0–7.5). The Figure 2.1 below suggests that state with higher GDP has a higher prevalence of diabetes. The data below made us believe that the prevalence of diabetes is dependent on the economic growth of the region (Anjana et al., 2017). The higher economic growth results in the higher caloric intake and hence higher risk of developing diabetes.

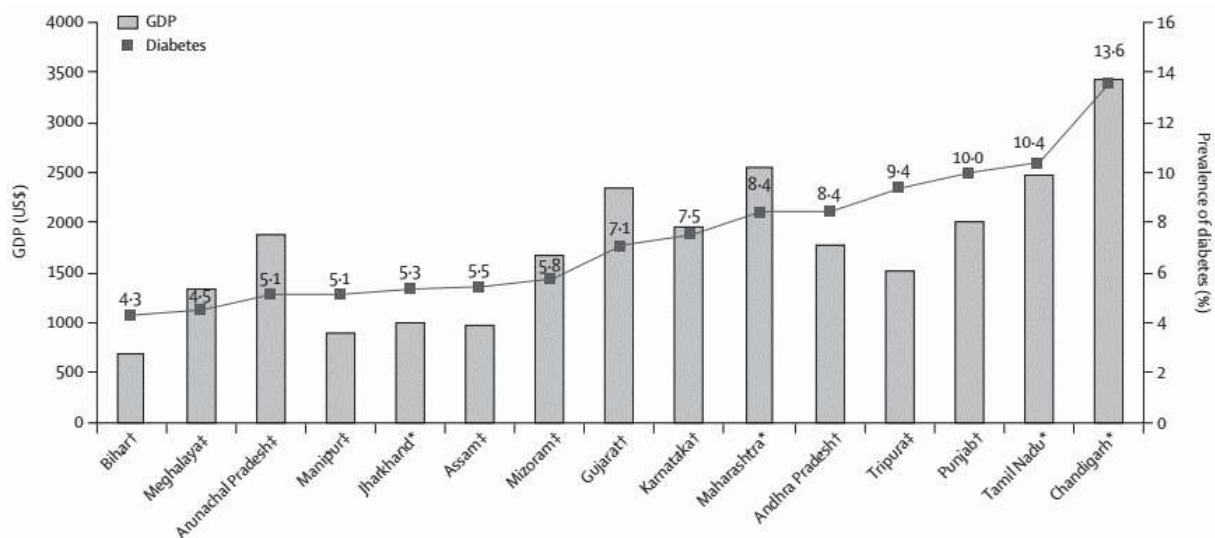


Figure 2. 1: Prevalence of diabetes and GDP per capita by state

The National Urban Survey conducted across the metropolitan cities of India reported similar trend: 11.7 percent in Kolkata (Eastern India), 6.1 percent in Kashmir Valley (Northern India), 11.6 percent in New Delhi (Northern India), and 9.3 percent in West India (Mumbai) compared with (13.5 percent in Chennai (South India), 16.6 percent in Hyderabad (south India), and 12.4 percent Bangalore (South India) (Kaveeshwar et al., 2014).

The diabetes prevalence has suddenly increased in last decades and is more common in the urban population. This very fact suggests that post-birth factors also significantly contribute to the occurrence of diabetes (Yajnik, 2004). The researchers suggest including, fetal, postnatal and adult components as the possible reason for the occurrence of diabetes in a patient. For a given BMI, Indians have a higher percentage of body fat and more visceral fat than members of other populations, this phenomenon is also termed as YY paradox on the name of researchers Yajnik and Yudkin (Yajnik, and Yudkin, 2004). In low birth, baby accelerated childhood growth increases the risk of adiposity and insulin resistance. The urban lifestyles, including poor diet and sedentary habits, further promote further obesity, insulin

resistance, and type-2 diabetes. There is evidence of early-onset diabetes cases being responsible for the development of various diabetic complications due to longer disease duration (Mohan et al., 2013; Mohan et al., 2012). Among those complications, neuropathy is the most common complication (24.6 percent) followed by cardiovascular complications (23.6 percent), renal issues (21.1 percent), retinopathy (16.6 percent) and foot ulcers (5.5 percent) (Ramachandran et al., 2001). The chronic nature of the disease makes it imperative to identify the risk early. Hence, there is a need for holistic diabetes management policies addressing all the factors related to occurrence and progression of the disease.

2.1.4 Prediabetes

The pre-diabetes subject is defined as a person who is at risk of diabetes. Pre-diabetes is a high-risk state for diabetes that has glycemic variables higher than normal, but lower than diabetes thresholds. The diabetic subject is an individual for whom GRBS (Glucometer random blood sugar) is ≥ 200 mg/dL and fasting glucose ≥ 126 mg/dL. Pre-diabetics included those with GRBS between 140 and 199 mg/dL and fasting glucose between 100 and 125 mg/dL. Another study defines pre-diabetes as a hemoglobin A1C (HbA1c) level between 5.7% and 6.4% or an impaired fasting glucose (IFG) level of 100 mg/dL to 125 mg/dl (ADA, 2015).

Impaired glucose metabolism is a substantial burden on population health, and research emphasizes the need for more effective prevention strategies, which should be implemented as soon in a person's life as possible (Ligthart et al., 2016). According to a research 5–10% of people per year with prediabetes will progress to diabetes, with the same proportion converting back to normal state. Prevalence of pre-diabetes is increasing worldwide and

experts have projected that more than 470 million people will have prediabetes by 2030 (Tabák et al., 2012). Another study concluded that India would have 62.4 million people with diabetes and 77.2 million people with pre-diabetes by the year 2030 (Anjana et al., 2011). The progression of diabetes has been rather faster than expected and Indian diabetic population has already crossed 69.2 million in the year 2015 itself (IDF, 2015).

2.1.5 Cost of Diabetes with Complications

The prevalence of diabetes is consistently reported above 18% in many parts of India, which is almost twice of the world average. Due to its very large population, India hosts the highest number of people living with diabetes. The growing epidemic of type 2 diabetes in India has been highlighted in several studies (Table 1). A study suggests that an estimated USD 2.2 billion would be needed to sufficiently treat all cases of type-2 diabetes in India and would have increased many folds considering the inflation in health care in recent years (Ramachandran et al., 2007). In India over 75 % of the people are not covered by any government and private insurance scheme (Forgan and Nagpal; 2012). The financial burden of health care falls heavily on individuals with the government contributing to one-third of total health spending and out-of-pocket payments representing about 58% of total health spending in 2012 (WHO,2012). Bhansali (2013) through his study done in northern India, estimates the cost of therapy with various complications in diabetes (Table 2.2).

Table2. 2: Cost of Diabetes with Complications

| S/N | Complications | Annual Expense |
|-----|-----------------------------|----------------|
| 1 | Not Any | 4493 INR |
| 2 | Diabetic Foot | 19020 INR |
| 3 | Renal Complication | 12690 INR |
| 4 | Cardiovascular Complication | 13135 INR |
| 5 | Above Two Complication | 17633 INR |

2.1.6 State of Diabetes Management in India

The healthcare infrastructure in India is below par. The diabetes management in India is plagued with numerous challenges like a number of qualified healthcare professional and basic facilities. HbA1C is the gold standard for diabetes detection but hardly available to a larger population (Kumar, 2010). There is lack of guidelines hence wide variation in treatment preferences across the country (Yih, 2010). The primary healthcare professionals are less empowered and trained. The early detection of the disease in a rural area can help reduce the burden of the disease. To reduce the economic burden of diabetes appropriate government interventions and combined efforts from all the stakeholders of the society are required. Aggressive clinical measures in terms of early insulin initiation combined with optimal doses of oral hypoglycemic agents and appropriate lifestyle modification could also have long-term positive effects on diabetes management.

2.2 Facility Planning, Logistic Strategies, and Resource Allocation

India has seen a sudden growth in diabetes incidences. The economic burden of the disease is humungous and cost of care is out of reach of the majority of the patients. Early diagnosis of the disease can help reduce the likelihood and severity of potentially life-threatening illnesses. India has progressed on various economic indicators in recent past, but its healthcare infrastructure is among the poorest. According to an online report published by 'Live Mint' a business daily of HT Media Group in November 2016, India is the second in income inequality list and the richest 10 % of the Indians own 80.7 % of the wealth (LiveMint, 2016). The most of the population in India is not able to afford good healthcare. This situation makes it imperative to allocate health resources in such a manner that it reaches the poorest of the poor.

2.2.1 Facility Planning, Logistic Strategies for Healthcare

For efficient and effective healthcare delivery, preventive health care programs become very important (Zhang et al., 2009). Unfortunately, the facilities for the early detection are rarely available at the lower centers in India and patients are referred to higher centers only after the disease has progressed to an advanced stage (McGorry et al., 2007). The facility location planning for preventive care is very crucial in ensuring early diagnosis and maximization of coverage. Similarly, the logistic planning for the network has a direct impact on the whole system's efficiency (Shariff et al., 2012). The treatment of the chronic disease involves frequent follow up visit to the doctor. The effective facility planning can further reduce the transportation cost in case of diabetes management. Thus, facility and logistic planning play an important role in health service planning, as it directly affects the healthcare cost and accessibility (Rahman & Smith, 1999).

2.2.2 Decentralization in Healthcare

Decentralization is the process of distributing or dispersing functions, powers, people or things away from a central location or authority. Health sector decentralization has attracted many healthcare researchers because of its perceived advantages while others warn against it in absence of significant evidence about its positive impact on the performance of health services. There is plenty of literature available on the topic decentralization of services. McIntyre and Klugman (2003) observe that decentralization results in disjuncture between the policy-making authority and the implementation capacity of service delivery levels. Another study done in Sudan found positive effect of the decentralization of tuberculosis (TB) services on the clinical profile and treatment outcome of tuberculosis (Nyirenda et al., 2003). A similar study done in Malawi concludes that implementation of decentralized TB services including an extended range of supervision options for Directly-Observed-Treatment (DOT) and the use of an ambulatory treatment regimen, achieved reduced hospital stay and bed occupancy and good treatment outcomes for TB patients. The literature further suggests that continuous and integrated healthcare services may be achieved in rural areas by decentralization of services, delegation and substitution of tasks, interdisciplinary and team-based working, the flexibility of roles, and cultural adjustments (Rygh and Hjortdahl, 2007). Many low and middle-income countries have decentralized their public health services in an effort to improve their equity, efficiency, and effectiveness. India follows a three-tier healthcare delivery system including Primary Health Centers (PHCs), Community Health Centers (CHCs) and District Hospital. However, a study done in China cautions against unrealistically rapid decentralization of health services in poor rural areas as it results in loss of control and corruption (Tang and Bloom, 2000). Another study done in New Zealand

recommended having appropriate management expertise before implementation of decentralization in healthcare services (Malcom,1989).Regmi et al. (2010) in their paper highlighted a complex picture, revealing diverse relationships between decentralization of health performance in terms of access, utilization, and participation in the decision-making process. The decentralization increases the accessibility at the same time results in poor control and utilization. Thus we can say that decentralization should be implemented cautiously to achieve its benefits.

Decentralization and Control

Collins and Green (1994) in their study concluded that decentralization results in loss of control of policymaker on implementation bodies.Kristki and Netto (2000) in their study report that rapid decentralization from the federal level to unprepared states and municipalities, leading to the weakening of local tuberculosis control program. When there is the difference in administrative and policy skills, in socio-economic standards and social capital are wide, decentralization may not be very successful (Tediosi et al.,2009).Even in decentralized systems, the role of the central body can be very important to contain health expenditure. Thus there is a need for a middle-path between complete decentralization and centralized control in healthcare services.

In best of our knowledge, there is the absence of any study discussing an objective approach for decentralization in health care, and this study attempts to fill this gap.

2.3 Lean, Agile and Leagile Strategy Implementation

India's constitution guarantees free healthcare for all its citizens (Britnell, 2015). All government hospitals are required to provide free of cost healthcare facilities to the patients and government has rights to control the cost of treatment in private hospitals to keep healthcare in reach of the majority of the population. Achieving cost efficiency at the cost of agility in healthcare may cost human life. This situation makes it imperative to manage the supply chain in such a way that cost of operation is controlled at the same time agility of the supply chain is not compromised. Thus we can say, a healthcare service provider needs to be agile (responsive) at the same time lean (cost effective).

The lean strategy is more suitable for the market with predictable demand, low variety, and long product life cycle while agile strategy works best in the market having volatile demand, high variety and shorter product life cycle (Agarwal et al., 2006). The lean strategy focuses on minimization of waste while agile strategy is more focused towards addressing the changing customer demand (Mason-Jones et al., 2000). The literature suggests that the agility is the next step after the leanness and when a system is lean then agility is best to be achieved (Harmozi, 2001). The healthcare system needs to be agile as well as lean at the same time because every event is critical and may cost a life. Achieving agility at the cost of affordability can pull the healthcare out of the reach of the majority of the population.

The need of achieving lean and agile objective at the same time has led to the emergence of a hybrid strategy known as leagility. The literature distinguishes between lean and agile operation in the supply chain using a divider known as Customer Order Decoupling Point

(CODP) or decoupling point (DP) (Naylor et al., 1999; Mason Jones et al., 2000; Aitken et al., 2002).

Fisher (2003) proposed a matrix for selection of right supply chain between two product types and two supply chain types. The two types of products used for categorization are functional and innovative product while the types of supply chain used are physically efficient and market responsive supply chains. Functional products have steady demand and long product life cycle and should be managed by an efficient supply chain that focuses on cost minimization and high utilization of resources. The innovative products having variable demand and short life cycle should be managed by a responsive supply chain that has extra capacity and flexibility (Figure 2.2).

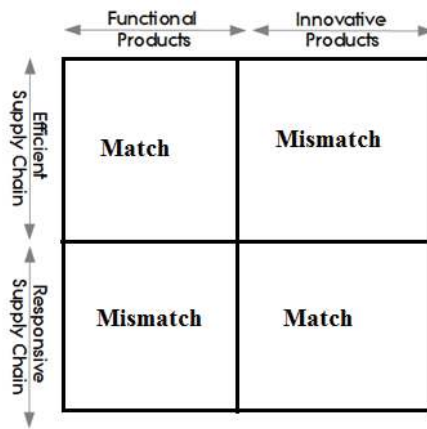


Figure 2. 2: Matching Supply Chain and Products

It is difficult to categorize hospital supply in to two categories namely functional and innovative product hence matching product with type of supply chain using Fisher's Matrix is not appropriate. The dimensions like criticality, cost and perishability also become important in classification of a hospital's supply.

Martin Christopher (2006) proposed the Global Supply Chain Matrix (GSCM) based on the demand and lead-time characteristics as depicted in Figure 2.3. According to GSCM leagile strategy is best suited for unpredictable demand and long lead time.

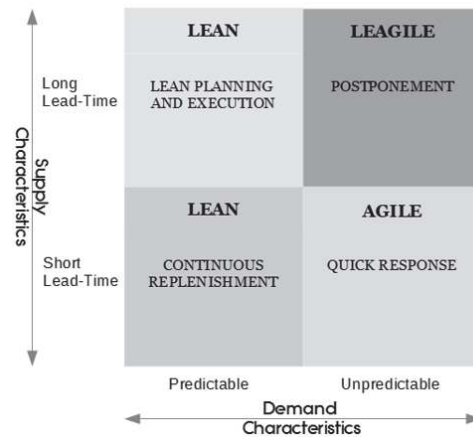


Figure 2. 3: Global Supply Chain Matrix

Lee (2004) in the paper titled ‘The Triple- a Supply Chain’ argues that the holy grail of supply chain management: ‘High Speed and Low Cost’ is not sufficient to give a company sustainable competitive advantage. They further note that the supply chain of winning companies are not just fast and cost-effective they are agile, adaptable and aligned. The method suggested for achieving this triple strategy heavily emphasizes on continuously providing supply chain partners with data on changes in supply and demand so that they can respond promptly. They also recommend providing equal access to forecasts, sales data and plans to supply chain partners.

Adopting the Leagile strategy in the service industry is a new research area. To adopt the Leagile concept in the service sector, we need to understand the difference between products and services. The services are intangible, perishable, inseparable (require interaction with the

customer) and heterogeneous (Palmer, 1994). Silvestro et al. (1992) classify services into three categories, i.e. mass services, service shops and professional services. The research focuses on healthcare services, which falls under the professional services. The demand for products used in case of healthcare services is unpredictable and lead-time varies from medium to long duration, which makes it a suitable candidate for lean strategy.

2.3.1 Leanness and Agility in Services

The lean thinking has evolved over last decade. This evolution can be summarized in the description of Womack & Jones's five principles of lean thinking (Table 2.3). They further observe that lean thinking can be applied in a healthcare system.

Table 2. 3: Five principles of lean thinking

| | |
|---------------------|---|
| Principle 1: | Provide the value customers actually desire |
| Principle 2: | Identify the value stream and eliminate waste |
| Principle 3: | Line up the remaining steps to create continuous flow |
| Principle 4: | Pull production based on customers consumption |
| Principle 5: | Start over in a pursuit of perfection |

The leanness in the service sector has been discussed by different researchers (Bhasin, 2011; Stentoft et al., 2011; Piercy et al, 2009). For example, Stentoft et al. (2011) discuss lean practices in case of the municipal sector while Poercy et al. (2009) discuss the application of lean practices in case of a call center. There is also an example of the application of lean

practices in healthcare using six-sigma approach (Kollberg et al., 2006; Koning et al., 2006). Tom et al (2009) conclude in their research that application of lean thinking can improve safety, achieve quality, boost staff morale and reduce costs simultaneously.

Goldman et al. (1995) defined four basic dimensions of agility as (1) enriching the customer (2) cooperating to enhance competitiveness (3) organizing to master change and uncertainty and (4) leveraging the impact of people and information. Like Leanness, there are plenty of articles discussing agility with reference to manufacturing but there is a paucity of articles discussing this concept in the context of services. Menor et al. (2001) discussed the agility in context of retail banking and concluded that agile banks performed better over time on an absolute measure of return on assets. McGaughey (1999) discussed the role of internet and communication technologies (ICT) in achieving agility in the service sector. Olaruntoba and Gray (2006) discussed the concept of agility in case of the humanitarian supply chain. Bowen and Yuangdahl (1998) argued that the agility of a supply chain depends on abilities of employees and supply chain partners. Strategic supplier partnership, sourcing flexibility, supplier evaluation and trust in supply chain members are the key dimensions of strategic sourcing to achieve the leagility. Khan and Pillania (2008) reported the substantial effect of supply chain partnership on supply chain agility and firm's performance.

Implication of CODP on the Value

Naylor et al. (1999) proposed the use of CODP for differentiating the lean and agile part of the value chain. The position of the CODP varies from the one type of the supply chain to another type of supply chain. The customer value in a supply chain can be defined as a function of various variables as follows (Olhager, 2012):

$$\text{Value} = f(Q, D, P, F, X)$$

Where;

Q= Quality (Conformance to specifications)

D= Delivery (Speed and reliability)

P= Price

F=Flexibility (Volume, Product /Service Mix and product range)

X= other aspects

In Make to Stock (MTS), environment price is typically the dominant criteria and act as the order winner. Quality and delivery are market qualifier while flexibility is generally less preferred. Thus customer value in case of MTS environment can be depicted as:

$$\text{Value (MTS)} = f(Q, D, \mathbf{P}, F, X)$$

In case of Make to Order (MTO) environment, flexibility is generally a dominant criterion while the price is really not an issue. Thus value in case of MTO environment can be depicted as:

$$\text{Value (MTO)} = f(Q, D, P, \mathbf{F}, X)$$

The position of CODP varies for a different type of product or service strategy. The position of CODP for various production strategies is depicted in Figure 2.4.

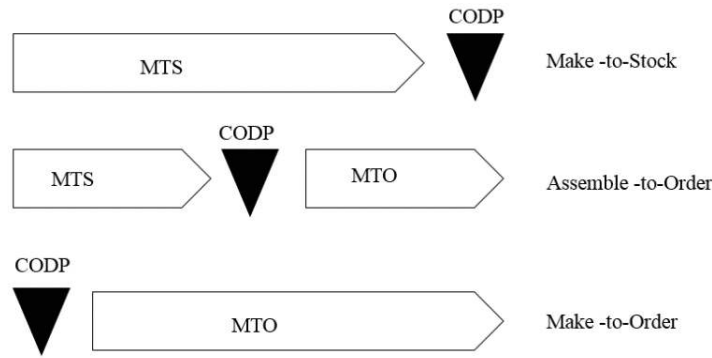


Figure 2. 4: Position of CODP for Different Strategies

The mass services are product focused and their operation is quite similar to manufacturing. The intangible part of the professional services like chronic care can't be stocked because they are produced as well as consumed at the same time. While the supply chains of the tangible components of healthcare services like medicine, health supplement, self – management assistive technologies (like glucometer, insulin pen, and customized shoe) can be managed lean. The chronic disease requires the use of same medicine and equipment for a large duration. Moreover, the most of the purchases are done by returning customers. This very nature of the chronic disease reduces the demand variability in case of some components of diabetes care like oral medicine and glucose strips.

There is evidence that collaborative purchasing can reduce the cost of purchase in case of the pharmaceutical supply chain (Stokes & Deady, 2003). But the collaborative procurement needs trust among various players for a successful implementation (Bhakoo & Chan, 2011). As there is evidence to suggest that success of a supply chain strategy depends on a strategic partnership between various supply chains players there should be a framework to assess the supply chain partnership in case of healthcare.

2.3.2 Cost Drivers in Diabetes Care Supply Chain

Diabetes has reached an epidemic proportion in developing countries (Ramachandran, 2005) like India. The International Diabetes Federation has highlighted that; “*The diabetes epidemic is here and threatens to overwhelm health systems if left unchecked* (Unwin et al., 2010). The chronic nature of diabetes makes the cost of diabetes management extremely high. This cost of diabetes management can be divided into two categories, namely direct cost, and indirect cost. The direct cost is the cost that includes the spending on medicines, diagnostic and hospitalizations. The indirect cost result from, loss of productivity due to frequent absences from work, inability to work because of disability, premature retirement, and even premature mortality as a result of complications. In addition to this cost, there is an intangible cost which includes reduced quality of life due to pain, anxiety, and stress (Björk et al., 2000).

The studies reveal that the cost of hospitalization, consultation and the cost of medicine have increased over the time (Kapur et al., 2007; Akari et al., 2013). The researchers have reported that the spend on medicine is higher in the age group of 51-70 years, which might be due to the increased number of co-morbidities (Henriksson et al., 2000; Al-Maskari et al., 2010; Hogan et al., 2003). A systematic review of the literature concludes that there is the considerable impact of diabetes on the cost to society, burden on health systems and productivity of employees (Seuring et al., 2015). Most of the literature focuses on inventory management strategies for the cost reduction in healthcare supply chain. There are very few publications that illustrate how supply chain partnership practices can be implemented to achieve cost reduction in healthcare.

In recent years, spending on medicine in the US has risen 13.1% on a nominal basis. The main driver of this trend is innovation, higher levels of price increases and lower patent expiry impact. Driven by a wave of recent innovations, specialty medicines now account for one-third of the spending on health care. In the US, Diabetes spending increased 30.5% to \$32.2 billion in 2014 resulting in net spending growth of 22.4% (Aitken et al., 2015). Nature of complexity of pharmaceutical products makes the diabetes supply chain complex. It is imperative that drugs be delivered at the right time to the right person in standard conditions (Yousefi et al., 2015). The research reports the rising cost of medicines, as a major cause of not adhering to medication in countries like US and Canada (Law et al., 2012). Cost-related non-adherence is reported as 9.6% in Canada and this number is bound to be greater in case of low-income countries like India. The impact of cost on disease outcome is more pronounced in the case of chronic diseases like diabetes.

The out of the pocket (OOP) spend on health care in India was reported as 89.1 percent by the World Bank in the year 2014. Considering the inability to decrease the cost of healthcare by traditional means, the attention of policymakers has shifted towards bringing efficiency in the healthcare supply chain (Chakraborty et al., 2014). Thus supply chain interactions, relationships, value creation activities and collaborative environment along the chain has increased in importance in recent years (Nollet and Beaulieu, 2003). There is evidence in the reported literature that collaborative purchasing has a direct impact on the cost of medicines and equipment. Medicines represent a considerable portion of healthcare expenditure and reducing this burden; can free considerable resources to improve the quality of healthcare for patients.

In India, there is an intense competition among drug suppliers, where suppliers generally compete with each other on cost. The multiple sourcing allows the buyer to get the best price for the supply, but it might become difficult to encourage commitment from suppliers. (Lonsdale and Watson, 2005). Integration in Supply Chain involves synchronous information access and process integration between the company and its supplier. In integrated supply chain Information technology (IT), plays a critical role in seamless transmission and processing of information critical for real-time decision making. The literature suggests that integration of supply chain may yield better performance within the healthcare supply chain on cost as well as commitment (Chen et al., 2013).

2.3.3 Supply Chain Partnership in Healthcare

Supply Chain Partnership (SCP) can be defined as a cooperative relationship to achieve business advantage and exclusive goals by paying attention to organizational commitment, coordination, senior management leadership, trust, open communication, conflict resolution techniques, and tangible or intangible resources in supply chains. The literature divides life cycle of SCP into four stages namely: identifying strategic needs, assessing and selecting a partner, implementing a partnership and reassessing and reshaping the partnership (Kim et al., 2010) (Figure 2.5)

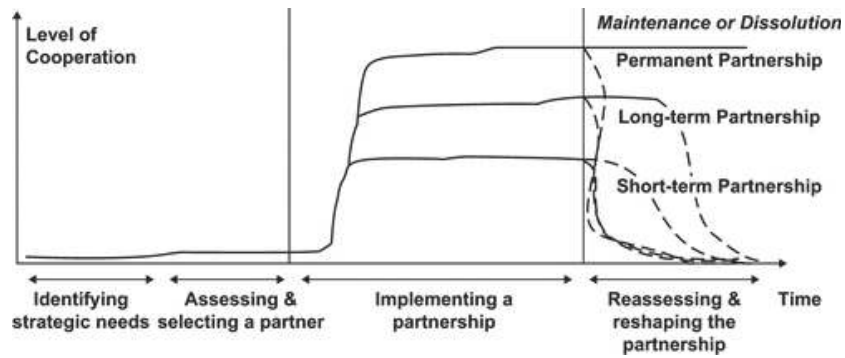


Figure 2. 5: Life Cycle of Supply Chain Partnership

It is widely accepted that a well-structured Supply Chain Partnership (SCP) enhances the effectiveness of the supply chain and reduces the cost (Lau et al., 2002). The supply chain partnership should be a key focus area for healthcare providers to reduce the cost of drugs without compromising on other important metrics like the lead- time. The drugs come with an expiry date and SCP can help in making the reverse supply chain more effective for expired drugs, which will further reduce the overall cost.

Traditionally the relationship between the healthcare provider and drug suppliers has been arm's-length and often adversarial with individual firms seeking to achieve cost reductions or profit improvements at the expense of another. The successful companies recognize that the transfer of costs up and down the supply chain does not make firms any more competitive, instead, firms that engage in cooperative long-term partnerships are more likely to be successful (Lamming, 1993; Christopher, 1999).

Supply chain partnership assessment has received less attention from researchers due to the absence of any objectivity in measurement (Gulati, 1998; Geringer, 1998; Christopher, 2016). The partnership performance varies from organization to organization depending on industry and resource capability (Glaister & Buckley, 1998; Han, 2018). In addition to this,

there is little distinction between indicators and determinants of supply chain performance. The objective measures are the measures, which are quantitative and comparable and have less bias related to data source and collection methods (Lecraw, 1983; Luo & Chen, 1995). It is very difficult to use financial measure in objective measurement. These measures may also fail to adequately reflect the objectives of the supply chain partnership that are not financial (Glaister and Buckley, 1998). The literature also reports the use of other objective measures: survival, stability, and duration of partnership for assessment of supply chain partnership (Sodhi & Son, 2009).

A framework of objective analysis of supply chain partnership should address two key questions: (1) what should be dimensions of analysis and (2) what aspect of SCP needs to be analyzed. In the reviewed literature, there is little suggestion about the dimensions of assessment of SCP. Most of the literature has relied on a questionnaire based on ordinal scales to measure the level of SCP. Such narrow approach might miss some important point when evaluating and interpreting various aspects of SCP performance (Kim et al., 2009).

Healthcare supply chain management is defined as the design, planning, execution, control, and monitoring of supply chain activities with the objective of creating net value for the patients. The literature suggests various tools like Plan-Do-Check-Act (PDCA), Six Sigma (Define, Measure, Analyse, Improve and Control (DMAIC)), Design for Six Sigma (DFSS) techniques and European Foundation for Quality Management (EFQM)Excellence Model for continuous improvement of processes (Basu, 2004; Soković and Pavletić, 2007; Westlund, 2001; Kondo, 1995).

The EFQM business excellence model is widely used in European Companies for assessment and improvement of the processes (Evans and Lindsay, 1999). It provides a framework for systematic, comprehensive and regular reviews of the organization's activities and results. The biggest benefit of using EFQM for self-assessment is that it not only reviews the organization's strengths but also identifies the area of improvements (Wongrassamee, 2003). EFQM helps an organization in balancing their enabler and results associated with them (Bassioni et al., 2008). The healthcare organization can use six sigma for quality improvement in the healthcare. The healthcare organization can identify the causes critical to quality and improve the processes to improve the quality. The organization can also use Quality Management Systems like EFQM for implementing Total Quality Management (TQM) in healthcare.

2.4 Patient's Utility for Service Attributes in Diabetes Care

The healthcare infrastructure in developing countries like India has improved in recent years. However, with progress in healthcare harder second-generation problems linked to the quality, rather than the availability, of care have emerged. Efforts to improve the quality of healthcare services in low-resource settings, including India, have typically focused on structural constraints. Literature suggests that there is a large gap between provider's knowledge and the care provided in India, also known as "know-do-gaps" (Das and Hammer, 2014). Larsson and Larsson (2009) explored the relationship between patients' service quality perceptions and their attitudes and found out that about 10 percent patients hesitated to continue to visit the same health care provider again citing know-do-gaps as the major reason. Sharma and Narang (2011) assessed the perception of patients towards the quality of health care services in rural areas of northern India and concluded that the quality of

healthcare services perceived higher in primary health care centers than in community health center. They further concluded that the major reason behind this perception is the inadequate availability of doctors, poor clinical examination and poor quality of drugs.

Seema Mehta (2011) studied the relationship between the service quality and patient satisfaction and concludes that the service quality is an important factor contributing towards patient satisfaction. Thakur (2014) studied the relationship between service qualities, customer satisfaction and customer's positive attitude in public sector and found that service quality and customer satisfaction are strongest variables for the positive attitude intention of customers. Murti et al. (2013b) in their study concluded that service quality leads to improving the customer's satisfaction which creates an impact on behavioral intentions.

A study done in India concludes that poor quality care in public sector hospitals coupled with the costs of care in the private sector has trapped India's poor in a vicious cycle of poverty, ill health and debt for many decades (Katyal et al., 2014). The cost of care in India is more than median per capita income and it is a major cause of non-adherence of medication regime (Peasah et al., 2015). The chronic care can take a leaf out of note from cost-effective care provided by Aravind Eyecare to solve this problem (Health Affair, 2016).

The inherent complexity coupled with growing demand for healthcare has put a lot of stress on the diabetes healthcare in India. The other problem faced by the patients is the selection of right healthcare provider. Before starting a treatment regime patients have to decide on where to consume the hospital services. The attributes neither critical nor having utility for patient's result in increased cost and hence non-adherence to the medical regime. The studies have shown that there is a positive correlation between medication non-adherence and cost of care (Bhosle et al., 2006). Literature suggests that there is a significant impact of non-

adherence on health care costs in several chronic diseases, such as diabetes and asthma (Iuga and McGuire, 2014; Sokol et al., 2005).

For designing a healthcare service, the understanding of patient's utility and preferences for different attributes becomes important (Leister & Stausberg, 2007). The selection of hospitals appears to be heavily influenced by patient or family choice, which increases with patient age and involves inherent differences in patient prognosis (Newgard et al., 2013). Studies show that some of the important criteria for selection of hospital are patient's own experience with a hospital, short distance from their homes, and the hospital's expertise (W de Cruppé, 2011). Taylor and Capella (1996) observe that hospital attributes are important for the consumer in choosing one hospital over another; however, not all service attributes are equally important in determining consumer preferences for hospitals. Hospitals choose their attributes in order to maximize their business objectives. These objectives may be related to revenue maximization or social welfare maximization (Custer, 1986). Hospitals employing the productivity strategy, specializing in fewer product lines, experienced less decline in profitability in recent years while excess diversification results in declines in profitability (Eastaugh, 1992).

A study done in Korea concluded that service quality is a most important determinant of patient satisfaction (Choi et al., 2004) but we were not able to find the similar conclusion for the Indian patients. The researchers in the US have developed healthcare provider recommendation system where a patient can search provider by using a variety of categories, such as, e.g., location, specialty, or physician name (Bachus et al., 2005). The literature suggests the use of Analytical Hierarchal Process (AHP) to access the healthcare choice

decision by the patients (Javalgi et al., 1991). A study done in Germany uses Conjoint Analysis to investigate the criteria used by patients in selecting a hospital (Leister and Stausberg, 2007). The literature suggests that conjoint analysis can yield potentially policy-relevant information about community preferences for health services (Stephen et al., 2000).

There is an abundance of literature on patient's preferences on health policies and health attributes (Akinci et al., 2004; Leister and Stausberg, 2007; Lindquist and Lane, 1991; Weng, 2006). However, there is lack of literature on the utility of patients for different healthcare attributes in India. Due to the differences in health insurance policies, health care systems, and the ecology of health care in different countries, research findings do not provide a consistent consensus (Weng, 2006).

2.5 Healthcare Quality Assessment for Diabetes Care

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 (Anderson, 1995). 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 attributes values are high. The patients don't possess the medical knowledge adequate to assess the performance of healthcare services (Fowdar, 2005). There is a 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).

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: a 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 (Grönroos, 1984). 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 to the proposer of the model, SERVQUAL is a generic instrument with good reliability & validity and has 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. They further conclude 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. According to Oermann & Templin (2000), the most important indicators of healthcare quality to the consumer are the expertise of healthcare provider, being able to communicate and spending 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 done by Brown and Swartz (1989) identified, ‘professional credibility’, ‘professional competence’ and ‘communication’ as factors significant in evaluating the service quality in case of the 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 studies show that physician’s communication skill and participatory decision-making style are strongly associated with diabetes management. The 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 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). To the best of our knowledge, there is a complete absence of any study on identification and categorization of the quality attributes in diabetes care.

The review of the literature concludes that there is a need for understanding the reason behind the sudden surge in the number of the diabetic patients in Varanasi. To address this gap, we

have developed a system dynamics model for prevalence, prevention, and control of diabetes. The findings of the system dynamics model are discussed in chapter three in detail. The research further explores the methods for Facility Planning, Logistic Planning and Resource Allocation for diabetes care in the city and the chapter four deliberates upon this aspect.

As suggested in the literature review supply chain for the diabetes care needs to be lean as well as agile. Chapter five proposes a leagile strategy for the diabetes supply chain and elaborates it using a case study of a specialty hospital from Varanasi.

The studies suggest that medication adherence is positively correlated with the patient's utility for the various attributes of the healthcare. This research designs a study to assess patient's utility for various service attributes and concludes that quality of the care is the most important factor for the patient. Finally, this study develops a quality assessment and implementation framework for diabetes care in India.