Barriers to Green Practices in Health Care Waste Sector: An Indian Perspective

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***Abstract*—Health care service is now became a basic need for people irrespective of their age, gender and culture due to increasing pollution levels and changing lifestyles associated with rapid civilization. Health care units (HCUs) generate huge amount of waste, while rendering health care service to mankind. The management of health care waste is of great importance due to its infectious and hazardous nature that can cause undesirable effects on human health and the environment. Government regulations and growing public awareness regarding health care waste issues have forced health care units to adopt suitable strategies for managing this waste. Many efforts have been made by environmental regulatory agencies and waste generators to better manage the waste from healthcare facilities in recent years. In fact new technologies and instruments have been developed to handle health care wastes. However waste management practices in health care sector are not free from challenges. An attempt has been made in this study to identify potential barriers that hinder the greening effort of the health care waste sector in India. Interpretive Structural Modelling (ISM) has been used to model and analyze the identified barriers and their interdependencies.**

***Index Terms*—Health care waste (HCW), green supply chain management (GSCM), challenges to waste management, health care unit (HCU), interpretive structural modelling (ISM).**

I. Introduction

The exponential growth of Health Care Units (HCU) such as hospitals and dispensaries in India has generated massive health care wastes creating an alarming situation for local governments. The waste generated by HCUs by the process of rendering health care services, can be hazardous, toxic and even lethal due to the presence of pathogens in sufficient concentration or quantity that could result in transmission of infectious diseases. Pollutants from these wastes that can cause adverse effects on human health have been identified. Two such pollutants the mercury and dioxin have been detected in significant amount in air and ash emissions from medical waste incinerators [1]. Globally, HCW issues have been seriously considered and many efforts have been done or are being done at international level to minimize hazards associated with HCW. In India, this problem has been recognised by the concerned agencies, and Government regulations have been framed to systematise implementation [2]. To comply with government regulations and to increase their public image HCUs in India are adopting green practices like other sectors, to address waste issues.

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Organizations facing competitive, regulatory and community pressures, are trying to address their serious environmental issues by greening their supply chains which aims at elimination or minimization of waste in all forms including energy emissions, chemical, hazardous and solid waste, along supply chain [3]. Green Supply Chain Management (GSCM) has gained popularity with both academics and practitioners with objectives of reducing waste and preserving the quality of product-life and the natural resources. The emergence of GSCM is treated as important innovations that assist organizations develop "win-win" strategies. By lowering the environmental risks and impacts, as well as raising the ecological efficiency, organizations can achieve profit and market share objectives [4]. It represents integrating environmental thinking into supply chain management, including product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumer as well as end-of-life management of the product after its useful life [5]. It is clear from the above definition of GSCM that waste management practices are part of GSCM activity.

II. Literature Survey

A. Health Care Waste

In literature, the terms 'Health care waste', 'Clinical waste', 'Infectious waste' and 'Medical/Hospital waste' are typically encountered, they may have similar meanings or be subsets of one another, which substantially inhibits using and comparing data from different countries [6]-[9]. The most authentic definition from the WHO characterizes healthcare waste (HCW) as those wastes generated from hospitals, medical centers, healthcare establishments and research facilities in diagnosis, treatment, immunization and associated research [10]. Health care waste (HCW) can be categorized into two broad categories as hazardous wastes and non-hazardous wastes. Nonhazardous waste include non-infected plastic, packaging material, paper etc. Bio hazardous waste is divided into two categories as (a) Infectious wastes like sharps, non-sharps, plastic disposables, liquid waste, etc. and (b) Non-infectious wastes like radioactive waste, discarded glass, chemical waste, cytotoxic waste and incinerated waste [11]. Some hospitals or pathological laboratory wastes may contain toxic chemicals, like mercury, xylene and formalin [12]. Although 75-90% of the hospital waste is non-hazardous and harmless as any of the other municipal waste, the remaining 10-25% is hazardous to humans or animals and deleterious to environment [11].

B. Issues Associated with Health Care Wastes

Health care waste poses a risk for patients and personnel who handle these wastes. It is infectious and hazardous and poses serious threats to environmental health and requires specific treatment and management prior to its final disposal [13]. Improper disposal practices of hospital waste affects the people who come in direct contact with it. Waste piles also attract a variety of disease vectors, including mosquitoes and flies [14]. It can cause environmental pollution, unpleasant odors, and growth of insects, rodents and worms; it may lead to transmission of diseases like typhoid, cholera, HIV, Tuberculosis, Hepatitis B and C through injuries from sharps contaminated with human blood [15]. Moreover antibiotics poured down the drain can kill beneficial microbes and bacteria in septic systems and dumping of healthcare waste in uncontrolled areas can have a direct environmental effect by contaminating soils and underground water. During incineration, if no proper filtering of flue gases is done, air can be polluted causing illnesses to the nearby populations [16].

C. Health Care Waste Statistics in India

Healthcare is one of India's largest sectors, in terms of revenue and employment, and the sector is expanding rapidly. During the 1990s, Indian healthcare grew at a compound annual rate of 16%. Today the total value of the sector is more than $34 billion. This translates to $34 per capita, or roughly 6% of GDP [17]. In India, there are about 6,00,000 hospital beds, over 23,000 Primary Health Centers, thousands of registered nursing homes, countless unregistered nursing homes and dispensaries, and above all a very large number of quacks practicing at every nook and corner of urban and semi-urban locality [18]. Rapid increase in population, increase in life style disease and growth of medical tourism are some of the causes of growth of this sector. The private sector accounts for more than 80% of total healthcare spending in India [17]. According to health information statistics 20% of total beds are in rural hospitals while 80% are in urban hospitals. Extrapolating from past figures of number of beds and average quantity of waste generation at the rate of 1 kg per bed per day, it is estimated that about 0.33 million tonnes of hospital waste is being generated per year [2].

D. Health Care Waste Management (HCWM)

Healthcare waste management includes all activities involved in waste generation, segregation, transportation, storage, treatment and final disposal of all types of waste generated in the healthcare facilities, stages of which require special attention. This will ensure that inputs (funds, equipment and facilities), activities and outputs (safe workplaces, healthy environment, healthy workers) for the safe handling and disposal of healthcare waste are in place [16].

E. Health Care Waste Management in India

In India, with exception to a few large hospitals, most of the smaller hospitals and nursing homes lack any effective system to safely dispose off their waste. Even the Government and municipal hospitals are no better than the private nursing homes in this regard. Wastes generated during health services, the used bandages, syringes, human tissues, used culture media containing microorganisms are dumped in the open bins on the roadsides or low lying area or directed into the water bodies. Thus, an unauthorized reuse of medical wastes by rag pickers is being promoted through irresponsible dumping of these dangerous wastes into open bins [12] and in turn facilitates in spread of many diseases. World Health Organization (WHO) predicted that India is on the verge of having an HIV epidemic. Tuberculosis (TB) and HIV combined together is taking great toll on the human health and life. Hepatitis B and C infections are on the rise. Mortality due to Hepatitis C has gone up significantly [18]. A study conducted by the Central Pollution Control Board (CPCB), an apex pollution monitoring body of Government of India, on incinerators in Delhi Hospitals, concluded that the incinerators were found to spew a high level of deadly residues and toxic emissions such as cancer-causing dioxins and furans besides chemicals which cause neonatal abnormalities, reproductive and skin disorders, endocrine disruption and suppression of the immune system [19].

F. Previous Studies

Significant research on waste management practices in health care sector has been carried out by number researcher in countries such as Finland [20],Tanzania [21], The Netherlands [22] Saudia Arabia [23] United States of America [24],[25],United Kingdom[26],[27] China[28],[29]

Studies on the health care waste management practices hospitals are very few in India. While most of the studies discuss harmful impact of improper waste management and status of current practices in Indian hospitals [30], [19], [14],[31], [32] very few studies analyses the issues and identifies various barriers to waste management practices in Indian health care sector[2], [18].

Previous studies show authors, in their discussions about waste management practices, overlooked potential barriers that inhibit implementation of the waste management strategies in health care sector. An attempt has been made here to identify the potential barriers hindering the strength of waste management practices in Indian health care sector.

III. Challenges to Waste Management Practices in Indian Health Care Sector

The public outcry against health care waste disposal practices and several public interest litigations (PILs) filed in various courts, exerted tremendous pressure on Government of India to enact a law governing health- care waste management (HCWM). Finally, in view of the serious situation involving biomedical waste management, the Ministry of Environment and Forests, Government of India created the Biomedical Waste (Management and Handling) Rules, which came into effect on 20th July, 1998 [31]. Despite these rules and initiations, a lot of challenges to health care waste management practices are faced by Indian health care sector. The major challenges identified from literature review are: be polluted causing illnesses to the nearby populations [16].

A. Lack of Segregation Practices (LOSP)

Segregation practice prevents non-infectious waste to get mixed with infectious waste. Lack of segregation practices significantly increases the quantity of infectious medical waste as mixing of infectious component with the general non-infectious waste, makes the entire mass potentially infectious [14]. Poor segregation practice of the waste starting from generation to disposal is observed in Indian hospitals. In some hospitals though better segregation practices are followed at the point of generation, waste handlers are found mixing it together during the collection and results in loss of ultimate value of segregation [32].

B. Improper Waste Management Operational Strategy (IWMO)

Operational plans should include the location and capacity of the storage containers, frequency of collection for various types of wastes and schedule of activities. Infectious wastes are to be stored in the designated colour-coded leak-proof containers for safe handling and can be disinfected / sterilized by the available facility in the hospital. Transportation of waste within the hospital is to be carried out in closed handcarts to avoid spillage of waste to a disinfection or treatment facility. After disinfection/sterilization the waste is transported to a common treatment facility, such as an incinerator or controlled landfill [2]. Studies show Indian HCUs have poor operational strategies as personnel responsible for these activities are mainly ward attendants and other supporting staff [18], and absence of documented waste management and disposal policy[32]. Moreover there are no waste management committees are present in Indian hospitals which should essentially be consist of the head of the establishment, all the departmental heads, hospital superintendents, nursing superintendents, hospital engineers with a waste management officer along with an environmental control advisor and an infection control advisor [2].

C. Insufficient Support from Government Agencies (ISFGA)

Support and guidance from regulatory authorities in the areas of waste management, regulations in the form of waste reduction and recycling targets, carbon credit earnings, development of minimum energy efficiency standards for equipments are necessary for prevention of pollution and reduction of environmental load on sustained basis. Lack of proactive environmentalism and low priority accorded to green procurement initiatives by the governments' acts as a significant barrier to Waste Management [33]. No agency in India has been assigned the task of spreading awareness [18]. Therefore Rules have not been publicized as widely as required. Hence, smaller HCUs may not be fully aware of them. Additionally a number of issues have not been dealt with in detail, such as standards of collection and storage devices, equipment, etc. [2].

D. Lack of Green Procurement Policy (LOGPP)

Personnel responsible for procuring health care products and services (materials managers or purchasing agents) come from varying backgrounds. Environmental background or training is not a prerequisite for the individuals responsible for securing health care products and services. Waste minimisation can be achieved by purchasing reusable items made of glass and metals which can be disinfected and reused [2]. For example, a polyolefin intravenous (IV) bag does not contain chlorine, so it has less potential to produce dioxins through incineration than an IV bag containing polyvinyl chloride (PVC) [1]. Similarly mercury thermometers can be replaced with mercury free thermometers. Health care units should stimulate the purchase of environmentally preferable products by mandating certain practices in their purchasing policy.

E. Unauthorized Reuse of Health Care Waste (URHCW)

Reuse of plastic syringes and other plastic material used in the health care is a thriving business of billions of Indian Rupees. More than one million people are engaged in rag picking (more than 100,000 in Delhi alone). The estimated figure of business on this score in Delhi alone is more than 50 million Indian Rupees per year [18]. Lucrative monetary returns and lack of awareness about the problems associated with biomedical wastes encourage waste-picking and reusing activities [19]. The waste collection and transportation workers in the hospital segregate the recyclable material for sale. In a similar way, all disposable plastic items, needles and glass are segregated by the wastepickers, from where the waste is deposited either inside the hospital grounds, or outside in the community bin [2]. It thereafter goes to the waste handlers, then to the rag pickers, to the packaging outlets situated in a decrepit area of a 'basti (slum)', to the medical shop, and finally sold to the unsuspecting patients or their relatives [18].

F. Lack of Top Management Commitment (LOTMC)

Governments and the health care providers have gone in for one type of option for treatment of the waste. No health care provider wants or has undertaken a base line survey to collect data regarding quantum of waste and its type being generated, nor about the waste generation points in its premises. Budgetary support is poor in the government run hospitals, the corporate hospitals and the nursing homes. Therefore they find it convenient to ignore the rules for monetary consideration [18]. Top management in most of Indian hospitals is showing inertia in dealing with the waste problem. The wastes are therefore instead of being segregated, discharged in a mixed condition to the site of disposal, separating only the saline bottles, which are sent for auctioning [32].

G. Lack of Adequate Facilities (LOAF)

Efforts to provide facilities for storage, collection, treatment and disposal of health care wastes as well as appropriate technologies have so far been limited in India. Additionally, adequate and requisite number of sanitary landfills is lacking in India. Therefore, the biomedical waste are openly dumped into the open bins on the road sides, low lying area or they are directed into the water bodies; through which severe disease causing agents are spread into the air, soil and water [12]. Self contained onsite treatment methods may be desirable and feasible for large healthcare facilities but are impractical or uneconomical for smaller institutes. An acceptable common system should be in place which will

provide free supply of colour coded bags, daily collection of infectious waste, and safe transportation of waste to offsite treatment facility and final disposal with suitable technology [30]. Moreover available disposal techniques are neither able to meet disposal requirements nor innovations in disposal options are in pace with the evolution of complexity of health care waste streams.

H. Financial Constraints (FC)

With dedicated systems being installed in most of the HCUs, financial provision is necessary for capital and recurring expenditure including funds for sufficient manpower, disinfectants, devices and equipment. Normally, a separate allocation of funds for waste management is not found in Indian hospitals. It is estimated that INR 3000–4000 (US$ 70–93) per tonne of hospital waste is required [2]. Additionally funds are required for conducting training and awareness programs for health care staffs. Smaller HCUs ignore waste management practices due to financial constraints [30].

I. Inadequate Awareness and Training Programs (IAATP)

Awareness of appropriate handling and disposal of health-care wastes among health personnel is a priority; it is essential that everyone should know the potential health hazards. Regular programs will help prevent exposure of health-care wastes and related hazards. Poster exhibition, proper labeling, and explanation by staff are effective methods. Seminars and workshops, and participation in training courses are also essential [12]. Management in most of Indian hospitals is not aware of cost savings achieved due to good waste management practices. It has also been estimated that disposal savings of between 40% and 70% could be realized through the implementation of a healthcare waste reduction program [26]

J. Reluctance to Change and Adoption (RTCAA)

General resistance to change is often a barrier to new programmes [5]. Employee's commitment to change programmes is crucial given that they actually execute implementation activities [34], [33]. Though now alternative technologies are permitted as per the Biomedical Rules, in India still it takes a long time to change the mindset of the people. Even now most of the health care providers and decision making authorities talk of incinerator only although autoclaves and other advanced waste handling equipments are available. Indiscriminate throwing of the waste is still seen in most of the hospitals and the waste handlers still are without protective clothing and gears. There is hardly any change in the applied knowledge and awareness seen in Indian hospitals [18].

IV. Interpretive Structural Modeling(ISM)

ISM is interpretive as the relation between the variables are decided based on the judgment of the selected group of experts, and it is structural as an overall structure can be extracted from the complex set of variables based upon their relationship [33] ISM is intended for use when desired to utilize systematic and logical thinking to approach a complex issue under consideration. It can act as a tool for imposing order and direction on the complexity of relationships among the variables. ISM is primarily intended as not only a group learning process, but can also used individually [35]

ISM is a powerful technique, which can be applied in various fields. Several examples of the use of ISM have appeared in the literature [35]-[39]

Steps for constructing ISM based model are as follows:

A. Structural Self-Interaction Matrix (SSIM)

ISM methodology suggests the use of the expert opinions based on various management techniques such as brain storming, nominal group technique, etc. in developing the contextual relationship among the variables. In this research, experts from the HCU's and academia were consulted in identifying the nature of contextual relationship among the barriers of waste management practices in Indian HCUs. In order to analyze the relationship among the HCWM barriers, a contextual relationship of 'leads to' type is chosen. For example, Inadequate Awareness and Training Programs leads to Lack of Segregation Practices. In a similar manner, the contextual relationships between the variables are developed. Keeping in mind the contextual relationship for each variable, the existence of a relation between any two variables (*i* and *j*) and the associated direction of the relation are questioned. Four symbols are used to denote the direction of relationship between the variables (*i* and *j*):

V: Barrier *i* will help to alleviates barrier *j*
A: Barrier *j* will be alleviated by barrier *i*
X: Barrier *i* and *j* will help to alleviate each other
O: Barrier *i* and *j* are unrelated.

Based on the contextual relationships, the SSIM is developed for the 10 variables identified as barriers of the HCWM practices in Indian health care sector shown in Table I.

TABLE I: Structural Self Interaction Matrix

Barriers → ↓	10	9	8	7	6	5	4	3	2	1
1. LOSP	O	A	A	O	A	O	O	A	V	X
2. IWMO	A	A	A	A	A	A	A	A	X	A
3. ISFGA	V	V	X	V	A	V	V	X	V	V
4. LOGPP	O	O	A	O	A	V	X	A	V	O
5. URHCW	O	O	A	A	A	X	A	A	V	O
6. LOTMC	V	V	V	V	X	V	V	V	V	V
7. LOAF	O	O	X	A	A	V	O	A	V	O
8. FC	V	V	X	V	A	V	V	X	V	V
9. IAATP	V	X	A	O	A	O	O	A	V	V
10. RTCAA	X	A	A	O	A	O	O	A	V	O

B. Reachability Matrix

The SSIM is transformed into a binary matrix, called the initial reachability matrix by substituting V, A, X and O by 1 and 0 as per the case. The rules for the substitution of '1's and '0's are as follows:

- If the (*i*, *j*) entry in the SSIM is V, then the (*i*, *j*) entry in the reachability matrix becomes 1 and the (*j*, *i*) entry becomes 0.
- If the (*i*, *j*) entry in the SSIM is A, then the (*i*, *j*) entry in the reachability matrix becomes 0 and the (*j*, *i*) entry becomes 1.

- If the (*i*, *j*) entry in the SSIM is X, then the (*i*, *j*) entry in the reachability matrix becomes 1 and the (*j*, *i*) entry becomes 1.
- If the (*i*, *j*) entry in the SSIM is O, then the (*i*, *j*) entry in the reachability matrix becomes 0 and the (*j*, *i*) entry becomes 0.

Following these rules, initial reachability matrix for the HCWM barriers is identified and the final reachability matrix is obtained by incorporating the transitivities, this is shown in Table II. In this table, the driving power and dependence of each variable are also shown. The driving power of a particular variable is the total number of variables (including itself), which it may help to achieve while the dependence is the total number of variables, which may help to achieve it

TABLE II: REACHABILITY MATRIX

Barrier	10	9	8	7	6	5	4	3	2	1	Driving
1	0	0	0	0	0	0	0	0	1	1	2
2	0	0	0	0	0	0	0	0	1	0	1
3	1	1	1	1	0	1	1	1	1	1	9
4	0	0	0	0	0	1	1	0	1	0	3
5	0	0	0	0	0	1	0	0	1	0	2
6	1	1	1	1	1	1	1	1	1	1	10
7	0	0	1	0	0	1	0	0	1	0	3
8	1	1	1	1	0	1	1	1	1	1	9
9	1	1	0	0	0	0	0	0	1	1	4
10	1	0	0	0	0	0	0	0	1	0	2
Dependence	5	4	4	3	1	6	4	3	10	5	

C. Level Partitions

From the reachability matrix the reachability and antecedent set for each variable are obtained. The reachability set for a particular variable consists of the variable itself and the other variables, which it may help to achieve. The antecedent set consists of the variable itself and the other variables, which may help in achieving them. Then, the intersection of these two sets is derived for all variables. The variable for which the reachability and the intersection sets are the same, is assigned as the top-level variable in the ISM hierarchy as it would not help to achieve any other variable above their own level. After the identification of the top-level element, it is discarded from the list of remaining variables. From Table III, it is seen that the Improper Waste Management Implementation Strategy (variable 2) is found at level I. Thus, it would be positioned at the top of the ISM hierarchy. This iteration is repeated till the levels of each variable are found out. The identified levels aids in building the digraph and the final model of ISM (Table III).

D. Formation of ISM-based model

The structural model is developed from the final reachability matrix and the digraph is drawn. Removing the transitivity, the digraph is finally converted into the ISM model as shown in Figure 1. In this developed model, the top level barriers (level I, here), are positioned at the top of the digraph and second level barriers occupy the position below the top level barriers. Similarly other barriers are positioned in the hierarchy according to their levels until the bottom level barrier (level V, here), is positioned at the lowest position in the digraph. Lack of Top Management Commitment (variable 6), having level V (highest level), have highest driving power and is positioned at the bottom of the hierarchy. It has a potential to drive the barriers Insufficient Support from Government Agencies and Financial Constraints, directly. Similarly the barriers Insufficient Support from Government Agencies (variable 3) and Financial Constraints (variable 8) lead to the variables Lack of Adequate Facilities, Lack of Green Procurement Policy and Inadequate Awareness and Training Programs , which are placed above them in the hierarchy. These variables lead to the variables placed immediately above them in the ISM hierarchy.

TABLE III: LEVEL PARTITION (ITERATION I-V)

Barrier	Reachability Set	Antecedent Set	Intersec-tion	Level
1	1	1,3,6,8,9	1	II
2	2	1,2,3,4,5,6,7,8,9,10	2	I
3	3,8	3,6,8	3,8	IV
4	4	3,4,6,8	4	III
5	5	3,4,5,6,7,8	5	II
6	6	6	6	V
7	8	3,6,8	8	III
8	3,8	3,6,7,8	3,8	IV
9	9	3,6,8,9	9	III
10	10	3,6,8,9,10	10	II

E. MICMAC analysis

The objective of the MICMAC analysis is to analyze the driving power (DP) and the dependence of the variables [35],[37]. In this analysis, the HCWM barriers described earlier are classified into four clusters (Fig. 2). The first cluster consists of the variables having weak DP and weak dependence which are also known as 'autonomous variables'. These variables are relatively disconnected from the system, with which they have only few links, which may not be strong. The variables that are positioned in the second cluster have weak DP, but strong dependence. The variables positioned in this cluster are known as Dominated or Dependent variables. Third cluster contains the variables having strong DP and strong dependence and are known as 'linkage variables'. These variables are unstable due to the fact that any change occurring to them will have an effect on others and also a feedback on themselves. Fourth cluster includes the 'independent variables' having strong DP but weak dependence. The DP and dependence of each of these variables are shown in Table II. In this table, an entry of '1' added along the columns and rows indicates the dependence and DP, respectively. Subsequently, the driver power-dependence diagram is constructed and is shown in Figure 2. For example, it is observed from table II, that barrier 1 (Lack of Segregation Practices) and barrier 10(Reluctance to Change and Adoption) have driving power 2 and dependence of 5, therefore, in Fig. 2, both of the barriers are positioned at a place corresponding to driver power of 2 and dependency of 5.

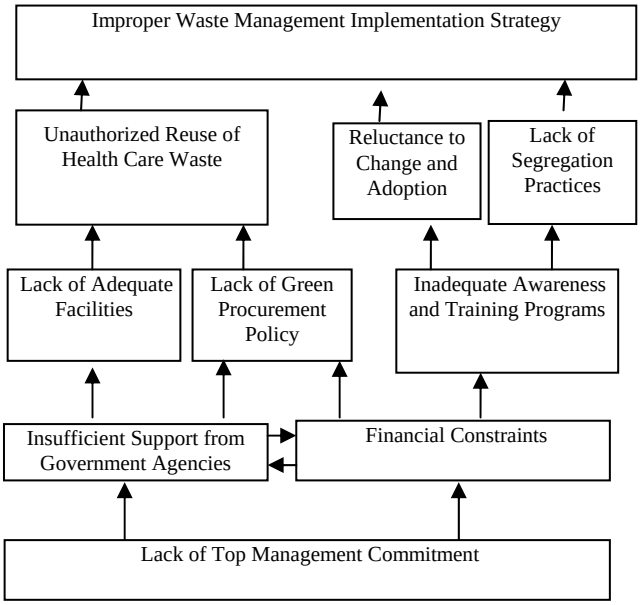

Fig. 1. ISM- based hierarchy

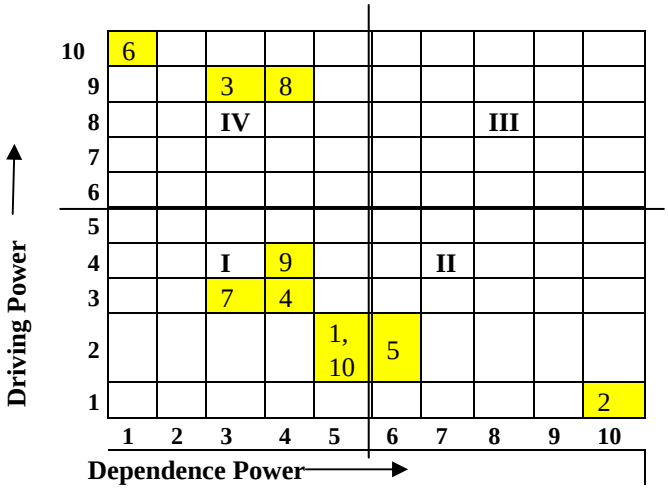

Fig. 2. Driving power-Dependence diagram

V. Discussion

Green Supply Chain Management(GSCM) has been widely adopted and implemented by various sectors to reduce environmental impact of their operations thus by gaining improved brand image and competitive advantage. With the increasing concern that waste produced by the health care units' posses the risk of causing environment hazard as well as serious health hazards, health care units are trying to implement GSCM practices to address their waste issue. The barriers discussed above are identified as having the potential to inhibit HCWM practices. Lack of Top Management Commitment is the barrier which is placed at the bottom of hierarchy indicating that it is the most significant barrier. The driving power –dependence diagram shows this barrier has the highest driving power, (10) and least dependence power, (1) indicating that this barrier can affect the impact of all other barriers. Similarly the barriers Insufficient Support from Government Agencies and Financial Constraints being occupied lower position in the hierarchy have an indication that these have significant inhibiting impact on HCWM. Position of the barrier Improper Waste Management Implementation Strategy on top of hierarchy indicates that it is the least significant barrier and from driving power –dependence diagram it is clear that the strength of this barrier is being affected by all other barriers positioned below it in the hierarchy.

VI. Conclusion

Health care units produce large amount of waste in the process of providing services to mankind. Many efforts have been made by environmental regulatory agencies and waste generators to better manage the waste from healthcare facilities in recent years but still these are not sufficient enough to prevent environmental hazards and associated health hazards caused by health care waste. So there is an urgent need for raising awareness and education on medical waste issues. This study has made an attempt to identify various challenges faced by Indian health care units for managing their waste properly and ensuring health and environmental safety. This information would be especially helpful as a guideline for improving and developing the health care related waste management standard criteria in India. This may be also useful for resolving problems with the said waste management process in India and provide basis for recommendations to the government for bringing necessary changes in the existing regulations and ensure enforcement of the rules. Ranking of the barriers with the use of ISM methodology may provide aid to , healthcare authorities, private healthcare industries and those interested in improving their existing heath care waste management strategies and standards by preventing them in focusing one or two barriers at random. The hierarchy will help the decision makers to decide their hierarchy of actions that will optimize their resource utilization.

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