SUPPLY CHAIN OF HUMAN ORGANS: 
A Case Study in the Hospital Complex of Sorocaba

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ABSTRACT

The supply chain management has great attention of both academics and executives as a way to improve the success of product development, quality targets and delivery, eliminate waste, improve customer satisfaction, reduce costs and gain competitive advantage individually and for the organizations as a whole string. However, SCM is poorly studied in the hospital sector, mainly in the donation of organs to be transplanted to other patients, This study is characterized as an exploratory and descriptive approach, which uses a method of deductive approach (from general to particular) as a method of procedure, and the case study as a method of data analysis, qualitative research, which is main objective help to understand the problems; conclusive and generally more formal and structured, which is intended to test specific hypotheses and examine relationships. The research instrument was used a semi-structured questionnaire to members of the hospitals.

Keywords: Supply Chain Management, Practice Management, Supply Chain, Supply Chain Hospital, Operating Performance.

1. INTRODUCTION

The hospital sector, our object of study is very important especially to the population through the provision of health care services, in addition to its economic importance. In Brazil, 20 million inpatients are admitted per year and hospital expenses represent 3.5% of its Gross Domestic Product (LA FORGIA & COUTTOLENC, 2008). The sector is also characterized by several peculiarities that results of a complex interaction between a large numbers of powerful stakeholders that have differing goals (Singh et al., 2006). Contain costs and maintain quality of care and patient safety challenges health service managers and policy makers (MONTGOMERY & SCHNELLER, 2007). The application of management practices in the supply chain in hospitals can offer significant opportunities to improve processes and better use of resources for the provision of health services.

A health organization is a productive system of health care, where the supply sector is integrated as a subsystem to meet the needs of supplies (consumables) and equipment (permanent materials) that develops and distributes those products, which are health professionals. The activities of health care are complex activities, seated on a supply chain that incorporates sequences of actions defined for the generation of their products (so called
Each procedure requires a specific mix of inputs (goods) and work processes (services), whose composition can vary among different organizations and even according to the different types of patients and staff from the same organization. Not only the products offered in health care organizations are complex and require high qualifications, but the inputs used in its production are increasingly numerous and sophisticated. (VECINA & REINHARDT, 2002).

The transplant involves the process of packaging, storage and transportation of organs within a lead time (time to perform a task) at predetermined time each organ ischemia (time the organ is without vascularization), ischemia leads obstruction to blood flow to peripheral tissues, the phenomenon is known as non-reperfusion. This obstruction is progressive, with thrombus formation in the microcirculation, platelet aggregation, cellular and tissue edema. The progression of this phenomenon leads to irreversible tissue damage and death of the member or retail micro surgery, the longer the duration of ischemia, the worse the prognosis, and that are linked directly to the lead time, from the moment that we actually diagnosed brain death until they walk the distances between the center and the actual transplant funding, so the faster this process occurs, the better the outcome for the patient transplant recipient.

Moreover, more specific issues are also involved such as scheduling of operating rooms, equipment and specialized equipment. This process starts from the identification of the potential donor brain death and its notification to the transplant center, its effectiveness, in turn, depends on two competing priorities: speed and quickness (HAYES et al, 2008), and precision with which the process is conducted, these two factors are essential, crucial for the patient receiver.

In recent decades organ transplantation has become a therapeutic option in an experiment able to prolong the lives of terminal patients. An issue of disagreement are the strategies for increasing organ procurement. Transplantation for many patients is synonymous with better quality of life and longer survival, for others the only chance of survival. However, the nobility of the goals of increasing organ procurement does not justify using unethical methods. No process can be considered as such during your course not excelling in maintaining attitude compatible with the principles governing ethical behaviour. For that Brazilian law is constantly looking through various discussions, lapidary to extract the most equitable distribution of donor organs.

In this context the SCM enters as a factor of competitive advantage contributing to the reduction of lead time, because it is a crucial factor in the patient's life, the integration between the chain links, information management, organization and preparation for the national arrives on time and on terms to be used on another human being are paramount to the overall process of this supply chain involving the capture and distribution of organs.

2. BACKGROUND
La Forgia & Couttelenc (2008) suggest, based on 2004 data, that 45% of health expenditures are financed by public funds. According to the authors, health spending in Brazil is high when compared to similar countries, and hospital expenses are the largest component of health expenditures in the country, representing 67% of the total. This shows that the hospital is a key element in this system, it concentrates most of the resources for the provision of health care.

According to La Forgia & Couttolenc (2008), hospitals in Brazil are responsible for the admission of 20 million patients annually, and although supplies represent a significant portion of hospital costs and be a critical factor in providing a health service fit there are irregularities and wasteful flow of these materials. According to the authors, managing the supply chain can bring to hospitals improves resource utilization and quality gains in health care.

Another important issue in the industry is the lack of integration in the provision of health care services and between the components sector (VECINA & MALIK, 2007). For the
authors, it is crucial to improve the management in public and private hospitals in search of efficiency, recognizing all those involved in the provision of medical health hospital and seek a synergistic action between them so that everyone can win. By identifying the challenges of the sector, we find that SCM can support and contribute to better resource utilization and improved delivery of health services by hospitals.

Thus, the justification is based on contribution by surveying situations and solving these problems in collection and distribution of donated organs. Besides the use of methods and tools that SCM can contribute significantly to the development and better management of all processes involved in transplants, searching through analysis of current problems, to show what are the causes that prevent SCM within the best answers to range satisfactory results.

3. METHODOLOGY

This research is characterized as exploratory and descriptive, using a method of deductive approach (from general to particular) as a method of procedure, and the case study as a method of data analysis, the qualitative approach, which has as main goal help to understand the problems, and the conclusive approach, usually more formal and structured, which is intended to test specific hypotheses and examine relationships. (MALHOTRA, 1988).

As a method of data analysis, the study is classified as a qualitative approach, because the research problem demanded that people be heard coordination level of the Search Service of Organs and Tissues of the Hospital of Sorocaba, in order to obtain opinions, his views on the real problems of organ involving patients, as a result, there was a consensus among stakeholders and interviews.

As the techniques and research tools, data sources and information that have been investigated in the Hospital de Sorocaba were people who work there, as well as documents produced. It was decided, in this case, techniques for performing data collection intensive direct observation: the interview and direct observation, with a research tool - a semi-structured questionnaire.

4. MANAGEMENT OF THE SUPPLY CHAIN FROM THE SECTOR HOSPITAL

According to Pereira (2002), is noticeable for society and especially for users of medical and hospital service that hospitals need to be prepared to handle extreme demands. It is faced with critical situations that the competence of the company hospital is tested. Thus, management should be organized to meet the needs of all patients, especially those who enter through the door of the emergency, without an appointment. This type of demand puts the service medical hospital on the list of more complex activities in the market, responsible for preserving the health and lives of patients. We stress the importance of lead time in this situation.

This vital responsibility is what makes the efficiency and effectiveness of supply chain management in the hospital and its linked chain, essential to the success of the goals of the hospital. Still on the subject, Pereira (2002) comments that the need to adopt innovations in the logistics system of any hospital, ultimately, is related to an extremely sensitive: the efficiency and effectiveness of such activity often depends on the life of the patient, in the specific case of this project: the harvesting of organs to save the lives of other patients.

According to Ribeiro (2004), the hospital logistics represents one of the biggest challenges of hospital administration, especially when evaluating the size of its importance in meeting the needs of the hospital, both in support service, cleaning, laundry, maintenance, and as auxiliary diagnostic, dialysis, surgery, blood bank, medical specialties and organ transplantation, the main object of this study.

Based on what was discoursed yet, it can be inferred that a major goal of hospitals is to improve the health status of their patients and, therefore, requires management tools able to minimize the trauma of internment. In this context the management of the supply chain
with their tools: integration, speed (performance of services), technology, reliability and accuracy of the information between the links, contribute to a desired level of service for all patients and also by sector.

In this particular case, the hospital logistics, used as a management tool, can ensure that all necessary resources for the treatment of patients available in the right place at the right time. Therefore, there must be an efficient layout planning of purchasing activities, warehousing, materials management in stock, as well as the distribution of such materials intended for use in hospital activities. Consequently, a good system of managing these activities should seek to minimize the high costs striving for operational efficiency in the sector.

It is common for a hospital continued use of a multitude of materials specific technical use. Where the person responsible for this activity does not have a broad knowledge on handling and managing these items can be created problems not only for those who work directly with the material as to who uses the services provided. (FRANCHETTI, 2002). In the case of organ involvement is crucial and management of all links in the chain, with respect to lead time extremely small, from the moment of capture need to organ transplantation in the patient / client receiver.

4.1 Practice Management Supply Chain
Just as there is no consensus in the conceptualization of SCM, the literature presents their practices from different perspectives, but the ultimate goal is common to them all, which is to improve organizational performance (Li et al., 2005). According to Li et al. (2005), SCM practices are defined as a set of activities used in an organization to promote effective management of their supply chain. Research conducted by Tan (2002) identified six dimensions that comprise it: the integration of the supply chain (all links and actors), speed and information sharing, and time responses between the links, management, customer service, proximity Geographic.

From another view, Chin et al. (2004) identify the practices of SCM in five groups: building customer-supplier relationship, use of information and communication technologies, reengineering the flow of materials and identification of performance measures in the timeline. Li et al. (2005) present practices into four groups: strategic partnership with the vendor, customer relationships, information sharing and quality. The next year Li et al. (2006) used to represent the five dimensions of SCM practices: strategic partnership with the vendor, customer relationships and information sharing and information quality in order to check their impact on competitive advantage and organizational performance, focusing on satisfaction customer.

Wong et al. (2005) in one of its SCM practices of lead-time management, distribution and logistics, customer focused. Zhou & Benton (2007) operationalize these practices considering two aspects: planning the supply chain and delivery practices. Sezen (2008) considers the practices in four dimensions: integration of supply chain information sharing with suppliers, sharing information with the client and the design of the supply chain within the industry.

Ward et al. (1998) present the dimensions of quality, time, flexibility and cost as competitive priorities. That is, organizations are challenged to choose which one to pursue and consider them as key capabilities. For the authors, these measuring competitive priorities are important to support decisions and choices. These metrics are already widely used in the hospital sector. Operating results are related to competitive advantage in terms of level of service, operational effectiveness, including cost, quality, flexibility and time (JEONG & HONG, 2007).

4.2 SCM Practices in Hospital Sector
According to Goldstein et al. (2002) studies have been conducted on the effects of location, strategy, technology and adoption of competitive priorities: quality of service, time of service and speed of preparation and methods for this time scale is met, whatever the type of
service, it impacts the competitive advantage and business performance. Kumar et al. (2008) have proposed redesigning the supply chain of health in Singapore in order to reduce cost in logistics and procurement of medical supplies and medicines, besides the aforementioned practices and a concern with the time dimension.

4.3 Planning an Action Logistics: Organ Transplants
The activity of organ transplantation is one of the organization’s products, hospital tip that involves complex logistics, coordinated jointly by the Central Notification, Organ Procurement and Distribution and Search Service, Organs and Tissues (SPOT) known before as OPO (Organ Procurement Organization).

The general planning of organ transplants considers at least the following members of the supply chain: donor, recipient, medical staff and hospital possible donor organ procurement and distribution, SPOT and transplant team. Research by Prince (2007) indicates that the failure rate in transplantations is around 30% due to refusal of authorization of the donor’s family. The remaining 70% are due to logistical problems in nature. In summary, the author concluded that, after consulting significant samples in the state of Sao Paulo, that perform transplants successfully is to coordinate activities of people, equipment, materials, services, transport and communication, as well as other resources, so that the actions happen in time and places scheduled. Behind a successful transplant are multiple procedures, as seen in the chain around transplants.

5. CASE STUDY: HOSPITAL COMPLEX SOROCABA
The study was performed in the Organ Procurement and Tissue Complex Hospital in Sorocaba (SPOT) before calling for OPO (Organ Procurement Organization). It consisted of interviews with responsible for the operation of this service. A SPOT of the Hospital de Sorocaba is responsible for several municipalities. SPOT has its operation during business hours, are not open 24 hours like in the case of organ procurement and distribution, but at night and on weekends and holidays, the nurse is responsible for “distance call,” available for the completeness of hospitals SPOT, for cases of suspected and confirmed brain death.

On the opening hours of the SPOT, just being in business hours is quite questionable, because certainly very committed to supporting the right process procedures of organ donation; it should be functionally the same equivalence of organ procurement and distribution, running 24 hours. The SPOT helps hospitals since the beginning of the ME protocol until the moment of capture organs, so the hospital through CIHDOTTs or not, comes into contact with the SPOT of the Hospital, is oriented on clinical examinations and after that the SPOT comes in contact with the companies agreed on, for the realization of (s) take (s) chart (s).

These companies contracted by the State Department of Health, which act as service providers, and enter the list of spots through public bidding, however such companies meet all spots of the state of Sao Paulo, and the spots should always respect that becomes necessary (s) take (s) chart (s), the mileage limit below 50 Km away from the SPOT requesting this location because of businesses and costs because the closer is the company’s lowest value SPOT paid for the exam by the State Department of Health, but if not possible then one should check the companies that are more than 50 km from the SPOT.

The company's nearest hospital is SPOT Set in Campinas, when not available is triggered the next company that is located in Sao Paulo, such companies providing these exams so that graphics have contacted the maximum period of up to 6 hours to go until the donor hospital, the exam and submit the report to SPOT via email or fax, they have no standard for this, but to keep better track of the duration of this process is conventionally along with such companies such condition.

However, the territorial dimension of these 47 municipalities that are under the administration of the SPOT of the Hospital of Sorocaba, is quite comprehensive as in the
question away, the nearest town is located only 4.6 km from the SPOT, while more distance is exactly 279 miles away, thus underlining the logistical complexity, and the challenge of managing the funding those 47 municipalities within the conditions imposed by the diffuse localization of these companies hired by the State Department of Health, because even in this initial process lead time, 2 required clinical examinations. It should be noted in the item lead time, the intervals between necessary clinical examinations and graphics, which are determined by the age of the potential donor, such as seven days to two months incomplete interval of 48 hours; two electrostatic encephalograms, two months incomplete one year interval of 24 hours; two electrostatic encephalograms; One year to two years of age by 12 hours: two electrostatic encephalograms and above two years interval of 6 hours: an EEG.

This dependence for the examinations graphics, these contractors located, not exactly where they should nearest hospital where the potential donor is extremely complicating for successful captures organs, because the more delay in beginning the process Confirmation of ME, one runs the risk of the donor can suffer a heart attack and lost a valuable opportunity to perform the uptake of different organs in the case of family consent.

The SPOT also calls along the Transplant Center of Sao Paulo, transport to collect the hospital where the donor serology and HLA (genes are important in the development of autoimmune diseases and transplant rejection responsible for organ and tissue), and take it to the Institute Dante Pazzanesse in Sao Paulo, but first the driver passes the SPOT of the Hospital de Sorocaba to withdraw authorization for Biological Material, and obviously this authorization should be made through the tools of technology (IT Information), which greatly expedite the process, reducing the transit time of that supply chain.

Not to mention that a single outsourcing company is responsible for this important service, is often used to bikes to reduce the time spent in traffic, starting this condition lead time noted as being quite affected because much will depend on traffic conditions existing at the time. Once the driver gets serology and HLA in the donor hospital, is noted in the document itself time and when it is delivered at the Institute of Cardiology Dante Pazzanese is also made note of the time, the Institute operates 24 hours per day, the average time for the release of the results is 3 hours, unless the need for repetitions in case of equivocal or inconclusive.

When the result of serology and HLA are available to SPOT meets all exams, notes the time of sending the e-mail or fax to organ procurement and distribution with all examinations and from attached from time to organ procurement and distribution have up to 6 hours to analyze the feasibility of funding (in terms of transplant organs) and arrange for transportation of transplantation teams to the hospital where the donor and at the same time performing triage on your system all compatible receivers, seeking to improve the process so take advantage of all organs for transplantation that are captured and summarily and it will depend entirely on logistics: location of the donor ischemic time of each organ (the organ that time will remain outside the body in liquid preservative, submerged in ice) used modal for locomotion of transplantation teams, traffic conditions when using the road system, traffic conditions such as weather and others when using the air mode, and location of receptors (where hospitals are already being admitted to the fasting time required to perform transplant).

Each organ transplantation team takes the captured of their specialization, eg. the team that captured the heart is responsible for transplant it, with only the kidneys is different, has a team makes capturing and kidneys are in power and responsibility of the SPOT, then is another team that will do the transplant.

When it is necessary ground transportation to organ procurement and distribution informs the Central Transplantation, seeking first the service of the government itself, the use of airplanes as the FAB (Brazilian Armed Forces) and the Eagle Military Police if it is not possible for these corporations do transportation, Transplant Center of calls between private airlines, jobs for transplantation teams to allocate the funding will make organ or
organ transplantation, it is intended for financial resources to pay the overhead expenses of transplantation teams.

If feasible capture all organs and tissues including skin and bones, will take on average 10 hours, most of this time is smaller because it does not capture all the organs and tissues such as bone, for example, that due to the demand of Banks Musculoskeletal Tissue, yet this time is variable depending on the skill and experience of each team, as well as the anatomical conditions of the donor organs because the organs to be raised are carefully removed, their structures (veins and arteries) clamped and prepared with all necessary technical in order to be transplanted in recipients (anastomosis of veins and arteries), this reflects the time it takes for the body to be delivered to the donor family that is around 18 to 24 hours, from the moment that is informed the family that their loved one is with BD (Brain Death).

First is found in the records of organ procurement and distribution 1 after the organ procurement and distribution 2 if not found compatible receiver is made a search on the list of SNT (National Transplant System). In the current model of SCM transplant in the region where the SPOT is responsible, who are 47 municipalities, so it is checked ME, serology and HLA patient is harvested and brought to the Institute Dante Pazzanese of Cardiology in Sao Paulo, which contributes significantly to delay the whole process could be much faster and more efficient if it were done here in Sorocaba, this would reduce the lead-time of waiting for the result of the examination to proceed effectively capture the organs, a process that would start with the confirmation that the donor patient is feasible, with the resulting location through the system by the compatible receivers and admission to the hospital where he is the giver of transplantation teams.

The modal used to collect material from serology and HLA, it is the road that is not very efficient in view of traffic conditions that is, at many times larger traffic demand extremely slow, such as in city traffic jams huge Sao Paulo, where is the reference laboratory for this examination. Another major obstacle of SCM in Sorocaba is when an ME in any county in which the SPOT is the responsibility of Sorocaba, it comes into contact with the companies agreed on, for the exams charts for proper confirmation of ME, which occurs is the location of these companies are not widely according to the real need for urgency, for example, in carrying out the tests for proving the ME, are located far from the hospital where the potential donor, which again undermines the whole operation of capture and removal of organs, it is another complicating factor, again increasing the lead time of the capture process to become effective after transplantation, penalizing chain efficiency.

For example: there was a brain death in Itu, SPOT Sorocaba resorted to list of companies, is the closest was located in Campinas, but the call was not possible to contact those responsible, who were on other commitments, and therefore the company closest was contacted in Higienopolis in greater Sao Paulo, thereby evident discrepancy existing logistics. Another issue is the cost, for example if the company hospital where she will make the graphics tests (EEG or Transcranial Doppler) is 50 Km from its location will be charged the state $ 600.00 (six hundred dollars) if you are a greater distance is charged $ 1,200.00 (one thousand two hundred dollars), which certainly makes the process very costly.

The age to be considered a donor is from seven days of life to 80 years. The list of recipients must be updated every three months, if not refreshed by the teams scattered throughout the Brazilian territory, when there Funding organ cannot do proper sorting of receptors and thereby negligently in any team, a receiver cannot be contemplated with the organ they need, to assist in the monitoring of their situation, patients receivers receive a registration number which gives them access to the SNT, and with that they can make inquiries with the Health Unit that are being met. The city of Sorocaba has the EEG machine, which is available only for cases of finding ME in the hospital and you cannot move it to nearby towns.

Thus one should always seek to manage the process of capturing and effective transplant in order to optimize the most of these resources (donated organs), because they involve many
elements of incalculable emotional point of view to the donor’s family, who after being informed of BD and interviewed by professionals involved in the donation process, asking them to authorize the donation of organs of their loved one, wish that their gesture of incomparable empathy and altruism towards others in need of such organ donations.

Effectively turning into transplants, it is extremely vital for the proper management of the components in the chain, the optimization of the entire process, involving transportation, infrastructure SPOT, and the correct distribution of the best located laboratories, IT investments since it is much precarious means of communication that are used, for example, still uses up the fax for sending and receiving documents, as well as the modal used that could be better directed to another faster, and a rather blunt the need to have a reference laboratory for the examination of serology and HLA closest.

Finally one need to keep a constant search for improvements that are closely related in the decision making of a very thorough analysis of the conditions and logistical feasibility, as observed in this study because the lead time factor is intrinsically linked to the success of the complex process as it is Supply Chain for an organ transplant.

For when strategically analyzed and checked all possibilities and efforts to improve the system, how to seek suppliers (companies providing graphics tests), location of such companies, as well as the urgent need for a reference laboratory for closer examination of serology HLA and therefore directly impacts the total time of the procedure, as well as invest in IT, making such adjustments and change of attitude in the face of a cause of extreme nobility is possible to make significant changes, such as:

- Reduce the donor’s hospital stay (releasing one more vacancy in the ICU to another patient in need with consequent reduction of the cost involved in maintaining donor that this is an irreversible);
- Reduce the time the result of serology and HLA (nearest laboratory);
- Reduce the time of delivery of the body donor’s family and consequently alleviate part of their suffering;
- Dramatically increase the quality of donated organs; (lower lead time impacts on better conditions of harvested organs);
- Reduce the time the test results graphs (hiring companies closer to hospitals);
- Significantly increase the number of organ transplants (shorter time leads to better use of the organ);
- Reduced costs (laboratories closest, lowest amount paid), lower expenditures on transportation;
- Reduced lead time for investment in Information Technology.

If the competent authorities become aware of all these problems and solve them even, making a huge gesture of respect and affection to all the people who can go through a situation like this, whether provided a possible donor being in a condition of BD irreversible, or standing on the other side of the issue, the condition quite emotionally conflicted: the family of the potential donor, for the lowest possible lead time is extremely important for both sides of the situation, doing that in a way, the suffering is alleviated.

We see therefore that a logistical planning applied to healthcare, is unquestionably essential to the lives of many people, on many occasions can mean the continuity of life or not, since it is fully conjugated in all processes where it requires agility, efficiency, rapid integration of links and Supply Chain, which the health care services are offered, and this research on SCM, the immediate observation of how the application of the tools and the correct management of the logistics chain are vital.

6. CONCLUSIONS
It was possible through this case study to verify the main problems of the SCM Organ Procurement and Distribution of the Hospital of Sorocaba, through a survey of the real workings of this chain, thus showing clearly where the bottlenecks. Through this observation to enumerate solutions that can be deployed with certainty in this important mode of service delivery to our society: the uptake, distribution, and organ transplantation.
In this case study it became evident that the application of logistics is extremely capable of driving any decision regarding the need for troubleshooting, since the implementation of all its tools allow efficient conduct a reliable analysis of each issue of SCM in any area knowledge and therefore is fully applicable in the pursuit of any situations in which there is evidence of problems with factors such as weather, infrastructure and any demand flow.

It was also very noticeable that this analysis logistics Supply Chain and pointing improvements through the integration of the links that form, and can be perfectly enforceable by the authorities, are in essence also capable of modifying the moral point of view, giving the system more equity, justice and ethics, because through that links changes in SCM, will significantly decrease the lead time in which donors are in their ICU beds, the lead time that families of these donors are exposed to the suffering of having to wait to the end of this donation process, and the lead time in which the receptors are anxiously awaiting a phone call warning them that someone made this gesture of extreme love and altruism, because it is in them that is the high value of this whole process.

So this SCM, the seconds, minutes and hours are extreme factors of competitive advantage in the quest for continuity of life, by reducing the percentage values that are more incalculable: the loss of a patient on the waiting receiver for a body that will no longer be picked up by the lack of integration of SCM solutions.

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