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# How Logistics Can Service Healthcare

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The impact of supply chain integration has been well documented in numerous industries. Healthcare is no exception: *Efficient Healthcare Consumer Response™* (EHCR) in the late 90s projected US\$11 billion in savings in supply chain related costs in the United States alone. However, we believe that external supply chain integration initiatives are drawing most of the attention, while the internal supply chain of hospitals remains the sore spot or weak link in supply chain integration. In view of the many pressures worldwide to reduce the cost of healthcare, as well as the difficulties of adapting healthcare systems to meet the growing needs of an aging population, new illnesses and cures and a severe shortage of nursing staff, this paper offers new management ideas based on case study research of leading international practices to better understand the role and impact of logistics in healthcare. It also presents examples of how to better integrate logistics activities through a unique combination of reengineering and activity-based costing. Indeed, the integration of the internal supply chain can not only bring together new sources of efficiencies in a logistics sense, but it can also impact the quality of care.

*Management is on the verge of a major breakthrough in understanding how industrial company success depends on the interaction between the flow of information, materials, money, manpower, and capital equipment* (Forrester, 1958). Forrester's words seem to have taken four decades to materialize. The long-awaited integration is only now coming about, thanks to the spectacular developments in information technology. Over the past few years, Supply Chain Management has imposed itself as a management concept that takes a holistic view of value creation for end users or consumers (Christopher, 1998).

During the last 20 years or so, the impact of supply chain integration has been well documented in numerous industries. Beginning with the apparel industry and its *Quick Response* movement in the

mid 80s and followed by the food industry and its *Efficient Consumer Response* (ECR) in the mid 90s - to name just two - billions of dollars in savings have been projected through better communication between partners. Healthcare is no exception: *Efficient Healthcare Consumer Response™* (EHCR) in the late 90s projected US\$11 billion in savings in supply chain related costs in the United States alone (CSC Consulting, 1996).

However, based on our experience as researchers and consultants, we believe that external supply chain integration initiatives, such as Continuous Replenishment (e.g. Vendor Managed Inventory or Vendor Managed Replenishment) and e-Commerce, are drawing most of the attention, while the internal supply chain of hospitals remains the sore spot or weak link in supply chain integration (Rivard-Royer et al., 2002).

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In view of the many pressures worldwide to reduce the cost of healthcare, as well as the difficulties of adapting healthcare systems to meet the growing needs of an aging population, new illnesses and cures and a severe shortage of nursing staff (Oxley and Jacobzone, 2001), this paper offers new management ideas based on case study research of leading international practices to better understand the role and impact of logistics in healthcare. It also presents examples of how to better integrate logistics activities through a unique combination of reengineering and activity-based costing. Indeed, the integration of the internal supply chain can not only bring together new sources of efficiencies in a logistics sense, but can also impact the quality of care.

### Internal distribution networks in hospitals

Hospitals are complex distribution networks, composed typically of storerooms providing dozens of nursing unit stock locations for medical supplies (Rivard-Royer et al., 2002). Add to this pharmaceuticals, office supplies, food, maintenance, cleaning, sterilization, linen and waste, and this complex network can rapidly transform itself into a nightmare. On a daily basis, supply carts, material management personnel, nurses and other staff continually circulate back and forth between storage areas and points of care trying to make sense of it all, but at what cost? Often at the cost of huge inventory volumes, and more importantly, tremendous energy spent managing this inventory (ordering processes, storage, distribution, standardization issues, etc.), searching for missing items, fire fighting, and the list goes on.

It is estimated that up to 46% of a hospital's total operating budget is spent on logistics related activities, which translates into 27% being spent on supplies and equipment and 19% on labor (Chow and Heaver, 1994). This 19% encompasses not only logistics professionals (buyers, stock

keepers, material handlers) but healthcare professionals as well. So, much like Mr. Jourdain in Molière's *Bourgeois Gentilhomme*, who realized that all along he had been speaking in prose, in a typical hospital, a staggering number of people are conducting logistics activities without being aware of it, and disturbingly, often it's the wrong people. For example, it is estimated that nursing staff will spend on average 10% of their time performing logistics tasks instead of taking care of patients, which can not only have cost and care implications, but in countries where there is a shortage of healthcare professionals, social implications as well, such as stress related diseases.

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The EHCR study on supply chain integration in healthcare revealed that 48% of supply chain related process costs were avoidable through the implementation of better logistics practices, particularly integration (CSC Consulting, 1996). It also revealed that the larger proportion of these costs, 41%, was incurred by healthcare providers, compared to 33% for manufacturers and 26% for distributors. It is based on these statistics, as well as our field experience, that we maintain that in the healthcare sector, the greatest benefits of supply chain improvement reside in healthcare institutions and that benefits envisioned by the EHCR work group cannot be achieved without first improving and integrating the internal supply chain of hospitals. The institutions are the initiators of

the overall process. Reengineering healthcare logistics could therefore bring together new sources of efficiencies, both in logistical and clinical terms.

Could reengineering logistics processes be one example of *Disruptive Innovations* (Christensen, 2000) or "behind the scene innovations," so often overlooked because they challenge traditional mindsets? Because *the raison d'être* of hospitals is to provide care, people have historically looked at healthcare problems and challenges through a clinical lens, striving to optimize the utilization of clinical resources and equipment from within clearly-defined specialties. We propose to look at some of these same issues through the support services lens - more specifically by using logistics or materiel management and by first addressing leading practices surveyed.

### Leading practices in healthcare logistics

When tackling logistics challenges, several options are possible. To study the many alternatives, we combined a survey of hospitals rated among the best in Europe and Asia with our overall knowledge of North American institutions and identified examples of leading practices in healthcare logistics, including technologies, working methods, work organizations and a blend of all three that could lead to higher performance. For simplicity's sake, these leading practices can be grouped into actions that have an impact on structure, such as building or ward design, and infrastructure, such as distribution methods and practices pertaining to the external or internal supply chain. The practices should be viewed as examples rather than a single or universal recipe blindly applied to all hospitals.

### Point of use distribution

Over the past decade in the United States, several larger hospitals have implemented point of use distribution methods, where major

distributors carry out all replenishment activities and deliver supplies directly to the point of use (Arthur Andersen, 1990). Also known as *Stockless Materials Management Programs*, which, in healthcare, is a rather scary expression, this Vendor Managed Replenishment (VMR) approach has many advantages, one of which is the removal of one link in the supply chain, the hospital's central storeroom. Over the years, this approach has generally proven itself to be advantageous to healthcare providers. When such programs are implemented, the distributor is linked to the point of use, which in supply chain management is a key step towards integration, but distributors have, so to speak, long been squeezed between a rock and a hard place, the hard place being manufacturers. In fact, one of the goals of EHCR was to get manufacturers on board with supply chain integration. Distributors offering these services are now trying to negotiate a better deal with providers, and some have rediscovered optimization through the old inventory management concept of *Economic Order Quantity* (EOQ), which better balances ordering and storage costs (Marino, 1998).

At the Centre Hospitalier Universitaire (CHU) de Montpellier, in France, point of use distribution has been approached in a different manner. Within a context where partnerships are difficult because of the many regulations of the French healthcare system, which create distance between government-owned care providers and suppliers, this university hospital has built its own distribution center to distribute medical supplies, pharmaceutical products, office supplies and cleaning products, including non stock items (items not stored in the hospital's central warehouse) to six hospitals. The center processes an average of 7,200 line items on a daily basis (Douet and Storper, 2001). This semi-automated hospital-owned platform opened in the late 1990s at a cost of approximately FF74 million (at

today's rates, this would be equivalent to €11.3 million). Savings are generated mainly from full time employees (FTE) and inventory reductions. The center has also had an impact in terms of quality of service and traceability (Landry and Beaulieu, 2000).

Finally, in the U.K., Exel is offering management of the entire hospital supply chain, from ward-level demand capture for all stock and non-stock products to delivery. Contrary to the typical U.S. approach, Exel acts as a third-party logistics provider and uses cross-docking between manufacturers and its client hospitals (Rivard-Royer et al., 2002).

### Automated transportation systems for small and large loads

In the French hospitals surveyed, we observed the presence of Automated Guided Vehicle systems (AGVs) for the transportation of large loads. AGVs integrate the transportation of medical and pharmaceutical supplies, meals, linen and waste. These vehicle systems carry carts through dedicated corridors (located in the basement) and elevators. Their schedule is programmed in accordance with the various care unit distribution schedules, with every cart having a unique identification and destination. For example, Hôpital François Quesnay (20 wards, 400 beds) has six AGVs called "tortues" (French for turtles), which move 25 carts for waste, 25 for pharmaceutical and medical supplies (shared), 25 for linen, and 17 cold link meal carts. The whole system cost approximately FF7.2 million (€1.1 million) with a payback estimated within four to five years. Furthermore, this technology, which has been implemented in several French hospitals, provides an alternative to distribution or transportation jobs that offer little added value and too few possibilities for promotion (Landry and Beaulieu, 2000).

In terms of light material transportation systems, three

technologies have captured our attention: an overhead rail transportation system called a "valisette" (French for briefcase), an integrated transport system and a robot. The valisettes are used to carry small loads, such as patient files, test results, lab tests, blood samples and non-stock purchases. Compared to the pneumatic tube technology that we often find in North American hospitals, valisettes are capable of carrying a larger load as well as more fragile items, such as glass containers. Moreover, they offer a form of marshalling that allows for the circulation of several containers at the same time and in all directions. It is a slower mode of transport, however, taking about 15 minutes to travel from one end of the hospital to the other, compared to just seconds with the tubes. The cost of the valisettes at Hôpital François Quesnay was FF2.5 million (€400,000) (Landry and Beaulieu, 2000).

In Japan, a number of recently-opened hospitals have also equipped themselves with integrated transport systems, most notably Tokyo University Hospital, where this type of system has been deployed in both of the hospital's towers. This system is comprised of vertical conveyors, which are capable of stopping at each floor and transporting bins in a variety of pre-determined sizes. The hospital uses a total of 1,600 high-density bins. Maximum transportation time is approximately 27 minutes, with the system transporting both new products (supplies, linens, serums, pharmaceutical products) and returns. Such a system costs approximately US\$160,000 per station (Landry and Beaulieu, 2003).

The last transportation technology observed was a robot nicknamed Joe, used to transport patient files, test results and pharmaceuticals, which complements the regular distribution activities at CHU de Montpellier. For example, it shuttles between the pharmacy and the wards in the evening and on weekends. Various routes are pre-programmed (origin-destination),

and sensors allow the robot to use regular corridors and elevators. The system is leased for US\$25,000 per year. Similar robots are currently being implemented in the United States as well.

### Hospital flow-through design

It is important to note that two of the three hospitals surveyed in France and three of the four surveyed in Japan were new buildings designed in view of the upcoming transportation technology. Furthermore, and more importantly, these hospitals' structural elements were also designed to streamline their product, information and people flows. In France, for example, visitors, patients and products all have dedicated elevators and to some extent dedicated corridors. In Japan, nursing stations are located in the center of the unit, often at corridor junctions, which provides nursing staff a view of the entire unit and quick access to medical supplies stored in the same location. When hospitals are viewed through this logistics lens, all of these flows are revealed and can be optimized at the design stage with a stunning impact, not only on support activities, but also on the quality of patient care.

### Two-bin replenishment system

The two-bin system (also called empty-full or no-count), developed in the 1980s by *Scan Modul System* and *MEDI-MATH*, (respectively Danish and Dutch companies), are an alternative to more popular centralized approaches, such as *exchange carts* or *par level* (also known as *topping up*) systems, where the quantities consumed are replaced at certain intervals through periodic reviews (Perrin, 1994). In the two-bin system, the quota of each item is evenly distributed into two compartments. The stock is then taken from the "active" compartment. When one compartment is empty, the nurses use the second or backup compartment. As with more traditional *par level* systems, this materials management-based full-cycle replenishment system

reduces the nursing workload. In addition, the two-bin system is more efficient, as there is no count or inventory taken at the ward level, and only empty compartments are scanned, triggering the replenishment process. Our research shows that this system generates substantial savings in terms of product ordering activities. For example, a material handler can typically scan products from nine wards (18 stocking locations) in 35 minutes, which is four to seven times faster than the popular *par level* systems (Landry et al., 2004). This approach also brings the additional benefit of stock rotation generated by the utilization of two containers, thus reducing the costs related to the common problem of product wastage generated by expired items.

Use of the two-bin system also increases the quality of the information on actual consumption at the point of use, which is, as mentioned previously, an essential element of supply chain integration. Typically, in a *par level* system, items are not counted every day or week depending on the replenishment cycle. Based on their experience, logistics and materiel management personnel sometimes count - and sometimes don't. It is thus difficult to know with any accuracy the actual consumption of items and to adjust inventory management parameters accordingly. This also increases the risk of stock outs, which can be critical in healthcare, as they can have a direct impact on the level of care provided. With the two-bin system, discipline at the data capture level is built in. Moreover, it reduces product handling thus increasing event-related sterility (infection control).

This system has proven to be both flexible and simple to use. We have seen the system used to manage not only medical supplies, but also commonly-dispensed drugs, office supplies, linen - even the coffee and powdered milk destined for each ward! Contrary to the previously presented practices, the flexibility of the system also allows for new as well as old buildings to benefit and

generates equal benefits. Deployed mainly in Europe, the two-bin system has been introduced to American hospitals over the past several years and more recently in Canada, where it is rapidly gaining in popularity.

In Japan, a few of the hospitals visited use a variation of the system, which sees the tag (or card), once removed, deposited into a box, from which it is picked up and delivered to central stores for scanning. This way of working, which resembles the kanban system, is explained partly through financial considerations and partly through an effort not to disrupt the nursing staff in the care units, their principal work location (Gemba in Japanese) (Landry and Beaulieu, 2003).

### Blending logistics with clinical resources

In addition to the above-mentioned examples of leading practices that are more technological in nature, something else caught our attention in France in terms of logistics work organization: nurses, or more generally speaking, people with a clinical background working in logistics. The practice surveyed in France is not unique to this country, as some hospitals in Canada and the United States have similar organizational structures. However, these usually focus on the materiel management-OR (Operating Room) interface. What we witnessed in France is not limited to the OR and, according to the people interviewed, has the following advantages:

- It facilitates the communication and understanding of all challenges related to the logistics and patient care unit interface;
- It makes it easier to meet user needs;
- It enables an active or even proactive participation in the standardization process and the definition of care protocols;
- It allows for constant surveillance of new products and techniques;
- Overall, it contributes to the professional image of logistics or materials management.

In Belgium, the position of logistics assistant was formally introduced in certain hospitals. However, here the logistics assistant reports to the head nurse of a ward unit. His or her role can vary according to the specific needs of each ward. For example, the assistant might deliver mail to patients, test results to staff, or simply adjust a television screen. Thus nurses and nursing assistants are no longer asked to do the myriad little tasks that take time and distract them from their work. As a result, service quality to patients is enhanced.

## Reengineering logistics

Hospitals vary greatly in their vocation, geographical location, physical layout, history, culture, etc., and this significantly influences how leading healthcare logistics practices can be applied, which precludes the implementation of generic solutions. We believe that to achieve true benefits from hospital logistics improvements, a good understanding of the processes and activities in place is required prior to selecting, adapting and implementing leading practices. As these practices are implemented, processes must be changed and resources adjusted according to the new requirements. Without proper change management and control, increased efficiencies will, in most cases, be lost, due to the fact, as dictated by Parkinson's Law, that the time required to do a task has a tendency of expanding to the time available to perform it, thus losing the time gained through improved processes.

It was with this in mind and through our research that we developed an analysis model that has produced promising results to date. The methodology we used consisted of a series of steps stemming from a number of reengineering models, including an activity-based costing (ABC) cost breakdown. However, rather than establishing costs based purely on a top down budget analysis method, as is typically done in the ABC approach, we also performed

intensive on-site observations, basically combining principles of ABC analysis with those of a time and motion study. The model created not only provided us with a clear picture of activities and processes in place at the sites that we examined, but also with the cost of performing these activities.

A precise estimate of the costs of a hospital's logistics activities not only provides insight into their importance, but also serves as a basis for supply chain simulation and reengineering exercises. Indeed, determining costs allows reengineering efforts to focus on areas where the greatest gains can be achieved.

From the profile and scenarios adapted to the reality of the institution being analyzed, simulations are conducted on aspects such as costs, division of tasks among departments and level of service, to name just a few.

This reengineering model was developed and applied in a number of hospitals. The two examples presented are drawn from these cases. The gains identified in the cases are for the most part time savings that would be realized upon implementation, providing adjustments are made to the workforce. The recuperated hours could also be reinvested into higher value-added activities for the institution.

## Case I

This first case involved the optimization of all processes associated with the supply chain material flows, from the receiving department to the primary storage locations, in all key user departments of a major supraregional university-affiliated trauma hospital in Canada.

In this case, the procurement of medical supplies for users was assured by three departments (stores, central distribution and purchasing). This resulted in the supply flow being managed by a variety of people in the institution. The distribution of medical

supplies to patient wards was also fragmented and involved stores and central distribution. We also noticed considerable involvement on the part of the nursing staff, despite the fact that the replenishment of patient care units was carried out by administrative support personnel using a combination of par level and exchange cart systems in order to reduce the involvement of clinical staff.

For the overall replenishment of medical supplies, the hospital used a number of procurement methods. Depending on the nature, consumption and format of the items and the nature of the department, replenishment could either have been carried out by central stores or the central distribution department. This duplication of effort also existed in control measures used by the hospital, which resulted in increased costs and workloads. In addition to the above-mentioned duplication, another significant weakness in the supply chain was observed: a lack of fluidity between the various internal links. Information was frequently communicated on paper rather than electronically, which slowed down its transmission and increased the risk of error.

The cost of the hospital's supply chain processes under study was estimated at more than CAN\$1,625,000 annually, for a total of more than 79,000 hours, or 43.5 FTEs. We then drew on our key findings to identify areas needing improvement within the hospital's supply chain processes. They included:

- a low degree of automation, both in terms of material flow and information transmission;
- a duplication of replenishment activities in central distribution and the stores department;
- significant involvement by nursing staff in the replenishment of medical and pharmaceutical supplies;
- logistics processes fragmented between many departments and positions;

• logistics equipment not adapted to the hospital's size, both in stores and user departments.

Recommendations were made to eliminate these inefficiencies. Simulations of the implementation of leading practices allowed us to determine that once implemented, these practices would generate estimated potential gains of CAN\$3,950,000 discounted over five years. To obtain these gains, we estimated that an investment of CAN\$2,034,000 over five years would be necessary. Therefore, the net discounted value of the gains totals CAN\$1,916,000 over five years, 42% of which were generated in nursing hours.

## Case II

For the second case, our analysis consisted of the replenishment process of medical supplies on a surgical 32-bed ward and included the gathering of products for utilization in the nursing unit of an acute care rural regional hospital in Canada. In this case, the replenishment process for the patient ward analyzed incorporated six stocking locations: two storerooms and four nursing stations. Items were replenished in the six locations by a member of the administrative support staff. These stocking locations were comprised of cupboards, drawers, shelves and fixed carts, which were set up according to the ward's physical constraints.

Observations made using our methodology allowed us to identify the steps and resources required to replenish the ward. In total, the process required more than 400 hours to replenish medical supplies valued at almost CAN\$12,000 per year, or more than 36% of the value of the items.

These activities did not include the picking of items or the movement of the nursing staff using the medical supplies. Based on observations, it was possible to estimate these activities at 10% of the total work time of these people. This translates to 4,030 nursing hours, worth approximately CAN\$73,000, which

were required just to gather medical supplies from the six storage locations on the ward.

The patient wards and, in the case observed, the six storage locations, represent the final link in the institution's internal supply chain. They constitute the last movement of the stock prior to the actual administration of care to patients. Initially, items were arranged in such a way that nursing staff could retrieve them without excess handling required. However, at the time the study was conducted, nursing staff generally returned to the nursing station to gather items while administering care to patients, then returned with the items to the patient's bedside.

Following the analysis, the six storage locations in the ward were replaced by a central storeroom and four moveable carts. The carts were stocked with the medical supplies, linens and bedding regularly required by the nursing staff. Unlike traditional processes, in this reengineered method medical supplies are transported on the carts rather than the nursing staff having to stop what they are doing to go and retrieve the items required to administer patient care.

Two months after reorganizing the storage locations, not only was the time required for the principal replenishment reduced by 60%, but the nursing staff indicated that they had decreased their movements by some 40% compared to the initial situation: more than 1,600 extra hours per year could be spent caring for patients. Recent Canadian studies have demonstrated that hiring a nurse generates just 572 hours of care per year due to all of the other activities they must perform. Therefore, this reengineering exercise created the equivalent of almost three new nurses for this patient ward.

## How logistics can service healthcare

From a more strategic perspective, we contend that within hospital structures, the logistics department should act as an internal support to

clinical activities, rather than playing a more traditional neutral role (Wheelwright and Hayes, 1985). This means moving from a limited role of no strategic value to the organization, where the goal is to minimize the negative impact of the logistics or material management department, to a more proactive role, where logistics provides credible and significant support to the organization. Logistics then becomes not only a source of savings in terms of support services, but also renders clinical professionals more productive (Landry and Beaulieu, 2002).

We have seen evidence of this through the emergence of the Resource Management function in the United States, which plays a value-added role through activities such as standardization, value analysis, management of contracts and vendor relationships. In Drachten (Netherlands), when the Nij Smellinghe hospital faced a number of challenges in its OR and day surgery scheduling in the late 1990s, it assigned this responsibility to its logistics department. Logistics began to hold meetings to look at schedules for both the coming week and month. Scheduling expertise was thus judged more important than clinical expertise in establishing the OR schedule.

This new trend is in contrast to the more traditional structure, where the Logistics or Materiel Management departments report to Finance. This tends to confine logistics activities to price reductions and can convey this short-sighted view throughout the hospital.

These examples, together with the leading practices presented, can open the door to an increased application of industrial concepts to services (in this case healthcare), as was first suggested by Theodore Levitt more than 30 years ago (Levitt, 1972, 1976).

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For the past several years he has led a major research program on the integration of the supply chain in the healthcare sector, during which, most notably, he has had an opportunity to observe hospital logistics practices in France, Holland, Belgium, England and Japan. His work has covered the full spectrum of this sector's logistics practices and has provided him with a global vision of the domain's various issues. He has authored numerous articles and has spoken on this subject at many conferences. In addition, he has and continues to supervise a number of master's theses on the healthcare sector.

**Richard Philippe** is the Principal Partner of TRIAX Consulting, a consulting services group specializing in hospital logistics. Mr. Philippe has over twenty years of experience in the healthcare sector. He is a member of AHRMM, the Association for Healthcare Resource and Material Management, and was invited to speak in 2000, 2002, 2003, and 2004 at its annual conference. He is also a board member of HSCN (the Healthcare Supply Chain Network), a non-profit Canadian organization interested in the optimization of the Canadian healthcare supply chain.