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Hybrid stockless: a case study
Lessons for health-care supply chain integration

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Abstract *Due to the diversity of its players, the American healthcare sector has experimented with different types of integrated supply chain management systems for medical supplies. In the 1980s, US distributors were offering customers the so-called stockless replenishment method, whereby the distributor picks and packs products according to the particular needs of each patient care unit and, in most cases, delivers them directly. By the late 1990s, stockless agreements had run out of steam, as distributors sought to optimize the balance between their efforts expended in hospital replenishment and the hospitals' inventory savings. Among the various reflections and initiatives aimed at finding such a new balance, we focused on the experience of a Quebec (Canada) hospital adopting a hybrid version of the stockless system, under which the distributor supplied high-volume products for the patient care unit in case quantities, leaving the institution's central stores to break down bulk purchases of low-volume products into point-of-use format (eaches). The study reveals marginal benefits from the hybrid method for both the institution and the distributor. However, it also reveals the importance of the manufacturer's role with respect to packing formats, and demonstrates that the rearrangement of storage areas can generate substantial savings, opening the way to means for improving the healthcare sector supply chain.*

Introduction

Due to the diversity of its players, the American healthcare sector has experimented with different types of integrated supply chain management systems for medical supplies (Arthur Andersen & Co., 1990; CSC Consulting, 1996). These initiatives came in response to the needs of institutions seeking to control rising costs (Jarett, 1998). For by adopting a systematic vision of distributor-healthcare institution relations, the two parties become part of the same system, sharing operations and thus running the risk of duplication (Henning, 1980). To reduce such wastage, US distributors began offering their customers the so-called stockless replenishment method, whereby the distributor picks and packs products according to the particular needs of each patient care unit. The products can then be delivered directly to the unit by the distributor (Chow and Heaver, 1994). This approach is thus equivalent to the full or partial outsourcing of a healthcare institution's point-of-use area replenishment operations. It is also similar to the ward order assembly

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distribution system offered by large pharmaceutical wholesalers in the UK (Karr, 1998).

This practice was deployed and eventually reached 10 per cent of US healthcare institutions (i.e. the majority of major centres), but by the late 1990s, it became apparent that stockless agreements were running out of steam. For example, from 1991 to 1998, the American newsletter *Health Industry Today* reported quarterly on the number of stockless agreements signed; it ceased doing so in the third quarter of 1998, after a large distributor dropped out of the race. The principal promoters of this practice, the medical supply distributors, began questioning the notion of implementing stockless delivery across the board (Werner, 1996). Instead, they turned to seeking an optimal balance between their efforts expended in hospital replenishment and the hospitals' inventory savings.

Among the various reflections and initiatives aimed at finding such a new balance, the Canadian healthcare sector, particularly in the province of Quebec, offers considerable interest. Over the years, Canada has seen a number of stockless initiatives in the healthcare field, but the nature of the government-controlled system and the labour union situation in Quebec have prevented the wholesale adoption of American practices, necessitating the development of adapted programs. It was in these circumstances that we undertook a case study aimed at analyzing the impact of a hybrid stockless method used in one attempt at adaptation. The healthcare institution selected for the study is located in Quebec. Our objective was to document this case as a potential avenue for improving the replenishment process in the light of recent developments favouring resource optimization.

This article is in three parts. The first describes the characteristics and benefits of stockless materials management, as reported in the studies surveyed. The second describes the methodology used and the results of a case study of a hybrid stockless system. The third and last part discusses the lessons to be learned from this experience with a view to integrating the healthcare sector supply chain.

Characteristics and benefits of stockless materials management

The healthcare sector supply chain is characterized by its complexity, which results on the one hand from the multitude of different supplies used by the institutions and the myriad distribution channels through which they flow; these supplies may come directly from the manufacturer or transit through a distributor. On the other hand, the complexity resides as well with the healthcare institutions themselves, which are not the end consumers. Hospitals must deploy their own logistics network for delivering supplies to the patient care units and, ultimately, to the users, or point of care. As a result, a major characteristic of the healthcare sector supply chain is the simultaneous presence of two chains: one external and the other internal (see Figure 1).

Attempts to integrate these two chains saw the practice of stockless materials management emerge in the US healthcare sector in the 1970s

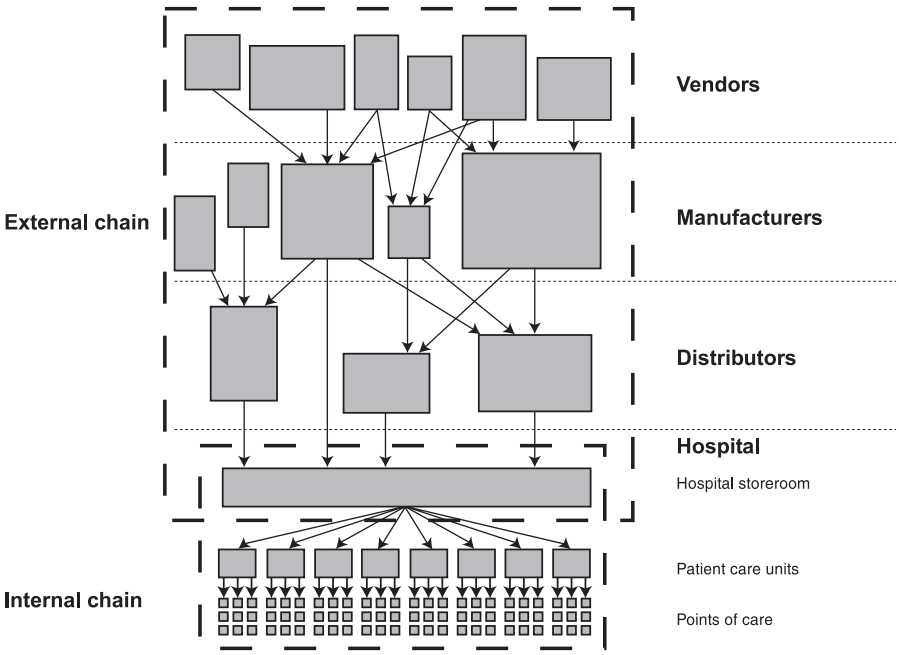

Figure 1.
Healthcare sector supply chain

Source: Adapted from Arthur Andersen & Co. (1990, p. 38)

(Housley, 1978) and become highly popular in the early 1990s. Arthur Andersen & Co. (1990, p. 127) gives this operational definition of the process:

> A program under which the vendor takes over the hospital's central distribution function (i.e. pick and pack operation). The vendor delivers products in "eaches" (single), sorted by user department, to the hospital receiving dock where they are transported directly to the department, usually on a daily basis.

According to Bolton and Gordon (1991), the stockless method requires a continuous flow of information between the point of use and the supplier in order to obtain visibility of demand. The information flow serves to synchronize replenishment and user needs. This method shifts the institution-distributor interface, moving it closer to the point of use (point of care) (see Figure 2).

Table I illustrates the main differences between conventional and stockless replenishment and highlights the principal advantages of the stockless system, which lie in inventory reduction, staff savings or enhanced service. In exchange for adopting this system, distributors initially charged a mark-up ranging from about 3 to 7 per cent (Wagner, 1990); however, more recent surveys indicate that mark-ups may be in excess of 15 per cent, depending on the type of product.

A first benefit of stockless replenishment is the reduction of inventory due to more frequent deliveries, leading to the near elimination of the hospital central stores (Chow and Heaver, 1994; Bolton and Gordon, 1991; Wagner, 1990). In addition to the data presented in Table I, other experiences confirm significant

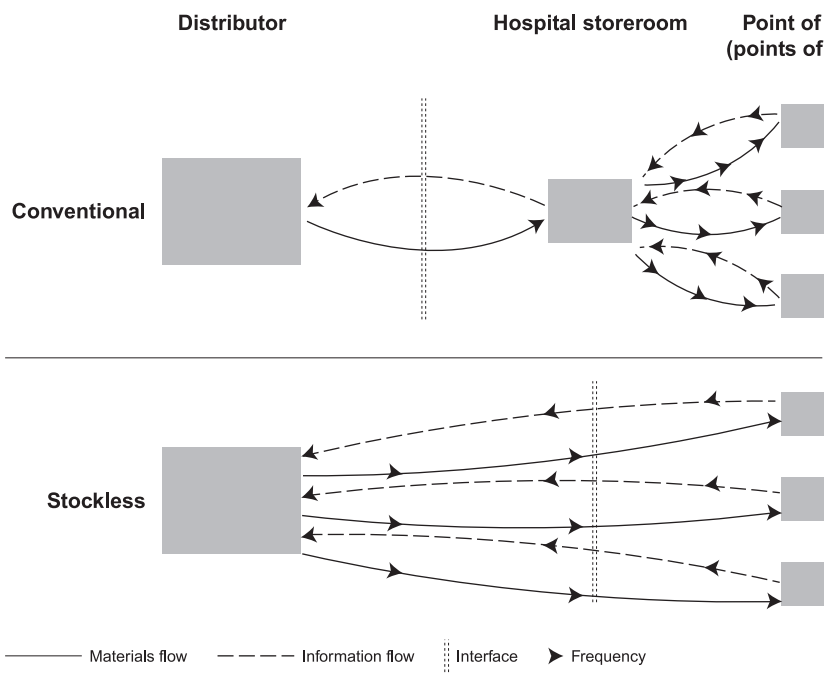

Figure 2.
Two replenishment methods and institution-distributor interface

inventory reduction. After implementing a stockless program, two hospitals reduced their on-hand inventory by more than 70 per cent, representing savings in excess of US$1 million in one case and $600,000 in the other (Wilson *et al.*, 1992). On an equivalent scale, a 427-bed facility reduced its inventory by nearly 80 per cent over five years by gradually moving from conventional to stockless replenishment (Kerr, 1991).

Issue	Replenishment methods	
	Conventional	Stockless
Supplier delivery method	Bulk	"Eaches" – unit of use
Supplier delivery frequency	Once a week	Daily
Number of suppliers utilized	35+	1-2
Clinical staff involvement in daily materials-related tasks	Significant	Almost none
Hospital receiving procedures	Receive/verify each item	Selected sampling, one-step receiving
Supplier fill rates	90-95%	98%+
Hospital storeroom size	6,000 sq. ft	300 sq. ft
Storeroom inventory	6-8 weeks supply	1-3 days supply
Inventory turnover	6.5 to 8.7	171 to 365
Total materials management (full time equivalents)	31	13

Note: Figure a typical 400-bed hospital
Source: Adapted from Arthur Andersen & Co. (1990, p. 65)

Table I.
Contextual characteristics of replenishment methods

The stockless method enables distributors to assume some of the institution's central stores duties, such as receiving, distribution and replenishment (Bolton and Gordon, 1991), as well as certain tasks performed at points of care, such as needs tracking (Nathan and Trinkaus, 1996; Bolton and Gordon, 1991). Chow and Heaver (1994), Wagner (1990) and Eull (1988) note a reduction in the workload of both materials management department and patient care staff needed for point-of-use replenishment following the adoption of stockless distribution. Thus, staff reduction is the second benefit. According to Eull (1988), staff reduction has proved to be one of the most significant sources of cost savings for healthcare institutions, since it is a recurrent saving, not a one-time saving like excess inventory reduction (where only inventory financing savings recur). Institutions using the stockless method have reduced their full-time equivalents (FTE) by 45 per cent, compared to conventional methods (Arthur Andersen & Co., 1990). One such institution reduced the FTE needed for replenishment tasks by 30 per cent, generating estimated savings of more than US$1 million (Kerr, 1991). Similarly, Wilson *et al.* (1992) observe a reduction of 15 to 20 materials management department FTE after the stockless method was introduced. In a case study, North (1994) notes that stockless distribution freed up 21 FTE representing annual costs of some US$385,000. These varying results can be attributed, in part, to the relative scope of the stockless program within the institution, the hospital size, the types of replenishment utilized and, notably, the degree of employee involvement in the process (Chow and Heaver, 1994; Eull, 1988).

A final benefit lies in a generally higher level of service (Chow and Heaver, 1994; Kowalski, 1991; Arthur Andersen & Co., 1990). Chow and Heaver (1994) place the level of service using the stockless method between 95 and 99 per cent, compared to 92 per cent using conventional replenishment. These estimates are close to those of Arthur Andersen & Co. (1990) (see Table I). The increased level of service translates into fewer product shortages in the patient care units (Eull, 1988; Nathan and Trinkaus, 1996).

It should be noted that since the mid-1990s, the advisability of extending the stockless method to all medical supplies and all healthcare institutions has been widely questioned. Marino (1998) explains that stockless distribution is not well suited to small rural healthcare facilities located more than 450 km (300 miles) from the distributor. In its Efficient Healthcare Consumer Response (EHCR) report, CSC Consulting (1996) stresses that the supply chain integration effort must include the manufacturer, rather than being limited to the hospital-distributor interface. Lastly, distributors themselves have questioned this approach, as the stockless method focuses on inventory cost reduction to the detriment of total inventory management costs. According to one distributor study, an increase in inventory could result in reduced operating costs (Owens & Minor, 1996). In short, despite the different initiatives, CSC Consulting (1996, p. 25) not long ago affirmed that the healthcare sector supply chain:

> . . . is characterized by clinician selected products, high inventory levels, discontinuous product flow, paper-based information flow, inconsistent technologies, inefficient buying practices, and high costs associated with the administration of contracts and rebates.

With numerous stakeholders seeking to optimize the supply chain, it seemed that a hybrid stockless system, combining the stockless method with a conventional approach to patient care unit replenishment, might provide an avenue for solutions. This led a medical supply distributor and a Quebec (Canada) hospital to develop a pilot project using a hybrid program. A hybrid version was necessary in order to adapt to the constraints imposed by Canada's government-controlled healthcare system, the Quebec labour union situation and the distance separating the distributor and the healthcare institution – factors that tend to limit the benefits of traditional stockless distribution. We felt that an assessment of the benefits of such an initiative would be pertinent, and would further serve to identify new avenues for improving the healthcare sector supply chain.

Hybrid stockless experiment

To this end, we conducted a case study in a healthcare institution in the province of Quebec (Canada), focusing on a single patient care unit, to assess the benefits of an approach we call "hybrid stockless". Our case study deals with the St. John patient care unit of the Eastern Hospital (to assure interviewee confidentiality, the name of the institution has been changed).

Methodology

The case study methodology allowed us to combine different data collection strategies: observation, interviews and the consultation of artifacts (Yin, 1994). Observations made by one researcher served to identify the steps and resources required for patient care unit replenishment. A questionnaire was administered to 60 per cent of the unit's nursing staff to measure their involvement in the management of medical supplies. Additionally, interviews were conducted with staff performing these tasks and with the head nurse to ensure that our observations and the results of the questionnaire were valid and representative of the normal flow of operations. Documents were consulted to obtain purchase, wage rate and other data.

The benefits of the stockless system are measured in relation to the institution's total costs. Total cost breakdown may be expressed in various terms; we have adopted those suggested by Norris (1988). Table II presents the different components and subcomponents of the total cost determined for the processes under examination.

Background and implementation

The Eastern Hospital is a regional healthcare facility. The St. John unit is a 32-bed urology unit where patient care is provided by 16 full-time nurses, 11 part-time nurses, one head nurse and two part-time unit clerks. This represents more than 40,300 hours annually for the provision of patient care

Components	Definition and key cost drivers
Unit costs	The cost or price of the items purchased.
Acquisition costs	The cost associated with acquiring the product (e.g. clerical time spent sourcing, preparing purchase orders, receiving, and accounts payable); also included is a portion of overhead, equipment, and supplies used in the process.
Possession costs	The cost associated with holding, managing, and controlling inventory in the warehouse and other areas where supplies are stored (e.g. inventory carrying costs).
Transaction costs	The cost of preparing and managing the documentation used to account for the entire procurement process (e.g. creating, filing, retrieving, and matching requisitions, purchase orders, and receiving documents).
Distribution costs	The cost of moving supplies throughout the hospital (e.g. from the warehouse to the user).
Operation costs	The cost of assembling and preparing material for use (e.g. sterilizing, packing, loading carts).
Utilization costs	The cost of actually using the product in its intended clinical application.

Table II.
Total cost components

Source: Norris (1988)

services. According to central stores records, medical supply purchases in 1998-1999 amounted to CA$18,945, or $371 per week (amounts hereafter are in Canadian dollars, valued at about US$0.70). The stockless pilot project began in April 1998. It was a hybrid program, somewhere between central stores replenishment and distributor replenishment. Stockless distribution was limited to half the patient care unit and half of all products kept on hand there. The Eastern Hospital is located more than 450 km (300 miles) from the distributor involved. Stockless deliveries were made once a week according to the same schedule followed by the distributor in making the hospital's regular deliveries.

When the experiment was assessed in June 1998, both hospital and distributor participants agreed that the project scope was too narrow to allow them to draw meaningful conclusions as to the benefits of the hybrid stockless system. They further agreed that the second phase of the pilot project should extend to the entire patient care unit from September 1998 to 18 January 1999. Our case study deals with this final 15-week period.

The hybrid stockless program at the St. John unit operated on a weekly cycle. Products distributed to the unit in case quantities were supplied by the distributor, while bulk purchases of low-volume products were broken down into point-of-use format (eaches) at the institution's central stores. The process was as follows:

- *Day 1.* A unit clerk fills out a combined distributor and central stores requisition reflecting the unit's medical supply needs. The requisition is sent by fax to the distributor and forwarded to the central stores.

- *Day 2.* Distributor stock handlers prepare the unit's order (case quantities). The cases are placed in separate shipping containers marked for the St. John unit.
- *Day 3.* The containers are shipped along with the regular delivery to the Eastern Hospital. On arrival, the marked containers are segregated, and the content is added to the order (eaches) already prepared by the central stores and delivered to the unit the same day. A St. John unit clerk shelves all the products.

It bears noting that contrary to US practice, the distributor did not charge a mark-up on the products managed under the stockless method in this pilot project.

Parallel to the implementation of the hybrid stockless program, and with a view to eventually accelerating storage area replenishment and saving steps for medical staff, the distributor worked with institution personnel to rearrange the patient care unit storage areas based on three criteria: the number of storage areas, staff time spent on replenishment-related activities (including trips to storage areas) and the range and quantity of products. The solution adopted consisted of centralizing all inventory in a single storage area managed by staff, combined with four mobile carts for use by the nurses. Despite the addition of the carts, the overall level of on-hand inventory was reduced. The carts served to store the medical supplies, gowns and linens required by the nursing staff on a regular basis. Medical supply replenishment was done visually, with each product's storage space on the cart corresponding to its quota. (Visual replenishment is fast and reduces inventory control tasks.) Only the central storage area was managed more meticulously, requiring a physical inventory to determine replenishment quantities. Products for particular patient conditions were added to the carts according to each day's care program.

Results

According to the data compiled for all line items sent to the central stores and the distributor, 59 per cent were replenished by the central stores and 41 per cent by the distributor. Initially, it was believed that the number of line items replenished by the distributor would be significantly higher. Contrary to the other experiences surveyed, this pilot project involved a limited number of products due to the incompatibility of the vendor's packing formats with the patient care unit's anticipated needs. To avoid having the distributor break down case quantities, it had been agreed that the institution's central stores would continue to manage certain products.

Table III presents the total cost before and after introduction of the hybrid stockless program. It illustrates the impact of management activities on the cost of the supplies being managed. Using the gathered data, we were able to estimate the average time attributable to product picking, including trips to storage areas, at 10 per cent of the total nursing time. This represents 4,030

Total cost components	Hours Before	Hours After	Costs in Canadian $ Before	Costs in Canadian $ After	Savings[a]
Unit costs	N/A	N/A	18,945.23	18,945.23	0.0%
Acquisition costs	136.5	136.5	2,047.70	2,047.70	0.0%
Possession costs	17.0	18.4	838.42	866.00	(3.29%)
Transaction costs	24.4	20.6	445.37	361.20	18.9%
Distribution costs	4,216.9	4,217.8	115,643.80	115,660.80	(0.01%)
Operation costs	43.1	27.5	861.55	549.42	36.23%
Utilization costs	NA	NA	NA	NA	NA
Impact of hybrid stockless on total cost	4,437.9	4,420.7	138,782.06	138,430.35	0.25%

Note: [a] Negative savings, in parentheses, indicate a cost increase.

Table III.
Impact of hybrid stockless on total cost

nursing staff hours ($112,840 at an hourly rate of $28) needed to pick products at six storage areas in the patient care unit. Our estimate was validated by the unit's head nurse. The internal distribution cost component represents nearly 83 per cent of the total cost ($115,643/$138,782), and the involvement of nursing staff is the chief factor. For this unit alone, the provision of care requires approximately $18,945 in on-hand medical supplies and generates close to $120,000 in activity costs for the internal replenishment supply chain: ($2,047.70 + $838.42 + $445.37 + $115,643.80 + $861.55 = $119,836.89).

The workload reduction was made possible by transferring certain operations to the distributor and cutting back on others. The central stores staff workload was lightened mainly by a reduction in the number of line items for products to pick. The hybrid stockless system reduced the total cost of replenishing the unit with medical supplies from the central stores by $351 (0.25 per cent of $138,782.06). Overall, some 17 hours were saved. Even taking into account the fact that the pilot project involved only one patient care unit, this negligible reduction runs contrary to the results of other stockless programs that have produced significant cost savings.

Discussion

Table IV compares the impacts of the stockless program studied at the Eastern Hospital with those found in the mainly American literature. Results showing the relative size of a total cost reduction further to the introduction of stockless distribution are not easily comparable to the experiences surveyed, which may involve all replenishment-related activities: determination of patient care unit needs, transmission of these needs to the distributor, receiving, delivery of product orders to the point of care and management of other activities inherent to patient care unit replenishing. The viability of the hybrid stockless as practiced in the St. John unit rests principally on productivity and salary condition differentials, since it involved only the transfer of certain marginal activities, not of the entire process or all the departments, which would have served to eliminate duplication.

Variables	Impact on activities	
	Experiences surveyed	Eastern Hospital
Method of distribution to patient care units	Delivery to units by distributor in case quantities	Delivery to unit by hospital staff in boxes or eaches
Ordering process	Transferred to distributor	Same requisition used for internal central stores and distributor
Receiving process	Transferred to distributor	Added task of sorting stockless shipping containers
Delivery frequency	Very significant increase: between 250% and 600% (5 to 7 deliveries weekly)	No change Same schedule as regular delivery (once a week)
Workload	Significant reduction of FTE	Overall reduction = 17 hours ($352, or 5% of total activities)

Table IV.
Synthesis of the stockless method impacts

This pilot project demonstrates that the hybrid stockless method, as practiced in the St. John unit, holds few advantages for distributors, since it entails additional work to prepare the orders without the benefit of additional revenue (in this case at least). Moreover, the hybrid nature of the project points up the limitations of supply chain integration based on the simple outsourcing of low-cost logistical activities, as compared to genuine integration. Among other things, the hybrid stockless approach came up against manufacturer packing formats: for example, the distributor sold case quantities of 144 while the patient care unit quota was 10. Clearly, the available format was disproportionate to the nursing needs. In such cases, must the healthcare facility store the excess and absorb the attendant cost, devote staff time to breaking down case quantities or pay a distributor to do so? If manufacturers are not included in the integration effort, the result may be a simple shifting of costs among downstream stakeholders rather than real savings for everyone concerned. In the mid-1990s, this reality gave rise to the EHCR forum, which brought together all those involved in integrating the supply chain (see CSC Consulting, 1996). At issue here, it appears, is a choice between internal and external supply chain efficiency, requiring a comparison of manufacturing, distribution and transportation efficiency, on the one hand, and efficiency in product picking and preparation for use within the institutions, on the other.

The results of this form of hybrid stockless have not been conclusive, and other alternatives are being examined. For example, some European hospitals are seeking suppliers that can deliver pre-packed consumables direct to individual wards (Riley, 2001). In the UK, 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 US approach, where distributors provide stockless materials management services, Exel acts as a third-party logistics provider and uses cross-docking between manufacturers and its client hospitals.

On another note, our study revealed an indirect benefit of the stockless system: changes to the physical layout in preparation for implementation. As mentioned above, the study had originally shown that the time spent going to storage areas and picking medical supplies represented about 10 per cent of total nursing time. The St. John unit was rearranged prior to introducing the stockless system, and the products are now laid out to allow the nursing staff to pick them singly, generally without additional handling, while saving steps. Nurses caring for patients go to the carts, pick the products and return to the bedside.

Two months after the layout was changed, the nurses reported that time spent on trips to storage (carts and central area) had decreased by some 40 per cent, compared to the initial situation. Multiple interviews revealed that, on average, the overall time spent on trips and locating products dropped from 10 per cent to 6 per cent. More than 1,600 hours could potentially be devoted to nursing thanks to the simple rearrangement of the patient care unit. Such hours can be of direct benefit to patient care and the vocation of healthcare institutions, particularly in the current context of nursing staff shortages affecting Canada and many other countries. The results of this initiative suggest a possible improvement to the healthcare supply chain in terms of medical staff support and, indirectly, with respect to the quality of patient care. The time savings resulting from the new storage layout have been accounted for separately, since they could be obtained independent of the stockless system; accordingly, they do not appear in Table III (distribution cost). It was only after analyzing the data that we realized the magnitude of these savings, since our focus had been on identifying the traditional benefits of the stockless method.

Clearly, this method promises further benefits beyond the distributor-patient care unit interface. Hospitals seeking to enhance the cost-effectiveness of resources deployed at all levels should look to patient care unit logistics as a potential source of substantial savings. Indeed, any consideration of hospital supply chain integration should be pursued through to the patient's bedside.

Conclusion

Although at the end of the day the various partners in the hybrid stockless pilot project at the Eastern Hospital concluded that the experiment should not be prolonged, we feel that this study is rich in lessons for future experiments in healthcare sector supply chain integration. It opens the door to wider discussion of the objectives of the stockless method. This method was originally designed to reduce hospital inventory and, especially, hospital resources devoted to inventory management and supply distribution. Although inventory reduction remains an important goal, it must be achieved through the introduction of innovative practices with far broader ramifications. Like the deployment of the just-in-time approach in the industrial sector, such initiatives must provide evident opportunities for improvement. Duclos *et al.* (1995) deal with a similar situation in their analysis of just-in-time practices in the service sector. They believe that this method is ultimately aimed at eliminating non-essential cost and that it must be based on the principles of continuous improvement and, we might add, the reengineering of logistical processes.

In considering alternatives to the stockless model, perhaps some thought should be given to the very nature of the term that expresses an absence of inventory – an obvious misnomer in the healthcare environment and one apt to cause concern. This concept, which was developed at the time Japan was capturing management's imagination with just-in-time production practices, would now do well to adopt a vocabulary associated with the overall effort to integrate the hospital supply chain. The terms "point-of-use distribution" or "point-of-care distribution" would be preferable to "stockless materials management", as they better describe the delivery of supplies directly to patient care units and the elimination of central stores. This proposal is in line with the need for a just-in-time terminology that better fits service industry requirements, as stated by Duclos *et al.* (1995).

Point-of-use, or stockless, distribution can be a means for institutions paralyzed by a lack of resources (human and financial) to benefit from savings and performance guarantees with minimal investment, once the system is deployed. While this method offers undeniable advantages for hospitals, the current thinking on stockless distribution goes beyond the hospital-distributor interface, and our study has shown the importance of the upstream players, the manufacturers, in finding new avenues of integration. If the hybrid stockless method discussed here is not a solution, perhaps a semi-stockless approach, limited to a certain number of hospital units, might be an answer, or perhaps the replenishment frequency should be reduced, or adjusted.

Based on the experiences surveyed, our study also shows that supply chain integration efforts have so far focused on the efficient replenishment of the external links of the chain, up to the patient care unit interface but rarely going beyond the main patient care unit storage areas. The long arm of the materials management department has been to some extent contained within its own traditional boundaries. However, the study suggests that there is additional potential for cost reduction and healthcare quality improvement in extending the area of action of the current supply chain into the patient care units. Although some approaches or studies present or touch on supply chain integration all the way to the patient, very few deal concretely with the actual practice. Our study reveals that in addition to the savings associated with patient care unit replenishment, savings related to internal unit logistics may also have a significant impact, both financial and in terms of healthcare quality.

Supply chain integration could thus be extended advantageously to the point-of-use locations necessary to patient care, possibly synchronized with the clinical chain, i.e. all medical or clinical activities required to provide continuous care. The deployment of new information technologies based on widely accepted communication standards (e.g. HL7, XML) could be a real catalyst for such integration. As our study indicates, the contribution of these new technologies in the healthcare sector depends on the scope of their implementation, which, for optimal benefits, requires a review of logistical and clinical activities at the point of care.

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