**Supply Chain Management**

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**Keywords**

* supply chain
* efficiency
* effectiveness
* quality of care

**Take Home Messages**

1. There are many challenges to implementing effective supply chain management, especially in developing countries.
2. Supply chain management is more than just the technology that keeps track of inventory and stock movements -- it’s about people and processes put in place to ensure the efficient and effective flow of supplies.
3. An effective supply chain can lead to better quality of care for patients, cost savings for an organization, and stabilization of the public health system.
4. An ineffective supply chain can have disastrous effects on a healthcare organization as well as the larger healthcare system that surrounds and supports it.

**Discussion Questions**

1. How does supply chain management impact patient care?
2. How does supply chain management affect the longevity of an organization?
3. How does adoption of a standard formulary (e.g. WHO Model List of Essential Medicines) impact supply chain management?
4. What factors need to be taken into consideration when performing forecasting for medical supplies and drugs to be used at a health center?
5. Discuss possible solutions to each of the challenges discussed in the chapter (uncertainty, lead time, people, process, communication, infrastructure, fragmentation, technology, data and data standards).

**Introduction**

The main objective of a supply chain is to deliver a product from the point-of-origin to the point-of-consumption in the most effective and efficient way possible. According to the World Health Organization (WHO), supply chain systems should “supply the right goods, in the right quantities, in the right condition, to the right place, at the right time, and at the right cost” (“The Logistics Handbook” 1998, 21).

While most supply chain practitioners would generally agree with this statement, the specific practices adopted by organizations to satisfy this objective vary widely.Within the healthcare field specifically, the goal of supply chain management is to guarantee the availability of the products needed to treat patients by maintaining an adequate supply of medications and medical supplies, preventing stock outs, and reducing waste from expired and damaged goods. The practices adopted by healthcare organizations in the United States, for example, may vary from those organizations working in rural, resource-poor settings in the developing world (Dowling 2011, 13-14).

When a supply chain system is functioning well, clinicians do not worry about how a healthcare commodity is manufactured, from which supplier it was purchased, or how it was transported from the country of origin to their facility. Nor are they concerned about how long it took for a shipment to get through customs or whether all items were received, unloaded, inspected, and put away in an efficient manner. However, when a supply chain system is not aligned with clinical objectives and is performing poorly - for example, when a much needed antibiotic is stocked out or when critical surgical equipment has been damaged - clinicians take notice. It is under these circumstances that clinical staff become familiar with supply chain management, or, more appropriately, with the lack of an effective and efficient supply chain management system. Clinical staff and management should take an active role in the decision-making related to their organization’s supply chain practices (Sullivan 2012, 14-15).

A well-run supply chain system can have a dramatically positive impact on a healthcare system. It can lead to better quality of care for patients, cost savings for the organization, and improvements in the public health system (“The Logistics Handbook” 1998, 2).

*Quality of care*

When a supply chain system is well-functioning, patients get the medicines and supplies they need in a timely manner without the need for substituting substandard items due to stockouts or expiry. In addition, in an efficient supply chain system the quality of the medications and medical supplies that are administered to patients have been thoroughly authenticated at every step of the supply chain, from regulation at the point-of-manufacturing, through national drug registries and customs clearance, to a pharmacist or nurse making final dosing, formulation, and expiration checks at the point-of-consumption. These added authentication steps reduce the risk of accidentally using medicines or supplies that are counterfeit, expired, or damaged, which enhances patient safety.

Quality of care can also be improved by data collection and integration between an electronic medical record system and a supply chain system. This comprehensive view of the entire supply chain can be useful in understanding which products led to successful patient outcomes, projecting future programmatic needs, protecting against corruption and ultimately allowing for an increase in the capacity of patients served (Sullivan 2012, 13).

*Cost effectiveness*

An effective supply chain system can also lead to cost savings for a healthcare organization. By accurately tracking, reviewing and projecting an organization’s supply needs, stock utilization is optimized. This translates to cost savings from fewer expired medicines and supplies. It also means valuable space and money is not wasted on managing slow-moving, obsolete or overstocked products.

When an organization is able to correctly predict which goods they will need at which times, purchasing options also open up. For example, group purchasing organizations (GPOs) are entities that create purchasing power for small companies by compiling their various unique orders into one large order, thus gaining access to bulk rates (Roark 2005, 36-40). Using a GPO to save money is only possible if an organization can forecast its needs effectively.

A framework contract is an agreement between organizations and vendors that may lead to cost savings for an organization. The goal of this type of agreement is to lock in prices for specific products over a fixed term to avoid price fluctuations due to factors such as global stock shortages. In order to put a framework contract in place, an organization will need to compile a list of specific products it anticipates needing to order over the term of the agreement and provide the vendor with a sense of the volume that is likely to be ordered. Relationships with suppliers and transporters should be continuously reviewed to ensure they remain the best choice for the organization (Sullivan 2012, 8).

Shipment costs also vary widely, which can be used to an organization’s advantage if lead times for necessary medicines are known ahead of time. For example, it is much cheaper to ship goods via sea freight than by air. However, because sea freight takes longer to arrive at the destination port than air freight, relying on sea shipments requires more advanced planning and more accurate projections of needed goods (“Managing a procurement system” 2012, 22-23).

Air transportation is very expensive so is only worthwhile when used in cases of emergency such as a stockout of a critical medicine. An organization may also respond to a stock out event by purchasing supplies in the local market, which may have higher costs and may not adhere to quality standards. Such emergency procurements, if stockouts occur frequently, can cripple a healthcare organization (Privett 2014, 228; “The Logistics Handbook” 1998, 109).

*Strengthen the public health system*

When a healthcare organization is running at maximum capacity, it does not overburden other health facilities in the catchment area by having to turn patients away due to stock outs. An effective organization or treatment program within an organization can also lead to collaboration with other healthcare groups. Best practices can be shared to improve national health outcomes, and consumption data can be shared to help with forecasting. In emergency situations, stock, equipment or warehouse storage space can also be shared among organizations or with local governments. In these ways, supply chain systems enhance the role and reputation of a healthcare organization within a community or even a nation.

Effective supply chain systems will incorporate a review of all prospective vendors, including local businesses. Ideally, a healthcare organization will purchase at least some medicines and supplies locally, which will not only support the local economy, but also build up local capacity by creating jobs at vendor sites. For example, certain bulky or heavy items, or locally manufactured items, may be cheaper and more efficient to procure on the local market once international shipping costs and transit times are taken into account (“Managing a procurement system” 2012, 14).

**Impact of poor supply chain management**

In contrast, poor supply chain management can cause health organizations to fail, seriously affecting their financial security by wasting resources and reacting to emergencies rather than accurately projecting future needs. Poor supply chain management practices can lead to problems related to inventory availability, quality assurance and larger systemic issues that can adversely impact all aspects of the organization, including an organization’s reputation with the local government, partner organizations, and the patient population it serves (Schouten 2011, 1).

Inventory availability problems occur when there is no visibility into what items are in stock, understocked, overstocked, expired, or about to expire or when there are insufficient human resources to adequately respond to these supply chain issues. The impact of stocked out, understocked, and expired items is obvious - patients do not get the treatment they need. The consistent availability of medications is especially critical for complicated treatment regimens such as antiretroviral (ARV) therapy for HIV/AIDS; missing a dose of ARV medicines can lead to increased morbidity, drug resistance and even death (Berger 2007, 46; Schouten 2011, 1).

Overstocked medicines and supplies are also an issue in that they waste valuable resources. The money and storage space wasted on unnecessary stock could have otherwise been used to purchase essential equipment and supplies. Storage space, because it is finite, is a valuable resource and some medical supplies, such as oral rehydration solution (ORS) used to treat dehydrated patients, take up a lot of space. An overstock of ORS means less space for other essential medicines (Sullivan 2012, 10).

Unfortunately, there are a lot of ways the quality of medicines and medical supplies can be compromised: medicines can be counterfeited by the supplier, tampered with during shipping, or damaged during putaway or while in storage (“The Logistics Handbook” 1998, 166). The quality of vaccines and other cold chain medications are even harder to maintain, as their storage conditions (temperature and humidity) must meet recommended standards that are monitored and validated at every step along the supply chain ("Supply Chains for Global Health." 2015; Kaufmann 2011, 1115). Quality assurance is a major issue, as it is difficult to maintain staff accountability, product authentication and close tracking in long supply chains.

Poor supply chain management practices can have deeply detrimental effects on the budgets, programs and staffing of a healthcare organization. If an organization is frequently making emergency purchases when items become stocked out or expired, their annual budget will skyrocket due to higher product prices and shipping costs (Privett 2014, 228; Larson 2014, 399-400). In addition, if medicines frequently stock out within a treatment program that is operated through a funding agency, the healthcare organization and the funding agency are susceptible to attacks on their effectiveness, which may lead to loss of credibility for both organizations (Dowling 2011, 11; Schouten 2011, 1). The donor organization may also be unwilling to provide additional resources for further funding, or the program may be cut completely which would require patients to find another way to continue their treatment.

From clinicians to warehouse staff, burnout and turnover are common occurrences in poorly functioning supply chains. When clinicians can not count on essential medicines being readily available from the pharmacy, there is a loss of trust in the healthcare organization as a whole. When staff are not provided with the training, shipping and moving equipment, storage space, and autonomy they need, there may be poor job satisfaction and even higher resignation rates . A smoothly operating supply chain benefits everyone (Dowling 2011, 16).

**Common challenges**

For healthcare organizations in the developing world, implementing a successful supply chain system is fraught with challenges. Each of these challenges is magnified in the global health context, as resources are scarce, supply chain expertise is not well-established, and problems have a direct impact on patient care. Here are just a few of the challenges that healthcare organizations face when implementing supply chain solutions.

*Uncertainty*

In general, most supply chain issues faced by healthcare organizations in developing countries revolve around uncertainty (Ganeshan 1995, 3). Uncertainty comes in many forms: supply-side shortages, delivery time variability, population growth, supply chain disruptions due to natural disasters, political unrest, untrained staff, and many other causes ("Unite For Sight." 2015; "Week One: HR as a Barrier to Effective Health Supply Chains." 2015). Are roads going to be accessible to distribute drugs from the central depot this week? Is there political instability that is preventing shipments from entering a port? How much anti-malarial medications do we need during the rainy season for a catchment area whose population has seen a variable percentage growth year over year?

Even when a supply chain system is performing at its best, the answers to these questions are filled with uncertainty, the effect of which can be stock outs, missed medical treatment opportunities, sicker patients, patients who seek treatment at other facilities, or worse, patients that are lost to followup due to non-adherence or death.

Most stock projections are based on past consumption data. In some cases, that data is incomplete or non-existent, which makes the output of a projection calculation nearly useless. Even in the case of good data, there is no guarantee that past consumption will predict future consumption for a given population (Schouten 2011, 3). In order to project future needs, one must also understand complex factors including disease prevalence within a catchment area, target population growth, spikes in consumption due to seasonality (e.g. rainy season), among others (“Managing a procurement system” 2012, 3; Sullivan 2012, 6). Maintaining a buffer stock is one way to mitigate risk of stock outs amidst uncertainty, but it comes at the cost of using valuable warehouse space that could have been used for different medications and supplies, or rooms in a hospital that would have otherwise been used for patient care (Sullivan 2012, 10; Privett 2014, 228)

*People*

A lack of human resources capacity is also a significant barrier to effective supply chain management. A lot of organizations rely on their existing staff to take on the responsibilities related to supply chain management. It is common for clinical staff (e.g. nurses or pharmacists) to be tasked with supply chain responsibilities without any formal training. That means that nurses, pharmacists, doctors and even administrative staff, who are already busy dealing with patient care and hospital management, are asked to tally up pill counts, project order quantities, complete monthly reports and perform other tasks that they are not trained or motivated to do (Brossette 2010, 2).

Even students who are trained as supply chain specialists, when such training opportunities are available, are not likely to work for a non-profit healthcare organization if there are more lucrative opportunities to work for a organization in the local private sector or in the developed world. Worse yet, employees who are certified and trained in supply chain management while working for a non-profit are at risk of being recruited by these larger organizations with the promise of better pay. So while education and training is important, additional incentives like competitive compensation and benefits are also essential to retain staff ("ASTMH | Challenges Global Health." 2015, 6).

Another major challenge when working in global settings is language. The language barrier between in-country and expatriate colleagues can usually be managed relatively well by a human resources department that hires locally or expatriates who speak the local language of the country (“Strengthening human resources” 2012, 5; “Learning about the local context” 2012, 9-10). However, it is not feasible to ask suppliers and distributors to ensure that all packaging comes in the local language, so it may be necessary for supply chain staff to speak multiple languages or risk missing important information on product packaging. This language barrier can be somewhat mitigated by tracking products using unique identifiers and/or barcoding, but the implementation of these systems requires additional resources so the cost is non-negligible.

Language is also a barrier for organizations that want to invest in training local staff because it can be difficult to find formal supply chain management training opportunities available in languages other than English (Brossette 2010, 3).

*Process*

In addition to having highly trained staff, it is important to have formalized processes specifically designed for an organization’s supply chain activities. From put-away to picking tasks, thoughtful and coherent standard operating procedures (SOPs) are key. After SOPs are established, there needs to be comprehensive training on their use for all staff, as well as consistent enforcement of rules around accountability. A lack of SOPs, training, or rule enforcement can lead to inventory inaccuracies, delayed distribution and stockouts.

SOPs should also be constantly evaluated, and redesigned if necessary. Improvement initiatives around a certain SOP can put strain on another aspect of the supply chain, so any changes need to be fully thought out to prevent unanticipated errors and bottlenecks. For example, the organization’s management may decide to increase the frequency of cycle counts from weekly to daily hoping to make on hand quantities more accurate. However, this would require a tradeoff in some other aspect of the supply chain. For example, it may necessitate adding new staff to handle the extra work or providing new technology to improve the cycle count process. If these added resources are not provided, the change will likely lead to employee burnout and increased error rates.

*Prioritization*

In many healthcare organizations working in resource-constrained settings, supply chain is usually an after-thought when it comes to setting priorities and allocating resources. Perhaps, rightly so, the focus is placed on healthcare delivery and is clinician-focused. However, supply chain should be seen as the backbone to the goal of providing quality healthcare to communities and the demands of an effective supply chain should be prioritized in order to guarantee that clinicians will have the tools they need to treat their patients.

*Communication*

The challenge of effective communication is not specific to supply chain management, but poor communication within the organization and/or with vendors can have a detrimental impact on supply chain performance. For example, organizations sometimes leave all supply chain management decisions to the warehouse staff, and management does not get involved unless there is a major medical error or fiscal crisis. At that point, a manager will send down a mandate for spending cuts or immediate performance improvements, with a poor understanding of the entire supply chain and how that mandate will impact it. Ideally, management will be involved throughout the entire supply chain process, from the initial needs assessment to the delivery of goods.

Organizations embarking on new projects or seeking funding for new initiatives sometimes fail to consider supply chain realities when developing a proposal. It is imperative that supply chain capacity and limitations be considered from the early stages of the project lifecycle in order to avoid challenging situations down the line. Failing to do so will often result in the need to revise an already agreed-on proposal, or, more likely, taxing already scarce resources to achieve an objective in a shorter-than-expected amount of time.

Communication with employees is also essential to ensure that everyone shares the same mission, and stays motivated to keep the supply chain running smoothly, especially when the supply chain directly impacts patient care. When employees feel accountable within the organization, they will feel comfortable making suggestions for improvement, getting involved with innovations and buying into new practices (“Strengthening human resources” 2012, 19).

Maintaining clear communication with external partners, such as suppliers and local ministries of health, will also improve the entire supply chain system. For example, providing suppliers with updated demand information will help them manage their production effectively so supply side shortages are reduced (Privette 2014, 230). Keeping accurate documentation and communicating often with ministries of health will ease issues with international shipments and customs clearances, as well national drug regulations and tax laws (“Managing a procurement system”, 15).

*Lead time*

Lead time is defined as the latency period between the moment when a product need is identified (i.e. through routine replenishment or a specific request) to the moment when the product is delivered and ready for consumption. International healthcare organizations have to deal with longer and more variable lead times than their domestic counterparts due to the fact that international supply chains are more complex, products need to travel longer distances, and customs clearance times can be unpredictable (Dowling 2011, 13; “The Logistics Handbook” 1998, 109; “Managing a procurement system” 2012, 28).

The longer, more variable lead times require better planning and coordination with external partners, like suppliers. Organizations must fine-tune their needs assessments and demand projections in order to come up with realistic forecasts for medicine and supply consumption. Longer lead times alone are not a problem if you can forecast your needs accurately - it is usually variability that causes most problems. The variability component requires an organization to keep larger amounts of buffer stock as protection against a missed delivery date or longer-than-usual customs clearance times. This leads to the overstock situation described above where money, time, and storage space are wasted on items that could have otherwise been used for other essential medications and supplies.

*Infrastructure*

Challenges related to infrastructure also lead to problems within the supply chain. Unstable power and internet impact the ability to collect data and transmit timely information, as well as the ability to maintain cold chains. Bad roads can lead to longer lead times and damaged products. This is especially troublesome in more rural locations, where the combination of these issues creates a perfect storm of supply chain dysfunction.

Power outages can also lead to damaged equipment, which will need to be repaired or replaced. In most cases this requires service from the manufacturer. Unfortunately, most organizations do not have this expertise in-house and the manufacturing companies usually cannot send service personnel in a timely manner, so damaged equipment can go unrepaired for months or years, leading to missed treatment opportunities. Having access to local or regional technical support is key with respect to medical equipment. Hopefully with time, local economies will grow and diversify in order to be able to service these equipment failures. Until then, care must be taken when determining which equipment to install due to the aforementioned issues (“Managing a procurement system” 2012, 10-11; “The Logistics Handbook” 1998, 81).

*Fragmentation*

Healthcare organizations working in developing countries must put thought into managing the complexity of medical services they will offer to patients (e.g. mental health, labor and delivery, pediatrics, HIV/AIDS management, geriatrics). The number of products required to run a hospital increases dramatically with each new medical service offered, along with the time and effort required to procure, store, count, and deliver each new product. In addition, having a supply chain staff that can execute an effective supply chain strategy for multiple diverse services takes considerable effort to master and should be done thoughtfully and with proper training and resources.

Some organizations will handle the necessary products for each medical service separately, thus creating multiple parallel supply chains. Such fragmentation of supply chain activities leads to stock redundancies, staffing overlaps, wasted money and an increase in potential errors. For example, a single healthcare organization may have several medical services that require a similar group of products. But if each service creates its own vertical supply chain, they might purchase the same product from different vendors at different costs, thus missing out on cost sharing with respect to bulk discounts, transport, delivery and labor. It also requires redundant storage within the same facility, wasting potentially valuable space.

Fragmentation leading to parallel supply chains is a huge burden on healthcare organizations as it is an extremely inefficient use of resources. However, the reason fragmentation occurs in the first place is not due to a lack of intelligence, but rather a mistrust of the organization’s supply chain system as well as the desire to supplement stock levels with donations from partner organizations. The staff of these various medical services have witnessed the effects of bad supply chain practices and have decided to become self-sufficient with respect to their own supply chain needs (Privett 2014, 227).

*Technology*

Organizations of all sizes have a desire to use the latest technology in hopes that it will solve all of their supply chain problems. Whether they are planning to adopt a brand new warehouse management system or implement radio-frequency identification (RFID) barcoding, these choices should not be taken lightly. A good supply chain management system can cost millions of dollars to implement and maintain over the first few years of ownership, which can cripple a small non-profit organization. If the organization is further unable to hire the right people to work with this new technology, the effects can be exacerbated (“The Logistics Handbook” 1998, 41).

Adoption of technology without an understanding of the true cost of implementation and maintenance is a recipe for disaster. Decision-makers should perform an exhaustive cost-benefit analysis to better understand what it will cost in monetary and human capital to get the system off the ground. The cost of technology adoption is often viewed myopically as the purchase and installation of software. However, a thorough cost-benefit analysis needs to include the cost of hardware and software, operational costs, as well as long-term support. Hardware and software costs include its original purchase, in addition to its configuration, implementation, and development, on-going hosting, setup fees, licenses, migration from an old system, and thorough acceptance and performance testing. Operational costs include hiring the appropriate number of skilled staff to maintain the software and perform data collection, as well as providing warehouse staff with trucks, pallet movers, conveyors, and forklifts. Operational costs should also include the cost of rewriting the SOPs used to define daily activities of the warehouse and distribution network. Lastly, the total cost of ownership should include long-term support costs such as maintenance and upgrades, hardware failures, scalability, and on-going developer costs for custom features. It is also important to understand that the more data is collected and made available, the more resources will be needed to effectively respond to the now-visible needs and demands of the supply chain. Organizations implementing new software (or any other tool that will make their inventory situation accessible and available) should anticipate this increase in work and plan on addressing it with appropriate staffing resources.

The lack of understanding around the total cost of ownership can add a huge financial and human resources burden to the organization. More challenges can arise when management fails to take proper steps to include warehouse and operations staff as stakeholders in decision-making. This can lead to a supply chain information system that has no buy-in from managers and employees. Staff will want to know why their jobs are becoming more difficult, so any supply chain system changes should be coupled with training sessions and explanations for the people doing the work. Otherwise, burnout ensues, motivation decreases, and the supply chain operation will suffer.

This is not to say that adopting technology and information systems is not an important part of the supply chain solution. In fact, it could be argued that technology is essential to a successful supply chain system. However, there are costs that need to be taken into consideration before implementing a technological solution. Adding technology to an already overburdened, understaffed and ineffective supply chain system can often make performance worse rather than better.

Too often technology is viewed as a panacea, especially in resource-poor settings. For example, mobile technology is booming, and yet the problems it was supposed to solve are not going away. The reason has nothing to do with the efficacy of mobile technology; instead it has everything to do with unrealistic expectations that technology will solve all problems without having to hire or train more qualified personnel and improve the processes around the technology. Technology will certainly play an important role in solving a lot of these problems but it is only after establishing a sound foundation with good personnel and effective processes that technology can take hold and help to improve the current situation in global health ("Supply Chains for Global Health." 2015).

*Data and data standards*

The effectiveness of a supply chain system is dependant upon the quality of available data. High quality data allows supply chain staff to make informed decisions on product and vendor selection, order quantity and timing; high quality data helps an organization be proactive rather than reactive and increases the efficiency of daily tasks.

Data maintenance requires both a good information system and dedicated resources to monitor data quality. A good information system can be either paper or electronic, but the goal is to create access to data that is standardized through a data collection process that is as streamlined as possible. At the most basic level, the information system should outline standards for the collection of product metadata, including unique product identifier, product name, description, manufacturer, manufacturer code, temperature requirements, and package sizes. To facilitate ordering, an information system should track whether or not a product should be reordered or not. This decision can be based on feedback from the end user about the quality of a product or it can be based upon the identification of formulary items, or items that should always be available for the clinical services the organization is delivering, as opposed to products that the organization no longer needs or are part of a special one-time purchase.

Ordering is also made more efficient by the centralization of data related to suppliers, including supplier code or identifier, lead time (for both the supplier to receive stock and transit and customs clearance time once the order is sent), and pricing. An organization may choose to give the supplier a rating or status as a “preferred” or a “secondary” partner based on factors like customer service, consistency of product availability, discounts, or human rights or environmental protection records.

To prepare accurate orders, an organization must have access to data about demand in service delivery locations. A lack of accurate demand data creates uncertainty and can cause an organization to waste money and valuable storage space by over-ordering, or put patient lives at risk by under-ordering. Accurate forecasting depends upon having information on patient population demographics, local prevalence of disease including the seasonality of disease, and having access to information about the organization’s plans to, for example, increase or decrease the geographical service area, to start or stop treating a cadre of patients, or to add or subtract a clinical service. Collecting consumption data over time will lead to increasingly more accurate ordering (“Managing a procurement system” 2012, 2; Sullivan 2012, 5-6).

Once stock arrives at a storage location, it is also important to maintain the accuracy of data about stock availability. Ensuring that physical stock (the stock available in the storage location) and theoretical stock (the stock recorded in the information management system) match is important because this gives staff located at other sites or abroad visibility into the stock on hand at specific locations, information that is useful to consider when making ordering decisions. In addition to quantity on hand, the expiration dates and lot numbers for these quantities must be kept accurate in information management systems. Warehouse managers can use this information to ensure that products with the earliest expiration date are used first, as well as locate and quarantine specific lot numbers in the case of product recalls from the manufacturer.

Data issues that can clog the supply chain system are numerous and can be minimized by having staff dedicated to managing data quality and standardization, including providing refresher trainings for data entry staff. Data issues that organizations should avoid are duplicate data (i.e. duplicate products or suppliers), outdated products or suppliers (i.e. products that have been discontinued or need metadata updated), and incomplete data for product or supplier metadata. However, organizations are frequently lacking staff to implement data quality improvement initiatives and even when staff time is devoted to data quality efforts, it is very time consuming to review, correct, and merge data (“The Logistics Handbook 1998, 89; “Using monitoring and evaluation for action” 2012, 22-26; Nachtmann 2009, 14-19).

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