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HELP – Healthcare Logistics Education and Learning Pathway

Analysis of National Reports in Healthcare Logistics in partner countries

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1. Introduction

The purpose of this analysis is to describe in reasonable detail the health care and health logistics systems of five European countries, which have received funding from EU Erasmus+KA2 Healthcare Logistics Education Learning Pathways project. This analysis will be the background to future education development in healthcare education throughout all the participating countries. The partner countries involved in this process are Finland, Belgium, Estonia, Netherlands and Spain and all educational levels were included.

The health care and health logistics systems vary in each country, but still you can find some level of similarity and difference. In all the participant countries the health care systems are based on legislation and three responsibility stages: state, province and municipality. In addition, health care emphasis is focuses on three primary areas preventive nursing, care and treatment.

In all countries, it was noted that there are two main kinds of healthcare providers; public and private organisations and supporting these are different kind of specialized hospitals

Finland's healthcare system is founded on government subsidised municipal healthcare services. This means that local authorities (about 311 municipalities) are responsible for organising healthcare services. Municipalities have a considerable degree of freedom to plan and organise the services within the limits of legislation and can provide the service either themselves or purchase the services from private or third sector (non-profit associations).

In comparison to this the Dutch healthcare system can be classified in the following terms: purpose of healthcare, functional characteristics, place of healthcare provision and nature of the illness or disorder. Spanish healthcare system can be very complex, involving many different types of management and organizational structures, generating many ways of managing logistics and supply chains in hospitals.

By compering these systems it is hoped that we can find new practice and methodology for the training of nursing, pharmaceutical and logistical students. To help them have the skills necessary to actively work in this field in the future.

2. A brief overview of the healthcare system of participant countries

2.1 Health policy and legislative framework

In all participant countries, the healthcare sector is guided by legislation, contributions of national system, guidelines, instructions and supervision. The basics of health policy seem to be same, citizens' proper care and treatment in all situations.

The Finnish Ministry of Social Affairs and Health with all its departments are taking care of the guiding, research and development of activities. Below the Ministry there are National Institute for Health and Welfare (www.thl.fi) and Finnish Institute of Occupational Health (www.ttl.fi) and as well the work of the National Supervisory Authority for Welfare and Health (www.valvira.fi) (Ministry of Social Affairs and Health 2018a) which supervises and guides healthcare professionals and medical facilities both in private and public sector (Valvira 2018). Estonia's health system benefits from strict separation of functions with the main actors being the Ministry of Social Affairs and its agencies, the Estonian Health Insurance Fund, and independent provider units operating under private law (so-called autotomized units). The Ministry of Social Affairs is also responsible for financing emergency care for the uninsured, as well as ambulance services and public health programs. Both the Ministry of Social Affairs and local governments finance social care.

Country	Ministries
Finland,	Ministry of Social Affairs and Health
	National Institute for Health and Welfare (www.thl.fi)
	Institute of Occupational Health
	Supervisory Authority for Welfare and Health (www.valvira.fi
Estonia	Ministry of Social Affairs
	Estonian Health Insurance Fund
	Independent Provider units operating under private laws
Belgium	9 Public Health Ministers
Netherlands	Ministry of Health, Welfare and Sport
Spain	The Ministry of Health and Social Policy

Table 1. Healthcare managing ministries in participant countries

In addition to strategic policy instruments, the legislation regulates strongly healthcare sector in Finland. From healthcare services point of view, the most important regulations are the Health Care Act (1326/2010), the Primary Health Care Act (66/1972), the Act on Specialised Medical Care (1062/1989), Occupational Safety and Health Act (738/2002), and Private Health Care Act (152/1990). In Spain, the most important regulations for health protection and care as stated in article 43 of the Spanish Constitution of 1978, General Health Law of 1986. The General Health Law was complemented in 2003 by the Law of Cohesion and Quality of the National Health System, This was aimed at define a common framework of action of the National Health System and of the health services, without interfering in the diversity of organizational formulas, management and service provision inherent to a decentralized State.

Main legislation	
Finland	the Health Care Act (1326/2010), the Primary Health Care Act (66/1972), the Act on Specialised Medical Care (1062/1989) Occupational Safety and Health Act (738/2002) Private Health Care Act (152/1990).
Estonia	Health Insurance Act Health Services Organisation Act National Health Plan 2009–2020
Netherlands	Healthcare Insurance Act Long-Term Care Act Social Support Act Youth Act
Spain	General Health Act 14/1986 of 25 April article 43 of the Spanish Constitution of 1978. The General Health Law was complemented in 2003 by the Law of Cohesion and Quality of the National Health System

Table 2. Main healthcare legislation in participant countries

The difference between participant countries healthcare legislation is the level of management. For example, in Spain, autonomous communities may take care of principles and coordination of health, international health, drug policy and National Institute for health management. State administration takes care of health planning, public health and regional health service management. Local councils are taking care of health and hygiene and collaborate in management of public services. In the Netherlands, central government is responsible for determining priorities within healthcare and functioning of the healthcare system.

The purpose of participant countries healthcare system is to provide healthcare of a good quality to everyone by legislation but own ways. In Netherlands, Estonia and Belgium there is an Act of Insurance, that provides clients the care and treatment they need regardless of age and condition. In Finland, it is also citizen's right but not funded by Insurance Act.

In participant countries, the amount of healthcare providers varies a lot. The providers may be public or private healthcare institutes

Finland	5 university hospitals 20 district hospitals 3 big private healthcare providers
Estonia	About 65 public and private hospitals in Estonia, including 35 nursing and rehabilitation hospitals.
Spain	17 autonomy communities

Table 3. Amount of healthcare providers

2.2 Organisational structure and delivery of services

2.2.1 Governmental healthcare system

Finland	No governmental level healthcare services		
Spain	preparing legislation and guiding its implementation, directing and guiding the development of healthcare services and healthcare policy, defining healthcare policy guidelines, preparing key reforms and guiding their implementation and coordination as well as being a with healthcare sector and political decision-making system. developing matters of health, in planning and delivery of services, as well as exercising the purview of the General Administration of the State to assure citizens the right to protection of their health.	primary care is available for all in 15 minutes specialist care (care centres and hospitals for outpatients and inpatients)	fully funded from taxes and predominantly within the public sector (70/30).
Estonia		Most hospitals are either limited liability companies owned by local governments or foundations established by the state, municipalities or other public agencies. The remaining few are privately owned.	

Table 4. Governmental healthcare system

2.2.2 Regional healthcare system

	Aims	Providers	Financing
Finland	Regional State Administrative Agencies are guiding and monitoring both municipal and private healthcare services and evaluates the ability and quality of basic services. Hospital districts Coordinates hospital services and specialised medical care services that cannot be expediently provided through primary health care and oversee the development and control the quality of laboratory and imaging services, medical rehabilitation, and other comparable specialised services provided. Hospital districts also coordinate research, development, and education in their area and are responsible for ensuring the compatibility of information systems used in local authority healthcare. For highly specialised medical care services, hospital districts are grouped into five catchment areas around university level teaching hospitals.	20 hospital districts and university hospital	Municipalities
Estonia		Primary health care is a set of ambulatory services for the most common health problems available to people based on their work, school or place of residence	

		Family doctors Family nurses Specialists Advice line 1220	
Spain	Responsibly to take care of health planning, public health and health care healthcare management healthcare services, rights, obligations	Community health services	Given budget to providers
the Netherlands	No regional healthcare system		

Table 5. Regional healthcare system

2.2.3 Municipal healthcare system

In Finland, Estonia, the Netherlands and Spain municipalities are responsible for organising social welfare and healthcare (physical, mental, or psychological; slightly (mentally) disabled and senior citizens). They can provide basic social welfare and health care services alone or form joint municipal authorities with other municipalities. Municipalities may also purchase social welfare and health care services from other municipalities, organisations or private service providers. The difference is that Spanish municipal system is more limited to health promotion and drug additions.

According to the legislation, the basic social welfare, public health and specialised medical care services that must be available in every municipality, but municipalities can decide the scale, scope and model of municipal service provision within the limits of legislation. This means that healthcare services can vary from one municipality to another.

In the Netherlands there is specialized act for youth (Youth Act 2015) It includes support, help, and care for children under 18 age and their families in case of problems with child rearing, psychological problems, and disorders.

2.2.4 Private healthcare system

Private healthcare is working beside public healthcare in all participant countries. All legislations are the same. Client may choose the way he/she wants to take care of their health needs. Municipal healthcare may buy some services from private health care organizations. The most common private services in Finland are physiotherapy, surgical procedures and other hospital services, medical care, dental care, imaging and laboratory examinations as well as occupational health care. (Ministry of Social Affairs and Health 2013; Lääkäripalveluyritykset ry (2018b) The private sector accounts for around 5% of total healthcare services within hospital services and approximately 25-30% of the total market for outpatient medical services and more than 35% in specialist medical services. (Lääkäripalveluyritykset ry 2018a)

According to estimates by Lääkäripalveluyritykset ry (2018b), there are approximately 16,000 private health care providers and practitioners in Finland. The most typical private health care provider in Finland is a physiotherapy unit of 2–3 workers (about 1450 provider units). The second most typical provider is a medical doctors' practice (about 1000 provider units).

Some examples of the large private provider units are a few hospitals and occupational health care units that may have several hundred employees. The majority of doctors working in the private sector are specialists, whose full-time job is in a public hospital or health centre.

In addition to private companies, non-governmental social welfare and health care organisations provide services both for a fee and free of charge. Non-governmental organisations receive a considerable proportion of their funding from public funds and from Finland's Slot Machine Association.

In Spain, there are mainly six different organizational models for hospitals. Private hospitals: Funded, managed and controlled by private organizations such as private foundations, corporations or health insurance companies. Examples of this are ASISA or QUIRONSALUD, with a network of clinics, hospitals, medical centres and private physician covering the whole country. In addition, some of the Spanish on-profit organizations are funded and controlled by their respective regional Health Service. This can be publicly or privately managed depending on the management rules established at the time of their creation by the governing body. There are also a particular type of public-private partnerships. The "Alzira model" was pioneer in this

management model, whose premises are public funding, public control, public property and private provision, i.e., public hospitals administrated by private management. Other public-private partnerships: there is a huge variety of management models based on public-private partnerships. For example, the introduction of Private Funding Initiatives (PFI) practices in Madrid, Castilla-León and Baleares, in which a private organization enter into a long-term contract with the Health Service in order to finance, build and sometimes manage part of new hospitals.

Expressed as the % of the Spanish GDP, health care accounted for the 6.4% for the public sector and the 2.8% for the private one. In the period 2010-2014, public health expenditure increased a rate of -2.8%, while private expenditure grown by an average of 3.8% per year.

In Estonia all health care providers are independent entities operating under private law. Family physicians operate as private entrepreneurs or paid employees of private companies owned by family doctors or local municipalities. Family physicians serve as the first level of contact and gate-keeper of the system (a gatekeeper is a health care professional - usually a primary care physician - who coordinates, manages, and authorizes all health services provided to a person covered by a certain health (insurance plan)). There are currently about 800 family physician practices in Estonia, and while there has been a growing trend towards group practices, approximately 70% of family physicians continue to work in solo practices. Family physicians are responsible for providing a core package of services to their self-selected constituencies (individuals registering with them under a practice list-system). Each family physician's practice list cannot contain more than 2000 patients or less than 1200 patients. All together, these practice lists cover the entire population. In addition, family doctors and nurses provide more than half of all ambulatory care visits, while ambulatory specialists deliver the remainder of these visits.

In the Netherlands some of the care is provided by private organisations such as: hospitals, nursing homes, home-care organisations; and persons such as general practitioners, medical specialists and physical therapists. Care provided is based on private contracts between healthcare insurer, provider and recipient. The actual healthcare provision is a matter between private parties. The care received depends on a business agreement with a person or organisation to receive care. Although the recipient does not pay the invoice. The care recipient also has a business agreement with the insurer. The recipient pays the insurer a premium and the insurer pays the

invoice if deemed. All involved parties are natural or legal persons and their agreements are covered in the rules of private regulation, the Dutch Civil Code.

2.2.5 Occupational healthcare system

Finnish Institute of Occupational Health (FIOH) helps companies to succeed by developing work, work communities and the work environment. Their extensive work life expertise is based on the personnel's high level of education, decades of experience, multidisciplinary research and continuous communication with workplaces. They also bring their best practices without delay to clients in both trainings and service activities. The main important focal areas are work ability and working career, digitalization, small and medium-sized enterprises and growth and transforming occupational health services. FIOH is also maintaining the quality of prevention of work-related illnesses, management of risks in the physical work environment, recognizing of new risks in the work environment, effective solutions for occupational safety and healthy workspaces. (Ministry of Social Affairs and Health 2016b)

The general Occupational Health and Safety (OSH) legislation in Spain, transposing Directive 89/391/EEC (Framework Directive), is mainly covered by Law 31/1995 on the Prevention of Work-Related Risks. It establishes the general principles for health monitoring of all workers (except domestic ones and self-employed) and its approval was the starting point for the development of the security system and health at work in Spain. The main bodies concerned with occupational safety and health (OSH) in the Ministry of Employment and Social Security are the National Institute of Safety and Hygiene at Work and the Labour Inspectorate. The autonomous regions have certain competencies in OSH matters that are carried out by the regional labour authorities and the regional OSH centres or institutes.

In Estonia and the Netherlands there is no occupational healthcare system.

2.3. Future of healthcare system

In all the participant countries, there is a reform either going on or in the plans of the healthcare system. In Finland the main issue is to reform the structure, services and funding of healthcare services. From 2020, public administration will be organised on three levels: central government, counties (autonomous regions), and local governments. In the future, the new established 18 counties will organise all public healthcare services in their area. (Government reform package 2018f)**.** The aim of the reform is to provide more customer-oriented, effective, cost-efficient and better-coordinated healthcare services on a more equal basis than before (Ministry of Social Affairs and Health 2010). By the social and healthcare reform, the Finnish Government aims to save approximately EUR 3 billion in the branch of government which includes the Ministry of Social Affairs and Health during 2019 - 2029 (Ministry of Social Affairs and Health 2016a). Besides structural reforms, the steering and operating models in healthcare will be thoroughly modernised. (Government reform package 2018c). In addition to the healthcare service structure, the financing of the healthcare services will change (Government reform package 2018b)

The objective of the healthcare reform is that everyone in Finland will have equal opportunities to get the adequate health and social services required by law. The county will safeguard that services are equally available to all people. Another objective is to integrate health and social services into well-functioning packages with smoother care pathways, faster access to healthcare services, and more efficient information transfers. One intention is also to increase clients' freedom of choice their healthcare service providers. In the future, clients can choose their public funded healthcare services (social and healthcare service centre, dental clinic, and specialised medical care) from service provision of public, private and third-sector organisations and change their healthcare services centre every six months. Clients will be granted a health and social services voucher or a personal budget for getting the private and third-sector healthcare services. (Government reform package 2018d & 2018e).

In Estonia, the health care system and its developments are affected by changes in the society. The population is ageing, shrinking, and moving. As a result of increased health awareness and improvement in diagnostics and the overall standard of living has increased, the number of appeals made to health service providers is increasing, as are the expectations of the people grows. Higher demands are placed on the availability, quality, and safety of health services as well as on the staff, whereas financial resources are always limited.

The strategic plan for health care system in Estonia is described in National Health Plan 2009–2020. General objective of the strategic field was that – by 2020, the health-adjusted life expectancy has extended from 60 years in average for men and 65 years in average for women, and the average life expectancy has extended to 75 years for men and to 84 years for women. Therefore, there are plans to change the primary health care system. The main coordinator for patients/ clients will be health centres that in the future will encompass different occupations from different fields. And the main coordinator at the centre will be a person who might have the competences of a logistics. The health centres will encompass also services like physiotherapy, pharmacist service, social workers and the health services that are not offered by a physician or a nurse. Therefore, all services that are not listed at Health Care Services Act as health services are also united into future Health Centres with the aim to help clients/ patients to move between different systems.

In Spain SIS Foundation carried out a series of exercises in order to gather the opinion of three group of stakeholders (patients, professionals and policy-makers and manager) regarding different topics such as governance and funding schemes, public health and health care, future changes… Main expected changes are the following (10):

- Since the population is ageing, health care expenditure is expected to increase.
- IT developments will be the basis for having an accountable sanitary system.
- Managers will have a more professional profile
- Professionals will be paid using pay-for-performance schemes.
- Emphasis will be put more on hospital specialization, reducing the influence of primary care as the centre of the system.
- Information to patients/citizens will be the basis for the system's sustainability
- Information will be provided about how providers perform, and to help patients and citizens to choose the best options.
- Empowerment of citizens and patients, and informed (even shared) decision-making will prevail.
- Co-payment on drug and therapeutic innovation will be implemented, together with an evolution of the current co-payment scheme towards an income-based one.

3. Healthcare logistics

Healthcare logistics basically is the same in all participant countries. In order to work i.e. as a hospital, there are certain needs that need to be fulfilled. For example, to be able to work as hospital is meant to work, it needs to have some kind of warehouse to store all equipment needed in healthcare. The vision of what healthcare logistics actually, varies between the participant countries.

For example, Estonia mentions in their report that healthcare logistics does not exist as a profession, but they have specific people who take care part of the logistics tasks. These assistants do not have medical background. Belgium sees healthcare logistics as a support to other processes including medical and non-medical services. Spain raises up issue that improvement in hospital logistics can make other functions in hospitals more efficient, but logistic criteria may depend on the respective Health Service's strategies on the organizational model of the hospital. Netherland tells in their report, that facilities have external parties maintaining warehouses or they outsource the whole external freight logistics.

As a conclusion of healthcare logistics, we know it exists in all participant countries, but all countries have their own name for the system. All participant countries have their unique systems, overall the common thing for all of them is that healthcare logistics are usually connected to patient logistics, though should also focus on material logistics. Supporting material handling and logistics also makes healthcare more efficient.

Healthcare organisations in Finland are process organisations that are complex and challenging, containing actions and structures that have demanding material and personnel flows in which logistics contribute greatly to the quality of the operations (Fraunhofer IML. 2013). When providing care services, the patient flow is the main flow and the role of the material logistics is to support it as effectively as possible. As patient flow is the key flow in healthcare, the material flows must be designed according to patient flows.

The Dutch health care system consists of multiple, different parties and facilities, of varying sizes. The different health care facilities are connected by the patients who go through many different services within the system. The patient can use the system

in different ways; the patient can use only the treatment facilities, only the care facilities, or a combination of both cure and care facilities.

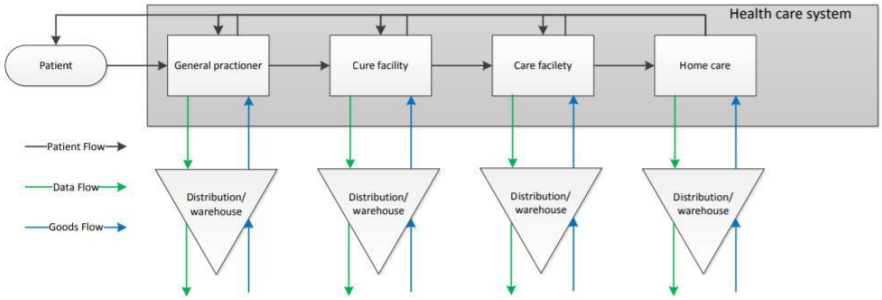


Illustration 0-1 General overview of health care system ((Oomen, 2016)

Connected to the health care system is the goods logistics supply chain, as shown in Illustration 0-1 General overview of health care system ((Oomen, 2016) Both process flows are linked. No cure or care without goods, and no goods if no cure or care is needed.

In Estonia here is no such profession as a healthcare logistics. Logistics issues are dealt by various professions and it differs from organization to organization.

In Spain It has been proved that, “improvements in hospital logistics could lead to excellent operating room and pharmaceutical management, better inventory management, enhanced vendor relationships and more effective work flow for hospital employees, and in turn, higher quality healthcare services.” (11). However, logistic criteria may depend on the respective Health Service’s strategies on the organizational model of the hospital.

The logistical processes within a hospital in Spain can be depicted as follows in Figure 4:

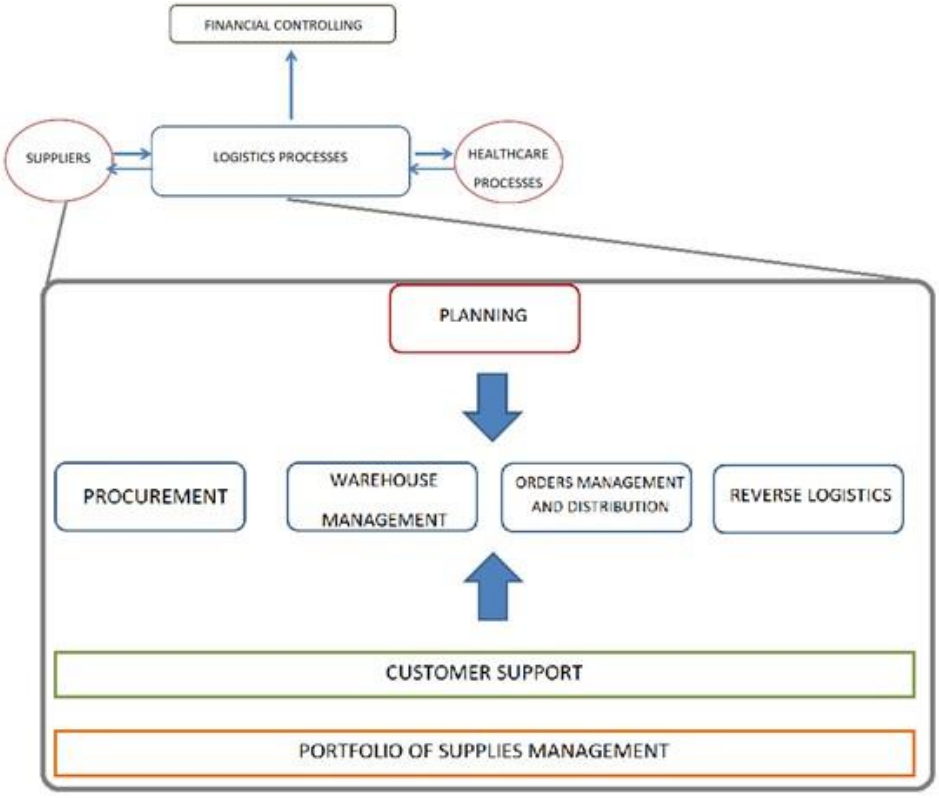


Figure 4 Logistical processes involved in healthcare (12)

3.1 Inbound healthcare logistics

Inbound healthcare logistics include material flow from outside the facility to inside, for example supplier delivers daily needed equipment to a central warehouse of a hospital.

The procedure, how this works variates between the countries. Legislation concerning pharmaceuticals is very strict in all countries. The main point is though same in all countries; when something is needed, it is ordered from supplier to be delivered. Belgium mentions in their report, that each hospital and organization decides on own supply chain management for the variety of material needed. In Belgium is also another model in use; external central warehouse, where all suppliers deliver. From

external warehouse, shipments are consolidated to all clients as ordered. The external central warehouse model is slowly growing in Belgium.

In Finland the national legislation on public procurement regulates procurement process for public hospitals and other public healthcare service providers.

Purchase department will get proposition to order needed goods, when warehouse inventory goes below per-defined amount. Purchaser makes a decision whether he should place an order and what is the purchasing cycle. The purchasing cycle is based on consumption forecast and consumption from past 12 months. After shipment arrives physically to warehouse, it will be inspected and checked before adding to warehouse inventory.

In Belgium each hospital/organization decides on own supply chain management for the variety of material needed. For pharmaceuticals, legislation is strict.

Materials: non-medical operational supplies (e.g. food), sterile & non-sterile goods (e.g. lab products), linen & laundry, waste (domestic & medical), technical materials and equipment (e.g. filters, blood gas analysers) - pharmaceuticals (e.g. syringes, compresses, stents, catheters, medication)

Basic choices, how to take care of logistics. Own Central warehouse: individual suppliers deliver to hospital warehouses. This is traditional way of working. Slowly growing option is an external central warehouse: suppliers deliver to central warehouse of logistics service provider, who organizes consolidated shipments to hospital.

Own central warehouse: individual suppliers deliver to hospital warehouse(s).

In Estonia inbound logistics is linked to provisioning process, which includes the purchasing, reception and management of inventory, that is, all the processes that provide the healthcare system with the necessary resources for its function.

Figure: Provisioning sub-processes by CEL Committee (5)

In the Netherlands goods Logistics: Effective and efficient propulsion of goods flows and information flows between goods suppliers and healthcare institutions, so that the right product is present at the right place and at the right time of the right quality for the patients.

The goods supply chain in the Dutch health care system consists of the chain between supplier and customer, with the customer being the health care facilities. The connection between those two parties is the demand forwarded by the purchasing department of the health care facilities and the freight traveling from the supplier to the client and all parties in between. The amount of parties involved in this supply chain is variable between facilities. Some facilities have their own warehouse and directly purchase from the different suppliers or wholesalers. Other facilities have external parties maintain their warehouses or they outsource the whole external freight logistics.

In the next illustration, the supply chain of the goods logistics in the health care system is visualised.

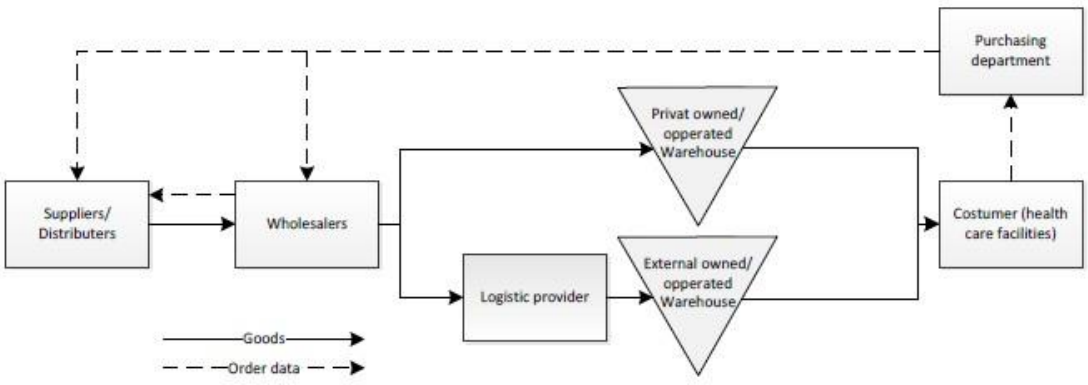


Figure: *Goods logistics supply chain (Oomen, 2016)*

3.2 In-house healthcare logistics

In-house logistics consists of everyday functions inside the organization. They can involve everything from food deliveries to laundry and pharmacy. In Finland, patient transfers are not part of in-house logistics, but there are local differences on areas in Finland.

As we known by increasing efficiency in logistics, other functions increase in efficiency too. If e.g. hospital is more efficient in logistics, more time comes available for practical nurses and other parties. The basic transport issues and deliveries for different wards can be dealt by transport or warehouse staff. All participant countries struggle with the same problem, how to be more efficient.

Spain and Finland have quite similar system on their procedures on shipment handling inside the hospitals. Usually hospitals central warehouses are located in the basement, near to loading docks, to make receiving and sending shipments more efficient.

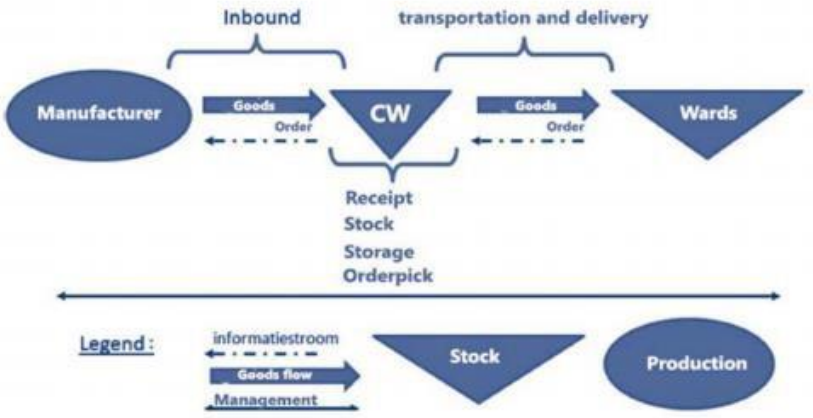
In-house logistics can also be looked as a service from central warehouse to different wards in hospital. e.g. ward can have a shelving service ordered from the warehouse, and warehouse fills needed equipment to wards own, smaller warehouse.

In-house healthcare logistics in Finland has been considered one of the key areas when developing healthcare logistics processes. Transport workers deliver shipments from central warehouse to internal clients. In addition, automated guided vehicles are used, and with some internal clients, is an agreement about shelving with central warehouse. In-house logistics and their precision are very important. Patient transfers are not part of the in-house logistics.

Within the Dutch healthcare institutions there is much demand for the In-house logistics department. This department ensures correct administration and handling of the goods flow within the healthcare institutions. Pagina 10 the logistics of goods in the

larger health care facilities start with a supplier delivering goods to a central warehouse, which in turn will distribute the goods to the different departments within the facility, as seen in illustration 4. From this central warehouse, the goods will be delivered to the different departments and the de-central storage of these departments. The goods delivered to a large health care facility will most likely not all come from a single supplier, but rather from multiple suppliers. Similarly, there can be multiple central warehouses, which cater to one or more facilities. An external party who is specialised in goods logistics also sometimes controls these warehouses. This chain is shown in illustration 2.

Illustration 0-2 General goods logistics plan (CW is the central warehouse) (RICHARD WESTERMAN, 2009)



The In-house logistics department processes orders from diverse departments within the healthcare institution. These orders/requests are handled by administration, or by means of a stock management system. They determine the order period and order amounts using specific formulas. These orders are sorted per division warehouse. When an order is booked, it will be delivered at the appropriate warehouse via administration. The order simply includes simply which products are needed for which department. Orders are differentiated by regular and rush orders (Vries, 2005). In Illustration 0-3 the steps of the order process are shown.

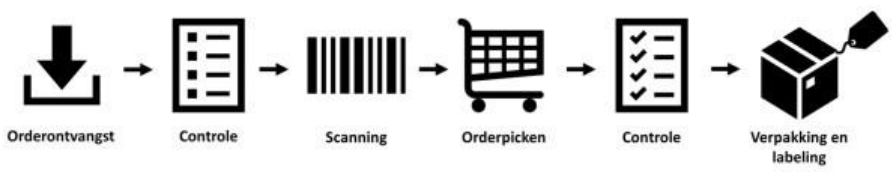


Illustration 0-3 Order processing in warehouse

Within healthcare institutions different departments often have their own stock location such as small pantries. These small stock locations are supplied from a central warehouse.

In-house logistics in Belgium, i.e. from central warehouse to the wards and units, are mostly carried out by logistic staff, nurses are freed from logistic duties. Logistic operations are not yet well organized in all organizations, also logistic *staff are sometimes very limited*.

Inventory control (ordering, receiving, storage, and picking) is slowly professionalizing. Tracking & tracing of goods (e.g. with RFID) is growing. Technology and standards are enablers here; legislation is becoming stricter.

In house logistics in Spain is related to the stock management, involving the intermediate storage of products and transportation inside the hospital. It takes place in the general warehouse of the hospital, where the majority (around the 90%) of products are received and stored, managed and distributed from. It is the centre of logistic activities since all provisioning and production processes take place there. Research studies showed a lack of proper technology to manage stock and information, obsolescence of installations and a lack of qualified labour in logistics in most of Spanish hospitals.

Figure 6 Stock management subprocesses by CEL Commitee (5)

A general warehouse is located in the same hospital or facilities nearby, usually is located at basement or ground levels, close to a loading dock where the vehicles unload the goods. Frequently, even when the procurement model is centralized by means of a logistics platform, the central warehouse is still in use. After the arrival of the supplies are checked by a warehouse worker (usually a healthcare assistant), who must sign the delivery note to accept that all goods were delivered in satisfactory

conditions, the supplies are identified with a code and registered in the inventory system.

Drugs and some medical supplies are usually received at the Pharmacy Department, which is also physically located at the ground floor or at a basement level. The goods are received at a pharmaceutical general warehouse that can share space with the one dedicated to the rest of supplies, or not, and are stored under different procedures, depending on the nature of the drug itself (refrigerated storage carousel, ambient temperature storage carousel, conventional racking systems or controlled drugs cabinets).

3.3 External healthcare logistics

The outgoing flow of goods is a lot smaller than incoming. Some participant countries tell that outgoing flow is in its infancy, and needs to be developed. Finland delivers shipments to external clients e.g. other health stations, dentists and home care. Other participant countries tell the same, drugs and so on are delivered from HO's to others, but there are also difficulties, are HO's are independent organizations, and not necessarily bonded to each other. It should be paid attention to how to make external logistics as efficient as in-house logistics.

External clients do orders via online shop in Finland. If external clients have shelving service, it is possible that they rarely have to do the orders by themselves.

Central warehouse uses transport companies they can rely on, when delivering to external clients. Transport contracts are done with few companies, and collection and delivery are ordered, when needed. As a return from external clients will come pharmaceutical waste and empty trolleys for example. If clients receive shipments with incorrect goods, they are usually sent back to central warehouse, when it is next normal delivery date. If urgent shipments, they are handled separately, and with its own schedule.

In the Netherlands the outgoing flow is much smaller than the incoming flow of goods. Waste leaves the care institution. Different recognisable flows are fat(s), foods, paper/carton, specific hospital waste. This waste is picked up by the logistics staff member and brought to

the central waste stations. From the central waste station, it is taken away by an external logistics services party, specialised in recycling. Finally, the healthcare institutions have a postal flow. This, as well, is picked up by a logistics staff member. Then it is taken away by a postal service. Uniforms/work clothing: Picked by the laundry service, cleansed and returned.

Cooperation between Hos in Belgium is still developing and rather limited, e.g. between hospitals within the same network or residential care facilities within the same organization.

Home deliveries, although still limited, are taking place for specific cases. Typical example is home dialysis, where hospital staff and equipment supplier work together.

Growth of activities is expected here, as Belgian government starts promoting HAH. (e.g. KCE-report # 250: Implementation of hospital at home: orientations for Belgium, pp93)

This process is linked to the order's management and distribution in Estonia, and implies the management and transportation of the products from the general warehouse to the different units within the hospital or outside it until they are consumed. It is focused on the optimization of the distribution of products inside the hospital and its main concern is synchronizing demand and supply, reducing delivery time and warehouses stock by revising internal transportation, distribution frequency and distribution system.

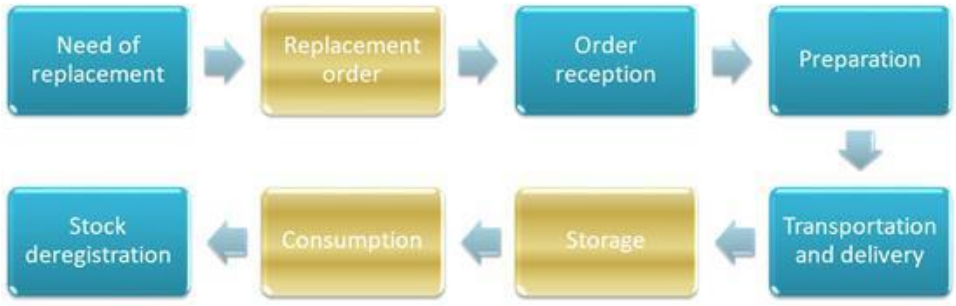


Figure 7 Order's management and distribution sub-processes by CEL Committee. Gold boxes take place in the each of the hospital stores whereas the blue ones are responsibility of general warehouses. (5)

Nurses and nursing assistants are responsible of the stock replacement in the hospital stores (storage of the materials in individual hospital departments) in almost every

hospital in Spain. They place, receive and store the orders; during this time they cannot perform their main functions related to healthcare. Furthermore, the lack of confidence in the supply process makes overstock materials and medicines that with frequency expire before they are used (14).

Once the medical supplies arrive at the central warehouse, the next step depends on whether the supplies are consumed by the majority of the units/departments of the hospital or the use/consumption is specific of some departments. If they are common-use supplies, they are classified into families (e.g. medical supply, instrumental, other) and stored at the central warehouse. There is a smaller warehouse at each area unit/healthcare centre that depends on the central one and places the orders to the general one. Usually, the nurses/nurses assistants check regularly the stock levels of those smaller warehouses and healthcare assistants usually do the restocking at night. In the past, these smaller warehouses managed differently than the central one, using a different codification. Also, there is a tendency towards holding more stock than the needed, increasing the costs and promoting the expiration of the item. Effort is being put forward in order to avoid this.

When the supplies are not of common-use, the central warehouse acts as a cross-docking area, and the goods are directly sent to the specific unit they belong, where later will be stored.

Reverse logistics worth special mention. It refers to all operations related to the flow of products and materials from their consumption point to the point of origin in order to recapture value or proper disposal (Hawks, 2006). Studies show that orders to distribute are allocated following a schedule of deliveries by departments and the return is not taken into account, preventing the optimization of reverse logistics (14). The main products that intervene in this process are defective products, which are returned to suppliers; and obsolete products or waste which is disposed of or recycled.

Figure 8 Reverse logistics subprocesses by CEL Committee (5)

In the case of drugs and some medical supplies, the process should be explained separately.

In the case of in-patients (patients admitted in the hospital and stay there for treatment until they are discharged), there are three general systems used for the distribution of drugs to in-patients (15):

1. Individual prescription order: drugs are given to the patient through a nursing station that manages the supplies for each of the individual patients.
2. Complete floor stock system: drugs are given to the patient through a nursing station that controls the drug supplies typically used on the unit.
3. Unit dose system: In the unit-dose system, drugs are received in the pharmacy prepared in mono doses. Once there, they prepare personalized unit doses for each patient (according to the medical prescription). The technological level of the system depends on the hospital size and the pharmacy budget. This is the most widespread model since it reduces errors and frees time to the nurses; however, in the units where it cannot be predicted which drugs are going to be administered to each patient at every time it cannot be used. Examples of these areas can be the UCI, the surgery room or Emergency area.

On the other hand, in the case of out-patients (those patients not occupying beds that are at the hospital for primary care purposes or a specific treatment, temporary) usually there is an out-patient department is equipped with an automated warehouse in order to distribute the drugs.

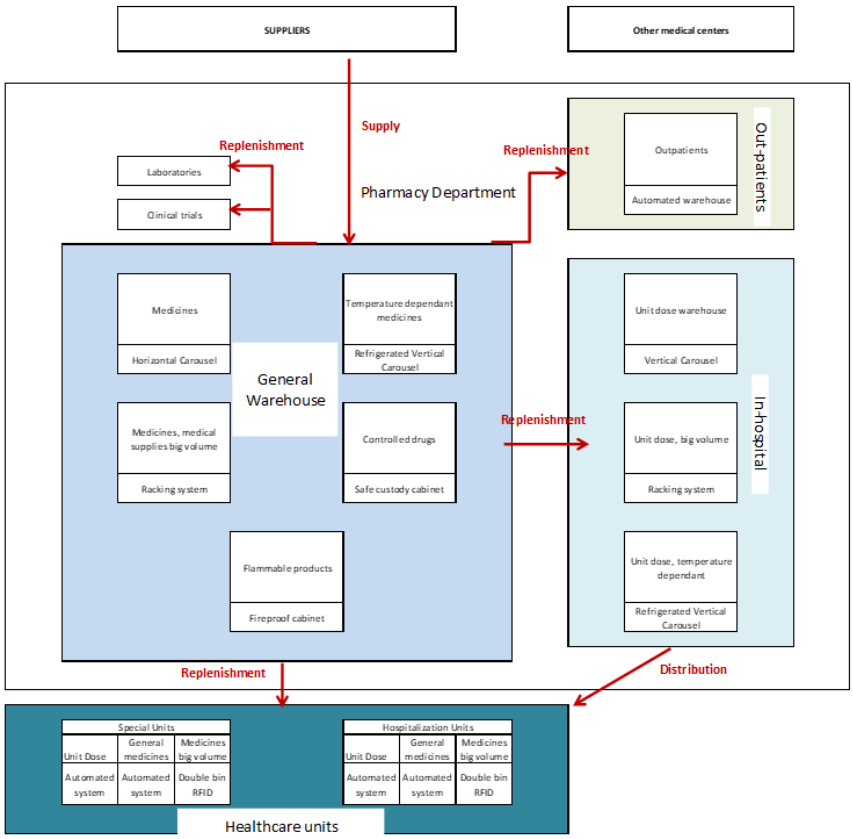


Figure 9 Drugs route inside the hospital (13)

The spaghetti diagram depicting the physical flow of medicines inside the pharmacy department is illustrated in Figure 10.

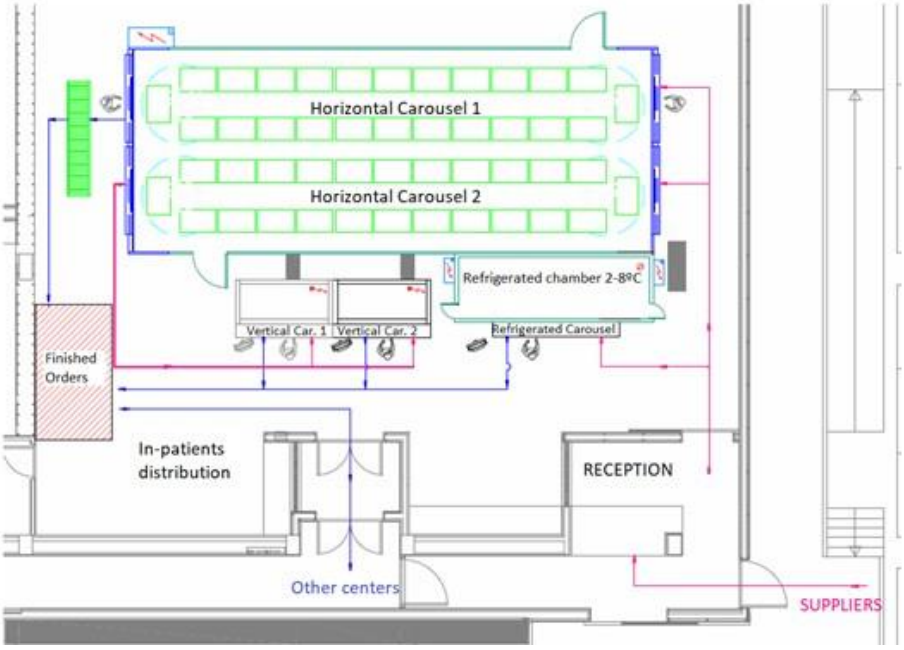


Figure 10 Flow of medicines (13)

3.4 Example on healthcare logistics in a public sector organisation

As an example of public sector in Finland we will use Päijät-Hämeen hyvinvointikuntayhtymä (later as PHHYKY). PHHYKY is owned by 12 municipalities, and serves more than 200 000 people. As PHHYKY is takes care of the public sector healthcare logistics, as well as handling the returns from external clients.

When shipments arrive to the central warehouse, warehouse staff will check the shipments and if everything is as ordered shipment will be added to warehouse inventory. PHHYKY has both internal and external clients. Internal clients are different wards in hospital, for example food and medicines transports. In both cases, schedule is very important and absolute trust is vital. Transport department or warehouse staff handle internal shipments. External clients are clients who are part of PHHYKY, but physically outside of the hospital. External clients place an order via online shop, after it will be collected from the central warehouse for delivery. Returns from external clients are normally empty trolleys and pharmaceutical waste, such as used needles.

PHHYKY has its own purchase department, who will place orders for products with low quantity in warehouse. They also have their own transport department for internal transports. Few transport companies handle transport for external clients. Though the central warehouse inside the hospital is old, and not originally meant as a warehouse, it is well organized and they have managed to make their work more efficient.

An example from Estonia**.** Background**.** Tiiu, 76 years old stumbled at home and broke her hipbone. Tiiu lives alone, her husband is dead and she has no children or grandchildren. Her other relatives are old and they mainly communicate via phone. She lives on the fifth floor in a house without elevator. After falling, she could not reach the phone and she started calling help hoping that some neighbour might hear her. Finally, neighbour called an Ambulance. The door was broken down and ambulance took Tiiu to hospital. After an operation, Tiiu stayed at hospital for fifteen days. After that the social worker arranges Tiiu´s stay in a care department, where she stayed 2,5 months. And finally she was ten days at rehabilitation centre where physiotherapists worked with her.

Meanwhile the social worker supplied her apartment with assistive devices, and e-services – emergency button and arranged home care services.

But now new problems cropped up: being independent she has problems to accept isolation. She is not used to be taken care of. This new situation caused depression and anxiety. Thanks to the social worker, Tiiu was accompanied by local volunteers.

2. Analyses. Risk factors

1. Safety risks at home were not assessed. There were carpets on the floors, cords were everywhere, and flowerpots hampered free movement. Tiiu mentioned that she has stumbled on the carpet also before, but she has not thought to remove it, because the carpet has been there for forty years.
2. Physical environment was an obstacle: the house has no elevator; she lives on the fifth floor. So, she could not go out independently, all this caused isolation. The living room was not designed for moving with assistive devices. The washing conditions were not adequate.
3. There was no procedure how to get help. Tiiu has a mobile phone, but when she fell, the phone was in another room. She has no contact person and she has not given her keys to another person.
4. Inadequate co-operation between health care and social care system: databases are not linked. The movement of the patient was not followed. There was no logical links between arranging necessary services for Tiiu: postoperative treatment, physiotherapy, home care services. There were also problems in information flow. There was a risk that the client will remain without necessary help.
5. There is no link between healthcare system and social care system to provide services.

3. Analyses. Defence factors

1. All safety risks at home are assessed. As prevention work there should have removed all carpets, furniture that hindered movement, there should have been assessed slippery floors at bathroom and checked the existence of supports. The regional care worker visits regularly the elderly people living alone and her task is to inform these people about risk factors and services available.
2. Suitable physical environment was designed. In co-operation with local municipality and Vocational rehabilitation centre Astangu Tiiu was provided

with shower instead of a bath, supports were put were necessary, and thresholds were removed. The financing came from on Project. However, the problem of her isolation still remains because she does not want to move to a more suitable flat on lower floor.

3. Emergency care security system was installed. In cooperation with Tallinn Health Care Centre there was installed an emergency button, which enables to call help immediately. Tiiu also gave extra keys to her neighbour. And additional falling detector was also installed at her flat.
4. There were problems in co-operations between different systems. The co-o peration exists but needs additional development. It is not right that the work was done due to some people's good will. The logistical activities should have been connected between two sectors. In an ideal world the family doctor could see information about his/her patient´s hospitalisation in his/her database, the social care worker could see information about her client's health status and information about necessary help.

The Virgen Macarena University Hospital in Spain is a public hospital located in the Spanish city of Seville. Its management depends on the Andalusian Health Service. The hospital gives service to a population of about 525,000 people. Its area of influence comprises 2 hospitals and 3 centres for medical specialties with a total of 955 hospital beds and 27 operating rooms.

In the period from 2005 to 2010, this hospital underwent to a process of implementing a comprehensive logistics management plan based on lean management principles and technological investments. Because of this, the current logistics operations involved are described (15).

From the logistical point of view, the hospital comprises 350 delivery points of which 65 are other warehouses (6 operating rooms, 3 centres for medical specialties, 9 medical centres and 47 area units). This example covers the non-medicine medical consumables (26% of the total budget for goods and services of the entire hospital).

Logistics platform

The old central warehouse at the hospital was replaced in 2007 by a logistics platform of a total surface of 2,800 m^2 at a distance of 14 km from the hospital facilities. The platform has a storage capacity of 2,359 pallets or 137,83 m^3. Processes can be done automatically or semi-automatically and there are a total of 1,081 different SKUs:

- 340 SKUs are stored in the picking area

- 380 SKUs are stored in pallets of different heights.
- 361 SKUs are stored into an automated vertical carousel

The platform workforce is composed of healthcare assistants belonging to the regional healthcare system (mostly civil servants).

Information System

A Logistics Information System for warehouse management (WMS) was integrated with the ERP (SAP based).

The warehouse workers are equipped with RFID readers so the stock levels can be updated on real time and human errors are minimized.

Distribution

The distribution of the supplies to the different delivery points (area units, medical care centres, …) is outsourced to a service provider (public tender).

Unit warehouses

The materials are supplied (twice per week) by the service provider to the different unit warehouses, managed under a Kanban system with two-bin method. The service provider workers, who oversee the restocking, check Kanban cards. However, in the event of an urgent service, the logistics platform is open the whole year at any time.

3.5 Example of healthcare logistics in a private sector organisation

Attendo in Finland is one of the private healthcare organizations for elderly clients. Clients hire the apartment and pays for nursing and other services. Equipment for basic needs is free of charge, except incontinence pads and some equipment for specific diseases they have (DM). All other equipment needed for nursing they need to buy. For incontinence pads and DM equipment delivery client's needs doctor's or nurses' certificate. Physical equipment they may get free from Lahti HC system, but it's recommend to buy those themselves. Nurses knowledge of diseases and symptoms that may need special equipment and the criteria of social benefits. Nurses needs to know the factories where to buy all things and be aware of the contracts of working

organization. Nurses and doctors have to have knowledge of responsibility areas of certificates.

The manager of nursing home and elderly care health centre is ordering all necessary equipment to the nursing home (all managers of nursing homes make their own orders). Producers of different hc equipment delivers the goods to nursing home once a week or in need. Practical nurses are taking care of the storage.

Incontinence pads and equipment for DM comes free of charge from free distribution of Lahti healthcare system, practical nurses are responsible for shelving to the correct places the delivery. Conclusion: there is a need for one employee to do whole circle of hc logistics.

The Accident Mutual Society of Zaragoza (MAZ), Spain, provides medical and hospital assistance to workers and self-employed workers who have suffered an accident at work or an occupational disease. This mutual society is the result of various mergers between different companies from that sector. In Spain, mutual societies are collaborating bodies of the Social Security and the management is private.

MAZ has more than 80 centres of its own and is present in all the Autonomous Cities and Communities of the country. MAZ Hospital in Zaragoza is considered one of the most qualified centres in occupational medicine in Spain. It has three hospitalization floors with a total 119 beds, with special focus on orthopaedics medicine and surgery and rehabilitation.

Procurement is made via public tender process. Besides the usual bidding conditions, such as technical specificities and cost, MAZ requires also to fulfil environmental and social criteria. Currently they manage a pool of 726 providers between sanitary (496) and non-sanitary (230).

The smaller size of this hospital compared to purely public ones, allows some flexibility in logistics processes. With a lean perspective in mind, the management body is focus on eliminating waste so that all activities/steps add value from the customer's

perspective. They shut down the general warehouse located at the hospital facilities two years ago, so the stock is stored in suppliers´ premises. Restocking is made directly to the unit warehouses by the suppliers. Also, most of unit warehouses use a Kamban system and the invoicing is made once the particular supply is consumed. In the case of surgical implants, for example, each one has a RFID tag which is read when the implant arrives to the unit warehouse and indexed into the system. Once it has been consumed after a surgery, the tag is read again and the system sends two orders, one for invoicing the item and another one for its restocking.

3.6 Future of Healthcare logistics

3.6.1 Future in Belgium

Currently there is a large difference between organizations in Belgium, some are already very well organized, others are still struggling with the basics.

Challenges: Introduction of a common logistics vocabulary for all levels of the organization - Creating awareness for logistics organization and optimization for all - Recognizing the need for logistic professionals and doing something about it.

Professionalization: own staff with support of specialized consultants and/or professional organizations. Logistics is hardly covered in education of caregivers, same for pharmacists – this makes the process of professionalization difficult.

Development of supporting models for logistic choices (cost vs service)

Being open to and ready for organizational changes, e.g. from single hospital to part of a network, growing HAH care. Technological opportunities, e.g. tracking & tracing of goods and people, real time monitoring of temperature sensitive goods, integrated software systems (ERP and beyond)

3.6.2 Future in Spain

A study based on interviews with healthcare professionals and managers (16), identified eight disruptive best practices that will change the future healthcare supply chains. They can be summarized depending on the logistics activity in which they impact as follows and complement the interviews that we have carried out with private and public sector healthcare professionals.

Provisioning:

- 3D-printing/additive manufacturing: in-house manufacturing of medical, maintenance supplies and even some types of drugs instead of buying them from a third party.
- New information exchange protocols with suppliers: Block chain for guaranteeing the traceability and security of the purchasing process.

Warehousing:

- Automatically Guided Vehicles: The AGV systems are used in material handling and transport, especially in repetitive tasks and without a driver.

Distribution:

- Chatbots: chatbots are computer programs with which it is possible to maintain conversation. This type of robots allows freeing work force in tasks such as customer service, helping to reduce costs and increasing efficiency.

Cross-cutting practices:

- Mobile devices for the treatment of information: new technologies will allow collecting information from different remote devices that can be used to analyse information and taking decisions.
- Internet of Things: use of sensors and devices for automatic capture of information in real time about inventories, movements or consumptions of materials.
- Big Data analytics for demand forecasting: tools that will allow the management of a large amount of information for analysis and identification of patterns. Among other applications, these types of techniques are used in the industry to predict the demand in order to anticipate and accommodate the supply chain.
- Automation of administrative processes, especially in repetitive tasks that vary very little in each repetition.

4 Competence needs in healthcare logistic

The basic competence needs are researched differently in every participant country and they are also inspected from different point of views. You can still though find lots

of similarities in them. In Spain basic competence needed in healthcare logistics include fundamental analytic tools, approaches, and techniques that are suitable in the design and operation of logistics systems and integrated supply chains. To accomplish this, the material should be taught from a managerial perspective. Particular emphasis is required on where and how specific tools can be used to improve the overall healthcare logistics performance while reducing the total logistics costs. In this sense, we should focus on the development of competences required to understand and use of fundamental models to demonstrate the underlying concepts involved in both inter- and intra-company operations.

Three areas that require competence development include:

1. Demand forecasting, planning, and management
2. Procurement, sourcing, and auctions
3. Inventory planning, management, and control
4. Transportation planning, management, and operations
5. Supply contracts and collaboration
6. Service Operations Management

Additionally, we believe that other topics need to be incorporated in competence development. These topics include:

1. Innovation in planning and control Management: RFIDs, data analytics, and sensors
2. Vehicle routing, scheduling, and fleet dispatching,
3. Supply chain network design
4. Management and minimization of supply chain uncertainty
5. The growing trend to take care of clients at home
6. The design of a patient process delivered by hybrid care. In such networks new processes are developed. Care and treatment institutions work together, delivering better and cheaper healthcare.
7. Further digitisation of the patient/client information.

Table 6 describes operational task and supervisory management based competence needs in Finland that have been identified in participant countries when developing healthcare logistician further education.

Operational task-based competencies	● can plan, realize, follow up and develop warehouse operations ● is familiar with duties connected to goods collection process ● is familiar with duties and systems involved in storage control ● is familiar with duties connected to handling of dangerous goods and chemicals ● knows how to fight infections based on laws, regulations and quality system ● is familiar with lean thinking
Supervisory management -based competencies	● can plan, guide, evaluate and develop operations and economy in own area of responsibility ● can plan, direct, evaluate and develop subordinates' work and competence ● can maintain and enhance customer and stakeholder relations ● can guide an initiate other to tasks of HL and take care of the work of guidance ● can plan and develop healthcare logistics, work of HL and understand the importance of the role of HL as a part of nursing process ● is familiar with applicable laws, regulations and guidelines

Interpersonal and personal skills	● working with different kinds of people ● handling work-related documentation ● taking care of well-being ● knowledge of languages and IT-systems ● customer-oriented way of working ● team working ● learning capabilities ● etc.

Table 6. Identified competence needs in different levels of healthcare logistic tasks.

5. Conclusions

Throughout this study, we have found areas of similarity and difference, the similarities help us to see that we are developing in the right direction and that in these areas we should continue to integrate them into our education curriculum. Especially in the areas of nursing, pharmaceuticals and logistics training, in all levels.

The differences allow us to evaluate the need to implement new methodology and practice into our way of working. This means that some of these ideas should be developed and piloted in our system. Until this is done, we cannot conclude whether this benefits and applies to all countries and all education levels.

References

Eskelinen, M. (2006) Tukipalveluiden kehittäminen. Case Töölön traumasairaala. TEKES-seminaari. 13.12.2006. Available at https://docs.google.com/viewer?a=v&q=cache:q21R0ZflKgAJ:www.hus.fi/default.asp%3Fpath%3D1,28,824,13120,15112,15558,15560+&hl=fi&gl=fi&pid=bl&srcid=ADGEEShpxd_rB_w50LTlI0kY7vEPXpvIWb8upwe-G5cw9sD5sPUHOGnhYSwr81g_qx0u-pg7OHDO4p3qyJlfWycG5RcbfQ7JoSUf1j6NnQgPkO59whSq_ggnBLAOD0g31GnfS30831Db&sig=AHIEtbQrT6UMtwh_D55EwZdcqvod3zIhHw. Read 20.3.2013.

CBS. (2017, December 15). *Nabijheid voorzieningen*. Retrieved from CBS Statline: http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=80305NED&D1=0-3,6,10&D2=0,101-104,106-115,117-143,146-156,158-238,240,242-250,252-259,261-278,280-290,292-320,322-334,336-378,380-385,387-429,431-469,471-475,477-521,523-538,540-563&D3=l&HDR=T&STB=G1,G2&VW=T

Central government . (2018). *Kwaliteit van de zorg*. Retrieved from Rijkscentral government : https://www.rijkscentral government .nl/onderwerpen/kwaliteit-van-de-zorg/kiezen-in-de-zorg

The Commonwealth Fund. (2010). *Health Policy Survey in 11 Countries. New York.* Retrieved from http://www.commonwealthfund.org/~/media/files/publications/chartbook/2010/pdf_2010_ihp_survey_chartpack_full_12022010.pdf: http://www.commonwealthfund.org/~/media/files/publications/chartbook/2010/pdf_2010_ihp_survey_chartpack_full_12022010.pdf

Finnish Government (2015) Finland, a land of solutions. Strategic Programme of Prime Minister Juha Sipilä's Government. Available: http://valtioneuvosto.fi/documents/10184/1427398/Ratkaisujen+Suomi_EN_YHDISTETTY_netti.pdf/8d2e1a66-e24a-4073-8303-ee3127fbfcac/Ratkaisujen+Suomi_EN_YHDISTETTY_netti.pdf.pdf. Read 15.4.2018.

Finnish National Agency for Education (2018) Liikenne- ja logistiikka-alan osaamis- ja koulutustarpeiden kehitysnäkymiä. Valtakunnallinen aikuiskoulutuksen ennakointi -projektin Dynamo-mallin valtakunnallinen ja alueellinen pilotointi. Reports of the Finnish National Agency for Education 2018:15. Available: http://oph.fi/download/189799_liikenne_ja_logistiikka-alan_osaamis_ja_koulutustarpeiden_kehitysnakymia.pdf. Read 16.4.2018.

Fraunhofer IML. (2013) Hospital logistics. Available: http://www.iml.fraunhofer.de/en/fields_of_activity/health_care_logistics_en/hospital_logistics.html. Read 21.3.2013.

Government reform package (2018a) Emergency services and specialised medical care structure reform. Available: http://alueuudistus.fi/en/emergency-services-and-specialised-medical-care. Read 15.4.2018.

Government reform package. (2018b) Financing. Available: http://alueuudistus.fi/en/government-policy-outlines. Read 15.4.2018.

Government reform package. (2018c) General description of the reform package. Available: http://alueuudistus.fi/en/general-information-reform. Read 15.4.2018.

Government reform package (2018d) Health and social services. Available: http://alueuudistus.fi/en/services-and-freedom-of-choice/language-rights. Read 15.4.2018.

Government reform package (2018e) Health and social services centre. Available: http://alueuudistus.fi/en/health-and-social-services-centres. Read 15.4.2018.

Government reform package (2018f) Providers of health and social services. Available: http://alueuudistus.fi/en/service-providers. Read 15.4.2018.

Government reform package (2018g) Reform of regional government. Available: http://alueuudistus.fi/en/reform-of-regional-administration. Read 15.4.2018.

Graban, M. (2008) Lean Hospitals Improving Quality, Patient Safety, and Employee Satisfaction. CRC Press.

Keskiväli, E. (2007) The logistics of an operation unit, Case The Central operation unit of Päijät-Hämeen sosiaali- ja terveysyhtymä. Bachelor's Thesis in Financial Management and Healthcare, Lahti University of Applied Sciences.

Kotonen, U., Tuominen, U. & Maksimainen, A-N .(2015) Experiences from healthcare logistician education. Paper presented at the 9th International Technology, Education and Development Conference (INTED2015), Madrid, Spain, 2 - 4 March, 2015.

Kotonen, U., Tuominen, U. & Kuusisto, M. (2013) Healthcare Logistician: A New Profession Needs a New Education. Paper presented at the International Conference, The Future of Education, Florence, Italy, 13 – 14 June, 2013

Lillrank, P. &Haukkapää-Haara, P. 2006. Terveydenhuollon tilaaja-tuottaja-malli. Available:http://ktm.elinar.fi/ktm_jur/ktmjur.nsf/all/F26FF8E12B71CEA9C2257100003540CA. Read 21.3.2013.

Lottermans, J. (2017). *Afstudeeronderzoek UMCG.* Groningen: Student bureau UMC Groningen.

Ludema, M. (2012). *Logistiek Darwinisme.* Rotterdam: Rotterdam University Press.
Moeke, D., & Verkooijen, L. (2013). *Journal of Social intervention: Theory and Practice*, Volume 22, Issue 2.

Lääkäripalveluyritykset ry (2018a) Toimialat. Available: http://www.lpy.fi/lpy_yksityinen_terveydenhuolto/lpy_toimialat. Read 15.4.2018.

Lääkäripalveluyritykset ry (2018b) Yksityinen terveydenhuolto. Available: http://www.lpy.fi/lpy_yksityinen_terveydenhuolto. Read 15.4.2018.

Ministry of Finance & Ministry of Social Affairs and Health (2016) Healthcare and social welfare reform package in Finland. General information 14 April 2016. Available: https://www.slideshare.net/stmslide/social-welfare-and-healthcare-reform-1842016. Read 16.4.2018.

Ministry of Social Affairs and Health (2010) Socially sustainable Finland 2020. Strategy for social and health policy. Available: http://urn.fi/URN:ISBN:978-952-00-3136-7 . Read 15.4.2018.

Ministry of Social Affairs and Health (2013) Health Care in Finland. Brochures of the Ministry of Social Affairs and Health 2eng. Available:

http://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/69930/URN_ISBN_978-952-00-3395-8.pdf?sequence=1&isAllowed=y. Read 15.4.2018.

Ministry of Social Affairs and Health (2016a) Health, social services and regional government reform: Equal and cost-effective services for all. Fact sheet 9/2016. Available: http://alueuudistus.fi/documents/1477425/1892966/Fact+sheet+Health+social+services+and+regional+government+reform++9_2016.pdf/0d3751dd-91bc-415c-bad5-de54be1fa87a/Fact+sheet+Health+social+services+and+regional+government+reform++9_2016.pdf.pdf. Read: 14.3.2018.

Ministry of Social Affairs and Health (2016b) Occupational Safety and Health in Finland. Available: http://stm.fi/documents/1271139/1332445/STM_esite_Tyosuojelu_suomessa_verkkoonUK.pdf/a2bd9c8c-6de8-43c7-8516-c149840498e1/STM_esite_Tyosuojelu_suomessa_verkkoonUK.pdf.pdf. Read 15.4.2018.

Ministry of Social Affairs and Health (2018a) Administrative branch. Available: http://stm.fi/en/administrative-branch. Read 15.4.2018.

Ministry of Social Affairs and Health (2018b) Health services. Available: http://stm.fi/en/health-services. Read 15.4.2018.

Ministry of Social Affairs and Health (2018c) Hospitals and specialised medical careAvailable: http://stm.fi/en/hospitals-and-specialised-medical-care. Read 15.4.2018.

Ministry of Social Affairs and Health (2018d) Occupational health care. Available: http://stm.fi/en/occupational-health-care.

Ministry of Social Affairs and Health (2018e) Primary health care. Available: http://stm.fi/en/primary-health-care. Read 15.4.2018.

Ministry of Social Affairs and Health (2018f) Social and health care client fees. Available: http://stm.fi/en/client-fees. Read 15.4.2018.

Ministry of Social Affairs and Health (2018g) Social welfare and health care system in Finland, responsibilities. Available:http://stm.fi/en/social-and-health-services/responsible-agencies. Read 15.4.2018.

Ministry of Social Affairs and Health (2018g) Strategy for Social and Health Policy. Available:_____http://stm.fi/en/article/-/asset_publisher/strategy-for-social-and-health-policy. Read 15.4.2018.

Oomen, V. (2016). *Losses of disposables in the Dutch health care system .* Delft: TU Delft (thesis report).

Pintelon, L. (2011). Healthcare logistics.
RICHARD WESTERMAN, F. D.-H. (2009). *GOEDERENLOGISTIEK IN DE ZORG.*

Schlanser, M.R. (2013) Optimization of Surgical Supply Inventory and Kitting. Master's thesis, Massachusetts Institute of Technology (MIT).

Suomen Palvelutekijat Oy (2013) Hoitologistikko-projektin loppuraportti. Available: https://asiakas.kotisivukone.com/files/hoitologistikkofi.kotisivukone.com/hoitologistikko_hoitotyon_tuottavuuden_nostajana.pdf. Read 10.4.2018

Tuominen, U., Kuusisto, M. & Hautamäki, J. (2017) Hyvinvointilogistiikan tulevaisuus. In: Hautamäki J. (Ed). (2017). LAMK aluevaikuttajana 2017. Publications of Lahti University of Applied Sciences 32, Available: http://www.theseus.fi/bitstream/handle/10024/139204/LAMK_2017_32.pdf?sequence=1&isAllowed=y. Read 16.4.2018.

Tuominen U, Serkola A. & Suomi R. (2014) Demand-driven material and resource logistics in surgery operations. Unpublished

Valtioneuvosto (2016) Government policy on healthcare, social welfare and regional government, issued 5.4.2016. Slide presentation. Available: http://valtioneuvosto.fi/documents/10616/2287640/Government+policy+outlines+on+reform+package+5.4.2016/87925207-7fc7-4091-9b37-824cd78157e9/Government+policy+outlines+on+reform+package+5.4.2016.pdf. Read 16.3.2018.

Valvira. (2018) Healthcare. Available: http://www.valvira.fi/web/en/healthcare. Read 15.4.2018.

Volkshealthcare. (2018). *Ziekenhuiszorg regionaal en internationaal*. Opgehaald van

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