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Chapter

Operations Knowledge Management in Health Care

Ann Svensson and Eva Hedman

Abstract

The aging population of the western world poses a medical challenge for the society of today and the future. The pressure on health care and its organization is increasing as the demand for health care is growing at the same time as the costs are continuously rising. There seems to be consensus regarding bottlenecks in health-care production systems, and that knowledge is needed in order to increase insights about operational decisions. This chapter is based on a qualitative case study conducted at a hospital in western Sweden. Eleven CEOs together with their production controllers were interviewed. The chapter aims to analyze knowledge management mechanisms in the infrastructure of a health-care organization. The analysis shows how mechanisms have significant impacts on the knowledge management practice in the operations management. A learning and knowledge creation culture, together with an organizational architecture for adaptive and exaptive capacity, and a business model for knowledge capitalization could support the production of smooth and effective health care in society, which is of high quality.

Keywords: health care, knowledge management, operations management, capacity planning, health-care sector, hospital

1. Introduction

Management of health care has received attention over some years [1], and the interest in this topic has increased during the last years, both in practice and in the literature. The COVID-19 pandemic, especially, has brought immediate focus to the capacity of resources in health care and its processes that are required to provide efficient and effective health care. The aging population of the western world also poses a medical challenge for the society of today and the future [2, 3]. The pressure on health care and its organization is increasing as the demand for health care is growing at the same time as the costs are continuously rising [4]. In hospitals, which is the focus of this study, health-care professionals aim to provide health care of high quality using the limited resources available, even though community-based services could be involved in the provision of health care for the inhabitants in a society. As such, a hospital can be described as a "network of service units with finite capacity through which patients are flowing" [5].

Operations management (OM) refers to the planning and control of processes that transform inputs into outputs. The term also applies to management of health care where patients who have requested health care are diagnosed, referred to a further service, or cured [6]. Resources at the hospital have to be managed to transform inputs to outputs. It is challenging to manage the health-care processes in

order to ensure an effective health care that uses the available resources efficiently [7]. Moreover, it is challenging to balance resources with fluctuating and uncertain demand as in health care [8]. There seems to be a consensus regarding bottlenecks in health-care production systems, and that knowledge is needed in order to increase insights about operational decisions [8]. There are, however, flaws in the understanding and management of the variations in demand and capacity [9]. Some studies claim that problems exist due to poor demand and capacity management practices [10, 11]. Even though the planning and management of health care has gained more interest during the last 20 years, both within research and practice, very few concrete steps have been take in order to improve the OM in health-care practice [1]. Appropriate knowledge about accessibility, demand, and capacity variations could improve patient processes [12] as well as planning and modeling processes [13]. Knowledge management (KM) in the health-care sector is intended to support the operation of planning, performance, and control of health care. Health-care systems need to be designed to achieve smooth flow of patients so that timely and appropriate care can be provided [14].

Massaro et al. have identified a research gap regarding KM in the public sector [15], even though organizational and managerial knowledge processes in health care have been increasingly studied during the past 20 years [16, 17]. Fugate et al. [18] claim that effective communication and KM play key roles in OM and the improvement thereof. However, most of this literature has not affected the development and organizational goals in the health-care sector, even though health-care organizations have adopted KM strategies to a certain extent [16]. The main success factors that influence the implementation of KM in the health-care sector are considered to be the infrastructure capability (such as information technology, organizational culture, and organizational structure) as well as the performance evaluation and measurement [16]. Developing an appropriate KM infrastructure is considered crucial for the improvement of quality in the health-care sector [19]. Few studies have, to this date, explicitly addressed the specific mechanisms in the KM practice systems in the health-care sector that are related to the infrastructure at the organizational level. Therefore, this chapter contributes with a qualitative analysis of the KM mechanisms in the infrastructure of a health-care organization. The analysis shows how mechanisms have significant impacts on the KM practice in the OM.

The remainder of this chapter is structured as follows: Section 2 provides a literature review of the OM and KM in the health-care sector. Section 3 provides the empirical setting and describes the methods used for data collection and data analysis. Section 4 presents the results of the study, which are discussed in Section 5. Section 6 concludes the chapter, together with the suggestions of a few topics for future research.

2. Literature review

2.1 Operations management in health-care organizations

OM is an interdisciplinary field that often uses mathematical modeling, analytic methods, and statistics to create production and capacity plans for controlling and improving an organization's ability to reinforce rational and meaningful management decisions at all levels [7]. Historically, these models and methods have mainly been used in the manufacturing industry. Recently, however, such models and methods have begun to be widely applied in the public sector as well, not least in the health-care sector. Production and capacity planning processes involve

communication and coordination of information between hierarchical and horizontal levels. Planning and control involve deciding in advance which activities to do, how to do the activities, who should do what, when activities should be done, and what capacities are needed. A variety of decisions related to the hospital health care have to be made based on medical resource and financial aspects [20]. Decision-making in production and capacity planning requires coordination and management of information and knowledge at different hierarchical levels and in different time frames. Thus, management of information and knowledge is also needed between various health-care services within a hospital, as well as between other health-care providers, at a horizontal level. Capability of KM adds value to operations performance and in effective use of knowledge through acquiring, sharing, and applying knowledge across various health-care services [21].

Within a health-care organization, there is need to balance the available capacity of various resources. The resources also need to be coordinated to manage different types of medical activities and treatments. Departments are also sharing resources, and the demand and availability is fluctuating and uncertain [8]. The resources and the available capacities need to be managed in order to match the demands. The goal is to deliver health care of high quality, using the limited resources available. Designing and organizing health-care processes implicates planning and controlling activities. The process of designing and organizing in turn also implies setting goals for the activities and planning and controlling the operations. Planning requires information and knowledge at different organizational levels. Planning and management in health care can, for example, refer to the planning of operating rooms, the need for nurses and scheduling patients [22]. Dexter [23], among others, has for example studied planning and scheduling of operating rooms. The management and planning of health care thus comprise dimensioning, planning, scheduling, monitoring, and controlling resources [7]. However, there is an apparent gap between the demand and the available capacities [8, 10, 24].

The efficiency of health-care processes is a result of planning and management at different managerial levels. Developing effective plans for using resources and capacities requires understanding and knowledge of the dynamics in the hospital system and the flow of patients through it [8]. The quality of decision-making in each department depends on the information available for planning and decision-making, also, in relation to other departments in the hospital system. Managers and professionals who are planning and making decisions need to have knowledge about many different aspects within the organization, even beyond departmental borders. Sub-optimization is also a threat against effective planning and management, as decisions are made within different departments. Hulshof et al. [7] found that higher efficiency can be achieved if decisions are made from a more integrated perspective. The integrated planning and management of health care also faces challenges as different departments can have different goals, and conflicts can exist between different goals. Complex relationships between decisions within different departments exist, and this complexity has been identified as the most significant hindrance to effective OM. Hulshof et al. [7] claim that models are still missing for the management of health-care processes, for example flows of patient between different departments. Therefore, models for OM and KM need to be created [22, 25], also for the infrastructure that should be the basis for the processes [16].

2.2 Knowledge management in health-care organizations

Knowledge-intensive and professional organizations as hospitals are complex in their nature and require attention to aspects relating to their complex dynamics [26, 27]. Traditional management and leadership models are no longer entirely

suitable for such knowledge-intensive organizations as health-care organizations [28]. In order to effectively create sustainable operations performance in health care, developments in knowledge capability is important [18, 21]. KM adds value to operations performance in organizations concerning cost, quality, flexibility, and delivery. Thus, knowledge is a strategically significant resource. KM can be viewed from two perspectives: process and infrastructure [21, 29, 30]. The process perspective reflects the capability in an organization, but the process is based and dependent on the infrastructure. The infrastructure perspective defines the technology, structure, culture, and mechanisms that enable the configuration of resources and operational routines in the organizational processes [21].

Technology has made it easier to transmit information in organizations, and is an important part of the infrastructure [18]. Many sophisticated information systems are used within health care, and they have a tremendous impact on the complex organizational context. Information systems also include different structures of their own. Information systems thus create structures for how people perform their work, and how they interact with the systems [20, 31]. By understanding the complex relationships between the health-care organization and the information systems that are used, it is possible to get a better understanding of how information systems can support OM and KM [32]. However, effective communication and a shared interpretation of the knowledge are critical for the performance of a health-care organization.

Three mechanisms for KM practice systems have been identified by Loon [33]; (1) learning and knowledge creation culture; (2) organizational architecture for adaptive and exaptive capacity; and (3) "business model" for knowledge capitalization and value capture. *Learning and knowledge creation culture* is based on culture theories, in which learning is seen as a set of values among a group of professionals, which underpin their behavior in creating knowledge. Those values are shaped by organizational structures. This mechanism influences the importance placed on formal and informal learning in the organization, and includes reward schemes, coaching programs and other formalized KM-specific roles and operations that strengthen the learning and knowledge creation culture. The *organizational knowledge architecture for adaptive and exaptive capacity* consists of the design of organizational systems, technologies, practices, skills, and behaviors, that for example facilitate sharing of knowledge. This mechanism shapes the orientation of technology use, to primarily codify knowledge or to use technologies to connect people to exchange tacit knowledge. Appropriate and relevant structures, technologies, and processes have to be developed to allow knowledge to be stored, transformed, and exapted to facilitate the performance of the organization. The *business model for knowledge capitalization and value capture* describes how an organization benefits from its KM practice system. This mechanism is directing how new knowledge is embedded in the organization's value proposition, as the organization has to be aware of how newly created knowledge will be characterized as useful and appropriate for its outcomes and defined goals.

3. Research method

3.1 Empirical setting

This study was conducted at a hospital in the western part of Sweden. The health care produced at this hospital consists of both acute and planned health-care services, divided in three different medical areas, each of which is further subdivided into smaller units; 17 in total. Acute and planned health care respectively, call for

different planning methods. The patients' paths through the different health-care departments of the hospital is also planned and controlled, regardless of whether the health care is of an acute or planned character. The possibility for booking each patient is set by the detailed planning in each health-care department. To achieve a patient path that is as smooth and effective as possible, coordination of plans between different departments is often needed.

The mission, orders, and economical frames of Swedish hospitals are decided by the political governance. A document called "the health-care agreement" prescribes the overall assignments for the hospitals. This framework has to be transformed into terms that are useful for the planning and control processes within the hospitals, and communicated to the hospitals [20]. The admission of patients is also an important aspect that determines the need for resources and capacity. Moreover, there are databases of waiting lists with different patient groups, and different economical efforts at regional and national levels that affect the production of health care at the hospitals. Other regional health-care organizations, as well as the home health care conducted in the municipalities, also affect the production of health care at the hospitals.

At the studied hospital, the planning and control process generates forecasts, production plans, capacity plans, etc. The forecasts and plans aim to balance the needs for care within the frames given by the political governance. The different plans are then broken down through the organization, into more details regarding time horizons, care services, and resources at each department and service unit [20].

The processes of creating production plans differ to some extent between different levels in the organization. The collection of data and the elaboration of plans are performed by staff members with different positions in the organization. At the operations level, nurses often collect the data, create the plans, and book the patients. At the clinical department level, the manager and the production controller create the production plans. The plans cover one financial year and are adopted at the clinics board meetings once per year. At the hospital level, the production controllers from the different hospital departments together with the hospital's chief economic controller are responsible for creating the plans. The plans are adopted at the hospital board meeting once per year. The follow-up is normally done routinely each month, both at the levels of departments and hospital. Different actions are then taken when there are deviations from the defined production plans.

3.2 Data collection

A qualitative approach was used in this case study [34, 35]. The qualitative case study approach is a strategy often used in studies of the use of information systems and KM within organizations [36, 37]. The case study produces context-dependent knowledge and experience without any attempt to make generalizations based on the collected data [38]. The study focuses on the planning and control of the production and capacity within the hospital health care as the case. Since the study focuses on a specific work practice, it is of great importance to use a methodological strategy that is adapted for research of the applied nature of the empirical setting [39]. The approach was to interpret the social phenomena in order to show what is socially constructed by the health professionals in their natural work practice.

Data were collected through qualitative interviews that focused on views and experiences expressed by people [37]. What types of managerial actions were performed within planning and control of hospital health care and how the work was conducted were of interest in this study. The data collection focused on

acquiring a deep insight into the planning and control of production and capacity of the health care provided at the hospital. A semi-structured interview guide was constructed based on a literature review of OM as well as the knowledge and experience that one of the authors has gained from her ordinary work practice of OM at the hospital.

Eleven interviews were held with 11 chief executive officers (CEOs) and their respective production controllers. The interviews lasted for about 2 hours each. Each CEO is responsible for one health-care service unit at the hospital, and they all collaborate with a production controller. Each production controller works at about four to five different health-care service units, and each health-care service unit consists of several departments. The 11 CEOs were chosen from units that need to cooperate with other units in some way. In total, six more CEOs work at the hospital, but their activities are less extensive, and a few have no direct contact with patients. By collecting data through interviews, it was possible to maximize the exploration of different perspectives and activities within the planning and control of production and capacity. The interviews were used as the primary data source. In addition, internal documents used in the planning and control of production and capacity were requested and used as a secondary data source. Both authors conducted all the interviews, which were tape-recorded and afterwards transcribed verbatim.

3.3 Data analysis

Thematic analysis was used for the qualitative analysis of the collected data [40]. This method was used to interpret the various aspects of KM mechanisms in the infrastructure of the health-care organization and its OM. By using a deductive thematic analysis, different codes were found in the empirically collected data. Then, a detailed analysis of the specific data that mapped to the aim of the study was conducted. Since the analysis focused on the specific theoretical aspects of the collected data, there is a clear connection between the analysis method and the theoretical perspective [39]. The aim was to analyze the collected data in depth as the data contain meanings that the respondents expressed as their experiences of the work practice rather than measure data quantitatively.

The coding process aimed to fit the theoretical preconception of the study. As such, the coding was theory driven, as we searched in the transcripts for codes within the predefined theory-based themes. The analysis resulted in codes at both a semantic and a latent level. Codes were identified both in the explicit meanings of the data and in the underlying ideas and assumptions. The latent codes are thus based on interpretations of the data during the analysis [40]. The analysis was inspired by a constructionist perspective since it was assumed that meanings and experiences are socially constructed within the context.

Based on the aim of the study, three different KM mechanisms were analyzed in the collected data: (1) learning and knowledge creation culture, (2) organizational architecture for adaptive and exaptive capacity, and (3) "business model" for knowledge capitalization and value capture.

4. Results

The health care provided at the hospital is based on needs, forecasts, and the division of resources between the departments. The operations at each of the three areas at the hospital affect each other. Different activities, together with the culture and infrastructure, affect the outcomes of the OM, and knowledge is thus managed
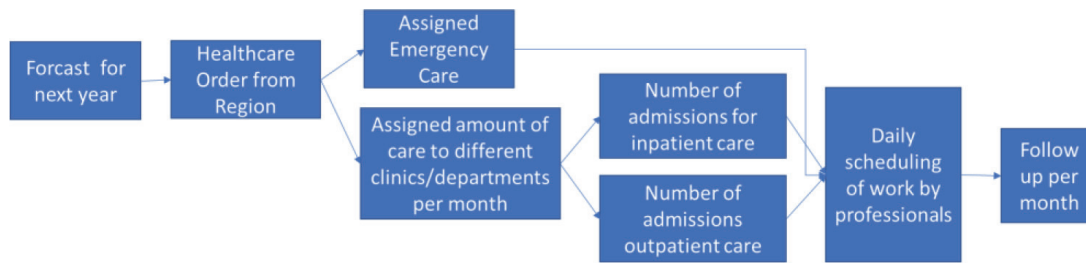
Figure 1.
Schematic view of OM for health-care planning at the hospital.

in different ways. **Figure 1** shows the OM planning process where knowledge mechanisms have to be in place for a smooth work.

4.1 Learning and knowledge creation culture

Middle managers would like to have data about the performance in real time, in order to be able to take appropriate actions if the situation starts to be worse, instead of saying the following day that: "oh well, now this was damn crazy yesterday". It should be possible to follow up and document lead times at the triage work, if it is going up and down. This is now just recognized based on experience of the staff. Thus, there is a prevalent culture where the staff adapts to changes in the admission of patients. Moreover, knowledge of how to match the schedule to the needs is important and it makes the planning much smoother. Knowledge and experience of where there are shortcomings and what needs to be changed in the planning saves a lot of resources. However, professionals need a lot of education to acquire such knowledge. The departments also have whiteboards for planning and following up on the daily management. The resource utilization can also be reassessed if anyone anticipates changes in the workload. Moreover, oral analyses are made at the departments on a daily basis. These analyses focus on what worked and what did not work, deviations and so on, and aim at learning and creating knowledge for the future operations and capacity planning at the department. These oral analyses are however not documented and deeper analyses are sometimes needed. Moreover, the results from the previous day are sometimes more or less obvious. There is a desire at the hospital to work with, and follow up, based on real-time data, instead of using data from the day before, in order to learn and create more appropriate knowledge, and be able to put in efforts a little earlier. A suggestion is to have a visual and real-time based monitor that shows the inflow, the operations, and outflow of the hospital as support for the daily planning.

Since the operations at the emergency department cannot be planned in advance, resources are allocated based on historical numbers of patients. It is somewhat unclear how many patients the emergency department can handle, as there is no defined assignment. The professionals work toward a goal of shortening the waiting times at the emergency department based on requirements from the regional level. Forecasts are dependent on whether someone discovers changed patterns in an ad hoc basis. It is difficult to compare outcomes since there have been so many changes at the hospital during the last years.

A certain number of operating rooms with staff and other resources must be available at the hospital. The planning of resources is not directly related to which operating activities will be conducted in these operating rooms. Instead, the operating rooms with staff and other resources are prepared for immediate use. The number of prepared operating rooms is measured in retrospect, based on how much the operating rooms were actually used at a specific time, or a specific day. The

managers have discussed whether they could do as much in 10 rooms as they do in 12 rooms, so it is not only a matter of the number of rooms. The dimensioning of capacity is thus not only based on knowledge about needs: traditions are also crucial. Different doctors or departments are, for example, used to be in one specific operating room, and may not want another doctor or department to use it. There are huge discussions about how the scheduling of the operating rooms should be arranged, and how the availability and the use of the operating rooms can become more effective. There are some ideas about how to solve this situation. As doctors often have other things planned at the same time, and the time is not clearly set aside for the operation, the schedules for doctors could be more strict. Learning how to manage the required resources has to improve.

Even though collaboration and knowledge sharing with other health-care organizations is highly prioritized, as it contributes to decreasing the emergent inflow of patients, the extent of collaboration and knowledge sharing within and between departments largely depends on staff availability. A coordinator at each department is responsible for having daily meetings with other coordinators, in order to gather knowledge from the doctors and distribute knowledge to the departments about what is going on at the moment, and what inflow and outflow of patients to expect during the day.

There is a test package for each group of disease, such as X-ray, blood tests and other screening activities. These tests need to be taken from each patient and analyzed. However, there is no follow-up if those standardized test packages are needed every time. Thus, the knowledge about the effectiveness of such test packages is not acquired at the hospital. This is one example of an area for improvements in the learning and knowledge creation culture, where the health-care OM could be more appropriate.

The learning and knowledge creation culture does not seem so formally structured in the organizational culture at the hospital. Planned activities that support learning and knowledge creation, especially activities that could contribute to improving the performance of the organization, do not seem to exist. KM practices do not seem to be an implicit assumption that guides how the professionals act. The interviewees did not discuss any specific or formalized KM-specific roles or operations which suggest that any formal KM initiatives exist. Yet, there are different informal learning and knowledge creation activities going on. Therefore, the learning and knowledge creation culture is not at all missing at this hospital.

4.2 Organizational architecture for adaptive and exaptive capacity

Three different IT systems are used for forecasting, planning, and follow-ups, however, they are used in different ways at different departments. The emergency department uses one more IT system that makes it possible to compare numbers in all the regional emergency departments, also at other hospitals. One IT system together with Excel sheets are used for scheduling the staff. Since the IT system alone does not give a clear picture of the schedule in order to plan, Excel sheets are also used. Information about activities conducted in relation to the patients is registered in another IT system. Some information is also registered in the patients' medical record system. These IT systems are not integrated and do not have all the functions that are actually needed. Since the staff must always be reminded of manual routines, the statistics cannot always be trusted. The data quality thus partly depends on how well the professionals remind each other to register information. For example, doctors have to manually register when meeting a patient in a planned visit and for how long time. This system also makes it difficult to detect deviations in the reported information and what has happened in reality.

The production of health care at the hospital depends on how the professionals are scheduled to work, as patients have planned visits to a specific department or visit the emergency department. This is a way of production, capacity planning, and dimensioning that is based on old traditions. Different amount of time is devoted to scheduling the staff, depending on how experienced the planning staff is in identifying shortcomings. The staff should have knowledge to schedule their own work, but sometimes a manager has to decide. Based on experience, the number of patients, and how their medical needs have to be followed up, the situation is monitored based on what is working and what is not working at each department. Managers want to follow up the daily work in order to analyze the performance, but this is only done occasionally based on knowledge about a normal situation. Since there are no routines for documenting the work performance, analyses and follow-ups are not documented.

Forecasts are reviewed once per year. The health-care agreement specifies a number of admissions; a number which is independent of the number of average admission days. The number of admissions is monitored and communicated to the decision makers. The use of resources cannot be estimates based on the specified number of admissions, since admissions can last from 1 day to a few months. This situation puts pressure on physicians to discharge patients before they are fully investigated. Activities related to patients with planned visits to specific departments need to be considered and planned to ensure a smooth workflow with appropriate capacity each day.

Readmissions do not take into account on what medical basis the patient was previously admitted, and there are no regulations of how readmissions are defined at or between hospitals. The health-care professionals have to use their own knowledge and experience in order to share knowledge about the medical status of the patient, and if the patient seems to be readmitted, or admitted for the first time. There are also daily meetings about the current situation among all the departments. Each discharge of a patient needs to be planned right from the time of the admission. Since many patients are frail elderly who need interventions from the municipality health care and the primary health care at home, other health-care providers need to be involved in planning the discharge.

The departments within each area have one daily meeting where the managers and coordinators meet for their common planning. It is important to exchange information about the discharge of patients, in order to reach the goals for the outflow. Both the common inflow and the common outflow are important to monitor within each area. Especially, the flow of patients at a medical elderly health-care department is important. At the same time, as a patient is admitted, the staff has to plan the discharge of the patient, and therefore it is important to quickly estimate the number of admission days for the patient. The coordinators also have contact with the physicians in order to allocate the patients between the different departments depending on their medical needs. Whether the patient is still admitted at a department related to the medical needs is also followed up after 1 day. Knowledge about the patients, their medical status, and number of admission days, is continuously shared. Knowledge about the status of the patients is also shared with nurses and other professionals in the municipalities where the patients live in order to plan for supporting them in their homes after discharge.

Improvement work, for example, regarding more effective working methods, is primarily initiated by department managers. Ideas often come from the staff. The ideas that come directly from the professionals are often the best ideas. A lot of brainstorming takes place at department meetings, and there are well-established routines and professional skills for how to transform the organization and achieve knowledge diffusion.

4.3 Business model for knowledge capitalization

The middle managers normally follow up on the statistics on a monthly basis. This could, however, in some situations be changed. Especially, if changes have been made, follow-ups could be done more often. The departments follow up on both a daily and a weekly basis, especially the number of discharges. Three different IT systems are used to follow up. In the case of warnings, or if the staff recognizes bottlenecks, analyses of what is happening and follow-ups will be conducted. Of course, all follow-ups result in some learning, but the knowledge is not diffused and implemented in the organization in a predefined way. However, the analyses further guide how the capacity is dimensioned. People at all levels, from the political and management levels, to the staff level at the hospital, who all naturally want to contribute to developing and improving the health care, get support from the data that the IT systems provide. Especially, the internal work is much in focus, to avoid queuing of patients.

The regional administration orders the amount of health care that should be produced at the hospital. The provision of health care is measured by the number of admission sessions rather than the number of admission days. This indicator does not say much about the resources needed and used, because each admission session can vary considerably in length. This indicator also makes it very difficult for the hospital managers to follow up on the situation, and it provides little information that is relevant for the dimensioning of resources and capacity. To make sure the admitted patients receive effective health care and improve the economic figures, it is important to plan the discharge already when the patients are admitted. Implicitly, this means that the hospital gains financially if the number of days per admission is low, and the number of readmissions increases instead. However, this also increases the risk for low quality of the health care. For example, a low degree of readmissions of frail elderly patients shows that the hospital has successfully transitioned the patients to other health-care providers close to patients' homes. It is unclear what measure to use to estimate resource use: number of admissions, or average admission time. This will in turn affect how long time the patients are admitted at the hospital, and the number of admissions says very little about the need for, and use of, resources.

A lot of work is dedicated to decreasing the number of visits at the emergency department. The work involves a lot of collaboration with the ambulance department, the primary health care, the municipality health care, the special department for frail elderly people, and the department for guidance of people via telephone. All those collaborative activities are believed to affect the inflow of patients in a positive way, so that fewer patients seek emergency health care at the hospital.

Information from the registered data is used by politicians and decision makers at the hospital. Politicians use the data to get knowledge about the health care in order to allocate money to different areas and specialties. The health-care departments use the data to get knowledge about their performance, in order to develop and improve the health-care activities and processes. Especially, readmissions of patient are followed up, in order to get knowledge about to what extent the transitions to other health-care providers are successful. At the moment, the departments follow up their performance once a week, and the politicians intend to follow up once a month.

The top managers at the hospital scan the statistics a few times per year. Once per year, they decide how many patients each department could take care of, for each group of disease. In that way, they choose how to distribute the health-care beds and other resources among different patient groups. The total number of patients who are considered in the dimensioning is decided at the regional level, as a

total budget for production of health care at each hospital. This dimensioning then affects whether patients need to be rejected or referred to another health-care provider, maybe to another health-care level, such as a primary health-care center.

4.4 Summary of results

For each of the three themes, the key results are presented in **Table 1**.

Learning and knowledge creation culture	• Desire to have performance data in real time to learn and take appropriate actions • Planning and following up part of the daily management • Ad hoc-based recognitions of changes can cause a reassessment of resources • Staff adapts to changes in admission of patients • A fixed number of operating rooms based on availability determines the resources • A need to manage required resources better • Historical numbers are used for the emergency department • Coordinators from different departments meet to exchange knowledge about inflow and outflow • A fixed set of standardized test packages is sometimes used for each group of disease • Desire to have knowledge to match the staff schedule with the needs • Knowledge of shortcomings could save a lot of resources • Oral analyses at departments on a daily basis to learn and create knowledge • No formally structured learning and knowledge creation
Organizational architecture for adaptive and exaptive capacity	• Many different IT systems are used in parallel and in different ways • Excel sheets are used for scheduling and planning • Manual routines that the staff have to be reminded of • Difficult to rely on manually registered data • Dimensioning of resources is needed for planned visits • Scheduling needs to be done by experienced staff • Follow-ups on an occasionally basis • Analyses and follow-ups are not documented • No routines for documenting work performance • Number of admissions in the care agreement, but each admission can vary in number of days • Collaboration with other health-care providers is needed for frail elderly patients • Monitoring of inflow and outflow of in-patients • Professionals share knowledge about the status of patients at daily meetings • Brainstorming for improvements is conducted at department meetings
Business model for knowledge capitalization	• Middle managers follow up on the statistics at least on a monthly basis • Department managers follow up on a daily and weekly basis • In the case of warnings, follow-ups and analyses are conducted • Analyses guide the dimensioning of capacity, especially to avoid queuing of patients • An ordered amount of health care should be produced • The number of admissions says very little about the resources needed • Unclear how to estimate resource use: based on number of admissions or average admission time • One goal is to decrease the number of visits at the emergency department • Politicians use statistics to allocate money to different health-care areas • The total number of patients is decided at the regional level • Departments use statistics to improve their activities and processes • Knowledge is not diffused in a predefined way

Table 1.
The three themes analyzed in the study and the results.

5. Discussion

Different professionals have roles and work with management, creation, and sharing of knowledge within the planning of production and capacity, as part of the operations at the hospital. A complete and overall articulated architecture for this work would be fruitful. As each department now has its own way of how to conduct the planning and knowledge work, a common architecture could better support the collaboration and coordination between departments. Obviously, different departments have their own characteristics that should be considered, but an architectural base could be designed and implemented at the hospital. The departments could then adapt the architecture to the extent that is needed at each department or health-care service unit based on their specific requirements. KM and OM could in this way be smoother and more effective, and better support the overall processes that support health-care work. Even though KM processes in operations is examined in the literature, see for example Fugate, et al. [18], the infrastructure for KM in health care does not seem to be fully analyzed in existing research, except in studies related to infrastructure for health-care systems and telecommunication, see for example Von Lubitz, Patricelli and Palma [41]. KM depends on the availability of both work routines and staff, to have defined processes that could fit into the knowledge-based architecture. Now, there are variations in the planning among the different departments from ad hoc-based and resource-based KM and OM to fixed plans and experience-based planning [20].

With an appropriate KM architecture in place, the OM can be smoother and more effective, as the planning of resources and capacity can be adjusted closer in time to when different health-care processes are conducted, and more detailed and correct information can be used to plan the capacity. This will create conditions for more flexibility and give better compliance between supply and demand of health care [7]. It is also important to establish routines for learning and knowledge creation within and between the departments and the health-care service units. The emphasis on cooperation, collaboration interaction, and work within groups of individuals can be seen as crucial for creation of knowledge [42].

It will be challenging to design and implement an overall infrastructure that could function as a basis for making changes in the learning and knowledge creation processes and support the OM. Changing the planning from a scheduling perspective, to a perspective based on the patients', often emergent, needs of health care, requires an OM based on "just-in-time." This also requires coordinated planning on a horizontal level, where knowledge can be integrated and shared, in order to plan a smooth overall health care. The managers, with the responsibility for planning and managing the health care, need to have the right information and knowledge and access to staff with competence and experience in production planning in order to design the health-care processes and related activities in detail. The practical and managerial implications are summarized in **Table 2**.

Practical implications	• Formal structures for learning and knowledge creation could save resources • Documenting analyses could support future learning • Documenting follow-ups could improve the planning and dimensioning of resources • Following up on the appropriateness of activities can make health care more effective • Integrating IT systems could increase data quality
Managerial implications	• Performance data in real time could make the planning smoother • Use of more reliable data could improve the planning and dimensioning of capacity and staff

Table 2.
Practical and managerial implications.

6. Conclusions

This chapter contributes with a qualitative analysis of infrastructural KM mechanisms that have significant impacts on the OM in a health-care practice at a hospital.

A learning and knowledge creation culture is important for the use of knowledge that is prevalent in the health-care organization. Such a culture could improve the real-time planning processes and better guide how the professionals act. Deviations could be documented, and learning and knowledge creation could be based on these experiences. The organizational architecture for adaptive and exaptive capacity supports the structure for information systems, technologies, and practices. Integration of these parts could improve the planning of capacity and make it smoother and more effective, as real-time information could also be used. The regular improvement work could also be supported by changing practice to increase the use of information systems for dimensioning of resources. A business model for knowledge capitalization is important in order to derive benefits from the knowledge in the health-care organization. Knowledge diffusion and collaboration in planning with other health-care providers will impact the overall dimensions of health care. This could also provide smoother and more effective health care in the society, which does not use more resources than necessary and is of high quality.

For future research, we suggest to further study the OM in health care and to analyze the complex system of processes and resources that is needed. It is of vital importance to have detailed and reliable data that could be aggregated to make better decisions in the OM. To develop methods for OM is important under normal conditions and even more important in pandemic situations, when the capacity of health care is under great pressure. In this complex system of OM, AI can also be an interesting topic to study.

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