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# What can be learned from the Covid-19 pandemic?

## A case study at Skaraborg Hospital Group

Master's thesis in Supply Chain Management

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## Abstract

Healthcare is a complex system and Swedish healthcare is struggling with capacity. During the Covid-19 pandemic starting in 2020, the healthcare system was put under enormous stress and capacity became an even more crucial aspect. The Covid-19 pandemic came with damaging consequences, and healthcare was forced to adapt to the circumstances. One area that received more attention was how production planning and control were conducted at the hospitals in Sweden. It is important to not lose this opportunity to learn from such a transformative event. This study investigates the learning from how the three hierarchical planning levels at a Swedish hospital managed the pandemic and how these learnings can improve the production planning and control processes at the hospital after the pandemic.

A Case study was done, data was collected during 20 interviews with managers at the hospital and a questionnaire was sent out to all managers at the hospital. With an abductive research approach, iteration of data, theory, and analysis was needed and the ability to modify and make changes to the theory was possible.

Concluding, the findings of the study showed proof of the crucial role of having a holistic perspective when conducting production plans. The study also identified the need for clarification of roles and mandates to improve the structure of the planning process. The implementation of planning levels should be further investigated. Well-functioning information flow and collaboration enhanced understanding and enabled collaborative planning. These learnings and their contribution to the hospital after the Covid-19 pandemic can improve the Production Planning and Control at the Swedish hospital to increase capacity utilization.

Keywords: Swedish healthcare, planning in Swedish healthcare, Production Planning and Control, PPC, hierarchical planning levels, Covid-19, pandemic

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Filippa Plantin and Annie Sjöholm, Gothenburg, May 2022

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## Glossary

*All Managers meeting:* Meeting for all managers at Skaraborg Hospital Group

*Chief of staff:* Individual part of the Top Management at the hospital

*Coronavirus:* A virus with mutations that can infect humans

*Covid-19:* The disease caused by the coronavirus

*Department Council:* A council for the 14 department managers at the Skaraborg Hospital Group

*Department manager*: DM, an individual responsible for one of fourteen medical and surgical areas at SHG

*Epidemic management group*: A group responsible for following and understanding the pandemic and its progression at Skaraborg Hospital Group

*Managing meeting:* Meeting for department managers and their unit managers

*National Board of Healthcare and Welfare:* A Swedish authority for knowledge regarding health- and social care

*Operating rooms:* O.R., the rooms where surgeries take place at a hospital

*Orientation meeting:* Meetings held for Department Managers, parts of the Specialized Hospital Management Group, and the Hospital Board

*Pandemic:* An infectious disease that is spread over several continents, for example, the Spanish flu

*Production Planning and Control:* PPC, is a plan for what to produce of different product groups or products over a set time period

*Process manager:* A unit manager with the medical responsibility for the department as well as the overall management of the care processes

*Regional Council:* The highest decision function and is responsible for the economy and the administrations' orientations in the region

*Region Västra Götaland:* A Swedish public organization responsible for healthcare and welfare, culture, public transport, and regional development in Västra Götaland, a Swedish region

*Skaraborg Hospital Group:* SHG, a Swedish hospital in Region Västra Götaland

*Section leader:* A section leader has some responsibilities at the unit and is subordinate to the unit managers

*Specialized Hospital Management Group:* SSL, a board appointed during the Covid-19 pandemic

*Specialized Regional Management Group:* A regional board appointed during the Covid-19 pandemic

*Surgery Council:* A council responsible for the allocation of operating rooms at SHG

*Unit Manager:* UM, reports to the department manager and is responsible for the unit

# 1. Introduction

Covid-19 has affected Swedish healthcare in various ways. At the Skaraborg Hospital Group (SHG) changes have been made to cope with the increased pressure and demand for healthcare during the pandemic. In this report, the Production Planning and Control (PPC) activities performed and communicated, before and during the pandemic, will be investigated to identify potential learnings to improve SHG's future PPC process. In the following chapter a background to the study will be given, followed by the study's scope and limitations. Lastly, the research questions will be presented.

## 1.1 Background

The healthcare system is complex. To address this complexity Glouberman and Mintzberg (2001a) present a framework where the healthcare system is divided into four worlds: community, control, cure, and care. These worlds represent various professions: trustees, managers, doctors, and nurses and their approaches to the institution. It is necessary to understand the relationships between the worlds and how the division between the worlds can be handled to minimize the gap. The authors emphasize the importance of coordination and alignment in this complex system to efficiently utilize the system's resources (Glouberman & Mintzberg, 2001a).

In Sweden, the government, regions, and municipalities are responsible for Swedish healthcare and according to Swedish law, citizens have the right to equal and accessible healthcare (Vetenskapsrådet, 2021). The Swedish healthcare system scores high on both efficiency and quality in international comparison (Sveriges kommuner och landsting, 2018). Still, the system has been facing and still faces challenges such as staff and bed shortages, management and control being executed far away from the processes, inefficient IT systems, and increasing waiting times (Waldenström, 2019; Sjöberg, 2019). With an increased demand for high-quality and extensive care, increased expenses are experienced (Bradbury and Lifvergren, 2016).

In 2018 the National Board of Healthcare and Welfare concluded that Swedish healthcare can become more accessible and resilient if the Regional Councils focus on conducting better PPC plans and predictions of future patient flow to even out the flows and to act on demand through daily capacity management (Socialstyrelsen, 2018). Some suggestions for improvements are to implement or make existing processes more efficient to improve the flow of patients, implement processes and information systems to support communication and decision making, as well as implement new roles and functions to coordinate the patient flows and make capacity management more efficient (Socialstyrelsen, 2018).

In March 2020 WHO declared Covid-19 to be a pandemic, and the already stressed situation experienced in Swedish healthcare became even more challenging. Reprioritization of beds at the care units was necessary to meet the increasing number of patients infected by the Coronavirus and resulted in reduced availability and longer waiting times for patients that did not suffer from Covid-19 (Socialstyrelsen, 2022).

According to Eriksson (2020), Swedish healthcare transformed as a response to the pandemic. Instead of focusing on strategic improvements, which were done before the pandemic, more emphasis was put on solving problems and improving the way of working as management and motivation were changed during the pandemic (Eriksson, 2020). Eriksson et al. (n.d.) state that the pandemic has resulted in a reduced gap between the different healthcare professions both inside and between the care units at the hospitals. Defeating Covid-19 also created a common goal for all involved in the national health service, which resulted in improved collaboration between various levels in the healthcare organizations (Eriksson et al., n.d.). This can be related to reduced barriers and improved interaction between the four worlds presented by Glouberman och Mintzberg (2001a).

SHG is a hospital run by the political organization Region Västra Götaland (Skaraborgs sjukhus, 2021) and was heavily affected by the pandemic. To manage the challenging times during Covid-19, SHG was forced to adapt its organization to be able to provide healthcare with high quality (Gustavsson & Lifvergren, 2020). With this background, this study will investigate what learnings can be drawn from how the PPC between the different planning levels and units at SHG developed during Covid-19 and how these learnings can improve the PPC post-Covid-19.

SHG's hierarchical planning levels are the Hospital Board, the Department Managers (DM), and the Unit Managers (UM). The hierarchical planning levels and the flow of information will be investigated based on three levels of control: strategic, tactical, and operative. These will be related to the framework presented by Vissers et al. (2001) and the four planning levels presented by Jonsson and Mattsson (2009), where execution and control are included in the operative control level.

## 1.2 Aim

The study aims to identify learnings from how PPC and the information connected to this process, between and within the three hierarchical planning levels at SHG, were managed during the pandemic and suggest how these learnings can improve and refine the PPC process at SHG post-Covid-19.

## 1.3 Limitations

The report will cover PPC at the three control levels: strategic, tactical, and operative. Material planning will not be covered in this report as it is less significant in a service organization compared to a manufacturing organization. Capacity planning will thereby be focused upon.

Information connected to PPC is relevant for this study, see figure 1. Other types of information are not covered and as the focus lies on the hierarchical planning and control levels, information, and communication between SHG and the patients are not covered.

Another limitation of the report is the selection of interviewees. The Hospital Board, the DMs, and the UMs are the hierarchical planning levels within SHG that are covered. Neither the

highest strategic level at SHG, the Political Board, nor the lowest level of execution, the staff, is covered in this research.

The interviewees are primarily individuals working at units and departments at the hospital that has been most affected by the pandemic, which indirectly was considered to have changed their working processes the most. As the aim of the study is to investigate the three hierarchical planning levels within the hospital, the Hospital Board was interviewed despite limited involvement in direct patient care. This assumption laid the foundation for the choice of interviewees, with the aspiration to get as many learnings as possible out of the sessions. As the study has a holistic view, the report is conducted on an aggregated level and will not provide detailed suggestions for specific units, but rather present recommendations applicable to SHG in general.

The study in particular focuses on the world of control and the work performed by the control world, and to understand how the control world affects the other worlds, it is necessary to understand the complexity of the system.

## 1.4 Research questions

To address the aim of this study, two research questions have been stipulated. The research questions are presented below and will be investigated and answered in the report.

*RQ 1. What learnings can be drawn from how the three hierarchical planning levels at SHG managed the Covid-19 pandemic?*

*RQ 2. How can these learnings improve the PPC process at SHG post-Covid-19?*

The study investigates the PPC process at three hierarchical planning levels at SHG before and during the pandemic. Identified learnings and their contribution will be investigated to answer the two research questions.

## 2 Theoretical framework

In the following chapter, the theoretical framework used as a basis for this report to answer the research questions is presented. The first subchapter presents theory on the healthcare system and its characteristics. This is followed up by theories on PPC. As PPC affects the entire hospital, communication, and information within the organization are important aspects. Theories covering these aspects are therefore used as well. For an organization to refine and develop identified learnings a process for learning is needed, to address this, theories on learning and ambidextrous organizations are provided.

### 2.1 The four worlds in the healthcare system

The healthcare system is difficult to manage mainly due to its complexity (Glouberman & Mintzberg, 2001a). According to Glouberman and Mintzberg (2001a) it is one of contemporary society's most complex systems and to sort out this complex system they have designed a framework. Glouberman and Mintzberg (2001a) indicate that healthcare can be divided into four worlds along two axes. The first division addresses practitioners who operate clinically and individuals who do not. The second division concerns the practitioners who are connected to the institution and those practitioners that are not equally as connected (Glouberman & Mintzberg, 2001a). The four worlds have different ways of organizing, different mindsets, and perform various types of activities in healthcare. The four worlds consist of care, cure, control, and community. Bradbury and Lifvergren (2016) address the patient to be what combines the worlds, where a patient focus is necessary to improve the healthcare system and the care that is provided, see figure 1.

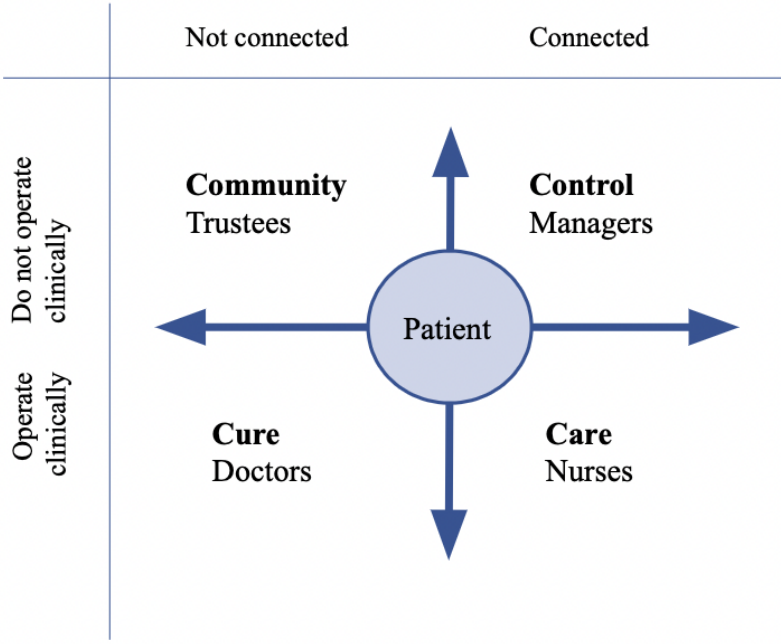


Figure 1. *The four worlds in healthcare based on Glouberman and Mintzberg (2001a), Bradbury and Lifvergren (2016) and Hellström et al. (2014)*

Furthermore, Glouberman and Mintzberg (2001a), explain that the management process within the hospital has different directions, is not homogeneous, and that the directions usually differ from each other. The four directions of the management are:

- **Up:** Managing towards those who own, fund, and control the hospital.
- **Down:** Managing towards the clinical operations and the treatment of the patients.
- **Out:** Managing towards actors formally independent, but still involved in the institution.
- **In:** Managing towards the people and units controlled by the institution.

**Cure,** in the lower-left quadrant, is mainly provided by the doctors (Glouberman & Mintzberg, 2001a). The doctors responsible to cure the patient and their meetings with the patients are often short and scheduled, while the nursing staff is responsible for the care of the patients. The doctors experience the hospital as their workplace, but the patients are perceived as being their most important employer (Glouberman & Mintzberg, 2001a). The doctors manage **out** since they do not report to the hierarchy of the hospital, and **down** since they perform the operations of the hospital.

As mentioned, **care** is provided mainly by the nurses of the hospital, but also by other specialists (Glouberman & Mintzberg, 2001a). They are strongly committed to the operations and the institution, and provide care continuously, in contrast to the doctors. Coordination of activities is a prerequisite for a functioning hospital, but there are rarely any individuals responsible for the coordination. However, the nurses at the units and departments are often the ones forced to perform it. The care is directly connected to the administration of the hospital and thereby managed **in.** It is also managed **down** since the focus is put on delivering service to the patient (Glouberman & Mintzberg, 2001a).

Managers **control** the hospital (Glouberman & Mintzberg, 2001a). They have formal authority over the hospital and its members. However, the actual leader and the formality of the hospital can sometimes vary. Since the managers have control over the entire institution and no direct operative involvement in the units or departments it is managed **in** and **up** (Glouberman & Mintzberg, 2001a).

According to Glouberman and Mintzberg (2001a) the **community** consists of representatives from the society like politicians, owners of the hospital, and authorities, referred to as trustees. These representatives form a committee that meets periodically to oversee the activities of the hospital. Due to the distance between the community and the cure and care, Glouberman and Mintzberg (2001a) mean that the attention of the community is often directed to the control. Since the community is not personally connected to the hierarchy nor the operations at the hospital they manage **out** and **up** (Glouberman & Mintzberg, 2001a).

The boundaries between the four worlds are inevitable and to make the system work it is necessary to divide the labor between them. However, according to Glouberman and Mintzberg (2001a) the absence of connections between the worlds is destructive for the organization. The different key characteristics and principles of the various worlds' organization is a barrier to

improved integration and thereby also a barrier to improvement of the system (Glouberman & Mintzberg, 2001a). **Cure** is organized as professional chimneys and care is an operating workflow (Glouberman & Mintzberg, 2001a). **Control** is organized as an administrative hierarchy, while **community** is organized as a formal board.

When a system like the 'Four world healthcare system' is highly differentiated, the level of integration within the system needs to be high (Glouberman & Mintzberg, 2001b). According to Glouberman and Mintzberg (2001b) this is not the case for the healthcare system. To reduce the issues in the healthcare system either integration between the 4Cs needs to be improved or a reduction of the differentiation in the system is needed (Glouberman & Mintzberg, 2001b). However, since the differentiation is a great strength of the system and its very purpose, the integration is the factor that needs to be improved to improve the system and reduce the issues in healthcare (Glouberman & Mintzberg, 2001b).

Glouberman and Mintzberg (2001b), suggest six various coordination mechanisms to improve the integration within the system.

- One of the most direct coordination forms is **Mutual adjustment**, which entails communication, usually informal, between individuals. The adaptation between each continues while the work advances.
- **Direct supervision** refers to someone being responsible to supervise and coordinate the work and not necessarily perform the work themselves.
- Another way to coordinate the healthcare system is to implement a standardized way of working. Glouberman and Mintzberg (2001b) present four ways to perform **Standardization***:*
    - **Standardization of work:** When standardizing the work, the coordination is done when designing and forming the way of working.
    - **Standardization of output:** Standardized output refers to having standardized ways of presenting consequences and the results of the work.
    - **Standardization of skills**: The standardization of knowledge and skills comes with clearly defined roles that enable the workers to coordinate automatically.
    - **Standardization of norms:** With standardized norms, the beliefs and values of the workers align, making them strive towards the same goals with similar expectations.

According to Glouberman and Mintzberg (2001b), the six mechanisms are often used to a certain degree in all organizations. However, the authors believe that the healthcare system is favoring the standardization of skills to a certain degree. The need for complementary coordination is highly needed since the healthcare system is often pushed to the limit where one type of coordination is not enough (Glouberman & Mintzberg, 2001b). The two mechanisms suggested as strong complements for the healthcare system are the standardization of norms and Mutual adjustment. By developing these mechanisms, the integration within the system could develop due to reformed culture and informal communication (Glouberman & Mintzberg, 2001b).

Even if there is a clear division between the four worlds, they are still part of one system with the common service to ensure "the overall health of the population" (Glouberman & Mintzberg, 2001a). The efforts to coordinate the system should according to Glouberman and Mintzberg (2001a) be across rather than inside each of the worlds and to make the four worlds less separated, integration is needed. According to Glouberman and Mintzberg (2001a), two forces can draw the worlds together, urgency being the first, which creates a sense of shared purpose. The second force is the employees' belief in fulfilling a purpose or calling when working at the hospital.

In addition to this, Bradbury and Lifvergren (2016) and Hellström et al. (2014) express that the patient is considered to be a central part of improving the collaboration between the four worlds. To improve the care and the healthcare system, a patient focus is necessary (Bradbury & Lifvergren, 2016). Further, to improve the care it is important to share information within the organization. With an increased patient focus, the stakeholders' behavior and attitudes might be changed and lead to increased motivation to improve the system (Bradbury & Lifvergren, 2016). To coordinate across the four worlds, plans for the organization are conducted. In chapter 2.2 PPC in both a manufacturing and a healthcare context will be presented.

## 2.2 Production Planning and Control in different contexts

Production planning and control, PPC, is a plan for what to produce from different product groups or products over a set time period. PPC is long-term planning, which can be divided into various levels of detail. It considers production, capacity planning, and inventory, with the purpose of minimizing the cost and being competitive in the market (Hérnandez et al., 2008).

*Manufacturing company*
The base for conducting PPC is to balance the demand and supply while being in line with the corporate strategy (Jonsson & Mattsson, 2009). The authors point out the importance of having a well-structured planning process that is selected based on the existing environment. For the PPC to function, it is important that it is anchored in the organization and understood overall.

The planning levels mentioned below do not have to be present in an exact manner described but are in general terms found in one way or another in all organizations. The three hierarchical levels of control at a company are divided into strategic, tactical, and operative control, with execution as a fourth additional level of control (Jonsson & Mattsson, 2009). As the control levels are connected, the subordinate planning levels are controlled by the above planning levels and the decisions taken at a subordinate level must therefore align with the decisions taken higher up in the hierarchy (Jonsson & Mattsson, 2009).

The first and highest control level is strategic and concerns the company's position in the market and could consider overall goals and allocation of resources (Jonsson & Mattsson, 2009). Strategic decisions also cover customer segment, supplier structure, manufacturing strategy, service levels as well as internal and external production resources (Jonsson & Mattsson, 2009). As strategic control concerns decisions and issues with a time horizon of a minimum of a year, it is neither possible to obtain highly detailed information nor requested as there are too many

uncertainties and variables that can impact the outcome when planning far into the future (Jonsson & Mattsson, 2009).

The strategic planning process Sales and Operations Planning (S&OP) involves all functions in an organization, but to a varying degree (Jonsson & Lindau, 2019). The process is carried out by top management and is based on the company's overall business strategy, mission, and goals (Jonsson & Mattsson, 2009). For this cross-functional process to work well, a good understanding of the process is necessary for combination with participation, trust, and documentation (Jonsson & Lindau, 2019). The cross-functional aspect of the process can result in a reduction of silo cultures and departments operating separately (Danese et al., 2018).

Dimensions that affect the design of the S&OP are detail complexity, dynamic complexity, industry, and organizational characteristics (Kristensen & Jonsson, 2018). The S&OP process is carried out in five steps including data gathering, demand planning, supply planning, pre-S&OP meeting, and executive S&OP meeting (Jonsson & Lindau, 2019). Through the use of forecasts of future demand, plans for deliveries, sales, and production of product groups are generated where the focus lies more on producing a certain volume than a specific product (Jonsson & Mattsson, 2009). It is relatively easy to adjust available capacity, as forecasts with a long-term perspective form the basis for the capacity requirements at this level. Adjustments to capacity concern the distribution of competence among staff, changing manning levels, opening new production plants, and phasing out existing plants (Jonsson & Mattsson, 2009).

The S&OP has the highest planning level, and with the longest planning horizon, one to two years, it has the lowest precision and degree of detail (Jonsson & Mattsson, 2009). The period length for the S&OP is monthly or quarterly and requires rescheduling within the same period time. A well-functioning S&OP process can result in an enhanced flow of information between demand and supply as well as increased customer service level, forecast accuracy, and reduction of inventory levels (Danese et al., 2018).

The second level of control is called tactical and is affected by the plans generated at the strategic control level. Tactical control concerns decisions and issues connected to adaptations and developments of the company structure, organization type, planning system and methods, procurement, and usage of resources (Jonsson & Mattsson, 2009). At the tactical planning level sales and production, plans are prepared, and capacity planning is conducted.

A tactical planning process is Master Production Scheduling (MPS) and is carried out by following five steps: forecast future demands, generate preliminary delivery plans, generate preliminary master production schedules, reconcile, adapt, and settle the prepared plans (Jonsson & Mattsson, 2009). MPS breaks down the volumes for the product groups established in the S&OP, to volumes per product type or product model in an engineer-to-order or make-to-order context to generate delivery plans (Jonsson & Mattsson, 2009). Current customer orders or forecasts, or the two in combination are used as input and result in delivery plans and production schedules for the products which concretize the quantities that are to be produced and delivered during a planning period (Jonsson & Mattsson, 2009). The delivery plans are also affected by the available capacity and need to be rather dynamic due to the inflow of orders that

needs constant consideration. It is often enough to use the capacity for the whole department as a capacity unit in MPS (Jonsson & Mattsson, 2009). There are activities or work centers in a system that limit the output, these are called bottlenecks and restrict the capacity decisions. To reduce the negative effects of bottlenecks, the bottleneck's capacity should be utilized to its fullest, while minimizing the times for set up and running large batches (Jonsson & Mattsson, 2009).

The MPS must be carried out with a planning horizon that is longer than the accumulated lead time for the product with the longest accumulated lead time (Jonsson & Mattsson, 2009). In most cases, the planning horizon is six months to a year with a period length of one or a couple of weeks and is rescheduled on a monthly or weekly basis (Jonsson & Mattsson, 2009). The shorter planning horizon at this level makes the possibility to adjust the capacity less flexible. MPS does not involve as many participants from other departments as S&OP, nor requires the same involvement from top management (Jonsson & Mattsson, 2009).

The third level of control is the operative control which concerns ongoing activities and day-to-day decisions. The operative control level is affected by the decisions taken at the tactical level and aims to execute those decisions. Precision and level of detailed information are high, and the time horizon is short at the operative level which enables setting delivery dates, monitoring delivery, and conducting short-term capacity and workload planning (Jonsson & Mattsson, 2009).

An example of an operative planning process is order planning. Order Planning generates material plans for the planned manufacturing orders and thus ensures materials supply on an item level to enable carrying out the material production schedules (Jonsson & Mattsson, 2009). Order Planning also considers requirements for capacity and supplies of capacity, where the planned and released manufacturing orders are used as a basis for the capacity requirements (Jonsson & Mattsson, 2009). Order Planning aims to achieve efficient material flows concerning delivery to the customer, tied-up capital, and resource utilization (Jonsson & Mattsson, 2009). The planning horizon for Order Planning is two to six months and as the period length is a week or a couple of days, where rescheduling needs to take place within the same time frame (Jonsson & Mattsson, 2009). As the planning horizon is even shorter at this level, the possibilities to adjust the capacity are scarce and only small changes to the available capacity can be conducted, such as re-allocating staff or using overtime (Jonsson & Mattsson, 2009).

When conducting material planning on this level, dependent versus independent demand, the available information for balancing the demand for and, supply of materials must be considered (Jonsson & Mattsson, 2009). If demand has no direct relationship to the demand for other items, the demand is independent and if it has a direct relationship, the demand is dependent. Information on requirements consists of allocations for manufacturing orders, customer allocations, exploded requirements, and forecasts (Jonsson & Mattsson, 2009).

When items are manufactured in-house, even more, detailed planning at the Order Planning level is necessary (Jonsson & Mattsson, 2009). This detailed planning of manufacturing orders

is called execution and control and covers the planning of the operations. Execution and control are carried out within a time horizon of one to four weeks and a period length of a day or a couple of hours. The plans for the operations are rescheduled daily (Jonsson & Mattsson, 2009).

In a traditional planning environment, execution and control consist of activities such as order initiation, order release control, material availability check, releasing manufacturing orders, priority control, labor reporting, and final reporting (Jonsson & Mattsson, 2009). Orders can be released based on their planned start time or the capacity supply. Once orders have been released to production, priority control is applied to ensure the execution of the orders to be conducted concerning throughput time and delivery precision. Plans are generated based on a direct customer order or by using forecasts (Jonsson & Mattsson, 2009).

Capacity planning is involved, to a varying degree and form, in all the hierarchical levels of control and aims to balance the demand for capacity with the supply of it. There are two strategies to handle capacity changes, one proactive and one reactive. Capacity can be changed prior to the changes in demand, called the lead strategy, or the capacity can be adjusted after the demand has changed, called the lag strategy (Jonsson & Mattsson, 2009). Flexibility can impact capacity, either through fast adjustments to product and product variants, through the usage of resources that can be used for several operations, or by the ability to change to customer requirements (Jonsson & Mattsson, 2009). Jonsson and Mattsson (2009) also point out that being flexible can be both costly and a revenue source. Capacity utilization is another aspect of capacity planning and can be handled in different ways.

In case of an imbalance between demand for and supply of capacity, corrective measures need to be taken. Ways to manage such imbalances can be through increasing or decreasing capacity by hiring or firing employees, buying new machines, increasing, or decreasing the number of shifts, subcontracting, or overtime (Jonsson & Mattsson, 2009). Capacity can also be re-allocated by transferring capacity between work centers or adjusted by using overtime or postponing maintenance activities (Jonsson & Mattsson, 2009).

*Healthcare*

A hospital differentiates itself from and shares similar characteristics with a manufacturing company (Rhyne & Jupp, 1988). The nature of the industries differs as a manufacturing company generally purchases raw materials and components, that through a predetermined process flow, produce an inert product, whereas a hospital in comparison operates in the people business (Rhyne & Jupp, 1988). The demand for a manufactured product is primarily independently initiated by a customer order where a bill of material concretizes the constituent articles. The demand for healthcare services is initiated by patients seeking treatment and is primarily independent. Instead of a bill of material, a bill of labor concretizes the required labor resources for a hospital. There is not necessarily a fixed sequence for the healthcare services provided. Just as for manufacturing companies, it is important to have a holistic view of the organization and handle it as a total healthcare system, not isolated departments (Rhyne & Jupp, 1988).

Vissers et al. (2001) present a hierarchical framework for how to manage the production control in healthcare, which entails controlling the balance between efficiency and service in a hospital environment. Vissers et al. (2001) argue that a dedicated framework for the production control of the hospital is needed, mainly due to the unique characteristics that the hospital entails. The processes and the product of the hospital have unclear content and the variability of the demand is high, preventing the use of a standardized approach for production control (Vissers et al., 2001). However, parts of the standardized approaches can be used according to the authors.

The characteristics of the hospital environment and its production control are in general that the supply is lower than the demand; supply is limited by the responsible organization, and high expectations from the patients to offer service of high quality (Vissers et al., 2001). Vissers et al. (2001) mean that the hospital wants to offer a reasonable standard of service while utilizing the resources to a maximum. Thereby, the hospital needs to focus on the costliest resources when managing the production control (Vissers et al., 2001). The five planning and control levels of the framework are presented below (Vissers et al., 2001).

At the highest level, level five, **Strategic planning** sets the direction of the hospital for the two to five years to come. In strategic planning, the decision to divide and decide upon the patient groups and departments is one of the most important parts (Vissers et al., 2001). **Patient volume planning and control** is the fourth planning level and at this level; the total amount of capacity needed for a patient group is decided, based on the number of patients and what target is set for the level of service (Vissers et al., 2001).

Vissers et al. (2001) then present the third level, **Resource planning and control.** At this level, a holistic view of the patient groups is needed to determine the total need of resources for each type of patient group for a set production period. It is important to balance the hospital's available resources with the needs of every type of patient group. Since many resources are shared between the patient groups it is important to make sure that the utilization rate is high and that the resources are available when it is required (Vissers et al., 2001).

The second level is referred to as **Patient group planning and control** and is focused on a group of patients (Vissers et al., 2001). This planning level controls the scheduling of the patients' day-to-day response to the service requirements and the regulations on resources for the specified patient groups. Management is responsible for deciding upon what care and level of performance to be provided, for example, deciding upon the reasonable patient mix and acceptable waiting times. Managing the acquisition of needed resources as well as balancing the utilization of resources, while controlling the patient flow are other important aspects to consider at this planning level (Vissers et al., 2001). The lowest planning level of the framework, **Patient planning and control,** is operative and manages the day-to-day activities like scheduling of individual patients and scheduling consultations of outpatients (Vissers et al., 2001).

A combination of the theory presented by Jonsson and Mattsson (2009) and the framework presented by Vissers et al. (2001) has been applied to understand and analyze the PPC process

at SHG. The planning levels presented by the authors have been combined to connect theory from a manufacturing context with theory from a healthcare context, see figure 2.

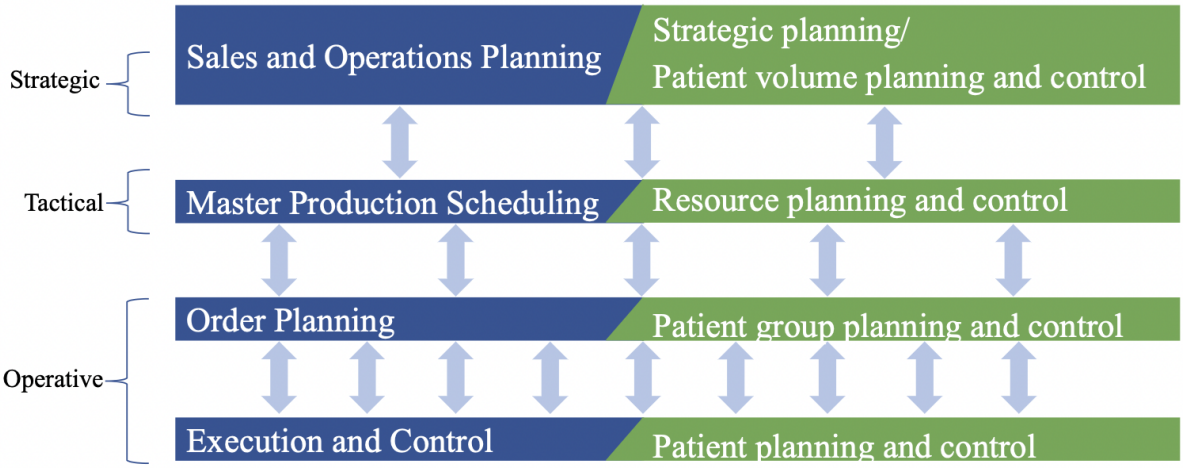


Figure 2. *Visualization of the three control levels and the information flow between them, connected to the four planning levels by Jonsson and Mattsson (2009) and the framework of Vissers et al. (2001)*

Clear communication and information are key ingredients at every planning level and prerequisites for a well-functioning planning process. The development of a PPC system requires good communication, but also individual, group, and organizational learning. In the next subchapter, the theory on information and communication followed by the theory on organizational learning will be presented.

## 2.3 Communication and information flow

The process when information is exchanged between two people and results in a common understanding is called communication (Lunenberg, 2010). According to Lunenberg (2010), the elements of communication are message encoding, the message transmission using a medium, message decoding, and feedback, for two-way communication. The carrier of the communication, the medium, affects the quality of the communication and can be either email, letters, and written reports for written media, or face-to-face conversations and telephone calls for verbal media. Non-verbal gestures also affect the quality of communication (Lunenberg, 2010).

There are four common communication barriers: process barriers, physical barriers, semantic barriers, and psychological barriers (Lunenberg, 2010). **Process barriers** concern barriers with the sender regarding the choice of medium and encoding, or with the receiver concerning for example decoding. **Physical barriers** refer to physical distractions such as distance between interacting individuals. **Semantic barriers** concern the words and phrasing used as well as how they are used as words tend to have different meanings for different persons (Lunenberg, 2010). **Psychosocial barriers** concern psychological distance, experience, and filtering where people's background, values, and emotions affect the interpretation of things (Lunenberg, 2010).

According to Lunenberg (2010) empathy, self-perception, culture, and feedback are common areas of communication breakdowns. For communication to be effective both the sender and receiver must respect each other and inhibit the ability to send and receive messages (Lunenberg, 2010).

Poor communication in a healthcare environment can lead to negative outcomes such as decreased safety for the patient, disruptions in the daily care, valuable resources used inefficiently, and inefficient use of economic means (Vermeir et al., 2015).

Face-to-face communication has been revealed to be the best way to communicate since it enables reading facial expressions and body language together with hearing (Vermeir et al., 2015). The development of technology and video conversation has enhanced the possibility to have face-to-face meetings in a more flexible way (Vermeir et al., 2015). However, written communication remains to be the most common medium to communicate in healthcare (Vermeir et al., 2015).

## 2.4 Learning Organization

*Theory of learning*

The development of a well-functioning PPC system requires the ability to learn on an individual, group, and organizational level. Illeris (2003) points out that to be a global competitor lifelong learning is necessary. Two fundamental assumptions are the base for the theory of learning presented by Illeris (2003). The first assumption is that learning can be divided into two various processes. One is the external interaction, which is the processes between the cultural, material, and social environment and the learner. The second process is the internal psychological process when the new impulses are connected to prior learnings. For learning to take place both processes must be active (Illeris, 2003).

The second assumption of the theory can be divided into three dimensions, the emotional dimension, the social dimension, and the cognitive dimension. The emotional dimension includes motivation, feelings, and mental energy while developing personal sensibility and securing the balance of the mind. Co-operation, communication, and participation are part of the social dimension. This dimension forms social skills and serves the integration of individual learning. The third and last dimension, the cognitive dimension, entails the ability to build up skills and knowledge when learning (Illeris, 2003).

This theory of learning can be structured in various ways and Illeris (2003) describes that depending on the context, learning can require less or more energy and lead to various results. The learning is thereby divided into four levels, with the first being cumulative learning. Cumulative learning is isolated learning, not connected to previous knowledge or understanding of context. This learning is most common in early life when learning how to be a human. Assimilative learning is considered the most common type of learning and is linked to previous patterns and knowledge of the learner. The accommodative learning, however, implies breaking down and transforming already existing patterns and knowledge to handle new situations. The

last level of learning is transformative learning which is characterized by restricting the emotional, social-societal, and cognitive dimensions simultaneously. This learning could be initiated by a crisis-like situation when a change is unavoidable and needs to be done to continue (Illeris, 2003). Another aspect to have in mind when discussing learning is non-learning. Various reasons for non-learning can be miss-communication, misunderstanding, miss interpreting, lack of motivation, contextual obstacles, and environmental disturbances.

Adding to Illeris' (2003) statement that learning is important to be competitive, Deimler and Reeves (2011), point out that an organization's competitive advantage also depends on its ability to change. The change in an organization can both be prevented and enabled by a sense of urgency (Fredberg & Pregmark, 2022), which is a dilemma. The urgency is vital and can be destructive (Bradbury & Lifvergren, 2016). Depending on how the urgency is experienced by the organization it can lead to fear and stress on one hand and focus, creativity, and productivity on the other (Fredberg & Pregmark, 2022). This urgency can be created by a perceived outside organizational threat or by a contemporary event (Fredberg & Pregmark, 2022). The ability to change can also be driven by the aspiration or motivation to change. Such a driver can result in increased participation and creativity with the possibility of successful transformations (Bradbury & Lifvergren, 2016). Since the wrong type of urgency, which creates fear and stress, leads to lost collaboration and reduced innovation and creativity, it is an important factor to handle within the organization (Fredberg & Pregmark, 2022).

Leadership is crucial when managing the sense of urgency in an organization (Fredberg & Pregmark, 2022). Fredberg and Pregmark (2022) present three different relationships that are important for the leaders to handle to create a sense of urgency without stress and fear:

- **Success-failure relationship:** The leaders must create an environment where the definition of success is clear while still tolerating and accepting failures and learning.
- **Safety-accountability relationship*:*** The leaders must demand accountability and expect high performance, while still creating a trusting and safe environment between the management and the projects.
- **Operative-strategic relationship:** The leaders must allow the project group to have the freedom to explore alternatives while being aligned with the strategy of the organization.

Managing these relationships creates a motivated and safe environment that can enhance learning. Individual learning is connected to organizational learning and for an organization to learn, a process for adapting and refining learnings is a prerequisite, and theory on the subject is presented next.

*Organizational learning*

Crossan et al. (1999) present a framework for organizational learning. Organizational learning and the relationship between exploitation and exploration form the basis for strategic renewal (Crossan et al., 1999). Organizational learning is divided into four processes: intuition, interpretation, integration, and institutionalization (4Is), and is multileveled: individual, group,

and organization. **Intuition** and **interpretation** are individual processes and refer to the recognition of patterns or possibilities and refining and developing such intuitions. **Interpretation** is closely intertwined with integration when it appears at a group level. **Integration** refers to the emergence of mutual agreements and understanding within a group. By taking coordinated action to develop formal routines and procedures, these can later become embedded and **institutionalized**. **Interpretation** connects the individual with the group level and integration connects the group with the organization level (Crossan et al., 1999). Crossan et al. (1999) also point out that cognition affects action and action affects cognition.

Moving between the processes and levels comes with some challenges. To move from **interpretation** to **integration**, individuals must communicate their tacit, cognitive maps to develop explicit knowledge. Explicit knowledge does however not result in a collective and shared understanding, which is another challenge. To address this one can forestall collective understanding by leading with action, instead of striving for a shared understanding before acting. The connection between **institutionalization** and **intuition** is also challenging as **intuition** can be easily driven out by **institutionalization**. As institutionalized learning, feedback hinders new learning, and feedforward, a tension between the two emerges. The feedback process enables the exploitation of new knowledge, but as institutionalized knowledge is hard to change it can prevent an organization from feed-forward and exploiting (Crossan et al., 1999).

*Ambidextrous organization*

An ambidextrous organization is an organization that can manage both exploration and exploitation in parallel (Birkenshaw & Gibson, 2002). According to O'Reilly and Tushman (2011), an ambidextrous organization can adapt to the environmental demands that are changing while still handling the current organization in an aligned way. To successfully achieve an ambidextrous organization management skills are important (O'Reilly & Tushman, 2011).

Two critical tasks need to be accomplished by the manager to reach ambidexterity in the organization (O'Reilly & Tushman, 2011). The first task is to sense the changes in the competitive environment where the organization is situated. It can be the changes in the technology, shifts in how the customers and competitors act, and other types of challenges. When these changes are sensed and identified the managers need to seize the changes by reconfiguring the organization to respond to the challenges (O'Reilly & Tushman, 2011).

Besides these critical tasks, O'Reilly and Tushman (2011) present five propositions that are necessary for the management to handle to form a successful ambidextrous organization. The propositions enable the organization to handle the separate units, one exploring and the other exploiting. Its presence also enables the organization to explore new threats and opportunities by sharing assets and allowing for the organization to develop (O'Reilly & Tushman, 2011; Birkenshaw & Gibson, 2002). This set-up results in duplication of effort, loss of morale in the business units focusing on exploitation, and lack of integration between the activities

(Birkenshaw & Gibson, 2002). However, separating alignment and adaptivity ensures attention is being paid to both activities (Birkenshaw & Gibson, 2002).

The five propositions presented by O'Reilly and Tushman (2011) are:

- The management needs to motivate the importance of both exploring and exploiting on a strategic level.
- Create a common identity with the same values and vision between the exploiting and the exploiting unit.
- It is important to have a senior team that owns and communicates the strategy to explore and exploit.
- The organizational structure of the separate units should be aligned to leverage the assets of the organization in the best way.
- The leadership needs to have the ability to handle and tolerate the tensions that can arise between the separate units.

The absence of these characteristics would result in an unwillingness to share the asset with an exploring unit that is not in itself as profitable (O'Reilly & Tushman, 2011). This would result in inefficient use of the common assets. Without common values, vision, reward system, and relentless communication; cooperation, mutual trust, and long-term perspective will be lost. If the senior team has not agreed on the importance of the ambidextrous form of the organization, it can lead to ambiguity. Lastly, if the handling of the conflicts between the units is lacking it would confuse (O'Reilly & Tushman, 2011).

However, this is not the only way to handle ambidexterity in an organization. To pursue both alignment and adaptivity in organizations, exploration, and exploitation can also be run in parallel (Birkenshaw & Gibson, 2002). If the activities are run in parallel, a business unit is responsible for both exploitation and exploration activities (Birkenshaw & Gibson, 2002). This approach can result in alignment-oriented activities driving out adaptation-oriented activities and where role definitions are not as clearly defined, but the advantage of this approach is the high level of integration ensured between the activities. A risk with this approach is to only focus on one of the activities and not pay attention to the other (Birkenshaw & Gibson, 2002).

# 3 Method

To address the aim of the study and answer the two research questions, a case study method with an abductive approach has been conducted. Qualitative data was collected during semi-structured interviews with key individuals at SHG, data was also collected through questionnaires and a literature review was completed to set the theoretical framework of the study. In the following chapter, the method of the study will be presented thoroughly.

## 3.1 Literature review

A literature review was conducted to set the theoretical framework for the study. Several databases and search words were used. The primary databases used were EBSCOhost Research Platform and Google Scholars. Search words used when collecting data were: PPC, information flow in organizations, information in organizations, information flow healthcare, planning levels in healthcare, communication in healthcare, service planning, and control, planning, and control healthcare, sharing information in organizations, successful information flows.

The reference lists of found literature using the above-presented approach were investigated further to find more relevant literature. Literature from previous courses was used, and relevant literature was also provided by the examiner and supervisors at Chalmers University of Technology and at SHG. National and regional evaluations of the Covid-19 pandemic in Swedish healthcare were found on national and regional municipalities' platforms.

## 3.2 Case Study

The research method chosen for the study is a case study approach, which can be described as a deep dive into a specific subject and phenomena in real life (Denscombe, 2014). Yin (2014) means that a case study is a useful research method in several situations, one being when the researcher has no or little control of the situation and questions like “why” and “how” are being asked about a contemporary event. The characteristics mentioned fit with the situation of Covid-19 at SHG, which is studied here. It was a distinctive advantage to use the case study method in this type of situation since there was a need to understand the circumstances of the situation and not only the situation of the specific event when answering the above questions (Yin, 2014). Since the case study was investigating this specific event at SHG, the result could only generate context-specific learnings (Denscombe, 2014).

A process of six steps was followed when conducting the case study (Yin, 2014), see figure 3. First, the case study must be defined. One of the most important parts of the first step of the process was to formulate the research question since it laid the ground for the entire research (Yin, 2014). Two research questions were formulated: “What learnings can be drawn from how the three hierarchical planning levels at SHG managed the Covid-19 pandemic?” and “How can these learnings improve the PPC process at SHG post-Covid-19”.

The limitation of the case study also needed to be well defined to have a clear picture of what will be investigated (Denscombe, 2014). The main limitation set for this study was to focus on

the PPC process at SHG and the flow of information connected to it. The second step of the process, designing the case study, includes five components that are especially important: the research question, the purpose of the study, the unit of analysis, connecting the data with the purpose and interpreting findings from the study (Yin, 2014). An essential part of the design phase was to identify relevant literature connected to the scope of the study and develop a theoretical framework (Yin, 2014). This theoretical framework was the base for generalizing the empirical findings of the study (Yin, 2014). The author also emphasizes the importance of validity and reliability throughout the entire process.

The third step of the process was to prepare for the specific study (Yin, 2014). Training in how to conduct an interview guide and how to structure an interview was part of the preparation. Yin (2014) expresses that one way to increase the reliability and improve the guidance of the researcher is to form a case study protocol, which contains a holistic view of the case study, the field procedures, the questions for the case study, and a guide for the report. A Gantt chart in combination with an interview guide was used as a case study protocol for this study.

Collecting data was the next step of the case study method (Yin, 2014). When collecting data for a case study, Yin (2014) and Denscombe (2014) indicate that a mix of data sources is necessary to get a wider understanding and obtain a holistic view of the situation investigated. Qualitative data was collected through interviews, questionnaires, and internal and external documents. According to Yin (2014), interviews are one of the most important sources of information as the study is about the affairs of humans. The interviews allow the researchers to understand the situation from a first-hand source who has experienced and observed the specific event as well as the circumstances of the event (Yin, 2014). After the first round of interviews, it was necessary to evaluate the questions and the collected data, as the empirical findings affect the direction of the study. After the first round of interviews, it also became evident what areas needed to be further investigated and thus required more specific questions.

Since the interviewees are human, the problems of poor recall and being biased needed to be considered and corroborated with other types of information to secure the reliability (Yin, 2014). Questionnaires, which are a subcategory of interviews, were also conducted as a complementary source to further strengthen the study (Yin, 2014). An additional complimentary source to be used was documentary information, which according to Yin (2014) is likely to be used as a source for all types of case studies. The result of a case study is not absolute (Yin, 2014), and to improve the reliability and validity, the definition of quality criteria presented by Halldórsson and Aastrup (2003) was used. It is also necessary to connect the empirical findings to theory to increase reliability and validity (Yin, 2014).

The fifth step of the process was to analyze the collected data by categorizing, testing, examining, and tabulating it (Yin, 2014). According to Yin (2014) the analysis phase of the study is the most challenging phase, and to reduce difficulties a general analysis strategy for all data is recommended. The strategy used was conventional qualitative content analysis presented by Hseih and Shannon (2005). The last step of the case study process is to conclude the findings of the study (Yin, 2014).

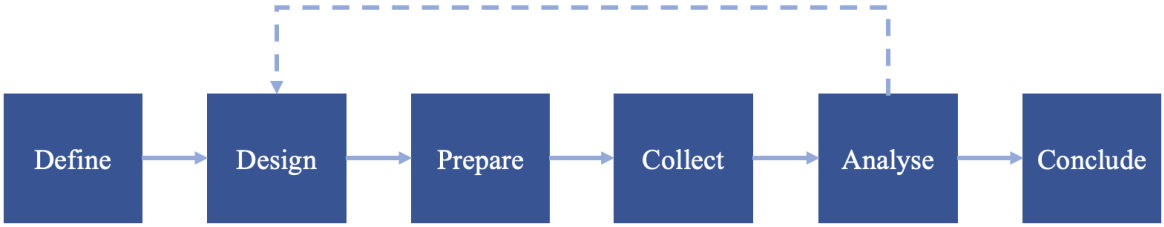


Figure 3. *The process of the case study method based on Yin (2014)*

Knowledge about the PPC during Covid-19 was limited since it was an ongoing event when the report was written, which made an explorative approach suitable when conducting the study. When doing the study, the assumption was made that the PPC process and the information flow changed during the pandemic, and to assess this assumption a deductive approach needed to be taken. However, an inductive approach was used as well to understand and explain the circumstances of the event and substantiate the changes with facts. In this study, systematic combining, which is an abductive research approach where inductive and deductive methods are combined, was used (Wigblad & Jonsson, 2008; Dubois & Gadde, 2002).

With an interplay between practice and theory, the abductive approach had the potential and advantage of creating the possibility to discover and reflect on events and create new knowledge (Wigblad & Jonsson, 2008; Dubois & Gadde, 2002). With the systematic combining method being a path-dependent process, it requires going back and forth between data sources, theoretical framework, and analysis to match reality with theory to discover new learnings (Dubois & Gadde, 2002). Consequently, the theoretical framework was successively refined, partly due to new unforeseen empirical findings as well as theoretical insights learned throughout the research process (Dubois & Gadde, 2002). As systematic combining builds on the successive refinement of the theory, the studied phenomena, and the analysis (Dubois & Gadde, 2002), it required iterations of the design, preparation, collection, and analysis phases of the case study. The iteration is illustrated with a dashed line in figure 3.

### 3.3 Semi-structured interviews

The interviews were chosen to be semi-structured. Semi-structured interviews, instead of focus groups, were preferably used as independent thoughts of individuals were desired for this study (Adams, 2015). According to the author, semi-structured interviews are preferred when a formative program evaluation is conducted, as the evaluation of the changed information flow at SHG, and key individuals' thoughts needed to be covered. Semi-structured interviews are also preferred when useful leads to pursue in a problematic situation are to be examined (Adams, 2015). Open-ended questions were used and allowed the interviewees to share information and insights that potentially would not have been covered otherwise, which was another advantage of this type of interview (Adams, 2015).

Open-ended questions were also used to reduce the risk of leading the interviewees in a certain direction, and at the same time have the possibility to cover important, otherwise, potentially missed aspects (Leech, 2002). However, open-ended questions come with the risk that the

interviewee gets off-topic, and in those scenarios, it was important to let them finish, before redirecting them back to the topic (Leech, 2002). When the questions were constructed, it was also important that no judgmental wording was used and that the questions were unbiased to not affect the interviewees' answers (Leech, 2002; Yin, 2003).

The interview guide, see appendix A, was structured to start with easier questions to initially build trust and let the interviewee have time to construct her narrative (Galletta, 2013). In the middle of the interview more specific and theory-laden questions were asked, and as the interview was about to finish interviewees were given the possibility to add any final remarks (Galletta, 2013). As all interviews can turn out differently, it is important to have a plan for different scenarios. By using planned prompts, the interviewer could ensure to cover all relevant aspects during the interviews despite the interviewee avoiding or not answering the initial questions (Leech, 2002). Leech (2002) also suggested using floating prompts, such as 'How?' and 'Why?' or asking for clarification to be useful approaches to ensure full coverage and correct interpretations.

The interviews were recorded to increase the engagement of both interviewers during the interviews (Adams, 2015). Anonymity and confidentiality were discussed and ensured. The interviews were conducted with both authors present and when needed, appropriate notes were taken to support the later analysis of the interviews and their recordings. One of the authors was responsible for asking the questions and leading the interview, while the other had a more supportive role and focused on body language and took notes to retrieve as much information as possible from every interview (Adams, 2015). The supporting role also included asking additional follow-up questions if found relevant. The collected data was then analyzed, and the empirical findings were systematically categorized and tabulated which is recommended by Adams (2015).

As the selection of interviewees greatly impacts the data collection and later analysis, a strategic selection of interviewees was done to guarantee a full representation of experiences and perspectives, as well as relevant responses (Galletta, 2013). The interviewees were chosen in collaboration with supervisors at SHG due to their deep knowledge of the organization and appropriate participants for the interviews. The collaborative selection of interviewees came with the risk of the representatives from SHG being biased, but the advantages of a collaborative selection were considered more valuable and necessary to ensure full coverage. Using questionnaires, and reaching out to all managers, ensuring that the general perception was perceived and minimized the risk of bias (Yin, 2014).

Interviewees were managers at SHG, selected based on their hierarchical level in the organization to cover the three control levels: strategic, tactical, and operative. The interviewees were also selected based on the department or unit they worked at. The department and units that had been affected the most by the pandemic were chosen, as they most likely had experienced more changes related to the PPC process. A full representation of experiences and perspectives from managers at different hierarchical planning levels, addressing the aim, was thereby achieved. A matrix including all interviewees is presented in appendix B.

The number of interviews conducted was based on the level of information that each interview generated, and when no new thematic patterns were collected the point of saturation was reached, and no further interviews were conducted (Galletta, 2013). In total 20 interviews were conducted. During two of the interviews, several individuals participated, but are referred to as one number to simplify the analysis and reading of the report. The interviews in question are I13 and I20. During interview 13, two individuals participated I13 and I14, and are referred to as I13. Interview 20 had four participants and is collectively referred to as I20. An additional source of information was the session with the supervisors from SHG. The collected data and information from these are referred to as S throughout the report.

## 3.4 Questionnaire

To further improve the reliability and validity of the data collected from the interviews a questionnaire with a wider respondent group was conducted. The questionnaire is presented in see appendix C. The participants were managers at SHG. Members of the Hospital Board, department managers, and unit managers all received the questionnaire. In total, the questionnaire was sent out to 172 individuals, with a response rate of 33,7 %, where respondents from all departments except one were represented. These are referred to as Q in the empirical findings. As Yin (2014) expresses, multiple sources are a prerequisite to ensure the quality of the data and by using questionnaires as a supplement to the data collection conducted through semi-structured interviews, multiple data sources were used. Using multiple data sources reduced the risk of only covering parts of the phenomena and thereby excluding relevant aspects, but also revealing aspects that were prior unknown to the researcher (Carter et al., 2014; Dubois & Gadde, 2002). Using triangulation resulted in a more comprehensive understanding of the study phenomena at SHG (Carter et al., 2014). The data collected from the different methods were analyzed separately and then differences and similarities were identified to be able to conclude the respective methods' influence on the result (Carter et al., 2014).

The formulation of the questions was important as it influenced the answers. To ensure a good response rate, and adequate responses, and facilitate the analysis, the questions needed to be formulated simple, short, specific, avoiding loaded words, and be leading (Williams, 2003). To ensure that relevant and comprehensive questions were formulated, insights from the semi-structured interviews were used when forming the questionnaire. The questionnaire was tested and evaluated by other hospital staff before it was sent out to increase the quality of the output. The questionnaire included questions about the present situation as well as questions on how the situation was before Covid-19, whereby time-memory bias was considered. As people tend to struggle with recalling events that have happened in the past, these questions were formed to be context-specific to enable good responses (Williams, 2003). The questionnaire was partly conducted with the supervisors at SHG as they saw it as an opportunity to collect more data that could be relevant for them, without demanding the managers to answer two different questionnaires. This explains why some data has been filtered out and is not used in this report.

## 3.5 Qualitative content analysis

Qualitative content analysis is the analysis method used in this study and is a collective name for several different analytic methods which offer a flexible approach to analyzing and interpreting text data from a predominately naturalistic paradigm (Hseih & Shannon, 2005). In this report, data was collected during interviews, questionnaires, and literature. The choice of qualitative content analysis method was based on the purpose of the study as well as the theoretical framework to understand and provide knowledge for the studied problem (Hseih & Shannon, 2005).

In this report conventional content analysis, which is one type of qualitative content analysis was used. It aims to describe studied phenomena where theory and literature are scarce (Hseih & Shannon, 2005). As categories were derived from the collected data, a more comprehensive understanding of the phenomena could be captured, and new insights emerged. During the analysis, the coding process was of great importance for the success, trustworthiness, and validity of the study (Hseih & Shannon, 2005). A conventional content analysis was carried out following the steps presented by Hseih and Shannon (2005).

The first step was to read the data collected, repeatedly, similar to when reading a novel (Hseih & Shannon, 2005), which was done after every interview by listening to the recordings. When the researchers had obtained a deeper understanding of the study the next step was to derive codes and key thoughts from the text by reading it word by word (Hseih & Shannon, 2005). Then the researchers continued to analyze the data by writing and concluding their first thoughts and impressions of each interview. Next, the labeling of the coding continues, and the codes created can cover multiple key thoughts (Hseih & Shannon, 2005). The codes and thoughts for all interviews were then summarized in a shared document. According to Hseih and Shannon (2005), 10 to 15 clusters are a favorable amount. If needed, the subcategories can be sorted into a smaller number of categories (Hseih & Shannon, 2005). For this report, five main clusters were formed with several subcategories. The five main clusters were organization, information flow, planning process, collaboration, and learning process, all connected to the PPC process. Hseih and Shannon (2005) recommend organizing the categories in a hierarchy structure, however, the researchers believed it was easier to visualize the findings by presenting them in a matrix. The last step before reporting the result from the conventional content analysis was to define all of the codes, subcategories, and categories.

## 3.6 Quality criteria

For a qualitative study the criteria for trustworthiness; credibility, confirmability, dependability, and transferability, can be used as a supplement to the criteria of internal validity, external validity, reliability, and objectivity (Halldórsson & Aastrup, 2003). By bridging between the conventional and alternative criteria for quality, a better assessment of the study can be made. By using the criteria for trustworthiness together with craftsmanship, a qualitative study's validity can be assessed (Halldórsson & Aastrup, 2003).

Halldórsson and Aastrup (2003) explain credibility, and internal validity, to be determined by the degree of correlation between the researchers' representations and the respondents' constructions. Thereby the respondents are vital for the result of the study (Halldórsson & Aastrup, 2003). In this study, credibility was addressed by using a questionnaire and interviewing 20 managers at SHG from different hierarchical levels. The respondents' different answers could then be compared to reach a greater understanding of the event and result in greater trustworthiness. To ensure proper coverage at the hospital, a matrix presenting the respondents and their departments was used, see appendix E. Due to anonymity, it was not stated if the data was collected during the questionnaire or the interviews.

Transferability, external validity, refers to the study's ability to generalize and is the second dimension of trustworthiness (Halldórsson & Aastrup, 2003). Both the time and space aspects affect the possibility to generalize the finding. However, findings and gained knowledge from one context can still be found relevant in another (Halldórsson & Aastrup, 2003). Thus, the findings from this study can be valuable in other contexts.

The conventional criteria reliability is referred to as dependability by Halldórsson and Aastrup (2003). In comparison to the reliability, dependability focuses on traceability and is thus not as strict concerning the stability of data over time. However, it is necessary to document the logic of the method decisions and the process to obtain dependability (Halldórsson & Aastrup, 2003). In this study, dependability has been addressed by clearly describing the methodology of the study, using references in a proper way, and enabling the tracing of data to its source, specific interview, or questionnaire.

Last, but not least, objectivity is important to achieve trustworthiness. In naturalistic research, objectivity is translated as confirmability and seeks to clarify the findings base on the collected data. It is important to demonstrate that the empirical findings have not been affected by researchers' bias, which can be achieved using a confirmability audit (Halldórsson & Aastrup, 2003). As the context was new to the researchers, an open mind was necessary to conduct the study. With support from supervisors at SHG, it was necessary to not let them impact the researchers' interpretations too much but instead collaborate with them to get a better understanding of the situation or to use them as sounding boards.

In addition to trustworthiness, the validity of the study is also affected by the quality of craftsmanship (Halldórsson & Aastrup, 2003). Validity as craftsmanship, where the research process is evaluated, is based on three aspects; validity is to check, validity is to question, and validity is to theorize. Through the use of triangulation, control for research bias and deviants, as well as feedback from respondents, the researcher can avoid being selective and thereby address "...to validate is to check" (Halldórsson & Aastrup, 2003, p.329). With interviews and questionnaires, a large group of respondents was given the chance to participate. In addition, the interviews were recorded and later listened to several times, which ensured that the researchers interpreted and remembered the interviewees' answers correctly. "To validate is to question" is addressed as the researchers are aware that their individual interpretations may differ when collecting data using qualitative methods (Halldórsson & Aastrup, 2003). Several

times the data was interpreted differently by the two researchers conducting the report. To reach a unified understanding, the interviews were recorded and could be listened to for reinterpretation. The researchers must also be aware of the theoretical background's impact on the result as it can govern the analysis and thereby be the reason for a certain result; "to validate is to theorize" (Halldórsson & Aastrup, 2003). By using an abductive path-dependent approach, the researcher is required to iteratively work with data, theory, and analysis. In that way, the researcher does not have to choose a theory early on but instead has the ability to modify and make changes (Kovács & Spens, 2005).

## 3.7 Method discussion

As Covid-19 was a fairly new phenomenon, not much research had been conducted on how the pandemic affected the PPC or this flow of information in healthcare systems. The lack of research on the particular subjects made a literature study very difficult, which is why the case study method was chosen. The case study approach only generates context-specific learnings, where the contribution will hopefully be useful for SHG. As Swedish hospitals experienced a situation similar to SHG's, the ambition is that the report can give hints or explanations on how other hospitals in Sweden can improve their PPC. To get more in-depth knowledge on how the pandemic affected SHG it could have been beneficial to reduce the research area to one or a few departments. In this study, the researchers, however, chose to investigate a broader area to get a holistic view of the effects of the pandemic, with the risk of losing in-depth knowledge.

A literature review was done for the theoretical framework. Perhaps a broader search could have been conducted to include studies and reports covering other crises than Covid-19 in a healthcare context. This was decided not to be done due to the special characteristics of the Covid-19 pandemic, its prolonged duration, and the aim of this study, studying the particular and contemporary event that Covid-19 generated for SHG.

The abductive approach chosen for the study is considered valuable since a combination of an inductive and deductive approach was needed to understand the specific event. When being allowed to go back and forth between theory and reality, it is possible to form a more suitable theory and method for the specific event being investigated. The abductive approach was beneficial to use when forming and conducting the interviews. It enabled improvements and changes to the interview guide, which increased the amount of relevant information received during the interviews.

The large amount of data gathered during the semi-structured interviews with open questions was considered to be the main drawback of the chosen method as parts of the data became irrelevant to the aim of the study. In addition, the data analysis was very time-consuming. Scheduling and conducting interviews were also time-consuming and resulted in a long data collecting period. When evaluating a specific contemporary event with the scarce amount of research conducted before, interviews and questionnaires were considered the best choice of data collection methods. An additional challenge when interpreting the data was that some of the interviewees got a new position at the hospital during the pandemic, for example, one

interviewee was working as a physician before, but as a UM during the pandemic. This was handled by only using the interviewees' current positions.

As questionnaires by default are relatively difficult to design, the formulation of questions to be adapted to the aim of this study was conceived as being too challenging. Hence, the questionnaire was decided to only be used to strengthen the results from the qualitative interviews, enabling a simpler formulation of questions and a more straightforward analysis of the answers. As the questionnaire was sent out to all managers at SHG, the interviewees had the opportunity to answer the questionnaire as well. Due to anonymity, it was not possible to separate the individuals that were both interviewees and questionnaire respondents, resulting in a risk of duplicates. The usage of exact figures could therefore be misleading. The risk for duplicates was, after discussion, thought of as relatively small as the interviewees probably saw their participation in the interviews to have been enough, thereby possibly ignoring the questionnaire. As this report presents context-specific learnings based on individuals' experiences of the pandemic, the result is not obsolete (Yin, 2014), and the risk was therefore considered manageable.

Concerning the coding of data, another method might have been possible to use. The qualitative content analysis came with the pros of enabling an iterative process, which was needed due to the large time gaps between the interviews versus the desire to utilize the limited time to the fullest when writing the report. To make the coding of data more efficient digital tools could have been used, but since the data was widely scattered including a lot of details the tool in itself would perhaps not have made that big of a difference.

From a quality criteria perspective, validity through trustworthiness can be addressed. The credibility of the study is dependent on the respondents (Halldórsson & Aastrup, 2003), and the use of a questionnaire enabled a collection of data from all managers. Due to the response rate, and the fact that a non-response analysis was not possible as due to anonymity the capture of the overall impression cannot be 100% ensured. For the interviews, a strategic selection was made to focus on the units or departments that had a central role at SHG during the pandemic. With another group of interviewees and a higher response rate, the empirical findings could have been different, which would have affected the result of this study.

As case studies generate context-specific learnings, the transferability can be considered relatively low. The findings from this study can still be useful in other contexts and be used as a starting point for discussion. With thoroughly used references to interviewees and questionnaires, the empirical findings can easily be traced back to their source, being important for high dependability (Halldórsson & Aastrup, 2003). The degree of dependability could have been even higher if the respondents and interviewees had not been anonymous.

Concerning objectivity, the close collaboration with the supervisors at SHG could have affected the result of the study. As the supervisors are biased it was important for the researcher to not take their information as a shared understanding of truth without investigating it further. Every session also ended with the researchers, on their own, having a debrief meeting to discuss raised

thoughts and concerns. Aspects brought up during the sessions with the supervisors were later asked about during the interviews, to avoid bias and subjectivity.

According to Halldórsson and Aastrup (2003), craftsmanship is an important part to ensure the validity of the report. They point out the importance of being unbiased when interpreting the collected data, which was considered throughout the report. Despite the attempt to be unbiased, the researchers believe that some data probably have been affected by contextual and emotional aspects. An example could be how good the connection was between the researchers and a particular respondent. Another aspect to have in mind when reading the report is that the selection of theory affected the outcome of the report. If the researchers would have chosen other theories, the report could have had a different focus.

## 4 Case description

Skaraborgs Hospital Group, SHG, is controlled by the political organization Region Västra Götaland and has four facilities located in Falköping, Skövde, Lidköping and Mariestad (Skaraborgs sjukhus, 2022; Skaraborgs sjukhus, 2016a). SHG has about 4500 employees, and 517 beds and is organized into 14 departments consisting of approximately 30 medical, psychiatric, and surgical specialties (Skaraborgs sjukhus, 2016a). The utmost responsibility for the organization is handled by the Regional Council, while the political management of the hospital is managed by SHG's Political Board (Skaraborgs sjukhus, 2022). The care that is to be provided at each institution in the region is negotiated every year. Depending on the care decided to be produced, the care agreement, SHG gets an economical reimbursement to be able to deliver this care. It is then the Hospital Director who is responsible for executing what has been agreed upon (Skaraborg Sjukhus, 2022). SHG's Political Board ensures and oversees that the ordered care is carried out and creates conditions and opportunities for SHG and the Hospital Board to develop in terms of investments (Skaraborg Sjukhus, 2022).

The organizational structure of the management at SHG is presented in figure 4. The 14 DMs respond to the Hospital Director and the Hospital Board. Every department is run by a DM, and every department is further divided into several units. Each unit is run by a UM, who is responsible for the daily operations at the units and the staff and responds to the DM.

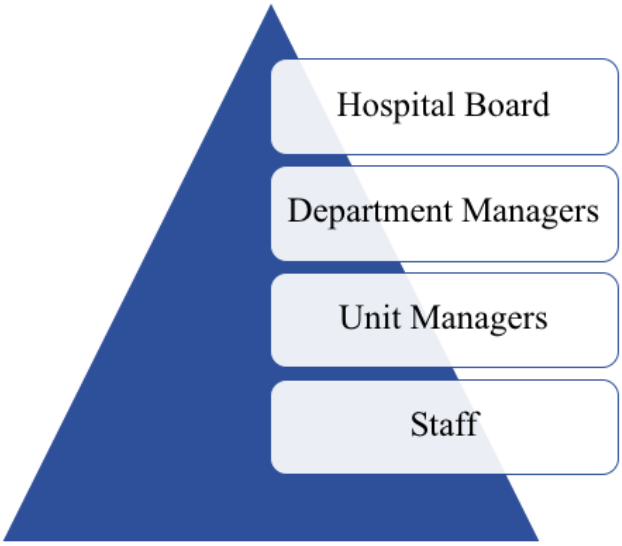


Figure 4. *Organization structure at SHG with the three hieratical planning levels and the staff level*

The vision of SHG is "The good life" and the future aspiration of the organization is to work "Together for better care and health", which entails ensuring the patients' health, creating a workplace of the future, and offering safe care in collaboration with other healthcare organizations (Skaraborgs sjukhus, 2016b). SHG must ethically ensure all are met with honesty, respect, and trust, and enable participation in the development and the fellowship of the organization (Skaraborgs sjukhus, 2016b).

SHG has plans for different crisis scenarios, such as the medical catastrophe plan including the pandemic plan (Gustavsson & Lifvergren, 2020). In March 2020 SHG treated their first patient with Covid-19 and as the disease was classified as a pandemic, SHG went from a normal state to an elevated state of emergency according to the established medical catastrophe plan (Gustavsson & Lifvergren, 2020). Apart from the normal state (N), three levels of preparedness exist and affect SHG in various ways: elevated state of emergency (ESE), reinforcement mode (RM), and catastrophe mode. The medical catastrophe plan included the implementation of a special healthcare management group, the Specialized Hospital Management group (SSL), and the establishment of the epidemic management group, Epidemic Management Group (Gustavsson & Lifvergren, 2020).

In April 2020 the level of preparedness was further raised to the reinforcement mode and SHG had by now changed the provision of care by reducing elective care and focusing on high prioritization and acute care, as well as the establishment of specific beds and patient flows for patients infected by the Coronavirus (Gustavsson & Lifvergren, 2020). In July 2020 SSL reverted to an elevated state of emergency and in September 2020, SHG returned to normal state (Gustavsson & Lifvergren, 2020). During 2020-2022 SHG adjusted its level of preparedness in accordance with the spread of infection in society, the stressed working situation, and the long queues at SHG, see figure 5 (Gustavsson & Lifvergren, 2020).

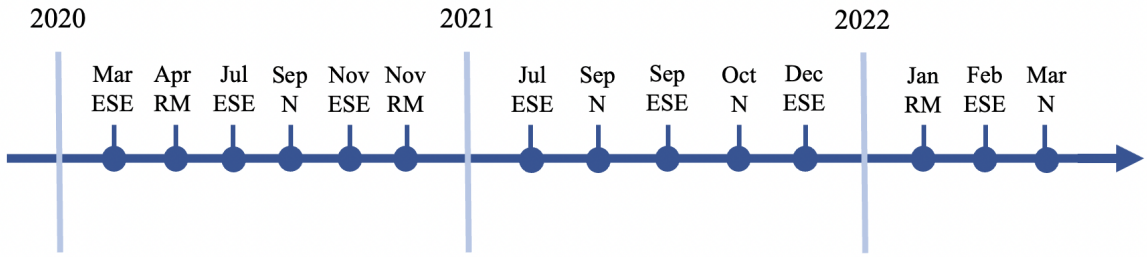


Figure 5. *SHG's levels of preparedness during 2020 to 2022*

The pandemic's different waves and the Swedish restrictions affected SHG in different ways. Staff had to stay at home with symptoms during the first wave since the testing capacity was low. During the second wave, the spread of the infections was different, and SHG had to be careful regarding the transfer of staff between units to avoid spread. During the fourth wave, the vacancy and sick leave were high due to the fast spread of infection in society. Almost 11% in comparison with normal 6-7 % of the staff had to stay at home daily.

# 5 Empirical findings

To answer the two research questions, "What learnings can be drawn from how the three hierarchical planning levels at SHG managed the Covid-19 pandemic?" and "How can these learnings improve the PPC process at SHG post-Covid-19?", the empirical findings are divided into three sections. First, the empirical findings covering SHG and the planning process before the pandemic will be presented. Second, the empirical findings covering SHG and the planning process during the pandemic will be presented. This structure enables a comparison between before and during, which is useful for the coming analysis. The chapter will lastly present the empirical findings covering learnings from the pandemic.

As the aim focuses on the hierarchical planning levels at SHG and their planning processes, the plans referred to are connected to PPC and SHG's production. It is the information connected to the PPC activities that are of relevance for the study and what is referred to when only using the term "information".

## 5.1 Before the pandemic

The following sub-chapter presents collected data connected to the PPC process and the situation at SHG before the pandemic. The data is structured into four areas identified during the data collection and the qualitative content analysis; data connected to the organization, the information flow, the planning process, and the collaboration.

### 5.1.1 Organization before the pandemic

*Hospital Board*

SHG is a large organization with the mandate to take decisions within the political frames set by the Regional Council (I4). The Hospital Board, which consisted of a Hospital Director and Vice Hospital Director together with a number of chiefs of staff, ran the hospital (I1, I10, I11, I17-I19). SHG has a hierarchical organizational structure (I12, I16) with top-down management (I4, I10). The Hospital Board handled all types of questions concerning SHG and its future before the pandemic (I3). As the Hospital Board has the financial power, all financial decisions or proposals needed to be run via the Hospital Board before execution, such as hiring new staff at a unit (I11, I16, I17, I19). The size of the organization and the structure of the Hospital Board resulted in a slow decision process and long communication routes (I17, I18). UMs and DMs were not involved in the decision process (I10, I11), and during the interviews, eight managers pointed out the slow decision process to be a result of the escalation that was needed before making decisions and acting (I1, I2, I4, I9-I11, I13, I18).

For several years SHG has focused on economy and savings (I2, I10, I11, I16). The DMs have thereby been financially regulated and forced to focus their attention on questions far away from the patients (I2, I10, I11, I16). Staff experienced a lack of resources and longer queues for care as a result of the large saving focus at SHG (I1, I3).

*The Surgery Council*

The Surgery Council was responsible for the allocation of the operating rooms (O.R.) at SHG and set the O.R. schedule four times per year, updating it every other week (I12, S). The allocation of the O.R.s was based on a historical O.R. distribution between the specialties (S, I3), and depending on the number of high prioritized patients the O.R. allocation was adjusted (S). A limiting factor for open O.R.s at SHG was the lack of both experienced O.R. nurses and anesthesia nurses (I11, I12).

### 5.1.2 The structure of the information flow before the pandemic

*Information - Hospital Board*

The Regional Council shared information with SHG's Political Board, who in turn informed the Hospital Board (I11, I17, I19). SHG got information about its mission and what care was to be provided during the coming year in the care agreement (I15). According to one manager, information sharing regionally and nationally, both upstream and downstream, was and still is a challenge (I4).

When the information was received by the Hospital Board it was transferred by the Vice Hospital Director to the DMs during Department Council meetings once a week (I8, I10, I11, I15). The Vice Hospital Director was responsible for summoning these meetings and transferring information and feedback to the Hospital Board (I10, I11). If questions, concerns, or suggestions for improvements were raised, the long time periods between the Hospital Board meetings and the Department Council meetings resulted in a protracted process (I11, I17). The Hospital Board was also sharing information with the entire organization via the intranet (I8, I12, I19). However, most of the information to the organization was given by the closest manager in the line organization (I12, I16-17, I20). The information flow at SHG is visualized in figure 6.

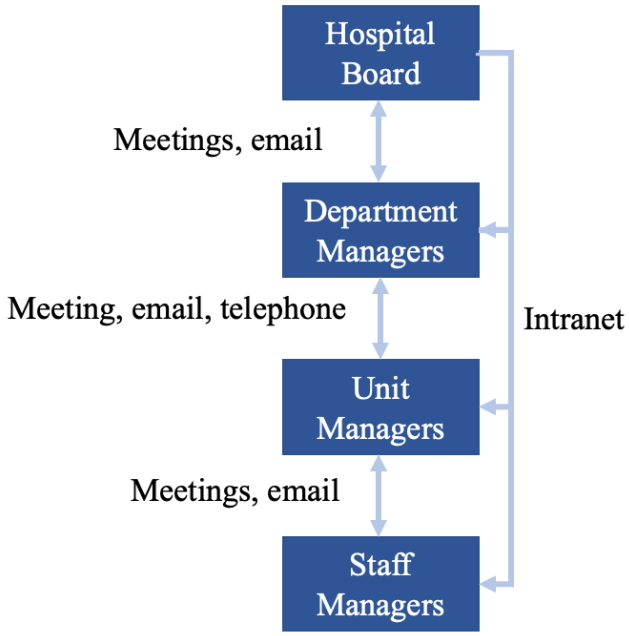


Figure 6. *The information flow related to PPC within SHG before the pandemic*

The DMs got a protocol from the Hospital Board containing information about the care agreement, available beds at the hospital, budget status, and what measures needed to be taken to maintain the balance between resources and the demand (I10). One manager believed that the DMs did not have enough information to support the planning process before spring 2020 and expressed that they:

"*...had a pretty lousy information flow.*" (I9, personal communication, 8th of March, 2022)

DMs also had meetings with colleagues from other institutions in the region every month to share information and discuss Intensive care unit (ICU) beds and surgery capacity (I1, I11).

*Information - Department Managers*

The DM was then alone (I2, I4, I20) responsible to transfer the information to the next level in the line organization. Information was transferred to the UMs via physical meetings, emails, and telephone communication (I8, I12, I19). Most of the information was shared verbally via meetings between DMs and their UMs during Managing meetings (I2). These meetings were conducted every (I1, I6) or every second week (I1, I16, I17, I19) on site. During these meetings, the managers discussed how to organize the work based on the guidelines and decisions taken by the Hospital Board, and future strategies and plans were discussed as well (I11). In some departments, DMs and UMs met daily to discuss daily planning (I20).

*Information - Unit Managers*

Via the line organization, UMs shared information with staff verbally during meetings on site (I2, I20). One UM had daily meetings for reconciliation with the staff (I17). Information about the current state and development plans as well as deviances, improvements, and working environment issues were discussed at regular workplace meetings (APT). These meetings were conducted with various frequencies, every week (I12) to every third week (I17) within the organization (I8, I12, I13, I16, I17), and a protocol was handed out to those who missed these meetings (I16). Additionally, the UMs sent out weekly information letters by email to the staff (I13, I16, I17, I19). The letters entailed updates regarding the past week, deviations, and information from the Hospital Board (I19). The UMs believed that they got enough information from higher hierarchical planning levels (I5, I6). According to several UMs, the information sharing both upstream and downstream was one of the hardest tasks to handle (I12, I17, I19).

### 5.1.3 Production Planning and Control before the pandemic

*Production Planning and Control - Hospital Board*

The Hospital Board met every other week and focused mainly on the economy, savings, long-term improvements, and a balanced budget when conducting PPC for SHG (I1, I2, I9-11, I15, I19). One manager was of the impression that the Hospital Board was more concerned about the economy than the core business when conducting PPC for the organization (I10). The Hospital Board discussed questions of varying character with both a long and short-term planning horizon (S). According to the questionnaire, PPC with a short-term planning horizon was based on staff resources but partly also on important focus areas, while on a longer horizon, PPC were based on equal parts of the economy, important focus areas, and staff resources.

According to one chief of staff, the most important guiding-star when conducting PPC in healthcare should be medical prioritization (I3) and it has been challenging to set the guidelines for one shared medical prioritization routine for the entire hospital and all medical specialties (I3).

*Production Planning and Control - Department Managers*

The DMs was responsible for handling the need of their entire department (I2), planning the production, ensuring capacity, staff, and competence at the units (I8), the working environment, and patient safety (I2, I4), while making sure that the budget was in balance (I4, I8, I10, I11, I15, I17). As stated in the questionnaire, the DMs mostly planned the department's operations with a weekly to quarterly planning horizon. PPC with a weekly horizon was based on staff resources and economic limitations. PPC conducted with a monthly or quarterly horizon was primarily based on staff resources and economy, and partly also on the patients' need for care at the department. The DM must also ensure that the care agreement was met and that SHG's vision was followed (I8, I10, I11, I15, I17). Due to financial regulation, the DM had less mandate to make decisions (I11), but one manager believed the DMs had enough mandate to accomplish their work (I18).

The DM carried out PPC with varying planning horizons (I2). The long-term strategic planning horizon extended from 1 to 10 years (I2, I11, I19) and could involve developments of the department and plans for educating staff (I1, I8, I9). The strategic planning was then broken down into shorter periods with an operative time horizon and more details (I2). The DM experienced the planning methods to be unstructured, and neither tactical nor co-planning between departments or units was used (I2, I20). Every week the DM discussed the business plans, patient security, and the budget, and identified potential improvement work together with the department's staff functions (I11). This information was later shared with the UMs during the managing meetings (I11).

When the department could not meet the demand due to lacking capacity, the DM handled the situation by buying private care (I1, Q), using overtime (I9, Q), or transferring patients to other hospitals in the region (I3, Q). According to the questionnaire, hiring new staff to handle the imbalance was also an additional option that was used sometimes, see appendix E. The reduced capacity during the summer period also affected the planning of the entire year's production at the departments (I18).

*Production Planning and Control - Unit Managers*

Decisions taken by the DMs were executed by the UMs (I2, I9) and the UMs led and delegated the work at the unit. The UMs were responsible for the working environment and staff health at the unit, for creating goals and a vision for the unit while meeting the unit's budget (I6, I17, I19). One UM emphasized the importance of having clear goals when striving forward (I13). According to the questionnaire, UMs conducted PPC with several planning horizons. With a daily and weekly horizon, PPC was based on staff resources as well as the patients' need for care, but partly also economic limitations. For PPC with a quarterly horizon, the economic

limitations had an even bigger impact, but staff resources and patients' need for care were still considered.

The UMs' goal was to maximize production (I12), and an imbalance between capacity and demand needed to be handled. The discrepancies were either handled by canceling surgeries (I16), working overtime (Q, I19), calling in staff to work extra (I19), buying private care (Q), hiring new staff (Q), or transferring staff between units (I17, Q), appendix E. The major reason for not being able to produce as much as possible is staff shortages (I1, I20).

According to a couple of managers, operative planning for the allocation of resources was done with an eight-week planning horizon, a period length of one week (I2, I20), and weekly or daily updates (I20). Two of the UMs expressed that PPC was based on data from previous years (I1, I5). The UM was occasionally supported by the DM when planning (I2). The UMs also believed that they had a relatively large mandate to make decisions (I5). At some units, a physical Care coordination meeting was held where UMs from different units discussed the allocation of staff and beds to utilize their resources in the most efficient way (I19, I20). This resulted in a better relationship and understanding between the units (I19, I20).

UMs worked with a longer time horizon as well, mainly regarding competence and skills development of staff, improvements, and development work at the unit (I13, I16, I17, I19, I20). Plan-Do-Check-Act cycles (PDCA), a control and improvement tool, were used to structure the improvement process (I19), and smaller, constant improvements were carried out regularly at the units (I13, I16, I17, I19). At one unit, daily reflection of work was exercised by the staff, either a shorter individual reflection or a meeting for all nurses after the shift was finished (I19).

Every staff member suggested their schedule for a period of 10 – 12 weeks with a planning horizon a few weeks longer than 10 – 12 weeks (I6). With this as a basis, the UMs together with a scheduling coordinator made sure that competence and capacity were met for all shifts (I5, I6, I13, I17, I19). Daily updates were then done due to sickness and other absences (I5, I19, I20). One UM planned up to five months ahead for the staff, which could be considered tactical planning (I16). To utilize resources more efficiently, co-planning of doctors and nurses was necessary according to one UM (I5).

### 5.1.4 Collaboration before the pandemic

Before spring 2020 the regional collaboration was described as scarred and unstructured in general, but according to three managers from three different hierarchical levels and functions the regional collaboration was tight and well-functioning (I2, I7, I9). At the highest hierarchical level, within the Hospital Board, the collaboration was good (I5), while the collaboration between the Hospital Board and DMs was described as less functioning (I11, I18, I19). One of the managers also stated that the Hospital Board's relationship with the entire organization was relatively limited (I19).

Each department focused on its own business and worked separately from each other. Thus, the collaboration and transparency between the departments were poor (I10, I12, I13, I16).

According to the questionnaire, nearly half of the respondents thought the collaboration between the departments was quite good while almost the same number of managers thought it was neither good nor bad. According to a manager, SHG's different departments as well as the hospital as a whole were lacking a holistic perspective when conducting PPC (I18). The collaboration between units within the same department was experienced differently by the interviewees; according to some this collaboration was close and well-functioning (I9, I17), while others described it as scarce as these units' work separated from others (I4, I12, I13). A majority of the managers answering the questionnaire believed the collaboration between units to be quite good, good, or really good.

One DM and one UM from the same department reported that the collaboration with the staff at the units was good. Additionally, several managers described physical meetings, physical presence, and accessibility at the unit to be enablers for good collaboration (I8, I15, I17, I19). A unit manager described its DM to be less involved and rarely present at the unit, which negatively affected the relationship with both UMs and staff (I16).

The relationship between staff was described as being less understanding and respectful before spring 2020 (I18) and that SHG, just as healthcare in general, was affected by a clear hierarchy between the healthcare professions (I9). However, most of the managers believed the collaboration between healthcare professions to be quite good, good, or really good (Q). Almost half of the managers described the collaboration between the hierarchical planning levels to be neither good nor bad, and approximately a third believed it to be quite good (Q).

## 5.2 During the pandemic

The following sub-chapter presents data connected to the PPC process and the situation at SHG during the pandemic. The data is structured into the four areas mentioned above; organization, information flow, planning, and collaboration, with two additional being data connected to the beginning of the pandemic and general effects of Covid-19.

### 5.2.1 The beginning of the pandemic

The knowledge about Covid-19 was low at the beginning of the pandemic (I8-11, I16, I19), and SHG learned more about the virus, patient care, sharing information, and conducting PPC with time (I10, I18, I20). Several of the interviewees believed that the hospital handled the start of the pandemic in a good way (I1, I3, I6, I11, I16), which was crucial for how SHG later dealt with the pandemic (I16). The general impression of the interviewees was that the hospital managed to mobilize fast despite the lack of knowledge or experience of anything like Covid-19 (I1, I5, I7-9, I18).

### 5.2.2 General effects of Covid-19

During the pandemic, an increased inflow of patients in total was experienced (I15). More specifically, the inflow of patients suffering from Covid-19 increased (I3, I5, I8, I9), whereas the inflow of other patient groups decreased (I2, I9, I19, I17). The increasing number of severe

Covid-19 cases resulted in an increased flow of patients to the Intensive Care Unit (ICU) and Department for Infectious Diseases, and a need for more staff in these units (I8).

The Covid-19 infected patients were more resource-intensive and required a longer time to be set aside for appointments for the staff to gear up, prepare and clean the rooms (I2, I13, I19, I20). The routines for the Covid-19 treatment were different from other patient routines regarding protective equipment and treatment (I6, I8). Units and rooms needed to be reorganized to minimize the spread of the virus when treating patients with Covid-19. For example, clean and dirty working stations and whiteboards for information sharing were implemented (I17, I20, Q). The new ways of working resulted in increased collaboration and knowledge of how to plan the care and the work at the units (I19).

The pandemic and the tough working environment that it generated have had a large impact on the staff. As capacity in terms of staff and beds has been a struggle throughout more or less the entire pandemic, staff have been forced to work very hard (I5, I7, I11, I16), working long shifts and some even shortening their vacation (I7, I12). Due to the hard-working climate and lack of recovery (I10), the staff is now exhausted (I10, I11, I16) and some have resigned (I16).

### 5.2.3 Organization during the pandemic

*Hospital Board*

The Hospital Board continued to work as usual, but as the handling of the pandemic was prioritized, they took a step back (I18). In the fall of 2021, one and a half years into the pandemic, a new Hospital Director was announced at SHG. The need for better collaboration and more direct communication with the DMs led to the implementation of a new Hospital Board structure including chiefs of staff and the DMs (I13, I18).

The budget planning at SHG was done in the same manner as before, but budget deviances were not followed-up to the same extent due to the extraordinary circumstances (I15, I18).
All managers thereby had the larger financial freedom to make their own decisions and hire staff (I1, I11). The reduced attention paid to the economy enabled an increased focus on core values for the managers (I2, I13). SHG was financially reimbursed by the Swedish Government for the expenses connected to the pandemic (I8, I15).

*Specialized Hospital Management Group*

At the beginning of March 2020, when entering the elevated state of emergency, SSL was established to deal with the pandemic-related questions (I1, I8, I18). SSL was led by the Hospital Director, with the Vice Hospital Director as the decision-maker (I18). The infection and ICU functions had important roles in SSL (I8) due to their competence and medical specialties. SSL used the already established medical catastrophe plan with the included pandemic plan as support but needed to adjust the plans to fit the period of the pandemic (I3-5, I7). The adjusted plan was divided into nine steps of escalation, depending on the inflow rate of patients with Covid-19 and the number of beds occupied by these patients (I5). Parts of the staff felt frustrated when SHG reorganized before the amount of Covid-19 infected patients had increased firmly. However, one UM believes that this preparation was critical for how they

later handled the pandemic (I16). On the other hand, one chief of staff believed that they were a bit too slow to pause the ordinary work at SHG (I18).

SSL was involved in the operative PPC for patients with Covid-19 (I1, I10), and material supply (I17) and handled organizational changes connected to the pandemic (I7). SSL even took operative decisions regarding individuals, such as vacation, due to the unique situation and shortage of staff (I18). SSL centralized the decision-making as they had a holistic perspective, and the decision function became compact and fast (I18).

SSL was the decision-making function during the pandemic and delegated tasks to be prepared by newly established groups (I18). The groups were responsible for five different areas: testing of personnel, managing overall capacity at SHG, managing ICU capacity, ensuring protective equipment, and supervising the pandemic and its progression (I1, I3-5, I7, I10, I15, I18). After preparation and decisions had been taken by SSL, DMs were informed, and tasks were delegated to later be executed by DMs (I18, I20).

In general, the decision process became faster, as less analysis and discussion preceded the decisions at SHG during the pandemic (I4, I8, I10, I11, I13, I16, I17, I20). One DM believed that the process was just like before but faster (I4). The fast decision-making did not always lead to the best result and had to be redone (I13). Some decisions were taken on a regional level and carried out at the same time at all institutions. The region as decision-maker and sender of the message resulted in a clearer and unambiguous communication with society (I4). As the spread of the infection varied in the region the decisions were not always adapted to the local situation at the institutions (I4).

*Epidemic management group*

In January 2020 Epidemic Management Group was established (I1, I3, I4, I18). Epidemic Management Group was responsible for following and understanding the pandemic and its progression (I1, I3, I4, I18) and prepared information to be used as the foundation for actions and decisions later taken by SSL (I5, I18). Epidemic Management Group had meetings once a week (I5, I13) and discussed the current situation in terms of the number of beds, patients, positive patients, mortality, new cases of Covid-19, and how communication of Covid-19 related information was to be handled (I5). Epidemic Management Group consisted of staff with relevant competencies and responsibilities for critical resources and was led by the Process Manager at the Department for Infectious Diseases, who was also the link to SSL (I3, I18).

*The Surgery Council*

Despite elective care being cut down during the pandemic, acute surgeries were still conducted. During the pandemic, the Surgery Council met once a week to discuss the prioritization of patients, the number of patients needing surgery, the number of surgery rooms available, and the number of patients with Covid-19 at the ICU (I3). Daily capacity adjustments were done due to sickness, daily variation, and transfer of staff (I3).

*Organizational remodeling and staff*

During the pandemic, new units were opened to handle the increased flow of patients suffering from Covid-19 (I1). At the end of March 2020 Unit 33 opened, which required transfer of staff (I13). The unit closed in May 2020 (I7), and another facility from Falköping was transferred to Skövde and became a Covid-19-unit, Unit 83-84. Before the pandemic, this unit was requested to be moved to Skövde, but the move was denied due to politics (I10). The pandemic pressured SHG to act, and the move was done fast (I16). Apart from these units, patients suffering from Covid-19 were also treated at already established units: ICU, Department for Infectious Diseases, Emergency Department of Medical, and Emergency Department for Surgery. The most critical Covid-19 cases were treated firsthand in the ICU and then at the Department for Infectious Diseases in Skövde (I9, I10, I13, I20).

To have enough capacity and in line with the escalation plan, staff was transferred to the Covid-19 units and the ICU (I13). It was first and foremost nurses with anesthesiologic competencies that were transferred as they were considered most suitable (I12). O.R. nurses also supported the ICU as all elective surgeries at that time had been canceled and parts of their unit had been closed down (I11, I19). When units were changed to Covid-19 units, the patients normally treated at these units needed to be treated elsewhere, which required the opening of new beds (I11). The lack of capacity forced the same number of staff to handle these beds as well, increasing the overall workload (I11).

During the pandemic, the psychosocial working environment was negatively affected for several reasons (I20). Staff feared the disease in the beginning (I5, I7, I17, I18, I20). The fear was addressed by sharing relevant and distinct information and having supportive managers (I5, I6, I13, I16, Q). The transferring of staff harmed the psychosocial working environment (I12) since the staff needed to adapt to new colleagues, new tasks, and new environments among others (I6, I16). The additional responsibilities for both the permanent and transferred staff increased the already stressful situation (I5). Despite the staff having to leave their comfort zone during the pandemic, feeling both excitement and fear, they have been unbelievably loyal and been part of the problem-solving activities at the units (I17, Q). Due to the protracted time of being in a pandemic, the staff has become exhausted (I17). Not all units, departments, and staff functions were equally affected by the pandemic (I15, I20) and this created a divergent understanding of the severity of the situation at SHG (I18, I11, I13).

### 5.2.4 The structure of the information flow during the pandemic

*Information general*

Early on, the Hospital Board focused on providing a structured information flow to keep the organization well-informed (I11, I18) and motivated (I9). Information was shared in a new way and depending on the intensity of the pandemic, meeting frequencies and information flow changed (I18). Tools for information sharing were improved during the pandemic (I2).

As the same structure was used for all meetings held by the Hospital Board and SSL (I11), it was easy to follow and understand the meetings, and easier to communicate and discuss the content (I11).

The information flow concerning PPC was described as more distinct and relevant by 43 % respectively 35 % of the managers (Q), see appendix. In the beginning, however, the information was experienced as unsorted by some interviewees (I11, I16, I20). Still, almost 70 % considered the information flow to have improved and 76 % considered it to have become more frequent during the pandemic according to the questionnaire (Q), see appendix E. Most of the managers felt well informed (Q), and the Hospital Board was considered to handle the information sharing well (I11, I17), but since the need for information about Covid-19 was rigorous, other information was harder to communicate (I2). The decisions that were to be carried out were informed about on short notice (I12, I20). The staff also got a better understanding of the Hospital Board's work due to the increased transparency and information sharing (I15). One process manager was under the impression that the new organization and information structure resulted in a flatter organization with a shorter communication route (I5). Due to the restriction of physical meetings, fewer were held (I13) and SHG was forced to learn how to handle and use digital meetings (I1, I8, I11, I12, I15 I17).

Some individuals at SHG felt frustrated when information shared from regional and national instances differed at times (I3, I4, I11), especially since it was given to everyone at the same time during Public Health Authorities' press conferences (I4, I5). With no time to prepare and plan internally, a feeling of plausibility and lack of credibility was experienced by the managers at SHG as they were not able to answer questions related to newly presented information (I4).

*Information - Hospital Board*

The Hospital Board got new information every day (I18) and experienced the information as relevant (I15, Q). The Hospital Board held less frequent and more focused meetings during the pandemic (I18). SSL had meetings two to five times a week and met more frequently than the Hospital Board (I4, I7, I8, I18). SSL was controlled by decisions taken by the Specialized Regional Management Group (I18), which several times a week discussed the number of ICU beds, staff, material and pharmaceutical shortages, routines, rooms, and capacity that the different institutions in the regions were to provide (I18). SSL then received this information (I13) and met after every Specialized Regional Management Group meeting to discuss the information and use it as input for PPC (I18). The responsible doctor in the region also informed SHG about the regional and national ICU capacity (I8). SSL was well informed (I18).

Epidemic Management Group prepared information (I4, I8, I9, I13, I18) and suggested a course of action (I4, I9) to SSL. Epidemic Management Group used data from the private lab, information about national and global spread, Public Health Authorities' and the National Board of Health and Welfare's information and recommendations (I4, I8). SSL then decided on a strategy and what activities needed to be carried out (I4). SSL delegated responsibility for tasks and activities to the DMs (I4).

The Hospital Board also shared information with the DMs. Before Covid-19 was classified as a pandemic, SHG arranged for frequent meetings with relevant DMs to set a good structure for information sharing downstream (I18). Information sharing, traditionally done via the line organization at SHG (I12, I16), was faster during the pandemic (I16). The information received

was easy to understand (I8, I10) and as good as one could expect in such uncertain times (I1). All DMs answering the questionnaire believed they got enough relevant information from the Hospital Board. Managers described the information flow as rigorous (I2, I6, I10) and sometimes even too rigorous and aggregated (I8, I9).

Orientation meetings were held for DMs, parts of SSL, and the Hospital Board (I2, I15, I18) three to five times per week (I2, I9, I10, I18) after SSL meetings (I18). The meetings had a clear agenda (I18), where the current situation regarding Covid-19 infected patients, allocation of beds, PPC for the next coming days or week, and decisions from SSL were discussed (I1, I2, I15, I18). The purpose of these meetings was both to inform concerned parties and to enable a discussion (I18). The DMs then appreciatively received PowerPoint slides to share with their UMs (I9, I10).

At the beginning of the pandemic the information focused more on Covid-19 as a disease, and today it is focused on the logistics and planning of the patient flows (I2, I16). The flow of information and information channels are to some extent still running, but not with the same intensity as during the most intensive periods of the pandemic (I16, I18).

The Hospital Board shared some information with all managers. After SSL meetings all managers at SHG were invited to an All managers meeting which was held one to five times a week (I1, I6, I8, I9, I11, I16-18, I20). The purpose of these digital meetings was to have a short informative meeting to ensure that all managers received the same information (I11) and to support the managers (I17, I18). The information entailed updates regarding the current situation at SHG, recommendations from Public Health Authorities, global and national spread of infection, pharmaceuticals, and treatment routines, occupied beds, material and material supplements, and information about shortages (I17). One UM expressed it as:

"*We received all the information that was possible to get.* "(I16, personal communication, 4th of April, 2022)

According to the questionnaire, 84 % of the respondents believed they got information frequently enough from the Hospital Board. The information became less filtered as the first-tier managers got direct information (I11, I20). The information was clear and easy to understand (I11, I17). After the All managers meetings everyone received the PowerPoint slides, which simplified the information sharing to the next level in the hierarchy (I17, I18).

One UM described the information as being shared late and that the Hospital Board could have shared information more constantly at the beginning (I12). Once the All managers meetings started, the information flow improved (I12, Q). Before the implementation of the All Managers meeting, the UM was critical to the flow of information and expressed it as:

"*Not much information sharing whatsoever.*" (I12, personal communication, 31st of March, 2022)

The Hospital Board shared information with the entire organization since it was important to keep everyone updated and avoid rumors (I7). The information was shared via the intranet, emails, and the line organization (I3-5, I7-9, I11-I13, I17, I18, I20). Most meetings were held digitally (I18). On the intranet, more than 100 documents covering hygiene and other routines were uploaded and frequently rewritten (I3, I4, I19). This overload of information (I8, I9, I19, I20) resulted in staff not having the time or all-day access to read their emails or the documents on the intranet, and missing out on information (I4, I10, I12, I17).

*Information from Department Managers*

The information-sharing via the line organization was faster than before (I12, I16). The DMs were responsible for transferring the information received at the Orientation meetings to the UMs (I4), which was accomplished during Managing meetings (I1, I8, I9, I17, I19,). The information was filtered to ensure relevance for the UMs (I8, I9), but entailed details about ICU and Covid-19 beds (I1). The Managing meetings were held more often than before (I1) and varied from every day (I6, I11, I20) and every week (I1, I6, I11) to every 14 days (I19) for different departments. It was important to inform and update the UMs often since there was a constant flow of new and frequently changed information (I11).

The DM also communicated with the UMs via email and Teams-meetings (I1). One DM shared a daily Covid report to the UMs (I8). According to one UM (I13) and the majority of the UMs answering the questionnaire, the information flow was perceived as being rigorous and relevant. At some units, a meeting to reconcile for UMs and DMs was held one (I20) to three times a day to discuss the current situation regarding beds and staff at the units (I10). One department also conducted developing meetings for the DM, the process manager, and the UMs (I10). Similar to the Orientation meetings, PowerPoint slides were created for the UMs to later present for staff to include everyone in the development process (I10).

*Information from Unit Managers*

The traditional information sharing via the line organization at SHG, and just as for higher hierarchical levels, this process was conducted faster between UMs and the staff (I16). The UMs were responsible for transferring information to staff (I4, I12, I19, I20). As much of the information, updates, and changes that were made affected the staff at the units and their working environment, it was of utmost importance that they received the information (I11). It was also important that the staff treating patients with Covid-19 felt safe (I19).

The UMs increased the frequency of meetings with the staff (I1, I16, I20), and from one (I16) to two times a day (I6, I20) information about the current situation regarding capacity and demand was shared (I6, I16, I20). It was problematic to share information verbally when physical meetings were to be avoided, and some UMs started to use a whiteboard to present the current Covid situation daily (I12, I13).

The regular APT meetings were impossible to conduct during the pandemic (I13, I19). Instead, an open discussion in the hallway was held in one unit (I13). One UM tried to have APTs as well as regular reflections digitally (I19). This UM also tried to maintain some sort of reflection

session during or after every shift for the staff. The sessions were designed to encourage open discussions and were not documented (I19). The UMs gave information via a report to the staff twice a week (I1) or sent out a weekly email about the latest information (I17, I19). The staff was responsible to read the shared information and it needed to be easy to understand (I6). Overall, the information was filtered to stay relevant for the staff and kept short to reduce the information overload (I13). In figure 7, the information flow during the pandemic at SHG is presented, where the green arrows indicate a new flow of information.

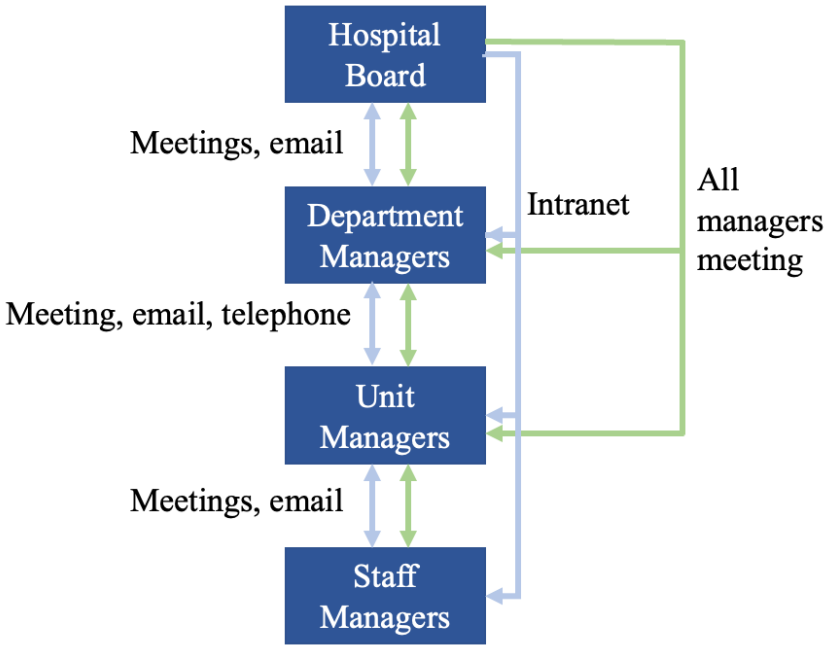


Figure 7. *Information flow within SHG during the pandemic*

### 5.2.5 Production Planning and Control during the pandemic

*Production Planning and Control - Hospital Board and SSL*

During the pandemic, the Hospital Board met as usual and discussed the same questions as before (I15, I18). As in previous years, the Hospital Board was controlled by the Regional Council (I10). According to the questionnaire, the Hospital Board planned the operations both long and short term during the pandemic, and PPC was mostly based on the patients' care needs but partly also on staff resources. However, there was a reduced focus on strategic planning and decisions, as resources were focused on handling the pandemic (I2, I3). The varying restrictions from the Swedish Authority affected the planning at SHG in various ways (I19).

SSL only focused on pandemic-related questions (I7). SSL decided on how and when to increase or decrease capacity (I9), rebuild units, transfer staff (I1, I20), educate staff (I4, I8, I10), and test staff (I4), and allocate beds (I1, I16, I10). As the inflow of patients with Covid-19 required all available resources, SHG was forced to prioritize acute care, which resulted in increased care queues (I1, I3, I11, I20).

SSL based their PPC on forecasts provided by The Public Health Authorities and information about the spread of Covid-19 in other regions since the spread in Skaraborg was a couple of

weeks behind what? (I18). The planning horizon for SSL entailed daily and weekly up to quarterly time periods (I1, I2, I10, I11, I18). SSL tried to have a slightly longer time horizon (I4), but due to large uncertainties and variations, it was difficult to have long-term plans (I3). When making decisions, SSL also valued the information from Epidemic Management Group and considered the DMs' opinions (I4), which made the DMs feel more involved (I10).

*Production Planning and Control - Department Managers*
The DMs had the same responsibilities regarding the economy, capacity, material, and patient security during the pandemic (I8, I9, I10). Their roles changed (I8, I11) partly due to them becoming in charge of new tasks during the pandemic (I4), and regarding the types of planning the DMs came to conduct. The strategic PPC was partly paused (I2, I8, I9, I11, I15, I20), and one DM described it as:

" ... *the focus was very much here and now.*" (I8, personal communication, 8th of March, 2022)

The education and competence development previously carried out was also paused as all resources had to be focused on dealing with the pandemic (I1, I9, I20). However, shorter improvement projects were done (I11).

The DMs became involved in and conducted more operative PPC (I8, I10, I11), with a weekly focus (I11). The results from the questionnaire showed that the staff resources and patients' need for care were used as the primary basis when conducting daily plans. The plans entailed a weekly planning horizon and were based on staff resources and needs for care, while the plans with a quarterly planning horizon were also based on economic limitations (Q). One DM stated that the operative planning horizon was shortened by half due to a large number of uncertainties during the pandemic and that the operative planning was updated weekly (I2). DMs handled the imbalance between capacity and demand mainly by using overtime, hiring new staff, and increasing the transfer of staff (Q), see appendix E.

The DMs followed the decisions taken by SSL and experienced having enough or even an increased mandate during the pandemic (I10, I11). Due to the need for fast decisions, some were taken without escalation as the DM reasoned:

"*You can make some decisions, and then be forgiven afterward.*" (I10, personal communication, 22nd of March, 2022)

SSL changed the allocation of beds at SHG depending on the inflow of patients (I1, I10). The DMs were paired together to handle the allocation of beds at SHG and discussed this during Care coordination meetings (I4). The DM for the Department for Anesthesiology, Surgery, and Intensive Care met digitally once or twice a week with colleagues from the other institutions in the region to discuss ICU beds with a weekly time horizon (I1, I7, I8). The DMs from the regional institutions shared a report daily to inform about the latest at their hospital (I8). The DMs were involved in planning for the opening and closing of Covid-19 beds, ICU beds, and units, together with the UMs the changes were executed (I8, I9, I11, I19).

*Production Planning and Control - Unit Managers*

The UM led and distributed the work at the unit and had the same responsibilities concerning staff health, working environment, competence, and capacity during the pandemic as before (I6). The UMs dealt with the imbalance between need and capacity through the transfer of staff between units (I5, I7, I17), overtime (I9, I13, I17, I19, I20, Q), commanding staff (I7, I17, Q), calling in staff (I19, I20, Q), buying private care (Q), or by canceling surgeries (I12), see appendix E. Some UMs could also hire new staff more easily due to fewer financial restraints (I5, I16, I17, Q). Both transfers of staff and overtime increased significantly during the pandemic according to the questionnaire. The reorganization was done to adapt to the care of patients infected by the Coronavirus and affected the UMs' planning regarding staff and the number of beds (I13, I19, I20). The simplicity to organize and preparing for Covid patients varied for the different units (I6, I20). The strategic PPC and development work normally carried out by UMs was paused during the pandemic (I13, I16, I17, I19, I20). Smaller continuous improvement projects were conducted during the pandemic (I13, I16, I17).

Like the DM, the UMs experienced an increased focus on operative PPC (I1, I5, I20, Q). The PPC with a daily and weekly planning horizon was based on staff resources and patients' care needs, and the economic limitations were less present than before according to the questionnaire. The same basis was used for the PPC with a quarterly planning horizon. However, the economic limitations were taken into more consideration. Scheduling of staff was done more or less with the same planning horizon and period as before but updated more frequently due to sickness among staff and an increase in patients (I6, I9, I12, I17, I19). Two UMs pointed out that it was the available resources, and not the need for care that laid the basis for the schedule (I12, I20). According to two other UMs, an increased focus on competence and capacity was necessary (I13, I19), and the uncertainties made scheduling difficult (I13, I19, I20). The planning horizon was shortened according to some UMs, and the situation required flexible production plans and staff (I5, I12, I20). During the most intense periods the schedules were updated every day (I20), and later every week (I16, I17).

Apart from daily planning concerning staff on-site (I6, I13, I20), ensuring daily capacity (I6, I7, I16, I19, I20), and managing patient coordination together with coordinators and nurses (I16), the UMs were involved and responsible for providing staff to other units (I5-7, I12, I16, I20). Transfer of staff depended on the inflow of Covid-19 infected patients (I12) and was initially short-term and requested daily (I17). Later, a schedule for a few weeks was handed out to the other units (I17), but as everyone was struggling with capacity, it was difficult to get staff transferred (I16, I20). Units that before the pandemic had held coordination meetings regarding staff and beds held these digitally during the pandemic (I19).

The UMs needed to plan for the education of the transferred staff a couple of days in advance (I1, I13, I16, I17). The new staff also needed to get access and find their way around the new units, which was time-consuming (I16). Another challenge when setting the schedule was to ensure that experienced staff was on-site during every shift, to support the transferred staff (I16).

The UMs had to focus on hygiene routines and the supply of protection materials at the unit (I5, I6, I9, I13, I16, I17). A couple of the interviewees experienced an increase in the mandate for the UMs and more autonomy (I5). UMs purchased new equipment and materials (I13, I17), and faster implementation of changes was possible due to fewer financial limitations (I13, I16, I17). As staff learned how to handle the new equipment, the units could perform some similar care, and the differentiation between the ICU, the Department for Infectious Diseases, and the Covid unit was reduced (I5, I12).

To manage the heavy workload for the UM, work tasks were delegated to other members of the staff, such as coordinators and nurses (I17). The UM was also supported by section leaders, subordinate to the UM while planning for staff, beds, material, information, and working environment (I19). This delegation of work and support was successful and is something that the UM wants to keep in the future (I17). Several UMs expressed that even more support was needed (I13, I16), while others believed to have enough support (I19).

### 5.2.6 Collaboration during the pandemic

*Collaboration - overall*

The collaboration at the hospital has increased during the pandemic (I7, I8, I11, I13, I18). The collaboration between the hierarchical planning levels was described as quite good or very good by 85 % of the respondents in the questionnaire. According to I13 one of the major reasons for the improvement of the collaboration was the common goal to manage Covid-19. One DM also points out the importance of having a close collaboration when making fast decisions (I11). Both trust and collaboration were reduced as meetings became digitally and more efficient (I8, I17, I19).

*Collaboration - Region Västra Götaland*

In general, the regional collaboration and communication, regarding both transferring of patients and knowledge, have improved during the pandemic (I3, I7, I8, I11, I13, I16, I18). Most focus was put on collaboration regarding O.R. and ICU since they were two of the most affected areas within the hospitals (I8, I9). I7 expresses that the collaboration between the hospital, region, and union representatives has increased (I7).

*Collaboration - Hospital Board*

The collaboration within the Hospital Board has increased during the pandemic (I4, I8, I9). The general impression is that the collaboration between the DMs and the Hospital Board increased during the pandemic (I3, I8, I10, I13, I18), especially since the DMs became part of the Hospital Board (I18). One DM pointed out that the collaboration between the UMs and the Hospital Board has increased as well (I16). The major reasons for improved collaboration with the Hospital Board were improved information sharing (I19) and increased transparency (I9, I11, I19).

*Collaboration - Departments*

The collaboration between departments (I2, I4, I5, I8, I12, I16, I18, I20) and the DMs have increased (I4); 68,9 % believed it to be quite good or very good during the pandemic. Common routines were developed, and departments helped each other (I16, I17) by solving problems together without escalating them to a higher level in the organization (I18). Increased transparency between the departments enabled better collaboration (I1). The collaboration between the units in the different departments increased as well (I12, I16, I20). The collaboration between DMs and UMs was positively affected by closer communication (I9, I12, I16). However, as some managers partly worked from home, the collaboration was negatively affected (I10, I15, I17).

*Collaboration - Units*

The general impression was that the collaboration between the units increased during the pandemic (I1, I2, I4, I6, I9, I13, I17, I20); 86 % described it to have been quite good or very good. Units that transferred and shared staff experienced an improved collaboration and communication (I17). The increased collaboration was strongly related to the increased trust, transparency, and understanding of the other units (I16). Two managers expressed their concerns after already witnessing tendencies of a lost collaboration (I3, I9). The collaboration between the UMs and staff has also increased according to I6, I12, and I19. However, I12 means that this was a result of the new manager constellation and not the pandemic.

In general, the collaboration between the staff within the unit has increased (I4-6, I11, I13, I16, I18, I19). According to the questionnaire, 91 % believed it to have been quite good or very good. Trust and understanding between the different healthcare professions have increased (I18, I16), which in turn created a will to work together (I13, I16). I17 also explained that more collaboration was needed between staff when handling Covid rooms. I9 believes that the classic hierarchical structure in healthcare was reduced during the pandemic as the staff started to respect one another more. Two UMs believe that the collaboration between the staff was similar to the situation before the pandemic (I12, I17).

## 5.3 Identified learnings

The last sub-chapter presents the collected data which covers learnings, connected to the PPC process, made at SHG during the pandemic. The learnings are structured into four areas; learnings connected to the information flow, the planning process, the collaboration, and the learning process at SHG.

### 5.3.1 Learnings regarding information flow

The importance of communication, management, and preparedness became evident during the pandemic (I7, I18, I20, Q). The information structure used at SHG before the pandemic was not built for a rigorous information flow (I2). By sharing information via the line organization, a rigorous information flow pressures the individuals transferring the information even more and can thereby be considered a vulnerable system (I2). Two UMs pointed out that the

information being shared from the DMs to the UMs can vary depending on how the DM interpreted the information from the Hospital Board (I12, I16).

The staff had a huge need for information, partly due to fear and lack of knowledge of the disease (I17). One DM stressed the importance of keeping up the high information flow, using communication tools and meetings (I9) as well as increasing transparency between top management and staff (I17), which the staff has gotten used to (Q). Having a functioning information flow was important (I6, I9, I10, I12, I17, I18) and managers stated that the PowerPoint slides received after both the All managers meeting and the Orientation meetings have been useful (I10). The information had a good structure, and the information flow has been working well (I17). The increased meeting frequency between all levels was appreciated (I10, I11) and the development of digital meetings resulted in higher efficiency (I9, I15, I19, Q) and increased flexibility (I19, Q). One manager, however, expressed the importance of having physical meetings with staff to enhance collaboration and trust (Q).

The Orientation meetings are still running but are now more focused on O.R. capacity (I18). As all DMs attend these, the consensus was accomplished and a holistic view regarding the need for O.R. slots was enabled (I18). The All managers meetings are also still running as it was found valuable to have direct contact and give all managers the same information, but now less frequent (I11, I16, I18, Q). One UM suggested a similar meeting as the All managers meeting to be held for everyone at SHG, to ensure a well-informed organization (I12). The Care coordination meeting that was held by the paired DMs has been useful and is something one DM wishes to keep in the future (I4).

### 5.3.2 Learnings regarding the planning process

*Production Planning and Control*

Healthcare staff is considered to be good at handling shorter crises (I7, I17), and the experience from the Covid-19 pandemic has resulted in more knowledge and a better understanding of the needed preparation and planning for future crises (I6, I9, Q). One area that received more attention at SHG during the pandemic was PPC (I2, I3, I18, Q). Several interviewees believed that an increased focus on planning and specifically production and capacity planning will be necessary to deal with the even longer queues that the pandemic has generated (I2, I3, I18, I20).

As an effect of the shortened planning horizons, units with planned care experienced an increased amount of missed appointments and idle time, but the need for rescheduling was reduced (I2, I20). As the short planning horizon comes with limitations, managers expressed the importance of having a broader perspective, a longer planning horizon, and planning together in the future (I1, I8, I20, Q). According to two managers a pandemic can not only be handled operatively, and tactical planning at a hospital-wide and department level is needed (I2, I20). SHG has started to implement tactical PPC in a structured way during spring 2022 (I20). Handling capacity problems together and having flexible staff with several medical competencies was considered useful by one DM. According to one UM, it will be challenging to keep a holistic mindset in the future as:

"*All departments are closest to their own patients.*" (I20, personal communication, 25th of April, 2022)

During the pandemic, SHG became more data-driven and used a model to visualize the waves of the infection (I18). As the system entails a lot of data, it could be used to an even larger extent in the future (I1, Q). One manager pointed out the need for conducting PPC based on forecast need or demand instead of on available capacity (Q).

*Decision process*

The faster decision process during the pandemic should be kept according to two DMs (I4, I8, Q). Two managers expressed that the decision process needs to be slowed down to some extent to make room for analysis and discussion. It is also important to reevaluate the decisions to see if a new one should be made or if it should be kept (Q). A clarification of mandate and being able to make decisions close to the affected process were pointed out as important learnings (I4, 120).

Some decisions taken and changes implemented during the pandemic had been discussed for a long time, and for these, the pandemic stressed the importance of making the decisions, which accelerated the organizational development (I2). Similarly, other changes would perhaps not have happened without the crisis (I15). The pandemic has also helped the organization to understand that fast decisions are possible as well as to put things aside and prioritize what is urgent (Q).

*Organizational remodeling and staff*

The opening of a specific Covid unit with staff from different units and departments was both difficult and costly and should therefore not be done in the future (I5, I10). By letting all departments treat Covid-19 infected patients, instead, patients that had a disease and also tested positive could be treated at the correct unit to ensure the best possible care for the patients (I10, I16, I20). If all units and departments were educated in Covid care, everyone would know what to do in case of a hospitalized patient testing positive for Covid-19 (I16, I20). This would have been safer for both the staff and the patients (I16).

The pandemic reminded the staff about their main mission, treating patients (I9). In the beginning, some staff considered the pandemic to be exciting to work with. However, the pandemic's protracted period successively reduced the excitement (I11). The staff developed and learned to readjust and to be more flexible (I3, I9, I19, Q) and the managers were amazed by how the staff handled and adapted to the stressful situation (I3, I9, Q). The staff's decisive role in the pandemic was commented on by one UM:

*"If you have the will and commitment, especially in a crisis, it is possible to change focus fast or be forced to change focus fast"* (I16, personal communication, 4th of April, 2022)

Learning from the pandemic was that a hospital-wide concept for how to transfer staff would have been beneficial and more efficient (I12). It was challenging to be transferred to a new unit

(I8) due to new colleagues, a new working environment, new routines, and fear of working with patients with Covid-19 (I6, I7, I17, Q). Some staff was also suspicious regarding the units' efficiency and their need for transferred staff since they did not want to be transferred to another unit (I9).

Another learning was that the permanent staff should have the responsibility for the patients at the unit and the transferred staff should have a more supportive role. Thus, the transferred staff could focus on maintaining competence to reduce frustration and fear (I12, I17). Some of the transferred staff's competence was not used to its fullest, and this was considered a waste of resources (I12). By transferring the same staff, education would not have been needed to the same extent, and the transfer would have been more efficient (I1, I6). As the transferred staff lead to an increase of individuals in some workgroups, the number of UMs would also have needed to increase to be able to support the staff properly and divide the workload better (I8). Managers' trust in their staff, delegating tasks, and giving them more responsibility worked well and should be kept in the future (I6, I17).

At times some units did not have enough patients to fill their beds, while others were struggling to keep up the capacity (I17, I20). As the number of patients infected by the Coronavirus affected the units to a varying extent, the resources should have been reallocated evenly (I8). One manager also expressed that some administrative staff with healthcare competence could have worked more hands-on to reduce the staff shortage (I17). If overcapacity had been practiced at SHG, it probably would have resulted in a better working environment, fewer ad hoc solutions, and less overtime, all being financially beneficial (I16).

### 5.3.3 Learnings regarding collaboration

The stressed situation motivated development in several areas and forced the organization to collaborate more, both managers and staff (I1, I15, I16, Q). One DM used the connections and relations already established to be able to solve problems and collaborate over borders (I10). Several of the managers at the hospital have experienced an increased feeling of unity as SHG had a common goal, which enabled a cultural change (I2, I11, I13, I15, I17, I18, Q). Some new groups and networks formed during the pandemic will be kept in the future, mainly as multiple competencies are a necessity to enable patient security on an aggregated level (I5). A respondent to the questionnaire also mentioned that the common platform and networks helped the organization to work towards the same goal. An additional comment from a respondent was that the collaboration between units performing similar care can benefit from collaborating as experiences and ideas can be shared (Q).

Due to improved and developed collaboration, an increased understanding of each other and knowledge about other units and departments have been accomplished (I12, I20). Increased collaboration between DMs and the decision-making function during the pandemic, led to several departments experiencing an increased awareness and appreciation for their importance and function in the organization by others (I2, I10, I20, Q). The impact that departments and units with many internal interfaces had on SHG's overall production, became more evident during the pandemic (I20, Q). For these resources, communication became crucial (I20).

Despite the staff shortage, all units managed to get through the day by collaborating (I17), and managing the pandemic was a team effort (I16). This collaboration is important to maintain as SHG faces new challenges in the future (I15, I16, Q). A strategy for how to maintain it in the future at SHG is under development (I18, I20) as SHG needs to have a well-functioning collaboration (I12, I17, I18).

### 5.3.4 Routines and processes for learning

All interviewees stated that continuous improvements were conducted, but a majority expressed that SHG did not have a clear structure for sharing and refining learnings (I11, I12, I16, I17, Q). Hence, lessons from local improvement efforts tended to stay at the units or departments (I11, I16, I20, Q). The managers answering the questionnaire nonetheless presented the main routines for sharing and refining learnings to be networks, managing meetings, APT meetings, intranet, and reflections in the working group. Other less prominent activities were formal evaluations and questionnaires and SHG's development days. Only 3 % stated that they did not know of any routines for sharing and refining learnings (Q). According to several managers ad hoc solutions are common (I11, Q). Several respondents to the questionnaire also stated that they lacked knowledge about where and how learnings were shared and communicated. One manager stated that good examples exist at SHG, but they find the networks used for sharing knowledge between managers to be underdeveloped (Q).

The evaluation process and improvements of medical processes and routines were well-functioning before the pandemic, but other processes were not evaluated or examined to the same extent at SHG (I10, I17). However, one non-medical process that has been evaluated occasionally before the pandemic was the summer period (I11, I12). During 2021, an evaluation of the Covid-19 pandemic was done (I11, I12). The managers expressed it to be difficult sharing knowledge and learnings with the rest of the organization (I17, Q).

One manager described the evaluation of non-medical processes as non-existent (I10) and another manager did not know how information was being refined and shared after evaluations (I11). The lack of documentation of improvements and implementations results in questioning already established routines and processes at the unit according to one manager, while another stated that improvements tended to stay on paper and not be implemented (Q). However, one manager pointed out that SHG had processes for maintaining and sharing knowledge and learnings, one being the shared routines (I18).

Several respondents to the questionnaire believe reflection, sharing knowledge and learnings, personal development, and improvement work are important but time-consuming activities that are difficult to prioritize in favor of patient care and a heavy workload. Improvements and good examples are easily forgotten, and reverting to old patterns and routines is easy, which has resulted in halted improvement and sharing processes (Q). Apart from the above, managers believe the slow organization and separated departments together with the staff's varying degree of motivation, susceptibility, and exhaustion to be barriers to sharing and refining learnings and making use of new knowledge generated during the pandemic (Q).

# 6 Analysis

In the analysis, the empirical findings of the study are interpreted and connected to the theory presented in the theoretical framework in chapter 2. The analysis is structured in four areas: information flow, planning process, collaboration, and learning organization all connected to the PPC process, and aims to answer the two research questions. A summary of the learnings, addressing RQ1, "What learnings can be drawn from how the three hierarchical planning levels at SHG managed the Covid-19 pandemic?" and, RQ2, "How can these learnings improve the PPC process at SHG post-Covid-19?", is presented in Appendix F.

## 6.1 Information flow

During the interviews, the importance of well-functioning information and communication systems was emphasized. Vermeir et al. (2015) state that the lack of a well-functioning information and communication system can result in dysfunctional information, causing reduced safety and poor utilization of resources. As PPC aims to achieve a balance between demand and supply (Jonsson & Mattsson, 2009), it is of utmost importance that the information system is working. Lunenberg (2010) points out that the carrier affects the quality of the information, which can be linked to the risk of mainly sharing information via the line organization.

Increased intensity of the information flow created improved transparency and knowledge in the organization during the pandemic. However, several managers highlighted the heavy and unstructured information flow experienced at the beginning of the pandemic to have been problematic. These problems can be defined as process barriers and can be reduced by choosing another medium or encoding the information differently (Lunenberg, 2010).

The increased number of meetings between all levels as well as the frequency of them have been appreciated. One reason is the improved transparency. Another reason could be that face-to-face communication is the best and most clear way to communicate according to Vermeir et al. (2015). These meetings were mainly done digitally due to restrictions but were considered to be more efficient and flexible by the managers. According to several managers, digital meetings also come with the risk of losing collaboration and trust, which could be connected to the physical barrier touched upon by Lunenberg (2010). To not lose the already established flow of information and the employees' habits to handle the information, the established channels and mediums for communication must, according to the managers, be maintained after the pandemic.

Summarizing the learnings from the information flow connected to PPC the two research questions are answered. One learning is to maintain the established meetings and channels of information formed during the pandemic to ensure a well-informed organization and improve the PPC. Further answering RQ1, SHG must consider their choices of medium and carrier when sharing information with the organization. It is also important to keep sharing relevant information with the organization and avoid information overload. SHG therefore must

consider the message and its receiver to address the process barriers and psychological barriers. Considering the above learnings, the staff at SHG will be well-informed and with improved input for the planning, the result of the planning process will be better, which answers RQ2.

## 6.2 Planning process

Based on the empirical findings, the impression is that operative, tactical, and strategic planning for PPC was done more or less at all levels before the pandemic and that there was no shared plan or strategy for what specific questions and decisions to be dealt with at the different hierarchical levels at SHG. Before the pandemic, the Hospital Board based the PPC on the care agreement and SHG's mission. For the more operative plans, staff resources and important focus areas were also considered. Plans for improvements on a strategic and tactical level were conducted by all managers and the Hospital Board at SHG, but with different focuses. SHG showed proof of some alignment of plans (Jonsson & Mattsson, 2009) as the care agreement was considered for the planning process at lower levels. Development plans could also be aligned and be based on the focus areas decided upon by the Hospital Board. By allowing the departments and units to pursue areas of their own within agreed limits, SHG could achieve both exploration and exploitation, and organizational ambidexterity (Crossan et al., 1999; Birkenshaw & Gibson, 2002; O'Reilly & Tushman, 2011). The managers stated they had enough mandate to make decisions as they managed and emphasized the constant need for escalation as they were managed up (Glouberman & Mintzberg, 2001a). The slow decision process and slow organization were considered problematic.

During the pandemic the structure for decisions and planning process was clearer; SSL led the pandemic-related work; the main focus was operative planning, and everyone became aware of what was discussed and decided upon by the different group constellations. The Hospital Board took a step back, and less focus was given to the care agreement, strategic, and tactical planning. As everyone from SSL down to the UMs was involved in operative and daily planning, all managers got to practice this type of planning. Since all hierarchical levels had an operative focus and shared goals, plans were aligned. As the tactical and strategic levels were less active during this period, alignment as Jonsson and Mattsson (2009) describe it, was not present. With a more mature PPC process for every hierarchical level, more aligned plans could be generated at tactical and strategic levels (Jonsson & Mattsson, 2009). SSL based its operative plans on forecasts for demand and need for healthcare services, which aligns with the recommendations by Jonsson and Mattsson (2009). The DMs normally base their operative plans on staff resources and economic limitations, and tactical plans on staff resources, economy, and partly the patients' needs for care. During the pandemic, the focus slightly changed for the operative plans as they were based primarily on staff resources and needs for care, and not on economical limitations. The plans conducted by the UMs remained more or less the same and were based on staff resources and need for care, with reduced financial limitations during the pandemic.

The formation of SSL and their close collaboration with the DMs have been stated to be a well-functioning model during the pandemic. By establishing a cross-functional team including individuals with special competencies and department knowledge the collaboration increased.

Additionally, a more holistic perspective was achieved, and more direct communication was established. As stated by Rhyne and Jupp (1988), Mintzberg and Glouberman (2001a), and Danese et al. (2018), a hospital needs to collaborate and have a holistic system view, to avoid operating as isolated departments or silos, which was done at SHG before the pandemic.

The escalation plan used by SSL is one example of a proactive capacity change, but as the pandemic constantly changed character, it was hard to be proactive. It is expensive to have unutilized resources on site, but as financial regulations were reduced during the pandemic, a proactive approach was possible (Vissers et al., 2001). It was stated by several interviewees that it was difficult to be other than operative due to large uncertainties which align with Jonsson and Mattsson (2009).

SHG dealt with the imbalance between capacity and demand in more or less the same way at the different hierarchical levels. Before the pandemic, most of the managers used overtime, transferred staff between units, hired new staff, or bought care from private caregivers. The same corrective measures were used during the pandemic at the hierarchical planning levels, but to a larger extent to deal with the increased imbalances between capacity and demand experienced at the different units and departments. As stated by one respondent, it is however important to consider the distribution of overtime, to reduce the risk of exhaustion. Vissers et al. (2001) state that demand, in general, is higher than supply in healthcare, and with an increase of patients during the pandemic, an even higher demand was experienced. This aligns with the shortage of staff experienced by the managers at SHG and explains the low number of managers freeing up resources using vacation.

When it was decided that all units were to take care of patients suffering from diseases within their specialties despite the patients testing positive for Covid-19, all staff needed to have knowledge about Covid-19 treatment, which is both time-consuming and expensive. As all units could provide Covid-19 care, more flexibility was achieved (Jonsson & Mattsson, 2009). The equipment for this type of care was needed at more units, which potentially resulted in an increased cost for SHG. With flexible capacity, staff can be transferred and share the workload to meet the demand (Jonsson & Mattsson, 2009).

The pandemic highlighted the vulnerabilities of the system, and the bottlenecks became even more prominent. Two shared resources at SHG are the radiology department and the O.R. unit. With a high inflow of patients with a dependent demand, it is important to coordinate PPC (Jonsson & Mattsson, 2009). Co-planning is already in progress at the Surgery Council, although the PPC is not based on demand, but on a historical allocation of O.R. time. Something similar, using medical prioritization as a guiding light, for all shared resources is needed to ensure efficient usage of costly resources (Vissers et al., 2001) while ensuring proper service of the population's health (Glouberman & Mintzberg, 2001a). Medical prioritization can be related to what Jonsson and Mattsson (2009) refer to as priority control. When the demand increased and the pressure on SHG became larger, the handling of the bottlenecks became even more important, which aligns with the recommendation made by Jonsson and Mattsson (2009). The bottleneck resources thereby got more attention from the other parts of the hospital.

Addressing RQ1, the learnings identified from the planning process are that SHG needs to implement a more structured planning process, clearly stating planning and control levels, mandates, and responsibilities. PPC should be based on forecasts for demand to a greater extent. Tactical planning should be further developed, flexible capacity implemented, co-planning enhanced, and a more holistic view should be applied when conducting PPC. The presented learnings improve the PPC, RQ2, as more aligned plans can be generated. An increased awareness of operative planning generates a better understanding of the planning process as a whole and an increased efficiency of resources is achieved, answering RQ2.

To further address the second research question, how the learnings can improve the PPC at SHG, the theory presented in chapter 2.2 could be applied in a normal state. The theory presented by Jonsson and Mattsson (2009) is based on a manufacturing context, which consequently needs to be considered thoroughly before implementing in a healthcare and service context. With the framework grounded in a healthcare context presented by Vissers et al. (2001), some of the potential risks of implementing a theory based on a manufacturing context are reduced. A suggestion for implementation is presented below. Top management should carry out strategic planning, for example, Sales and Operations Planning (S&OP) (Jonsson & Mattsson, 2009). From Vissers et al. 's (2001) framework, strategic planning and patient volume planning and control align with the characteristics of the S&OP process. As S&OP is a cross-functional process it is important to include all functions in an organization to achieve a good output (Jonsson & Lindau, 2019). Before the pandemic, SHG carried out strategic PPC, focusing on staff resources. According to Jonsson and Mattsson (2009), SHG should base PPC on the demand for care primarily, similar to what was experienced during the pandemic.

The Hospital Board at SHG should carry out the strategic planning. According to Jonsson and Mattsson (2009), plans with a longer planning horizon have the advantage of being more flexible due to the low level of details; this should be considered by top management when conducting PPC, as they can make more rigorous and long-term adaptations. With a Hospital Board including chiefs of staff and DMs, with competence in the organization's processes, the S&OP process can be smooth due to the cross-functionality established and result in an enhanced information flow, increased service level, more holistic perspective, and reduced silo cultures (Danese et al., 2018). At this level, SHG should handle imbalances between capacity and demand by distributing competence among staff within the organization, opening and closing units, and readjusting manning levels when needed (Jonsson & Mattsson, 2009).

The lack of tactical planning on a hospital and department level has been addressed during the pandemic and is about to be implemented at SHG. For tactical planning, Jonsson and Mattsson (2009) state Master Production Scheduling (MPS) to be a favorable process with a shorter planning horizon and period length than S&OP. According to Jonsson and Mattsson (2009) the tactical process, MPS, uses either current customer orders or forecasts, or the two in combination as input and is controlled by the decisions taken at the S&OP level. Resource planning and control is the tactical planning process suggested by Vissers et al. (2001) and

capacity is planned on a product group level. This aligns with the focus on the whole department concerning planning objectives and capacity in MPS (Jonsson & Mattsson, 2009). However, Vissers et al. (2001) point out the importance of co-planning of the shared resources in the organization to ensure high utilization. Using the planning levels from Jonsson and Mattsson (2009) applied to the hierarchical planning levels at SHG, see figure 8, together with the reduced need for involvement of top management, the tactical planning should be carried out by the DMs. Before the pandemic, DMs planned for different planning horizons with a larger focus on long-term planning for their specific department.

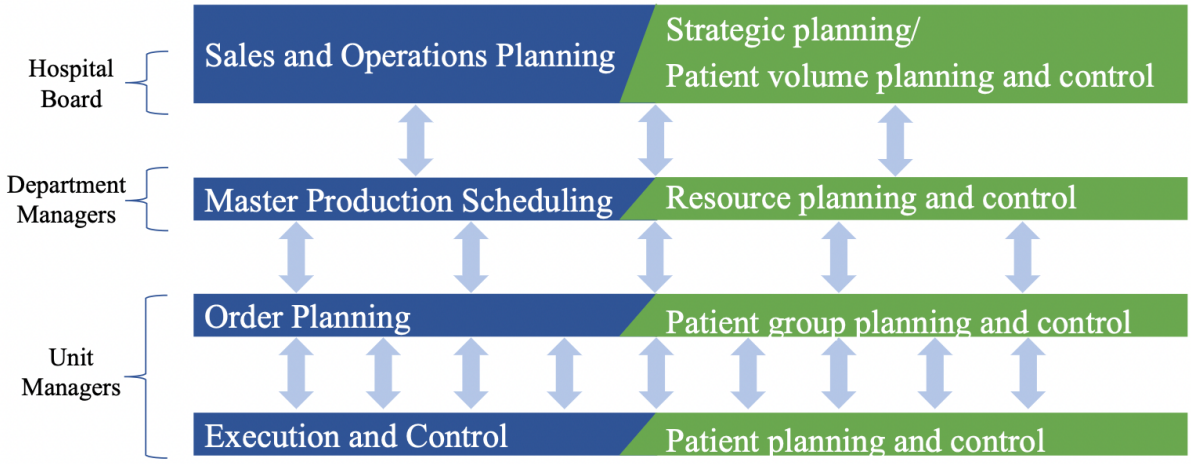


Figure 8. *The suggested application of the planning levels from Jonsson and Mattsson (2009) and Vissers et al. (2001) applied to the hierarchical planning levels at SHG*

UMs carried out most of the operative planning at SHG before the pandemic and during the pandemic, all managers were involved in operative PPC. Many of the activities and decisions previously handled by UMs, such as the number of beds, capacity for the coming weeks, and approval of staff vacation, were done by SSL. Such plans align with the Order Planning process presented by Jonsson and Mattsson (2009) and patient group planning and control by Vissers et al. (2001). Both require more frequent updates and less flexible freedom. Order Planning considers capacity requirements for the released orders (Jonsson & Mattsson, 2009). This is in line with how SHG dealt with operative planning both during and before the pandemic. The most detailed planning level, presented by Jonsson and Mattsson (2009), is execution and control, or patient planning and control by Visser et al. (2001), and was mainly performed by the UMs, both during and before the pandemic. UMs were responsible for prioritizing patients and controlling availability and capacity for the execution every day. During the pandemic, some of the UMs expressed the need for reevaluating the PPC several times a day, which indicated that the planning horizon was shortened. Operative planning and execution and control should be carried out by UMs in a normal state.

In a normal state, where the economy is one of the biggest controlling factors for SHG, the reactive approach is probably more common as a hospital needs to focus on utilizing its costliest resources more efficiently (Vissers et al., 2001). If longer planning horizons would have been

used during the pandemic, more adjustments could have been made to the capacity problems (Jonsson & Mattsson, 2009).

The largest difference before and during the pandemic was the shorter planning horizons, fewer financial limitations, and an increased focus on the demand when conducting PPC. The shorter planning horizon was needed as the pandemic's characteristics demanded it. It resulted in increased stress and re-scheduling of staff with short notice, but also missed appointments for the planned care units and idle time.

## 6.3 Collaboration

SHG realized the importance of increased collaboration within the hospital, and through increased collaboration and an improved information system, SHG handled the pandemic more efficiently. According to Glouberman and Mintzberg (2001a), the collaboration across and within the four worlds is important, but problematic due to their various key characteristics. Glouberman and Mintzberg (2001b) present six coordination mechanisms that could be used to improve the integration or reduce the differentiation between the worlds. Several of these coordination mechanisms have been identified in the case of SHG and can be seen as reasons for the improved collaboration. The first coordination mechanism identified as standardization of work was the shared routines formed to handle patients with Covid-19. A second coordination mechanism identified is Mutual adjustment, addressed through the improved communication and understanding of each other within the organization. Standardization of norms is identified as a coordination mechanism as well. During the pandemic the entire hospital struggled with the same main problem, to ensure capacity. Treatment of the increased number of patients forced SHG to collaborate, which correlates with Bradbury and Lifvergren (2016) and Hellström et al. (2014) who point out the patient to be the combining factor of the four worlds. These shared beliefs and values made them strive towards the same goal. According to Glouberman and Mintzberg (2001b), the Mutual adjustment and the standardization of norms are strong complements for the healthcare system to improve collaboration. O'Reilly and Tushman (2011) further indicate that without common values, vision, and communication systems, collaboration and trust will be lost, which was mentioned by several of the managers at SHG as well.

In addition to the coordination mechanism, the two forces presented by Glouberman and Mintzberg (2001a) are identified as enablers for improved collaboration at SHG during the pandemic. The interviewees clearly express a feeling of being one team, with a holistic view of working towards a shared goal when being exposed to a crisis. Everyone was reminded of their main goal, treating patients. This correlates with the force of sharing a purpose and feeling a sense of urgency. The second force, working to fulfill a higher purpose, can also be seen at SHG as the managers pointed out that the staff pushed beyond their limits to handle the stressed situations and were unbelievably loyal.

As Glouberman and Mintzberg (2001b) point out, collaboration can be increased either by improving the integration or reducing the differentiation between the four worlds. At SHG both

these changes have been done during the pandemic. While the increased communication and transferring of patients are examples of integration, differentiation was reduced between cure and care, as they worked closer to each other and shared tasks.

There are several identified learnings from a collaboration perspective that affected the planning process, RQ1. SHG has been reminded of the importance of collaboration, having a holistic view, and a shared goal when conducting PPC. Several of the interviewees expressed a concern that the collaboration will be lost when the pandemic has reached its end. The coordination mechanisms must be addressed, and the reduced differentiation and improved integration need to be preserved to maintain collaboration. However, the boundaries between the four worlds are inevitable and as differentiation is one of the system's strengths (Glouberman & Mintzberg, 2001b), SHG should prioritize integration in the future. The learnings addressed above answer RQ2 as they reduced differentiation and improved integration, which resulted in better collaboration and co-planning. With common values, and visions, the staff at SHG worked more as one team with a holistic perspective, which led to a workgroup working very hard to achieve its mission. All directly or indirectly affect the PPC process positively.

## 6.4 Learning organization

One of the most important learnings identified is the lack of a structured and communicated learning process at SHG. Without a functioning learning process, the identified learnings presented will be irrelevant and SHG will not be able to refine or share the learnings within the organization to improve the PPC process in the future. Below, recommendations are presented for how SHG can achieve and improve its organizational learning.

The pandemic affected the three dimensions of learning presented by Illeris (2003) for the staff at SHG. By triggering both fear and excitement for the staff, the emotional dimension was addressed, and through increased collaboration and communication the social dimension was affected. With a high need for constant learning as the pandemic and its characteristics changed, cognition was also affected. Based on the empirical findings, the employees at SHG have increased their medical knowledge. As knowledge linked to previous patterns as well as breaking new ground was accomplished, assimilative and accommodative learning was achieved (Illeris, 2003). The pandemic's effect on society and the daily work at SHG forced the staff to intuit patterns and interpret these, examples being Covid-19 as a new disease and the new organizational structure. As mutual agreements were developed for collaboration, decision making, and Covid-19 treatment among others, integration slowly took place. As these later became embedded in the organization, institutionalization was to some extent achieved (Crossan et al., 1999). Similar to the transformative learning presented by Illeris (2003), the pandemic was initiated by a crisis. The pandemic was a new phenomenon and SHG had no other choice than to change its organization and handle the situation by learning gradually.

The managers mentioned that a large number of changes were done at a fast pace during the pandemic. However, several of the managers point out that the changes would probably have

happened despite the pandemic, but at a slower pace. This effect can be related to the sense of urgency presented by Fredberg and Pregmark (2022). Covid-19 increased the urgency within the organization, which became more focused and productive, and thereby made faster changes possible (Fredberg & Pregmark, 2022).

Sharing and refining learnings in an organization are the basis for organizational learning. Apart from during the pandemic when most of the education, improvement work and reflections were paused, SHG used several different strategies for organizational learning. APT, PDCA cycles, networks, different meetings, and reflection in workgroups were the most common tools used to refine and share learnings at SHG. With this structure for learning, new ways to act on an individual, group or organizational level were discussed. The new patterns were then discussed during the different types of meetings, and resulted in a revision of previous patterns, followed by reflection at the next meeting, seen as learning loops at the different levels. As these activities were done regularly, an interplay between think, reflect and act was enabled, which is a fundamental part of individual, group, and organizational learning according to Crossan et al. (1999).

As individual learning is a prerequisite for organizational learning (Crossan et al., 1999), activities like reflection and personal development must be prioritized to address intuition and interpretation (Crossan et al., 1999). Based on the empirical findings, the handling of the pandemic is a good example of SHG's well-functioning individual learning. Using PDCA cycles, reflection, different meetings and networks, new ways to act on an individual, group or organizational level were discussed. The new patterns were then discussed during the different types of meetings, and resulted in a revision of previous patterns, followed by reflection at the next meeting, seen as learning loops at the different levels. Summoning specific meetings and networks for learnings to be shared, address interpretation and integration to achieve group learning (Crossan et al., 1999). The last step is institutionalization and requires that the shared learnings result in formal routines, which later are embedded in the organization (Crossan et al., 1999). The empirical findings point towards institutionalization as the biggest obstacle for SHG as the learnings tend to stay at a group level and not be shared on an organizational level.

The managers also pointed out the difficulties with the current learning process, where a clear and shared understanding of the process is lacking. As stated by O'Reilley and Tushman (2011), a shared agreement of being an ambidextrous organization is needed to avoid ambiguity.

Summarizing, there are several identified learnings that can improve the learning process in general at SHG. These identified learnings further result in an improved learning process for refining all learnings identified to improve the PPC process at SHG presented in this chapter, thereby indirectly answering RQ1 and RQ2.

# 7 Discussion

In the following chapter some of the identified learnings from the empirical findings and the aspects brought up during the analysis will be discussed further. The discussion is presented in the four areas: information flow, the planning process, collaboration, and learning organization, all in relation to Production Planning and Control.

## 7.1 Information flow

It is important for SHG to address the drawbacks of sharing information in the line organization by using other mediums, as was done during the pandemic. Digital meetings are useful when a larger group of people, physically dispersed, are the receivers of the information. The digital meeting provides flexibility, can secure a larger spread of information, and does not need a physical spacious location. This format is potentially best suited for information sharing and less discussion, such as in the All managers meetings.

The message is another thing to consider for SHG. Some information is more sensitive and affects the individuals directly, such as changes in the organization. This type of information might require room for discussion and feedback, in order for the affected individuals to feel heard. A digital format might be challenging due to the absence of physical presence, but most important must ensure room for feedback and should therefore be held in smaller groups. One example of such a structure is the Managing meetings where the UMs meet with their DM.

By implementing the planning levels presented by Jonsson and Mattsson (2009) and Vissers et al. (2001) in the analysis, a clearer structure for the information flow connected to the PPC could be provided. This could help SHG to canalize the information, share the right information to the right level and hopefully avoid information overload.

Tools such as PowerPoint slides provided after the All managers meetings are considered helpful as it reduces the risk of misinterpretation or loss of information. The employees at SHG got used to the information flow and the medium transferring it during the pandemic. To not lose this habit, SHG should keep the established channels and mediums for communication. When in a normal state, the intense frequency of meetings and information sharing is potentially not necessary as SHG is not in a crisis. SHG must decide on a proper frequency for the meetings as every meeting should add value, as it otherwise is a waste of time. During the pandemic the communication between the units, and understanding of each other's units and work also improved, which probably resulted in less misinterpreting of information and miscommunication, thus also reducing non-learning within the organization.

One manager suggested a similar meeting type as the All managers meeting to be held for the entire staff periodically. However, there is a risk with this strategy, similar to what was experienced with Public Health Authorities' national press conferences, the fact that the managers would not have time to prepare and interpret the information before staff starts asking questions.

## 7.2 Planning process

When analyzing the data from the interviews it was clear that many of the managers, despite their level in the hierarchy, were planning for different planning horizons, all from one month to several years before the pandemic. The various planning horizons made it very problematic to decide the general planning horizons for each hierarchical planning level at SHG. However, the various planning horizons show that the planning structure at SHG is unclear and fragmented overall.

Since the top management structure was different, with the Hospital Board before and SSL during the pandemic, it is difficult to compare the two. Despite having different planning horizons and periods, SSL's holistic approach at least showed proof of the importance of collaborating and including relevant parts of the organization when conducting PPC. Perhaps this laid the foundation for the changed formation of the Hospital Board that now includes both chiefs of staff and DMs. One way to maintain the holistic approach further, but on an aggregated level, is through the use of S&OP. As S&OP comes with the advantages of an enhanced information flow between demand and supply, an increased customer service level, and forecast accuracy (Danese et al., 2018), SHG must improve its planning process to better address the long care queues.

The empirical findings show that co-planning is important to utilize the resources' capacity to its fullest. This is especially important for resources that are dependent on each other, similar to dependent demand for material planning (Jonsson & Mattsson, 2009), since not correlated PPC could lead to idle time and increased costs. Regardless of co-planning, some units will probably always be more affected during times of crisis due to their medical specialties, such as ICU and the Department for Infectious Diseases during Covid-19.

The decisions taken by SSL, and by the Hospital Board before the pandemic, were occasionally decisions taken far away from the care processes it affects. Due to limited knowledge about the unit or department-specific characteristics, this can be problematic as decisions are not always applicable to the specific environment. Potentially, the inclusion of DMs in the Hospital Board can minimize such situations. The feeling of being controlled was experienced during the pandemic, but with fewer financial regulations more freedom was given as well.

Top-down management and the need for escalation of decisions resulted in a slow and time-consuming process, which can be addressed by having a clearer planning process stating what is decided upon at every planning and control level. Combining this with a vision to be a learning organization, the managers can deal with the operative-strategic relationship by setting the frames for the organization but still allowing for freedom at lower levels. With the hierarchical planning process, decisions for SHG at an organizational level would be conducted by top management, while more detailed and specific decisions concerning PPC could be taken lower down in the hierarchy. It is, however, important to not give too much room for own decisions as it could lead to departments and units operating on their own with no connection to the organization as a whole.

The changed organizational structure where top management is controlling and making operative decisions is a waste of resources and competence in addition to less time allocated for tactical and strategic questions. This has, however, resulted in learning and an increased understanding of operative planning. With this knowledge, these aspects could be considered when conducting PPC higher up in the hierarchy and potentially result in plans that more easily can be aligned with lower levels. To mostly conduct operative planning overall should not be done in the future, but the holistic perspective needs to be maintained (Rhyne and Jupp 1988).

SHG managed the increased patient flow in a good way, partly due to the shared understanding and common goals. The two years of the pandemic have drained SHG's resources and now face challenges with exhausted staff and longer care queues. With a structured planning process, resources can be utilized in a better and more sustainable way, which potentially can result in less shortage of staff. It will be crucial for SHG to consider these aspects in the future; to ensure the balance between demand and supply, in addition to reducing the workload for the staff, avoiding exhaustion, and instead enabling recovery. SHG must also carefully consider the choice of the planning method to ensure that the best method is applied to their system and its specific characteristics (Jonsson & Mattsson, 2009).

## 7.3 Collaboration

The relationship between the community and control worlds presented by Glouberman and Mintzberg (2001a) has not been discussed in this report since it is limited to the Hospital Board and the managers at SHG. Anyhow, the empirical findings indicate that there was less financial regulation at SHG during the pandemic. The reduced regulation probably resulted in limited contact between the community and the control. However, the relationship might have been strengthened since there was less observation and less feeling of being controlled.

The collaboration between the managers and the doctors and nurses improved during the pandemic, which enabled for improved learning since the communication between the three worlds improved the integration of learning. As managers were asked to work from home, their relationship with the doctors and nurses was also negatively affected. These are the experiences of the managers, and interviewing nurses and doctors could have impacted the result differently.

As the pandemic individuals from cure, care and control were involved in work normally performed by only the control world during the pandemic, the distinct divisions between the worlds presented by Glouberman and Mintzberg (2001a) were perhaps not as static during the crisis. One example is when doctors and nurses supported the Ums' planning process. Another example where individuals moved between the worlds was the changing and supporting of tasks done by doctors, cure, and nurses, care.

As one of the respondents to the questionnaire pointed out, similar units should be collaborating more since they have many interfaces and can share experiences. Sharing learnings between and within the four worlds is necessary to achieve institutionalization. In connection to this, it

can be beneficial to collaborate and share knowledge between units with no interfaces as well, since some learnings can be reformed and used in other situations. Despite having different characteristics, many of the units and departments are facing the same challenges with capacity and economy. Thus, collaborating in several areas can be useful. According to O'Reilly and Tushman (2011), an organization with aligned units can leverage the assets of the organization in the best way.

## 7.4 Learning organization

Being a competitive organization, which SHG wishes to be, requires learning and the ability to change (Illeris, 2003; Deimler & Reeves, 2011). By being an ambidextrous organization, both exploration and exploitation need to be managed (Birkenshaw & Gibson, 2002). Leadership is important when being a successful ambidextrous organization (O'Reilly & Tushman, 2011). Hence, it is of utmost importance for SHG to strive to continuously develop good management to be successful. The five propositions presented by O'Reilly and Tushman (2011) require commitment from both top management and the managers at SHG. To be an ambidextrous organization, this vision must also be shared with the entire organization (O'Reilly and Tushman, 2011). The Hospital Board works with the ordinary tasks but also has a foundation in the strategic focus areas where they are trying to improve SHG, which can be connected to exploration and, to some extent, also to exploitation.

During the pandemic, SHG was forced to be an ambidextrous organization. Despite elective care being down-prioritized, patients seeking treatment for diagnoses other than Covid-19 still came to the hospital, and thereby SHG dealt with the current situation (O'Reilly & Tushman, 2011). SHG also dealt with a new type of disease, which had characteristics that forced SHG to invent new ways of acting, showing proof of exploration.

When exposed to a crisis, Fredberg and Pregmark (2022), emphasize the managers' roles when creating a sense of urgency without stress and fear. The managers need to handle different relations, two being the success-failure and safety-accountability relationships. The two relationships focus on communicating what is expected from the staff, together with ensuring a trusting and safe environment where the staff is allowed to fail. As all staff has medical education, the staff is aware of what performance is expected. In the case of Covid-19, it was also important that the staff had relevant education in Covid-19 treatment and routines. By evaluating performance and planning processes more, SHG could become aware of its flaws and be able to adjust accordingly. With clear directives, proper education, and communication, the staff and the managers could better manage the relationship with the staff and successfully uphold a sense of urgency. The third relationship, operative-strategic, comes with a holistic perspective connecting to both success-failure and safety-accountability relationships. It is the managers that provide the frames and guidelines for the organization and need to allow operative freedom. Without operative freedom, the staff might feel insignificant and less motivated, which would impair SHG's performance overall.

Moving between the 4Is can be challenging for a learning organization. Crossan et al. (1999) point out the difficulties of moving from interpretation to integration, to be the individual's communication of tacit knowledge to achieve explicit knowledge. Explicit knowledge does not result in shared understanding by default. One example is the transfer of information through the line organization, as information is interpreted different parts of the organization experience a varying degree of how well-informed they are. For SHG to deal with these challenges, semantic and psychosocial barriers need to be handled. Taking action before a shared understanding is another solution (Crossan et al., 1999), which was the case to some extent at SHG during the pandemic. The individuals lower down in the hierarchy experienced this as troublesome and appreciated transparency and involvement more.

Hence, SHG probably should include the staff to achieve a better outcome. By educating them on improvement and planning processes, as well as how to become a learning organization, SHG could reach a shared understanding. With the 4I loop presented by Crossan et al. (1999), SHG could achieve institutionalization and organizational learning. During the pandemic, the 4I learning loops done at an individual micro level, such as PDCA, were connected on a meso level by the flow of Covid-19 infected patients as the pandemic affected the entire hospital. Later these learnings were connected at a macro level during meetings with a holistic view, connecting the entire organization. The input from these meetings was then reflected upon and interpreted by the individuals, creating a start of a new learning loop. This is an example of how SHG connects the 4I learning loops and achieves organizational learning. Hence, SHG must have a strategy for how to connect the learning loops when the system is not experiencing a pandemic, forcing them together. This strategy must then be communicated, and the entire organization must understand it for SHG to be able to make use of it. For this strategy to be successful, an organization-wide understanding needs to be perceived.

To ensure that the learnings and knowledge generated during the pandemic are refined and shared in the organization, SHG must improve the communication of the established means for, and the importance of, sharing learnings. To avoid ad hoc solutions, making the same mistakes repeatedly at different departments, and not learning from previous experiences, it is crucial to set aside time for these activities and truly institutionalize the learnings.

# 8 Conclusions and suggestions for future research

The report aimed to identify learnings and how these can be refined to improve PPC at SHG. As the study has a holistic view, the report is conducted on an aggregated level and does not provide detailed suggestions for specific units or departments. The learnings presented can accordingly be used as a foundation for further investigations and discussions at SHG to develop their operations.

The primary learning for how to improve the planning process at SHG is to implement a more structured PPC process, where the mandate and expectations for each level are clarified. In accordance with Sjöberg (2019) and Waldenström (2019), the decisions should also be made closer to the care processes. Another learning identified in the research, in line with Socialstyrelsen (2018), is that it is important to have a well-functioning information flow to improve PPC.

During the pandemic, it was clarified that a well-functioning information flow was of great importance when conducting PPC at the different hierarchical levels of the organization. The information flow at SHG was enhanced as a result of the new phenomenon, Covid-19, and should be maintained and further developed in the future. The research supports Eriksson (2020) and Eriksson et al. (n.d.) statement that the collaboration within the organization improved during the pandemic. The improved collaboration resulted in improved learning and enabled for co-planning of PPC, and as the collaboration and understanding of each other's work increased, conducting PPC with a holistic view was possible. Another learning is to make the PPC simpler through the use of more flexible resources. For SHG this could be done by sharing resources in terms of staff with broad medical competence.

One of the most central learnings identified in this research is that the learning process needs to be further developed and communicated to the organization. With no established and known process connecting the learning loops, the learnings will be lost. As Eriksson (2020) points out, the pandemic made the organization more motivated to find new ways of working and solving problems. This is in line with the sense of urgency identified during the research, which created productiveness and motivation to manage the pandemic at SHG. By maintaining and improving ambidexterity and organizational learning, SHG will be better prepared for and adapt more easily to changes in the future.

Summarizing, we recommend SHG implement a more structured planning process for PPC, and further develop the learning process. In addition, SHG should maintain and continuously develop the information flow and the collaboration to improve the PPC process at the hospital.

For future research, several interesting areas should be investigated further. The PPC in a hospital environment could be further investigated by examining how the different planning levels presented by Jonsson och Mattsson (2009) can be implemented more in detail in a healthcare and service context. Investigating what type of information, and what mediums would be most beneficial for every planning and control level, as well as what type of

relationship should be established between the different levels, might be another interesting topic. Further, an interesting future study would be to investigate how SHG can connect the learning loops in an appropriate way. To reduce the context-specific learning similar research should be done at other hospitals in the future.

In this study, control has been the foremost focus, but to understand the control world and how it affects the system, an understanding of the whole healthcare system is needed. For future studies, a deeper investigation of all four worlds could be interesting to get a comprehensive view of the entire hospital's experiences and learnings from the pandemic. As care and cure are the worlds affected by the PPC conducted by the control, such a study would be helpful to fully understand the complexity of the system.

The framework presented by Mintzberg and Glouberman (2001a) gives clarity to the complex nature of the healthcare system. Our impression is that individuals in the system can move between the worlds or be involved in several. We, therefore, believe it to be useful to have a partially dynamic approach towards the division of the four worlds at times.

In conclusion, the pandemic has generated a lot of negative aspects for Swedish healthcare, but it has also generated a lot of learnings and improvements. It is now of utmost importance that these learnings are refined and shared.

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# Appendix

## Appendix A: A translation of the Interview Guide, version 6

Introduction:
We are studying at Chalmers and are writing this thesis until June as a part of the masters program Supply chain management. As we wrote in the email, the essay is roughly about how the Covid-19 pandemic has affected your way of working with planning and thus the questions today will be built around that.
With this opportunity to interview you, you will help us to understand what happened and how you experienced the work during the pandemic. You will also help us identify learning from this special event to improve your work situation post Covid-19.

- You will be anonymous, so it will not be possible to track you as an individual
- Can we record?

Intro questions:

- Tell us about your role at the hospital?
- What is your area of responsibility?
- Which department do you work at? area of activity?
- How do you see your role etc?

- How have you experienced the last two years with Covid-19 in your workplace?
- Are there any special lessons you will take with you? The top three things?

- If we look at the start of the pandemic - how did the hospital handle the pandemic, how did the hospital act? What happened / was done?
- Of the change that took place - how did you experience them?
- What has worked well?
- What has worked less well / poor?
- What could have been done differently?
- Something that is still missing?

If we continue to talk about what it was like under Covid, then we have some questions regarding the information flow and the planning process.

DURING THE PANDEMIC
The planning process:
the flow of covid patients (needs), what resources did you have to meet the need, capacity (what did you have to fill the need?)

- How was the planning process structured during the pandemic?
- What kind of planning did you do during the pandemic?
- Do you plan with different time horizons?
- What are you planning for at the different ones?
    - (Strategic),Tactical, Operational
- What do you need to consider when planning?
- What information do you need to be able to adapt capacity and needs?

- How were situations handled when the need was greater than the allocated resources, capacity imbalance?
- Who was the planning for and how was it communicated?
- Do you carry out the planning yourself or does it take place in collaboration with someone / someone else / others?
- How often is the planning updated / revised?
- What works well/less well with the process?

- Did the planning process change or evolve under Covid?
    - if different types of information, data were used, different people were involved in the planning
    - Was it different in the beginning / middle / "end" of Covid?
    - Why, why not?

- What kind of decision did you have the mandate to make during the pandemic?
- Do you feel that you should have a mandate to make other types of decisions?
    - more / less, higher / lower level?
    - Why / why not?

- What lessons do you take with you from how you planned during the pandemic?
- Have you learned anything as a hospital when it comes to planning?
- Has what you learned about planning during the pandemic affected how you work today, will it affect your way of working after the pandemic?

In general when it comes to lessons learned
- How do you ensure you learn from different experiences?
- How do you work with refining and sharing learnings at SHG or in your area of activity?
- Do you in any way ensure that what you have learned is included and disseminated in the organization to avoid losing what you have learned?
- Are there any established processes or routines for incorporating the lessons learned?
    - forums, responsible persons, documentation, etc.
- What is it that prevents you from taking the lessons from the pandemic?

If we move to the information flow and discuss it during the pandemic….

Information flow:
- How did you experience the information flow regarding the planning of care beds and staff (production planning, resource vs needs) during the pandemic?
- What information did you get from above levels?
- What did it contain? (eg number of patients, beds, lack of resources, planning horizon, etc.)
- From whom, to whom was the information intended?
- How often and how extensive was the information?
- When did you get the information about planning?
    - early or late (long before or close to)?
- Did you experience a long-term or short-term focus (ie how far in the future could you plan for with the information provided?)
- Did you understand the information?
- What did you do with it?

- What type of decision was made based on the information received?
- What information did you pass on?
- From whom, to whom?
    - Horizontal?
- How often and how extensive?

- What conditions did you have for information sharing?

- Did the flow of information change or evolve during the course of the pandemic?
    - type of information disseminated, different forums, media that the information went through changed, from which person it came / went to, frequency, amount,
    - Was it different in the beginning / middle / "end" of the pandemic?

- What lessons do you take with you from how the information flow connected to planning of beds and staff was managed during the pandemic?
- Have you learned anything as a hospital when it comes to information sharing / information dissemination of the planning of care places and staff?
- Has what you learned about information sharing / information dissemination during the pandemic affected how you work today, will it affect your way of working after the pandemic?

If we now move on to talk about what it looked like before the pandemic regarding the information flow and the planning process.

BEFORE THE PANDEMIC
The planning process:

- Before the pandemic, when there were no patients suffering from Covid-19, what did the planning process look like then? Planning of beds and staff
- How did the planning process look like before Covid?
- Did you do planning with different time horizons?
- What did you plan for at the different ones?
    - Strategic, Tactical, Operational
- What did you need to consider when planning?
- What information do you need to be able to adapt capacity and needs?
- How were situations handled where the need was greater than the allocated resources?
- Who was the planning for and how was it communicated?
- Do you carry out the planning yourself or does it take place in collaboration with someone / someone else / others?
- How often is the planning updated / revised?
- What worked well/less well with the planning process?

- What kind of decision did you have the mandate to make before the pandemic?
- Do you feel that you should have a mandate to make other types of decisions
    - more / less, higher / lower level?
    - Why / why not?

So if we move on to the information flow, we also have some questions about what it looked like before Covid-19.

Information flow:

- How did you experience the flow of information regarding the planning of beds and staff (production planning, i.e. the planning of what is to be done at the hospital versus the resources / staff (balance capacity / resource with needs)) before Covid?
- What kind of information did you get? (eg number of patients, places, lack of resources, etc.)
- From whom, to whom?
- How often and how extensive?
- When do you get the information about planning?
    - early or late (long before or close to)?
- Did you understand the information?
- What did you do with it?
- What type of decision was made based on the information received?
- What information did you pass on?
- From whom, to whom?
    - horizontal?
- How often and how extensive?
- What conditions did you have for sharing information?

If different answers before and during the pandemic:
Have we interpreted you correctly: Do you feel that there has been a change? If so, how did you experience that change?

The long care queues:

- Now the system is also overloaded (with long queues), how do you handle it / how should you handle it?
- Is there anything from the changed way of working during the pandemic that could be used to deal with the queues now?

Collaboration around planning - The relationship and communication between these

- What does collaboration regarding planning look like at the hospital today, has it changed since before Covid?
    - How did that change?
    - good or bad, or both?

- The collaboration and communication between you and your manager regarding planning?
- The collaboration and communication between you and those you are responsible for (employees) regarding planning?
- The collaboration and communication between professionals (nurses, assistant nurses and doctors) regarding planning?
- Between ( units / departments) around planning?
- The regional collaboration regarding planning?

Closure:

- Is there anything else you would like to mention regarding what we have discussed today? Any last comment?

Thank you for taking your time, your answers will really be helpful to us.
We will give all the interviewees the opportunity to comment and give feedback, to validate and ensure that we have interpreted the answers correctly.
Can we email you if we have further questions and concerns?

## Appendix B: Matrix for reference

| Abbreviation | Interviewee | Reference | Position |
|---|---|---|---|
| I1 | Interviewee 1 | Personal communication 14th of February 2022 | Unit Manager |
| I2 | Interviewee 2 | Personal communication 16th of February 2022 | Department Manager |
| I3 | Interviewee 3 | Personal communication 16th of February 2022 | Chief of staff |
| I4 | Interviewee 4 | Personal communication 22th of February 2022 | Department Manager |
| I5 | Interviewee 5 | Personal communication 25th of February 2022 | Unit manager/Process Manager |
| I6 | Interviewee 6 | Personal communication 1st of March 2022 | Unit Manager |
| I7 | Interviewee 7 | Personal communication 3rd of March 2022 | Chief of staff |
| I8 | Interviewee 8 | Personal communication 8th of March 2022 | Department Manager |
| I9 | Interviewee 9 | Personal communication 8th of March 2022 | Department Manager |
| I10 | Interviewee 10 | Personal communication 22nd of March 2022 | Department Manager |
| I11 | Interviewee 11 | Personal communication 31st of March 2022 | Department Manager |
| I12 | Interviewee 12 | Personal communication 31st of March 2022 | Unit Manager |
| I13 | Interviewee 13/14 | Personal communication 1st of April 2022 | Unit Manager, (Section leader) |
| I15 | Interviewee 15 | Personal communication 1st of April 2022 | Chief of staff |
| I16 | Interviewee 16 | Personal communication 4th of April 2022 | Unit Manager |
| I17 | Interviewee 17 | Personal communication 5th of April 2022 | Unit Manager |

| | | | |
|---|---|---|---|
| I18 | Interviewee 18 | Personal communication 6th of April 2022 | Chief of staff |
| I19 | Interviewee 19 | Personal communication 7th of April 2022 | Unit Manager |
| I20 | Interviewee 20 | Personal communication 25th of April 2022 | Four Unit Managers |
| Q | Questionnaire | Personal communication Deadline 26th of April 2022 | Managers |
| S | Supervision sessions | Personal communication from 21-11-24 to 22-05-18 | Supervisors |

## Appendix C: A translation of the questionnaire - What can be learnt from the pandemic?

- Background questions
    - Gender
        - Female
        - Male
        - Non binary
        - Other
        - Do not want to answer
    - What department do you work at?
        - K1
        - K2
        - K3
        - K4
        - K5
        - K6
        - M1
        - M2
        - M3
        - M4
        - M5
        - M6
        - Administrative office
        - Other
    - What role do you have at SHG?
        - Unit Manager
        - Department Manager
        - Process Manager
        - Chief of staff
    - What is your professional background?
        - Nurse
        - Assistant nurse
        - Medical secretary
        - Psychologist
        - Physician
- Collaboration before and during the pandemic

Collaboration refers to collaboration and communication regarding planning of patients' care needs and resources at SHG.

- How was collaboration between medical professions within the department before the pandemic?
    - Really good
    - Quite good
    - Neither good or bad
    - Quite bad
    - Really bad
- How was collaboration between medical professions within the department during the pandemic?

        - Really good
        - Quite good
        - Neither good or bad
        - Quite bad
        - Really bad
    - How was collaboration between unis within the department before the pandemic?
        - Really good
        - Quite good
        - Neither good or bad
        - Quite bad
        - Really bad
    - How was collaboration between units within the department during the pandemic?
        - Really good
        - Quite good
        - Neither good or bad
        - Quite bad
        - Really bad
    - How was collaboration between departments before the pandemic?
        - Really good
        - Quite good
        - Neither good or bad
        - Quite bad
        - Really bad
    - How was collaboration between departments during the pandemic?
        - Really good
        - Quite good
        - Neither good or bad
        - Quite bad
        - Really bad
    - How was collaboration between the three hierarchical planning levels (Hospital Board-Department manager-Unit manager) at SHG before the pandemic?
        - Really good
        - Quite good
        - Neither good or bad
        - Quite bad
        - Really bad
    - How was collaboration between the three hierarchical planning levels (Hospital Board-Department manager-Unit manager) at SHG during the pandemic?
        - Really good
        - Quite good
        - Neither good or bad
        - Quite bad
        - Really bad
- Planning before and during the pandemic

Planning refers to planning of patients' care needs and resources at SHG.

    - Before the pandemic I planned the operations on short term (day/days) based on
        - staff resources
        - patients' care needs

        - economical frames
        - did not plan on short term
    - During the pandemic I planned the operations on short term (day/days) based on
        - staff resources
        - patients' care needs
        - economical frames
        - did not plan on short term
    - Before the pandemic I planned the operations on medium term (week/weeks) based on
        - staff resources
        - patients' care needs
        - economical frames
        - did not plan on short term
    - During the pandemic I planned the operations on medium term (week/weeks) based on
        - staff resources
        - patients' care needs
        - economical frames
        - did not plan on short term
    - Before the pandemic I planned the operations on long term (month/months) based on
        - staff resources
        - patients' care needs
        - economical frames
        - did not plan on short term
    - During the pandemic I planned the operations on long term (month/months) based on
        - staff resources
        - patients' care needs
        - economical frames
        - did not plan on short term
    - How did you handle the imbalance between need for care and available capacity while planning before the pandemic?
        - transfer of staff between units
        - staff got vacation
        - staff worked overtime
        - hired new staff
        - fired staff
        - imbalances were not handled
        - ordered staff
        - bought care from private care givers
        - moved patients regionally
    - How did you handle the imbalance between need for care and available capacity while planning during the pandemic?
        - transfer of staff between units
        - staff got vacation
        - staff worked overtime
        - hired new staff
        - fired staff
        - imbalances were not handled
        - ordered staff

        - bought care from private care givers
        - moved patients regionally
- Information flow during the pandemic

Information refers to information used as foundation for the plans you conduct

    - I got the information I needed to make decisions regarding the planning I conducted during the pandemic
        - strongly agree
        - agree
        - neither agree or disagree
        - disagree
        - strongly disagree
    - I got information often enough from my closest manager during the pandmeic
        - strongly agree
        - agree
        - neither agree or disagree
        - disagree
        - strongly disagree
    - I got information often enough from the Hospital Board during the pandemic
        - strongly agree
        - agree
        - neither agree or disagree
        - disagree
        - strongly disagree
    - I got information often enough from other higher instances than the Hospital Board during the pandemic
        - strongly agree
        - agree
        - neither agree or disagree
        - disagree
        - strongly disagree
    - The information I received was relevant for me
        - strongly agree
        - agree
        - neither agree or disagree
        - disagree
        - strongly disagree
    - How do you experience the information flow during the pandemic in comparison with before?
        - unchanged
        - better
        - worse
        - more frequent
        - less frequent
        - more relevant
        - less relevant
        - more clear
        - less clear
        - more unambiguous

        - less unambiguous
        - other
- Learning
    - What are the main learnings you will take with you from the pandemic regarding your way of working and acting at SHG?
    - What routines are there at SHG for refining and sharing learnings?
        - Networks
        - Workplace meetings (APT)
        - Formal evaluations and questionnaires
        - Intranet
        - Different types of managing meetings
        - reflection in the workgroup
        - Different routines for improvement activities
        - Do not know of any routines
        - Other
    - Do you experience any barriers for transferring and sharing learnings at SHG?
    - Do you have any other aspects you would like to share with us?
- Thank you!

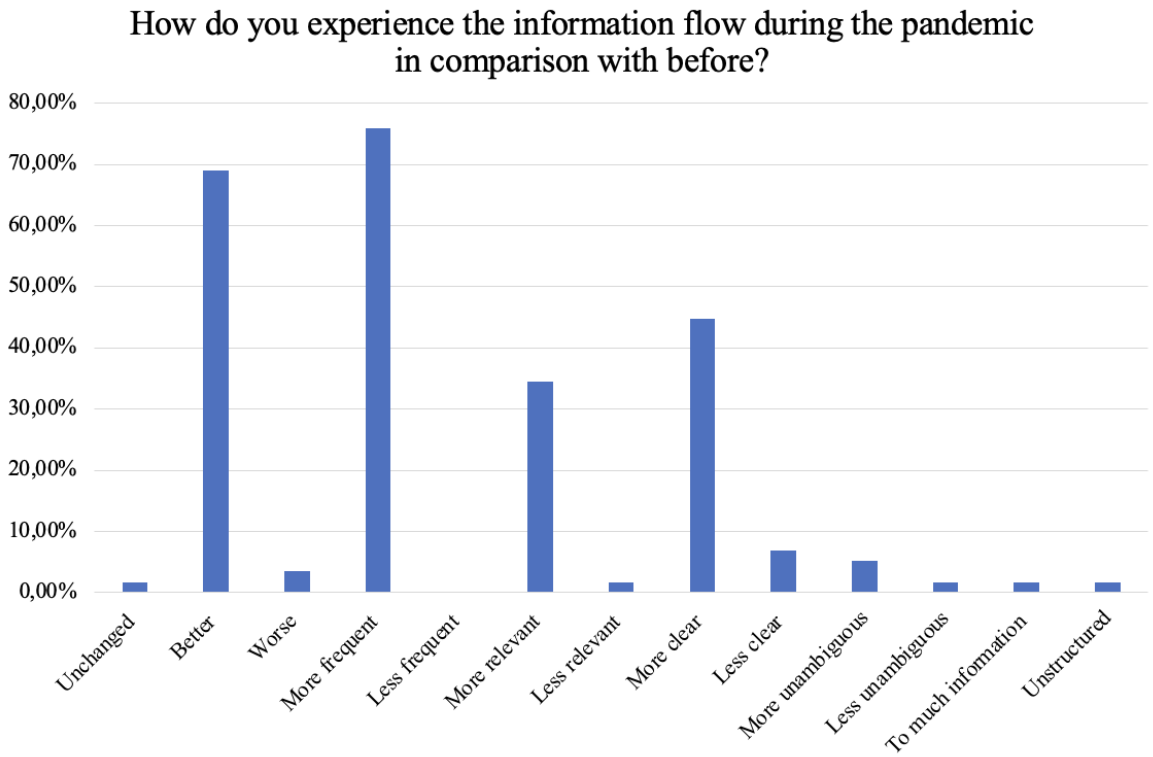
**Appendix D: Coverage matrix**

Green cells indicate covered departments and hierarchical planning levels

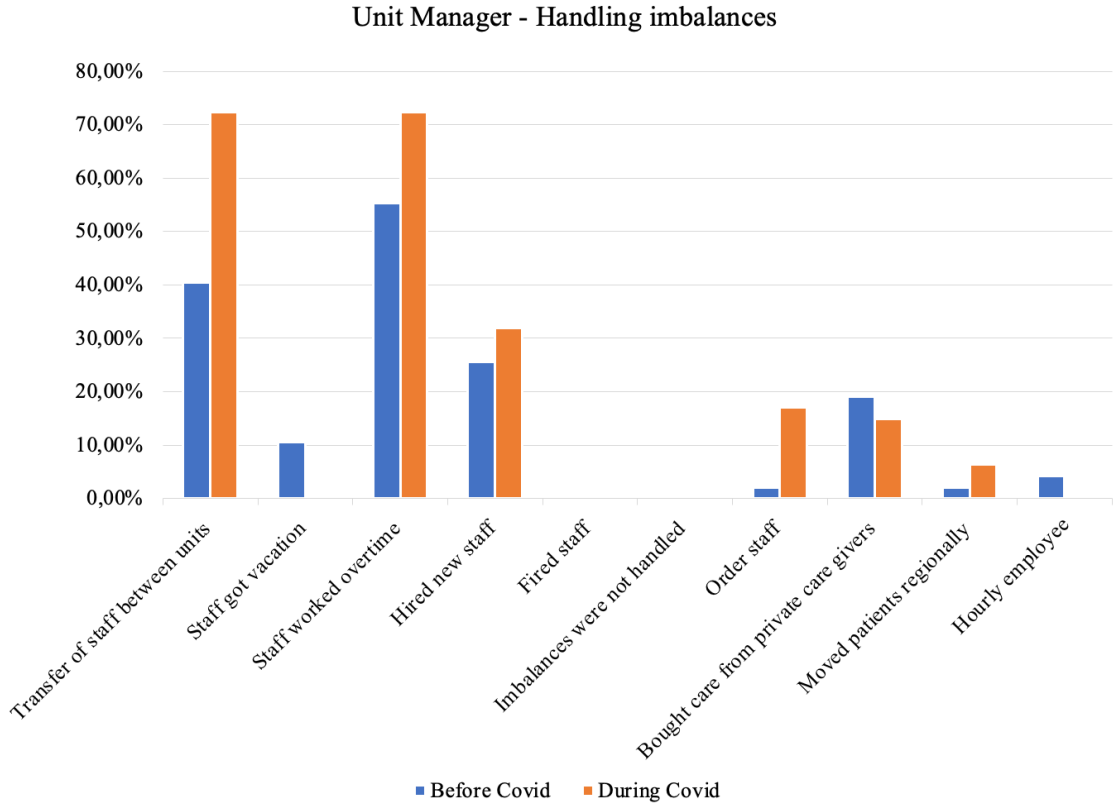
| Departments | Department Manager | Unit Manager | Hospital Board |
|---|---|---|---|
| Administrative Office | | | |
| K1 | | | |
| K2 | | | |
| K3 | | | |
| K4 | | | |
| K5 | | | |
| K6 | | | |
| M1 | | | |
| M2 | | | |
| M3 | | | |
| M4 | | | |
| M5 | | | |
| M6 | | | |
| S1 | | | |

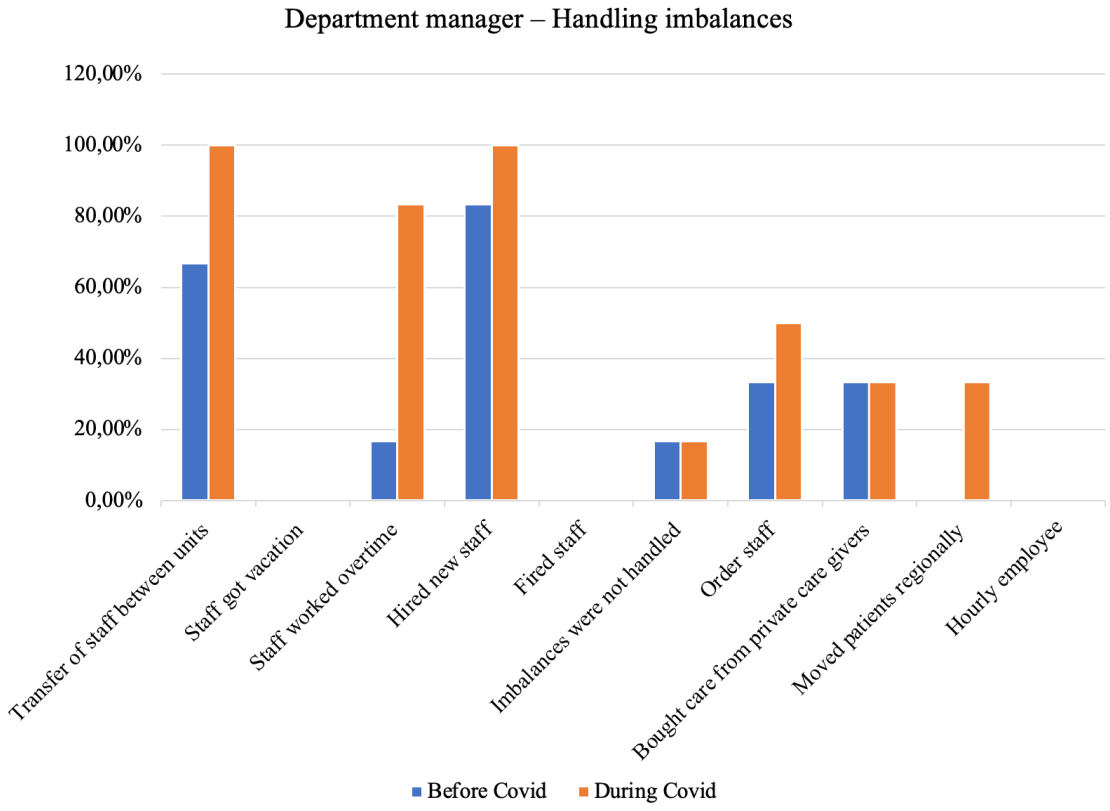
## Appendix E: Parts of the result from the questionnaire

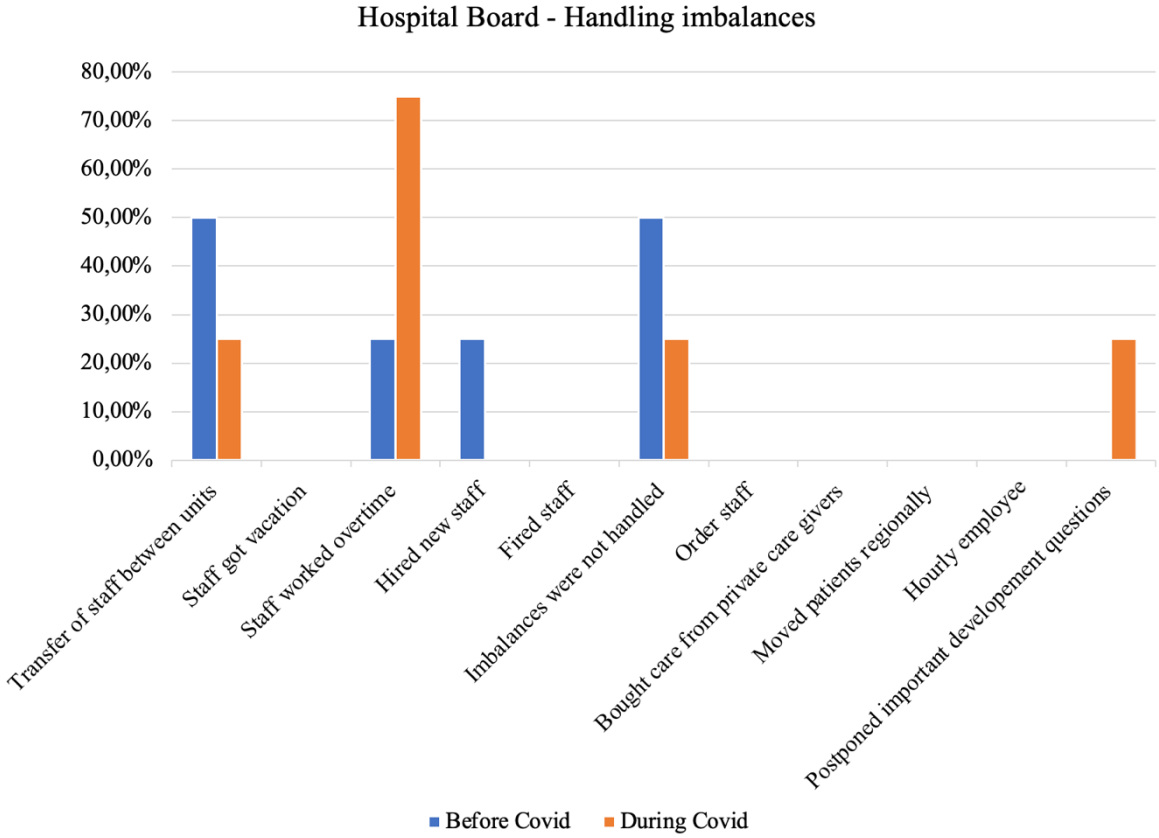
*Information*




*Planning*

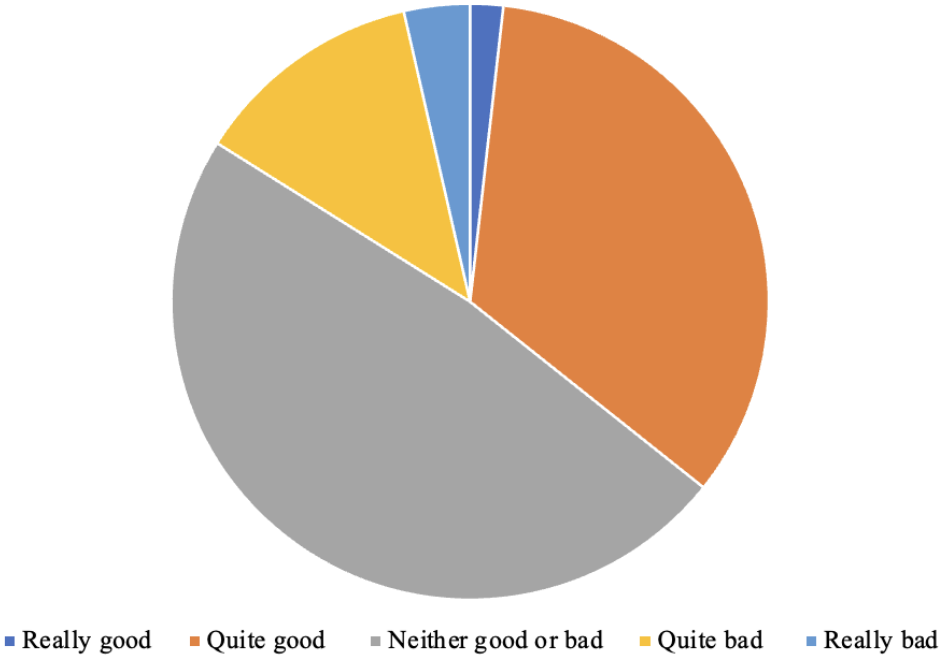



Department manager – Handling imbalances
120,00%
100,00%
80,00%
60,00%
40,00%
20,00%
0,00%
Transfer of staff between units
Staff got vacation
Staff worked overtime
Hired new staff
Fired staff
Imbalances were not handled
Order staff
Bought care from private care givers
Moved patients regionally
Hourly employee
Before Covid
During Covid

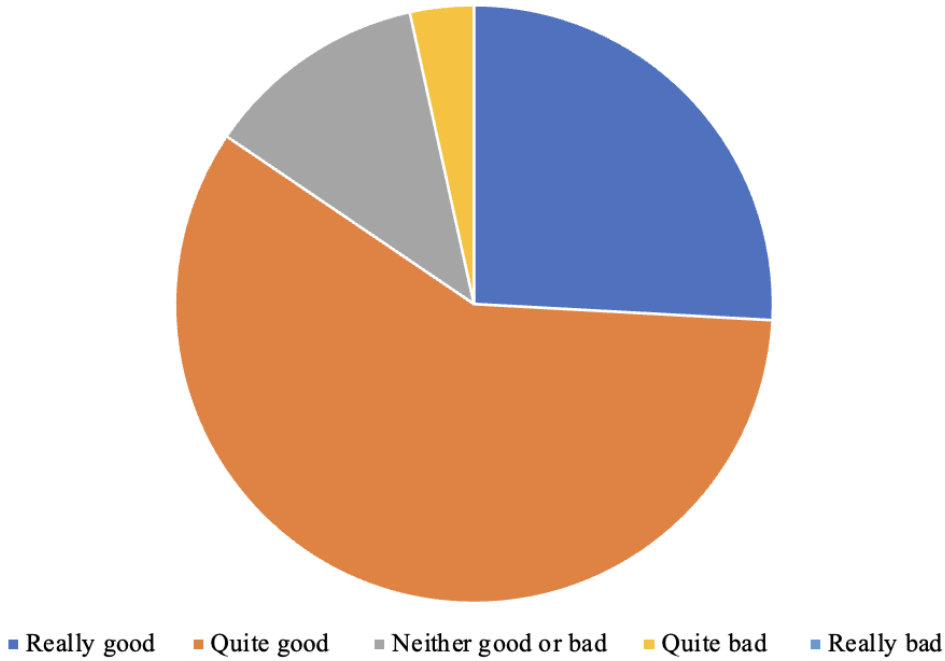

Hospital Board - Handling imbalances
80,00%
70,00%
60,00%
50,00%
40,00%
30,00%
20,00%
10,00%
0,00%
Transfer of staff between units
Staff got vacation
Staff worked overtime
Hired new staff
Fired staff
Imbalances were not handled
Order staff
Bought care from private care givers
Moved patients regionally
Hourly employee
Postponed important developement questions
Before Covid
During Covid

*Collaboration*

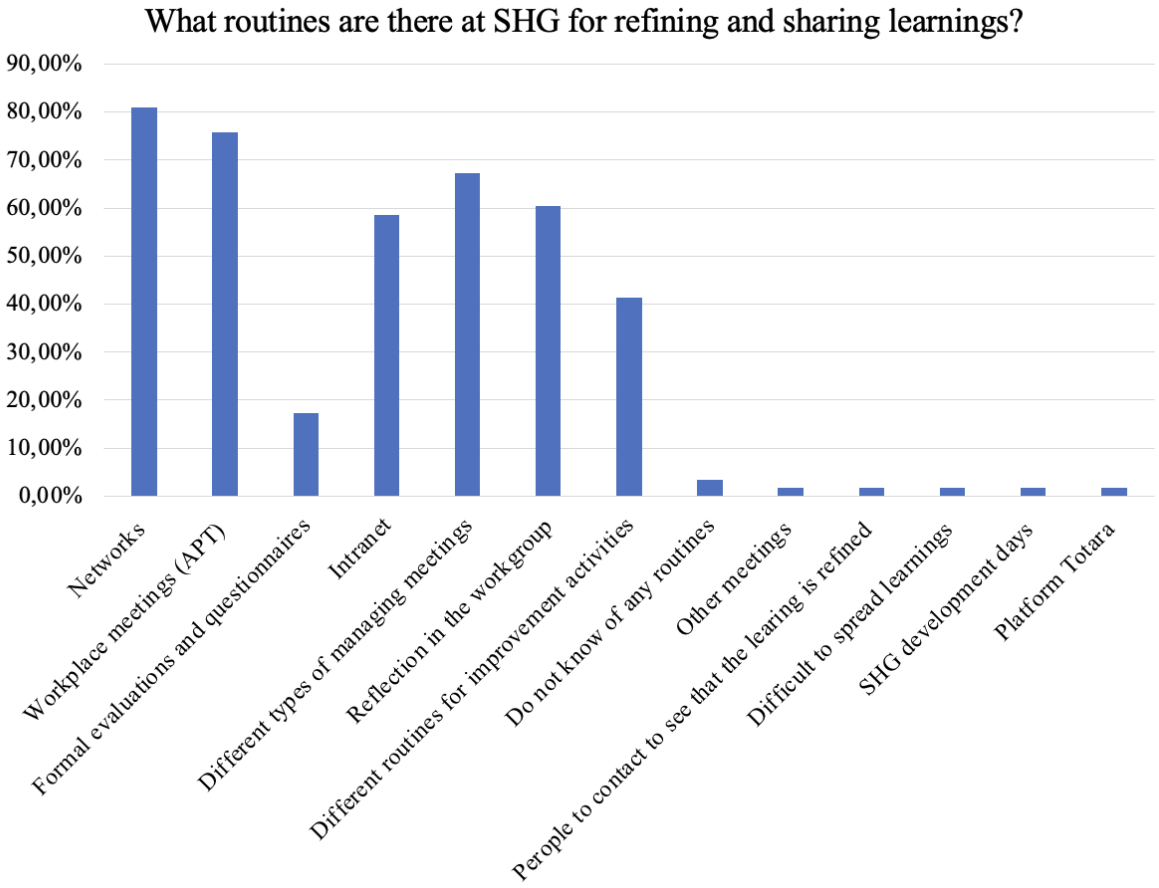
How was collaboration between the three hierarchical planning levels (Hospital Board-Department manager-Unit manager) at SHG before the pandemic?




How was collaboration between the three hierarchical planning levels (Hospital Board-Department manager-Unit manager) at SHG during the pandemic?



*Learning organization*



## Appendix F: Summary of the learnings and how these improve Production Planning and Control

| Summary of the learnings and how these improve Production Planning and Control | |
|---|---|
| Research question 1 | Research question 2 |
| **Information** | **Effect of learning** |
| Have a well-functioning information flow | Increased patient safety, good utilization of resources |
| The carrier affects the information | Adjust carrier depending on the message and the receiver |
| The medium affects the information | Adjust medium depending on the message and the receiver |
| Have an intense flow of relevant information | Increased transparency |
| Use digital meetings | Increased efficiency and flexibility, good tool for information sharing |
| Maintain established meetings and channels | Well-informed organization |
| Use tools to simplify information sharing | Less misinterpretation and loss of information |
| **Planning** | **Effect of learning** |
| Have a more structured planning process based on the theory of Jonsson and Mattsson (2009) and Vissers et al. (2001) | More efficient resource utilization |
| Make decisions closer to the care process it affects | Faster and more feasible decisions |
| More demand driven planning | Production in accordance with demand |
| Clarify mandate | Less escalation, faster decisions |
| Have a clearer decision process | Faster decisions and less confusion |
| Use co-planning | More efficient resource utilization, especially for resources depending on each other |
| Have a holistic view when planning | More efficient resource utilization |
| Have a Hospital Board where DMs are included | Enables a holistic view and a deeper understanding for the organization when planning |
| An increased understanding for operative planning | Alignment with operative planning when conducting strategic plans |
| **Collaboration** | **Effects of learning** |
| Maintain increased collaboration | Increased understanding, efficient use of resources |

| | |
|---|---|
| Use Standardization and Mutual adjustment | Increased collaboration |
| Have common values and beliefs | Increased collaboration and trust |
| Increased communication and transferring of staff | Improved integration and flexibility |
| Sharing tasks and working closer to each other | Reduced differentiation |
| Similar units should collaborate | Shared knowledge, more efficient |
| All units should collaborate to some extent | Similar challenges regarding economy and capacity |
| **Learning organization** | **Effects of learning** |
| Should have a structured and communicated learning process connecting the learning loops | Learnings cannot be adapted and refined |
| Connect the 4I learning loops | A prerequisite for institutionalization |
| Individual learning is important | A prerequisite for organizational learning |
| Group learning is important | A prerequisite for organizational learning |
| Create a sense of urgency without fear and stress | Improved focus and productivity |
| Managers must handle the Operative-Strategic relationship | Enhance learning, work towards same goal |
| Managers must handle the Success-Failure relationship | Enhance learning, reduce fear to fail |
| Managers must handle the Safety-Accountability relationship | Enhance learning, feeling accountable |
| Develop good management | Positively affects the organization and the learning within the organization |
| An unanimously desire to be a learning organization | No ambiguity and increased learning |

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