UNIVERSITY OF TWENTE.

Faculty of Behavioural, Management and Social Sciences

Department of Technology Management and Supply

Master Thesis

Master of Science (M.Sc.) Business Administration

Purchasing & Supply Management

Barriers to preparedness and planning for future disruptions: a perspective from German healthcare organizations

Author: Merle Sophie Tucholka

1st Supervisor: Dr. Carolina Belotti Pedroso Bominaar

2nd Supervisor: Dr. Klaas Stek

Number of pages: 169

Abstract

Preparing for a global healthcare crisis has become increasingly critical as events, such as the COVID-19 pandemic, have exposed vulnerabilities in healthcare systems and supply chains worldwide. The purpose of this research is twofold: (1) to identify barriers to preparedness of healthcare organizations and (2) to explore best practices utilized by purchasers of German hospitals. Guided by existing literature, a case study research was conducted and 15 semi-structured interviews with purchasers from 11 German hospitals were performed. The analysis of the interview data revealed a total of 14 barriers to hospital preparedness falling into the categories: barriers to both physical and intangible preparedness activities, barriers to physical preparedness activities, and barriers to intangible preparedness activities. Additionally, 24 best practices utilized by purchasers during the pandemic were found which can be categorized into six key categories, including storage, human resources, knowledge management, operations- and process management, financial resources, and community. This research also offers a roadmap as a practical contribution to guide hospitals to implement best practices. Furthermore, the study critically analyses governmental actions and policies, aiming to inform policymakers and aid in the creation of more effective policies and strategies for future healthcare crises.

Keywords: Hospital preparedness, emergency preparedness, barriers to preparedness, best practices, healthcare procurement

Management Summary

The COVID-19 pandemic exposed vulnerabilities in healthcare systems, including challenges in procurement and supply chain management. The objective of this research is to examine the experiences of German hospitals during the pandemic, particularly from the view of purchasing staff, in order to identify barriers to preparedness and best practices utilized during the pandemic. To achieve these objectives, 15 semi-structured interviews with purchasing staff from 11 German hospitals were held.

Analysing the qualitative data, 14 barriers to preparedness were revealed that can be sorted into three categories: barriers to both physical and intangible preparedness activities, barriers to physical preparedness activities, and barriers to intangible preparedness activities. The barriers that appeared most often in the interview data are the unpredictable nature of the pandemic, small storage facilities, product obsolescence, and cost and reimbursement. The study also identified 24 best practices adopted by purchasers of German hospitals that helped them maintain essential services during the pandemic. The interview data revealed that the most critical best practices during the pandemic were building a cross-functional task force, communication among members of a GPO and having an emergency plan.

Drawing on the best practices identified in this research, a questionnaire and a practical roadmap designed to guide hospitals in implementing the best practices and improving their healthcare emergency disaster preparedness were developed. These tools offer a step-by-step guide and self-assessment mechanism that help hospitals evaluate the purchasing practices they used during the pandemic and compare them to the results of this study. Gaps in best practices can further be identified and systematically addressed to improve their ability to respond to future crises.

This research also offers practical recommendations for the German government to improve its support for healthcare institutions in a future healthcare disaster. Based on the experiences of German hospitals during the COVID-19 pandemic, it is suggested that the government should leverage the purchasing professionals' expertise, instead of buying materials themselves, in order to prevent issues of material shortages, price increases, and quality issues. Furthermore, the communication between the government and the healthcare organizations needs to be enhanced, fostering clearer guidelines and effective collaborations. Developing and maintaining a digital infrastructure would be helpful to achieve more effective communication. Additionally, the

government should help financially struggling hospitals in a timely manner, to assure the continuous operation of these healthcare institutions. Supporting domestic production to stabilize supply and ensure a reliable supply of essential materials would also strengthen the resilience and preparedness of the healthcare sector.

Table of Content

List of abbreviations……x

List of tables……... xi

List of figures……..……....xi

Research Paper: Barriers to preparedness and planning for future disruptions: a perspective from German healthcare organizations xii

1 Introduction....1

2 Literature Review....4

2.1 The supply chain: examining its role in the context of the healthcare sector....5

2.2 Supply chain risk: analyzing the atypical disruptive impact of the pandemic 6

2.3 Pandemic context: PPE supply shortages left healthcare workers without proper protection and drove up prices....9

2.4 German context of the pandemic: the federal state structure and the absence of a nationwide emergency plan posed challenges during the pandemic....11

2.5 Preparedness: better preparedness results in a better response....13

2.6 Disaster preparedness activities: there are physical and intangible disaster preparedness activities with both advantages and barriers....14

2.7 Best practices to prepare for a pandemic: integrating inventory pre-positioning and enhancing disaster management competencies as a best practice 19

2.8 Research Model: a blueprint for investigating barriers and best practices in healthcare crisis preparedness....22

3 Methodology....24

3.1 Case-study research: Understanding the “why” behind the interviewee’s behavior and actions....24

3.2 Validity and reliability....25

3.3 Interview protocol: Utilizing literature-based questions to investigate barriers and best practices 25
3.4 Sampling and data collection: Conducting semi-structured interviews with purchasers of German hospitals 26
3.5 Analyzing and coding the data 28
3.6 Deductive and inductive coding 29
3.7 Coding the data with open coding, axial coding, and selective coding 29
4 Results 30
4.1 Ownership of hospitals in Germany: public ownership, non-profit ownership, and private ownership 30
4.2 The purchasing situation in Germany during the pandemic: supply shortages and high prices 32
4.3 Purchasing at German hospitals: an in-depth analysis of barriers and best practices across 11 healthcare institutions 33
4.3.1 Hospital 1 (Purchaser A, Purchaser B, Purchaser C, Purchaser D) 34
4.3.2 Hospital 2 (Purchaser E, Purchaser F) 39
4.3.3 Hospital 3 (Purchaser G) 42
4.3.4 Hospital 4 (Purchaser H) 44
4.3.5 Hospital 5 (Purchaser I) 46
4.3.6 Hospital 6 (Purchaser J) 48
4.3.7 Hospital 7 (Purchaser K) 50
4.3.8 Hospital 8 (Purchaser L) 52
4.3.9 Hospital 9 (Purchaser M) 54
4.3.10 Hospital 10 (Purchaser N) 56
4.3.11 Hospital 11 (Purchaser O) 59
4.4 Cross-analysis of results 60

4.5 Comparing hospitals: visualizing the organization's disaster preparedness scenario before the pandemic in a 2 by 2 matrix 61

4.6 Comparing hospitals: The operator and the membership in a GPO have no influence on the degree to which a hospital prepared for a pandemic 63

4.7 Barriers to preparedness: the study found 14 barriers to preparedness in three categories 64

4.7.1 Barriers to both physical and intangible disaster preparation 65

4.7.2 Barriers to physical disaster preparation activities 65

4.7.3 Barriers to intangible disaster preparation activities 68

4.7.4 Assessing the significance and recurrence of barriers to preparedness 70

4.8 Best practices employed during a pandemic: Identification and categorization of practices employed by purchasers during the pandemic 72

4.8.1 Storage: having a storage facility, increasing the storage range and additional storage space are best practices during a pandemic. 73

4.8.2 Human resources: Have a person responsible for pandemic preparations, preparation workshops, and all purchasing employees can do all purchasing activities are best practices 74

4.8.3 Knowledge Management: Having an emergency plan, and an emergency material checklist are best practices 74

4.8.4 Operations- and process management: nine best practices belong to this category. 75

4.8.5 Financial resources: Investment-stop for pandemic-unrelated goods, and personnel reduction to reduce costs are best practices 77

4.8.6 Community: Framework agreements, communication among GPO members, communication among hospitals, having a network, and building a cross-functional task force are best practices 78

4.8.7 Assessing the significance and recurrence of the best practices 81

4.9 Revised research model: integrating interview findings to enhance the conceptual framework for emergency preparedness 85

4.10 A roadmap: improving hospital preparedness through implementing the best practices 86
4.10.1 Step 1: Understanding the best practices presented in this research 87
4.10.2 Step 2: Assessment of practices implemented in the hospital 87
4.10.3 Step 3: Conduction of a gap analysis 88
4.10.4 Step 4: Development of an action plan 88
4.10.5 Step 5: Engagement of stakeholders 89
4.10.6 Step 6: Creation and implementation of new preparedness activities 89
4.10.7 Step 7: Review and continuously improve preparedness activities 90
4.11 The role of the German government: critique and suggested solutions 91
4.11.1 Critique on the German government: 9 points of critique were found during the interviews 92
4.11.2 Suggestions for improvement for the German government 95
5 Discussion and conclusion 98
5.1 Expanding the framework of barriers: three instead of two overarching categories of barriers to preparedness were found 98
5.2 Comparing literature and research findings: shared barriers are costs and product obsolescence 99
5.3 Uncovering novel barriers to preparedness: the study found eleven barriers to preparedness that are new to literature 100
5.4 Best Practices: Research supports the mixed method approach and discovers 24 best practices 103
5.5 Practical Contributions: A roadmap and questionnaire for implementing best practices, highlighting critique, and offering solutions to the government 105
5.6 Conclusion 106
5.7 Limitations 107
5.8 Future research 107
6 References 109

7 Appendix 115
7.1 Appendix A: Interview protocol 115
7.2 Appendix B: Codebook 119
7.3 Appendix C: Questionnaire for developing a preparedness plan 129

List of abbreviations

Abbreviation	Full term
CEO	Chief Executive Officer
COVID	Corona Virus Disease
DMC	Disaster Management Competencies
FFP (2)	Filtering Facepiece (2)
GPO	Group Purchasing Organization
JIT	Just-in-Time
LLC	Limited Liability Company
MDR	Medical Device Regulation
MERS	Middle East Respiratory Syndrome
NAFTA	North American Free Trade Agreement
OECD	The Organization for Economic Cooperation and Development
PPE	Personal Protective Equipment
SARS	Severe acute respiratory syndrome
WHO	World Health Organization

List of tables

Table 1: Definitions of supply chain risks and their references 7
Table 2: Operational- and Disruptive risks and their properties 7
Table 3: Typical disruptive risks vs. pandemics 9
Table 4: Tangible and intangible disaster preparedness activities. 16
Table 5: Disaster response scenario modelling 20
Table 6: Categorization of countries in scenarios 22
Table 7: Overview of semi-structured interviews with purchasers from German hospitals 28
Table 8: Three different types of hospital operators: public, non-profit and private operators 31
Table 9: Hospital operator, GPO membership, and disaster response scenarios of German hospitals 64
Table 10: Barriers to disaster preparation activities found during the interviews 70
Table 11: The best practices found during the interviews 81
Table 12: Applying Roadmap Steps to Cross-Functional Task Forces 91
Table 13: Critique and suggestions for improvements for the German government 98

List of Figures

Figure 1: Research model 23
Figure 2: Categorizing the hospitals into disaster preparation scenarios. 62
Figure 3: Frequency analysis of barriers to physical and intangible disaster preparation activities 71
Figure 4: Occurrence of best practices during the interviews 83
Figure 5: Revised research model 85
Figure 6: A roadmap for improving hospital preparedness 86

Research Paper: Barriers to preparedness and planning for future disruptions: a perspective from German healthcare organizations

Abstract

Preparing for a global healthcare crisis has become increasingly critical as events like the COVID-19 pandemic have exposed vulnerabilities in healthcare systems and supply chains worldwide. The purpose of this research is twofold: (1) to identify barriers to preparedness of healthcare organizations and (2) to explore best practices utilized by purchasers of German hospitals during the pandemic. Guided by existing literature, a case study research was conducted and 15 semi-structured interviews with purchasers from 11 German hospitals were performed. The analysis of the interview data revealed a total of 14 barriers to hospital preparedness falling into the categories: barriers to both physical and intangible preparedness activities, barriers to physical preparedness activities, and barriers to intangible preparedness activities. Additionally, 24 best practices utilized by purchasers during the pandemic were found which can be categorized into six key categories, including storage, human resources, knowledge management, operations- and process management, financial resources, and community. This research also offers a roadmap as a practical contribution to guide hospitals to implement best practices.

Keywords: hospital preparedness, emergency preparedness, barriers to preparedness, best practices, healthcare procurement

1. Introduction

During the COVID-19 pandemic all stages of the healthcare supply chain, including production, logistics, and distribution to hospitals and other healthcare institutions were disrupted (Iyengar, Vaishya, Bahl, & Vaish, 2020). Shortages of medical supplies, especially personal protective equipment (PPE), were documented by the World Health Organization (WHO, 2020), validating the prediction of medical supply chain professionals who anticipated a “black swan” event (Lavassani, Iyengar, & Movahedi, 2022). These “black swan” events, characterized by their unpredictability and significant effects (Tõnurist & Hanson, 2020), are caused by destabilization factors such as powerful weather, pandemics, port closures, and political instability (National Academies of Sciences & Medicine, 2018). The fast-expanding demand for healthcare equipment fuelled the competition between governmental organizations for limited resources. This competition escalated the disruption and price increases (Dai, Bai, & Anderson, 2020), emphasizing the need for hospital preparedness and effective procurement strategies.

Preparedness has been identified as a critical component in reducing the global impact of disasters (Kunz, Reiner, & Gold, 2014). It is a dynamic state of readiness that depends on the surrounding circumstances, societal dynamics, and the completion of tasks intended to prevent fatalities and lessen the effects of natural disasters (Nojang & Jensen, 2020). In reality, only a small number of governments have developed concrete strategies to prepare for unanticipated or chaotic disasters. Different nations have had differing degrees of success in building the resources required to anticipate and address "black swan" events (OECD, 2018). To prepare for an outbreak of a disease, Germany had pandemic preparation programs in place at both the federal and state levels, which concentrated on a possible influenza (H1N1) pandemic (Köppen, Hartl, & Maier, 2021).

However, even though the Federal preparedness plan describes the use of medical equipment in the form of PPE, the plan does not elaborate on purchasing strategies (Robert Koch Institut, 2020).

The expenses and difficulties of a pandemic are exemplified by the COVID-19 pandemic. More importantly, it serves as a great example of how a future pandemic can be prevented or mitigated through preparedness (Naguib, Ellström, Järhult, Lundkvist, & Olsen, 2020). Pandemics provide unique problems for emergency response because of their widespread impact and protracted recurrence (Kappler, Wiesner, & Davis, 2024).

Recognizing the vulnerabilities of healthcare organizations in developing preparedness plans for crises, including challenges in procurement and supply chain management is critical to understand how to prepare for future pandemics. By understanding these challenges, healthcare institutions can develop strategies to overcome them. Furthermore, this study recognizes the importance of learning from best practices utilized during the pandemic. A best practice is an approach or collection of approaches that are recognized by authorities as the most effective in a specific industry or business (Cambridge Dictionary, 2024). By examining the best practices employed by hospitals in response to the pandemic, strategies can be developed to better equip healthcare institutions for future "black swan" events. The objective of this research is to analyse the experiences of German hospitals during the pandemic, particularly from the view of purchasing experts, to identify barriers to preparedness and best practices utilized during the outbreak. Thus, the following research questions are proposed:

RQ1: What are the main barriers to developing preparedness plans to address supply disruptions faced by hospitals?

RQ2: What are the best practices learned by hospitals during the COVID-19 pandemic in order to prepare for future supply disruptions?

A case study research was conducted and adopted as a methodological approach. In total, 15 semi-structured interviews were performed at 11 German hospitals. This study is divided into four sections. First, a theoretical framework is presented including disaster preparedness, barriers to preparedness, and a brief contextualization of the German healthcare scenario during the first stages of the pandemic. The research methodology is explained in the second section of this paper. The third section presents the main results of this study and the final section consists of conclusions.

This study adds to the existing literature by identifying the main barriers to preparedness. Although research on this topic has been conducted in the past (Hendrickson, 2020; Orlando, Tortora, Pezzi, & Bitbol-Saba, 2022), a focus on the healthcare procurement perspective is still missing. By addressing this gap, the study offers a theoretical contribution. Additionally, this study identifies the best practices used by healthcare organizations, further enriching the theoretical understanding of healthcare preparedness. From the best practices, and a roadmap is developed as a guide to developing preparedness plans, which is the practical contribution of this research. The roadmap is a tool that offers guidance to hospitals to strengthen their preparedness for future crises.

2. Contextualization

More than any other event in the previous few decades, COVID-19 highlighted the significance of supply chain management. Organizations were not properly prepared for the

pandemic, the "Great Lockdown," and the tidal wave of disruptions that hit every industry and region (Craighead, Ketchen Jr, & Darby, 2020). The outbreak, which originated in the Wuhan area of China, had an immediate impact on Chinese exports and significantly limited supply availability in global supply chains (Ivanov, 2020). This circumstance resulted in a worldwide shortage of personal protective equipment (PPE) (Vanhooydonck et al., 2021), and a buyer's market of PPE transformed into a supplier's market in a very short amount of time. At the beginning of the pandemic, nurses were on the front lines of supply chain failures, without the tools they needed to safeguard themselves and the patients they cared for (Dai, Zaman, Padula, & Davidson, 2020), and the purchasing and logistics divisions of the hospitals had to deal with delivery bottlenecks, advance payments, and panic buying (Dostal, 2020). The following sections highlight the German context of the COVID-19 pandemic, the main barriers faced by healthcare organizations to preparedness, and the best practices learned.

2.1 German context of the pandemic: the federal state structure and the absence of a nationwide emergency plan posed challenges during the pandemic

Germany, a federal parliamentary republic with 83 million people living in 16 states, has a decentralized healthcare and disaster management system where states operate independently from the federal government. Its governing mechanisms are intricate, with power being divided among numerous levels and sectors (Hattke & Martin, 2020). The government was criticized for not presenting a uniform nationwide emergency plan that included a basic strategy for defending against a pandemic more than a decade ago. The federal structures of the health care system pose a challenge in the event of a Germany-wide disease outbreak, especially when insufficient resources must be distributed across the borders of federal states (Reichenbach, 2011). Due to the COVID-19 pandemic's effects, it became difficult for German hospitals to acquire adequate stock beginning in early 2020 (Vanhooydonck et al., 2021). The increased rivalry among healthcare institutions directly restricted the hospital's ability to function (Wurmb et al., 2020). States and hospitals competed against one another in auctions for medical supplies, equipment, and medications (Aubrecht, Essink, Kovac, & Vandenberghe, 2020), and have received widespread attention for their inadequate capacity and level of preparedness (Wurmb et al., 2020).

2.2 Preparedness activities for supply disruptions and associated barriers

Preparedness is a means of organizing supply chain resources, designing inter-organisational structures, planning, and training to ensure efficient response (Listou, 2018). Two groups of disaster preparedness activities can be identified, namely physical and intangible activities. Physical preparedness activities include expenditures on material resources, such as developing infrastructure or stockpiling various types of inventories (Kunz et al., 2014). By establishing a stockpile of medical supplies, a nation can handle potential supply chain disruptions for essential goods (OECD, 2020b), and this strategy might also lessen the motivation for nations to impose export restrictions on medical items (OECD, 2020b). However, there are barriers that might hamper the effectiveness of preparedness activities. Barriers can be defined as circumstances that make it problematic or impossible for something to happen or to be achieved (Collins, 2022). For example, stockpiling typically results in significant investment costs and is specific to one location (Kunz et al., 2014). There are many stocks with expiration dates that must be respected, including PPE and medicine. These time-dependent inventories must be continually checked to make sure they are still functional (Whybark, 2007). The second type of disaster preparedness activity, intangible

activities, involves investing in disaster management competencies (DMCs) (Kunz et al., 2014). Disaster management competencies consist of five essential components. Human resources (i) include choosing and educating individuals who can organize, coordinate, act, and intervene as necessary. Knowledge management (ii), the second component, involves capturing, codifying, and transferring knowledge. The third component, operations- and process management (iii), emphasizes the role of logistics. It includes setting up agreements to facilitate rapid resource movement establishing alternative suppliers, trade lanes, and transportation modes. The fourth DMC, financial resources (iv), ensures smooth operations by allocating adequate funds and resources for disaster response. The final component is the community (v). It is essential to find efficient ways of collaboration with key partners. A way to achieve this is through mutual framework agreements. All five components must interact for greater preparation and, consequently, a more effective response (Van Wassenhove, 2006). Disaster management competencies are frequently universal and transferable between nations. As a result, high levels of catastrophe response can be ensured with a lot less initial cost. There are many advantages to investing in such competencies in comparison to physical pre-positioned assets. First, a company's DMC can be deployed globally. Second, when a disruption strikes, DMCs enable organizations to immediately transfer supplies from a central warehouse to the location where the disaster occurred. Third, investing in DMC is less expensive than pre-positioning products in bulk at several sites (Kunz et al., 2014). However, there are also some barriers related to intangible disaster preparedness activities. Obtaining the financial resources is the fundamental problem preventing many organizations from moving forward (Van Wassenhove, 2006). Furthermore, there is no recognized standard for a curriculum of disaster management competency. This leads to it is difficulties in assessing the preparedness of an organization (Cranmer et al., 2014). An overview of physical and intangible disaster preparedness activities is presented in Table 1.

Table 1: Tangible and intangible disaster preparedness activities, adopted from (Cranmer et al., 2014; Kunz et al., 2014; OECD, 2020b; Van Wassenhove, 2006).

Type	Disaster preparedness activities	Advantages	Barriers
Physical	Infrastructure, Pre-positioning of inventory (stockpiling)	- Ability to handle potential supply chain disruptions for essential goods or services - might lessen the motivation for nations to impose export restrictions	- significant investment costs - location specificity that can rarely be shifted to disasters occurring elsewhere - product obsolescence of stored goods
Intangible	Disaster management competencies: - human resources, - knowledge management, - operations and process management, - financial resources, - community	- can be deployed globally - enable organizations to immediately transfer supplies - less expensive than pre-positioning products	- costs and obtaining the financial resources for building DMCs - no standard for curriculum for disaster management competency leads to subjective evaluation of preparedness

2.3 Best practices: integrating inventory pre-positioning and enhancing disaster management competencies

Kunz et al. (2014) examined three extreme case scenarios and a mixed scenario to evaluate various disaster response strategies. In scenario A, no pre-disaster preparedness activities were performed. This led to weak results and relief items were delivered only weeks after the disaster struck. In scenario B, physical pre-positioned inventory was placed in disaster-prone nations. Here, demand could be satisfied immediately after the disaster occurred. Compared to scenario A, the response costs were lower, since pre-positioned items were sent through slow modes of transportation. However, the holding costs for inventory were high and donors were reluctant to fund such investments. Another alternative is provided by scenario C, where organizations invest in disaster management competencies. In this scenario, the demand was satisfied much quicker than in scenario A, and the costs were significantly lower than in scenario B. While transportation costs during a disaster increased due to the reliance on air transportation, this approach was still proven to be more cost-effective than pre-positioning goods. The study revealed that integrating pre-positioning inventory strategies with enhancing disaster management competencies leads to superior outcomes (Kunz et al., 2014).

3. Methodology

This study adopts a case study approach to investigate the research questions. A case study research method is a tool that helps researchers explore a phenomenon or situation within its real-life setting by collecting data from various sources. This method enables researchers to explore the studied issue from multiple perspectives which further reveals the different aspects of the situation. Using case-study research leads to a better understanding of the circumstances (Baxter & Jack, 2008). This approach is appropriate for answering the research questions of this study as it helps the researcher to gather detailed data on the perspectives and experiences of purchasers of German hospitals, which provides a deeper understanding of the purchasing situation in the healthcare sector before and during the crisis. In this study, the barriers to preparedness and the best practices learned by hospitals during the COVID-19 pandemic are discussed. The researcher wants to understand the "why" behind the purchaser's behaviour and activities and seeks a thorough comprehension of the underlying causes, attitudes, and motivations. A case-study research approach is appropriate for answering the research questions of this study, as this method allows for an in-depth exploration of the barriers to preparedness the hospitals experienced before the pandemic, as well as the best practices purchasers used during the COVID-19 pandemic. The case study research allowed the researcher to gather detailed data on the perspectives and experiences of purchasers of German hospitals, providing a deeper understanding of preparedness in healthcare organizations.

A semi-structured questionnaire was developed to conduct the interviews. Although the interviewer prepares a list of predefined questions, semi-structured interviews flow naturally and provide participants the chance to discuss whatever topics they deem significant (Longhurst, 2003). Open-ended questions are typically used. Semi-structured interviews have the potential to reveal previously undiscovered information, which is a significant advantage. Participants can be thought of as experts due to their prior knowledge; as a result, when given enough liberty to speak freely, new, and unique information can emerge (O'Keeffe, Buytaert, Mijic, Brozović, & Sinha, 2016).

3.1 Sampling and data collection:

The number of interviews required to reach data saturation for semi-structured interviews is frequently between 15 and 25 (Kaae & Traulsen, 2020). For the empirical analysis, 15 semi-structured interviews with purchasers from 11 German hospitals were conducted. The interview consisted of three main parts: introduction, the main interview, and outro. The questions in the main interview were based on the best-case scenario for emergency preparedness as well barriers to preparedness, according to the literature. The introduction of the interview outlined the research objectives, while the main interview asked the participants about pandemic impacts on PPE procurement and factors that posed barriers to preparedness. Afterward, the respondents were asked about best practices, and their responses to the pandemic. In the outro part, the interviewees were given the opportunity to provide any further thoughts. Sampling is often impacted by practical problems, like access restrictions. Snowballing, a methos of asking current participants for recommendations for future participants (Kaae & Traulsen, 2020), was employed to overcome this challenge. After conducting the first interview with Purchaser A, this method was used to identify more potential participants. The researcher also contacted purchasing departments via telephone and email. All interviews were performed from January to May 2023 and lasted from 19:23 to 59:06 minutes.

3.2 Analysing and coding the data

The interviews were recorded and afterward transcribed with the subjects' consent and the transcripts were examined to create concepts from qualitative data. It is critical to maintain the interviewee's anonymity throughout the research process. Transcribing the audio recordings into textual data is the first stage in the analytical process (Kaae & Traulsen, 2020). To understand the interview data, coding was employed, as suggested by (DeCuir-Gunby, Marshall, & McCulloch, 2011). From these codes, a codebook was created. A codebook is a set of codes, definitions, and examples, and it is used as a guide for analysing interview data (DeCuir-Gunby et al., 2011). By employing the process of coding and creating a codebook, a systematic analysis of the interview data was conducted. This method forms the foundation for drawing meaningful conclusions and answering the research questions.

4. Results

4.1 Barriers to preparedness: the study found 14 barriers to preparedness in three categories

During the interviews conducted with purchasers, 14 barriers to preparedness emerged. These barriers can be categorized into three main groups: barriers to physical disaster preparation activities, barriers to intangible disaster preparation activities, and barriers that apply to both physical and intangible disaster preparation activities.

4.1.1 Barriers to physical disaster preparation activities

There are seven barriers to preparedness found in connection to physical disaster preparation activities. The first barrier is costs and reimbursement and involves the challenges of purchasing materials and obtaining reimbursement from health insurance companies, who cover patient treatment costs. In Germany, annual state-level negotiations between the insurance companies and hospital associations determine the base rate for inpatient treatment, considering

factors such as labour and material cost increases (Bundesministerium für Gesundheit, 2024). Hospitals get reimbursed by health insurance companies for materials for inpatient patient treatment, however, this does not apply to materials that are put into storage in case of a disaster. "If there is no reason for the purchase, especially in an area that requires isolation, the costs will not be reimbursed" (Purchaser H). The second barrier to physical preparation is the unknown type of disaster and necessary material. "I can purchase protective gowns and masks as extra safeguards if I am certain that germs will be the ones moving via the air. But there are many other disasters that we could encounter" (Purchaser E). Product obsolescence third barrier of this category. PPE, such as FFP2 masks have an expiration date after which they are unusable. "In the end, it expires unused and has to be disposed of" (Purchaser D). Having only a small storage facility also hinders hospitals from conducting physical preparation activities. Some hospitals do not have the space to store goods to prepare for a disaster. "We only have a small storage facility" (Purchaser G). Connected to the previous barrier of having a small storage facility is the next barrier: the cost of (additional) storage. "There are certainly the costs of the actual storage facility, that is a barrier" (Purchaser D). The lack of local production was also seen as a barrier to future pandemic preparations. Since almost no PPE is produced in Europe, European hospitals are dependent on suppliers from Asia. "There are still very few production facilities in Europe for PPE. We are dependent on supply from Asia. Furthermore, when huge amounts of materials need to be sent, there are incredibly long delivery times" (Purchaser H). The last barrier to physical preparation activities is the Medical Device Regulation (MDR). According to Purchaser E, suppliers lose their accreditation for products and must be re-certified with increased requirements: "The MDR is crucial in this situation: suppliers may remove items from their range even though they are actually needed, but it is no longer worthwhile for the suppliers to be certified or recertified" (Purchaser E).

4.1.2 Barriers to intangible disaster preparation activities

During the interviews, four barriers to intangible disaster preparation activities were found. The first barrier to intangible preparation is personnel shortage. Due to a lack of staff, purchasers at hospitals are very occupied with their everyday tasks. "We do not have enough human resources; this is the biggest barrier to continuing with preparation" (Purchaser N). Additionally, high organizational efforts are needed to prepare intangibly. Most hospitals and municipalities are not able to manage this effort. "We often had a nationwide workshop but unfortunately it no longer exists. It is a huge effort; the workshops are just not conducted anymore" (Purchaser J). Intangible disaster preparations are also expensive, which is why the cost of such efforts is a barrier to preparedness. "There is a huge financial investment involved" (Purchaser D). The last barrier to implementing intangible disaster preparation activities is knowledge loss. If the lessons learned during the pandemic were not written down by the purchasers and the purchaser leaves the organization, the knowledge gained would be lost, as explained by Purchaser K: "If my colleague and I left the organization, the remaining colleagues would no longer know where to order" (Purchaser K). An organizational knowledge gap may result when purchasers who have amassed expertise regarding vendors, procurement procedures, and best practices leave the company.

4.1.3 Barriers to both physical and intangible disaster preparation

Barriers to preparedness that apply to both physical and intangible disaster preparation are possible unnecessary expenses, the unpredictability of the pandemic, and the unpredictability of governmental actions. Two purchasers (Purchaser A, E) name possible unnecessary expenses as a

barrier to disaster preparedness. This term refers to the notion, that a hospital invests in physical or intangible activities that might never be used, resulting in a waste of money. Purchaser A described it like this: “Money is spent on preparations, which is essentially wasted since you never know if you'll need them or if the disaster will occur in a different way entirely from what you had anticipated” (Purchaser A). Almost all purchasers viewed the unpredictability of the pandemic as a barrier. No one expected a global outbreak to happen to such an extent. “The actual spread of a pandemic in Germany and Europe has, up to this point, been a utopian thought, we were unaware of its true consequences” (Purchaser H). Another barrier in this category is the unpredictability of governmental actions. This refers to the regulations and guidelines issued by the government connected to the pandemic. “It was impossible to predict the decision of the federal government. Accordingly, we could only roughly prepare” (Purchaser C). An overview of all barriers to preparedness found in this study can be seen in Table 2.

Table 2: Barriers to disaster preparation activities found during the interviews

Barriers	
Barriers to physical preparation activities	Costs and reimbursement
	Unknown type of disaster and necessary material
	Product obsolescence
	Small storage facilities
	Cost of storage
	No local production
	Medical device regulation
Barriers to intangible preparation activities	Personnel shortage
	High organizational efforts necessary
	High costs for intangible preparation activities
	Knowledge loss
Barriers to both physical and intangible preparation activities	Possible unnecessary expenses
	Unpredictability of pandemic
	Unpredictability of governmental actions

4.2 Best practices employed during a pandemic: Identification and categorization of practices employed by purchasers during the pandemic

Analysing the interview data, 24 best practices utilized by hospitals during the pandemic were identified. These best practices are divided into six categories, using the framework suggested by literature. The categories include physical as well as intangible activities, as suggested by (Kunz et al., 2014), including the subcategories of disaster management capacities: storage, human resources, knowledge management, operations- and process management, financial resources, and community, as presented by (Van Wassenhove, 2006). An overview of all best practices and their categories can be seen in Table 3.

4.2.1 Storage: having a storage facility, increasing the storage range and additional storage space are best practices during a pandemic.

In the realm of physical disaster preparedness activities, the storage of materials plays an important role. During the interviews, three best practices were found that can be sorted into this category. The first best practice is for hospitals to have their own storage facility. “It is important to have your own warehouse. It is nice to calculate, if the warehouse is on the street or if you have a single-supplier strategy. However, this practice failed during the pandemic” (Purchaser E). Another best practice in this category is increasing the storage range. This refers to extending the number of days, a hospital can operate with the materials in storage. “We now have a storage range of 40 days for all items and up to 60 days for particularly high-risk items” (Purchaser E). Additional storage space is another best practice. If there was limited storage space at the hospital’s location, additional storage space was acquired. “We acquired another storage facility and have put more things in stock, including ventilation systems and central venous catheters. We did not purchase them in every size, but at least so you had something to work with” (Purchaser A).

4.2.2 Human resources: Have a person responsible for pandemic preparations, preparation workshops, and all purchasing employees can do all purchasing activities are best practices

Disaster management competencies, as introduced by (Van Wassenhove, 2006), highlight the importance of investing in human resources. Within this context, purchasers of healthcare organizations have identified three best practices that belong to this category. The first best practice is designating one or more individuals to oversee pandemic preparedness. “In the event of a pandemic, or even in times when there is no pandemic, the pandemic representative can check whether there is sufficient stock and whether the people have enough knowledge” (Purchaser L). Preparation workshops were also named to be a best practice. These workshops allow participants to share expertise, improve communication, and work together. “I have attended workshops where the topics were always fire alarms or power outages in hospitals. These workshops gave us an opportunity to exchange knowledge and ideas” (Purchaser J). Another best practice is for all employees to be able to conduct all purchasing activities. Distributing purchasing responsibilities across multiple individuals may avoid knowledge silos, and maintain business continuity. ”There is no isolated knowledge, the general work can be done by all employees. This means that I can always combine my strengths in certain areas depending on the situation to remain able to act” (Purchaser N).

4.2.3 Knowledge Management: Having an emergency plan, and an emergency material checklist are best practices

The next part of intangible disaster management activities is knowledge management. Best practices that were found during the interviews belonging to this category are having an emergency plan, and having an emergency material checklist. The first best practice in this category is for the hospital to have an emergency plan. According to Purchaser K: “It was a best practice, that we had a crisis response plan. We already thought about possible scenarios before the pandemic” (Purchaser K). For the future, it is also seen as a best practice to develop an emergency plan based on the experience gained during the pandemic. “I think everyone has emerged from the pandemic a little smarter and it was certainly a time that was very instructive for us to develop appropriate pandemic plans” (Purchaser D). The second best practice in this category is to have an emergency

checklist. This list contains all materials, that are necessary for a hospital to keep operating. Purchaser L describes it like this: “We created a list of materials in collaboration with the responsible doctors and then extrapolated how much we would need for 90 days. Then we bought those materials. (Purchaser L)

4.2.4 Operations- and process management: nine best practices belong to this category

Operations- and process management is the third category of disaster management competencies, as described by (Van Wassenhove, 2006). Nine best practices that fit into this category. The first best practice mentioned is having alternative suppliers. This refers to the notion that a hospital should not rely too heavily on one single source of supply. “We have learned that it is safer to pay attention to risk diversification and to have several suppliers on board” (Purchaser E). Fostering supplier relationships is another best practice. “What helped us a lot is the close partnerships we have with some of our suppliers. That ultimately saved us” (Purchaser N). The next best practice in this category is to have local suppliers. “We now have a partner here in Germany. The respiratory masks and the surgical masks are produced in Germany. We are positioned quite well” (Purchaser C). For an organization to have a fast purchasing process is also a best practice. “It was always crucial to act quickly when making purchases of goods that may become scarce” (Purchaser A). Furthermore, it was important to be flexible. Hospitals may adapt their purchasing strategies to changing market conditions, supply chain interruptions, and changing needs when they are flexible. “Ultimately, you have to react flexibly, that is a crucial thing “(Purchaser B). The approval of all purchasing channels is another best practice. Many hospitals are part of group purchasing organizations (GPOs). Usually, hospitals are bound to the suppliers with which the GPO has contracts. However, during the pandemic, this limitation was removed to provide hospitals access to the entire market for supplies. “The approval of all purchasing channels was advantageous. We were permitted to conduct our own purchasing and had access to the full global market to exercise procurement” (Purchaser H). The control of supply distribution was a best practice implemented by suppliers. “Some suppliers said: you get what you always get and no more. Other companies would only supply you with 80% of your order and gave the remaining 20% to those who urgently needed it” (Purchaser A). This practice, implemented by suppliers, is also connected to the next best practice: buy what you need but also think of others. It refers to maintaining a thoughtful balance between fulfilling the needs of the hospital, as well as considering the needs of other organizations. “The biggest challenge is, that you don't just think about yourself. You have to fight the pandemic together and we have to support each other (Purchaser M). The last best practice of this category is to continuously order from a supplier. “It is important to stay in the ordering process. Companies delete orders if they could not be fulfilled. You must continuously order materials, otherwise, you will be at the end of the list of suppliers, and there is nothing left” (Purchaser G).

4.2.5 Financial resources: Investment-stop for pandemic-unrelated goods, and personnel reduction to reduce costs are best practices

The next crucial part of intangible disaster management capacities is financial resources. The first best practice in this category is the investment stop for all goods that are not related to the pandemic. “You must save wherever possible. Investments that had nothing to do with containing the pandemic were suspended, and capital goods orders that were not required to keep the hospital

operating were no longer permitted" (Purchaser I). Connected to this is the next best practice, namely personnel reduction. "A big expense is personnel costs. There were employees in service areas that had nothing to do since parts of the hospital were closed. They were let go. These were the most effective measures in the short term" (Purchaser I).

4.2.6 Community: Framework agreements, communication among GPO members, communication among hospitals, having a network, and building a cross-functional task force are best practices

The last part of intangible disaster management capacities is community. Four best practices that fit into this category were found. The first best practice in the community category is to have framework agreements in place. "It is advantageous to have a fixed framework agreement where the suppliers are obliged to deliver. You then pay 1 to 2 cents more, but you have made a fixed agreement with a supplier and you can protect yourself" (Purchaser I). The second best practice found is communication among members of a GPO. Members were able to interact and support one another by sharing information. "The group purchasing organization had a COVID network. You could always take a look into this database and purchasers would write down where they got materials." (Purchaser G). Some hospitals also supported other hospitals close to them. "We also called other hospitals that were around the corner and we supported each other. That was the best practice ever" (Purchaser M). The next best practice mentioned is for the purchaser of the hospital to have connections to other players in the field to help predict material shortages. "Networking is crucial since it allows one to anticipate future shortages. That means that if the hospital is the first to purchase, it is in a better position" (Purchaser A). Additionally, it is beneficial to have contacts in other industries. "I have a relatively thick network. That is why I had people who were able to help me relatively quickly with imports of materials to Germany" (Purchaser O). The last best practice of this category is for hospitals to build cross-functional task forces. "A best practice was gathering the knowledge of individuals. There is a Corona team, it is very diverse and everyone could contribute something" (Purchaser J).

Table 3: The best practices found during the interviews

Type of activity	Categories	Best Practices
Physical	Storage	Having own storage facility
		Increasing storage range
		Attain additional storage space
Intangible	Human Resources	Have a person responsible for pandemic preparations
		Preparation workshops
		All purchasing employees can do all purchasing activities
	Knowledge Management	Having an emergency plan
		Emergency material checklist
	Operations- and process management	Having alternative suppliers
		Fostering supplier relationships
		Having local suppliers

		Being fast in the purchasing process
		Being flexible
		The approval of all purchasing channels
		Suppliers regulated distribution of needed materials
		Buy what you need, but also think of others
		Continues ordering from suppliers
	Financial resources	Investment-stop for pandemic-unrelated goods
		Personnel reduction to reduce costs
	Community	Framework agreements
		Communication among GPO members
		Communication among hospitals
		Having a network
		Building a cross-functional task force

From the interviews, it became clear that fourteen of fifteen purchasers considered the mixed disaster preparation scenario, a proposed by (Kunz et al., 2014), as the best option. Purchaser N justifies this: "The mixed scenario is the best. You must keep a stock of material and build up certain competencies among your staff to be able to react more quickly" (Purchaser N).

4.3 A roadmap: improving hospital preparedness through implementing the best practices

To enhance hospitals' preparedness for a future crisis, a roadmap with seven steps was developed, drawing on the best practices discovered in this research. The roadmap can be seen in Figure 1.

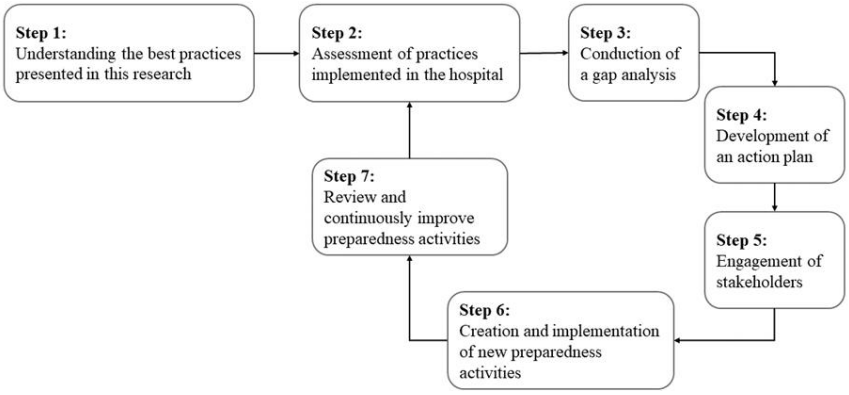

Figure 1: A roadmap for improving hospital preparedness

At the first step of the roadmap, the purchasing department of the hospital needs to gain an understanding of the best practices identified in this research. To achieve this, the organization should thoroughly review the best practices and their definitions in the results part of this study. The second step in the roadmap focuses on assessing the practices implemented by the hospital during the pandemic. Here, the hospital's purchasing department needs to assess the various purchasing strategies and actions they took during the pandemic. This self-assessment may encourage the hospital team to critically evaluate their experiences and identify the strengths and

weaknesses of their hospital. Step three of this roadmap focuses on conducting a gap analysis. First, a questionnaire will be distributed to the members of the hospital team. This questionnaire will help to evaluate which practices have been implemented successfully and what practices have not been applied and may require improvement. From this data, as well as from the documentation of best practices conducted in step 3, the gaps between the organization's current practices and those recommended in this research can be identified. Furthermore, the team members should be encouraged to categorize gaps based on their potential impact, ease of implementation, and required resources. These findings should be documented and serve as a basis for developing an action plan. The fourth step of the roadmap involves creating a strategic action plan to bridge identified gaps and incorporate best practices into the emergency preparedness plan of the hospital. Here, the establishment of clear objectives and goals for addressing prioritized gaps is required. Furthermore, necessary resources such as personnel, time, and funding need to be determined. Step five of the roadmap is focused on engaging stakeholders in the planning process to ensure a smooth implementation of the action plan. Here, relevant stakeholders need to be identified, including hospital management, staff, and suppliers. It is also important to incorporate feedback from stakeholders, answer questions, and listen to concerns. Step six is centred on the creation and implementation of new preparedness activities. Here, the hospital provides relevant training for staff members to give them the crucial skills and knowledge to implement these new activities. The focus of step seven is the continuous improvement of preparedness activities through regular review and feedback from stakeholders. It is crucial to assess the implemented disaster preparedness activities periodically to evaluate their effectiveness and identify areas for improvement. After analysing this feedback, the hospital can refine the existing preparedness activities and implement necessary adjustments or updates. To make sure the hospital's best practices and preparedness activities remain up-to-date and effective, the healthcare organization needs to stay informed of new developments and emerging trends in healthcare crisis management.

5. Discussion and Conclusion

The existing literature highlighted several barriers to hospital preparedness which were divided into two categories: physical and intangible barriers. Physical barriers described are significant investment costs, location specificity, and product obsolescence. Intangible barriers found in the literature are costs and obtaining the financial resources, as well as the lack of a standardized curriculum for disaster management competency (Kunz et al., 2014; Whybark, 2007).

The interviews revealed three instead of two overarching categories of barriers to preparedness, with 14 barriers in total. The first category of barriers is barriers to physical preparedness activities. These are costs and reimbursement, unknown types of disaster and necessary material, product obsolescence, small storage facilities, cost of storage, no local production, and the medical device regulation. The second category is intangible barriers to preparedness activities. Here, four barriers were found, which are: personnel shortage, high organizational efforts necessary, high costs, and knowledge loss. The third category is barriers to both physical and intangible preparedness activities. These barriers apply mutually to intangible and physical preparedness actions, rather than simply one or the other. Within this category, three distinct barriers were identified which are: possible unnecessary expenses, the unpredictability of the pandemic, and the unpredictability of governmental actions.The findings presented in this section provide a comprehensive answer to

Research Question 1, highlighting the barriers to preparedness hospitals experienced before the COVID-19 outbreak.

As suggested by literature, there are two types of disaster preparedness activities, namely physical and intangible activities. Physical activities include expenditures on material resources, such as the development of infrastructure and stockpiling of various types of materials. Intangible activities include investments in disaster management capabilities (Kunz et al., 2014). Five eras of disaster management competencies were suggested by previous research, namely: human resources, knowledge management, operations- and process management, financial resources, and community. These five components must all interact for greater disaster preparation (Van Wassenhove, 2006).

Building upon the knowledge gained from literature, the interviews provided valuable insight into best practices utilized during the COVID-19 pandemic. From these interviews, 24 best practices were identified, which correspond with both physical activities mentioned by (Kunz et al., 2014), and the five disaster management competencies proposed by (Van Wassenhove, 2006). The category that contains physical activities is storage. Here, three best practices were found, namely: having own storage facility, increasing storage range, and attaining additional storage space. Three best practices belong to the intangible category of human resources, which are: have a person responsible for pandemic preparations, preparation workshops, and all purchasing employees can do all purchasing activities. Knowledge management is the second category of intangible activities. Here, the best practices found during the interviews are: having an emergency plan and having an emergency material checklist. Operations and process management is the intangible preparedness category, where nine best practices can be sorted. Having alternative suppliers, fostering supplier relationships, having local suppliers, being fast in the purchasing process, being flexible, approval of all purchasing channels, buy what you need, but also think of others, suppliers regulated distribution of needed materials, and continues ordering from suppliers are the best practices of this category. The fourth category of intangible activities is financial resources. From the interviews, it was found that investment-stop for pandemic-unrelated goods, and personnel reduction to reduce costs can be attributed to this category. Lastly, community is the fifth category of intangible activities. The best practices that belong to this category are framework agreements, communication among GPO members, communication among hospitals, having a network, and building a cross-functional task force. Through the exploration of the best practices used by purchasing staff during the pandemic, this study has successfully addressed Research Question 2.

Regarding best practices to prepare for a pandemic, the literature suggested that combining pre-positioning inventory with purchasing disaster management competencies would lead to superior outcomes (Kunz et al., 2014). As discovered during the interviews, purchasers agree that this mixed method of disaster preparation is the best method to follow. Therefore, the findings of this study corroborate the existing literature as both emphasize the importance of the mixed method approach.

A practical contribution of this research is the development of a roadmap that is designed to guide hospitals to enhance their preparedness for a future healthcare crisis, as seen in the results part of this study. The roadmap is based on the best practices discovered in this study and healthcare

institutions can use this roadmap as a valuable tool to help them navigate future healthcare crises and develop a detailed emergency plan.

5.1 Conclusion

The main objective of this research was to identify barriers to preparedness as well as find the best practices used by hospital purchasers during the pandemic. Two research questions guided this study: (1) What are the main barriers to developing preparedness plans to address supply disruptions faced by hospitals (2) What are the best practices learned by hospitals during the COVID-19 pandemic in order to prepare for future supply disruptions? The comprehensive analysis of the interviews, held with 11 purchasers of 15 German hospitals, has uncovered 14 barriers to preparedness in three overarching categories, as well as 24 best practices in 7 categories. Furthermore, the study provides the procurement department of hospitals with a practical roadmap, that serves as a comprehensive guide to improve the preparedness of the hospitals for a future healthcare crisis. In conclusion, this study highlights the importance of strategic approaches to hospital preparedness. The knowledge gained from this research, in combination with the roadmap for hospitals, supports the continuous efforts to improve the purchasing of healthcare institutions.

5.2 Limitations

A limitation of the study is the restricted geographic scope. The interviews were conducted with 15 purchasers, working at 11 German hospitals. The findings of this study may not apply to other countries with different healthcare systems, policies, and cultural contexts. Another limitation is that barriers to preparedness and best practices identified in this study specifically emerged in the context of the COVID-19 pandemic. This could lead to a limited generalizability to a non-pandemic context. During other types of disasters, needs and challenges could be different.

5.3 Future research

As found during the interviews, communication among members of a group purchasing organization and hospitals in general were best practices. Future research could focus on identifying and analysing collaborative networks among hospitals and other healthcare institutions, and further assess the benefits and challenges in the context of hospital preparedness. Future studies could focus on the establishment and strengthening of local supply chains in the healthcare sector. The study could further explore potential strategies and interventions that the government can implement to support the development and maintenance of these local supply chains to prepare for future pandemics.

1 Introduction

In January 2020, the World Health Organization (WHO) declared the outbreak of the Coronavirus in China a public health emergency. An increasing number of countries detected their first cases and soon after, the organization acknowledged that the disease had become a pandemic (Carroll et al., 2020, p. 50). The virus spread to over 200 countries and the world was placed under a Great Lockdown as countries installed essential quarantines and social distancing procedures to contain the pandemic. Due to its extent, the viral outbreak is regarded as the most significant economic event in modern history since the Great Depression (Gopinath, 2020).

From the early months of the COVID-19 pandemic, shortages of medical equipment, especially personal protective equipment (PPE), have been documented by the World Health Organization. The WHO warned of severe and mounting disruptions due to rising demand, hoarding, panic buying, and misuse. It further advised governments and the industry to act quickly to ease export restrictions, boost supply, and implement measures that stop speculation or hoarding (WHO, 2020). Medical equipment shortages, however, were not unexpected. In recent decades, supply chains have become more global and more reliant on imports from economies like China (Gereffi, 2020, p. 296). A study conducted by Lavassani et al. (2022) about the supply chain of medical equipment indicated that the industry's 5-tier backward supply chain contains about 160,000 dyadic connections distributed across the globe (Lavassani et al., 2022, p. 2). This illustrates the complexity of managing supply chains. While a global supply network can provide stability in the face of regional disruptions, the recent worldwide pandemic has highlighted many of the difficulties and risks connected to it (Lavassani et al., 2022, p. 1).

The novel coronavirus global pandemic of 2020 has heightened awareness of supply chain shortages of personal protective equipment and testing kits (Gereffi, 2020, p. 287). The pandemic was the “black swan” that had been predicted by medical supply chain professionals in recent years (Lavassani et al., 2022, p. 1). The phrase "black swan" describes unexpected, unpredictable events that have significant effects (Tõnurist & Hanson, 2020, p. 15). These events are caused by destabilization factors such as powerful weather, pandemics, port closure, and political instability (National Academies of Sciences & Medicine, 2018, p. 10). Global supply chains have been considerably affected as a result of the fast-expanding demand for healthcare equipment, such as goggles, masks, and other personal protective equipment. Countries had to compete for products, resulting in bidding wars and significant price increases (Dai, Bai, et al., 2020, p. 2748).

At the beginning of the pandemic, the German government was not able to acquire enough personal protective equipment for medical staff. Since there was a lack of experience in dealing with global supply chains, the government had to ask multinational companies to purchase and procure healthcare equipment for Germany (Petersen, 2020). German purchasers did not just have to compete for medical equipment with purchasers from other countries, but also with other German states, hospitals, and clinicians. All organizations were competing for the same limited international supply (Dai, Bai, et al., 2020, p. 2748). One of the main reasons for that was the lack of preparedness. Preparedness can be defined as the readiness of an organization to deal with a situation (Cambridge Dictionary, N/A). Disaster preparedness has been identified as a critical component in reducing the global impact of disasters (Kunz et al., 2014, p. 261). Most nations have recently gone through a serious crisis for which their government and risk management systems were unprepared. These types of events present a challenge to crisis managers due to their unexpectedly enormous magnitude, novelty or unprecedented nature, and complexity, all of which create ambiguity about their outcomes and the best way to address them (OECD, 2018, p. 86). Countries that have identified the most critical hazards and threats to their territory, and people have made progress in implementing plans to be prepared for major risks by building anticipation capability (OECD, 2018, p. 56). The majority of nations reportedly already have systems and methods in place to keep track of crises and raise public awareness of them. However, only a small number of them have developed concrete strategies to prepare for unanticipated or more chaotic crises that do not coincide with historical events. This demonstrates that countries have achieved varying degrees of success in creating the resources needed to prepare for and respond to "black swan" events (OECD, 2018, p. 92).

To be prepared for an outbreak of a disease, Germany had pandemic preparation programs in place at both the federal and state levels, which concentrated on a possible influenza (H1N1) pandemic (Köppen et al., 2021, p. 75). However, even though the federal preparedness plan describes the use of medical equipment in the form of PPE, the plan does not elaborate on purchasing strategies (Robert Koch Institut, 2020).

The ability of institutions—public health authorities, healthcare systems, and emergency response bodies—to identify, report, and address outbreaks is reflected in the state of an epidemic's preparedness. Healthcare organizations are required to identify and evaluate outbreak events that may have serious ramifications, to report outbreaks and their causes to pertinent national and

international organizations and networks, and to take appropriate action to lessen the outbreaks' effects on human health, society, and the economy (Oppenheim et al., 2019, p. 2). Therefore, the goal of this research is to examine the barriers that healthcare organizations experienced while developing plans for pandemic preparedness, even though the risks of highly dispersed global supply chains were known. Additionally, this research strives toward detecting and documenting the best practices learned from this pandemic as a basis for creating a plan for possible disruptions in the future. This research focuses on the German context to understand the main barriers to preparedness and the best practices learned from the pandemic.

Pandemics are nothing new, they have occurred throughout history. Although pandemics of this magnitude are rare, examples of other spreading diseases can be found in the past (Dasaklis, Pappis, & Rachaniotis, 2012, p. 393). The recent events have uncovered weaknesses in the supply chain of medical gear, primarily of personal protective equipment. The research question that arises is:

Research Question 1: *What are the main barriers to developing preparedness plans to address supply disruptions faced by hospitals?*

To be better prepared for the next "black swan" event, past challenges and mistakes from the recent COVID-19 pandemic need to be identified and evaluated. It is also crucial to examine innovative strategies and valuable lessons learned during this unprecedented time. By exploring the best practices hospitals used to respond to the pandemic, strategies can be developed to better equip hospitals for a future healthcare emergency. The second research question therefore is:

Research Question 2: *What are the best practices learned by hospitals during the COVID-19 pandemic in order to prepare for future supply disruptions?*

This research attempts to contribute to filling this gap in literature by investigating barriers to preparedness of healthcare institutions for a future disaster. Furthermore, very few studies about the disruptions caused by the COVID-19 pandemic used empirical methods to collect and analyse data. Many articles were based on the viewpoints of researchers, as expressed in perspective pieces, discussion papers, and commentary (Chowdhury, Paul, Kaisar, & Moktadir, 2021, p. 21). A theoretical contribution of this research is the use of a case study method with semi-structured interviews, which is an empirical research method. It, therefore, adds to the current literature by using qualitative data. Moreover, understanding preparedness in the context of a pandemic will be extended with the knowledge of what barriers to preparedness for a pandemic exist and what

lessons have been learned to prepare for the future. Studies on the topic of preparedness have been conducted in the past (Hendrickson, 2020; Orlando et al., 2022). However, the topic of barriers to preparedness in the context of healthcare institutions has been under-researched.

As a practical contribution, this research helps to identify and document the best practices adopted by purchasing personnel of hospitals during the COVID-19 pandemic, providing valuable insights for hospitals to develop more effective preparedness plans for future healthcare emergencies. “Studying and monitoring previous disaster response can improve preparedness” (Handfield, Finkenstadt, Schneller, Godfrey, & Guinto, 2020, p. 1065). On the basis of these best practices, this study offers a practical contribution by developing a roadmap and questionnaire for hospitals. These tools provide valuable guidance to hospitals to strengthen their preparedness by implementing the most impactful strategies. This research also offers recommendations for the German government on enhancing its support for healthcare institutions in future healthcare crises, which is another practical contribution. Ultimately, the findings of this study aim to enable a more prepared and flexible response to upcoming emergencies.

To provide answers to the research questions, the research is divided into four sections. First, a theoretical framework is presented, including supply chain risk, disaster preparedness, barriers to preparedness, and a brief contextualization of the German healthcare scenario during the first stages of the pandemic. The research methodology is explained in the second section. The third section shows and discusses the results of this study and the final section consists of a discussion and conclusion.

2 Literature Review

More than any other event in the previous few decades, COVID-19 highlighted the significance of supply chain management. Organizations were not properly prepared for the pandemic, the "Great Lockdown," and the tidal wave of disruptions that hit every industry and region, despite the comprehensive body of research and armament of company exemplars (Craighead et al., 2020, p. 839). Most economies were negatively impacted by the COVID-19 pandemic, regardless of their size or stage of development (Bogataj & Bogataj, 2007, p. 2). The outbreak, which originated in the Wuhan area of China, had an immediate impact on Chinese exports and significantly limited supply availability in global supply chains (Ivanov, 2020, p. 2). The demand for some supply chains

has risen dramatically, and the supply has been unable to keep up with supplying products like facial masks, hand sanitizer, and disinfection spray (Ivanov & Dolgui, 2020, p. 2904).

2.1 The supply chain: examining its role in the context of the healthcare sector

A supply chain is a network of trading partners linked by financial, information, and product/service flows (Fugate, Sahin, & Mentzer, 2006, p. 1). It can also be described as a grid of interconnected and dependent organizations that cooperate and work together on a mutual basis (Christopher, 2016, p. 3) or a system that incorporates all stakeholders directly or indirectly associated with satisfying a customer request (Chopra & Meindl, 2001, p. 15). The constantly evolving global marketplace has created a new allure for multinational corporations to seek out attractive labour markets to lower costs, locate close to customers, improve customer service, and expand into new markets in emerging countries to increase profits (G. Schmidt & Wilhelm, 2000, p. 3). Global setups allow access to raw materials, subsidized finance opportunities, and broader product markets (Manuj & Mentzer, 2008, p. 134).

Since the 1980s, businesses have begun to offshore their operations to low-cost and/or low-wage nations, bringing the goods and services created abroad back to their home nations. The North American Free Trade Agreement (NAFTA), which was signed in 1994, as well as the openness and economic changes occurring in China and India in the 1980s and 1990s, all contributed to the growth of this practice in the 1990s. As a result, businesses frequently relocated whole production lines to nations like Mexico or China (Farrell, 2004, p. 1; Schoenherr, Tummala, & Harrison, 2008, p. 100). Offshoring one's production, however, might result in a more intricate supply network and greater hazards, most notably supply chain risks. Moving one's operations overseas has its benefits, but some risks must be considered and balanced against those benefits (Schoenherr et al., 2008, p. 100). Risks related to the supply of goods can grow exponentially when the goods are outsourced and the supply network becomes more complicated, has more unknowns, and is more susceptible to supply chain disruptions (Hallikas, Puumalainen, Vesterinen, & Virolainen, 2005, p. 74). As a result of this sourcing shift, purchasing organizations are more vulnerable to supply disruption concerns (Ellis, Henry, & Shockley, 2010, p. 34). Globalization and the rise of the COVID-19 pandemic have increased supply chain complexity, which is viewed as a significant driver of supply chain risk and hence increases supply chain vulnerability. External risks posed by the Covid-19 pandemic disrupted worldwide supply chains, leading to delays, supply interruption, workforce

shortages, and demand changes, resulting in poor supply chain performance (Duong, Vo, Carvalho, Sampaio, & Truong, 2022, p. 19).

2.2 Supply chain risk: analysing the atypical disruptive impact of the pandemic

The risks of complex supply chains are widely acknowledged in the literature (Manuj & Mentzer, 2008, p. 133). However, they have been loosely defined. As a result, authors have come up with a variety of definitions for supply chain risk (Diehl & Spinler, 2013, p. 4), as presented in Table 1.

Definitions of Supply Chain Risk	Reference
"The potential occurrence of an incident associated with inbound supply from individual supplier failures or the supply market, in which its outcomes result in the inability of the purchasing firm to meet customer demand or cause threats to customer life and safety."	(Zsidisin, Ellram, Carter, & Cavinato, 2004, p. 397)
"Any risks for the information, material and product flows from original supplier to the delivery of the final product for the end user."	(Jüttner, Peck, & Christopher, 2003, p. 7)
"The negative deviation from the expected value of a certain performance measure, resulting in negative consequences for the focal firm. Hence, risk is equated with the detriment of a supply chain disruption, i.e. the realized harm or loss."	(S. M. Wagner & Bode, 2006, p. 303)
"The potential variation of outcomes that influence the decrease of value added at any activity cell in a chain, where the outcome is described by the volume and quality of goods in any location and time in a supply chain flow."	(Bogataj & Bogataj, 2007, p. 291)
"Supply risks reside in the course of movement of materials from supplier's suppliers to the focal firm, and include reliability of suppliers, single versus dual sourcing, make or buy decisions, centralized versus decentralized sourcing, and security issues."	(Manuj & Mentzer, 2008, p. 138)
"An individual's perception of the total potential loss associated with the disruption of supply of a particular purchased item from a particular supplier."	(Ellis et al., 2010, p. 36)

"The likelihood and impact of unexpected macro and/or micro level events or conditions that adversely influence any part of a supply chain leading to operational, tactical, or strategic level failures or irregularities".	(Ho, Zheng, Yildiz, & Talluri, 2015, p. 5)

Table 1: Definitions of supply chain risks and their references

Understanding the supply risks that exist is crucial to an organization's performance. Failure of a supplier to deliver products or services can have a negative impact on the purchasing firm and, as a result, the downstream supply chain (Zsidisin et al., 2004, p. 398).

Supply chain risks can be generally divided into two risk categories, namely operational risk, and disruptive risks (Tang, 2006, p. 453). The inherent uncertainties that exist in supply chains are referred to as operational risks. Customer demand and cost rate unpredictability, as well as supply uncertainty leading to operational challenges such as equipment failure, power loss, and critical personnel absence, are just a few examples. The likelihood of these risks is medium to high with a relatively low impact and short-term negative effects. Disruptive risks refer to major disturbances like earthquakes, floods, terrorist attacks, employee strikes, natural disasters, and pandemics. These disruptions have a relatively low likelihood of occurring; however, their impact is high and they may have short- or long-term negative effects on the supply chain (Schoenherr et al., 2008, p. 101; Tang, 2006, p. 453; Torabi, Baghersad, & Mansouri, 2015, p. 23). Table 2 gives a clear overview of operational- and disruptive risks and their properties.

Type of Risk	Explanation	Risk Categories	Likelihood and Impact
Operational Risks	Uncertainties that exist in the supply chain	Customer demand and cost rate unpredictability, equipment failure, power loss, absence of critical personnel	Medium to high likelihood, low impact with short-term negative effects
Disruptive Risks	Major disturbances	Earthquakes, floods, terrorist attacks, employee strikes, Industrial accidents, natural disasters, pandemics	Low likelihood, high impact with short- or long-term negative effects

Table 2: Operational- and Disruptive risks and their properties, adapted from (Schoenherr et al., 2008, p. 101; Tang, 2006, p. 453; Torabi et al., 2015, p. 67)

Most businesses create policies to protect their supply networks from recurring, low-impact risks. Many, on the other hand, almost completely disregard high-impact, low-probability risks (Chopra & Sodhi, 2004, p. 54). A company could minimize or downplay the threat of a pandemic because it assumes that its industry will not be affected by the pandemic's impacts. With so many risks to manage, a pandemic, a high-effect but low-probability event, may be overlooked in favour of more pressing ones (Craighead et al., 2020, p. 855). Some risky events, such as the SARS pandemic, may not occur frequently enough in global supply chains to allow for probabilistic decisions (Manuj & Mentzer, 2008, p. 136).

Along three interconnected dimensions, pandemics qualitatively differ from typical supply chain disruptive risks, which are scope, spillover, and shifts. Scope can be defined as "the state of the environment in which a situation exists" (Vocabulary.com, 2022). The scope of a typical disruption is confined to a specific region or industry. Port strikes that hinder businesses in an explicit area of a nation or a hurricane that affects commerce in a certain area are examples of typical disruptive risks. While one area is affected by these events, other areas continue business as usual. During a pandemic, however, every industry and the entire world is affected, rather than one contained area (Craighead et al., 2020, p. 839). The second dimension is spillover. The authors compare a typical disruption to a boulder tossed into a lake which frequently starts with a big shock and then settles down to a few small ripples. During a pandemic, however, a torrent of essentially identical waves spreads from sector to sector and from region to region (Craighead et al., 2020, p. 839). Everywhere in the world, the virus's intensity was comparable. This means that everywhere, the direct initial shock was the same size (Kohlscheen, Mojon, & Rees, 2020, p. 5). Thirdly, the dimension of shifts is clarified. Supply and demand are typically affected by a disruption, which often affects one but not the other. For instance, a supplier's bankruptcy can cause a brief loss of supply, but it might not have much of an impact on demand. The force of disruptions during a pandemic, however, can drive supply and demand to extremely high and low levels. These substantial changes happened in the same product category, as stay-at-home orders drove up demand for consumer-grade toilet paper but drove down demand for industrial-grade toilet paper (Craighead et al., 2020, pp. 839-840). While business-to-consumer operations soared as a result of the pandemic, there was a corresponding decline in industrial and commercial activity (Gurtu, Johny, & Buechse, 2022, p. 2). An overview of the differences between typical disruptive risks and pandemics is presented in Table 3.

Type of disruptive risk	Scope	Spillover	Shifts
Typical disruptive risk	Confined to a specific region or industry.	Like a boulder tossed into a lake which frequently starts with a big shock and then settles down to a few small ripples.	Supply and demand are affected, often affecting one but not simultaneously the other.
Pandemic	Every industry and the entire world are affected.	Like a torrent of essentially identical waves spreads from sector to sector and from region to region.	Can drive supply and demand to extremely high and low levels.

Table 3: Typical disruptive risks vs. pandemics, adapted from (Craighead et al., 2020, pp. 839-840)

Overall, pandemic outbreaks cause a great deal of unpredictability, and businesses need a structure to follow when building pandemic strategies for their supply chain (Ivanov, 2020, p. 9). To mitigate risk, supply chains must be built to include event preparedness, enable an efficient and effective reaction, and be capable of returning to their former state or even better after a disruptive event (Ponomarov & Holcomb, 2009, p. 124).

2.3 Pandemic context: PPE supply shortages left healthcare workers without proper protection and drove up prices

Personal protection precautions are required in the event of a COVID-19 pandemic. These precautions are employed to first create a barrier between patients and healthcare workers, and then to provide anti-viral respiratory protection for the healthcare workers (Vanhooydonck et al., 2021, p. 876). The main producing country of personal protective equipment is China. Attributable to the low production costs and high quality, China has become the global leader in the production of a wide range of products such as PPE, including gloves, protective facemasks, and gowns (Cohen & van der Meulen Rodgers, 2020, p. 5). Prior to the pandemic, China was the only country able to mass-produce clinical gowns and supplied half of the world's stock of surgical masks (Burki, 2020, p. 785).

The COVID-19 pandemic has resulted in a worldwide shortage of personal protective equipment (Vanhooydonck et al., 2021, p. 876). Global health systems were tested during the pandemic and highlighted a slew of flaws, emphasizing the crucial importance of the healthcare supply chain. At the beginning of the pandemic, nurses have been on the front lines of supply chain failures, without the tools they needed to safeguard themselves and the patients they cared for (Dai, Zaman, et al., 2020, p. 1). The lack of PPE was a common problem for outpatient caregivers. Missing robes, protective masks, and disinfectants were noted as burdensome because procuring PPE was difficult (Mojtahedzadeh, Wirth, Nienhaus, Harth, & Mache, 2021, p. 10).

Furthermore, in the healthcare industry, the Just-in-Time (JIT) business model is popular and urges firms to decrease inventories as much as possible to reduce operational costs and the amount of cash held in inventory (Gereffi, 2020, p. 295). Many hospitals have embraced JIT purchases of supplies such as FFP2 masks as a cost-cutting measure, similar to how manufacturers like to hold less inventory to be more competitive (Whalen, Helderman, & Hamburger, 2020). This outsourcing is making health care largely reliant on supplies from around the globe (Handfield et al., 2020, p. 168). Just-in-time staffing and supplies, "rightsizing," and other competitive healthcare and supply chain techniques operate together to undermine preparedness by lowering the number of hospital beds and making sure that those, that are already there, are as full as possible (Hick & Biddinger, 2020, p. 1).

The market for personal protective equipment was undergoing serious disruptions around the world (Boseley, 2020). The cost of purchasing FFP2 respiratory protection masks increased by 3000 percent over a few days, going from 0.45 Euros to 13.52 Euros. Logistics coming from China was the biggest issue. In the wake of the pandemic, transportation virtually came to a complete halt. Every nation was competing for protective gear (Kampf et al., 2020). It was challenging for all nations to urgently secure enough resources for their own needs due to the unprecedented and simultaneous worldwide demand for these commodities and significant disruptions in the international market (Winkelmann et al., 2022, p. 365). Masks became hard to obtain, clinics without protective gear were being reported in the media, and these items were even being stolen in some hospitals. A buyer's market transformed into a supplier's market in a very short amount of time. Prices reached uncontrolled levels and suppliers became unable to fulfil orders. Additionally, there were medical masks with false certificates. The purchasing and logistics divisions of the

hospitals had to deal with delivery bottlenecks, advance payments, and panic buying throughout the whole pandemic period (Dostal, 2020).

Another bottleneck was seen at the distribution stage, where disruptions in logistics and transport complicated the delivery of masks to the customers. Delays were caused by export restrictions by several countries or newly introduced authorization or certification procedures. Furthermore, the assessment of real-time needs, prioritizing deliveries, and anticipation of changes were major challenges (OECD, 2020a, p. 5). A lack of material visibility technologies resulted in absent demand insights and the inability to detect shortages (Handfield et al., 2020, p. 1070).

2.4 German context of the pandemic: the federal state structure and the absence of a nationwide emergency plan posed challenges during the pandemic

With 83 million people living in 16 states, Germany is a federal parliamentary republic. The states are independent from the federal government in terms of most issues, including healthcare and disaster management. Municipalities are guaranteed the right to local self-governance by the constitution (Hattke & Martin, 2020, p. 618). Its governing mechanisms are intricate, with power being divided among numerous levels and sectors. This intricacy is partially a result of having the oldest social health insurance system in the world, which upholds the values of solidarity, self-governance, and competition. In accordance with the subsidiarity principle, the German public health system is run at the municipal level. The 16 states act as intermediary organizations that handle interstate issues and offer centralized services, while 400 local health authorities are in charge of implementing infection-control measures. The Robert Koch Institute (RKI) is tasked with conducting scientific research, especially on infectious diseases, and epidemiological monitoring at the federal level. Its function is advisory rather than operational, supporting and counselling local and state health authorities, medical professionals, and politicians (Hattke & Martin, 2020, p. 619).

Already in 2011, it was criticized that there is no uniform nationwide emergency plan that includes a basic strategy for defending against a pandemic. This makes crisis management difficult at all levels. The federal structures of the health care system and civil protection pose a challenge in the event of a Germany-wide epidemic. Especially when, in a crisis, insufficient resources have to be distributed across the borders of federal states (Reichenbach, 2011, p. 42).

At the beginning of the pandemic, Germany had agreed to the Chinese government's proposal to sell the current supply of masks and other personal protective equipment back to China. Any Chinese materials that Germany might have had in stock were now being exported again with the notion that China needed the protection gear more urgently. Shortly after, in response to demands from Italy and Switzerland to buy similar items from Germany, that country imposed an export ban on masks and protective gear. It was now obvious that Germany had a supply shortage. The broad lack of availability of fundamental protective supplies afterward turned into a recurring aspect of Germany's coronavirus crisis (Dostal, 2020, p. 547).

Due to the COVID-19 pandemic's effects, including the increase in global demand, panic buying by the general public, depleted strategic stocks, unstable wholesale markets, the unreliable quality of imported masks, disruption of the supply chain, and other effects, it became difficult for hospitals to acquire adequate stock beginning in early 2020 (Vanhooydonck et al., 2021, p. 876). This increased rivalry among healthcare institutions directly restricted the hospital's ability to function (Wurmb et al., 2020, p. 2). The more the virus spread, the more feverishly the government and hospitals tried to obtain the urgently required protective gear or medications. State authorities or even individual hospitals found it increasingly challenging to obtain the protective masks, clothing, or goggles that they urgently needed, so the federal government took over central purchasing for Germany. The result was a race for resources (Rinke, 2020). States competed against one another in auctions for the sale of medical supplies, equipment, and medications by private companies that either already owned them or had control over their manufacturer (Aubrecht et al., 2020, p. 11). In order to take advantage of economies of scale and prevent rivalry amongst the states, the Federal Crisis Committee coordinated multiple federal agencies without a specific mandate to scale up a joint procurement program for personal protective equipment (Hattke & Martin, 2020, p. 620). These goods were distributed according to a distribution key that the federal states agreed upon (Schnabel & Hegele, 2021, p. 16). Individual businesses or states were still permitted to make their own purchases without being restricted by this centralized process (Hattke & Martin, 2020, p. 620). Due to this circumstance, hospitals were incentivized to overuse the centrally purchased PPE supply while still making individual PPE purchases. The hospitals did not stop overstocking PPE until they were certain that it would be provided reliably (Hattke & Martin, 2020, pp. 623-624). The centrally organized procurements by the federal and state governments, however, did not bring about the hoped-for relief from the shortage of materials (Bannwarth, 2021). In the spring of 2020,

the federal government had completed contracts for over six billion masks through various procurement channels. The government chose to purchase masks by using the open house procedure. This was an accelerated tendering process to get masks as quickly as possible. All companies that were able to deliver protective masks by a certain date were automatically awarded a contract – even if the costs were at 4.50 Euros per FFP2 mask. After just a few days, however, it became apparent that the federal government had to take many times more masks than planned. Furthermore, a not inconsiderable proportion of the masks supplied had been withdrawn from circulation because they did not pass quality tests. Around 570 million FFP2 and FFP3 masks and 270 million surgical masks have been blocked for delivery (Steinmann, 2022).

Due to the COVID-19 pandemic, hospitals and healthcare systems have received widespread attention for their inadequate capacity and level of preparedness (Wurmb et al., 2020, p. 6). Planning for hospital emergencies and being prepared are essential to navigating such difficult circumstances (Wurmb et al., 2020, p. 1).

2.5 Preparedness: better preparedness results in a better response

Preparedness is a type of insurance that one recognizes the value of but hopes will never be needed (Listou, 2018, p. 513). It "is a means to design inter-organizational structures, to organize supply chain resources, and to (jointly) plan and train to ensure efficient response if a response is called for" (Listou, 2018, p. 501). Despite the enormous importance of this notion, preparedness has received very little attention in managerial literature in the past (Orlando et al., 2022, p. 2). However, more studies are emerging to focus on emergency preparedness (Bao, Liao, & Hine, 2019, p. 1). Organizations are starting to pay attention to the teachings from past catastrophes and understand that they must put forth a lot of effort not only in the aftermath of tragedies but also in the interim. They are starting to consider how they may improve their performance by being more prepared. There is no doubt that better preparation results in a better response (Van Wassenhove, 2006, p. 481).

"Despite significant investments in global health surveillance and capacity building, large parts of the world are unprepared to manage infectious disease threats" (Oppenheim et al., 2019, p. 2). Many nations are ill-equipped to handle problems that arise inside their borders. To make sure that vulnerable nations are operationally prepared and capable of responding to public health emergencies like the COVID-19 outbreak, preparedness investments urgently need to be scaled up. Due to a shortage of funding, conflicting national priorities, and a high turnover rate among

healthcare professionals, many nations struggle to maintain or expand their national preparation capacities. To better prepare the globe for future health emergencies, it is important to assess each nation's level of preparedness and implement the most important lessons learned from previous significant public health emergencies (Kandel, Chungong, Omaar, & Xing, 2020, p. 1052).

2.6 Disaster preparedness activities: there are physical and intangible disaster preparedness activities with both advantages and barriers

Two groups of disaster preparedness activities can be identified, namely physical and intangible activities. The first type of activities are physical preparedness activities and include all proactive expenditures on material resources in disaster-prone nations, such as developing infrastructure or stockpiling various types of inventories. In this regard, authors recommend storing relief materials in advance in warehouses (Kunz et al., 2014, p. 262). Through establishing a stockpile of medical supplies and other vital commodities, a nation is able to handle potential supply chain disruptions for essential goods or services that have become apparent during the crisis. Strategic stockpiling can also lessen some risks that are more frequently connected to emergency contracts, such as risks related to integrity, and it might lessen the motivation for nations to impose export restrictions on medical items (OECD, 2020b, p. 28). However, there are some barriers. Barriers can be defined as circumstances that make it problematic or impossible for something to happen or to be achieved (Collins, 2022). Stockpiling typically results in significant investment costs that donors are frequently hesitant to pay because such expenditures are specific to one location and can rarely be shifted to disasters occurring in other areas (Kunz et al., 2014, p. 262). There are many stocks with expiration dates that must be respected, including PPE and medicine. This has several effects on how they are managed on a daily basis. Time-dependent inventories must be continually checked to make sure they are still functional for the intended purpose when the need arises (Whybark, 2007, pp. 231-232). Due to the uncertainties surrounding the date and location of the next disaster, pre-positioning relief inventories in disaster-prone nations are problematic since they demand substantial expenditure (Kunz et al., 2014, p. 262).

The second type of disaster preparedness activity is intangible activities. It has been acknowledged that investing in disaster management capabilities, such as training staff, establishing customs agreements in advance with disaster-prone nations, or coordinating import operations with regional customs clearing procedures circumvent the restriction to one location (Kunz et al., 2014, p. 262). For these reasons, Van Wassenhove (2006) suggested that organizations invest in disaster

management competencies (DMC) rather than pre-positioning goods (Van Wassenhove, 2006, p. 481). Disaster management competencies consist of five essential components. The first component is human resources (i). This involves choosing and educating individuals who can organize, coordinate, act, and intervene as necessary. Knowledge management (ii) is the second component. It is essential to learn from past disasters and capture, codify, and transfer knowledge. Thirdly, the component of operations and process management (iii) arises. Here, logistics is recognized as a central part of preparedness. To move resources quickly, goods, agreements, and means are set up. This also entails the establishment of alternative suppliers, trade lanes, and modes of transport. Financial resources (iv) are the fourth component of preparedness. For operations to run as smoothly as possible, sufficient money and financial resources must be prepared. The final component is the community (v). It is essential to find efficient ways of collaboration with key partners. A way to achieve this is through mutual framework agreements (Van Wassenhove, 2006, pp. 481-482). All five components must interact for greater preparation and, consequently, a more effective response (Van Wassenhove, 2006, p. 482). By making such DMC investments, organizations may be well-equipped and have the skills they need to act quickly in the event of a crisis. These qualities are frequently universal and transferable between nations. As a result, high levels of catastrophe response can be ensured with a lot less initial cost (Kunz et al., 2014, p. 262). There are many advantages to investing in such capabilities as opposed to tangible pre-positioned assets. First, as opposed to pre-positioning supplies that need to be reproduced in numerous locations, a company's DMC can be deployed globally. Second, when a disruption strikes, DMCs (especially ones connected to import operations) enable organizations to immediately transfer supplies from a central warehouse to the location where the disaster occurred. Third, investing in DMCs is less expensive than pre-positioning products in bulk at several sites (Kunz et al., 2014, p. 262). However, there are also some barriers related to intangible disaster preparedness activities. Obtaining the financial resources to pay for the training and processes that would improve preparedness and, as a result, lead to more successful logistical operations, is the fundamental problem preventing many organizations from moving forward. Donations made in response to a disaster go into relief efforts rather than toward education and investments in preparedness measures for times in between disasters (Van Wassenhove, 2006, p. 482). Furthermore, there is no recognized standard for a curriculum of disaster management competency. Due to this subjective evaluation, it is difficult to assess the preparedness of an organization (Cranmer et al., 2014, p. 73). An overview of physical and intangible disaster preparedness activities is presented in Table 4.

Type	Disaster preparedness activities	Advantages	Barriers
Physical	Infrastructure, Pre-positioning of inventory (stockpiling)	- Ability to handle potential supply chain disruptions for essential goods or services - might lessen the motivation for nations to impose export restrictions	- significant investment costs - location specificity that can rarely be shifted to disasters occurring elsewhere - product obsolescence of stored goods
Intangible	Disaster management competencies: - human resources, - knowledge management, - operations and process management, - financial resources, - community	- can be deployed globally - enable organizations to immediately transfer supplies - less expensive than pre-positioning products	- costs and obtaining the financial resources for building DMCs - no standard for curriculum or disaster management competency leads to subjective evaluation of preparedness

Table 4: Tangible and intangible disaster preparedness activities, adopted from (Cranmer et al., 2014, p. 73; Kunz et al., 2014, p. 262; OECD, 2020b, p. 28; Van Wassenhove, 2006, pp. 481-482).

To summarize the findings from above, physical preparedness activities such as stockpiling and building infrastructure might provide the ability to lessen the effects of supply chain disruptions for essential goods and services as well as decrease the motivation of countries to impose export restrictions to prevent shortages in their own countries. However, stockpiling requires a significant investment, is bound to a specific location, and involves a risk of the products going obsolete (Kunz et al., 2014, p. 262; OECD, 2020b, p. 28; Whybark, 2007, pp. 231-232). One example of obsolescence is filtering facepieces (FFP). FFP-type respiratory protection masks, also called N95 respirator masks, are recommended for wearer protection. Because FFP masks age naturally, they

have an expiry date after which their effectiveness cannot be guaranteed. Legally, once the expiry date has passed, respiratory protection masks cannot be resold, made available, or utilized (Lepelletier et al., 2020, p. 416). At the beginning of the pandemic, the former German Minister of Health had procured 5.8 billion masks for six billion euros. 730 million surgical masks and 60 million FFP2 or similar half masks whose expiry date has now passed will be thermally recycled in the near future since they cannot be utilized or resold (Focus online, 2022). We can, therefore, conclude that:

Proposition 1: Physical preparedness activities have some downsides, such as high investment costs, inflexibility of location, and risk of obsolescence, which discourages organizations from adopting these preparedness activities.

As mentioned above, implementing intangible preparedness activities has some advantages over implementing physical preparedness activities. The costs for these activities are lower, they can be deployed globally instead of being limited to one location and they enable organizations to transfer resources to the place where a crisis occurs (Kunz et al., 2014, p. 262). However, there are some factors discourage organizations from implementing these preparedness activities. Education and training require agreement on a set of shared competencies and learning objectives to ensure that course curricula are based on a well-defined and testable body of knowledge, skillset, and methodology in order to be effective (Walsh et al., 2012, p. 45), but there does not seem to be a recognized standard for curriculum or disaster management competency (Cranmer et al., 2014, p. 73). A further issue is obtaining the financial means to pay for the training and processes that would increase preparedness. Donations given in response to a disaster go toward relief activities rather than education and investments in disaster preparedness measures (Van Wassenhove, 2006, p. 482). These assumptions are strengthened by a study conducted in the context of the Canadian healthcare system. It was found that, except for simulated drills and exercises, opportunities for leaders to develop emergency management expertise are almost exclusively contingent on the occurrence of crises. Outside of the company, advanced training opportunities may be difficult to obtain due to a mix of barriers, including a lack of funds and restrictions on the availability of training programs (Hertelendy, Tochkin, Richmond, & Ciottone, 2021, pp. 8-9). Therefore, we can assume that:

Proposition 2: Although intangible preparedness activities can deliver more benefits than tangible preparedness activities, they can be more complex to execute, discouraging organizations from implementing this type of preparedness activities.

Barriers to preparedness were also identified by Jaque (2011), who conducted a study in the context of corporations in the field of chemicals and petrochemicals (Jaques, 2011, p. 4). However, these findings might also apply to the healthcare sector. It was found, that there are six main areas of barriers. The first area is denial and failure to prioritize. The interviewees explained that putting crisis management in place is nice to have, but will not influence the short-term results of the company. The focus of managers is, however, on day-to-day issues and pressures and preparedness plans are of lower priority. Furthermore, an attitude problem is present, where managers think that the chances of a disaster happening are very small and that nothing will happen (Jaques, 2011, p. 4). The second area of barriers to preparedness is the lack of experience and full understanding of potential risks. Here, the interviewees expressed that if a manager never had to deal with a crisis, they would not understand the potential issue and believe that it would not happen to them. Companies do not take risks serious enough until something goes wrong and employees are not fully trained on the full range of risks (Jaques, 2011, p. 5). Inadequate systems and processes are the third area of barriers. Implementing processes and systems is essential to identify risks. However, without great leadership and interpersonal skills, no amount of process will serve as an adequate safeguard. Conducting training, followed by audits is crucial for the systems and processes to be effective. Otherwise, they turn out be inadequate (Jaques, 2011, p. 6). The fourth barrier to preparedness is insufficient size and resources. It was agreed upon by the interviewees that larger companies had a higher availability of resources, and, therefore, are better able to prepare for crises. Planning, followed by testing it, is an expensive process. Larger organizations can put together a crisis management team since they often have the resources and functional specialties needed. There may be resistance to using consultants and contractors as part of the crisis management plans if the organization does not have access to internal resources. Therefore, it was believed that the expense and resource commitment would be a barrier to smaller organizations (Jaques, 2011, pp. 6-7). Unwillingness or inability of executives to share crisis experiences is the fifth area of barriers. The interviewees of the study conducted by Jaques (2011) stated that CEOs of different companies do not meet to discuss crises. They want to protect the reputation of their organization and would not share information that has a competitive impact. Discussing risk

management and areas of weakness would negatively impact the company's reputation. Furthermore, it was stated that people feel uncomfortable or embarrassed to talk about difficult situations (Jaques, 2011, p. 8). The sixth and final barrier to preparedness is failures of leadership and upward communication. Crisis management is likely to suffer if leadership at the top of the business does not give it enough attention, which increases the likelihood that leadership at lower levels will do the same. Furthermore, organizational culture has an impact on the communication. If employees do not have an environment in which they feel free and able to raise concerns about risks in a constructive way, they might not talk about "bad news" (Jaques, 2011, p. 9).

2.7 Best practices to prepare for a pandemic: integrating inventory pre-positioning and enhancing disaster management competencies as a best practice

A study was conducted by Kunz et al. (2014), in which the authors modelled three extreme case scenarios and a mixed scenario of a disaster response. In scenario A, no pre-disaster preparedness activities were performed. This led to weak results. Relief items were delivered only weeks after the disaster struck. In scenario B, physical pre-positioned inventory was placed in disaster-prone nations. Here, a positive effect was shown. Due to the pre-positioning, demand could be satisfied immediately after the disaster occurred. Compared to scenario A, the response costs were also lower, since pre-positioned items can be sent through slow modes of transportation. However, the holding costs for inventory were high and donors were reluctant to fund such investments due to the high expenses as well as the dangers of not utilizing the pre-positioned goods in the event of a non-disaster. Another alternative is provided by scenario C, where organizations invest in disaster management capacities instead of pre-positioned inventory. It was found that in this scenario, the demand was satisfied much quicker than in scenario A. Moreover, the costs for this type of disaster preparedness were significantly lower than in scenario B. While investment in DMC resulted in much lower preparedness costs, it involves higher costs for transportation during a disaster since items must be sent by air transportation. However, it is still less expensive than pre-positioning goods. Additionally, mixed scenarios were tested. Here, the outcomes showed that combining pre-positioning inventory with purchasing disaster management competencies invariably leads to superior outcomes. Depending on the amount of available financing, the recommended split between pre-positioned inventory and DMC will vary; however, in general, it is advised to spend approximately 50% of the maximum DMC preparedness cost and use the remaining funds to

prepositioning inventory (Kunz et al., 2014, pp. 267-269). An overview of the different scenarios and their outcomes is given in Table 5:

Scenario	Outcome
Scenario A: no pre-disaster preparedness activities	Weak results, relief items were delivered only weeks after the disaster struck
Scenario B: physical pre-positioned inventory	Demand can be satisfied immediately after the disaster occurs, but holding costs are high and funding is difficult
Scenario C: organizations invest in disaster management capacities	Demand is satisfied much quicker than in scenario A, costs were much lower than in scenario B
Mixed Scenarios: combining pre-positioning inventory with purchasing disaster management competencies	Leads to superior outcomes. Advice: spend approximately 50% of the maximum DMC preparedness cost and use the remaining funds to preposition inventory

Table 5: Disaster response scenario modelling, adapted from (Kunz et al., 2014, pp. 267-269).

Most nations have been compelled to reconsider their approaches to risk management and implement safeguards that can be activated in the case of an emergency. Apart from routine exclusions for urgency and emergencies, the bulk of governments relied on their existing procurement procedures (OECD, 2021, p. 168).

As mentioned before, at the beginning of the pandemic Germany had some safety stock. However, the supply of masks and other personal protective equipment was sold back to China which further led to a supply shortage of PPE in Germany (Dostal, 2020, p. 547). It can, therefore, be concluded that Germany was in a situation similar to scenario B at the beginning of the pandemic. However, as Germany sold the stock of PPE back to China, Germany faced a shortage of PPE, similar to scenario A. Just as described in the research by Kunz (2014) this led to weak results. A race for resources occurred (Rinke, 2020), and states competed against one another in auctions for the sale of medical supplies, equipment, and medications (Aubrecht et al., 2020, p. 11).

Finland was one of the few nations that had a stockpile, therefore, it was in a good position to react quickly to the crisis. (OECD, 2020b, p. 27). Since pre-positioned inventory was available, Finland can be categorized as being in scenario B at the beginning of the pandemic (OECD, 2021, p. 168).

Japan already invested in the resilience orientation of the country in December 2019. This stimulus had nothing to do with COVID-19 but instead addressed Japan's need to strengthen overall catastrophe resilience in the aftermath of floods, earthquakes, power outages, and other shocks in 2018 and 2019. The focal points of the investment were national resilience plans and disaster reconstruction as well as economic risk countermeasures. Japan's pandemic reaction was delayed and inadequate, as it has been in most other countries. However, Japan's confirmed cases were far lower than those of most of its G20 and OECD peers (DeWit, Shaw, & Djalante, 2020, pp. 2-3). It can, therefore, be assumed that Japan invested in disaster management competencies before the COVID-19 pandemic occurred, and the country can be categorized as belonging to scenario C.

In terms of pandemic response, an example of preparedness is South Korea. Building on its experience managing the Middle East Respiratory Syndrome (MERS), South Korea was able to quickly flatten the epidemic curve without imposing stay-at-home orders, closing businesses, or putting in place many of the more stringent measures taken by other high-income nations until late 2020. It accomplished this by creating clear instructions for the general population, carrying out extensive testing and contact tracing, and aiding those in quarantine in order to facilitate compliance. The robust enabling environment in South Korea allowed the administration to move swiftly and successfully. The government implemented 48 reforms to strengthen public health emergency planning and response following its ineffective reaction to a MERS epidemic in 2015 (June-Ho Kim, 2021). Additional PPE storage has been set aside by some hospitals. The largest PPE stockpiles were kept by Seoul's top public hospital for disaster preparedness (Kang et al., 2020, p. 1084). From this description, South Korea can be categorized as belonging to the mixed scenario, since the country invested in disaster management capacities and stockpiled PPE at hospital locations. A categorization of the four countries in the scenarios is visualized in Table 6.

Scenario	Outcome
Scenario A: no pre-disaster preparedness activities	Germany after selling stock back to China
Scenario B: physical pre-positioned inventory	Finland, Germany before selling stock back to China
Scenario C: organizations invest in disaster management capacities	Japan
Mixed Scenarios: combining pre-positioning inventory with purchasing disaster management competencies	South Korea

Table 6: Categorization of countries in scenarios, adapted from (Kunz et al., 2014, pp. 267-269).

As previously stated, the results of the mixed scenarios demonstrated that a combination of pre-positioning inventory and investing in disaster management capacities can produce better results. When compared to situations without preparedness, such a mixture of physical and intangible preparedness activities has a great potential to reduce lead time while having modest expenses (Kunz et al., 2014, pp. 29-30). South Korea implemented this mixed method. Based on its previous experience managing the Middle East Respiratory Syndrome (MERS), South Korea was able to quickly flatten the pandemic curve. Following a poor response to a MERS epidemic in 2015, the government implemented reforms to boost public health emergency planning and response as well as stockpiling personal protective equipment (June-Ho Kim, 2021; Kang et al., 2020, p. 1084). It can, therefore, be assumed that:

Proposition 3: A mixed method of stockpiling before a pandemic in combination with investments in disaster management competencies is the best solution to prepare for a future pandemic.

2.8 Research Model: a blueprint for investigating barriers and best practices in healthcare crisis preparedness

This research focuses on factors that posed barriers to purchasing personnel protective gear at healthcare institutions to prepare for a pandemic. Without question, better planning yields a better response (Van Wassenhove, 2006, p. 481). However, despite the extensive body of research and

arsenal of firm exemplars, healthcare organizations were not adequately prepared for the pandemic, the lockdown, and the wave of disruptions that affected every industry and location (Craighead et al., 2020, p. 839). Discovering the barriers of preparedness, which are circumstances that make it difficult or impossible for something to occur or be accomplished (Collins, 2022), it is important to overcome them.

After reviewing the literature, a research model was created. It visualizes that the barriers to preparedness influence the capacity of an organization to implement preparedness activities. This research focuses on the barriers to physical and intangible preparedness activities, however, for the sake of completeness, barriers to preparedness found by Jaques (2011) are also included in the research model. Further, the application of best practices also affects an organization's ability to carry out subsequent preparation actions. Both the capacity of an organization and the implementation of best practices then determine the degree of emergency preparedness of an organization. The research model can be found in Figure 1. It is possible, though, that some elements will be deemed relevant while others may not.

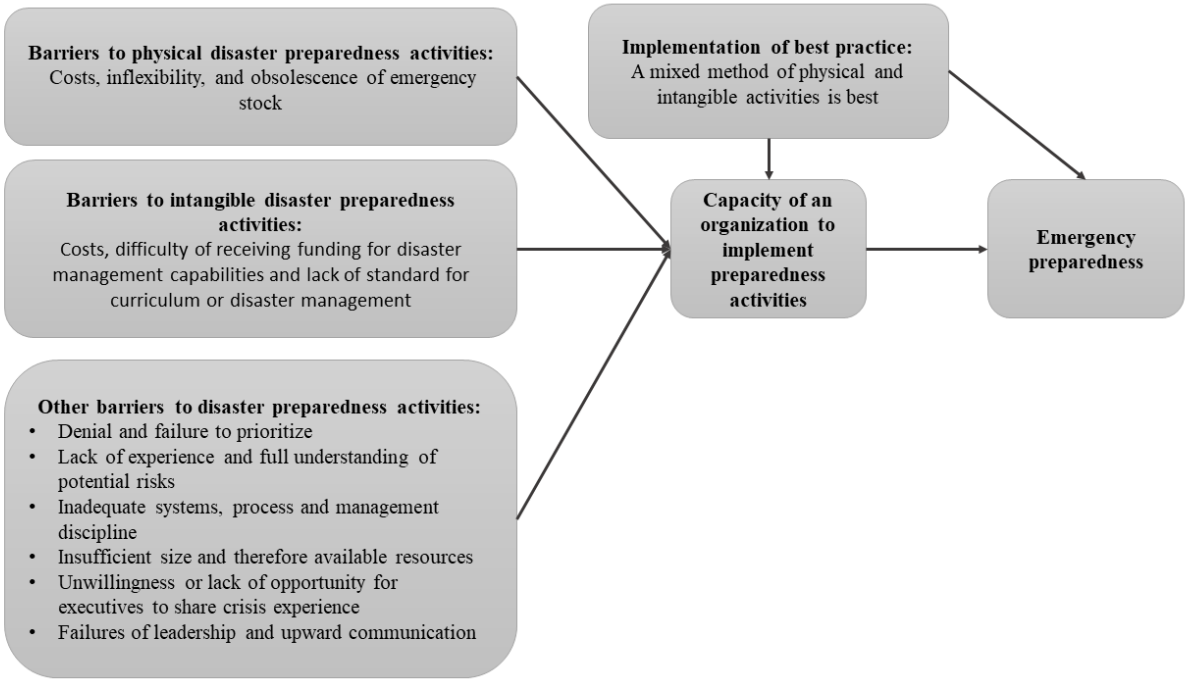

Figure 1: Research model

3 Methodology

Qualitative research methods are used when the researcher wants to understand the "why" behind people's behaviours or activities. From this standpoint, qualitative research allows for an in-depth understanding of the underlying reasons, attitudes, and motivations behind distinct human behaviours. It is useful for describing complicated phenomena that are located and ingrained in local environments in great detail (Kaae & Traulsen, 2020, p. 49; Rosenthal, 2016, p. 50). The goal of qualitative research is to comprehend a topic at a deeper level rather than to accurately depict it numerically. Therefore, qualitative research focuses on the comprehension and justification of the dynamics of social relations and is concerned with parts of reality that cannot be quantified (Queirós, Faria, & Almeida, 2017, p. 370). The data generated by qualitative approaches is a record of how people express themselves, what they claim to believe, and what they do (Kaae & Traulsen, 2020, p. 49).

3.1 Case-study research: Understanding the “why” behind the interviewee’s behaviour and actions

A case-study research method is a tool that helps researchers explore a situation within its real-life setting by collecting data from various sources. This method of data collection enables researches to explore the studied issue from multiple perspectives which further reveals the different aspects of the situation. Using case-study research leads to a better understanding of circumstances (Baxter & Jack, 2008, p. 544). In this study, the barriers to preparedness and the best practices learned by hospitals during the COVID-19 pandemic are discussed. The researcher wants to understand the “why” behind the purchaser’s behaviour and activities and seeks a thorough comprehension of the underlying causes, attitudes, and motivations. A case study research approach is appropriate for answering the research questions of this study, as this method allows for an in-depth exploration of the barriers to preparedness the hospitals experienced before the pandemic, as well as the best practices purchasers used during the COVID-19 pandemic. The qualitative research method helps the researcher to gather detailed data on the perspectives and experiences of purchasers of German hospitals, which provides a deeper understanding of the purchasing situation in the healthcare sector before and during the crisis.

When studying subjective understandings, feelings, beliefs, attitudes, experiences, and/or ideas, interviews are a popular and valuable tool. Critical issues in present procedures can be recognized, addressed, and rectified through them. Interviews can also detect well-functioning practices and

help to strengthen them. They are a sort of conversation between a researcher and one or more interviewees to explore the interviewee's integrative and holistic perspectives (Kaae & Traulsen, 2020, p. 51). A semi-structured questionnaire was developed to conduct the interviews. It consists of a verbal exchange in which the interviewer uses questions to try to elicit information from the subject. Although the interviewer prepares a list of predefined questions, semi-structured interviews flow naturally and provide participants the chance to discuss whatever topics they deem significant (Longhurst, 2003, p. 143). Open-ended questions are typically used. Semi-structured interviews have the potential to reveal previously undiscovered information, which is a significant advantage. Participants can be thought of as experts due to their prior knowledge; as a result, when given enough liberty to speak freely, new, and unique information can emerge. Questions should be clear and simple for interview subjects to understand, relevant to their own experiences, ethically and culturally sensitive, and ensure that the information flow is aided rather than impeded (O'Keeffe et al., 2016, pp. 1912-1913).

3.2 Validity and reliability

The degree to which an instrument performs as intended is referred to as its validity (Andrade, 2018, p. 498). The prepared questions or subjects are based on the literature to ensure the authenticity of the study and the prepared questions are asked in the same order and format to reduce bias in the interviews. Flexibility persists even when using prepared questions (C. Schmidt, 2004, p. 204).

The consistency with which findings are obtained is referred to as reliability (Andrade, 2018, p. 498). Reliability is the term used to describe the credibility of the study, and how they were applied and implemented in a qualitative research study. Reliability refers to the methodological process consistency, hoping that results remain largely constant throughout time and between different researchers and/or procedures used. The number of participants and the extent to which measure participants provide the same response are taken into consideration to ensure reliability (Rose & Johnson, 2020, p. 4).

3.3 Interview protocol: Utilizing literature-based questions to investigate barriers and best practices

Three key parts made up the interview protocol: an introduction and background information, the main interview portion, and the outro portion. The main questions of the interviews are derived from the proposed best-case scenario for emergency preparedness as well as factors that pose

barriers to preparedness, according to the literature. In the introduction and background section, the participants were informed about the aim of this research. It is particularly important to appropriately notify the interviewee of the goal of the research study when conducting interviews ethically (Kaae & Traulsen, 2020, p. 54). Furthermore, the respondents' background and line of work were briefly evaluated to ascertain whether they had a sufficient understanding of hospital purchasing and whether they had encountered the COVID-19 pandemic. The purchasers would have been disqualified if they had stated that they lacked sufficient knowledge of the circumstances during the COVID-19 outbreak. During the second part, the main part of the interview, the interviewees were asked how the pandemic impacted their ability to purchase personal protective equipment. The purchasers were then presented with the study that was conducted by Kunz et al. (2014) and were asked to match their position during the first wave of the pandemic with the scenarios presented in the study. This provided general insights into the hospital's situation. Next, the interviewees were asked about the factors that determined their situation and the variables that hindered the hospital from being better prepared for a pandemic. Afterward, the respondents were asked to go into further detail about their learnings, best practices, and their responses to the pandemic. These inquiries sought to extend the subject and enable the respondent to offer fresh perspectives that the earlier inquiries might not have produced. In the final part, the outro portion of the interview, the interviewees were given the opportunity to provide any further thoughts. An overview of all interview parts and questions can be seen in Appendix A.

3.4 Sampling and data collection: Conducting semi-structured interviews with purchasers of German hospitals

For the empirical analysis, 15 semi-structured interviews from 11 German hospitals were conducted. Interviews are crucial for understanding how informants perceive the issue at hand and provide greater knowledge from their point of view, which is especially crucial for COVID-19 (O'Keeffe et al., 2016, pp. 1912-1913). A critical stage to producing useful results is participant sampling. Interviews are known for producing significant amounts of data; therefore, researchers frequently must involve a small number of participants. To guarantee that all pertinent patterns are identified and shown consistently, this requires a minimum number of participants. As a result, recruiting continues until no new patterns are found; this is known as data saturation, and it necessitates that analysis be done along with data collecting (Kaae & Traulsen, 2020, p. 53). Reaching topic saturation is one typical benchmark for qualitative sample sizes (DeJonckheere &

Vaughn, 2019, p. 4). The number of interviews required to reach saturation for semi-structured interviews is frequently between 15 and 25 (Kaae & Traulsen, 2020, p. 53).

In this research, the target group for conducting these interviews is purchasers at German hospitals. Practical problems, such as access restrictions, frequently have an impact on sampling. One choice is to "snowball," which entails asking current participants and subject-matter authorities for recommendations of future participants who meet the inclusion requirements (Kaae & Traulsen, 2020, p. 54). There are 1903 hospitals in Germany (Statistisches Bundesamt, 2022) which were all affected by material shortages during the COVID-19 pandemic (Vanhooydonck et al., 2021, p. 876). After conducting the first interview with Purchaser A, the snowball method was used to identify more potential participants. The researcher also contacted purchasing departments via telephone and email. There was a total of 15 purchasers from 11 hospitals who agreed to participate in the interviews. Therefore, 15 extensive semi-structured interviews with hospital buyers from Germany were undertaken. All interviews were performed from January to May 2023, concentrating on the first wave of the pandemic. The interviews lasted from 19:23 to 59:06 minutes. There were some interviewees who offered more specific information, as well as background explanations and spoke more animatedly overall. This explains why some interviews lasted longer than others. On the other hand, some interviewees showed a lower level of interest in the interviews than others. This explains why some interviews were shorter than others. Speaking at different speeds is another reason for the variations in durations. Some interviewees spoke quickly and without having to think for very long, which contributed to the interview's overall short time. A more detailed overview is presented in Table 7.

Organization	Description	Interview Medium	Duration
Hospital 1	Purchaser A	Telephone	23:16 minutes
	Purchaser B	Telephone	28:55 minutes
	Purchaser C	Telephone	26:44 minutes
	Purchaser D	Video Call	44:06 minutes
Hospital 2	Purchaser E	In Person	23:43 minutes
	Purchaser F	Telephone	26:24 minutes
Hospital 3	Purchaser G	Telephone	40:54 minutes
Hospital 4	Purchaser H	Telephone	19:23 minutes
Hospital 5	Purchaser I	In Person	34:35 minutes
Hospital 6	Purchaser J	In Person	19:34 minutes
Hospital 7	Purchaser K	Telephone	24:07 minutes
Hospital 8	Purchaser L	Telephone	59:06 minutes
Hospital 9	Purchaser M	Video Call	22:22 minutes
Hospital 10	Purchaser N	Telephone	23:41 minutes
Hospital 11	Purchaser O	Telephone	23:08 minutes

Table 7: Overview of semi-structured interviews with purchasers from German hospitals

3.5 Analysing and coding the data

The interviews were recorded and afterward transcribed with the subjects' consent. The transcripts were examined to create concepts from qualitative data. It is not enough to simply take notes on the interviewee's responses to get all the important details. Interviews ought to be audio-recorded for this reason. Additionally, it is critical to maintain the interviewee's anonymity throughout the research process. Transcribing the audio recordings into textual data is the first stage in the analytical process (Kaae & Traulsen, 2020, p. 54).

Making sense of interview data requires several steps. Researchers must code data to understand the meaning of interviews (DeCuir-Gunby et al., 2011, p. 137). Codes are labels or tags that provide the descriptive or inferential data gathered during a study with a unit of meaning. Codes are allocated to data chunks, typically phrases, sentences, or paragraphs that are tied to a particular context or situation, to ensure understandable labelling (Miles & Huberman, 1994). The researcher can start investigating how their data supports or contradicts the hypothesis that is guiding their research by applying codes to raw data. Coding is essentially a circular process since it allows the researcher to revisit the raw data in light of theoretical discoveries and recent research literature. A codebook is a set of codes, definitions, and examples, and it is used as a guide for analyzing

interview data. Since they give a defined operationalization of the codes, codebooks are crucial for conducting qualitative research analysis. The codebook consists of three crucial components: the code label, the full definition, and an example (DeCuir-Gunby et al., 2011, p. 138).

3.6 Deductive and inductive coding

There are two types of code development, namely the deductive development of codes and the inductive development of codes. When using the deductive approach, a pre-defined list of codes is established in a structure known as a coding frame. This strategy aids in narrowing the coding to topics that are recognized to be significant in the body of literature and is frequently connected to theory testing or theory improvement. The codes used in deductive coding are typically theoretical ideas or themes taken from previously published literature. The number of codes in a deductive coding approach will normally be quite small, with perhaps only five to ten codes produced from the theoretical framework (Linneberg & Korsgaard, 2019, p. 264). When constructing codes using the inductive method, codes are formed straight from the data. Here, the code development involves using words or phrases that interview participants said. By reflecting what is in the data rather than the researcher's views and preconceived notions, the codes remain closely tied to the data. When doing an exploratory investigation or when no immediate theoretical notions are available to help you understand the phenomenon being studied, the inductive approach is appropriate (Linneberg & Korsgaard, 2019, p. 263). Since this research is exploratory and limited theoretical notions are available, the inductive coding approach is used.

3.7 Coding the data with open coding, axial coding, and selective coding

There are three coding methods, namely open coding, axial coding, and selective coding, which will be used in this research. The development of theory from the open, axial, and selective coding of the gathered data allows the researcher to develop deeper theoretical meaning. Researchers can access informants' opinions, perspectives, and responses to study topics in a nuanced way using this coding technique (Williams & Moser, 2019, p. 46). The initial level of coding is known as open coding. The researcher is identifying distinct concepts and topics for categorization through open coding. By establishing initial broad thematic domains for data aggregation, the first level of data is arranged. In actuality, the researcher must sort through the informant's responses and group-related terms, or concept indicators, into initial, broad thematic areas, and raw data is reduced into smaller groups (Williams & Moser, 2019, p. 48). The second level of coding is axial coding. Axial coding further clarifies, aligns, and categorizes the themes in contrast to open coding, which

concentrates on finding emerging themes. The obtained data can be sorted, refined, and organized to create clear theme groups in advance of selective coding after open coding is finished and the shift to axial coding is made (Williams & Moser, 2019, p. 50). In order to create core codes, axial coding analyses linkages between open codes. The most closely related (or overlapping) open codes with strong proof for their existence form major (core) codes (Strauss, 1987, p. 109). The third level of coding is selective coding. It enables the researcher to choose and include ordered data categories from axial coding in cogent and meaningful terms. The process of enabling further data refinement, choosing the primary thematic category, and then methodically lining up the primary theme to other categories that have been judiciously coded is crucial to enabling the story or case to emerge from the data categories (Williams & Moser, 2019, p. 52). The codebook of this research can be found in Appendix B.

4 Results

In order to develop a thorough understanding of the context in which each of the interviewed hospitals functions, it is essential to determine which operator runs the care facility. The legislator defines an operator as a natural or legal person who is in charge of managing a hospital. Licensed hospitals generally have the authority to settle bills with the Statutory Health Insurance, regardless of their ownership. Three different categories of ownership are recognized in Germany: public ownership, non-profit ownership, and private ownership (reimbursment.institute, 2023).

4.1 Ownership of hospitals in Germany: public ownership, non-profit ownership, and private ownership

28% of all German hospitals are publicly owned hospitals (Wagner, 2022). Operators of public hospitals are organizations governed by public legislation. This implies that, for instance, the states or the federal government operate hospitals. Both a public-law form (such as a joint association, foundation, direct or in-house operation), as well as a private-law form (such as an LLC), may be used to operate them. Contrary to public operators, non-profit hospital operators are associated with charitable, social, or religious organizations. Their efforts are guided by the ideals of voluntarism and a non-profit mindset. There are no plans to turn a profit. Instead, the goal is to pay for operating expenses. Non-profit hospital operators can be non-profit associations and foundations, charitable organizations, religious orders, and congregations (reimbursment.institute, 2023). 33% of German hospitals are run by a non-profit organization, such as the German Red

Cross or the Protestant or Catholic Church (Wagner, 2022). Operators of private hospitals may be either natural individuals, legally recognized businesses under private law, or legally recognized (partial) partnerships. Their goal is to generate profit, unlike the other ownership kinds. Therefore, the objective is to raise more money than is necessary to pay for running expenses. Private hospital operators can be stock corporations, civil law partnerships, LLCs, and foundations under private law (reimbursment.institute, 2023). Privately owned hospitals make up the largest proportion at almost 39% (Wagner, 2022). An overview of the three different types of ownership can be seen in Table 8.

Type of ownership	Explanation	Example of organization
Public	Hospitals operated by governmental bodies, governed by public legislation.	Federal government, states, districts, counties, municipalities, municipal corporations, cities.
Non-profit	Hospitals associated with charitable, social, or religious organizations, guided by voluntarism and a non-profit mindset.	Non-profit associations and foundations, charitable organizations, religious orders, congregations
Private	Hospitals operated by individuals, legally recognized entities, or partnerships with a profit-oriented objective.	Stock corporations, civil law partnerships, limited liability companies, foundations under private law

Table 8: Three different types of hospital operators: public, non-profit and private operators, adapted from (reimbursment.institute, 2023).

As already mentioned in the methodology section, a total of 15 purchasers of 11 hospitals in Germany were interviewed. The following section will describe the general purchasing situation at the beginning of the pandemic, hospitals and their preparation measures for a possible pandemic, their barriers to a more elaborate preparation as well as the best practices they used to navigate through the situation. After a description of each organization, a cross-analysis will be presented to compare the hospitals.

4.2 The purchasing situation in Germany during the pandemic: supply shortages and high prices

Previous literature has presented an overview of the purchasing situation at the beginning of the pandemic. Through the interviews conducted with purchasers of German hospitals, a more detailed description of the situation can be presented. At the beginning of the pandemic, it was very difficult to acquire personal protective equipment. Due to the disrupted supply chains, vendors were unable to provide the hospitals with materials. For example, Purchaser E claims: “For the most part, you could no longer get hold of the materials because the supply chains were disrupted and the traditional suppliers that you buy from, were no longer able to supply materials” (Purchaser E). The majority of PPE is produced in Wuhan, China. Simultaneously, Wuhan was the epicentre of the pandemic. This caused a disruption of supply chains. As the initial outbreak occurred in Wuhan, the manufacturing capacities for PPE were severely affected due to lockdowns and restrictions. This further led to a global shortage of PPE, since many countries were dependent on supplies from Wuhan. Purchaser J highlights this statement: "Wuhan was the centre of the pandemic. Also, 90% of the protective materials come from China and then 90% of them from Wuhan, so it is clear (the supply of the world with PPE products) cannot work" (Purchaser J). Complicating the supply situation further, Germany had no domestic production. Not only PPE materials are mostly imported from China, but also raw materials that are necessary to produce them (Purchaser G,H,N). In some instances, packaging materials were not acquirable which led to the situation, that the product could not be provided, as explained my Purchaser G: “If the material for the lids of the disinfectant bottles was missing, then they could not bottle the disinfectant” (Purchaser G). Due to the unavailability of products, there was a significant increase in PPE prices and a change from a buyer's market to a supplier's market occurred (Purchaser E,F,G,H,I,K). Purchaser F elaborated on this circumstance: “The demand was high and the suppliers were in control because we were dependent on them. That was just the unfortunate situation” (Purchaser F). However, switching to a different supplier was extremely challenging because the vendors who could still offer materials concentrated on their current clients (Purchaser F,G). Purchaser G describes the situation as follows: “If gloves from one company were no longer available, then you tried to switch to the next supplier. But that supplier decided that the existing customers take precedence and did not accept inquiries from any new customers” (Purchaser G).

Simultaneous to the unavailability of protective gear, hospitals were forced to provide masks not only to staff and patients in a specific area of the hospital but to every staff member and patient, which increased their material usage. The consumption of PPE was incredibly high (Purchaser E,G). The increased use of materials is described by Purchaser E: “We just used up more material. Since we suddenly had the obligation to wear masks regularly, we naturally had an extremely high consumption “(Purchaser E). Purchaser G confirms this situation: “Not only a few wards had to be protected, but the entire staff and all the patients” (Purchaser G). To address the high demand and low availability of PPE and to provide any kind of protection, hospitals had to look for alternatives. “At the beginning of the pandemic, our cleaning ladies teamed up, because they were the best at sewing and sewed masks themselves in the cafeteria. That was our own emergency aid so to say” (Purchaser E).

In conclusion, the pandemic's early stages revealed a lack of personal protective equipment, creating difficulties for hospitals. A change from a buyer's market to a supplier's market occurred as a result of disrupted supply chains, particularly those coming from China, which made it even harder to source key components. At the same time, hospitals were obliged to provide PPE to all staff members and patients which increased their material usage. Consequently, hospitals were forced to look for alternatives and find innovative ways to fill the supply gap as a result of the price increase and rising demand.

4.3 Purchasing at German hospitals: an in-depth analysis of barriers and best practices across 11 healthcare institutions

This chapter presents an extensive exploration of the experiences of 15 purchasers of 11 German hospitals. In order to obtain the results of this study, a thorough data analysis of the interviews was conducted to identify barriers and best practices. Through the examination of the interviewee’s responses and experiences, several barriers and strategies employed during the pandemic emerged.

The barriers to preparedness and the successful best practices are explored for each hospital to thoroughly understand the purchasing dynamics of the hospitals. During the interviews, the participating purchasers were questioned about past challenges they faced in preparing for a pandemic, focusing on the purchasing process. Additionally, the purchasers were asked about future barriers they expect to encounter based on their knowledge of the healthcare sector. By examining their responses, key obstacles and difficulties were identified.

The purchasers were further asked about the best practices they used during the pandemic. In the context of this research, a best practice can be defined as an approach, a strategy, or an action that proved to be effective in responding to the pandemic. By analysing the answers to the interview questions, the best practices used by purchasers during the pandemic were identified. Furthermore, purchasers were asked about practices they want to apply in the future to better prepare for a pandemic or another healthcare crisis. This indicates that during the interviews, both ideal practices for the future and implemented measures during the pandemic were discussed.

4.3.1 Hospital 1 (Purchaser A, Purchaser B, Purchaser C, Purchaser D)

Hospital 1 is operated by a federal state and can be categorized as a public hospital. Four purchasers were interviewed to gain insight into purchasing processes before and during the COVID-19 pandemic.

Before the pandemic, Hospital 1 stored some materials, however, these materials were not specifically held for a pandemic, but for general use. “We have many important items in stock, they are available in larger quantities. The storage had nothing to do with the pandemic, it was a buffer in the beginning, but that only lasts for a short while” (Purchaser A).

Before the start of the pandemic, there was an emergency plan in place at Hospital 1. “There was a corresponding emergency plan, which was developed before the outbreak of the COVID-19 pandemic, but which has certainly now developed significantly further due to the scope and massiveness of this pandemic” (Purchaser D). However, a hospital also must be able to react to upcoming situations, since it is difficult to plan for every situation, as Purchaser D explains: “There are limits to what is written down in a pandemic plan because you cannot take every eventuality into account. It's a requirement to have a plan, but you must also be able to react to the situation” (Purchaser D). There were no specific intangible disaster preparedness activities in place. However, Purchaser C views the extensive work experience of the purchasers as helpful during the pandemic. “I have 25 years of professional experience here. I know what to do and what to buy” (Purchaser C). Purchaser B adds to this by stating that past experiences with crises helped to get a better understanding: “Knowledge management is available in sufficient form with past catastrophes, there just haven't been that many. Certainly, there was the volcanic eruption in Iceland, which paralyzed half the world. Of course, these are things from which one also learns” (Purchaser B).

Purchaser D further elaborates: “There were similar situations, albeit not as serious as the COVID-19 pandemic. Some colleagues who have been with us for a long time. Organizations can benefit from their experiences when addressing similar situations” (Purchaser D).

The hospital is part of a group purchasing organization which Purchaser A described as partially useful since there was a possibility to get in contact with suppliers through the GPO. “Of course, we had different addresses for material, also through the group purchasing organization” (Purchaser B).

Purchaser B thinks that Hospital 1 did have some preparations in both a physical and an intangible way and categorizes the hospital in scenario 4 (the mixed scenario) of the disaster preparedness scenarios. “I think I see us in four, that we already have a combination” (Purchaser B). Purchaser D confirms this categorization: “Yes, that would be 4, the combination of all of that” (Purchaser D). The buyers also suggest that a mixture of physical and intangible preparation activities would be best. “It is always good to have stock as a buffer. It would be good if we had all the financial resources at our hospital. Also, the topic of logistics. If this is clarified in advance, that would be helpful” (Purchaser C). Purchaser B agrees with this statement: “I consider them both to be essential, they are factors that have to mesh and also work in equal parts somewhere” (Purchaser B).

Barriers

A barrier to preparedness was the unpredictability of the occurrence of a pandemic. Purchaser A defines the situation as follows: “No pandemic was anticipated that came so quickly. I think that's challenging” (Purchaser A). This situation is further elaborated upon by Purchaser C: “You never expected a pandemic to happen, that's why everyone was completely surprised. We thought: that is in China, but it doesn't come here” (Purchaser C). The extent to which the pandemic spread across the world was also unforeseeable, which caused purchasers to underestimate the amount of material needed. “We thought it wouldn't come here and then we said, we only buy what we need for the influenza and that's all we need to stock up on. We were wrong about that” (Purchaser C). Furthermore, the cost of acquiring materials and training that might never be used is a barrier to preparedness, as described by Purchaser A: “Of course, there are costs. You must buy everything first and it lies around unused. In principle, you must keep something that costs money but is not useful at the moment. That's difficult from an economic point of view” (Purchaser A). Purchaser

C confirms this barrier: “I think that would be a question of costs. Everything must be paid for” (Purchaser C). Having only a small storage facility was a factor that prevented Hospital 1 from storing larger quantities of material. This is a barrier to preparedness. “The only problem is that we just don't have much storage capacity” (Purchaser C). Purchaser B elaborates: “A barrier is definitely always the spatial structure in clinics, which would not allow storage or something like that” (Purchaser B). A barrier to storing personal protective equipment is product obsolescence. PPE has an expiry date after which the products cannot be used anymore and must be exposed. Purchaser A mentioned this barrier: “I find that very difficult because the stuff usually expires after five years. That always has to be checked. It's lying around somewhere and it expires and then you throw it away” (Purchaser A). Purchaser B agrees that product obsolescence is a barrier: “The products do not last long enough” (Purchaser B). Additionally, it is unclear what the next disaster might be and what kind of protective materials will be needed. This is also a barrier to preparedness, mentioned by Purchaser A: “You don’t know whether the next catastrophe will come or not and if so, whether it will come as one thinks or whether it will be a completely different catastrophe” (Purchaser A). The costs for the storage facilities are also a barrier to preparedness: “Then, of course, there are the storage costs. I am talking about the actual costs for storage. It also has an impact on the balance sheet” (Purchaser D).

A barrier for the future is the absence of local production of PPE. Even though local companies tried to produce personal protective equipment during the pandemic, these firms now stopped production since customers are buying the materials for a lower price in Asia again. “We continued to buy from the local company, but then they called me at some point and said sorry we can no longer produce because most organizations no longer buy from us and buy the Chinese goods again” (Purchaser C). The German government promised to support local production during the pandemic, however as the pandemic progressed and protective gear from Asia was available again, the governmental interest in local firms faded. Purchaser C thinks that if there is another pandemic, the same scenario will happen again. “The government promised to support and respect everything, but then they were no longer interested. Most purchasers buy in China again and I think, that would also be the case in the event of the next pandemic” (Purchaser C).

To implement intangible preparedness activities to gain disaster management competencies, the barrier of costs has to be overcome as well. Trainings could be implemented and they cause costs. “There is some financial investment involved, it needs an authority to get coordinated. I could

imagine mandatory training courses" (Purchaser D). Another barrier to preparedness is personnel shortage. Buyers in this hospital are occupied with their day-to-day work and do not have the time to take care of more responsibilities. Purchaser C thinks that more staff needs to be employed to redistribute the workload, so there is some capacity for planning for an emergency: "The capacities for the employees must be there since we all have a lot to do and don't know what to do first. New staff would have to be hired to redistribute the workload" (Purchaser C).

Best practices

The first best practice mentioned by the hospital was attaining additional storage space. According to Purchaser A:

> We opened another storage facility. It was basically just a logistician, where we stored things that we needed, including critical things like ventilation systems or central venous catheters, things that are usually not necessarily in stock but are essential in the care of intensive care patients. Not in every size, but at least you would have something to work with. We will continue to do so simply because we have realized that we cannot get rid of everything that we have acquired during the pandemic. (Purchaser A)

Purchaser B confirms this best practice: "Now we have rented a small, additional warehouse to have something in storage so that it doesn't happen again" (Purchaser C). The next best practice, suggested by Purchaser A, is that a hospital should have one person responsible for pandemic preparations. "I would say there should be a pandemic representative. This person oversees the things that need to be done to improve the organization for pandemic preparation. We did not have anything like that before, that would certainly make sense" (Purchaser A). In addition to appointing one or more persons to be responsible for preparations, another best practice is the creation of an emergency plan. This was presented by Purchaser D during the interviews:

> Everyone has become a bit smarter through the pandemic. It was a very instructive time to develop corresponding pandemic plans, not just for us but also for the state and the federal government as well. With this experience, you can now approach a similar scenario in a much more structured way. (Purchaser D)

While an emergency plan is crucial, fostering supplier relationships is also seen as a best practice. Purchaser C worked with the sales force of the suppliers for years and has, therefore, built a

relationship with them: “I have known them for years. If the supplier can give anything then they will give us something when we order” (Purchaser C). Purchaser D agrees with this best practice: “A good standing with the suppliers, and also a good supplier business relationship makes it easier.” The purchaser further adds: “Those relationship channels are very important when things get critical. We then find solutions together with our strategic partners with our suppliers to reduce bottlenecks” (Purchaser D). Having local suppliers is also a best practice. Hospital 1 was able to find a supplier based in Germany that produced masks, which benefited the hospital. “There is also a partner in Germany that we now have. The FFP2 masks, and also for the surgical masks with the ear loops are produced in Germany and we are in a pretty good position there” (Purchaser C). Besides having local suppliers, it is also essential to streamline the purchasing process and be fast. Purchaser A explains that buying material quickly that might become scarce in the future secured the supply. “Time is money. It was always very important to be quick with any items that could become hard to come by soon” (Purchaser A). Purchaser B confirms this best practice and also adds that being flexible is a best practice. “Ultimately, we acted quickly and very flexibly from the outset, so we basically made the greatest possible changes here”. He also adds: “In the end, you must react flexibly, that is the crucial thing” (Purchaser B). While flexibility is seen as a best practice, Purchaser A also mentioned a practice that was seen as successful. Suppliers ensured a fair distribution and prevented hospitals from overstocking massively: “Suppliers said: you get what you always get and no more. Some companies only supplied 80% of your requirements, and gave the remaining 20% to those who needed it very urgently, I think that is a very good tactic” (Purchaser A). In connection with that, Purchaser A understands how crucial it is to remember that other hospitals are also in need of supplies: “You are not alone on the planet and every hospital has to take care of its patients” (Purchaser A). Another best practice is having framework agreements with suppliers. Purchaser B describes that it is best to have contracts with suppliers that specify that they always have a stock of material reserved for the hospital: “Conclude contracts with companies, so they always have a warehouse for us and that's reserved for us because we don't have the storage capacity and we can then call it up.” Purchaser B further explains: “I have a company with whom I have a framework agreement that always keeps the goods for me, I make an annual contract with them” (Purchaser C). Communication among members of a group purchasing organization is also a best practice. In case of a severe shortage, members could ask other members for help and they also notified each other in case of an upcoming material shortage. “If nothing works anymore, then you can try to get something through communicating with other

members of the GPO. And then there is also the exchange on which products are getting scarce" (Purchaser A). Some members also notified others when they located a source for supply. "Every now and then we got notified: you can buy something at supplier X, they still have supply" (Purchaser C). In general, collaboration with key partners was an important aspect during the pandemic, as Purchaser D explains:

> Cooperation with key partners is a very important aspect. We are part of a group purchasing organization, we were also looking for cooperation there, and were also in groups in which we exchanged ideas: How can we support each other? How can we contract suppliers to get what we need to get through the pandemic? That was also an additional benefit of being part of a GPO. You can achieve more when the houses join forces than when you appear there as a single house. (Purchaser D)

Having a network is another best practice. Through the network, the purchasers of the hospitals will acquire knowledge of which products might be difficult to purchase in the near future. Purchaser A explains it like this: "For the clinic itself it is important to have a good network, so you know before the others where a shortage will arise. And that means you are of course the first to buy" (Purchaser A). While the establishment of a strong network is essential to foster information sharing and collaboration, it is also important to build a task force within the hospital. A task force was built in Hospital 1, which is also seen as a best practice. "There was a Corona task force or, in general, a pandemic task force, an emergency group that then met regularly to assess current events and initiate measures" (Purchaser D).

4.3.2 Hospital 2 (Purchaser E, Purchaser F)

Hospital 2 is operated by a religious order and can, therefore, be categorized as a non-profit organization. Two purchasers were interviewed to gain insights into their purchasing situation during the pandemic.

At the beginning of the pandemic, the hospital had some difficulties acquiring PPE, since their usual suppliers were no longer able to provide materials and prices had soared. In order to provide any kind of protective material, the cleaning ladies of the hospital started sewing masks made from fabric (Purchaser E, Purchaser F). The hospital had some preparations in case of a pandemic.

Before the outbreak, personal protective equipment was stored, due to experiences from previous disease outbreaks, as described by Purchaser E:

> There have already been several endemics we had to deal with, for example, swine fever or bird flu and other diseases that have also spread to humans. We had learned that we had to have a certain quota of material to protect ourselves, i.e. all personal protective equipment had to be there, and we did have some in storage. (Purchaser E)

However, the stored materials were used up quickly, since all staff and patients needed to wear protective gear. "Of course, they didn't last long because not only a few wards had to be protected, but all the staff and all the patients who came" (Purchaser E). Furthermore, the masks that were in storage, could not be used from a certain point, since there was a switch in governmental regulations. "We couldn't use all masks that we had as an emergency reserve for such cases. It was common practice to have FFP2 masks with an exhalation valve and suddenly the government said that they do not protect well enough" (Purchaser E). Therefore, one can conclude that the hospital had some physical disaster preparation, but the governmental regulations nullified these attempts, by only allowing FFP2 masks without an exhalation valve. Purchaser F describes the situation like this:

> It was a back-and-forth with the masks at first. At one point it was allowed to wear masks with a valve, then our employees were no longer allowed to wear fabric masks or anything else, only marked FFP2 masks with a CE certification. (Purchaser F)

Intangible preparations existed for a general disaster, but there was not a specific plan for purchasing during a pandemic. “Hospitals are always prepared for emergencies, but the extent of it surprised us” (Purchaser E). Purchaser F adds: “We didn't have a real pandemic preparation plan, I would say” (Purchaser F). Hospital 2 can, therefore be categorized in disaster preparation number 1(no preparation before the pandemic), leaning toward number 2 (physical preparation measures before the pandemic), since there was protective gear stored, but the hospital was not allowed to use it. The purchasers mentioned that a mixed approach of both physical and intangible preparation measures is the best scenario for preparing for a pandemic. “Of course, a combination of both is always important” (Purchaser E). Purchaser F agrees with Purchaser E: “I would say that such a mixture of this physical and intangible preparation activity is good” (Purchaser F).

Barriers

There were certain barriers in the way of a more complete pandemic preparation. According to Purchaser E, the outbreak of the pandemic was not predictable: "Of course, we could have prepared a bit more, we would have created more storage capacities, but that was not foreseeable" (Purchaser E). Purchaser F also sees this as a barrier: "The pandemic came very suddenly and nobody expected it" (Purchaser F). Furthermore, the reaction of the German government was not predictable: "It was also handled differently in each country. We are in Germany of all places and that our government acted exactly as it did was not foreseeable. You were able to prepare a bit, but that was not enough" (Purchaser E). Additionally, preparing for a pandemic is expensive. The cost of taking precautions for a situation that may never arise is another obstacle. Purchaser E mentioned: "Management says: we are now spending a lot of money on something that will never happen. You almost have to agree. It is challenging to defend yourself from situations where you cannot determine the risk" (Purchaser E). The type of illness that will emerge and the way it will spread will both have an impact on preparation. Another barrier to preparedness is the lack of knowledge about a future type of disease. Purchaser E explains that different PPE will be needed for different types of disease transmission:

> If I know for sure it will be germs that spread through the air, then I can take special precautions, such as masks and protective gowns. But there are still more risks that you might be faced with. If I do not know, it is difficult (Purchaser E).

Additionally, personal protective equipment has an expiry date and the products cannot be stored eternally, therefore, Purchaser F views product obsolescence as a barrier: "Having PPE in storage is difficult because the durability of course also expires" (Purchaser F). The last barrier named by Purchaser E of Hospital 2 is the new medical device regulation (MDR). "The MDR plays a very important role here. Suddenly, articles are no longer available, because suppliers stopped producing them, even though those materials are needed. This happens, because is not worthwhile for the supplier to have them recertified" (Purchaser E).

Best practices

There are several best practices found during the interviews with the purchasing personnel of Hospital 2. Purchaser E mentioned, that the hospital still had its own storage facilities and described this as a best practice: "It is important to have your own warehouse. Before the pandemic, it was

very popular to have the warehouse on the street, but that notion has shattered during the pandemic." A lesson, that Purchaser E learned from the pandemic is to increase the storage range:

> Before the pandemic, there was a storage range of 14 days. We still had a real warehouse and I am grateful that we did not abandon it and outsourced it. And now we have a stock range of 40 days for all items and up to 60 days for high-risk items. (Purchaser E)

Another best practice that the purchasers want to implement for the future is making an emergency plan, as described by Purchaser F: "Don't think: it won't affect us, but have a master plan" (Purchaser F). Furthermore, the purchaser learned that it is, indeed, better to have alternative suppliers. "One has learned that it is safer to pay attention to risk diversification and to have several suppliers on board" (Purchaser E). It is not just important to have alternative suppliers but also to foster relationships with current suppliers, according to Purchaser F: "The contact with the supplier's sales force is also very important. It is crucial that we must stay in contact" (Purchaser F). Being part of a group purchasing organization was also seen as a best practice by Purchaser F: "It was a good thing that you had a group purchasing organization that sort of regulated the price. It was an advantage to be part of a GPO and to look for the gloves and other materials there" (Purchaser F).

4.3.3 Hospital 3 (Purchaser G)

Hospital 3 is operated by two parties. One party is a non-profit organization, the other party is a city. Therefore, the hospital is partially run by a non-profit organization, and partially operated by a public entity. An interview with one purchaser was conducted (Purchaser G).

At the beginning of the pandemic, this hospital also had difficulties acquiring personal protective equipment and Purchaser G described, that there were no preparations before the pandemic: "Before COVID-19, we did not prepare ourselves. In fact, we fell into the deep end" (Purchaser G). To make sure that all healthcare institutions in the district were provided with protective gear during the pandemic, the institutions worked together. "We worked together here in our district. Whenever you knew where to get something, you passed that information on to the nursing homes and other institutions in the district" (Purchaser G). Even though healthcare institutions of this district collaborated, the purchaser of Hospital 3 did not have contact with other hospitals from the federal state: "I had no contact with other hospitals and we only worked together with our district association here" (Purchaser G).

The purchaser categorized the hospital in disaster preparation scenario 1: no preparation before the pandemic. “Scenario 1, because no one thought of a pandemic, and because the storage capacities are not available here either” (Purchaser G). Even though the hospital did not have any kind of preparedness for the pandemic, the purchaser mentioned that a mixture of physical and intangible preparedness activities is the best strategy: “Stockpiling is important in any case. And then I think what is very important is cross-organizational communication” (Purchaser G).

Barriers

There are three barriers found during the interview with Purchaser G of Hospital 3. The first barrier is the unpredictability of the pandemic. The buyer explained that no one had considered that a pandemic would happen in Germany: “No one ever thought about a pandemic” (Purchaser G). Product obsolescence and the effort connected to this circumstance is also described as a barrier by Purchaser G: “You must make sure that things do not expire and you must have a constant throughput of material. Of course, that involves an extreme amount of work, because you must clear out this storage facility and restock new goods.” (Purchaser G). The last barrier, Purchaser G described, was the lack of storage space within the hospital:

> Before the pandemic started, I did not have the opportunity to prepare. I have such a small warehouse. It is very difficult to store larger quantities here. During the pandemic, we got a container placed in the yard because I did not know where to put all these things. (Purchaser G)

Best Practices

Four best practices were found during the interview with Purchaser G. The first best practice mentioned is to foster a positive relationship with suppliers:

> I have always been nice and friendly. That really helps. I spoke with a great deal of supplier sales personnel who were engaged in a variety of activities. They checked their basement to see if they still had any samples or whatever if it was necessary. (Purchaser G)

In connection to this, Purchaser G also mentioned that it is a best practice to continuously order from suppliers to keep your status as a customer. “If you are having delivery problems, it is also important to stay in the ordering process. Because some companies sometimes delete orders” (Purchaser G). The third best practice found from interviewing Purchaser G is being part of a GPO. As part of a group purchasing organization, Hospital 3 had access to a list of suppliers for PPE

materials. The GPO conducted its own investigation into where materials were still accessible and offered a forum for members to interact. “They (the GPO) tried to contact suppliers and get offers from them or gave us tips and said: “supplier X” has a lot of surgical gowns” (Purchaser G). Purchaser G further elaborated: “You could always check the network, and other buyers would write where they got their materials from. If you did not know who to contact, you could take a look onto the platform” (Purchaser G). Therefore, being part of a GPO is also seen as a best practice. As already mentioned, Hospital 3 and other hospitals did not work together. Purchaser G advises that hospitals collaborate in the future. “Maybe the hospitals should work together sometimes in ordering processes or helping each other out” (Purchaser G).

4.3.4 Hospital 4 (Purchaser H)

Hospital 4 is part of a larger network of hospitals, which is owned by several health insurance companies and can be categorized as a private hospital. One purchaser of this hospital was interviewed (Purchaser H).

The purchaser described, that, since other infectious diseases have occurred in the hospital, some storage of PPE took place. As a result, the hospital always has specific precautions and safety gear available in case patients must be isolated. Before the start of the pandemic, Hospital 4 had a basic emergency plan. “There is always a basic preparation for emergency situations in the so-called hospital alarm plan. However, this is kept general, for fire disasters, terrorist attacks, pandemics, etc., which determine certain processes” (Purchaser H). The hospital is also part of a group purchasing organization that took over some of the intangible preparation for a pandemic. This will further be described in the best practice part of Hospital 4.

Due to the combination of previously stored goods, the basic emergency plan, and the membership in a group purchasing organization, the purchaser categorizes Hospital 4 in the mixed scenario of the preparation scenario. “I would still put us in the mixed scenario. As I said, we had this hospital alarm plan which described how the procurement and emergency reserves of personal protective equipment had already been carried out in advance” (Purchaser H). When asked what the best preparation scenario for a pandemic would be, the purchaser also viewed a mixture of physical and intangible preparation measures as the best option. “I would say that the mixed scenario is best because you can partially prepare in both areas and have basic structures that you can then expand afterward” (Purchaser H).

Barriers

From the interview with Purchaser H, five barriers to preparedness were identified. The buyer of Hospital 4 saw the unpredictable nature of a pandemic as a barrier to better preparation. “Up to this point, having a pandemic in Germany or Europe was a utopian thought” (Purchaser H). Furthermore, the purchaser viewed the unpredictability of federal decision-making as a barrier: “It was not possible to estimate the real effects and decisions of the federal government” (Purchaser H). In addition to the challenges arising from the unpredictability of governmental actions, Purchaser H also sees the cost and reimbursement of materials as another barrier to preparedness:

> If there is no reason for procurement, especially in an area that requires isolation, the goods cannot be billed for proceeds. In other words, the federal government specifies which materials can be purchased in which case, so that the hospitals have the opportunity to get reimbursement from health insurance companies. If there is no pandemic, we are not authorized to make investments or major purchases in the field of protective equipment because we cannot account for them. (Purchaser H)

The fact that Hospital 4 has a finite amount of storage space is another obstacle. Night transportation is used to deliver their everyday requirements. During the pandemic, the hospital had to acquire additional storage space to store their protective gear. Purchaser H describes this method as follows:

> We don’t have any storage space available because we get our daily needs via overnight transport. During the pandemic, we then had to create this space for storage. We have a central warehouse and the daily requirements are called up, and shipped to us over night. (Purchaser H)

Purchaser H further recognizes the issue of the lack of production facilities for personal protective equipment in Europe and the consequent reliance on the Asian market going forward:

> As was the case of COVID-19, there is always a possibility that Asian manufacturers reserve the materials for their own country and do not deliver them to the European market. There are also extremely long delivery times when these large quantities are to be shipped, we are talking about 6-8 weeks and sometimes even more. (Purchaser H)

Best practices

Since Hospital 4 is part of a group purchasing organization, it has access to the resources of this GPO, which the purchaser described as beneficiary:

> We are looked after by a group purchasing organization. Therefore, we have access to large trading relationships and framework agreements with strategic buyers. They are more involved in these processes and always have a certain emergency plan or supply chains behind the A-suppliers, who then guarantee supply at the individual house level. (Purchaser H)

Due to the membership in set GPO, hospitals that are members are usually obliged to order through the suppliers that have contracts with the GPO. During the COVID-19 pandemic, this obligation was lifted, which Purchaser H described as a best practice: "We are tied to the GPO's procurement channels. However, these contracts were never negotiated for this scale of products. We then got the approval to order supply independently and had access to the full world market to exercise sourcing" (Purchaser H). Another best practice was building a cross-functional task force. "We introduced a so-called Corona Task Force, which consisted of administration, nursing, and medical services. When there were material or staff bottlenecks, there was a productive exchange and people helped each other out" (Purchaser H).

4.3.5 Hospital 5 (Purchaser I)

Hospital 5 is operated by three different parties: an insurance company, a city, and a different hospital. It is a specialist clinic and a non-profit organization. The term specialist clinics refers to hospitals that offer treatments in their specialty (Wagner, 2022). In contrast to this, there are general hospitals that offer full inpatient treatment (STC, 2016). One purchaser was interviewed (Purchaser I).

Large parts of Hospital 5 were closed during the pandemic because it is a specialist facility and not accountable for providing general medical care to the public. This resulted in extremely few infections among the workers and patients, but it also caused existential issues. Purchaser I described the situation as follows:

> The location was halfway closed. With regards to the number of cases, this was expressed positively, because there was no outbreak here on site. Due to the closure, we could get into

existential difficulties if we cannot accept patients for months. The corresponding refinancing will take a very long time before the loss of revenue from the decrees stops. (Purchaser I).

There were no physical preparation activities before the pandemic. “The preparation of a huge stock is not feasible due to the capital commitment” (Purchaser I). The purchaser also did not mention any intangible preparation activities implemented before the pandemic and categorized the hospital into scenario 1: no disaster preparation. Purchaser I states: “Before the pandemic, I would put us at category one” (Purchaser I). Even though the hospital did not have any preparation for a pandemic, the purchaser thinks that a mixture of physical and intangible preparation activities is best: “The mixture scenario is probably the best” (Purchaser I).

Barriers

Six barriers to preparedness were identified from analysing the interview with Purchaser I. The first barrier found is the unpredictability of the occurrence of a pandemic. Purchaser I explained: “There has never been a pandemic in Germany or Europe of this scale and with this extent of material usage. There was no preparation. For us, it was unknown territory” (Purchaser I). Besides the challenges presented by the unpredictability of a pandemic, another barrier mentioned during the interview is the reimbursement system of materials. Purchaser I mentioned that this system is not fast enough to keep up with price increases of the material: “If there is an increase of 8%, the supplier can increase their prices for hospitals by 8%. The hospitals, however, do not get this money reimbursed by health insurance companies” (Purchaser I). Continuing the topic of materials, another barrier described by the purchaser is the unknown type of disease that may occur in the future and what type of protective material will be necessary to protect staff and patients. Purchaser I clarified: “There are other types of pandemics, whether PPE is sufficient or not, is questionable. How often do you have to exchange PPE? What must be considered?” (Purchaser I). Another barrier regarding materials is the possibility of PPE becoming obsolete. Purchaser I justified the low amount of stored materials: “Hospitals are always under cost pressure. You cannot plan far ahead and build up for a pandemic situation, especially since the articles also expire” (Purchaser I). Furthermore, Purchaser I mentioned that only small storage facilities are provided in Hospital 5, which makes it difficult to prepare for a healthcare crisis: “Our storage facilities are very small” (Purchaser I). A barrier for the future, the purchaser mentioned, is the new medical device regulation. New policies are implemented to produce medical equipment. “The new MDR has an impact on the delivery availability of products” (Purchaser I).

Best practices

From interviewing the buyer of Hospital 5, four best practices emerged. The first best practice, the hospital implemented, was the investment stop for all goods, that were not immediately necessary. Purchaser I elaborated: "There was an investment stop. It was no longer allowed to order capital goods that were not necessary to maintain operations "(Purchaser I). There were also efforts to reduce personnel costs. "We offered personnel to forego salary through unpaid vacation. This was the chance to reduce personnel costs. There were also service personnel who were let go, because the clinic was partially closed, and the service was no longer needed" (Purchaser I). Another best practice stated by Purchaser I is the membership in a GPO. Communication of members of the GPO took place during the pandemic, which was seen as positive: "We helped each other to overcome the crisis" (Purchaser I).

For the future, Purchaser I believed it is a best practice to have some framework agreements with suppliers:

> It's best if you change the supplier relationships in such a way that you have a fixed framework agreement, where the suppliers are obliged to deliver, where you then maybe pay the price of 1 to 2 cents more, but you have made a firm agreement that you can protect yourself on that point. (Purchaser I)

4.3.6 Hospital 6 (Purchaser J)

Hospital 6 is operated by a religious order and falls under the category of a non-profit organization. One purchaser was interviewed (Purchaser J).

Before the pandemic, Hospital 6 had an emergency plan. Purchaser J described it as follows:

> We already had a pandemic plan beforehand. And we have an alert- and operational plan here. This plan describes what the hierarchy is like, what must happen at what point in time, who is in command and control, who deputizes in the command and control, and what must happen in the command and control. All possible emergencies are described from fire to power failure to bomb threats. (Purchaser J)

The hospital also had a storage area with enough supplies to run it for two weeks. "We had a small storage facility here, with which we could have operated for two weeks. A pandemic lasts longer,

we have learned that in the meantime" (Purchaser J). The hospital is not a member of a group purchasing organization and did not collaborate with other hospitals during the pandemic.

Since the hospital had an extensive emergency plan, as well as material stored for such emergencies, the purchaser sees Hospital 6 in the mixed scenario of disaster preparedness. They had a combination of physical and intangible disaster preparedness activities in place. "I see us at a mixture, number 4" (Purchaser J).

Barriers

During the interviews, four barriers to preparedness were mentioned by Purchaser J. The first barrier, this purchaser named, was the unpredictability of an occurrence of a pandemic: "No one expected a pandemic, well, at least I don't know anyone" (Purchaser J). Another barrier is, that protective gear has an expiry date and becomes obsolescent. Purchaser J explained: "The material has an expiry date which will pass" (Purchaser J). As mentioned in the best practice part of Hospital 6, the purchaser participated in workshops for emergencies in the past. However, these workshops are not offered anymore. Barriers to organizing these workshops are the high organizational efforts needed as well as the costs. "That's a huge effort, they don't have the money for it anymore" (Purchaser J).

Best practices

Through the analysis of the interview with Purchaser J, three best practices emerged. The first best practice is participation in workshops. These were focused on fire alarms and power failure, but the purchaser described them as helpful. "I have been to workshops more than once, and it was always about fire alarms or power failures in hospitals. We often had a nationwide workshop like this where we exchanged ideas, but unfortunately, that does not exist anymore" (Purchaser J). While workshops for disaster preparation play an essential role, having a strong network is also a best practice. Hospital 6 was able to acquire masks from China. This was possible due to the network, the purchaser had. Having a network is, therefore, a best practice for Purchaser J:

> It was up to us to purchase protective gear through relationships with China. It was crucial to know people. We have a colleague here who works with another company. She connected us with someone who sells masks in Shanghai. I then contacted him and we wrote back and forth. (Purchaser J)

Building a cross-functional task force and uniting knowledge is also seen as a best practice by Purchaser J: “Gathering the knowledge of individuals was also a good practice. There is a Corona team, it's still active. I think that's a good mix. Everyone could contribute” (Purchaser J).

4.3.7 Hospital 7 (Purchaser K)

Hospital 7 is a non-profit organization, operated by a limited liability company. One purchaser was interviewed (Purchaser K).

Hospital 7 had an emergency plan in place, complete with a crisis management team, prior to the pandemic's onset. “We have had a so-called crisis response plan since the beginning of our clinic” (Purchaser K). There was never a need for the crisis management team to get together before COVID-19, but they did so frequently during the pandemic. “We discussed things and initiated measures, looked at where the deliveries were missing, what could be done, which manufacturers can be contacted. We found ways to navigate through the pandemic quite well” (Purchaser K). Some personal protective equipment was stored at the hospital. Every ward of the hospital had its own small storage space and also ordered materials themselves. “We have decentralized purchasing on each ward, and each department has a small storage facility” (Purchaser K). However, the storage space in Hospital 7 is very limited.

From the description above, the hospital can be sorted into category three of the disaster preparation scenarios, since it had mostly prepared with intangible preparation measures, as Purchaser K explained:

> We were not completely without preparations, we had a crisis response plan for many years, and we also lived this crisis response plan, so we were already prepared. In terms of inventory, we were not optimally positioned, but we were lucky in the early days that we reacted quickly. (Purchaser K)

The purchaser further thinks that the best disaster preparation scenario is a mixture of physical and intangible activities: “You must be prepared in writing and have fixed procedures in combination with certain stocks and regular meetings to always update the whole thing. That's actually how we do it, only that we can't store this stock” (Purchaser K).

Barriers

By analysing the answers to the interview with Purchaser K, six barriers to preparedness for this hospital were found. The first barrier, Purchaser K mentioned is the unpredictability of an occurrence of a pandemic: “I think a pandemic is always very unpredictable. That was the first one we had here in Germany, but I think pandemics are very unpredictable overall” (Purchaser K). Not only did the purchaser view the occurrence of the pandemic as unpredictable, but also the actions of the German government: “Politics are also not predictable” (Purchaser K). The next barrier mentioned is the barrier of cost and reimbursement of protective materials. Buying stock is expensive and there is always the concern that the money will not be reimbursed by health insurance companies. “We spent large sums of money at the beginning and didn't know what would get refinanced by insurance companies” (Purchaser K). Buying large quantities of materials is not just a financial risk, but there is also the risk of products becoming obsolete. The purchaser was concerned about the large amount of trash that could be produced due to product obsolescence: “It's about keeping the balance between storing the protective equipment and not producing too much waste, due to expiry dates of materials” (Purchaser K). Even if the hospital wanted to buy large amounts of materials, Hospital 7 would not have the storage space to accommodate it due to limited storage space: “We have problems here with storage because we simply do not have the space. My office was filled with boxes because we did not know where to put all materials” (Purchaser K). A barrier to the preparation for a future pandemic mentioned by Purchaser K is the loss of knowledge. In case the purchaser and another employee of the department will leave the organization, know-how would be lost. “If my colleague and I left, the remaining employees wouldn't know where to order” (Purchaser K).

Best practices

As mentioned above, Hospital 7 had an emergency plan in place, which Purchaser K described as useful: “Since 2008 there has been a crisis response plan with a firmly defined crisis team, which has actually proven itself now” (Purchaser K). This task force was labelled as a best practice by Purchaser K as well: “We had a crisis team. Meetings took place daily at first, then weekly, and finally every four weeks. The team had been around for a long time but has never been needed” (Purchaser K).

4.3.8 Hospital 8 (Purchaser L)

Hospital 8 is operated by a limited liability company and is a private hospital. One purchaser was interviewed (Purchaser L).

Before the outbreak of COVID-19, Hospital 8 had some protective gear in storage, due to their experience with past diseases. “Due to endemic processes that we have experienced, for example, bird flu, we have bought full-body protective suits, and we have provided foot baths, and so on. We have a basic quota that protects us” (Purchaser L). Intangible preparations were also in place. The hospital received some compensation from the government, and it also had the financial resources to immediately allocate to acquiring PPE. “The funds for this have also been provided by the company. During the pandemic, there were also state subsidies. As a result, the financial resources were virtually secured” (Purchaser L).

Due to the combination of above mentioned physical and intangible preparation activities, the purchaser categorized Hospital 8 in the mixed scenario of disaster preparation: “Number 4 (the mixed scenario), that’s where we are.” Purchaser L also adds: “I would say that we cannot do more at the moment. We are already ahead of other hospitals” (Purchaser L).

There is no connection to a group purchasing organization. Purchaser L describes the hospital as a “lone fighter” and mentions that their lack of membership increases the speed with which the hospital can act. “We're much quicker than a sluggish organization, it's clear: the more people sit around the table, the harder it is to get results” (Purchaser L). There was also no cooperation with other hospitals. During the pandemic, when material scarcity was at its highest, Purchaser L tried to make a deal with a German logistics company, the German hospital association, and a tradesman with great connections to China and certified producers of PPE. However, the deal did not go through. According to Purchaser L, the hospitals of the county did not get back to him to participate in acquiring protective gear:

> The only thing I tried was with (a German logistics company), and (the hospital association of the federal state). I tried to make a deal with a local businessman who had excellent relationships with China, including with certified manufacturers. And we planned to order air freight from (a German logistics company), with which we could supply all the (federal state). Do you know why this did not work? The hospitals of the federal state did not report back to me about collaborating on this plan. That's a scandal! (Purchaser L)

Barriers

After analysing the answers to the interview questions, three barriers to preparedness were found for Hospital 8. The first barrier Purchaser L mentioned is the unpredictability of the occurrence and the magnitude of the outbreak. “The way we experienced it, hardly anyone could have foreseen it” (Purchaser L). According to Purchaser L, it is not just unpredictable when and if a pandemic occurs, but also what kind of disease will cause it. This is also a barrier to preparedness. Purchaser L states: “The next case can be very different. It might not affect the lungs; it could affect the skin. We don't even know” (Purchaser L). Another barrier to preparedness for a future pandemic is the Medical Device Regulation. Many suppliers will lose their certification for products. These products will, therefore, not be available anymore. “For many companies, this means that they will no longer be able to supply their products because they had lost their certification” (Purchaser L).

Best practices

From the interview with Purchaser L, five best practices could be identified. The first best practice is to have a person responsible for pandemic preparations. This person is responsible for making sure that employees have enough knowledge and the representative also checks on the availability of necessary material. This best practice was not implemented in the hospital, however, Purchaser L views this as a best practice for the pandemic: “Having a representative, that does things in the event of a pandemic or a pandemic free time, checking whether stocks are sufficient, whether people have enough knowledge, etc. That is like fire drills. The system repeats itself there” (Purchaser L). Another important practice is to have a pandemic emergency plan. Purchaser L contends that hospitals alone should oversee the development of such a plan, although clinical associations can help in some ways because they are familiar with the hospital architecture:

> It is important that the clinic makes an emergency plan because the clinic knows its own actual infrastructure. In terms of regulation, clinical associations can provide assistance, a kind of checklist, and what is most important in connection with a so-called disaster plan, and then the clinic has to adapt this plan to its own circumstances. (Purchaser L)

The third best practice suggested by Purchaser L is the establishment of a list with all necessary materials that are needed in an intensive care unit. This list should be developed in cooperation with purchasers and doctors. Purchaser L described the process of creating this list as follows:

> In March 2020, we rented 136 pallet spaces in our clinic and provided a 90-day bridging period for all products that can cover a mass rush to the intensive care units, which means we have all the vital materials that are needed in the intensive care unit. Beforehand, we worked out a list with the responsible doctors and then extrapolated how high the requirement was for 90 days and we bought that. (Purchaser L).

The purchaser empathized that this preparation must be seen as a best practice: “Every hospital must have a logistics emergency plan that specifies what material is required for life-sustaining measures” (Purchaser L). The purchaser explained what he meant by this as follows:

> I will try to make this clear to you with an example: I spoke to the heart catheter laboratory about the topic of strengthening resilience. In the cardiac catheter laboratory, we have coronal stents, which are the things that are inserted into the vessels, we have a configuration selection of over 40 pieces per type. That's 40 different configurations; size, length, and width. We asked the doctors: Which 5 of them are the ones with whom you can do almost anything? There is no longer a choice, you must limit yourself so much that you are able to save lives with just a range of five products. (Purchaser L).

Another best practice was, that the purchasing processes of the hospital were conducted very fast. According to Purchaser L: “We were quick to prepare” (Purchaser L). Furthermore, the task force was created, that held meetings about the current needs for materials. These meetings were also documented. “A crisis team has been formed. This team met via phone once a week or even several times if necessary. There was also documentation there, so all the sessions have been documented and are of course available to posterity” (Purchaser L).

4.3.9 Hospital 9 (Purchaser M)

Hospital 9 is operated by a limited liability company and is privately owned by this company. The hospital is also part of a larger group of hospitals. One purchaser was interviewed from this hospital (Purchaser M).

According to Purchaser M, there were some shortages at the start of the pandemic, and temporary measures were put in place. However, it was tolerable because the hospital is relatively small. Additionally, the hospital was able to collaborate with other healthcare institutions from its wider the wider network. Hospital 9 is also a member of a group purchasing organization that offered

support throughout the pandemic. Before the start of the pandemic, the hospital had a pandemic concept in place and stored a small amount of protective gear. Purchaser M explained:

> We had a so-called pandemic concept. We developed it because of Ebola. There was the risk of a spillover of the disease that could possibly come to Germany. We acquired emergency sets and had protective suits, but only a small number of them. We had a small stock, but for a pandemic like COVID-19, we were not prepared. (Purchaser M)

To summarize: some PPE was stored at the hospital, but not enough for a pandemic like COVID-19, and a pandemic concept was present. Therefore, Hospital 9 can be categorized in disaster preparation scenario 3 (intangible preparation action), with a small tendency towards the mixed-method disaster preparation scenario. Purchaser M thinks, that the third disaster preparation scenario is the best to implement: “I would say, the third scenario is the best” (Purchaser M).

Barriers

Three barriers to preparedness were found through analysing the interview data. The first barrier that prevented better preparation was the unpredictability of the occurrence of a pandemic. Purchaser M mentioned: “A pandemic happens so seldomly, we are such a small hospital and Germany never had a pandemic before” (Purchaser M). The second barrier found is costs and reimbursement of materials. When buying large amounts of stock, capital is then tied up in it, according to Purchaser M: “It's dead capital, it's capital that's tied up, depending on what kind of value it is” (Purchaser M). The next barrier found is the small storage space available at Hospital 9. Even if the hospital wanted to store materials in case of a pandemic, that would not be possible due to limited storage space. “We have the capacity to get by for a week, maybe 10 days, but the storage is much too small” (Purchaser M).

Best practices

Evaluating the interview data from Hospital 9, four best practices occurred. The first best practice Purchaser M mentioned was that an organization should buy what they need, but also think about the fact that other organizations also need materials: “The biggest challenge is, that you don't just think about yourself. You have to fight the pandemic together and we have to support each other. The competitive thinking has to stop to guarantee patient safety” (Purchaser M). Secondly, Purchaser M named the collaboration among hospitals of the GPO to be a best practice. When

needed, this group served as a support system. Purchaser M explained: “We supported each other a bit as a hospital group and it was good that something was there, that you could fall back on” (Purchaser M). To make it clear which hospital possessed certain materials, every hospital in the group created inventory lists. Purchaser M further elaborated that when there was a shortage, the hospitals assisted one another. “We have kept so-called stock lists of who has which materials and if there are shortages, one location has given something to the other. That is how we got through the pandemic” (Purchaser M) In connection to this, the purchaser suggests, that there should be more communication among hospitals in general: “You really have to work as a team. For me, the biggest challenge is that everyone does their own thing. But you have to try to create storage capacities as a community” (Purchaser M). The purchaser adds: “Many hospitals over-stocked. That's the biggest challenge. You must try to fight such a pandemic together and we then support each other. The competitive thinking needs to stop to guarantee the patient safety” (Purchaser M). Hospital 9 also tried to collaborate with hospitals that were in proximity. “We called other hospitals that were around the corner and spoke to them and we supported each other. That was the best practice ever” (Purchaser M). Furthermore, the creation of a task force by the GPO was described as helpful by Purchaser M. The GPO created this task force and actively tried to acquire protective equipment, according to Purchaser M: “This GPO has formed a so-called task force and has also tried to manage suppliers and acquisitions of protective materials. Yes, it was also partly helpful” (Purchaser M).

4.3.10 Hospital 10 (Purchaser N)

Hospital 10 is run by a limited liability organization with a non-profit focus. One purchaser was interviewed (Purchaser N).

In Hospital 10, there was no physical preparation before the pandemic, since the hospital only has limited storage space, as Purchaser N mentioned: “We have a space problem” (Purchaser N). The hospital focused more on intangible preparation activities, like ensuring that every staff member can roughly carry out every purchasing task, and, therefore, avoiding isolated knowledge. “There is no isolated knowledge, the basic work can be done by all employees who work in the area” (Purchaser N). The purchasing department, therefore, focused on the competency of staff. More detailed descriptions of those two aspects will follow under “barriers” and “best practices”. Purchaser N describes that the hospital had an emergency plan prior to the pandemic: “We already had an emergency plan beforehand, where certain things, including pandemic situations, were

roughly outlined" (Purchaser N). However, this plan was not specific to purchasing but to an emergency in general.

The hospital is a member of a group purchasing organization and also had framework agreements in place, however, those were described as useless during the pandemic by the purchaser. Purchaser N explained that if the supplier, with whom the hospital has framework agreements, does not receive raw materials to produce their products, they cannot supply the hospital:

> We are in a purchasing group and there are certainly framework agreements, but a framework agreement is useless if the manufacturer doesn't get the raw material for it, you can conclude as many framework agreements as you want. If the warehouses remain empty at the supplier, then the framework agreement is of no use. (Purchaser N)

There was only restricted contact with other hospitals during the pandemic. The buyer emphasized that having connections to business partners was already far more significant: "We had limited contact with other hospitals. Most of them were busy with their own problems. It was more important to have the right contact person in supplying companies than to any other buyers, we benefited significantly more from that" (Purchaser N).

Since Hospital 10 focused on intangible preparedness activities, Purchaser N categorizes the hospital in scenario three with of disaster preparedness, which means that they had intangible disaster preparedness, but no physical preparedness: "In 3, not consciously focused on the pandemic, but we simply built up the right areas of competence and capacities" (Purchaser N). However, the buyer thinks that a mixture of physical and intangible activities is the best scenario to prepare for a pandemic: "The mixed scenario is best from my point of view. You must keep stocks of material to bridge delivery bottlenecks, and also build up certain competencies of the staff and with your partners in order to be able to react faster under certain circumstances" (Purchaser N).

Barriers

From the interview data of Hospital 10, three barriers to preparedness were found. The unpredictability of a pandemic was named as the first barrier to preparedness. Purchaser N mentioned that hospitals cannot foresee what awaits them with the next pandemic: "The biggest challenge with a pandemic like this is actually that you never know what's coming" (Purchaser N).

Another barrier is the lack of storage space. Purchaser N stated that he previously conducted research and compared hospital storage facilities. It became evident from this comparison that the hospital only had 60% of the space that other hospitals had:

> I made a benchmark a few years ago. Compared to the size of the hospital, our central storage location, which we actually have available, is only about 60% of the size that other clinics have of this size. We have a space problem. During the coronavirus pandemic, wings of the hospital were closed at times because there was no staff. We then simply used former patient rooms as storage areas. (Purchaser N)

Additionally, personnel shortage is named as a barrier to preparedness by the purchaser. The purchasing department staff members are too preoccupied with their regular duties to take the time to step out of their routines to prepare for a potential emergency, according to Purchaser N:

> The main reason is simply that we don't have enough human resources. We are usually busy with our daily routine. If you want to be prepared, your colleagues also have to interrupt their work and that's where it gets difficult because things just don't get done. That is the biggest barrier of all to push ahead for a great preparation. (Purchaser N)

Best practices

Four best practices emerged after analysing the interview with Purchaser N. The first best practice described by Purchaser N is that all purchasers of the department can do the work of the other purchasers:

> There is no isolated knowledge, the basic work can be done by all employees who work in the area. Of course, this means that I always have the opportunity to bundle my strengths in certain areas, depending on the situation, to remain able to act. That is human resource management. Everyone can do anything, that is the motto we follow here and accordingly, we can act well in critical situations like during the coronavirus pandemic. Ultimately, this is knowledge management, meaning that as many people as possible have expertise in all relevant areas that relate to procurement. (Purchaser N)

With the experience obtained throughout the pandemic, the rough emergency plan from before the pandemic will be improved upon, according to Purchaser N: “We have already worked on our crisis management again. Our crisis management team is good at the moment. It has also changed in

terms of its structure, its setup, the distribution of tasks and responsibilities are really optimized again" (Purchaser N). From this, it can be interpreted that having an emergency plan is a best practice. Besides having an emergency plan, having good relationships with suppliers was also important. This is also seen as a best practice by Purchaser N: "What helped us a lot is simply the close partnerships we have with some of our suppliers or subcontractors, those two things saved us in the end" (Purchaser N). The last best practice named by Purchaser N is building a cross-functional task force, including transdisciplinary collaboration: "We have benefited from interdisciplinary cooperation. We really worked hand in hand" (Purchaser N).

4.3.11 Hospital 11 (Purchaser O)

Hospital 11 is part of a larger group of hospitals that is operated by a private company. One purchaser was interviewed (Purchaser O).

Since the hospital is part of a hospital group, this hospital group simultaneously acts as a group purchasing organization and also has a central storage location that contains a small reserve of materials. "We are organized group-wide. We have an emergency stock in our central storage facility. Sometimes these storage facilities are full, partially they are not so full, but we always hold a small reserve" (Purchaser O). The hospital did not have an emergency plan for a pandemic, but they did have an emergency plan for a general emergency, including mass casualties and fires:

> Before the pandemic, we were already prepared for a catastrophe because we also prepared different catastrophe scenarios in-house, such as a mass casualty incident, or a house fire, or a ship going under. We have such programs. There is a program for serious infectious diseases as well. In other words, the basis has always been there. (Purchaser O)

Since this hospital was fortunate enough to have a purchaser with great connections, the hospital was able to collaborate with other healthcare institutions of the region and help them out with acquiring PPE. "I helped the fire department, the nursing homes, and rehab clinics since we were a bit lucky because we had a few connections" (Purchaser O).

Overall, both physical and intangible disaster preparation measures were in place. Hospital 10 can, therefore be placed in the mixed method disaster preparation scenario. Purchaser O confirms: "I would put us under 4 (the mixed scenario)" (Purchaser O). The buyer also thinks that the mixed scenario is best: "The combination of both is very important. You need to be able to prepare the people for it physically and then intangibly" (Purchaser O).

Barriers

Two barriers to preparedness were found by interviewing Purchaser O. The first barrier is the unpredictable nature of governmental regulations. The government modified the guidelines on what protective materials must be used throughout the pandemic. This was not predictable and, therefore, difficult to prepare for in advance of the pandemic. “You could not know the critical products before and the government has changed the regulations here again and again as part of the pandemic” (Purchaser O). The second barrier found is the costs and reimbursement regulations. “The costs for materials are partially not reimbursed by health insurance companies and hospitals must cover them themselves. The financing of hospitals is catastrophic; bankruptcy can come quickly, if it takes a long time for governmental aid to step in” (Purchaser O).

Best Practices

By examining the interview data, two best practices came to light. Purchaser O communicated with other local hospitals, independent of their membership in a GPO or hospital group. This communication amongst hospitals is seen as a best practice by the purchaser: “We talk to our neighbouring clinics, regardless of the ownership. We will help each other, there is no competition. Cooperation is very important” (Purchaser O). The second best practice found is having a network. Even if Hospital 10 is part of a hospital group with central purchasing, the purchaser likes to have his network as a backup:

> I happen to have a thick network. It partially reached Hong Kong. And that is why I had people there who could help me relatively quickly with imports to Germany. I like to rely on our purchasing group, but I also like to have a security net with personal connections. You need a stable, communicative network with the respective suppliers of consumables and capital goods. (Purchaser O).

4.4 Cross-analysis of results

Following a detailed description of each hospital's circumstances, the next section will provide an overview of all interview data, which will then be compared and examined in more detail. The hospitals and their various operators will first be named. It will also be ascertained whether the hospitals are part of a group purchasing organization and which catastrophe preparation scenario the hospitals identified with before the pandemic.

This section further discusses the barriers to preparedness found during the interviews and compares the answers of the interviewees. Then, the best practices for purchasing during a pandemic are listed and further explored. A revised research model will be presented as well as a roadmap for hospitals to navigate future crises. Points of critique on the German government will be presented as well, accompanied by suggestions for improvement to enhance healthcare crisis management in the future.

4.5 Comparing hospitals: visualizing the organization's disaster preparedness scenario before the pandemic in a 2 by 2 matrix

To visualize the level of preparation of each interviewed hospital before the pandemic, a 2 by 2 matrix was created, using the four disaster response scenarios developed by (Kunz et al., 2014, pp. 267-269). Based on the assessment of the interviewed purchasers, the hospitals were categorized on how the purchasers perceived the physical and intangible disaster response preparation before the pandemic. The x-axis measures the level of physical preparedness of the hospital before the pandemic from “non” to “a lot”. The y-axis measures the level of intangible preparation activities from “non” to “a lot”.

Hospitals in the bottom left corner can be described as having few physical preparation activities, as well as a low level of intangible preparation activities. This agrees with scenario 1 of the study conducted by (Kunz et al., 2014). Analysing the interview data, Hospital 3 and Hospital 5 fit into this category. Both hospitals did not have any preparation activities before the pandemic. Purchaser I explained: “Before the pandemic, I would categorize us in disaster response scenario 1” (Purchaser I). Hospital 2 had some physical preparation by storing masks, however, this preparation was nullified by governmental regulations regarding the ban of masks with valves. Purchaser E clarified:

> It is regrettable to mention that we were unable to utilize the masks we had on hand in case of a disaster. It was customary up until that point to obtain FFP2 masks with an exhalation valve. Suddenly, though, the RKI changed the regulation and determined that these masks do not protect well enough and only FFP2 masks without valves can be used. (Purchaser E)

Therefore, it can be concluded that Hospital 2 also belongs to scenario 1, being on the border of scenario 2.

Examining the data collected from the interviews it is revealed that no other participating hospital had a combination of low intangible preparation measures and high physical preparation measures. Consequently, no hospitals can be categorized in the lower right corner of the matrix.

The upper left quadrant of the matrix includes hospitals that had a low level of physical preparation activities, but simultaneously, a high level of intangible activities. This quadrant is comparable with disaster preparation scenario 3 (Kunz et al., 2014). Looking at the data collected from the interviews it becomes apparent that Hospital 7, Hospital 9, and Hospital 10 belong in this category. Before the pandemic, they were prepared intangibly but lacked physical preparation. Purchaser J described the situation as follows: "We had an emergency plan in place. This plan was not specific to a pandemic, but to mass casualty incidents, but these disaster management competencies helped during the pandemic" (Purchaser J).

Hospitals in the upper right quadrant of the matrix are considered to be both intangibly and physically prepared for a disaster, matching the mixed scenario (Kunz et al., 2014). Reviewing the interview data, it becomes clear that Hospitals 1, 4, 6, 8, and 11 had both physical and intangible disaster preparations in place before the pandemic. Purchaser H explained: "I would categorize us in the mixed scenario. As previously mentioned, we had a hospital alarm plan in place, which included pre-planning the purchase and emergency stockpiling of personal protective equipment" (Purchaser H). The 2 by 2 matrix can be found in Figure 2.

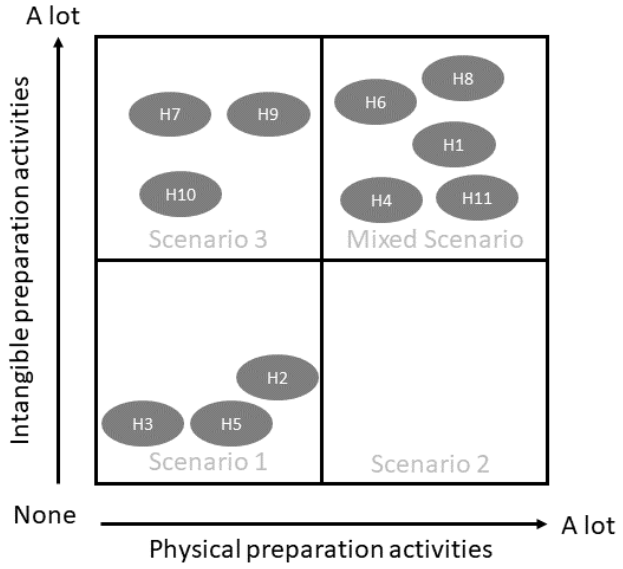

Figure 2: Categorizing the hospitals into disaster preparation scenarios, based on (Kunz et al., 2014).

From the interviews, it became clear that fourteen of fifteen purchasers considered the mixed disaster preparation scenario the best option, despite the fact that only five of the eleven hospitals fall into the upper right quadrant of the matrix. Purchaser N justifies his decision for the mixed scenario as being the best as follows: “The mixed scenario is the best. You must keep a stock of material to bridge delivery bottlenecks and build up certain competencies among your staff and with your partners in order to be able to react more quickly” (Purchaser N). Purchaser D agrees that the mixed scenario is the best choice to prepare for a disaster:

> The best disaster preparation scenario is the scenario that actually links these preparation activities together because I think it's not just about physically building up an inventory of consumables and equipment. That alone is not enough. Disaster management capacities are needed, and in this respect, I believe it is a healthy mix of physical and intangible preparation activities that are necessary because they only work together. (Purchaser D)

Purchaser O also agrees: “It is crucial that the two types of activities are combined. People must first be physically and subsequently intangibly prepared. It needs to be a well-balanced combination” (Purchaser O).

Reacting to Proposition 3

As discussed above, the majority of purchasers think, that a mixed scenario is the best option to prepare for a disaster. The results of the interviews confirm the proposition that the mixed method of stockpiling before a pandemic in combination with investments in disaster management competencies is the best solution to prepare for a future pandemic. Proposition 3 can, therefore, be accepted.

4.6 Comparing hospitals: The operator and the membership in a GPO have no influence on the degree to which a hospital prepared for a pandemic

The interviews with 11 German hospitals revealed that neither the operator of the hospital nor the membership in a group purchasing organization had a significant impact on the degree of preparation for a pandemic. No clear pattern or association between hospital operator type, GPO membership, and disaster response scenario can be observed. Public, private, and non-profit hospitals, as well as GPO members and non-members, have a mix of disaster preparation scenarios. However, it can be observed that membership in a group purchasing organization is a common

practice for German hospitals since nine out of eleven hospitals are part of a GPO. An overview of these findings can be seen in Table 9.

Organization	Operator	GPO Member?	Physical preparedness before the pandemic	Intangible preparedness before the pandemic	Disaster Response Scenario before the pandemic
Hospital 1	public	yes	high	high	Mixed scenario
Hospital 2	non-profit	yes	a little	low	Scenario 1-2
Hospital 3	non-profit/public	yes	low	low	Scenario 1
Hospital 4	private	yes	high	high	Mixed scenario
Hospital 5	non-profit	yes	low	low	Scenario 1
Hospital 6	non-profit	no	high	high	Mixed scenario
Hospital 7	non-profit	yes	low	high	Scenario 3
Hospital 8	private	no	high	high	Mixed scenario
Hospital 9	private	yes	low	high	Scenario 3
Hospital 10	non-profit	yes	low	high	Scenario 3
Hospital 11	private	yes	high	high	Mixed scenario

Table 9: Hospital operator, GPO membership, and disaster response scenarios of German hospitals

Since there is no consistent pattern between the type of operator of a hospital, GPO membership, and disaster preparation scenario, other factors are more important in determining disaster preparedness. The following sections will discuss the barriers to preparedness found during the interviews, as well as the best practices used by hospitals to conduct purchasing during the pandemic.

4.7 Barriers to preparedness: the study found 14 barriers to preparedness in three categories

During the interviews conducted with purchasers, 14 barriers to preparedness emerged. These barriers can be categorized into three main groups: barriers that apply to both physical and intangible disaster preparation activities, barriers to only physical disaster preparation activities, and barriers to only intangible disaster preparation activities. A full overview can be seen in Table 10.

4.7.1 Barriers to both physical and intangible disaster preparation

Barriers to preparedness that apply to both physical and intangible disaster preparation are possible unnecessary expenses, the unpredictability of the pandemic, and the unpredictability of governmental actions. Two purchasers (Purchaser A, E) name possible unnecessary expenses as a barrier to disaster preparedness. This term refers to the notion, that a hospital invests in physical or intangible activities that might never be used, resulting in a waste of money. Purchaser A described it like this: “Money is spent on preparations, which is essentially wasted since you never know if you'll need them or if the disaster will occur in a different way entirely from what you had anticipated” (Purchaser A). Almost all purchasers viewed the unpredictability of the pandemic as a barrier. No one expected a global outbreak to happen to such an extent. Purchaser H summarizes this barrier as follows: “The actual spread of a pandemic in Germany and Europe has, up to this point, been a utopian thought, we were unaware of its true consequences.” Purchaser C adds to this: “I would say that we never expected a pandemic to take place. That is why everyone was completely surprised” (Purchaser C). Purchaser F agrees: “The pandemic came very, very suddenly and no one expected it.” Hospitals were, therefore, unable to properly prepare: “I should probably reiterate that you were unable to adequately prepare for the pandemic we experienced” (Purchaser E). Another barrier to both physical and intangible preparation actions is the unpredictability of governmental actions. This refers to the regulations and guidelines issued by the government connected to the pandemic. “You were unable to prepare, as the government changed regulations numerously throughout the pandemic” (Purchaser O). This factor was also highlighted by Purchaser C: “It was impossible to predict the decision of the federal government. Accordingly, we could only roughly prepare” (Purchaser C).

4.7.2 Barriers to physical disaster preparation activities

There are seven barriers to preparedness found during the interviews in connection to physical disaster preparation activities. These are costs and reimbursement of products, the unknown type of disaster and necessary material, product obsolescence, small storage facilities, cost of storage, no local production, and the new Medical Device Regulation.

The barrier of costs and reimbursement refers to purchasing materials and getting the costs of them refunded by health insurance companies. Health insurance companies bear the expense of the treatments of patients. In Germany, the amount that health insurance companies pay for inpatient patient treatment is determined by annual state-level negotiations between the insurance companies

and hospital associations (state base rate). Among other things, general cost increases in labour and material expenses are taken into consideration (Bundesministerium für Gesundheit). Therefore, hospitals get reimbursed by health insurance companies for materials for inpatient patient treatment. However, this does not apply to materials that are put into storage in case of a disaster. "If there is no reason for the purchase, especially in an area that requires isolation, the costs will not be reimbursed" (Purchaser H). Purchaser K confirms this barrier: "At the beginning of the pandemic, we purchased materials for large sums of money and we didn't know what we would get refinanced." The next barrier to physical preparation is the unknown type of disaster and necessary material. No one can predict the type of disaster that will occur in the future and what products will be essential for treating and protecting patients and healthcare workers. "I can purchase protective gowns and masks as extra safeguards if I am certain that germs will be the ones moving via the air. But there are many other disasters that we could encounter" (Purchaser E). Purchaser L agrees with this statement: "The next disease could affect us completely differently. It might not affect the lungs, but the skin. We cannot know" (Purchaser L). Product obsolescence is another barrier found during the interviews. Personal protective equipment, such as FFP2 masks have an expiration date after which they are unusable. "The stuff usually expires after five years" (Purchaser I). Purchaser D adds: "In the end, it expires unused and has to be disposed of" (Purchaser D). When a hospital buys large quantities to prepare for a pandemic, the hospital's capital is tied up in these goods, which go bad after some time. "Capital is tied up in these products. The items expire, which of course makes it relatively difficult for a clinic" (Purchaser I). Having only a small storage facility also hinders hospitals from conducting physical preparation activities. Some hospitals just do not have the space to store goods to prepare for a disaster. Purchaser G mentioned: "We only have a small storage facility" (Purchaser G). During the pandemic, alternative storage solutions had to be established, according to Purchaser K: "We still have problems with storage here because we simply don't have space. My office was completely filled with boxes because we didn't know where to store them" (Purchaser K). Not just offices were used to store material during the pandemic, but also former patient rooms. Purchaser N elaborated: "During the pandemic, wings of the hospital were closed because there were no staff. We then simply used former patient rooms as storage areas" (Purchaser N). Connected to the previous barrier of having a small storage facility is the next barrier: the cost of (additional) storage. "There are certainly the storage costs, the costs of the actual storage facility, that is a barrier" (Purchaser D). The lack of local production was also seen

as a barrier to future pandemic preparations. Since almost no PPE is produced in Europe, European hospitals are dependent on suppliers from Asia. Purchaser H clarified:

> When we talk about a global pandemic, like the one that affected the COVID-19 virus, there are still very few production facilities in Europe for personal protective equipment. In such cases, Asian manufacturers will typically reserve the materials for their own market and not supply the European market. Furthermore, when these huge amounts need to be sent, there are incredibly long delivery times—we are talking about six to eight weeks, sometimes even longer. (Purchaser H)

The dependence on suppliers from Asia for personal protective equipment poses a challenge for German hospitals, as it limits their ability to stockpile essential resources when the first signs of a disaster become apparent. The last barrier to physical preparation activities for a future disaster is the Medical Device Regulation (MDR). New regulations will come into effect. According to Purchaser E, suppliers lose their accreditation for products and must be re-certified with increased requirements:

> The MDR is crucial in this situation: suppliers may remove items from their range even though they are actually needed, but it is no longer worthwhile for the suppliers to be certified or recertified because there are far too few certification bodies". (Purchaser E)

Purchaser L confirms this: "For many companies, the MDR meant that they could no longer supply their products because they had lost their certification" (Purchaser L). Hospitals may find it problematic to accumulate the resources needed for physical preparatory operations if suppliers have difficulty getting or keeping their products certified, which could compromise their capacity to respond to public health emergencies.

Reacting to Proposition 1

Seven barriers to physical disaster preparedness activities were identified from the interviews conducted with fifteen purchasers. These barriers include costs and reimbursement of products, the unknown type of disaster and necessary material, product obsolescence, small storage facilities, cost of storage, no local production, and the new Medical Device Regulation. With regard to Proposition 1, these findings support the notion that physical preparedness activities have

downsides that might discourage organizations from adopting them. Therefore, Proposition 1 can be accepted.

4.7.3 Barriers to intangible disaster preparation activities

During the interviews, four barriers to intangible disaster preparation activities were found: personnel shortage, high organizational efforts necessary, high costs, and knowledge loss.

The first barrier to intangible preparation is personnel shortage. Due to a lack of staff, purchasers at hospitals are very occupied with their everyday tasks and do not have the capacity to also take care of intangible disaster preparations. Purchaser N explained:

> The main reason is simply that we do not have enough human resources, so usually the personnel are occupied in the hamster wheel of everyday work. Not only do you have to get yourself out of the hamster wheel of everyday work, but you also must take your colleagues out of it and that is where it becomes difficult because things just do not get done. This is the biggest barrier to continuing with preparation. (Purchaser N)

Additionally, high organizational efforts are needed to prepare intangibly. Most hospitals and municipalities are not able to manage this effort. Purchaser J used to participate in workshops: “We often had a nationwide workshop but unfortunately it no longer exists. It is a huge effort; the workshops are just not conducted anymore” (Purchaser J). Intangible disaster preparations are also expensive, which is why the cost of such efforts is a barrier to preparedness. Purchaser D confirms this barrier:” There is a huge financial investment involved” (Purchaser D). In the past, some intangible preparation activities in the form of workshops were organized by the municipality where Hospital 6 is located, however, these efforts were stopped, due to a lack of funding: “They just don’t have the money for it anymore” (Purchaser J). The last barrier to implementing intangible disaster preparation activities is knowledge loss. If the lessons learned during the pandemic were not written down by the purchasers and the purchaser leaves the organization, the knowledge gained would be lost, as explained by Purchaser K: “If my colleague and I left the organization, the remaining colleagues would no longer know where to order” (Purchaser K). An organizational knowledge gap may result when purchasers who have amassed expertise regarding vendors, procurement procedures, and best practices leave the company. This knowledge loss may make it more difficult for a hospital to organize, coordinate, and communicate during future emergencies

since inexperienced or new employees may find it difficult to understand the intricacies of preparedness.

Reacting to Proposition 2

Proposition 2 is supported by the research findings, which show that there are four obstacles to intangible disaster preparation activities: personnel shortage, high organizational efforts necessary, high costs, and knowledge loss. These barriers indicate that intangible disaster preparedness activities can, indeed, be complex to execute, which may further discourage hospitals from implementing this type of preparedness activities.

Barriers		**H1**	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**	**H8**	**H9**	**H10**	**H11**
Barriers to both physical and intangible disaster preparation activities	Possible unnecessary expenses	x	x									
	Unpredictability of pandemic	x	x	x	x	x	x	x	x	x	x	
	Unpredictability of governmental actions		x		x			x				x
Barriers to physical disaster preparation activities	Costs and reimbursement				x	x		x		x		x
	Unknown type of disaster and necessary material	x	x			x			x			
	Product obsolescence	x	x	x		x	x	x				
	Small storage facilities	x		x	x	x		x		x	x	
	Cost of storage	x										
	No local production	x			x							
	Medical device regulation		x			x			x			
	Personnel shortage	x									x	

Barriers to intangible disaster preparation activities	High organizational efforts necessary						x					
	High costs	x					x					
	Knowledge loss							x				

Table 10: Barriers to disaster preparation activities found during the interviews

4.7.4 Assessing the significance and recurrence of barriers to preparedness

Looking at the interview data, it becomes clear that the unpredictability of the pandemic had a significant influence on the preparedness of hospitals for a pandemic. Purchasers frequently mentioned the challenges with planning for a healthcare crisis and resource allocation. This barrier has the potential to destabilize the healthcare system and affect all areas, including patient care, staffing, and supplies. The unpredictability of the pandemic was named as a barrier to preparedness by ten out of eleven hospitals, making it the most frequently cited obstacle. Due to its widespread impact on various aspects of hospital purchasing operations, as well as the emphasis placed on this barrier by participants, one can conclude that the unpredictability of the pandemic is the most significant barrier to preparedness.

A thorough inspection of the interview data further revealed that small storage space was a barrier to hospital preparedness. Purchasers often mentioned the difficulties in stockpiling protective gear, such as PPE due to limited storage capacities. Many hospitals relied on the Just-in-Time inventory system, which left them vulnerable to supply chain disruptions. This barrier to preparedness was named by seven of eleven hospitals during the interviews. Due to its impact on the ability of the hospital to maintain adequate stock levels and the considerable emphasis placed on this barrier by purchasers, the barrier of small storage facilities is the second most critical barrier to hospital preparedness in this research.

The further examination of the interview data highlighted the challenges caused by product obsolescence to hospital preparedness. Purchasers mentioned the problems with maintaining adequate supplies of medical products, particularly when these products become obsolete and are unusable. Financial resources are wasted in case of product obsolescence and a hospital must navigate the removal and replacement of obsolete materials. The barrier of product obsolescence

was mentioned by six out of eleven hospitals. Since this barrier has a substantial impact on inventory management, it is the third most critical obstacle to hospital preparedness.

Another challenge to hospital preparedness, as suggested by analysing the interview data, is cost and reimbursement. The interviewees often mentioned the financial strain associated with purchasing essential materials, particularly when there was a limitation or uncertainty connected to the reimbursement of product costs from healthcare insurance companies. Five out of eleven hospitals empathized this circumstance as an obstacle, and it can be classified as an important barrier to preparedness.

Ten other barriers were not discussed in the previous text, however, the interview data revealed that these barriers should not be dismissed, since they may still have implications for healthcare institutions and can present unique challenges to hospitals. An overview of the frequency the barriers to preparedness were mentioned during the interviews can be seen in Figure 3.

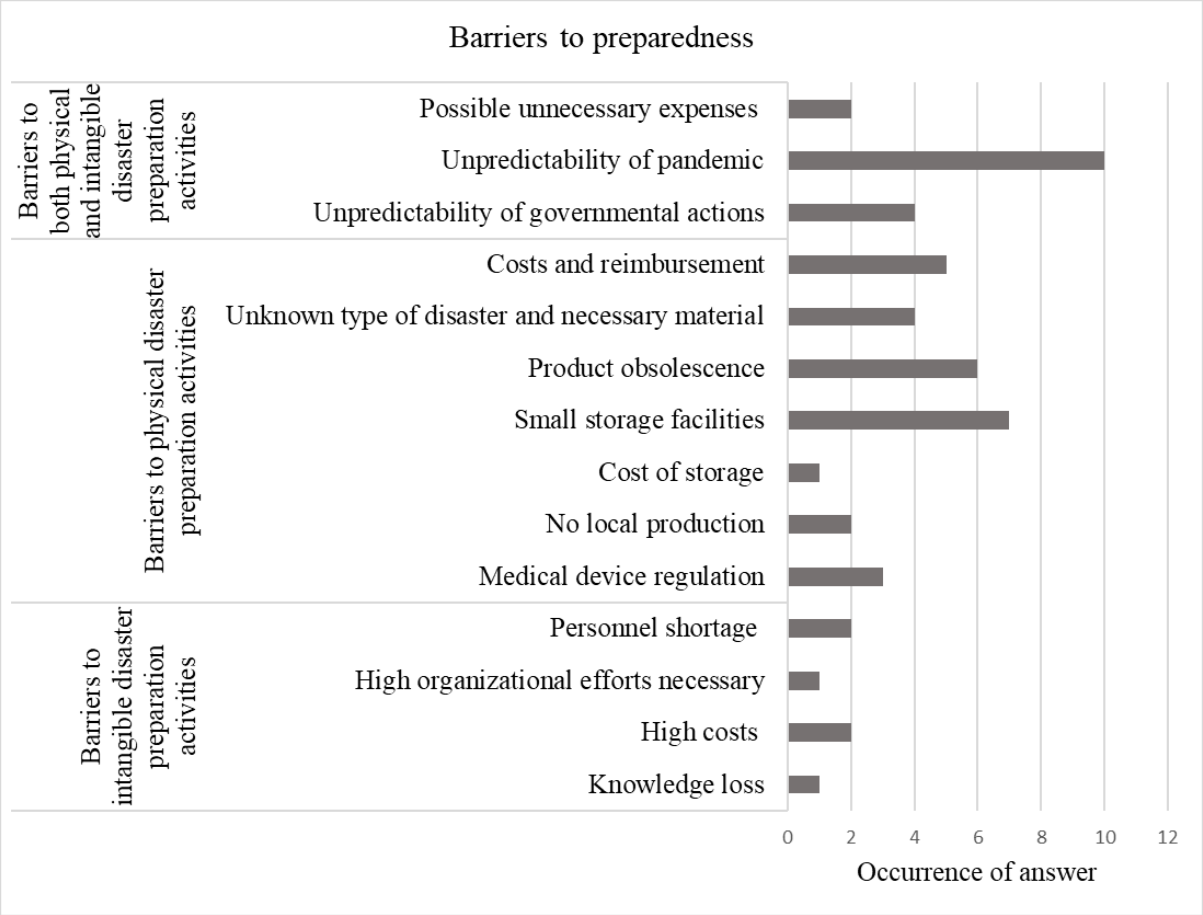

Figure 3: Frequency analysis of barriers to physical and intangible disaster preparation activities

Reacting to Research Question 1: 14 barriers were found during the interviews with purchasers of German hospitals

In response to Research Question 1: "What are the main barriers to developing preparedness plans to address supply disruptions faced by hospitals?", the analysis of the interview data revealed 14 barriers to hospital preparedness. These are possible unnecessary expenses, the unpredictability of a pandemic, the unpredictability of governmental actions, costs and reimbursement, unknown type of disaster and necessary material, product obsolescence, small storage facilities, cost of storage, no local production, the medical device regulation, personnel shortage, high organizational efforts necessary, high costs, and knowledge loss. Among these, four barriers to preparedness stood out to be the most critical due to their impact on numerous aspects of the purchasing process of the hospital. The unpredictability of the pandemic was found to have a significant impact on hospitals' ability to prepare and allocate resources since it challenged healthcare organizations to adapt to rapidly altering circumstances. The interview data further revealed that small storage facilities is another barrier to preparedness, as it hindered hospitals from stockpiling materials. Hospitals were forced to rely on Just-in-time inventory systems or ad additional storage space. Another significant barrier extracted from the interview data is product obsolescence. Purchasers described difficulties in storing and managing inventory due to the expiration of the materials. Furthermore, the examination of the interviews also revealed the significance of costs and reimbursement as a barrier to preparedness. The financial constraints and uncertainties surrounding the reimbursement of materials by healthcare insurance companies impacted the hospital's budgets and resource allocation. Although the other ten barriers appear less in the data collected through the interviews, they should not be overlooked, since they may present unique challenges to specific healthcare institutions.

4.8 Best practices: Identification and categorization of practices employed by purchasers during the pandemic

Analysing the interview data, 24 best practices utilized by hospitals during the pandemic were identified. In order to better understand the various actions and strategies purchasers employed, these best practices are divided into six categories, using the framework suggested by literature. The categories include physical as well as intangible activities, as suggested by (Kunz et al., 2014), and are further divided into the subcategories that include the disaster management capacities: storage, human resources, knowledge management, operations- and process management, financial

resources, and community, as presented by (Van Wassenhove, 2006). By using the established framework, the goal is to provide a comprehensive understanding of the approaches taken by purchasers of healthcare organizations to navigate the challenges posed by the COVID-19 pandemic. The following text will explain each category and its associated best practices. An overview of all best practices and their categories can be seen in Table 11.

4.8.1 Storage: having a storage facility, increasing the storage range and additional storage space are best practices during a pandemic.

In the realm of physical activities, the storage of materials played an important role in ensuring healthcare organizations have the required resources available during the pandemic. During the interviews, three best practices were found that can be sorted into the category of storage. The first best practice is for hospitals to have their own storage facility. Purchaser E describes it like this:

> It is important to have your own warehouse. It is nice to calculate, if the warehouse is on the street or if you have a single-supplier strategy. That was a popular practice before and was taught that way. However, that has changed suddenly. This practice failed during the pandemic. (Purchaser E)

Another best practice in this category is increasing the storage range. This refers to extending the number of days, a hospital can operate with the materials in storage, according to Purchaser E:

> We order very differently these days. We listen more to the computer and have increased our inventory range. Before the pandemic, the inventory range was 14 days. We still had a real warehouse, which I am also grateful for. We did not abandon it and outsource it. And now we have a storage range of 40 days for all items and up to 60 days for particularly high-risk items. (Purchaser E)

Additional storage space is another best practice. If there was limited storage space at the hospital's location, additional storage space was acquired. Purchaser A summarizes the situation as follows:

> We acquired another storage facility. It was basically just a logistician. We have put more things in stock, including ventilation systems and central venous catheters. Things like these are not normally in stock but are absolutely essential for intensive care patients. We did not purchase them in every size, but at least so you had something to work with. (Purchaser A)

4.8.2 Human resources: Have a person responsible for pandemic preparations, preparation workshops, and all purchasing employees can do all purchasing activities are best practices

Disaster management competencies, as introduced by (Van Wassenhove, 2006), highlight the importance of investing in human resources. Within this context, purchasers of healthcare organizations have identified three best practices during the interviews that belong to this category: have a person responsible for pandemic preparations, preparation workshops, and all purchasing employees can do all purchasing activities.

Designating one or more individuals to oversee pandemic preparedness is seen as a best practice. "I would say that there should be one or more pandemic representatives. They do things for the hospital to be better organized, that would certainly make sense" (Purchaser A). Purchaser L agrees with this practice: "In the event of a pandemic, or even in times when there is no pandemic, the pandemic representative can check whether there is sufficient stock, whether the people have enough knowledge, and so on" (Purchaser L). Preparation workshops were also named to be a best practice. These workshops allow participants to share expertise, improve communication, and work together, enabling them to anticipate problems before they arise and come up with workable solutions. Purchaser J explained: "I have attended workshops where the topics were always fire alarms or power outages in hospitals. We had a nationwide workshop like this, but unfortunately that no longer exists. These workshops gave us an opportunity to exchange knowledge and ideas" (Purchaser J). Another best practice is for all employees to conduct all purchasing activities. Distributing purchasing responsibilities across multiple individuals may avoid knowledge silos, and maintain business continuity. Purchaser N mentioned:

> There is no isolated knowledge, the general work can be done by all employees who work in that area. This means that I always have the opportunity to combine my strengths in certain areas depending on the situation to remain able to act. Everyone can do everything, that is the motto we follow here and we can of course also act well in critical situations such as during the Corona pandemic. (Purchaser N)

4.8.3 Knowledge Management: Having an emergency plan, and an emergency material checklist are best practices

The next vital part of intangible disaster management activities is knowledge management. Best practices that were found during the interviews belonging to this category are having an emergency

plan, and having an emergency material checklist. These best practices emphasize the importance of planning and resource organization, enabling healthcare organizations to effectively respond during a healthcare crisis.

The first best practice in this category is for the hospital to have an emergency plan. According to Purchaser K: “It was a best practice, that we had a crisis response plan. We already thought about possible scenarios before the pandemic” (Purchaser K). For the future, it is also seen as a best practice to develop an emergency plan based on the experience gained during the pandemic. Purchaser D elaborated:

> I think everyone has emerged from the pandemic a little smarter and it was certainly a time that was very instructive for us as a house and to develop appropriate pandemic plans. You can now approach a similar scenario in a much more structured way. (Purchaser D)

The second best practice is to have an emergency checklist. This list contains all materials, that are necessary for a hospital to keep operating. Purchaser L describes it like this:

> In March 2020, we rented 136 pallet spaces in our hospital to provide a 90-day bridging period for all products that can cover a mass rush to the intensive care units. This means that we have all the vital materials in storage that are required in the intensive care unit. Beforehand, we created a list of materials in collaboration with the responsible doctors and then extrapolated how much we would need for 90 days. Then we bought those materials. (Purchaser L)

4.8.4 Operations- and process management: nine best practices belong to this category

Operations- and process management is the third category of disaster management competencies, as described by (Van Wassenhove, 2006). During the interviews of this study, ten best practices that fit into this category were found, namely: having alternative suppliers, fostering supplier relationships, having local suppliers, being fast in the purchasing process, being flexible, approval of all purchasing channels, suppliers regulated distribution of needed materials, buy what you need, but also think of others, and continues ordering from suppliers.

The first best practice mentioned is having alternative suppliers. This refers to the notion that a hospital should not rely too heavily on one single source of supply, but rather source materials from multiple suppliers to minimize the risk. Purchaser E explained: “We have learned that it is safer to pay attention to risk diversification and to have several suppliers on board. I must have an

alternative supplier or information about the supplier must be available" (Purchaser E). Purchaser F agrees: "The strategy is simply to position ourselves more broadly, by working with alternative suppliers" (Purchaser F). The next best practice mentioned during the interviews is for the purchaser of the hospital to have a wide network. Connections to other players in the field help to predict material shortages. Purchaser A mentioned: "For the clinic itself, networking is crucial since it allows one to anticipate future shortages. That means that if the hospital is the first to purchase, it is in a better position" (Purchaser A). Fostering supplier relationships is another best practice. This refers to having a good relationship with suppliers and collaborating with them to solve problems. "What helped us a lot is the close partnerships we have with some of our suppliers. That ultimately saved us" (Purchaser N). Purchaser D agrees with this statement: "We used the supplier relationships that we had, including relationship channels. That is actually very important when things become critical. We can then find solutions together with our strategic partners and our suppliers to avoid or reduce bottlenecks" (Purchaser D). Additionally, it is important to always be kind to the strategic partner. "I was always nice and friendly. This really helps" (Purchaser G). The next best practice in this category is to have local suppliers, since this leads to a shorter supply chain. "We now have a partner here in Germany. The respiratory masks and the surgical masks with the ear loops are produced in Germany. We are positioned quite well" (Purchaser C). For an organization to have a fast purchasing process is also a best practice. Being fast is essential to attain materials that might be scarce soon. "Time is money. It was always crucial to act quickly when making purchases of goods that may become scarce" (Purchaser A). Furthermore, it was important to be flexible. Hospitals may adapt their purchasing strategies to changing market conditions, supply chain interruptions, and changing needs when they are flexible. "Ultimately, you have to react flexibly, that is a crucial thing" (Purchaser B). The approval of all purchasing channels is another best practice. As mentioned above, nine hospitals that were interviewed for this study are part of a group purchasing organization. Usually, hospitals are bound to the suppliers with which the GPO has contracts. However, during the pandemic, this limitation was removed to provide hospitals access to the entire market for supplies. Purchaser H elaborated:

> The approval of all purchasing channels was advantageous. We, as a hospital, are actually tied to the purchasing and logistics of our GPO. In other words, we have so-called A-suppliers with whom we have fixed contracts. Of course, the needs were never negotiated or met on this scale

> we experienced during the pandemic. We were then permitted to conduct our own purchasing for our hospital and had access to the full global market to exercise procurement. (Purchaser H)

The control of supply distribution was a best practice implemented by suppliers that hospital purchasers approved of. This indicates that to avoid overstocking, suppliers only provided an equal quantity of products after reviewing previous orders from hospitals. Other suppliers only fulfilled 80 percent of ordered goods and gave the remaining 20 percent to hospitals in dire need for them to keep operating. This strategy was explained by Purchaser A:

> Some suppliers said: you get what you always get and no more. Other companies would only supply you with 80% of your order and gave the remaining 20% to those who urgently needed it, which I also think is a very good tactic. (Purchaser A)

This is also connected to the next best practice: buy what you need, but also think of others. It refers to maintaining a thoughtful balance between fulfilling the needs of the hospital, as well as considering the needs of other organizations, leading to a fair distribution of resources. "There were hospitals that were really bunkering, very anti-social behaviour, I have to say. You can certainly stash something, but you are not alone on this planet. Every hospital has to care for its patients" (Purchaser A). Purchaser M agrees with this: "The biggest challenge is, that you don't just think about yourself. You have to fight the pandemic together and we have to support each other. The competitive thinking has to stop to guarantee patient safety" (Purchaser M). The last best practice of this category is to continuously order from a supplier. During a crisis, it is important to stay in the ordering process, since some suppliers may delete orders when they have been placed a long time ago and could not be fulfilled. Purchaser G explained:

> If there are delivery problems, it is important to stay in the ordering process. Sometimes companies delete orders if they have been placed four or five months ago and could not be fulfilled. You must continuously order materials, otherwise, you will be at the end of the list of suppliers, and if you are unlucky, there is nothing left. (Purchaser G)

4.8.5 Financial resources: Investment-stop for pandemic-unrelated goods, and personnel reduction to reduce costs are best practices

The next crucial part of intangible disaster management capacities is financial resources. The effective management of financial resources is essential for hospitals to maintain functionality and

respond promptly to a healthcare emergency. Two best practices were found during the interviews: investment-stop for pandemic-unrelated goods, and personnel reduction to reduce costs.

The first best practice in this category is the investment stop for all goods that are not related to the pandemic. This measure is necessary for the hospital to save money and remain solvent. As Purchaser I explained:

> As a hospital, you have to make sure that savings are being made wherever possible, which was done in the procurement area. Investments that had nothing to do with containing the pandemic were suspended, and as a result, capital goods orders that were not absolutely required to keep the hospital operating were no longer permitted. (Purchaser I)

Connected to this is the next best practice, namely personnel reduction. For the business to stay solvent, this method was also implemented to reduce expenses. Purchaser I mentioned:

> A big expense for a hospital is personnel costs. The hospital offered to forego salary through reductions of work time and unpaid vacation. Of course, there were also employees in service areas that had nothing to do, since these parts of the hospital were closed. They were let go. These were the most effective measures in the short term. (Purchaser I)

4.8.6 Community: Framework agreements, communication among GPO members, communication among hospitals, having a network, and building a cross-functional task force are best practices

The last part of intangible disaster management capacities is community. During the interviews, four best practices that fit into this category were found, namely: framework agreements, communication among GPO members, communication among hospitals, having a network, and building a cross-functional task force. These best practices empathize the importance of creating a supportive network within the healthcare sector which further leads to the ability of organizations to share resources, knowledge, and expertise in responding to the challenges of the pandemic.

The first best practice in the community category is to have framework agreements in place. “It is advantageous to have a fixed framework agreement where the suppliers are obliged to deliver. You then pay 1 to 2 cents more, but you have made a fixed agreement with a supplier and you can protect yourself” (Purchaser I). This framework agreement can include the continuous storage of materials in the facilities of the supplier due to a lack of space at the hospital. Purchaser C clarified:

“We conclude contracts with companies so that they always have a warehouse reserved for us because we don't have the storage capacity” (Purchaser C). The second best practice found is communication among members of a group purchasing organization. Members were able to interact and support one another by sharing information about which suppliers could still provide materials due to the GPOs' infrastructure. “The group purchasing organization had a COVID-network. You could always take a look into this database and purchasers would write down where they got materials. That was helpful when you did not know which supplier to contact” (Purchaser G). Hospitals in a GPO could alert one another about impending product shortages with the use of this kind of network. “There was also the exchange about what materials were getting scarce. It was helpful to gain this knowledge” (Purchaser A). Hospitals within a GPO also talked about how they could help each other out and how to possibly approach suppliers. Purchaser D mentioned:

> There were occasions in which we exchanged ideas: How can we support each other? How can we contract suppliers to get what we need to cope with the pandemic? That was also an additional means of being part of a purchasing group. (Purchaser D)

A few hospitals in the same GPO even provided help to one another by disclosing material supply levels. If one hospital ran out, another would supply. “We, in the group purchasing organization, looked at who had what in stock and supported each other” (Purchaser M). However, the support of some hospitals was not just contained to hospitals within their GPO, but also hospitals located close to each other. This communication among hospitals in general is also a best practice. “We also called other hospitals that were around the corner and talked to them, and we supported each other. That was the best practice ever” (Purchaser M). Instead of viewing each other as competition, some hospitals worked together regardless of which GPO they were a part of. “We also talk to our neighbouring clinics regardless of the membership. We help each other so there is no thought of competition. Cooperation is very important” (Purchaser O). The next best practice mentioned during the interviews is for the purchaser of the hospital to have a wide network. Connections to other players in the field help to predict material shortages. “For the clinic itself, networking is crucial since it allows one to anticipate future shortages. That means that if the hospital is the first to purchase, it is in a better position” (Purchaser A). Also having a network inside of the organization, with colleagues from other departments can be helpful. “You had to know people. And we have a colleague here who is from China and works for another department. She knew another colleague from China that sold masks. I then contacted him, that had been an advantage”

(Purchaser J). In addition to having ties to organizations in the healthcare industry that could potentially be able to assist in problem-solving in an emergency, it is beneficial to have contacts with other industries. “It was important to know the right contacts in the industry, we benefited significantly from that” (Purchaser N). Purchaser O agrees: “I happen to have a relatively thick network. It extends to Hong Kong. That is why I had people who were able to help me relatively quickly with imports of materials to Germany” (Purchaser O). The last best practice of this category during the pandemic was for hospitals to build cross-functional task forces. These task forces enabled a more thorough and cooperative approach to problem-solving and decision-making by bringing together a variety of talents, viewpoints, and areas of expertise. “A best practice was gathering the knowledge of individuals. There is a Corona-team, it is very diverse, I think that is a good mix. Everyone could contribute something” (Purchaser J). Purchaser K agrees with this best practice: “Good cooperation between all professional groups, that was actually the best thing. A lot of communication and good collaboration were important.”

An extensive overview of best practices identified in each hospital can be found in Table 11.

Type of activity	Categories	Best Practices	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11
Physical	Storage	Having own storage facility		x									
		Increasing storage range		x									
		Attain additional storage space	x										
Intangible	Human Resources	Have a person responsible for pandemic preparations	x							x			
		Preparation workshops						x					
		All purchasing employees can do all purchasing activities										x	
	Knowledge Management	Having an emergency plan	x	x					x	x		x	
		Emergency material check list								x			
		Having alternative suppliers		x									

	Operations- and process management	Fostering supplier relationships	x	x	x							x	
		Having local suppliers	x										
		Being fast in the purchasing process	x							x			
		Being flexible	x										
		The approval of all purchasing channels				x							
		Suppliers regulated distribution of needed materials	x										
		Buy what you need, but also think of others	x								x		
		Continues ordering from suppliers			x								
	Financial resources	Investment-stop for pandemic unrelated-goods					x						
		Personnel reduction to reduce costs					x						
	Community	Framework agreements	x				x						
		Communication among GPO members	x	x	x	x	x				x		
		Communication among hospitals			x						x		x
		Having a network	x					x					x
		Building a cross-functional task force	x			x		x	x	x	x	x	

Table 11: The best practices found during the interviews

4.8.7 Assessing the significance and recurrence of the best practices

Analysing the interview data, an emphasis on the importance of a multidisciplinary approach becomes evident. Purchasers highlighted the positive aspects of building a cross- functional task force, including diverse expertise to continue purchasing during the challenging time of the pandemic. As the most cited best practice, with seven out of eleven hospitals mentioning it during the interviews, building a cross-functional task force can be seen as the most critical best practice for navigating a healthcare crisis.

The interview data revealed that communication among members of the group purchasing organization played an important role in attaining protective gear during the pandemic. Purchasers highlighted the importance of sharing information, strategies and sometimes even supplies to address the purchasing difficulties during the pandemic. This best practice was mentioned by six of eleven hospitals. Due to the significant impact of communication among GPO members on the purchasing process during the pandemic, the best practice is the second most critical factor for improving the purchasing process during a crisis. Notably, the best practice of communication among hospitals is similar. Although this best practice has appeared less often in the interview data, purchasers acknowledge its significance.

Exploring the interview data further, it becomes clear that having a well-developed emergency plan before the start of a healthcare crisis played an important role in facilitating a fast and structured response to the pandemic. The interviewees empathized the ability of this plan to approach the purchasing process in a structured way and minimize response time. Having an emergency plan was mentioned by five out of ten purchasers, thus, this best practice is the third most critical factor for purchasing during a pandemic.

Besides the aforementioned best practices, the analysis of the interview data revealed 20 additional best practices. While they might have been mentioned less frequently, they should not be ignored, as they might be significant for specific hospitals. Hospitals must assess these best practices' applicability within the context of their own organization. An overview of the occurrence of the best practices can be found in Figure 4.

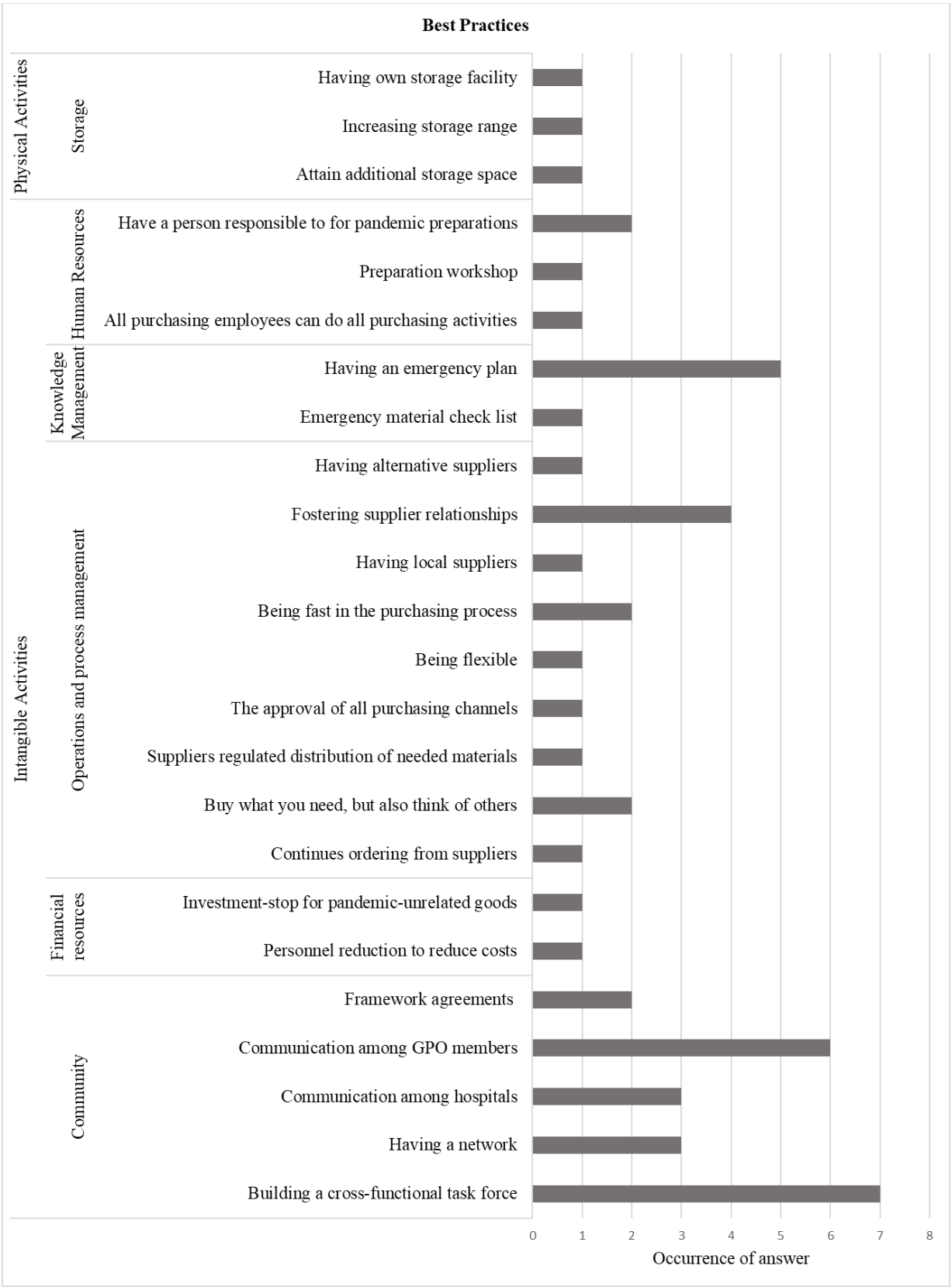

Figure 4: Occurrence of best practices during the interviews

Reacting to the Research Question 2: the interviews revealed 24 best practices in 7 categories

The study's second research question was: "What are the best practices learned by hospitals during the COVID-19 pandemic in order to prepare for future supply disruptions?" From the description above, it becomes clear that hospitals have recognized and put into practice a variety of best practices to improve their stand during the pandemic. 24 best practices were found, which are: having own storage facility, increasing storage range, attaining additional storage space, having a person responsible for pandemic preparations, preparation workshops, all purchasing employees can do all purchasing activities, having an emergency plan, emergency material check list, having alternative suppliers, fostering supplier relationships, having local suppliers, being fast in the purchasing process, being flexible, the approval of all purchasing channels, suppliers regulated distribution of needed materials, buy what you need, but also think of others, continues ordering from suppliers, investment-stop for pandemic unrelated-goods, personnel reduction to reduce costs, framework agreements, communication among GPO members, communication among hospitals, having a network, and building a cross-functional task force. These best practices can be sorted into physical and intangible activities, according to (Kunz et al., 2014). Storage is the category of best practices that falls under physical activities. The categories: human resources, knowledge management, operations- and process management, financial resources, and community are adapted from (Van Wassenhove, 2006) and contain intangible activities. Through analysing the interview data, three key best practices were identified. Building a cross-functional task force fosters cooperation and multidisciplinary expertise in order to address complex challenges. Communication among members of a group purchasing organization facilitates information exchange and resource allocation. Lastly, having an emergency plan prior to a healthcare crisis ensures a quick and coordinated response. These practices, as well as the best practices less mentioned, are crucial for hospitals to consider, as they are factors that help a hospital to prepare for a future crisis. Therefore, the second research question is answered.

4.9 Revised research model: integrating interview findings to enhance the conceptual framework for emergency preparedness

After reviewing the results of the interviews, the research model was adapted. It visualized that the barriers to both physical and intangible preparedness activities, the barriers to physical preparedness activities, and the barriers to intangible preparedness activities have an influence on the capacity of an organization to implement preparation activities. Furthermore, the application of best practices in the categories of storage, human resources, knowledge management, operations- and process management, financial resources, and community affects an organization's ability to carry out subsequent preparation actions as well. The level of an organization's preparedness for emergencies is then determined by both its capacity and its application of best practices. The revised research model can be found in Figure 5.

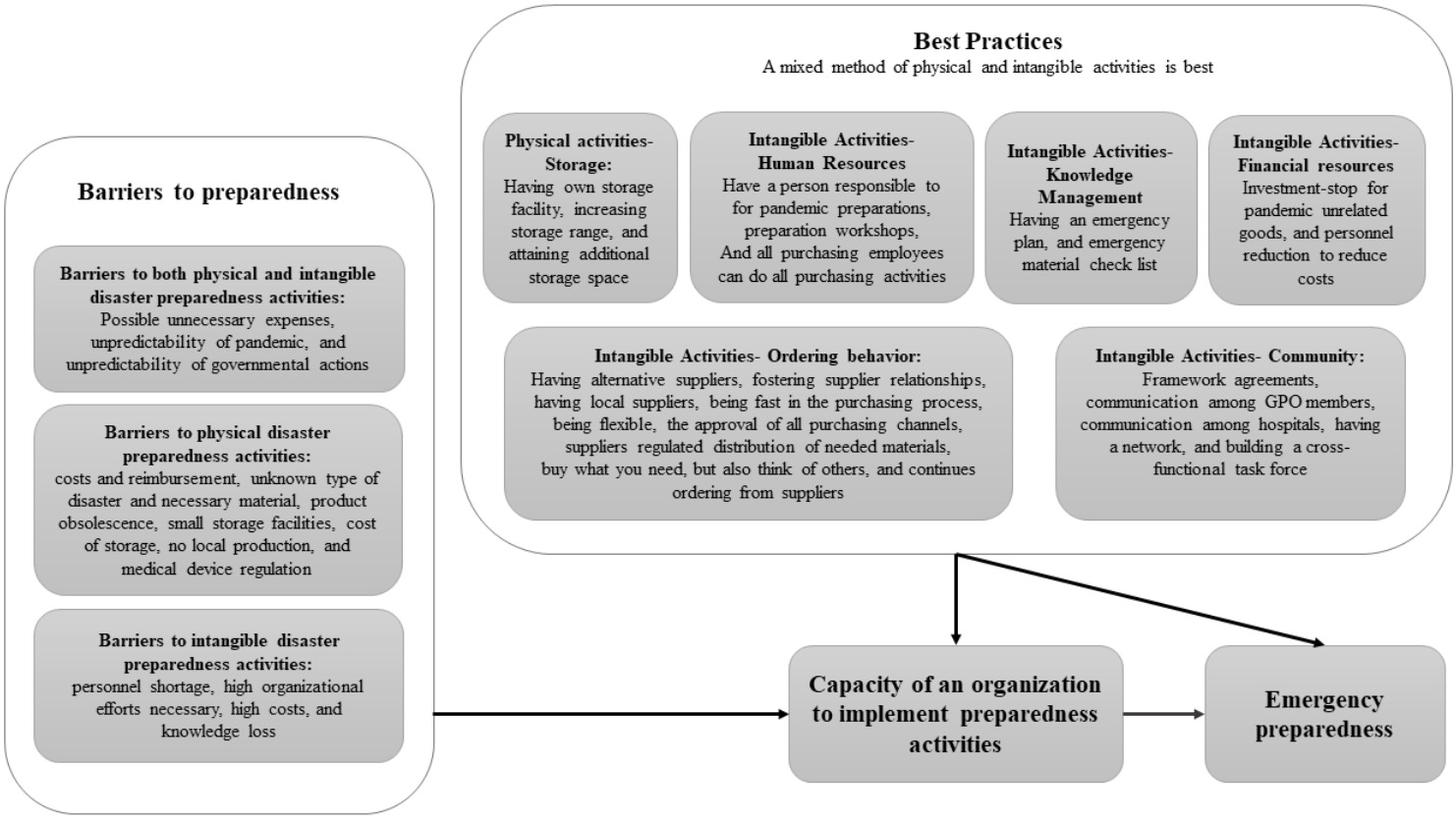

Figure 5: Revised research model

4.10 A roadmap: improving hospital preparedness through implementing the best practices

Hospital preparedness has become increasingly important in the face of global healthcare emergencies such as the COVID-19 pandemic. The ability of hospitals to respond effectively to healthcare crises relies heavily on their preparedness to manage unpredicted challenges and adapt to rapidly evolving circumstances. Drawing from the lessons learned during the pandemic, this roadmap aims to provide a step-by-step guide for healthcare organizations to improve their preparedness for future healthcare emergencies. The roadmap consists of seven steps that are designed to guide healthcare organizations through the process of understanding, assessing, and implementing best practices. These steps include (1) Understanding the best practices presented in this research, (2) Assessment of practices implemented in the hospital, (3) Conduction of a gap analysis, (4) Development of an action plan, (5) Engagement of stakeholders, (6) Creation and implementation of new preparedness activities, and (7) Review and continuous improvement of preparedness activities. An overview of the roadmap can be seen in Figure 6.

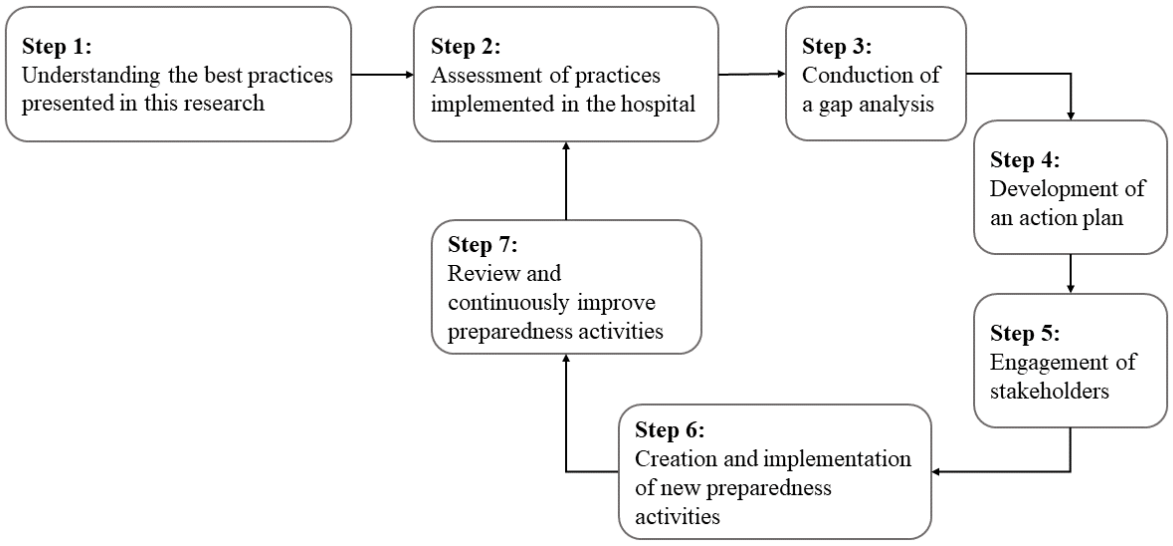

Figure 6: A roadmap for improving hospital preparedness

To support hospitals in assessing their purchasing practices, current preparedness measures, and identifying areas for improvement, a comprehensive questionnaire has been developed that can be found in Appendix C. This questionnaire is based on the best practices found during the interviews and contains questions corresponding to each best practice, allowing hospitals to evaluate their performance in various aspects of crisis management. The questionnaire is structured to provide a

detailed and systematic assessment of each best practice identified in the study. For example, the best practice that was mentioned most often during the interviews is building a cross-functional task force. The questionnaire includes multiple questions covering the composition and training of the task force, its tasks and responsibilities, communication methods, time and resource investments, and lessons learned for a future crisis. This level of detail allows hospitals to evaluate their purchasing methods during the pandemic in a comprehensive manner and identify specific areas where improvements are needed.

4.10.1 Step 1: Understanding the best practices presented in this research

The first step of the roadmap is for the hospital to gain a clear understanding of what constitutes a best practice. In the context of this research, this term refers to effective purchasing practices and strategies that were employed during the pandemic. The best practices, therefore, offer a strong foundation for hospitals to manage and prepare for potential future healthcare crises effectively. Furthermore, the purchasing department of the hospital needs to gain a wide-ranging understanding of the best practices identified in this research. To achieve this, the organization should thoroughly review the best practices and their definitions in the results part of this study. To ensure a well-rounded perspective, it is recommended that multiple individuals in the healthcare organization review the best practices. This could further lead to a group discussion and may facilitate a deeper understanding, which will ultimately enhance the ability of the team to comprehensively answer the questions provided in the questionnaire.

Looking at the best practice of "building a cross-functional task force", in this step of the roadmap, the purchasers understand what a cross-functional task force is, its purpose, and its benefits through reading the results part of this research.

4.10.2 Step 2: Assessment of practices implemented in the hospital

The second step in the roadmap focuses on assessing the practices implemented by the hospital during the pandemic. Here, the hospital's purchasing department needs to assess the various purchasing strategies and actions they took during the pandemic. They further need to determine which practices were most effective in managing the challenges presented by the pandemic and were crucial to maintaining the hospital's operations. This self-assessment may encourage the hospital team to critically evaluate their experiences and identify the strengths and weaknesses of their hospital. The documentation of these findings is essential to move on to step 3.

The hospital following this roadmap is documenting all the best practices, they utilized in purchasing during the pandemic. Here, they may or may not uncover that one of their best practices was “building a cross-functional task force”.

4.10.3 Step 3: Conduction of a gap analysis

Step three of this roadmap focuses on conducting a gap analysis. First, the questionnaire, provided in Appendix C, will be distributed to the members of the hospital team. This questionnaire will help to evaluate which practices have been implemented successfully and what practices have not been applied and may require improvement. From this data, as well as from the documentation of best practices conducted in step 3, the gaps between the organization’s current practices and those recommended in this research can be identified. By contrasting the hospital teams' actions during the pandemic with the best practices described in this study, the hospital team can pinpoint areas that require improvement. Furthermore, the team members should be encouraged to categorize gaps based on their potential impact, ease of implementation, and required resources. These findings should be documented and serve as a basis for developing an action plan. Hospitals can pinpoint specific areas in which they need to modify or develop their procedures to better prepare for emergencies in the future by carefully reviewing the questionnaire responses related to each best practice. The information gathered from this gap analysis will serve as the basis for step 4 of the roadmap's action plan creation.

Continuing with the example of the best practice of “building a cross-functional task force”, the purchasers now go through the questions posed in the questionnaire. The questionnaire’s detailed questions concerning the implementation of cross-functional task forces will help the hospital determine if they had an effective task force in place during the pandemic and which areas of improvement are present. There are questions about the composition, communication, and overall effectiveness of the task force that may reveal that the healthcare organization had a well-rounded team, but had difficulties with communication among members. In this instance, the gap analysis would draw attention to the cross-functional task force's need for improved protocols or communication techniques.

4.10.4 Step 4: Development of an action plan

The fourth step of the roadmap involves creating a strategic action plan to bridge identified gaps and incorporate best practices into the emergency preparedness plan of the hospital. Here, the

establishment of clear objectives and goals for addressing prioritized gaps is required. Furthermore, necessary resources such as personnel, time, and funding need to be determined.

For example, if the gap analysis revealed that the hospital's task force struggled with effective communication during the pandemic, the action plan could have the objective of improving this communication by implementing regular team meetings and establishing clear communication protocols. Another objective could be to enhance collaboration and information sharing within the task force by utilizing collaboration platforms and tools to facilitate the exchange of information and updates. Furthermore, the hospital needs to determine the essential resources such as personnel, time, and funding. Here, the hospital may allocate a budget for the implementation of the collaboration tools or invest in training to enhance the task force members' communication skills.

4.10.5 Step 5: Engagement of stakeholders

Step five of the roadmap is focused on engaging stakeholders in the planning process to ensure a smooth implementation of the action plan. Here, relevant stakeholders need to be identified, including hospital management, staff, and suppliers. All parties involved in the planned practice adjustments must be informed of them and how they would improve the hospital's future preparedness for disasters. At this point, it is also important to incorporate feedback from stakeholders, answer questions, and listen to concerns. The hospital can encourage commitment among stakeholders and improve the effectiveness of the action plan's implementation by actively involving them in the planning process.

In the case of the cross-functional task force, the stakeholders may include hospital management, purchasing staff, and suppliers who were part of the task force during the pandemic. To address the communication gaps identified within the task force, it is crucial to inform these stakeholders about the planned improvements, such as implementing regular team meetings and using a collaboration tool. All stakeholders should be aware of how these adjustments will enhance the hospital's future preparedness for a healthcare emergency.

4.10.6 Step 6: Creation and implementation of new preparedness activities

Step six of the roadmap is centred on the creation and implementation of new preparedness activities. Here, necessary resources, such as personnel, time, and funding are allocated to support the employment of the new preparedness activities. The hospital provides relevant training for staff members to give them the crucial skills and knowledge to implement these new activities.

Establishing a communication channel to facilitate an effective exchange between involved stakeholders may also lead to a successful implementation of new preparedness activities.

In the case of the cross-functional task force, new activities might be developed to improve communication among members. Here, the assigned budget that was set earlier, could be used to purchase, or create a communication tool and staff members are appointed to oversee the implementation. A training program for members could cover topics such as effective communication techniques, a tutorial on using the new collaboration tool, and best practices for information sharing.

4.10.7 Step 7: Review and continuously improve preparedness activities

The focus of step seven in the roadmap is the continuous improvement of preparedness activities through regular review and feedback from stakeholders. It is crucial to assess the implemented disaster preparedness activities periodically to evaluate their effectiveness and identify areas for improvement. To gain diverse perspectives on the activities' performance and impact, the feedback of stakeholders such as management, staff, and suppliers is necessary. After analysing this feedback, the hospital can refine the existing preparedness activities and implement necessary adjustments or updates. To make sure the hospital's best practices and preparedness activities remain up-to-date and effective, the healthcare organization needs to stay informed of new developments and emerging trends in healthcare crisis management. By committing to a procedure of constant review, feedback, and improvement, the hospital can maintain a state of preparedness and adaptability.

Looking at the example of cross-functional task forces, this step involves assessing the implemented communication improvements and making essential adjustments over time. A key aspect is to periodically update the communication tools and channels to ensure they remain effective and efficient. This could involve adding new features or technologies that enhance information sharing within the task force, as well as evaluating the performance of the existing tools. Furthermore, as new staff members join the hospital or the task force, it is essential to provide them with the necessary training and education on effective communication practices and on how to use the communication tools. An overview of which actions to take using the example of the best practice "Building a cross-functional task force" can be seen in Table 12.

Step in the Roadmap	Example: Cross-functional task force
Step 1: Understanding the best practices presented in this research	Understand what a cross-functional task force is and recognize its benefits and importance in crisis management
Step 2: Assessment of practices implemented in the hospital	Asses the best practices the hospital used during the pandemic. A task force may or may not be one of the best practices the hospital implemented
Step 3: Conduction of a gap analysis	Answer the questions from the questionnaire, compare the answers with the best practices found in this study, and conduct a gap analysis. The outcome (example): a cross-functional task force was introduced, but there were weaknesses in the communication among members
Step 4: Development of an action plan	Set objectives to address communication gaps and allocate resources for improvements, such as a communication tool and training for task force members
Step 5: Engagement of stakeholders	Inform task force members and other stakeholders about the planned measures, such as the introduction of communication tools and training, and listen to their feedback and concerns
Step 6: Creation and implementation of new preparedness activities	Develop and introduce new communication tools and provide training for staff on effective communication
Step 7: Review and continuously improve preparedness activities	Periodically assess and update communication tools and practices, and educate new staff members

Table 12: Applying Roadmap Steps to Cross-Functional Task Forces

4.11 The role of the German government: critique and suggested solutions

The COVID-19 pandemic has highlighted the critical role that the German government played in supporting hospitals and other healthcare organizations during the crisis. While efforts helped to mitigate the spread of the disease and ease some of the strain on hospitals, these governmental efforts also presented unique challenges. During the pandemic, the German government was participating in purchasing activities for essential materials like PPE. However, these efforts were

perceived by purchasing personnel of hospitals as ineffective. “The purchasing actions the government took were very ineffective. Products only reached our hospital when we no longer needed them” (Purchaser E). Purchaser B agrees:

> The money used for purchasing these goods could have been invested differently. I believe that governmental purchasers react, act, and analyse in a less pragmatic and down-to-earth manner. We have enough capable people in the institution who can do the purchasing themselves and better. (Purchaser B)

Some purchasers even go as far as calling the purchasing of the German government a catastrophe (Purchaser N). An overview of all points of critique, as well as some suggestions for improvements can be found in Table 12.

4.11.1 Critique on the German government: 9 points of critique were found during the interviews

As the COVID-19 pandemic unfolded, various governmental measures have faced critique from stakeholders within the healthcare sector. Nine points of critique have been discovered during the interviews with purchasing professionals of German hospitals. These are: the government causing material shortages, the government causing higher prices, low-quality products, unclear communication, rapidly implemented regulations, the unusability of materials, slow implementation of digital infrastructure, closing specialized clinics and causing financial trouble, and unfulfilled commitment to support local production.

The first point of critique that came from purchasers is that the governmental purchases of PPE caused material shortages for hospitals, which made responding to the pandemic more difficult. “The government's procurement policy during the pandemic has led to a significant shortage of materials on the market” (Purchaser N). One of these materials was disinfectant. Purchaser G describes the situation as follows:

> The impact of the government's actions has been so severe that the hospitals were not able to get any supplies. We had extreme delivery difficulties due to the purchasing activities of the government. Disinfectants were one of the scarce products. The companies based here in Germany were forced to give their stored materials to the government and that is why we, as a hospital, had no material. (Purchaser G)

The second point of critique is that the government caused higher prices due to their purchases of PPE. At the onset of the pandemic, the purchasing efforts of the government contributed to increased competition and price fluctuation for essential materials. “I think that at the beginning of the pandemic, the government negatively impacted the market for materials. The government was another player who wanted to acquire materials, which increased demand and created competition. It drove prices up” (Purchaser I). Purchaser L agrees and states: “When the government demands material, the prices automatically go up. It has a cost-driving effect.”

Thirdly, the quality of the materials procured by the German government was low, rendering them unusable in many instances. “We once received masks from the government that were so faulty that we had to send them back” (Purchaser M). Purchaser D had a similar experience with materials purchased by the government: “The federal government bought protective items that had no certification as a medical device at all. Now, I have ten pallets of these masks in the warehouse. I cannot use them in the hospital” (Purchaser D).

Another point of dissatisfaction for purchasers was the unclear communication of the government. This led to confusion and uncertainty among hospitals trying to purchase materials during the crisis. Purchaser A elaborated:

> It was all very unclear what came from the ministry. For example, they wanted to provide us with materials such as cannulas and syringes for the vaccinations. However, all the information was so vague. It did not give us any advantage, so instead, we took care of purchasing the materials ourselves. (Purchaser A)

Rapidly implemented regulations also posed a challenge to hospitals. The short-term changes, the government put in place, hindered the hospitals` ability to effectively plan and adapt their operations in response to the evolving crisis. “This short-term nature of the legal situation and the changes in the law was a catastrophe for a hospital” (Purchaser K). One example is the introduction of mandatory COVID-19 tests for hospital staff. “I remember when the compulsory COVID testing was introduced on a large scale. This was announced overnight. Clinics then had to test every employee each day. Suddenly, all clinics had to acquire tests, which was not known beforehand” (Purchaser I).

Another consequence of these changing regulations was that hospitals were left with materials that could no longer be used in compliance with updated guidelines. This caused the unusability of already acquired materials and led to an additional strain on resources. Purchaser F explained:

> In the beginning, it was a back-and-forth with the masks. At one point, we were allowed to use masks with a valve, and fabric masks were also originally allowed. We then had to switch to FFP2, our employees were not allowed to wear masks with valves or fabric masks anymore, only FFP2 masks that are marked with a CE mark. Because the FFP2 mask requirement came, we were in a booming market where there was almost nothing left to buy. (Purchaser F)

Another critique point mentioned during the interviews was the slow establishment and implementation of digital infrastructure. “There were official digital platforms, where you could buy something. However, these platforms were only published after half a year. By the time we had access to them, the prices of our suppliers were better than those from the government” (Purchaser I).

Furthermore, a point of critique was the closure of specialized clinics. During the pandemic, these clinics were not allowed to accept new patients, and could, consequently, not generate any income. Since the normal overhead costs were still present, these clinics were financially struggling due to the closure, as explained by Purchaser I:

> The location was partially closed. Of course, this was positive in terms of the number of cases because there was no outbreak of COVID-19 here on site, neither among employees nor among patients. However, existential difficulties could be the result of the closure, and getting financial compensation from the government takes a very long time. (Purchaser I)

A recurrent point of criticism during the interviews related to the government's unfulfilled promise to support local production of essential materials. Despite the assurance of the government to prioritize domestic manufacturing, the lack of action leads to continuous reliance on foreign suppliers. Purchaser C mentioned:

> The government promised to support and respect local production. However, after the pandemic ended, they were not interested anymore. This would of course also be the case in the event of the next pandemic. A lot of hospitals are purchasing materials from China again, and local

suppliers had to give up. No one paid attention to local suppliers, they were not supported. In case of a new healthcare crisis, we would face the same situation again. (Purchaser C)

The text above reveals that purchasers of German hospitals have expressed nine distinct points of critique on the purchasing actions of the German government during the pandemic. By considering these nine points, it becomes clear that there is room for improvement in the purchasing strategy of the German government.

4.11.2 Suggestions for improvement for the German government

Given the likelihood of similar challenges arising in a future healthcare crisis, the government needs to learn from past experiences and address their shortcomings. By transforming the nine points of critique presented in this study into actionable recommendations, policymakers can work towards developing a more effective approach for future healthcare crisis management. The purchasers interviewed in this study also have some suggestions on what to improve on to have a better outcome during the next pandemic. The recommendations for improvement to the government encompass leveraging the expertise of purchasing professionals for short-term and long-term purchases, building clear and effective communication channels, building, maintaining, and regularly updating a digital infrastructure for material marketplaces, helping clinics financially in a timely manner, and supporting domestic production.

In order to prevent the German government from causing material shortages and higher prices, as well as purchasing low-quality products, the government should leverage the expertise of healthcare organizations purchasing professionals in the acquisition of crucial products. This method would ensure that critical supplies align with the specific needs and requirements of healthcare organizations and enable informed decision-making as well as quality assurance. “If you need materials urgently, the easiest way is to contact the people who have done the purchasing of medical products professionally for many decades, namely the hospitals themselves” (Purchaser N). Looking for a long-term solution, an important recommendation from purchasers involves the establishment of an emergency storage by the government. This centralized stockpile may help healthcare facilities gain accessibility to necessary materials rapidly during a crisis and further reduce the risk of widespread shortages. “The state could have a pandemic warehouse to really avoid a major disaster” (Purchaser I). Purchaser B adds: “Ultimately, measures need to be taken to create emergency reserve warehouses to make the appropriate pandemic resources available in advance. Buying during a disaster is always more expensive” (Purchaser B). A promising

development resulting from the pandemic is the growing dialog between hospitals and the government. The government is entrusting the responsibility of overseeing the stock of emergency materials to some hospitals. Purchaser D explained:

> We are now responsible for managing the emergency stock of our federal state, for materials such as PPE. This means that we received an order from the state some time ago that we would manage their stocks, which means replenishing what is used but also circulating what is in danger of going obsolete. (Purchaser D)

Purchaser N is similarly working with the government:

> We have received a letter regarding stockpiling for the federal government. It was requested that we stock up on material for the next pandemic and to include them in the standard portfolio. The government probably noticed that their stocks, some of which they had in some bunker, were either rotten, had expired, or were no longer the standard. That is probably why they are now trying to set up warehouses directly in the hospitals together with the clinics for such a pandemic. (Purchaser N)

Another key suggestion coming from purchasers is the need for improved communication and information exchange between the government and healthcare facilities. This enhancement would enable a more effective and coordinated response to the healthcare crises. “The forces must work together to make the disaster more controllable. A concept of effective information exchange is missing” (Purchaser L). Purchaser B adds: “Ultimately, leaner structures and leaner communication channels have to be built” (Purchaser B). By building clear and effective communication channels between healthcare organizations and the government, a better understanding and appropriate reaction can be ensured on both sides. This type of channel would also be helpful when it comes to regulations that need to be implemented rapidly. Open communication and active collaboration would be fostered and the purchasers would gain first-hand knowledge directly from the government, instead of being notified of changes through the media. The unusability of materials may also be reduced through this measure since the purchasers would be more aware of changes in regulations and could plan more efficiently with this information.

A point of critique was the slow implementation of digital infrastructure regarding a digital marketplace for necessary material. To prevent this during a future pandemic, the government could prioritize improving and further developing a platform that can be utilized during a future

healthcare crisis. Since a platform has already been built during the pandemic, the government could transform this platform into a powerful tool for facilitating efficient procurement and resource allocation. This platform should have a user-friendly interface and features and should be regularly updated, maintained, and improved.

Hospital purchasers also highlighted the importance of financial assistance from the government for clinics that were forced to close and experienced financial losses during the pandemic. This support would help alleviate the financial strain on struggling hospitals, and ensure that they can continue to provide healthcare services. Purchaser I mentioned:

> What helps is the support from public funds, especially when governmental regulations restrict the clinic from being able to maintain its operation. If the government refinanced 100% of additional costs the clinic had, the clinics would be protected from insolvency and can act much better. (Purchaser I)

Purchaser I also stated that "getting financial compensation from the government takes a very long time" (Purchaser I). Thus, streamlining the procedure for providing monetary assistance to financially troubled hospitals will prevent bankruptcy and guarantee that the hospitals' medical services remain accessible to the general public.

Another critique from purchasers presented above was, that local suppliers were not supported by the government, even though the government had promised this support beforehand. Consequently, a lot of suppliers went out of business at the end of the pandemic, and materials are sourced from China again. The government should assist local suppliers in remaining in business to avert a situation similar to the material scarcity that occurred during COVID-19 as a result of the reliance on Asian suppliers. Measures could include collaborating with domestic manufacturers and industry experts to come up with a detailed strategy to bolster local production capabilities. Included in this strategy could be partnerships with domestic manufacturers that foster innovation, as well as financial incentives and tax breaks.

Reflecting on the critique of governmental measures during the pandemic, if becomes evident that addressing these issues is crucial for fostering a more effective and supportive government response in a future healthcare crisis. A summary of all points of critique, as well as suggestions for improvement, can be found in Table 13.

Critique	Suggestions for improvement
Causing material shortages	Leverage the expertise of purchasing professionals for short-term and long-term purchases
Causing higher prices	
Low-quality products	
Unclear communication	Building clear and effective communication channels
Rapidly implemented regulations	
Unusability of materials	
Slow implementation of digital infrastructure	Building, maintaining, and regularly updating a digital infrastructure for material marketplaces
Closing specialized clinics and causing financial trouble	Helping clinics financially in a timely manner
Unfulfilled commitment to support local production	Supporting domestic production

Table 13: Critique and suggestions for improvements for the German government

5 Discussion and conclusion

In this chapter, the results of this study will be discussed and linked to the theoretical framework. Furthermore, the theoretical- as well as the practical contributions of this research will be explained. Limitations of this study are also discussed, as well as opportunities for future research.

5.1 Expanding the framework of barriers: three instead of two overarching categories of barriers to preparedness were found

The existing literature highlighted several barriers to hospital preparedness which were divided into two categories: physical and intangible barriers. Physical barriers described are significant investment costs, location specificity, and product obsolescence. Intangible barriers found in the literature are costs and obtaining the financial resources, as well as the lack of a standardized curriculum for disaster management competencies (Kunz et al., 2014, p. 262; Whybark, 2007, pp. 231-232). This study takes an organizational perspective on how hospitals can better prepare for a future pandemic. Furthermore, a study conducted in the chemistry sector uncovered six additional barriers to preparedness, which are: denial and failure to prioritize, lack of experience and full understanding of potential risks, inadequate systems, process and management discipline,

insufficient size and therefore available resources, the unwillingness or lack of opportunity for executives to share crisis experience, and failures of leadership and upward communication (Jaques, 2011, pp. 4-9). Due to the lack of studies documenting the barriers to preparedness that healthcare organizations face to developing preparedness for crisis situations, the barriers were partially extracted from literature on general disaster management, and partially from a study conducted in the chemical sector. The chemical sector is known to be more exposed to crises due to the potential damages and disasters. New barriers associated with the healthcare sector emerged from the data analysis of the interviews held with 15 purchasers of 11 German hospitals. New barriers to preparedness of the healthcare sector found through this research are possible unnecessary expenses, the unpredictability of the pandemic, the unpredictability of governmental actions, costs and reimbursement, unknown type of disaster and necessary material, small storage facilities, cost of storage, no local production, the medical device regulation, personnel shortage, high organizational efforts necessary, high costs, and knowledge loss.

The data obtained during the interviews of this study has provided a detailed understanding of the barriers to hospital preparedness. The interviews revealed three instead of two overarching categories of barriers to preparedness, with fourteen barriers in total. This has already been presented in Table 10 in the results section of this study. The first category is barriers to both physical and intangible preparedness activities. These barriers apply mutually to intangible and physical preparedness actions, rather than simply one or the other. Within this category, three distinct barriers were identified which are: possible unnecessary expenses, the unpredictability of the pandemic, and the unpredictability of governmental actions. The second category of barriers is barriers to physical preparedness activities. These are costs and reimbursement, unknown type of disaster and necessary material, product obsolescence, small storage facilities, cost of storage, no local production, and the medical device regulation. The third category is intangible barriers to preparedness activities. Here, four barriers were found, which are: personnel shortage, high organizational efforts necessary, high costs, and knowledge loss.

5.2 Comparing literature and research findings: shared barriers are costs and product obsolescence

In comparing the existing literature with the findings of this study, it was found that two similar barriers emerge. These are costs and product obsolescence.

The existing literature and the data revealed during the interviews had some overlapping barriers to hospital preparedness. A recurring factor is a constraint posed by the costs of preparation, which emphasizes the financial burden that is associated with preparedness activities. The literature presents various cost-related barriers, such as costs for obtaining materials (Kunz et al., 2014), and costs for intangible activities such as establishing disaster management capacities (Van Wassenhove, 2006, p. 482). In connection to this also stands the insufficient organizational size and the unavailability of funds (Jaques, 2011, pp. 4-9). Similarly, the interviews revealed cost-related barriers to preparedness. Here, these barriers were present in all three categories. Possible unnecessary expenses (barrier to both physical and intangible preparation measures), cost of materials in connection to the notion that the hospital might not get reimbursed by the health insurance companies (barrier to physical preparation measures), and high costs for educational measures such as workshops (barrier to intangible preparation measures) appeared during the interviews. From the literature as well as from the interviews we can conclude that the financial implications of preparedness activities pose a considerable obstacle to healthcare organizations.

Product obsolescence is a barrier to physical preparedness activities that emerges in both the literature as well as in the interviews. The literature draws attention to product obsolescence as a possible side effect of pre-positioning inventory. Since stored materials eventually expire, they become useless in an emergency (Whybark, 2007, p. 482). In the interviews, product obsolescence was explicitly named as a barrier to physical preparedness activities. According to both the literature and the interviews, healthcare organizations must carefully balance between stockpiling necessary materials and ensuring that those supplies remain functional and effective.

5.3 Uncovering novel barriers to preparedness: the study found eleven barriers to preparedness that are new to literature

While the interviews revealed similar barriers to the ones that were named in existing literature, the interviews also exposed some novel barriers that were not previously discovered. These novel barriers are the unpredictability of the pandemic, the unpredictability of governmental actions, cost and reimbursement, the unknown type of disaster and necessary materials, no local production, small storage location, cost of storage, Medical Device Regulation (MDR), personnel shortage, knowledge loss, and high organizational efforts necessary.

The unpredictability of the pandemic emerged as a significant barrier to both physical and intangible preparation measures. Almost all purchasers stated that the unprecedented scale and the

rapid spread of the global outbreak caught them by surprise. Since previous healthcare crises have not exhibited the same level of global reach, this barrier may not have appeared in previous literature. The unexpected nature of the pandemic and its swift progression created substantial challenges for healthcare organizations. The newfound understanding of the role of unpredictability in hindering preparedness efforts offers valuable insights into the challenges during COVID-19, which is a contribution to literature.

Another factor that has not been discussed in literature is the barrier of the unpredictability of governmental actions, which belongs to the category of both physical and intangible barriers. The interviews brought to light the crucial role that decisions about policies had on the healthcare landscape, and that they often introduced challenges to hospitals. This external influence necessitated the adaptability of hospitals, as regulations changed during the public health crisis. The COVID-19 pandemic presented governments with unprecedented challenges, forcing them to rapidly introduce new policies to address the evolving healthcare crisis. Previously, this barrier has not been discussed in literature. This may be due to the fact that no other recent public healthcare crisis has required such extensive and fast-evolving government intervention. Thus, this barrier is a contribution to the existing body of knowledge.

As discussed earlier, cost is a factor that appears in both literature and during the interviews. However, a specific barrier to physical preparedness activities related to costs that appeared during the interviews was the reimbursement system of hospitals in connection to health insurance companies. German hospitals face unique challenges since their operating costs are primarily financed by health insurance companies. This structure can create difficulties in obtaining funds for stockpiling emergency supplies or investing in staff training, since these activities may not be reimbursed by health insurance companies (Bundesministerium für Gesundheit, 2024). The challenges of cost and reimbursement as a barrier to physical preparedness activities have likely not been presented in previous literature, since it is specific to the German healthcare system. It is, therefore, a contribution to research on hospital preparedness.

Another barrier to physical preparedness activities, that was not mentioned in literature, was that nobody knows what kind of materials will be necessary for a future healthcare crisis. It can be difficult for healthcare organizations to prepare for all possible scenarios and diseases and store various types of materials. This factor has not appeared in previous literature, and a possible explanation could be the focus of this literature on smaller-scale outbreaks or natural disasters such

as the study conducted by (Kunz et al., 2014). This barrier is, therefore, a valuable addition to the research.

As mentioned earlier, the literature suggests that the Just-in-Time business model is popular in the healthcare industry. This business model urges organizations to decrease inventory as much as possible to reduce costs, as well as the amount of money that is held in inventory (Gereffi, 2020, p. 295). Many healthcare organizations have adopted these Just-in-Time purchases of supplies such as PPE, making them reliant on materials from around the world (Handfield et al., 2020, p. 168; Whalen et al., 2020). During COVID-19, however, conducting this practice was not possible anymore, since supply chains were disrupted. The circumstance that there is no local production of personal protective equipment is seen as a barrier to physical preparedness of hospitals. This lack of local production leaves healthcare organizations heavily dependent on imports, especially from Asia. The absence of local production of PPE and heavy reliance on distant suppliers create a precarious situation for healthcare organizations adhering to the JIT model. As mentioned during the interviews, the demand for PPE surged during the pandemic, and hospitals faced extended delivery times and supply shortages due to their dependence on Asian manufacturers. There are two more barriers to physical preparedness for hospitals in connection to the Just-in-Time method: small storage facilities at the hospitals, as well as the associated cost of additional storage. As hospitals use the JIT model and operate with minimal inventory, they often do not allocate substantial space for storage facilities. This lack of storage space becomes a barrier when hospitals need to stockpile supplies in preparation for emergencies. Expanding or creating storage facilities necessitates storing materials in preparation for a healthcare crisis requires a financial investment. This can pose a financial challenge to hospitals. The vulnerability of the JIT model suggested to hospitals was exposed during the pandemic, particularly regarding the ability of hospitals to maintain adequate stockpiles of necessary supplies. The literature has not previously considered these barriers, which stresses the importance of this study's findings in broadening the understanding of the barriers to hospital preparedness.

The European Union Medical Device Regulation was also seen as a barrier to physical preparedness by the interviewees. The regulation was introduced in 2021 and is, therefore, relatively new. This barrier may not have been discussed in literature in connection to disaster preparedness, because its impact is still to be assessed. As previous literature has not acknowledged

this barrier, the inclusion in this study expands the understanding of challenges in hospital preparedness.

Two barriers to intangible preparedness are personnel shortage and knowledge loss. Personnel shortage significantly impacts the capacity of purchasing staff to dedicate time and resources to disaster preparation activities. Since day-to-day tasks and responsibilities often consume the already limited personnel resources, there is little time left for undertaking further responsibilities related to disaster preparation. Knowledge loss is another barrier connected to staff at a healthcare organization. This issue arises when experienced purchasers who possess important knowledge about best practices, suppliers, and procurement procedures leave the organization without properly documenting information to colleagues. This loss of knowledge can hinder organizations to navigate future disasters. The unique challenges posed by the COVID-19 pandemic have likely amplified the impact of personnel shortage and knowledge loss on hospital preparedness. This focus on the COVID-19 pandemic may be the reason why these barriers have not been debated in former literature, since previous disasters may not have created such significant human resource challenges in the context of hospital preparedness. While these two barriers have not been discussed in research, the interviews conducted in this study highlight their importance in the context of hospital preparedness. Therefore, they are an addition to literature.

Another intangible barrier identified during the interviews is the high organizational effort that is required for disaster preparation. This barrier is closely related to the barrier of high costs for such preparation activities, including training workshops, as well as coordination efforts among stakeholders. While high costs are mentioned in literature, the barrier of high organizational efforts was found during the interviews of this study and is an addition to literature. The absence of the high organizational effort barrier in existing literature may be attributed to the circumstance, that earlier research was primarily focused on the financial costs associated with preparedness activities, such as in the study conducted by (Van Wassenhove, 2006). Although the financial component is undoubtedly important, the interviews for this study have brought to light the importance of the larger organizational resources required for healthcare crisis management.

5.4 Best Practices: Research supports the mixed method approach and discovers 24 best practices

As suggested by literature, there are two types of disaster preparedness activities, namely physical and intangible activities. Physical activities include expenditures on material resources, such as the

development of infrastructure and stockpiling of various types of materials. Intangible activities include investments in disaster management capabilities (Kunz et al., 2014, p. 262). Five eras of disaster management competencies were suggested by previous research, namely: human resources, knowledge management, operations- and process management, financial resources, and community. These five components must all interact for greater disaster preparation (Van Wassenhove, 2006, pp. 481-482).

Building upon the knowledge gained from literature about physical and intangible disaster preparedness activities, the interviews conducted with purchasing professionals provided valuable insight into best practices they utilized during the COVID-19 pandemic. From these interviews, 24 best practices were identified, which correspond with both physical activities mentioned by (Kunz et al., 2014), and the five disaster management competencies proposed by (Van Wassenhove, 2006). The category that contains physical activities is storage. Here, three best practices were found, namely: having own storage facility, increasing storage range, and attaining additional storage space. Three best practices belong to the intangible category human resources, which are: have a person responsible for pandemic preparations, preparation workshops, and all purchasing employees can do all purchasing activities. Knowledge management is the second category of intangible activities. Here, the best practices found during the interviews are: having an emergency plan and having an emergency material checklist. Operations-and process management is the intangible preparedness category, where nine best practices can be sorted into. Having alternative suppliers, fostering supplier relationships, having local suppliers, being fast in the purchasing process, being flexible, approval of all purchasing channels, buy what you need, but also think of others, suppliers regulated distribution of needed materials, and continues ordering from suppliers are the best practices of this category. The fourth category of intangible activities is financial resources. From the interviews, it was found that investment-stop for pandemic unrelated-goods, and personnel reduction to reduce costs can be attributed to this category. Lastly, community is the fifth category of intangible activities. The best practices that belong to this category are framework agreements, communication among GPO members, communication among hospitals, having a network, and building a cross-functional task force.

The identification of the 24 best practices, corresponding with the physical and intangible activities highlighted by (Kunz et al., 2014), and the disaster management competencies introduced by (Van Wassenhove, 2006), present a contribution to literature on disaster preparedness. This research

extends the previous literature by specifically examining the unique challenges the global pandemic provided, which differs significantly in scope, spillover, and shifts compared to other disruptive risks, as suggested by (Craighead et al., 2020, pp. 839-840). The findings of this study address the gap in the literature and offer real-life life examples of best practices implemented by hospitals during a global healthcare crisis.

Regarding best practices to prepare for a pandemic, the literature suggested that combining pre-positioning inventory with purchasing disaster management competencies would lead to superior outcomes (Kunz et al., 2014, pp. 267-269). As discovered during the interviews, purchasers agree that this mixed method of disaster preparation is the best method to follow. Therefore, the findings of this study corroborate the existing literature as both emphasize the importance of the mixed method approach. This alignment strengthens the notion that the combination of proactively stockpiling and implementing disaster management capabilities can lead to improved outcomes during a public healthcare crisis.

5.5 Practical Contributions: A roadmap and questionnaire for implementing best practices, highlighting critique, and offering solutions to the government

A practical contribution of this research is the development of a roadmap that is designed to guide hospitals to enhance their preparedness for a future healthcare crisis, as seen in the results part of this study. The roadmap is based on the best practices discovered in this study and was developed by using the questionnaire provided in this research. This questionnaire can be found in Appendix C. Healthcare institutions can use this questionnaire and roadmap as a valuable tool to help them navigate future healthcare crises and develop a detailed emergency plan.

This study also presents some critiques of the actions and policies of the government during the pandemic. By highlighting this critique, the study draws attention to areas where governmental actions may have fallen short and created challenges for hospitals instead of assistance. This critique further enables policymakers to recognize areas that need to be improved upon in the future and develop targeted solutions. Furthermore, some suggestions for improvement are provided to assist the government in preparing for a future healthcare crisis, as seen in Table 12 in the results part of this study. The critique of the government in connection with the suggested solutions is also a practical contribution of this research.

5.6 Conclusion

The main objective of this research was to identify barriers to preparedness as well as find the best practices used by hospital purchasers during the pandemic. Two research questions guided this study: (1) What are the main barriers to developing preparedness plans to address supply disruptions faced by hospitals? (2) What are the best practices learned by hospitals during the COVID-19 pandemic in order to prepare for future supply disruptions?

The comprehensive analysis of the interviews, held with 11 purchasers of 15 German hospitals has uncovered multiple barriers to preparedness and best practices in hospital procurement during the COVID-19 pandemic. Among the barriers, the unpredictability of the pandemic, small storage facilities, product obsolescence, and costs and reimbursement were the barriers that have emerged as the most critical ones. Regarding the best practices, building a cross-functional task force, encouraging communication among GPO members, and having an emergency plan prior to the pandemic were identified as the most important strategies to conduct purchasing during the healthcare crisis.

Furthermore, this research has ramifications that go beyond identifying the barriers to preparedness and best practices. The study provides the procurement department of hospitals with a practical roadmap in combination with a questionnaire, that serves as a comprehensive guide to improve the preparedness of the hospitals for a future healthcare crisis. These resources provide hospitals with a methodical framework and self-evaluation tool to analyse and contrast their purchasing strategies during the pandemic with the findings of this research. Additionally, this study offers practical recommendations for the German government to improve its support for healthcare organizations in case of future healthcare crises. These recommendations include leveraging purchasing professionals' expertise, improving communication between healthcare organizations and the government, developing and maintaining a digital infrastructure, providing quick financial assistance to struggling hospitals, and supporting domestic production of protective gear.

In conclusion, this study highlights the importance of strategic approaches to hospital preparedness. Hospitals can better manage resources as well as strengthen their resilience to future healthcare crises by prioritizing the most critical best practices and taking into account the most interfering barriers to preparedness. The knowledge gained from this research, in combination with the roadmap for hospitals and the recommendations for governmental support during a crisis, support the continuous efforts to improve the purchasing of healthcare institutions.

5.7 Limitations

A limitation of the study is the restricted geographic scope. The interviews were conducted with 15 purchasers, working at 11 German hospitals. The findings of this study may not apply to other countries with different healthcare systems, policies, and cultural contexts. Furthermore, the study includes a higher number of private- and non-profit hospitals compared to public hospitals. This may limit the applicability of the findings to public hospitals, which often have different organizational structures, financial resources, and operational practices compared to non-profit and private hospitals. In addition, most hospitals whose purchasers took part in the interviews belonged to group purchasing organizations. Only two hospitals did not belong to a GPO. Due to the dominance of GPO member hospitals in this study, there may be an overemphasis on barriers and best practices unique to these hospitals, possibly at the expense of other strategies that would be more applicable to non-member hospitals. Another limitation is that barriers to preparedness and best practices identified in this study specifically emerged in the context of the COVID-19 pandemic. This could lead to a limited generalizability to a non-pandemic context. During other types of disasters, needs and challenges could be different.

5.8 Future research

Building a cross-functional task force was the best practice that was mentioned most often by purchasers. This study identified this best practice; however, it did not go into depth about the factors that make this task force successful. Future research could identify and analyse key components and characteristics of cross-functional task forces in hospital settings. It can further focus on the impact of these task forces on communication, emergency planning, and resource allocation. In connection to this, it could be investigated how factors like leadership, organizational support, and team dynamics influence the effectiveness of cross-functional task forces.

Having an emergency plan was discovered to be a best practice during the pandemic. However, hospitals may require assistance in developing this plan. Future research could focus on examining the role of public organizations in supporting hospital preparedness. These organizations could include government agencies, hospital associations, public health institutions, and other relevant entities.

Another category of best practices is community. As found during the interviews, communication among members of a group purchasing organization and hospitals in general were best practices. Future research could focus on identifying and analysing collaborative networks among hospitals

and other healthcare institutions, and further assess the benefits and challenges in the context of hospital preparedness. The study could also examine what factors influence the effectiveness of these networks in enhancing hospital preparedness, such as resource- and information-sharing, communication, and trust.

Having local suppliers was mentioned as a best practice during the interviews. Future studies could focus on the establishment and strengthening of local supply chains and the role, the government can play in this. Here, the researcher could identify critical resources that can be sourced locally and are essential for hospitals to mitigate global supply chain disruptions. The study could further explore potential strategies and interventions that the government can implement to support the development and maintenance of these local supply chains.

6 References

Andrade, C. (2018). Internal, external, and ecological validity in research design, conduct, and evaluation. *Indian journal of psychological medicine*, *40*(5), 498-499.

Aubrecht, P., Essink, J., Kovac, M., & Vandenberghe, A.-S. (2020). Centralized and decentralized responses to COVID-19 in federal systems: US and EU comparisons. *Available at SSRN 3584182*.

Bannwarth, R. (2021). EINKAUF UND LOGISTIK: EINKAUF UND LOGISTIK ZU PANDEMIEZEITEN. Retrieved from https://daskrankenhaus.de/thema/detail/einkauf-und-logistik-einkauf-und-logistik-zu-pandemiezeiten/

Bao, G., Liao, Z., & Hine, D. (2019). Managerial cognition, emergency preparedness and firm's emergency response performance. *Journal of Risk Research*, *22*(12), 1490-1502.

Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The qualitative report*, *13*(4), 544-559.

Bogataj, D., & Bogataj, M. (2007). Measuring the supply chain risk and vulnerability in frequency space. *International Journal of Production Economics*, *108*(1-2), 291-301.

Boseley, S. (2020). WHO warns of global shortage of face masks and protective suits. Retrieved from https://www.theguardian.com/world/2020/feb/07/who-warns-global-shortage-face-masks-protective-suits-coronavirus

Bundesministerium für Gesundheit. (2024). Krankenhausfinanzierung. Retrieved from https://www.bundesgesundheitsministerium.de/krankenhausfinanzierung

Burki, T. (2020). Global shortage of personal protective equipment. *The Lancet Infectious Diseases*, *20*(7), 785-786.

Cambridge Dictionary. (Ed.) (2024).

Cambridge Dictionary. (N/A). prepared. Retrieved from https://dictionary.cambridge.org/dictionary/english/prepared

Carroll, W., Strenger, V., Eber, E., Porcaro, F., Cutrera, R., Fitzgerald, D., & Balfour-Lynn, I. (2020). European and United Kingdom COVID-19 pandemic experience: the same but different. *Paediatric respiratory reviews*, *35*, 50-56.

Chopra, S., & Meindl, P. (2001). Strategy, planning, and operation. *Supply Chain Management*, 13-17.

Chopra, S., & Sodhi, M. (2004). Supply-chain breakdown. *MIT Sloan management review*, *46*(1), 53-61.

Chowdhury, P., Paul, S. K., Kaisar, S., & Moktadir, M. A. (2021). COVID-19 pandemic related supply chain studies: A systematic review. *Transportation Research Part E: Logistics and Transportation Review*, *148*, 102271.

Christopher, M. (2016). *Logistics & supply chain management*: Pearson Uk.

Cohen, J., & van der Meulen Rodgers, Y. (2020). Contributing factors to personal protective equipment shortages during the COVID-19 pandemic. *Preventive medicine*, *141*, 106263.

Collins. (2022). barrier. Retrieved from https://www.collinsdictionary.com/de/worterbuch/englisch/barrier

Craighead, C. W., Ketchen Jr, D. J., & Darby, J. L. (2020). Pandemics and supply chain management research: Toward a theoretical toolbox. *Decision Sciences*, *51*(4), 838-866.

Cranmer, H., Chan, J. L., Kayden, S., Musani, A., Gasquet, P. E., Walker, P., . . . Johnson, K. (2014). Development of an evaluation framework suitable for assessing humanitarian workforce competencies during crisis simulation exercises. *Prehospital and disaster medicine*, *29*(1), 69-74.

Dai, T., Bai, G., & Anderson, G. F. (2020). PPE supply chain needs data transparency and stress testing. *Journal of general internal medicine, 35*(9), 2748-2749.
Dai, T., Zaman, M. H., Padula, W., & Davidson, P. M. (2020). Supply chain failures amid Covid-19 signal a new pillar for global health preparedness. *Journal of clinical nursing*.
Dasaklis, T. K., Pappis, C. P., & Rachaniotis, N. P. (2012). Epidemics control and logistics operations: A review. *International Journal of Production Economics, 139*(2), 393-410.
DeCuir-Gunby, J. T., Marshall, P. L., & McCulloch, A. W. (2011). Developing and using a codebook for the analysis of interview data: An example from a professional development research project. *Field methods, 23*(2), 136-155.
DeJonckheere, M., & Vaughn, L. M. (2019). Semistructured interviewing in primary care research: a balance of relationship and rigour. *Family medicine and community health, 7*(2).
DeWit, A., Shaw, R., & Djalante, R. (2020). An integrated approach to sustainable development, National Resilience, and COVID-19 responses: The case of Japan. *International Journal of Disaster Risk Reduction, 51*, 101808.
Diehl, D., & Spinler, S. (2013). Defining a common ground for supply chain risk management–A case study in the fast-moving consumer goods industry. *International Journal of Logistics Research and Applications, 16*(4), 311-327.
Dostal, J. M. (2020). Governing under pressure: German policy making during the coronavirus crisis. *The Political Quarterly, 91*(3), 542-552.
Duong, A. T. B., Vo, V. X., Carvalho, M. D. S., Sampaio, P., & Truong, H. Q. (2022). Risks and supply chain performance: globalization and COVID-19 perspectives. *International Journal of Productivity and Performance Management*.
Ellis, S. C., Henry, R. M., & Shockley, J. (2010). Buyer perceptions of supply disruption risk: A behavioral view and empirical assessment. *Journal of Operations Management, 28*(1), 34-46.
Farrell, D. (2004). Beyond offshoring. *Harvard business review, 82*(12), 82-90.
Focus online. (2022). Bund will 800 Millionen Masken „thermisch verwerten". Retrieved from https://www.focus.de/politik/deutschland/haltbarkeit-abgelaufen-bund-will-800-millionen-masken-verbrennen_id_160866509.html
Fugate, B., Sahin, F., & Mentzer, J. T. (2006). Supply chain management coordination mechanisms. *Journal of Business logistics, 27*(2), 129-161.
Gereffi, G. (2020). What does the COVID-19 pandemic teach us about global value chains? The case of medical supplies. *Journal of International Business Policy, 3*(3), 287-301.
Gopinath, G. (2020). The Great Lockdown: Worst Economic Downturn Since the Great Depression. Retrieved from https://blogs.imf.org/2020/04/14/the-great-lockdown-worst-economic-downturn-since-the-great-depression/
Gurtu, A., Johny, J., & Buechse, O. (2022). Paper and packaging industry dynamics during COVID-19 and their strategies for the future. *Strategic Management*.
Hallikas, J., Puumalainen, K., Vesterinen, T., & Virolainen, V.-M. (2005). Risk-based classification of supplier relationships. *Journal of purchasing and supply management, 11*(2-3), 72-82.
Handfield, R., Finkenstadt, D. J., Schneller, E. S., Godfrey, A. B., & Guinto, P. (2020). A commons for a supply chain in the post-COVID-19 era: the case for a reformed strategic national stockpile. *The Milbank Quarterly, 98*(4), 1058-1090.
Hattke, F., & Martin, H. (2020). Collective action during the Covid-19 pandemic: The case of Germany's fragmented authority. *Administrative Theory & Praxis, 42*(4), 614-632.

Hendrickson, J. R. (2020). The Coronavirus and Lessons for Preparedness. *Special Edition Policy Brief*.
Hertelendy, A. J., Tochkin, J., Richmond, J., & Ciottone, G. R. (2021). Preparing for the next COVID-19 wave in Canada: managing the crisis facing emergency management leaders in healthcare organisations. *BMJ Leader*.
Hick, J. L., & Biddinger, P. D. (2020). Novel coronavirus and old lessons—preparing the health system for the pandemic. *New England Journal of Medicine, 382*(20), e55.
Ho, W., Zheng, T., Yildiz, H., & Talluri, S. (2015). Supply chain risk management: a literature review. *International Journal of Production Research, 53*(16), 5031-5069.
Ivanov, D. (2020). Predicting the impacts of epidemic outbreaks on global supply chains: A simulation-based analysis on the coronavirus outbreak (COVID-19/SARS-CoV-2) case. *Transportation Research Part E: Logistics and Transportation Review, 136*, 101922.
Ivanov, D., & Dolgui, A. (2020). Viability of intertwined supply networks: extending the supply chain resilience angles towards survivability. A position paper motivated by COVID-19 outbreak. *International Journal of Production Research, 58*(10), 2904-2915.
Iyengar, K. P., Vaishya, R., Bahl, S., & Vaish, A. (2020). Impact of the coronavirus pandemic on the supply chain in healthcare. *British Journal of Healthcare Management, 26*(6), 1-4.
Jaques, T. (2011). Barriers to effective crisis preparedness: CEOs assess the challenges. *Asia Pacific Public Relations Journal, 12*(2).
June-Ho Kim, J. A.-R. A., SeungJu Jackie Oh, Juhwan Oh, Jong-Koo Lee (2021). Emerging COVID-19 success story: South Korea learned the lessons of MERS. Retrieved from https://ourworldindata.org/covid-exemplar-south-korea
Jüttner, U., Peck, H., & Christopher, M. (2003). Supply chain risk management: outlining an agenda for future research. *International Journal of Logistics: research and applications, 6*(4), 197-210.
Kaae, S., & Traulsen, J. M. (2020). Qualitative methods in pharmacy practice research. In *Pharmacy practice research methods* (pp. 31-54): Springer.
Kampf, L., Grill, M., Henze, A., Wellmann, G., Flade, F., & Baars, C. (2020). Geschäft mit Schutzkleidung-"Jeder versucht, sich zu bereichern". Retrieved from https://www.tagesschau.de/investigativ/ndr-wdr/masken-coronavirus-101.html
Kandel, N., Chungong, S., Omaar, A., & Xing, J. (2020). Health security capacities in the context of COVID-19 outbreak: an analysis of International Health Regulations annual report data from 182 countries. *The Lancet, 395*(10229), 1047-1053.
Kang, J., Jang, Y. Y., Kim, J., Han, S.-H., Lee, K. R., Kim, M., & Eom, J. S. (2020). South Korea's responses to stop the COVID-19 pandemic. *American Journal of Infection Control, 48*(9), 1080-1086.
Kappler, S., Wiesner, L., & Davis, S. (2024). Pandemic preparedness and response. In *Ciottone's Disaster Medicine* (pp. 36-42): Elsevier.
Kohlscheen, E., Mojon, B., & Rees, D. (2020). The macroeconomic spillover effects of the pandemic on the global economy. *Available at SSRN 3569554*.
Köppen, J., Hartl, K., & Maier, C. B. (2021). Health workforce response to Covid-19: What pandemic preparedness planning and action at the federal and state levels in Germany? Germany's health workforce responses to Covid-19. *The International journal of health planning and management, 36*(S1), 71-91.
Kunz, N., Reiner, G., & Gold, S. (2014). Investing in disaster management capabilities versus pre-positioning inventory: A new approach to disaster preparedness. *International Journal of Production Economics, 157*, 261-272. doi:10.1016/j.ijpe.2013.11.002

Lavassani, K. M., Iyengar, R., & Movahedi, B. (2022). Multi-tier analysis of the medical equipment supply chain network: empirical analysis and simulation of a major rupture. *Benchmarking: An International Journal*.

Lepelletier, D., Grandbastien, B., Romano-Bertrand, S., Aho, S., Chidiac, C., Géhanno, J.-F., & Chauvin, F. (2020). What face mask for what use in the context of the COVID-19 pandemic? The French guidelines. *Journal of Hospital Infection, 105*(3), 414-418.

Linneberg, M. S., & Korsgaard, S. (2019). Coding qualitative data: A synthesis guiding the novice. *Qualitative research journal, 19*(3), 259-270.

Listou, T. (2018). Samhandling, Preparedness and Supply Chains. In *Interaction:'Samhandling'Under Risk*: Cappelen Damm Akademisk/NOASP (Nordic Open Access Scholarly Publishing).

Longhurst, R. (2003). Semi-structured interviews and focus groups. *Key methods in geography, 3*(2), 143-156.

Manuj, I., & Mentzer, J. T. (2008). Global supply chain risk management. *Journal of Business logistics, 29*(1), 133-155.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*: sage.

Mojtahedzadeh, N., Wirth, T., Nienhaus, A., Harth, V., & Mache, S. (2021). Job demands, resources and strains of outpatient caregivers during the COVID-19 pandemic in Germany: A qualitative study. *International Journal of Environmental Research and Public Health, 18*(7), 3684.

Naguib, M. M., Ellström, P., Järhult, J. D., Lundkvist, Å., & Olsen, B. (2020). Towards pandemic preparedness beyond COVID-19. *The Lancet Microbe, 1*(5), e185-e186.

National Academies of Sciences, E., & Medicine. (2018). Impact of the Global Medical Supply Chain on SNS Operations and Communications: Proceedings of a Workshop.

Nojang, E. N., & Jensen, J. (2020). Conceptualizing individual and household disaster preparedness: the perspective from Cameroon. *International Journal of Disaster Risk Science, 11*, 333-346.

O'Keeffe, J., Buytaert, W., Mijic, A., Brozović, N., & Sinha, R. (2016). The use of semi-structured interviews for the characterisation of farmer irrigation practices. *Hydrology and Earth System Sciences, 20*(5), 1911-1924.

OECD. (2018). Assessing Global Progress in the Governance of Critical Risks. *OECD Reviews of Risk Management Policies, OECD Publishing Paris*.

OECD. (2020a). The Face Mask Global Value Chain in the COVID-19 Outbreak: Evidence and Policy Lessons. Retrieved from https://read.oecd-ilibrary.org/view/?ref=132_132616-l4i0j8ci1q&title=The-Face-Mask-Global-Value-Chain-in-the-COVID-19-Outbreak-Evidence-and-Policy-Lessons

OECD. (2020b). Public procurement and infrastructure governance: Initial policy responses to the coronavirus (Covid-19) crisis. doi:https://doi.org/10.1787/c0ab0a96-en

OECD. (2021). Government at a Glance 2021. *OECD Publishing, Paris*. doi:https://doi.org/10.1787/1c258f55-en

Oppenheim, B., Gallivan, M., Madhav, N. K., Brown, N., Serhiyenko, V., Wolfe, N. D., & Ayscue, P. (2019). Assessing global preparedness for the next pandemic: development and application of an Epidemic Preparedness Index. *BMJ global health, 4*(1), e001157.

Orlando, B., Tortora, D., Pezzi, A., & Bitbol-Saba, N. (2022). The disruption of the international supply chain: Firm resilience and knowledge preparedness to tackle the COVID-19 outbreak. *Journal of International Management, 28*(1), 100876.

Petersen, L. (2020). Internes Papier: VW, Lufthansa & Co. sollen für Bundesregierung Schutzmasken besorgen und nach Deutschland schaffen. Retrieved from https://www.businessinsider.de/politik/deutschland/internes-papier-vw-lufthansa-co-sollen-fuer-bundesregierung-schutzmasken-besorgen-und-nach-deutschland-schaffen/

Ponomarov, S. Y., & Holcomb, M. C. (2009). Understanding the concept of supply chain resilience. *The international journal of logistics management*.

Queirós, A., Faria, D., & Almeida, F. (2017). Strengths and limitations of qualitative and quantitative research methods. *European journal of education studies*.

Reichenbach, G. (2011). *Risiken und Herausforderungen für die öffentliche Sicherheit in Deutschland: Szenarien und Leitfragen; Grünbuch des Zukunftsforums Öffenlichte Sicherheit*: ProPress-Verlag-Ges.

reimbursment.institute. (2023). Krankenhausträger. Retrieved from https://reimbursement.institute/glossar/krankenhaustraeger/#

Rinke, A. (2020). Kampf um Beatmungsgeräte, Impfstoff - Corona lässt Nationalismus sprießen. Retrieved from https://www.reuters.com/article/virus-ressourcen-idDEKBN21319K

Robert Koch Institut. (2020). Ergänzung zum Nationalen Pandemieplan – COVID-19 – neuartige Coronaviruserkrankung Retrieved 15.05.2022 https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirus/Ergaenzung_Pandemieplan_Covid.html

Rose, J., & Johnson, C. W. (2020). Contextualizing reliability and validity in qualitative research: toward more rigorous and trustworthy qualitative social science in leisure research. *Journal of Leisure Research, 51*(4), 432-451.

Rosenthal, M. (2016). Qualitative research methods: Why, when, and how to conduct interviews and focus groups in pharmacy research. *Currents in pharmacy teaching and learning, 8*(4), 509-516.

Schmidt, C. (2004). The analysis of semi-structured interviews. *A companion to qualitative research, 253*(258), 7619-7374.

Schmidt, G., & Wilhelm, W. E. (2000). Strategic, tactical and operational decisions in multi-national logistics networks: a review and discussion of modelling issues. *International Journal of Production Research, 38*(7), 1501-1523.

Schnabel, J., & Hegele, Y. (2021). Explaining intergovernmental coordination during the COVID-19 pandemic: Responses in Australia, Canada, Germany, and Switzerland. *Publius: The Journal of Federalism, 51*(4), 537-569.

Schoenherr, T., Tummala, V. R., & Harrison, T. P. (2008). Assessing supply chain risks with the analytic hierarchy process: Providing decision support for the offshoring decision by a US manufacturing company. *Journal of purchasing and supply management, 14*(2), 100-111.

Statistisches Bundesamt. (2022). Krankenhäuser: Einrichtungen, Betten und Patientenbewegung. Retrieved from https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Gesundheit/Krankenhaeuser/Tabellen/gd-krankenhaeuser-jahre.html

STC. (2016). Worin unterscheiden sich Krankenhäuser? Retrieved from https://www.stc-makler.de/blog/privat/kranken-pflege/krankenhaeuser/

Steinmann, T. (2022). Masken-Lieferanten fordern 425 Mio. Euro vom Bund. Retrieved from https://www.capital.de/wirtschaft-politik/politik/masken-lieferanten-fordern-425-mio--euro-vom-bund-31638362.html

Strauss, A. L. (1987). *Qualitative analysis for social scientists*: Cambridge university press.

Tang, C. S. (2006). Perspectives in supply chain risk management. *International Journal of Production Economics, 103*(2), 451-488.

Tõnurist, P., & Hanson, A. (2020). Anticipatory innovation governance. doi:doi:https://doi.org/10.1787/cce14d80-en

Torabi, S., Baghersad, M., & Mansouri, S. (2015). Resilient supplier selection and order allocation under operational and disruption risks. *Transportation Research Part E: Logistics and Transportation Review, 79*, 22-48.

Van Wassenhove, L. (2006). Blackett memorial lecturet humanitarian aid logistics: supply chain. *Journal of the Operational Research Society, 57*(5), 475-489.

Vanhooydonck, A., Van Goethem, S., Van Loon, J., Vandormael, R., Vleugels, J., Peeters, T., . . . Veelaert, L. (2021). Case study into the successful emergency production and certification of a filtering facepiece respirator for Belgian hospitals during the COVID-19 pandemic. *Journal of manufacturing systems, 60*, 876-892.

Vocabulary.com. (2022). Scope. Retrieved from https://www.vocabulary.com/dictionary/scope

Wagner. (2022). Die Krankenhaustypen in Deutschland - Was ist das richtige Krankenhaus für mich? Retrieved from https://klinikradar.de/magazin/die-krankenhaustypen-in-deutschland-was-ist-das-richtige-krankenhaus-fuer-mich/

Wagner, S. M., & Bode, C. (2006). An empirical investigation into supply chain vulnerability. *Journal of purchasing and supply management, 12*(6), 301-312.

Walsh, L., Subbarao, I., Gebbie, K., Schor, K. W., Lyznicki, J., Strauss-Riggs, K., . . . Mitas, J. A. (2012). Core competencies for disaster medicine and public health. *Disaster medicine and public health preparedness, 6*(1), 44-52.

Whalen, J., Helderman, R., & Hamburger, T. (2020). Inside America's mask crunch: A slow government reaction and an industry wary of liability. *Washington Post*.

WHO. (2020). Shortage of personal protective equipment endangering health workers worldwide. Retrieved from https://www.who.int/news/item/03-03-2020-shortage-of-personal-protective-equipment-endangering-health-workers-worldwide

Whybark, D. C. (2007). Issues in managing disaster relief inventories. *International Journal of Production Economics, 108*(1-2), 228-235.

Williams, M., & Moser, T. (2019). The art of coding and thematic exploration in qualitative research. *International Management Review, 15*(1), 45-55.

Winkelmann, J., Webb, E., Williams, G. A., Hernández-Quevedo, C., Maier, C. B., & Panteli, D. (2022). European countries' responses in ensuring sufficient physical infrastructure and workforce capacity during the first COVID-19 wave. *Health Policy, 126*(5), 362-372.

Wurmb, T., Scholtes, K., Kolibay, F., Schorscher, N., Ertl, G., Ernestus, R.-I., . . . Kowalzik, B. (2020). Hospital preparedness for mass critical care during SARS-CoV-2 pandemic. *Critical Care, 24*(1), 1-6.

Zsidisin, G. A., Ellram, L. M., Carter, J. R., & Cavinato, J. L. (2004). An analysis of supply risk assessment techniques. *International journal of physical distribution & logistics management*.

7 Appendix

7.1 Appendix A: Interview protocol

1. Introduction and background

1.1 Introduction of the research to the interviewee

First, I want to thank you for agreeing to an interview for my study. The goal of this interview is to investigate preparedness barriers and best practices that were found while buying protective gear during the pandemic. It will take roughly 20-30 minutes to complete the interview. I will ask you numerous questions on suggested criteria based on the literature. There will also be some general and finishing questions. Your name, job title, and company name will be omitted to protect your privacy. If you accept, the firm name will be changed to Purchaser A, B, C, D, E, or F.

a. Do you consent to me recording the interview before we begin?
   Yes/No

b. Do you have any questions about the interview or the study before we get started?
   Yes/No [Discuss questions]

Do not be afraid to ask me questions if anything is unclear during the interview. There is room for unplanned questions because the interview is semi-structured and has open-ended questions.

1.2 Personal questions

a. Please introduce yourself, tell me for which organization you are working, and tell me what position you are working in.
b. Please describe your job.
c. How long have you been working in this organization?

1.3 Governmental actions during the pandemic

a. What general guidelines were established by the government for the purchase of medical supplies during the pandemic?
b. How did the governmental measures affect your hospital in terms of procurement of medical supplies during the pandemic?
c. How would you describe the effectiveness of the governmental measures?

2. Main Interview

2.1 Preparedness plans and barriers of preparedness

a. Can you describe the process that your hospital used to prepare for a pandemic before the COVID-19 outbreak?
b. What resources were most important in helping your hospital prepare for and respond to the COVID-19 pandemic?
c. How did your hospital's preparedness plan for a pandemic compare to the actual challenges you faced during the COVID-19 outbreak?

2.2 Preparedness scenarios based on (Kunz, Reiner & Gold, 2014)

There are two types of preparedness activities:

1) Physical preparedness activities including infrastructure and prepositioning of inventory. This includes all proactive expenditures for emergency resources in disaster-prone nations, such as the development of infrastructure or stockpiling of various types of materials.
2) Intangible preparedness activities include investments in disaster management competencies in the of human resource management, knowledge management, operations and process management, financial resources, and community.
    a. human resource management
        i. This includes the selection and training of individuals who can organize, coordinate, act, and intervene in times of need.
    b. knowledge management.
        i. This refers to learning from past experiences and capturing, codifying, and sharing knowledge.
    c. operations and process management
        i. Logistics are a central component of preparedness. To move resources quickly, materials and agreements need to be established. This also includes the establishment of alternative suppliers, trade routes, and means of transport.
    d. financial resources

        i. To ensure operations run smoothly, sufficient funds and financial resources must be provided.
    e. Community
        i. It is essential to find efficient ways to collaborate with key partners. A way to achieve this is through mutual framework agreements.

a. Which type of preparedness scenario best reflects the activities carried out in your hospital (physical, intangible, both)?
b. Why did you choose this type of preparedness scenario?
c. What are the advantages of this type of preparedness compared to the other (physical vs intangible)?

From this, we get 4 Scenarios:

1) No pre-disaster preparedness activities
2) Physical pre-positioned inventory
3) Investment in disaster management capacities
4) Combining pre-positioning inventory with purchasing disaster management competencies

a. Which scenario did your organization belong to and why?
b. Which of the above-mentioned scenarios would be the best in terms of preparing for a pandemic? Why?

2.3 Barriers to preparedness

a. What challenges and barriers have you experienced in the past in preparing for a pandemic regarding procurement? Can you give examples?
b. What do you consider the biggest barriers for hospitals in preparing for a future pandemic?

2.2 Best practices

a. Were there any specific practices or strategies that were particularly effective in helping your hospital respond to the pandemic?
b. What are some behavioral changes you have adopted?
c. How do you think hospitals can overcome these challenges and better prepare for a pandemic?
d. Are there any lessons learned or best practices that your hospital plans to apply in the future to better prepare for a pandemic or other public health emergency?

3. Outro

a. Space for comments
b. Word of thanks
c. Do you know any other purchasers of hospitals I could contact, and could you provide me with some contact information?
d. Can I contact you again if I have any more questions?
e. Would you like to receive the results of my research?

7.2 Appendix B: Codebook

Codebook: Barriers to Preparedness

Category	Code: Barrier	Description	Example	Purchaser
Barriers to both physical and intangible disaster preparedness activities	Possible unnecessary expenses	Concerns about investing in resources that may not be needed or used, leading to a waste of funds.	"Money is spent on preparations, which is essentially wasted since you never know if you'll need them or if the disaster will occur in a different way entirely from what you had anticipated."	A
	Unpredictability of pandemic	The uncertainty surrounding the onset, duration, and severity of a pandemic makes it difficult to plan and prepare effectively	"I would say that we never expected a pandemic to take place. That is why everyone was completely surprised"	C
	Unpredictability of governmental actions	The uncertainty about governmental actions regarding policies, guidelines, or support during a crisis can make preparation actions more difficult for hospitals	"It was impossible to predict the decision of the federal government. Accordingly, we could only roughly prepare"	C
Barriers to physical disaster preparedness activities	Costs and reimbursement	Financial constraints, including the costs for necessary supplies and the concerns about reimbursement for these expenses through healthcare insurance companies	"At the beginning of the pandemic, we purchased materials for large sums of money and we didn't know what we would get refinanced."	K
	Unknown type of disaster and necessary material	It is difficult to predict the specific type of disaster and what materials are required, making it challenging to stock the appropriate supplies	"The next disease could affect us completely differently. It might not affect the lungs, but the skin. We cannot know."	L
	Product obsolescence	The risk of stocked materials becoming outdated or expiring before they are needed, resulting in waste and additional expenses	"In the end, it expires unused and has to be disposed of"	D

	Small storage facilities	The hospital only has limited storage space for essential materials	“We still have problems with storage here because we simply don't have space. My office was completely filled with boxes because we didn't know where to store them”	K
	Cost of storage	The financial burden connected to maintaining and managing storage facilities	“There are certainly the storage costs, the costs of the actual storage facility, that is a barrier”	D
	No local production	Dependence on international suppliers due to the absence of local production	“When we talk about a global pandemic, like the one that affected the Covid virus, there are still very few production facilities in Europe for personal protective equipment."	H
	Medical device regulation	The MDR comes with complex regulatory requirements for medical equipment. It can decrease the ability and willingness of suppliers to get a product recertified and they may stop producing this material	“For many companies, the MDR meant that they could no longer supply their products because they had lost their certification.”	L
Barriers to intangible disaster preparedness activities	Personnel shortage	A shortage of skilled healthcare purchasers can lead to a decreased time availability of staff to focus on preparation measures for a future crisis	“The main reason is simply that we do not have enough human resources, so usually the personnel are occupied in the hamster wheel of everyday work. Not only do you have to get yourself out of the hamster wheel of everyday work, but you also must take your colleagues out of it and that is where it becomes difficult because things just do not get done. This is actually the biggest barrier to continuing with preparation”	N
	High organizational efforts necessary	Extensive planning and coordination are necessary to organize events to improve intangible preparedness	“We often had a nationwide workshop but unfortunately it no longer exists. It is a huge effort; the workshops are just not conducted anymore”	J
	High costs	Significant financial investments are necessary to carry out events to improve intangible preparedness	”There is a huge financial investment involved.”	D

	Knowledge loss	The loss of organizational knowledge due to staff turnover	"If my colleague and I left the organization, the remaining colleagues would no longer know where to order"	K

Codebook: Best Practices

Category	Code: Best Practice	Description	Example	Purchaser
Storage	Having own storage facility	Establishing/ having a dedicated storage space for essential supplies	"It is important to have your own warehouse. It is nice to calculate, if the warehouse is on the street or if you have a "single-supplier strategy. That was a popular practice before and was taught that way. However, that has changed suddenly. This practice failed during the pandemic".	E
	Increasing storage range	Expanding the number of days the hospital could function without purchasing new materials by increasing the number of essential materials	"We order very differently these days. We listen more to the computer and have increased our inventory range. Before the pandemic, the inventory range was 14 days. We still had a real warehouse, which I am also grateful for. We did not abandon it and outsource it. And now we have a storage range of 40 days for all items and up to 60 days for particularly high-risk items"	E
	Attaining additional storage space	Securing extra storage facilities, either on-site or off-site	"We acquired another storage facility. It was basically just a logistician; we stored the things we needed there. We have put more things in stock, including ventilation systems and central venous catheters. Things like these are not normally in stock but are absolutely essential in the care of intensive care patients. "	A

Human Resources	Have a person responsible for pandemic preparations	Designating a specific individual or team to oversee and manage preparedness efforts	"In the event of a pandemic, or even in times when there is no pandemic, the pandemic representative can check whether there is sufficient stock, whether the people have enough knowledge, and so on."	L
	Preparation workshop	Conducting training workshops to educate staff on emergency procedures, roles, and responsibilities	"I have often attended workshops where the topics were always fire alarms or power outages in hospitals. We had a nationwide workshop like this, but unfortunately that no longer exists. These workshops gave us an opportunity to exchange knowledge and ideas"	J
	All purchasing employees can do all purchasing activities	Cross-training purchasing professionals to perform various roles within the purchasing department of the organization	"There is no isolated knowledge, the general work can be done by all employees who work in that area. This means that I always have the opportunity to combine my strengths in certain areas depending on the situation in order to still remain able to act. Everyone can do everything, that is the motto we follow here and we can of course also act well in critical situations such as during the Corona pandemic"	N
Knowledge Management	Having an emergency plan	Developing a detailed plan that outlines roles, responsibilities, and procedures that are followed during a crisis in order to ensure a coordinated response	"It was a best practice, that we had a crisis response plan. We already thought about possible scenarios prior to the pandemic"	K
	Emergency material check list	Creating a comprehensive list if essential supplies to guide procurement and inventory management	"In March 2020, we rented 136 pallet spaces in our hospital to provide a 90-day bridging period for all products that can cover a mass rush to the intensive care units. This means that we have all the vital materials in storage that are required in the intensive care unit. Beforehand, we created a list of materials in collaboration with the responsible doctors and then extrapolated how much we would need for 90 days. Then we bought those materials."	L

Operations- and process management	Having alternative suppliers	Building relationships with multiple suppliers to reduce the dependence on a single source of materials	“The strategy is simply to position ourselves more broadly, by working with alternative suppliers”.	F
	Fostering supplier relationships	Cultivating strong, collaborative relationships with suppliers	“What helped us a lot is the close partnerships we have with some of our suppliers. That ultimately saved us”	N
	Having local suppliers	Sourcing materials from local suppliers to reduce lead time and decrease the impact of global supply chain disruptions	“We now have a partner here in Germany. The respiratory masks and the surgical masks with the ear loops are produced in Germany. We are positioned quiet well”	C
	Being fast in the purchasing process	Acting quickly in the purchasing process to acquire material in a timely matter before scarcity occurs	“Time is money. It was always crucial to act quickly when making purchases of goods that may become scarce”	A
	Being flexible	Adapting the purchasing process to changing circumstances	“Ultimately, you have to react flexibly, that is a crucial thing“	C
	The approval of all purchasing channels	The removal of restrictions and the approval of purchasing from any supplier who is able to deliver necessary goods	“The approval of all purchasing channels was beneficiary."	H
	Suppliers regulated distribution of needed materials	Suppliers distributed their materials so that every healthcare facility had the chance to get some supplies and help their patients	“Some suppliers said: you get what you always get and no more. Other companies would only supply you with 80% of your order, and gave the remaining 20% to those who urgently needed it, which I also think is a very good tactic”	A
	Buy what you need, but also think of others	Balancing the need to acquire supplies for the hospitals with the responsibility to avoid hoarding them and contributing to shortages of other organizations	“The biggest challenge is, that you don't just think about yourself. You have to fight the pandemic together and we have to support each other. The competitive thinking has to stop to guarantee patient safety.”	M

	Continues ordering from suppliers	Ordering materials on a regular basis in order to receive goods and not be forgotten by the supplier	"If there are delivery problems, it is important to stay in the ordering process. Sometimes companies delete orders if they have been placed four or five months ago and could not be fulfilled. You must continuously order materials, otherwise, you will be at the end of the list of suppliers, and if you are unlucky, there is nothing left"	G
Financial resources	Investment-stop for pandemic-unrelated goods	Temporarily stopping all non-essential investments to save money	"As a hospital, you have to make sure that savings are being made wherever possible, which was done in the procurement area. Investments that had nothing to do with containing the pandemic were suspended, and as a result, capital goods orders that were not absolutely required to keep the hospital operating were no longer permitted"	I
	Personnel reduction to reduce costs	Reducing staff levels to cut cost	"A big expense for a hospital is personnel costs. The hospital offered to forego salary through reductions of work time and through unpaid vacation. Of course, there were also employees in service areas that had nothing to do, since these parts of the hospital were closed. They were let go. These were the most effective measures in the short term"	I
Community	Framework agreements	Entering into pre-negotiated agreements with suppliers to secure favorable terms	"It is advantageous to have a fixed framework agreement where the suppliers are also obliged to deliver. Perhaps, you then pay 1 to 2 cents more, but you have made a fixed agreement with a supplier and you can protect yourself"	I
	Communication among GPO members	Facilitating open communication and collaboration among members of the same GPO to share resources, strategies, and best practices	"The group purchasing organization had a Covid-network. You could always take a look into this database and purchasers would write down where they got materials. That was helpful when you did not know which supplier to contact"	G
	Communication among hospitals	Facilitating information-sharing and support among hospitals within the same region	"We also called other hospitals that were around the corner and talked to them, and we supported each other. That was the best practice ever"	M

	Having a network	Building a network of contacts within the healthcare and supplier communities, but also with industries that could potentially be advantageous during a crisis	"I happen to have a relatively thick network. It extends to Hong Kong. That is why I had people who were able to help me relatively quickly with imports of materials to Germany."	O
	Building a cross-functional task force	Establishing a diverse team from various departments of the organization	"A best practice was gathering the knowledge of individuals. There is a Corona team, it is very diverse, and it is still active. I think that is a good mix. Everyone could contribute something"	J

Codebook: Critique on government

Code: Critique	Description	Example	Purchaser
Causing material shortages	The governmental initiative to start purchasing materials in large quantities led to a shortage of supply for healthcare organizations	"The government's procurement policy during the pandemic has led to a significant shortage of materials on the market"	N
Causing higher prices	Governmental involvement in the market led to higher prices for essential products	"I think that at the beginning of the pandemic, the government negatively impacted the market for materials. The government was another player who wanted to acquire materials, which increased demand and created competition. It drove prices up"	I
Low-quality products	The quality of products purchased by the government was sometimes low and the products were unusable for hospitals	"We once received masks from the government that were so faulty that we had to send them back"	N
Unclear communication	Confusing or insufficient communication from the government made it difficult for hospitals to plan and respond effectively	"It was all very unclear what came from the ministry. For example, they wanted to provide us with materials such as cannulas and syringes for the vaccinations. However, all the information was so vague. It did not give us any advantage, so instead, we took care of purchasing the materials ourselves"	A
Rapidly implemented regulations	Swift changes in regulations caused challenges to healthcare providers	"This short-term nature of the legal situation and the changes in the law was a catastrophe for a hospital"	K

Usability of materials	Due to a change in regulation, some materials that were bought before the pandemic were not usable for hospitals anymore	"In the beginning, it was a back-and-forth with the masks. At one point, we were allowed to use masks with a valve, and fabric masks were also originally allowed. We then had to switch to FFP2, our employees were not allowed to wear masks with valved or fabric masks anymore, only FFP2 masks that are marked with a CE mark. Because the FFP2 mask requirement came, we were in a booming market where there was almost nothing left to buy"	F
Slow implementation of digital infrastructure	Delays in adopting digital platforms prevented a fast distribution of materials purchased by the government	"There were official digital platforms, where you could buy something. However, these platforms were only published after half a year. We then had to figure out how to get access to the platform and by the time we did, the prices of our own suppliers were better than those from the government"	I
Closing specialized clinics and causing financial trouble	Forcing the closure of specialized clinics and not helping them financially in a timely manner	"The location was partially closed. Of course, this was positive in terms of the number of cases because there was no outbreak of COVID-19 here on site, neither among employees nor among patients. However, existential difficulties could be the result of the closure, and getting financial compensation from the government takes a very long time"	I

Unfulfilled commitment to support local production	The government promised to support domestic suppliers but did not fulfil this promise	"The government promised to support and respect local production. However, after the pandemic ended, they were not interested anymore. This would of course also be the case in the event of the next pandemic. A lot of hospitals are purchasing materials from China again, and local suppliers had to give up. No one paid attention to local suppliers, they were not supported. In case of a new healthcare crisis, we would face the same situation again"	C

7.3 Appendix C: Questionnaire for developing a preparedness plan

In the analysis of the interview results, several best practices employed during the pandemic to navigate the crisis were identified. With a clear understanding of these best practices, it is now essential to apply this knowledge and integrate these insights into a questionnaire. The questionnaire consists of a series of questions in connection to the best practices. Each hospital should answer these questions for themselves and the answers to these questions will serve as a basis for hospitals to develop their own preparedness plan for a future healthcare crisis. Hospital associations can act as the distributor of this framework and they can also assist healthcare institutions with answering the questions. This approach was presented by Purchaser L: "The hospital associations can guide the process, but the clinic must make the plan because the clinic knows its own infrastructure. In terms of regulation, you can only assist, with a kind of checklist and what is most important in connection with a so-called disaster plan and then the clinic has to adapt this plan to its own circumstances. They can get help from the association, then the association must prepare something. That is how, as a purchasing manager, I also programmed certain structures through certain plans, such as strengthening resilience." This framework is the practical contribution of this study.

In order to provide a clear and organized structure, the questions posed to the hospitals will be prearranged according to the six categories of the best practices, which are: storage, human resources, knowledge management, operations- and process management, financial resources, and community. By sorting the questions according to these key categories, hospitals can assess their current preparedness systematically, and identify areas for further development. This can further enhance their resilience to a public health crisis.

Storage

As established before, three best practices were identified during the interviews that belong to this category: Having own storage facility, increasing storage range, and attaining additional storage space.

Questions regarding the best practice: having own storage facility at the hospital and attaining additional storage space

1. Does the hospital have its own storage facility?
    a. If yes:
        i. Was this storage facility sufficient during the peak of the COVID-19 pandemic?
        ii. What would you do similarly during the next public healthcare crisis?
        iii. What would you improve on?
        iv. Who was responsible for overseeing this facility?
        v. Were there any challenges in maintaining the storage facility during the pandemic?
            1. If yes, how were these challenges addressed?
    b. If not, where did you store the materials needed during the pandemic?
        i. Was this solution satisfactory in your opinion and would you use the same approach again during the next healthcare crisis?
            1. If yes:
                a. What specific actions did you take?
                b. Who oversaw the decisions made connected to the storage facility?
                c. Where was this storage facility located?
                d. Was there an external storage space provider involved?
                e. Which provider did you work with?
                f. Who is the contact person?
                g. What were the associated costs?
                h. How did you organize the transfer of goods to your hospital?

            2. If not:
                a. what would you do differently next time?
                b. Which decisions did you regret and what were the specific downsides?

c. Who would you consult for advice or collaboration during a future crisis?

Questions regarding the best practice: increasing storage range

1. What was your storage range for necessary materials like FFP2 masks, gloves, gowns, etc. **before** the start of the pandemic?
    a. Was this storage range sufficient?
        i. If yes:
            1. How did you plan for materials before the start of the pandemic?
            2. Was there a specific technical tool that was used and if so, which ones (e.g., inventory management systems or digital tracking tools)?
            3. Which suppliers did you work with?
            4. Who conducted the purchasing within the healthcare organization?
        ii. If not:
            1. How did you adjust the storage range?
            2. How did you figure out what storage range would be appropriate **during** the pandemic?
                a. How often was the inventory assessed and updated during the pandemic?
                b. How did you manage your inventory?
                c. Who was responsible?
                d. Did you get a problem with product obsolescence?
                    i. If yes:
                        1. What did you do with the obsolete materials?
                        2. How did you dispose of it?
                        3. Which organization was responsible for the disposal?
                        4. Which contact person within that disposal company did you talk to?

Human resources

There are three best practices that belong to this category, namely: having a person responsible for pandemic preparations, preparation workshops, and all purchasing employees can do all purchasing activities

Questions regarding the best practice: having one person responsible for pandemic preparations

1. Did you have a designated individual or a team that was responsible for pandemic preparations before the start of the pandemic?
    a. If yes:
        i. Who was this person? Who was part of the team?
        ii. What were the specific tasks?
        iii. How much time was spent conducting responsibilities of this role?
        iv. Which department did the individual or the members of the team belong to?
        v. What was the professional background of the person or team?
        vi. Was this role filled successfully?
            1. What are your criteria for success?
    b. If not:
        i. Will you appoint one or more persons in case of a future public healthcare crisis?
        ii. Who will be suitable?
        iii. What will their responsibilities be?

Questions regarding the best practice: preparation workshops

1. Does the purchasing staff participate in preparation workshops regarding disaster preparedness?
    a. If yes:
        i. Who organized this workshop
        ii. How useful was it?

iii. What did you learn?
iv. How much did it cost?

2. What topics are useful to cover in a workshop regarding disaster preparedness in hospitals?
3. How would you measure the success of such a workshop?

Questions regarding the best practice: all purchasing employees can do all purchasing activities.

1. Can all purchasing staff perform all purchasing activities?
    a. If yes:
        i. How does the hospital make sure, that all purchasing staff have the necessary skills and knowledge to handle a wide range of responsibilities?
        ii. What cross-training or job-rotation systems are in place to develop a versatile and adaptable purchasing team?
        iii. How does the hospital ensure effective communication within the purchasing teams? What channels of communication are used?
        iv. What lessons have been learned from the past pandemic and how have these lessons been incorporated into the purchasing strategy of the hospital?
    b. If not:
        i. What happens if one or more purchasers are unavailable to work?
        ii. How can you ensure that all purchasers can perform all purchasing tasks?

Knowledge management

There are two best practices, that belong in this category, namely having an emergency plan and having an emergency checklist.

Questions regarding the best practice: having an emergency plan

1. Did the hospital have a comprehensive emergency plan that outlined roles, responsibilities, and protocols for a healthcare crisis before the pandemic?

a. If yes:
    i. How was this plan useful in regard to the pandemic?
    ii. What elements were included in this plan?
    iii. What elements were helpful?
    iv. How did hospital staff have access to this plan?
    v. How were the elements of this plan communicated to the staff?
    vi. Who was involved in executing this plan?
b. If not:
    i. How did the development of a plan during the pandemic go?
    ii. Who was involved?
    iii. How effective was it?

2. How often was the emergency plan reviewed and updated during the pandemic?
    a. What initiated the changes?
    b. Who was involved?
    c. What mistakes did you make that you learned from?
3. With the knowledge gained from the challenges of the pandemic, how was the emergency plan adjusted for future healthcare crises?
    a. What are elements that were added to the plan?
    b. How is hospital staff trained on this emergency plan and their respective roles during a healthcare crisis?

Questions regarding the best practice: emergency material checklist

1. Do you have an emergency material checklist for your hospital that contains all materials, that are necessary for a hospital to keep operating?
    a. If yes:
        i. Which materials are part of this checklist?
        ii. How did you adjust this checklist to better fit the needs during the pandemic?
            1. How often was it updated?
            2. Who initiated this update?
        iii. Did you order the products on the checklist at any time of the pandemic?

1. If yes:
    a. What specific incident triggered the buying process?
    b. Where did you store the products?
    c. How much of each product was stored?
    d. How much did it cost you?

b. If not:
    i. Who can help you to develop this checklist for your hospitals? Which departments and individuals should you collaborate with?

Operations- and process management

There are nine best practices that fall into the category of operations- and process management. These are: having alternative suppliers, fostering supplier relationships, having local suppliers, being fast in the purchasing process, being flexible, approval of all purchasing channels, buy what you need, but also think of others, suppliers regulated distribution of needed materials, and continues ordering from suppliers.

Questions regarding the best practice: having alternative suppliers

1. Does the hospital have a list of alternative suppliers in case of a supply chain disruption?
    a. If yes:
        i. How did you find these alternative suppliers?
        ii. How did the hospital select alternative suppliers that meet your quality and reliability standards?
        iii. Where do you store information on these suppliers and is it readily available to all purchasers?
        iv. How would you describe your current relationship with them?
        v. In case of a supply chain disruption, which alternative suppliers would be the first ones you would contact?
        vi. Which contact persons within the organization of the alternative supplier would you approach?
    b. If not:
        i. Where would you find alternative suppliers?

ii. Who should be responsible for finding alternative suppliers?
iii. What are the selection criteria for alternative suppliers?

Questions regarding the best practice: fostering supplier relationships

1. How does the hospital establish and nurture strong relationships with its suppliers to ensure reliable and timely access to essential materials?
    a. Who is responsible for which supplier?
    b. Which employee of the supplier did you foster a relationship with (e.g. key account manager)?
    c. What communication channels are used to stay in touch with this person and maintain and improve the relationship?
    d. What measures can be taken to improve the relationship?

Questions regarding the best practice: having local suppliers

1. Does the hospital purchase materials from local suppliers to reduce the risk of supply chain disruptions?
    a. If yes:
        i. Which suppliers do you work with?
        ii. Which person in your organization is responsible for purchasing materials from local suppliers?
        iii. How was working with local suppliers advantageous during the pandemic?
        iv. What are the costs in comparison to purchasing materials from suppliers that are not local?
    b. If not:
        i. Which local suppliers could you add to the list of alternative suppliers in case of a supply chain disruption?
        ii. What are the obstacles to finding local suppliers?
            1. How can you overcome them?

Questions regarding the best practice: being fast in the purchasing process

1. Would you describe your ordering process as fast during the pandemic?

a. If yes:
    i. How does the hospital make sure, that the purchasing process remains efficient during a healthcare crisis?
    ii. What information is required for the hospital to be fast?
    iii. Where do you get this information from?
    iv. What strategies are in place to reduce bureaucratic hurdles or administrative delays that may slow down the purchasing process?
b. If not:
    i. What is the reason for not being fast?
    ii. How can this be improved?

Questions regarding the best practice: being flexible

1. Would you describe your ordering process as flexible during the pandemic?
    a. If yes:
        i. How does the hospital maintain flexibility in the ordering process to adapt to the changing needs during the pandemic?
        ii. What measures are in place to enable rapid shifts in purchasing priorities, inventory management, and supplier relationships when necessary?
    b. If not:
        i. What is the cause of the inflexibility of the hospital's purchasing processes?
        ii. How can this be improved?

Questions regarding the best practice: the approval of all purchasing channels

1. Were all purchasing channels approved during the pandemic?
    a. If yes:
        i. Who gave the approval?
        ii. How helpful was this measure? Did it make a difference?
        iii. How did the hospital make sure that all approved channels were reliable and capable of fulfilling the hospital's needs?
    b. If not:

i. Were the approved suppliers sufficient to fulfill the hospital's needs?
ii. What would you do differently during a future public healthcare crisis?

Questions regarding the best practice: suppliers regulated distribution of needed materials

1. Did any of your suppliers regulate the distribution of needed materials during the pandemic? Did they decide how much material each of their client hospitals gets?
    a. If yes:
        i. How did this affect you?
        ii. Which suppliers regulated their supply?
        iii. How do you rate this measure? How fair did you think it was?
    b. If not:
        i. In the event of a future crisis, what equitable procedures should be followed for the distribution of necessary materials among all hospitals?

Questions regarding the best practice: buy what you need, but also think of others

1. During the pandemic, did the hospital take other hospitals' needs into account while making purchases?
    a. If yes:
        i. How did the hospital balance its own procurement needs with the needs of other healthcare institutions during the pandemic?
        ii. What measures were in place to prevent overstocking or hoarding of essential materials that could lead to a shortage for other healthcare organizations?
    b. If not:
        i. How would you behave during the next healthcare crisis?

Questions regarding the best practice: continuous ordering from suppliers

1. Did you order continuously from suppliers during the pandemic?
    a. If yes:

i. How did impact the relationship with the supplier, that could not fulfill the orders at the start of the pandemic?
ii. When orders were not fulfilled, what tactics were used to manage expectations and communicate with suppliers?

b. If not:
i. What impact did the hospital's lack of ongoing ordering have on its relationships with suppliers and its capacity to obtain supplies?
ii. Were any alternative tactics or methods used to guarantee a consistent supply of necessary materials?

Financial resources

Two best practices were found during the interviews that belong to the category financial resources. These are: investment-stop for pandemic unrelated-goods and personnel reduction to reduce costs

Questions regarding the best practice: investment-stop for pandemic-unrelated goods

1. Does the hospital implement an investment stop for goods that are not directly related to the pandemic during a healthcare crisis?
   a. If yes:
      i. What specific goods does the hospital not invest in anymore?
      ii. What goods does the hospital still invest in during the pandemic to keep the hospital running?
      iii. How does the hospital determine which investments can be canceled or postponed?
      iv. Who is responsible for the decision-making on which goods are still invested in?
   b. If not:
      i. What kind of investments could be neglected during a pandemic to save costs?

Questions regarding the best practice: personnel reduction to save costs

1. In response to the COVID-19 pandemic, did the hospital reduce personnel to save costs?
    a. If yes:
        i. In which areas or departments did the hospital reduce personnel?
        ii. How did this affect the financial situation during the pandemic?
        iii. Who was responsible for deciding to reduce staff?
        iv. Who was responsible for communicating with the staff that was no longer needed?
        v. After the pandemic, which strategies did the hospital implement to reintegrate affected staff?
    b. If not:
        i. In which areas would you consider reducing staff in order to save costs during the next public healthcare crisis?
        ii. Who would make the decisions on which staff to let go?
        iii. How would the hospital maintain staff morale and engagement when implementing personnel reduction?
        iv. What strategies would be useful to reintegrate staff after the end of the healthcare crisis?

Community

The last category of best practices is community. Framework agreements, communication among GPO members, communication among hospitals, having a network, and building a cross-functional task force are part of this category.

Questions regarding the best practice: framework agreements

1. Did the hospital have framework agreements in place with key suppliers to secure essential materials during a healthcare crisis?
    a. If yes:
        i. Which suppliers did you have framework agreements with?
        ii. What were the specificities of these agreements?

iii. Was the collaboration with suppliers you had framework agreements with more successful than with suppliers you did not have framework agreements with during the pandemic?

1. If yes:
    a. How was this collaboration more successful?
2. If not:
    a. Why was it not more successful?
    b. What could be done better? What can be adjusted in the next framework agreement?

b. If not:

i. Which suppliers are you planning to implement framework agreements with?
ii. On which criteria do you select them?
iii. What are the specificities that are important to you?

Questions regarding the best practice: communication among GPO members and communication among hospitals

1. Was there a collaboration/information exchange with members of your GPO or other hospitals regardless of GPO membership?
    a. If yes:
        i. Which hospitals did you collaborate with?
        ii. Who did you communicate with?
        iii. Who was responsible within your hospital for communicating with other hospitals?
        iv. How and why was this collaboration initiated?
        v. What communication channels were used?
        vi. How did this collaboration go?
        vii. What advantage did it give you?
        viii. Want went well during the collaboration?
        ix. What can be improved upon?
    b. If not:

i. Which other GPO members or hospitals that are in proximity to you would you collaborate with during the next public healthcare crisis?
ii. How would you contact them? Which channels would you use?
iii. Who would be responsible for initiating this contact?

Questions regarding the best practice: having a network

1. Did purchasers of the organization have a network with other hospitals and companies in the healthcare industry?
    a. If yes:
        i. Which individuals or organizations proved to be helpful during the pandemic?
        ii. How did you know them?
        iii. How did they help you?
        iv. Who was the person within your organization who initiated and maintained contact?
        v. If the person within your organization, whose network was activated during the pandemic would leave your organization, would you still be able to achieve the same outcome?
    b. If not:
        i. What can be done for purchasers to build a network?
            1. Are there any events, where purchasers could get to know other purchasers and contact persons of companies of healthcare materials?

Questions regarding the best practice: building a cross-functional task force

1. Did you implement a cross-functional task force during the pandemic?
    a. If yes:
        i. Who was part of this task force? How were the members selected and trained?
        ii. What were their tasks?

iii. How much time did it take to establish the task force?
iv. How much time did the members spend working with the task force?
v. How was this task force coordinated?
vi. How did the task force communicate and how often?
vii. In case of a new public health crisis, what would you do similarly regarding the task force? What went well?
viii. What would you improve upon?
ix. What costs were involved with establishing this task force?

b. If not:
i. In case of a new pandemic, who will be part of the task force?
ii. What would be their tasks?
iii. How would you communicate?
iv. What budget would be available for the establishment?