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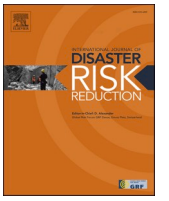

Crisis management in the pharmaceutical industry during the COVID-19 pandemic

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ABSTRACT

Despite the vulnerabilities of the pharmaceutical industry and its critical role in functioning healthcare systems, no previous crisis management theory–based empirical studies focusing on this field during the COVID-19 pandemic has been published. The present study aims to fill this gap and identify areas for development to improve future crisis preparedness. Organisational crisis management process models provided a theoretical framework. A cross-sectional survey study was conducted during the second wave of the pandemic (October–November 2020). This online survey was developed based on the crisis management process models and sent to managing directors working in the pharmaceutical and wholesale companies (n = 73) in Finland. Descriptive statistics were calculated, and open-field responses were analysed qualitatively using content analysis. Nine semi-structured interviews with industry leaders and managers conducted in March–May 2021 were utilised in data triangulation. The results revealed that crisis preparedness improved concurrently during the pandemic due to increased risk perception, updated preparedness plans and operational changes. Crisis decision-making was made via teams or shared efforts between key persons. Anticipation of and responses to increased demand and stocking, coordination and collaboration among pharmaceutical supply chain stakeholders were identified as key challenges. The study extends crisis management process models to the pharmaceutical industry context and advances this research field by drawing on a novel approach for data collection utilising crisis management process models for survey development. Practical implications for improving future preparedness are suggested.

1. Introduction

Over the past few years, the global coronavirus disease 2019 (COVID-19) pandemic has created numerous challenges for societies, such as medicine and vaccine shortages compromising medical care and leading to severe health risks [1]. Without preventative vaccines or curative medicines, the early phases of the pandemic were devastating. Stockouts of medicines were prevalent, as hoarding and stocking up at pharmacies and hospitals challenged the pharmaceutical supply [2,3]. Demand fluctuations, manufacturing capacity issues, the unavailability of raw materials and manufacturing supplies, the shutdown of transportation systems, bottlenecks in global supply chains, and a lack of employees due to infections or suspected infections characterised the impact of the COVID-19

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pandemic on pharmaceutical supply chains around the globe [4–6]. Medicine shortages were a chronic issue already before, but the pandemic further augmented such problems [7].

The frequency of different crises affecting organisations has increased in general [8–10]. Natural disasters affect a wide range of organisations, and organisational crises extend to stakeholders due to many interdependencies. Pharmaceutical manufacturing and supply is highly interdependent, and many vulnerabilities have been detected [11–13]. Dependence on foreign manufacturing and long or complex production chains increase the risk of disruptions [12]. National lockdowns and border closures in China and India, two of the largest active pharmaceutical ingredient (API) manufacturing countries, resulted in delays and uncertainty in the medicine supply during the COVID-19 pandemic [11]. In addition, pharmaceutical supply chain logistics heavily depend on information systems and software, which are vulnerable to cyberattacks, power outages or system failures [13]. International Pharmaceutical Federation (FIP) has issued 'Responding to disasters: Guidelines for pharmacy 2016' [13], which provides notices also for pharmaceutical industry [14].

Empirical crisis management research in the context of the pharmaceutical industry is limited, covering earlier studies on crisis preparedness [15,16] and learning after an organisational crisis [17]. Descriptive communications have evaluated the impacts of the COVID-19 pandemic [5,18–20], and described management strategies [20,21]. Recent empirical studies provide insights into pharmaceutical supply chain risk management and resilience during crises [4,22–24]. In addition, components and strategies of pharmaceutical supply's operations management during preparedness and response were identified in a recent scoping review [25].

Although the pharmaceutical industry played a critical role in the response to the COVID-19 pandemic, there is a lack of crisis management theory-based empirical research on this topic. Considering the vulnerabilities of the industry and its importance to the functioning of healthcare systems and patients' lives, empirical studies shedding light on crisis management in this specific industry are necessary. The aim of this study was to describe and analyse crisis management in the pharmaceutical companies and wholesale during the pandemic in a Finnish context and identify areas for development to improve future crisis preparedness. The research questions were:

1. Pre-crisis: How were pharmaceutical companies prepared for a crisis?
2. Crisis response: How pharmaceutical companies responded to the crisis?
3. Post-crisis: What lessons have been learned to improve preparedness at the organisational and pharmaceutical supply chain levels?

2. Literature review

The first part of the literature review (Section 2.1.) focuses on organisational crisis management process literature, which serves as the backbone of the study, and provides a look beyond the pandemic. The second part of the literature review (Section 2.2.) collects previous empirical studies on preparedness and responses in the pharmaceutical industry.

2.1. Crisis management literature

According to a widely utilised definition, crisis management is 'a systematic attempt by organisational members with external stakeholders to avert crises or to effectively manage those that do occur' [26,27]. Crisis management is part of organisational management, which includes crisis prevention and damage minimisation goals. Thus, it is closely related to issue and risk management, which can be seen as components of crisis prevention [28,29]. A well-managed crisis can even be beneficial to organisations, leading to strengthened customer loyalty and improved competitive standing [30].

To the best of our knowledge, a general theory that explains how crises are best managed does not exist [26,27,31]. One type of crisis can differ significantly from another – for example, pandemics and cyberattacks causing breakdowns in electrical or information systems. What is considered sufficient capacity and effective response, and what is needed to achieve successful management, may vary, as well. Theories of organisational crisis management range from sensemaking [36,37], extreme context [38] and crisis management process models [27,39–42]. In addition, crisis leadership studies provide insights on leadership skills and capabilities nurturing effective crisis management [43]. This study builds on the widely accepted three-stage process, which divides crisis management into pre-crisis, crisis and post-crisis macro-level stages [26,28,39]. Various elements that support effective crisis planning, response and recovery are incorporated into the macro-level process.

Organisations in the pre-crisis stage can reduce the likelihood of a crisis and minimise its eventual impact by detecting signals of potential issues and mitigating and managing risks [28,39,44]. Preparation for a crisis involves establishing crisis teams, creating crisis response plans and conducting training. The crisis management team, a cross-functional group of people who have been designated to handle crises, is responsible for creating and applying crisis plans in simulated or real settings and handling issues that are not covered by the plan [28,45,46]. Crisis management plans preassign tasks and collect useful information in advance, thus enabling quick responses [26,28,47]. Written plans, even those created for a different crisis, assists in quickly identifying feasible actions [48]. The simplest way to train employees is to familiarise people with the crisis management plan; for example, an evacuation plan is typically introduced to all employees [49]. This should be followed by more specific training, such as tabletop or functional exercises that can reveal weak spots and lead to significant improvements in preparedness [50].

The crisis stage is initiated by a crisis event that can emerge suddenly or evolve slowly [27,28,39]. Responses focus on addressing the situation and maintaining core operations, and they often consist of planned and ad hoc actions. The resulting complexity, instability and uncertainty challenge rational, data-driven decision-making [51], and in an urgent and high-pressure crisis environment, decision-makers tend to rely on ready-made solutions [48]. Data analysis is used, particularly in cases where analysis capability

is readily available. Proactive decision-making saves time, effort and money and reduces the severe consequences of crises [52]. Crisis management teams, plans and collaboration with stakeholders have been linked to successful crisis responses [26,27,45,53,54]. Crisis teams and stakeholder collaboration during a crisis facilitate the continuous updating of the situation, allowing for accurate and timely actions to take place.

Finally, the post-crisis stage is dedicated to self-evaluation and learning from the experience, with the aim of enhancing preparedness for future crises [28,39]. Due to the complexity and unpredictability of crises and the various decisions and actions required to manage them, responses to crises usually comprise both successful and unsuccessful choices and decisions [27,32–35]. Without this self-evaluation and learning, a company may repeat the same mistakes and fail to improve employees' competencies, policies and processes for future challenges [44,55]. Organisational learning occurs when errors are shared and analysed following the distribution of lessons learned to enact changes in the routine process (i.e. to transform lessons into actions) [56,57]. Crisis management process models position learning in the post-crisis stage; however, researchers have argued that learning exists throughout the crisis cycle [58]. Moreover, process models have been criticised for ignoring the possibility of stages overlapping or occurring simultaneously, which can often occur during complex and dynamic crises [29].

2.2. Previous research in the context of the pharmaceutical industry

Studies focusing on crisis preparedness have been conducted during non-crisis times before the influenza H1N1 (swine flu) pandemic [15,16]; thus, it is likely that preparedness has evolved since then. According to Watkins et al. [16], biotechnology and pharmaceutical companies in Montgomery County, Maryland, United States, were not well prepared for a pandemic at the time of the study: the majority (80 %, 40/50) of the participating companies did not have any type of preparedness plan. Similarly, Priporas and Vangelinos [15] explored crisis management practice and crisis prevention in Greece and found that crisis management departments and programs existed mainly in large multinational companies (75 %, 12/16) and that relatively smaller pharmaceutical companies trusted mainly on their executives' experience in handling crises. The majority (69 %, 11/16) of the participating companies had experienced a crisis, with crisis management departments mainly prioritising continuous internal education, signal detection and developing two-way communication systems.

Several COVID-19–related studies have provided insights on the response strategies used during the pandemic. Bø et al. (2023) interviewed a global pharmaceutical company as part of their study on supply chain resilience in Norway. This company had pre-established continuous risk monitoring and mitigation procedures in place that enabled the fast prioritisation of critical medicines manufacturing and supply capacity and the employment of temporary personnel when faced with the risk of potential disruptions. Long-term relationships with key suppliers and changing the distribution transport suppliers enabled a fast response to hoarding and consequent demand falls. Sufficient and timely risk monitoring, as well as actionable and sufficiently detailed mitigation strategies and contingency plans, were emphasised. Pharmaceutical supply operations involve various interconnected components, which affects the capability to mitigate medicine shortages [25]. Issues posed by the pandemic were solved through proactive actions, active information and resource exchange, and coordination and collaboration among stakeholders [21,24,25]. In addition, supply operations play an important role in preventing shortages. Tasks in this regard included needs assessment, demand forecasting, logistics assessment, procurement, storage, distribution and monitoring [25]. In addition, human resources management and information management serve as key components of managerial operations [23–25]. According to a Taiwanese study, strategies to manage medicine shortages in collaboration with authorities and the pharmaceutical industry included listing and tracking medications in a shortage risk, identifying alternative sources of APIs or medications, reviewing applications for relevant APIs, establishing financial incentives and reimbursement plans to alleviate the cost burden of alternative sources, and reinforcing a supply-demand balance ruling to ensure rational medicine distribution, allocation and stockpiling [21].

3. Context

The Finnish pharmaceutical industry consists of pharmaceutical importers and manufacturers, the majority of which belong to multinational global pharmaceutical companies. Advocacy organisations for the pharmaceutical industry include Pharma Industry Finland (PIF), which represents 39 pharmaceutical companies mostly focusing on innovative medicines, and the Finnish Association for Generic Drugs (FAGD) which represents eight pharmaceutical companies that concentrate on generic medicines [59,60]. Pharmaceutical companies manufacture and import medicines for wholesalers, who then store and distribute medicines and vaccines to pharmacies. There are few pharmaceutical wholesalers in Finland; however, two major ones distribute almost 100 % of pharmaceuticals in Finland. Pharmaceuticals are mainly distributed via one-channel system, meaning that each pharmaceutical company maintains an exclusive agreement with one wholesaler permitted to distribute their medicines to pharmacies and hospitals [61]; however, multichannel solutions are utilised by some pharmaceutical companies.

Finland is highly dependent on foreign manufacturing and imports [62]. Thus, mandatory reserve supplies have been considered necessary to ensure the national availability of certain pharmaceuticals in crises and unexpected disruptions. The Act on Mandatory Reserve Supplies (979/2008) obligates the Finnish pharmaceutical industry, importers, health care units and the National Institute for Health and Welfare to maintain crisis-related pharmaceutical stockpiles that can last 3–10 months. The Decree on Mandatory Reserve Supplies (1114/2008) identifies pharmaceuticals to be stocked and provides instructions for organising and maintaining reserves, defines frames for exceptions and establishes criteria for compensation and the supervision of stocks. The National Emergency Supply Agency (NESA) coordinates the security of supply with relevant organisations to maintain sufficient buffers [63].

The first wave of the COVID-19 pandemic reached Finland in March 2020 [64]. The Emergency Powers Act was brought into force

for the first time since the Second World War, centralising power to the government and enabling measures to safeguard the pharmaceutical supply. The second wave of the pandemic hit Finland in October 2020, with confirmed COVID-19 infections continuing to rise until the end of the year [65]. Comirnaty®, developed by Pfizer/BioNTech was the first approved COVID-19 vaccine [66–68]. On the December 27, 2020, the first patient was vaccinated in Finland. Various infection waves occurred during the years 2020–2024. The importance of supply security and preparedness was recently emphasised in the Finnish government programme published in June 2023 [69], which states that the Act on Mandatory Reserve Supplies will be reformed and other measures to secure the supply and availability of medicines will be taken.

4. Materials and methods

4.1. Data collection

This cross-sectional study was conducted during the second wave of the pandemic, in October–November 2020. A closed web-based questionnaire served as the main data source for the study to protect the health of the respondents at a time of increasing infection rates and to save their time. A checklist for reporting results of internet e-surveys (CHERRIES) was applied [70]. In addition, nine semi-structured interviews of industry leaders and managers conducted in March–May 2021served as a secondary data source. Interview data, which comprised of 73 pages of interview transcripts, was utilised in data triangulation to confirm and enrich the findings. The interview data collection process has been described in detail elsewhere [71].

Crisis management literature (especially process models [27,28]) provided a theoretical framework for questionnaire development. Applying process models for survey development provided a novel approach to the research field, as previous studies drawing on process models were primarily based on interviews, documents or media data [26]. Existing publications on pandemic preparedness and response in the pharmaceutical industry were explored to contextualise questions. The questionnaire was developed by the research group, whose members had both content-based and methodological expertise. In addition, the survey was evaluated by an expert from the PIF. Finally, the questionnaire was sent for a face validity, usability and technical functionality assessment to a pilot group (n = 2), resulting in three minor modifications for clarity. The pilot group's members were directors from the pharmaceutical and wholesale industries providing content expertise from different types of organisations. One had research experience. The definition of a 'crisis', in the context of this study, was explained to the respondents via an information letter accompanying the questionnaire: the term signified the global COVID-19 pandemic crisis, which affected the Finnish pharmaceutical supply chain. The traditional definition of resilience – the ability to adapt to and maintain psychological equilibrium during times of high stress [72] – was applied in the questionnaire.

The online version of the questionnaire was created using the Microsoft 365 Forms web application (Microsoft Corporation, Redmond, WA, USA). The questionnaire was divided into background questions and three content pages: the pre-crisis, crisis response and post-crisis stages (see Appendix A: Questionnaire). The questions 1–6 in the first part focused on preparedness, such as respondents' perceptions of risks and crisis plans. The questions 7–19 in the second part focused on responses and the continuity of operations; for example, questions about crisis management teams, operational changes, collaboration with stakeholders and information sources. Finally, the questions 20–29 in the third part focused on self-evaluation and the lessons learned. The questions mainly used either structured format with 'Yes/No' or Likert-scale options. All questions were mandatory; however, some optional open fields were included to gather additional narrative information for clarification ('if yes, please specify'). Participants were able to review their responses before submitting them. An invitation to the survey was disseminated to managing directors of the pharmaceutical and wholesale companies via PIF (n = 39) and FAGD (n = 8) or via email (n = 26). To prevent multiple entries from the same individual, an invitation to participate was sent to a pre-specified target group. A follow-up reminder was sent two weeks later.

4.2. Data analysis

Completed questionnaires were analysed. Descriptive quantitative data and qualitative data analyses for open-field responses were conducted using Microsoft 365 Excel® software (version 2311, Microsoft Corporation, Redmond, WA, USA). Open-field responses were analysed qualitatively using deductive content analysis [73]. An analysis matrix was developed, and the data were gathered by content and grouped based on similarities. The answers related to lessons learned regarding the pharmaceutical supply chain were analysed together (questions 26 (Q26) and Q27). In addition, the responses related to lessons learned from organisational crisis management (Q28–Q29) were analysed together.

Data triangulation was conducted using transcripts from semi-structured interviews. Interview transcripts were cross-referenced with survey responses to identify divergent, corroborative or supplementary information. The focus of the interviews was on cross-sectoral collaboration among pharmaceutical supply chain stakeholders during the pandemic [71], however, some interview questions provided insights to organisational crisis management. Quotations related to the survey topics were primarily drawn from interview question 1, '*Tell us briefly about your personal experience in the hospital pharmacy's crisis management during the COVID-19 pandemic*', and question 22, '*How would you improve the preparedness of the Finnish pharmaceutical supply chain for future crises?*' Additional relevant parts of the interviews were also considered. The quotations were compiled using Microsoft 365 Excel® software and cross-referenced with each section of the survey results.

4.3. Research ethics

The present study followed the guidelines of the Finnish National Board on Research Integrity [74]. An ethical pre-evaluation of the survey study protocol was conducted by the University of Helsinki Ethical Review Board in Humanities and Social and Behavioural Sciences (reference number: 42/2020).

The study data were collected, stored and handled based on national data protection instructions and the instructions of the University of Helsinki. A data protection notice was provided to the participants, and their informed consent was obtained prior to data collection. The participants were provided with information about voluntary participation and their ability to withdraw from the study at any time. Personal identifiers were deleted from the interview transcripts. The questionnaire was answered anonymously.

5. Results and discussion

A total of 20 crisis leaders and managers from the pharmaceutical and wholesale companies responded to the questionnaire, resulting in a response rate of 27 %. The participants' demographics are detailed in Table 1. About half of the respondents (55 %, 11/20) were managing directors or country managers, others representing production, quality, public relations or business management functions (45 %, 9/20). The results from the three crisis stages are summarised in Table 2 and discussed in the following chapters.

5.1. Pre-crisis: crisis preparedness

The initial section of the questionnaire explored risk perceptions and the adoption of crisis management efforts. According to the crisis management literature, organisational crisis management preparations depend on institutionalised practices, regulations and management's perception of risks [27,49]. The respondents evaluated the risk of a crisis affecting the pharmaceutical supply chain before and during the pandemic (Fig. 1). Following the onset of the pandemic, leaders' risk perception of crises rose from 25 % to 85 %, which was denoted as 'likely' or 'very likely' on a Likert scale. Personal experience and the rise of risk perception may lead to improvements in organisational crisis management preparations [27,49,75]. To the best of our knowledge, this is the first study reporting pharmaceutical industry leaders' risk perception of a crisis concerning the pharmaceutical supply chain and how COVID-19 affected this perception.

Crisis management plans save time and increase the efficiency of decision making during crises by preassigning tasks and collecting information in advance [26,48]. The companies had pre-existing contingency plans for a variety of different scenarios related to medicine safety or quality, such as serious adverse events; product defects and recalls; disruptive events, such as war, fire, robbery, explosion, accident, terrorism, cyberattacks, and breakdown of machines, distribution hubs, offices; personnel-related events, such as strikes and staff shortages; damage to indispensable systems, such as electricity, water or data communication system; natural disaster, such as pandemics; and reputation issues and medicine shortages in general. Business continuity plans were implemented to ensure continuity of logistics and manufacturing while complying with mandatory reserve requirements. These plans were educated to the entire staff (n = 6, 30 %), managers and supervisors (n = 6, 30 %), for relevant persons (n = 3, 15 %) or the managing director (n = 2, 10 %). In some organisations, the plan was only provided to the management team (10 %, n = 2) or those working in middle management and higher (5 %, n = 1). Pre-existing crisis management plans were activated in response to the pandemic in 15 companies (75 %). Such plans were not used in 5 (25 %) companies, primarily due to the absence of an existing plan, inadequacy in a real-life scenario, or because there was no significant influence on operations. A new crisis management plan for the COVID-19 pandemic was created by 19 (95 %) companies. One company did not create a new plan because crisis management mainly required communication and because it could have been organised based on an existing plan. The interview transcripts also exhibited the variety of

Table 1
Demographic characteristics of the respondents.

Characteristic	Description	n (%)
Job title	Managing director, country manager/CEO	11 (55)
	Other titles[a]	9 (45)
Years of experience as managing director/in current position	0–5	9 (45)
	5–10	5 (25)
	10–15	1 (5)
	15–20	3 (15)
	>20	2 (10)
Work experience after graduation, years	10–15	2 (10)
	15–20	2 (10)
	>20	16 (80)
Organisation type	Pharmaceutical company, no pharmaceutical production in Finland	12 (60)
	Pharmaceutical company, pharmaceutical production in Finland	4 (20)
	Pharmaceutical wholesale	4 (20)
Number of employees	<50	7 (35)
	50–100	4 (20)
	>100	5 (25)

[a] Other directors/managers: production, quality, public relations, business management; CEO = chief executive officer.

Table 2
Summary of the crisis management efforts, self-reflection and learned lessons from the three crisis stages.

Pre-crisis stage: Crisis preparedness		% (n)
Crisis plans	Existing crisis plans used for the pandemic	75 (15)
	New crisis plans created for the pandemic	95 (19)
Crisis stage: Pandemic response and business continuity		**% (n)**
Signal detection	Initial actions taken either in February 2020 or earlier	60 (12)
Crisis teams	Crisis response teams appointed	85 (17)
Decision-making	Shared decision-making (within teams or other means)	100 (20)
Operational changes	Internal communication and management	90 (18)
	Storage	40 (8)
	Human resources	40 (8)
	Procurement	25 (5)
	Actions to anticipate and prevent medicine shortages	100 (20)
Collaboration with external stakeholders	Increased or improved with peers or other pharmaceutical supply chain stakeholders	65 (13)
	No collaboration regarding pandemic response with peers or other pharmaceutical supply chain stakeholders	35 (7)
Post-crisis: Self-reflection and learned lessons		**% (n)**
Self-reflection in organisational crisis management	No areas for development identified	45 (9)
	Communication related learnings	60 (12)
	Leadership and decision-making related learnings	55 (11)
	Organisational capacity related learnings	35 (7)
	Preparedness related learnings	15 (3)
Pharmaceutical supply chain's successes	Collaboration and information exchange	45 (9)
	Medicine availability	15 (3)
	Mandatory reserve stockpile	10 (2)
	Authorities' flexible and rapid action	11 (2)
Pharmaceutical supply chain's challenges	Anticipation and response to increased demand and stocking	30 (6)
	Lack of coordination and collaboration	30 (6)
	Medicine availability problems	10 (2)

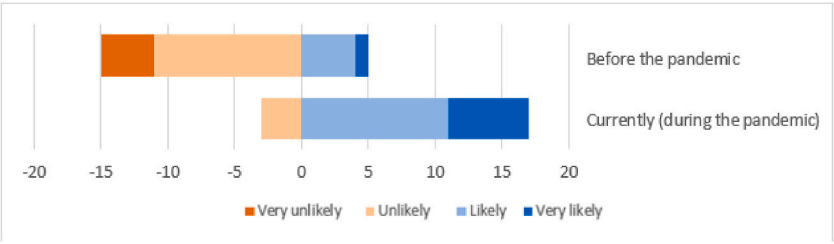

Fig. 1. Respondents' risk perception of a crisis concerning the pharmaceutical supply chain before and during the COVID-19 pandemic (evaluated on a Likert-scale, n = 20). X-axis represents the number of the positive (likely-very likely) or negative (unlikely-very unlikely) responses.

pre-existing preparedness plans. According to Interviewee 3, *'crisis revealed weak spots in company's preparedness that have been fixed now'*.

Although preparedness plan coverage in the industry was rather high before the pandemic, COVID-19 resulted in increased coverage. However, plans or standard operating procedures do not help much if only a few are aware of them [28]. Crises could potentially affect the entire staff, and increasing the number of employees with knowledge of the plan could provide a company with security and advantages when crises strike. Crisis simulations were not asked about the survey; however, one company described yearly and extensive crisis simulations in an interview. These simulations prepared the organisation well for the acute phase of the COVID-19 pandemic with clear processes and responsibilities.

5.2. Crisis response

The second part of the questionnaire focused on pandemic responses and continuity of operations. Most of the participants reported a rapid response to the pandemic, with initial actions taken either in February 2020 or earlier (60 %, n = 12). This demonstrates well-functioning signal detection in most pharma companies. Others took their initial actions in March 2020 (35 %, n = 7) or later (5 %, n = 1). These actions included establishing crisis management teams, updating crisis management plans, ensuring continuity of business and supply, monitoring availability of medicines and prevention of potential shortages, avoiding/cancelling business trips, favouring remote work, enhancing cleaning and disinfection, limiting access to production, collaborating with stakeholders and agreeing on

actions with partners.

Researchers suggest that organisations who trust in crisis management teams for crisis preparation and response are likelier to succeed compared to organisations in which crisis management responsibility rests with an individual [27,45]. Pandemic response teams were appointed at 85 % (n = 17) of companies. Team members' roles were mainly related to crisis management and communication. More specifically, they followed national guidelines and collected updated information, created and revised internal instructions, communicated inside the company, updated risk management plans to cover different scenarios, and ensured transportations. The interviews further emphasised the focus on business continuity: ensuring employee safety and digital transformation, redefining new roles and ways of working and ensuring medicines for distribution and materials for production. Topics such as how to handle operational capacity or logistic issues and the current disease situation and its effects on the company's restriction measures were discussed constantly in crisis teams. Continuous adaptation was made according to the situation. One interviewee described clear global priorities that guided crisis management and communication. The survey responses reveal that crisis team members were managing directors or directors/managers from communication, logistics and supply chain, medical, quality, regulatory, sales, marketing and business functions. In cases where a crisis team was not set up in a company (15 %, n = 3), decisions were made by the managing director, responsible person, or management board with other leaders responsible for human resources, logistics or sales. No organisation reported individual responsibility in decision-making, and the findings indicate that the pharmaceutical industry relies on shared decision-making in crisis management.

Fig. 2 illustrates the usefulness of different information sources used to support decision-making in crisis management. The most useful sources for the pharmaceutical industry were the Finnish Institute for Health and Welfare (THL), the Ministry of Social Affairs and Health (STM) and traditional media. These information sources were echoed in the interviews.

The respondents described several operational and organisational changes. Most of the surveyed companies (90 %, n = 18) adjusted their internal communication and management due to the pandemic. Crisis management teams were established, the anticipation of potential issues intensified. Authorities were informed of disruptions to supply with a low threshold. Internal and/or external communication increased in general and shifted to various digital platforms. Also, the shift to remote work transformed internal and external communication, managerial work and ways of working. Changes in storage were noted by eight respondents (40 %), mainly due to increases in medicine stock. In addition, in manufacturing companies, stocks for raw materials and PPEs were increased to the extent possible. Adjustments in procurement were made in five (25 %) companies. These included increasing monitoring, anticipating increased consumption and ensuring deliveries to Finland. At the time this study was conducted, manufacturing changes were made in one manufacturing company that focused on responding to the increased demand for certain products. Hoarding was prevalent during the early stages of the pandemic, resulting in increased workload and overtime work. Eight (40 %) companies reported changes in human resources. Employees were trained and redirected to digital teams carrying out production and quality functions. Tasks were reduced in research and development, sales and marketing departments. Outsourced personnel were added to enable quick reactions to possible sick leaves. At the time of this study, one company had undergone organisational changes and moved its centralised functions from Finland to a regional organisation. These findings were reinforced by the interviewees.

All companies (100 %, n = 20) took actions to anticipate and prevent medicine shortages during the pandemic. These included

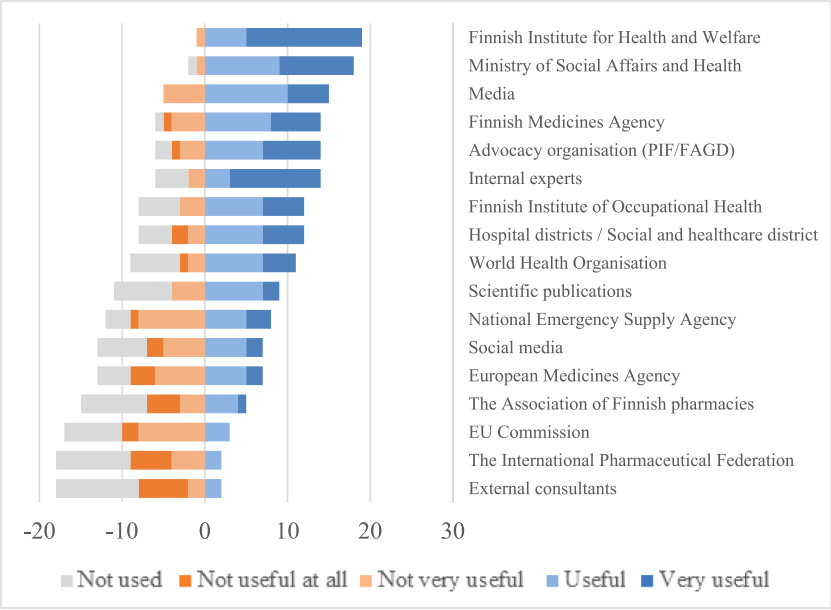

Fig. 2. Usefulness of different information sources to support decision-making in the pharmaceutical industry during the COVID-19 pandemic (estimated on a Likert-scale, n = 20). X-axis represents the number of the positive (useful-very useful) and negative (not very useful-not useful at all-not used) responses.

monitoring orders, delivery and transportation times and changes in demand. Stocks were raised, manufacturing and supply were adjusted to reflect increased needs, and products were ordered from a manufacturer earlier than before. Alternative manufacturing sites were investigated, and critical products were identified. In the case of possible interruptions, preventing actions were made. For example, medicine freight importation and deliveries were secured and carried out through an isolated area of Southern Finland. Reserve pharmaceuticals were taken for use and the distribution of critical medicines was prioritised over other products. Continuous internal discussions and communication with the headquarters were applied to ensure the availability of medicines in Finland. Also, collaboration with manufacturing sites, hospitals, authorities and other industry stakeholders intensified to identify potential risks or heightened needs. Previous research literature recognised proactive actions, information and resource exchange, coordination and collaboration among stakeholders as solutions to challenges posed by the pandemic [21,24,25]. This research enriches previous findings and adds importance of reserve pharmaceuticals and multinational companies' internal communication in preventing national medicine shortages. The interview data confirmed the survey findings and further elaborated logistic challenges. According to interviews, border controls and restrictions in truck, ship and aeroplane freight and Asian logistic issues caused delays and needs for alternative solutions in medicine and material transportation. These challenges were in line with the earlier literature [4–6], however, importance of ship freight was emphasised in the Finnish context.

Previous research has shown that sharing information and resources, as well as problem-solving, coordination and trusting relationships with external stakeholders, increased the effectiveness of crisis management [26,54]. Collaboration was also one of the most important supply chain resilience elements according to pharmaceutical supply chain managers [24]. Organisation of cross-sector collaboration and its influence on crisis management effectiveness has been recently studied in the pharmaceutical supply chain context [71]. These findings enrich and complement previous studies from the perspective of industry leaders and managers. In most of the surveyed companies, collaboration and communication with peers or other pharmaceutical supply chain stakeholders changed during the pandemic (80 %, n = 16). Thirteen (65 %) respondents described having either improved or increased collaboration. The number of questions and instructions increased, and information sharing was more open than before. Both formal and informal communication were discussed by the interviewees. According to Respondent 2: *'Collaboration has intensified and increased … Everyone clearly has the same common mission and goal (minimising the disease situation and morbidity and ensuring the continuity of operations and supply security)'*. Information sharing between industry and wholesale, hospital and community pharmacies, authorities and other pharma companies via advocacy organisations were detailed. The interviewees found that collaboration between supply chain stakeholders enabled the formation of a common situation picture. Three responses were empty. Despite the various benefits of stakeholder collaboration in crisis, a significant portion (35 %) of the responding companies did not collaborate with other stakeholders, increasing their risk of encountering potential information gaps. The interview results confirmed and deepened the information about variety in collaboration. In addition, interview data further added information about collaboration in ultra-cold vaccine importation and distribution to hospital pharmacies through pharmaceutical companies and the THL instead of any wholesale company.

5.3. Self-reflection and learned lessons

The third part of the questionnaire focused on the post-crisis stage and consisted of an evaluation of the pandemic's impacts, self-reflection and lessons learned from an organisational and the pharmaceutical supply chain perspective. The respondents assessed the pandemic's impacts on staff and management resilience, organisational cohesion ('team spirit') and the organisation's resources and finances on a Likert scale, as shown in Fig. 3. These impacts were mainly negative, although variation existed. Unexpected workload surge, ambiguity and insecurity challenged leaders and employees, which is seen in decreased management and staff resilience.

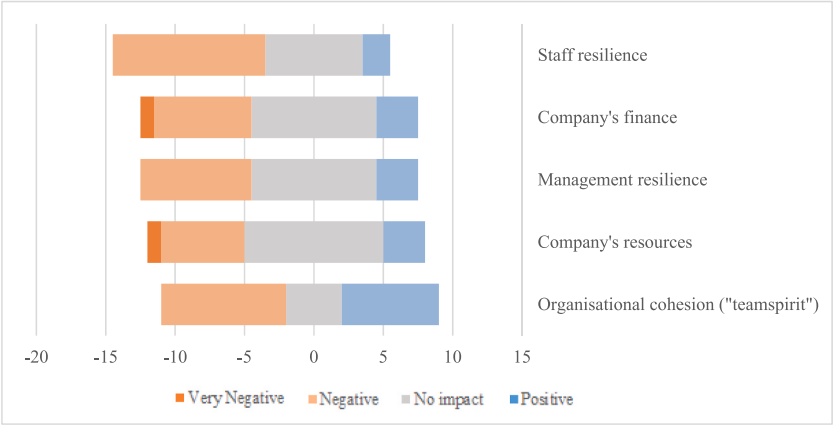

Fig. 3. Respondents' self-evaluated pandemic impacts (evaluated on a Likert-scale, n = 20). X-axis represents the number of the positive, neutral (no impact) or negative (negative or very negative) responses. Neutral responses are positioned around zero. No 'very positive' responses were reported.

However, no impact and positive impact were also reported. Organisational cohesion (team spirit) demonstrated the most positive changes. Similar results have been reported from the pharmacy and healthcare sectors [2,76,77]. Feelings of meaningfulness and pride were felt, which can also partly explain positive changes in resilience. Interviews further characterised the impacts of COVID-19 and provided potential explanations to 'no impact' and 'positive impact' responses: in the early phase of the pandemic, workload increased for managers and most employees but decreased for frontline employees. In addition, digital transformation changed the way of working and made it more intense, as meetings became shorter and more focused. Hoarding in the acute stage of the pandemic increased short-term sales in some therapy areas; however, decreased patient access to healthcare caused a decline in medicine consumption and treatment debt in chronic diseases, explaining variation in the pandemic's impacts on companies' finances and resources. Lastly, innovative vaccines against the coronavirus were developed by some pharma companies, which might have contributed to the team spirit, management and staff resilience in such companies through their life saving potential. Vaccines' impacts on companies' finances is not seen at the time of this study.

Although about half of the respondents (45 %, n = 9) did not identify areas for development in organisational crisis management at the time of the study, all responses provided insights into crisis management lessons. Such lessons were categorised into communication- (60 %, n = 12), leadership and decision-making– (55 %, n = 11), organisational capacity– (35 %, n = 7) and preparedness-related (15 %, n = 3) themes. Communication-related lessons included importance of continuous and clear internal and external communication, even when there was no news. It was critical to repeat important messages multiple times and ensure that all employees received these messages. Leadership and decision-making–related lessons included developing an understanding of the extent of the situation, clear and fast goal setting instead of reactivity, consistency, clear responsibilities and authorisation in decision-making, staying calm and not panicking, anticipating and making fast and effective decisions in the early phases to avoid prolonging the situation and clear procedures. According to survey respondent 11, a global response was adjusted based on local needs: *'We realised that there are differences in the needs of different countries and even regions within countries. At first, a broad global, EMEA or Nordic approach was adopted, but in hindsight we could have moved to more localised action plans sooner.'* Organisational capacity–related lessons included an emphasis on the importance of a strong crisis team with sufficient resources and organisational capability to adapt to change and provide human resources support. Finally, preparedness-related lessons covered the importance of preparing and regular practising for potential crises during ordinary times. These lessons were echoed in the interviews, and the importance of crisis meeting memos, the structured informing of employees and the documentation of crisis responses was emphasised.

The respondents identified the pharmaceutical supply chain's successes and challenges. Responses related to medicine availability and collaboration with stakeholders were mixed. Successes were identified related to collaboration and information exchange (45 %, n = 9), medicine availability (15 %, n = 3), mandatory reserve stockpile (10 %, n = 2) and authorities' flexible and rapid action (10 %, n = 2). Collaboration was described as good, dense, constructive, open and solution oriented. Information exchange was at a high level, and pre-existing collaboration structures provided a forum for discussion and information sharing. After the initial phase of the pandemic, which was characterised by hoarding and stocking, medicine availability was rather good, partially because of increased domestic pharmaceutical production. Mandatory reserve supplies provided a buffer for medicine shortages. Rapid actions by authorities, such as the Finnish Medicines Agency (FIMEA), were crucial to crisis response. While one respondent saw NESA's actions as a success, another respondent asserted that NESA did not provide real help or resources. Interviews further revealed NESAs' role in the pharmaceutical industry's crisis management. NESA's value was evident in its assistance with border control and ship freight issues, coordination of local supply security collaboration, and provision of information on alternative PPE providers and prerequisites for country entries of foreign employees. Interviewee 8 praised local supply security group coordinated by NESA, which focused on critical infrastructure, disease situations and local solutions. However, some interview respondents noted that NESA did not coordinate the crisis response as they had expected.

Challenges identified by the respondents related to anticipation and response to increased demand and stocking (30 %, n = 6), lack of coordination and collaboration (30 %, n = 6) and medicine availability problems (10 %, n = 2). As order volumes doubled rapidly, pharmaceutical wholesalers were not able to response immediately. Despite early preparations, the magnitude of the escalation surprised companies, and the demand peak was unanticipated. A recent study from Finland found that a high proportion (42 %) of community pharmacies suffered wholesalers' challenges in scaling delivery capabilities when order volumes surged [2]. In Norway, a pharmaceutical company was able to tackle hoarding quickly by changing the distribution transport suppliers [4]. Finland's one-channel system, in which the majority of pharmaceutical companies are paired with only one wholesaler, increases the risk of such problems in case of a rapid increase in demand or other disruptions. One company in Finland described their positive experiences with multichannel solution in Finland: *'… Now we have more wholesalers in our chain. This made it easier for us during the pandemic – the idea that not everything goes through [a wholesale company]. In my opinion, that decentralized solution is quite good because more routes can be used' (Interviewee 4)*. Challenges were also identified in relation to collaboration among pharmaceutical supply chain or social and health care stakeholders. Continuous and transparent collaboration was emphasised, and coordination from authorities was requested. Transparency was also demanded by Interviewee 3, who noted that their painkiller medicines were not delivered according to pharmacies' orders, instead, they were completely stopped for a few weeks based on the wholesaler's decision without any discussion and without informing the company. Described by one interviewee, FIMEA potentially played a role in controlling the demand-supply: *'FIMEA knows what the product quantities are … for example, on the basis of which, of course, the distribution of scarcity is potentially made' (Interviewee 6)*. However, according to the survey responses, attempts to control the demand–supply balance (i.e. sharing scarcity) were not centrally coordinated, leaving pharmaceutical companies the responsibility for reasoning without knowing what authorisation they were acting under. Coordination was requested in a survey response: *'There should be one authorised actor who could be able to communicate centrally, quickly and authentically with pharmaceutical industry, wholesalers and health care districts and would be authorised to give instructions (e.g. in sharing scarcity!). … That actor should have sufficient knowledge of companies', hospitals', and the*

Ministry of Social and Health officers' operational prerequisites.' (Respondent 15). These suggestions align with the literature, which acknowledges the importance of both collaboration and coordination in multi-organisational response to crises [78–80]. Solutions to prevent hoarding and improve collaboration between authorities and pharmaceutical companies were requested in the survey and interview responses. According to Respondent 11, ' … *new regulations introduced during the pandemic (for example, regulations on safety stock levels and the export of drugs required for certain products) were not created in collaboration with pharma suppliers – this would have been good to plan for.'* The interview data further specified solutions to improve crisis preparedness in the pharmaceutical supply chain, including regular collaboration and trust building prior to crisis, collaboration among stakeholders in scenario evaluation (i.e. the identification of potential crises) and objectives (rational level of preparedness) prior to crisis, developing a collaboration model for crisis including roles, responsibilities and coordination responsibility, anticipation of hoarding through signal detection for global trends (*e.g.* in case of COVID-19, using Italy a benchmark), coordinated collaboration with government offices related to pharmaceutical production chain and improving the general awareness of crisis management. These solutions are supported by the crisis management literature.

5.4. Theoretical considerations

The present study extended empirical crisis management process research to the pharmaceutical industry and provided an alternative approach to data collection, as the majority of the studies drawing on process models were based on interviews, documents or media data [26]. This online survey approach enabled the acquisition of responses even as infections were increasing and could also benefit other studies in the acute phase of a crisis in which data collection is challenging [26,81]. Although focusing on a specific phase could have yielded more detailed findings, the process perspective exhibited its advantages through its holistic and structured approach. The post-crisis results provided data from a cross-sectional timepoint, which complements the learnings acquired after the pandemic. In line with the previous literature, the crisis phases in this study overlapped as preparedness improved and lessons were learned over the course of the crisis response [29,58].

5.5. Study limitations and future research avenues

The response rate of 27 % in this study can be considered sufficient for indicative findings and must be interpreted with caution. This rate is similar to that of an earlier survey study in the Finnish pharmaceutical industry context [82]. The survey data were complemented with semi-structured interviews for data triangulation. No deviations appeared in the triangulation; the survey data were instead supported and deepened. Due to its cross-sectional survey design, the studies' findings reflect self-reported answers at a single time point and cover only the early stages of the pandemic. This limited timeframe does not capture the full spectrum of changes and adaptations that organisations underwent as the pandemic evolved. For example, the development of COVID-19 vaccines was left out of the questionnaire but covered in the data triangulation. Moreover, participants were asked to remember events and experiences from the beginning of the pandemic, which could have possibly led to recall bias and hindsight bias; they may have inadvertently reshaped their memories to fit their current understanding of events. Such biases may have influenced the accuracy and completeness of their responses. Respondents' different professional backgrounds may have affected the focus of the responses and open-field answers, although these backgrounds provide a wider picture of the various of actions used in crisis management compared to identical backgrounds.

To achieve the full spectrum of crisis management efforts and their changes during the pandemic, a longitudinal study is needed. The present study focused on the views of crisis leaders and managers. However, an employee perspective could provide more detailed information for evaluating crisis management decisions. Studies covering multiple countries, for example, studies on Nordic, European Union (EU) or Organisation for Economic Co-operation and Development (OECD) areas, would enable a more comprehensive view of prevention, preparation, response and learned lessons in the current context. In addition to the current study, these studies could also provide valuable insights in updating FIPs 'Responding to disasters: Guidelines for pharmacy 2016' in the pharmaceutical industry context [14].

5.6. Practical implications

Anticipation and responses to increased demand and stocking were identified as challenges. This information was provided in relation to the hoarding that occurred during the early stages of the crisis and in part caused by the media's announcements. Despite high levels of preparedness, adjusting accommodation to rapidly increased need took time. Three possible solutions to improve anticipation are suggested:

1. Company-level: The response in the majority of the companies was fast in general; however, the respondents stated that more effective actions should have been taken earlier. Do you know potential issues for core functions which could arise in a crisis? Do you know how to solve these issues based on the continuity plan? Developing organisational decision-making capacities during ordinary times offers prerequisites to fast and effective decision-making when a crisis hits [47,48]. Data management systems can assist in the formation of an accurate situation picture. Artificial intelligence (AI) could be developed, for example, in scenario planning.
2. Company/pharmaceutical supply chain–level: Conducting tabletop or full-scale simulations enables finding potential information gaps, resource needs and problems during disruptive situations. At the supply chain level, such simulations should focus on

common problems [71]. Do you know how to secure core functions in case of an electricity system failure or a data management system breakdown?
3. Pharmaceutical supply chain–level: Despite a high level of preparedness, accommodating rapidly increased needs takes time. Advance notifications of upcoming regulation, potential issues or upcoming changes from authorities to stakeholders and vice versa would improve anticipation.

Although collaboration was praised by many respondents, a lack of coordination and collaboration was identified as a challenge. Improving prerequisites for coordination and information sharing at the pharmaceutical supply chain level is important for ensuring equitable medicine availability among hospitals and primary care facilities. A collaborative crisis management model could clarify stakeholders' and government offices' roles and responsibilities in terms of coordination responsibility. Official guidelines of supply-demand balance ruling for distribution, purchase and storage could be provided to pharmaceutical companies and health care facilities by authorities in a crisis. This has been described in the literature as exemplary [21].

6. Conclusion

From the scientific perspective, the present study extended empirical crisis management process models to the pharmaceutical industry context and provided an alternative approach to data collection utilising process models for survey development, as the majority of prior studies drawing on process models were based on interviews, documents or media data. Although preparedness in the industry was relatively high before the pandemic, it was improved during the pandemic due to increased risk perception, updated preparedness plans and operational adjustments. Crisis decision-making was carried out by teams or through shared efforts between key persons. Numerous operational adjustments were made to ensure medicine availability. Communication-, leadership and decision-making–, organisational capacity– and preparedness-related themes were identified challenges in companies' crisis management. Anticipation of and responses to increased demand, stocking, and coordination and collaboration were identified as challenges encountered along the pharmaceutical supply chain. Thus, in future, crisis preparedness improving efforts in the pharmaceutical industry should focus on building prerequisites for fast and effective responses and information sharing with stakeholders. Data management systems supporting decision-making during a crisis and simulations revealing information needs or resource gaps are recommended.

CRediT authorship contribution statement

S. Latonen: Writing – original draft, Visualization, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **S. Pussila:** Writing – review & editing, Visualization, Formal analysis. **H. Seeck:** Writing – review & editing, Supervision, Methodology, Investigation, Funding acquisition, Conceptualization. **M. Airaksinen:** Writing – review & editing, Supervision, Methodology, Investigation, Funding acquisition, Conceptualization. **A.M. Juppo:** Writing – review & editing, Supervision, Methodology, Investigation, Funding acquisition, Conceptualization.

Declaration of competing interest

S. Latonen reports a relationship with Novo Nordisk Farma Oy that includes: employment. S. Pussila reports a relationship with Orion Pharma that includes: employment. A.M. Juppo, M. Airaksinen and H. Seeck declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijdrr.2025.105566.

Data availability

The data that has been used is confidential.

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