



# Organizational interventions and strategies for COVID-19 pandemic management in acute care setting: A qualitative interview study with nurse leaders in German hospitals

Maria Zink<sup>a,\*</sup>, Johannes Wendsche<sup>a</sup>, Steffi G. Riedel-Heller<sup>b</sup>, Franziska Jung<sup>b</sup>, Marlen Melzer<sup>a</sup>

<sup>a</sup> Federal Institute for Occupational Safety and Health (BAuA), Fabricstrasse 8, Dresden, 01099, Germany

<sup>b</sup> University of Leipzig, Institute for Social Medicine, Occupational Health and Public Health, Leipzig, Germany

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## ABSTRACT

**Background:** The rapid spread of SARS-CoV-2 in 2020 exposed unprepared healthcare systems worldwide. In Germany, acute care hospitals faced significant challenges, particularly in organizing adequate personal protective equipment, managing high mortality rates, and accommodating extended hospitalization of patients with COVID-19.

**Objective:** This study aimed to explore the perspectives of nurse leaders on organizational interventions and strategies implemented in hospitals to address pandemic-associated challenges and derive knowledge for future crises.

**Design:** A qualitative descriptive study was conducted between July 2022 and June 2023, utilizing semi-structured interviews with nurse leaders across different management levels (strategic, middle, and operative management) in hospitals in Saxony, Germany.

**Setting:** This study was conducted in hospitals across Saxony, Germany.

**Participants:** The study included 30 nurse leaders from nine different hospitals, representing a diverse sample in terms of hospital characteristics (ownership, hospital size, regional distribution, and level of care) and participant demographics.

**Methods:** Data were collected through semi-structured interviews, transcribed, and analyzed using qualitative content analysis in MAXQDA.

**Results:** Eight strategies were identified (four core and four secondary) with various corresponding interventions that hospitals used to manage the pandemic, including infection control, adaptation of hospital capacities, human resource management, direct patient care delivery, management of the provision of non-COVID-19 care, transparent organization of the flow of information and decision-making, cooperation and teamwork, and evaluation and flexible adaptation. This study highlights the importance of flexibility, creativity, internal and external support, leadership, crisis communication, participatory decision-making, evaluation, and error management in crisis management.

**Conclusion:** This study provides a comprehensive documentation of hospital pandemic management from the perspective of nurse leaders, offering a basis for future research and practice. Effective hospital pandemic management requires a flexible, context-specific approach supported by strong leadership, internal and external support, and participatory processes. These findings

\* Corresponding author.

E-mail address: [zink.maria@posteo.com](mailto:zink.maria@posteo.com) (M. Zink).

emphasize the need for ongoing evaluation during crises and for a culture that encourages reflection and learning from crises to improve future responses.

### What is already known

- Numerous studies have been published on managing pandemic-related challenges and crisis management strategies in hospitals from both international and national perspectives.
- Some studies include nurse leaders' perspectives but focus on leadership competencies or hospital resilience in general or focus on the pandemic's onset and do not report organizational interventions throughout the pandemic.

### What this paper adds

- This study identifies eight strategies with corresponding interventions, which varied across hospital size and regional location, and contributes to a deeper understanding of hospital pandemic management to learn for future crisis responses.
- Employee support initiatives included flexible hours and mental health resources, though psychological support for staff was underutilized despite being available.
- This paper provides more details on the relevant aspects of successful crisis management, such as participation, transparent communication, internal and external support, leadership quality, reflection, and error management.

## 1. Background

Since the initial occurrence of SARS-CoV-2 in Wuhan in December 2019, the virus has rapidly spread worldwide, impacting many unprepared nations ([World Health Organization, 2021](#)). According to the World Health Organization (WHO), as of August 12, 2024, 7.1 million people worldwide have died due to SARS-CoV-2 infection, including 175,000 in Germany, this study's region of interest ([World Health Organization, 2024](#)). The COVID-19 pandemic posed challenges to hospitals' crisis management, necessitating organizational interventions and strategies.

### 1.1. COVID-19 in acute care in Germany

The COVID-19 pandemic has brought acute care facilities, as critical infrastructures, to the forefront of public attention in Germany and globally. High mortality rates among hospitalized patients with COVID-19, along with prolonged stays and ventilation durations, especially in intensive care units, significantly strained personnel resources amidst high staff sickness rates ([Hentschker et al., 2023](#); [Karagiannidis et al., 2022](#)). This situation led to the postponement of other treatments, potentially causing negative consequences for non-COVID-19 patients ([Hentschker et al., 2023](#)).

Although the threat of a pandemic virus outbreak had been predicted by various experts, such as the German Bundestag's risk analysis of a pandemic involving the Modi-SARS virus ([Deutscher Bundestag, 2019, 2013](#)), the COVID-19 pandemic, particularly in its early stages, posed and has continued to pose substantial challenges to hospital crisis management (e.g., shortages of protective equipment and medical staff; see [American Hospital Association, 2022](#); [Blum et al., 2020](#); [Bundesärztekammer, 2021](#); [Karagiannidis et al., 2020](#); [World Health Organization, 2020](#)).

### 1.2. Crisis management during a pandemic

Pandemics, though considered unlikely, require rapid responses when they occur. They create a high degree of uncertainty, are characterized by strong and long-lasting impacts, and involve significant volatility in crises, presenting unique challenges for crisis management ([Boin and Hart, 2010, 2003](#); [Lloyd-Smith, 2020](#); [Steen and Morsut, 2020](#)). During the COVID-19 pandemic, hospitals were repeatedly tested, with pandemic management differing from traditional crisis management due to the prolonged crisis period and the highly variable pandemic dynamics ([Morse and Warshawsky, 2021](#)).

Crisis management is defined as the systematic handling of crises ([Frodl, 2022](#)) and encompasses conceptual, organizational, and operational interventions across four phases: prevention, preparedness, response, and recovery ([Boin and Hart, 2003](#); [Hetu et al., 2018](#); [Trauboth, 2022](#)). Crisis management operates at both strategic and operational levels, each with distinct responsibilities. The strategic level involves tasks such as attributing meaning to a situation, making strategic decisions, transitioning from crisis to normalcy, and generating a learning experience. These tasks typically fall under the category of political leadership with societal leadership roles. At the operational level, first responders—those closest to crisis impacts—use their expertise to mitigate risks and minimize consequences. This level requires accurate situational awareness, resource mobilization, decision-making regarding immediate actions, and effective communication and collaboration among relevant actors ([Boin and Hart, 2010](#)).

Owing to Germany's classification of healthcare facilities as critical infrastructure and the federal system dividing responsibilities between federal and state law, hospital management and political actors share the responsibility of ensuring public health ([Bundesamt](#)

für Bevölkerungsschutz und Katastrophenhilfe, 2024; Bundeszentrale für politische Bildung, 2021; Deutsche Krankenhausgesellschaft, 2023). Consequently, political regulations at both the federal and state levels directly affect hospitals' operational capabilities (e.g., the Maternity Protection Act and the Infection Protection Act). Hospitals, therefore, became part of the operational level of nationwide pandemic management, necessitating strategic and operational responses to the pandemic within their institutions. The boundaries between the levels of crisis management became blurred, and the multitude of pandemic-related political directives and laws added to the already complex healthcare and working systems (Bundesministerium für Familie, Senioren, Frauen und Jugend, 2021; Bundesministerium für Justiz, 2021).

### 1.3. Crisis management and work organization

Work organization plays a crucial role in operational crisis management within institutions and is an integral part of work system design (Bethel et al., 2022). Work organization typically involves planning and structuring the division of labor between humans and technology, organizational structure and processes, collaboration within the work system, work planning and control, leadership within the work system, and systems for working hours and incentives (Schlick et al., 2010). Adjusting work organization enables institutions to respond appropriately to crisis-related challenges (Merkle, 2014). At the pandemic's onset, German hospitals lacked concrete work organizational interventions and strategies to guide their responses to the pandemic's challenges (Schmola and Koch, 2022).

### 1.4. Nurses

Nursing staff form an essential component of the highly complex work system in hospitals (American Nurses Association, 2024). In Germany, the COVID-19 pandemic introduced numerous challenges for nurses across all areas of acute care (Zink et al., 2024b). For the approximately 486,100 nurses employed in German hospitals (as of December 31, 2020; Destatis, 2022), pandemic-related challenges, such as insufficient rest due to staff shortages, concerns about personal infection and family health, and additional overtime, added to existing work conditions (Weigl and Schreyer, 2021; Zink et al., 2024b). A study by a German health insurance provider showed that hospital nurses reported an increase in sick days from 2021 to 2022, with a peak of 28 sick days per person in 2023, the year following the pandemic (Techniker Krankenkasse, 2024). Maintaining the health of nursing staff is crucial to sustaining care amid widespread staff shortages. The WHO has described the nursing staffing situation as a "ticking time bomb" that could lead to a catastrophe in the European region in the coming decades (World Health Organization, 2022).

Ensuring adequate nursing services and staffing is a vital component of crisis management and is influenced by work organization (Frodl, 2022; Holden et al., 2013). Research on work organization in hospital units suggests that nurses' experiences of strain are influenced by organizational factors (Stab and Hacker, 2016). Crisis-related adjustments to work organization can contribute to successful crisis management and alleviate the burden on nurses. More attractive health-promoting working conditions, even in times of crisis, can help retain staff in the profession (Auffenberg et al., 2022).

This study, conducted across German hospitals, aimed to answer the following question to generate insights about work organizational interventions and strategies at the institutional and unit levels based on pandemic experiences:

1. What work organizational changes, interventions, and strategies have been reported by nurse leaders in hospitals to address pandemic-related challenges?

### 1.5. Current literature and practical purpose

Since the pandemic's onset, numerous studies have examined pandemic-related challenges and crisis management strategies in hospitals from both international (Donelli et al., 2022; Freitas et al., 2021; Gillberg et al., 2023; Jääski et al., 2024; Poortaghi et al., 2021) and German national perspectives (Behar et al., 2022; Finke et al., 2022; Schmidt-Stiedenroth et al., 2023; Zhelyazkova et al., 2023). Some of these studies include the perspectives of nurse leaders (Freitas et al., 2021; Jääski et al., 2024; Poortaghi et al., 2021), focusing on the crisis management competencies of nursing leaders (Jääski et al., 2024), or hospital resilience (Gillberg et al., 2023). Of these studies, many were focused on the first year of the pandemic (Gillberg et al., 2023; Poortaghi et al., 2021; Schmidt-Stiedenroth et al., 2023; Zhelyazkova et al., 2023) or on isolated interventions (Zink et al., 2024a).

Despite the critical role of hospital nurses in pandemic responses, no study has systematically analyzed how their work organization evolved throughout the entire COVID-19 pandemic (March 2020–April 2023 in Germany) from the perspective of nursing leadership. Addressing this gap is essential, as analyzing these structural changes can provide evidence-based insights to enhance hospital crisis management by integrating lessons learned from this pandemic. Given the heightened risk of future pandemics due to the escalating climate crisis (IPBES, 2020; Settele, 2020; Trauboth, 2022), this study provides valuable insights that can inform practical strategies for optimizing hospital operations. Its findings can support hospital administrators and public health authorities in implementing targeted interventions to strengthen pandemic preparedness and improve nurses' working conditions during future crises.

To address the research question and achieve the study's objectives, a descriptive qualitative design was employed and semi-structured interviews were conducted. The qualitative design allows for an in-depth understanding of complex, context-specific experiences and offers rich insights into the perspectives of nurse leaders, which quantitative approaches may not capture. A qualitative approach is particularly well-suited for investigating novel and underexplored phenomena, such as the COVID-19 pandemic, where existing knowledge is limited (Hammarberg et al., 2016).

## 2. Methods

### 2.1. Study context and setting

In Germany, on November 25, 2021, the national pandemic emergency was officially declared over ([Bundesministerium für Gesundheit, 2024](#)), with COVID-19 protection laws later expiring on April 7, 2023 ([Die Bundesregierung, 2023](#)). The Robert Koch Institute identified nine pandemic phases (six waves and two plateaus) in Germany between January 2020 and June 2022 ([Tolksdorf et al., 2022](#)).

Saxony, a German federal state, was particularly affected by the pandemic. Since the pandemic's onset, 17,486 people in Saxony have died with or from COVID-19 (as of August 10, 2024; [Corona-in-Zahlen.de, 2024a](#)). At 0.9 %, Saxony had Germany's second-highest mortality rate. In Saxony, one in four people is over 65 ([Bund-Länder Demographie Portal, 2024](#)), with a mortality rate of 1.7 % for those aged 60–79 years and 9.8 % for those > 80 years ([Corona-in-Zahlen.de, 2024b](#)). Nationwide, Saxony has the lowest vaccination rate (66 % as of April 8, 2023, [Impfdashboard, 2023](#)). Societal and political attitudes toward COVID-19 political regulations posed challenges for pandemic management and healthcare facilities in Saxony ([Jaschke et al., 2023](#); [Volk, 2021](#)).

Saxony's 76 hospitals have approximately 25,000 beds and 22,133 nurses (as of 2019; [Verband der Ersatzkassen e.V., 2024](#)). Hospitals are categorized as general hospitals (Level 1: basic care; Level 2: specialized care; Level 3: maximum care) and specialist hospitals ([Staatsministerium für Soziales und Gesellschaftlichen Zusammenhalt, 2024](#)).

### 2.2. Study design

This study used a descriptive qualitative design. Semi-structured interviews were conducted with nurse leaders from various management levels (e.g., strategic, middle, and operative management) in hospitals across Saxony (translated guide in Supplementary File 1). To prevent memory lapses, a graphic depicting pandemic-related events was used (Supplementary File 2). Interview data were supplemented with quantitative organizational data (e.g., hospital size, nursing staff size) and interviewee sociodemographics. The Ethics Committee of the German Federal Institute for Occupational Safety and Health approved research project F2541 (047/2021).

### 2.3. Recruitment of nurse leaders

The study aimed to recruit at least 24 nurse leaders from eight hospitals. Nurse leaders in hospitals in Saxony across different clinical and regional areas, management levels, and ownership types were purposively sampled. This approach ensured a diverse representation of pandemic experiences. In qualitative research, sample heterogeneity contributes significantly to the robustness of the findings ([Merkens, 2003](#); [Patton, 2015](#)); hence, inclusion criteria for hospitals were the location of the facility in non-metropolitan or metropolitan regions in different parts of Saxony, and privately, publicly, or non-profitably led hospitals. Inclusion criteria for interviewees were being a nurse leader in a Saxonian hospital, working in the same hospital and in a leading position during the pandemic and working in or being responsible for an area strongly affected by the COVID-19 pandemic (e.g., COVID-19 units, intensive care units, closed units). The objective was to recruit at least three nurse leaders from each hospital, with a minimum of one nurse leader being part of strategic or middle management and two nurse leaders being part of operative management of two different units.

Two project members conducted recruitment via phone and email. In total 17 hospitals were contacted multiple times. Upon positive response, further study documents on study objective were sent to obtain informed consent, which was given by 11 hospitals (64 % response rate). Reasons for negative response were time restrictions, staff shortage, high patient load, negative pandemic experience, time required to fulfill organizational data survey, time required for nurse leaders to receive management approval for study participation, and no approval of participation by the hospital's management. One of the participating hospitals dropped out before the first interview due to illness among nurse leaders. Participants received 50 Euro for their participation.

### 2.4. Data collection

The research team developed, refined, and piloted an interview guide internally and externally. Major revision was undertaken after internal piloting (with a researcher formerly working in nursing, and one student). After external piloting only minor revisions were necessary. The researcher team discussed repeating pilot interviews and decided against repetition and for including pilot interviews in the data set due to the disproportionate effort required from participants and the satisfactory quality of interviews. After interviewer training and mutual observations among the three interviewers (during piloting and the first six interviews), 31 interviews were conducted between July 2022 and June 2023, following the pandemic's end. These lasted 45–90 min, and were recorded using a digital recorder, with approximately 1600 min of interview data analyzed. The interviews took place in a quiet and private room at the participants' workplaces, with only participants and researchers present during the time of the interview. Initial questions covered the current COVID-19 situation followed by perceived pandemic-related challenges for their organization, team, and nursing staff. Subsequently, they were asked to describe their hospital's strategic approach and the work organizational interventions throughout the pandemic. Interviewers took notes for each interview (see first page of Supplementary File 1).

### 2.5. Data analysis

The 31 audio files were transcribed and analyzed using descriptive qualitative content analysis in MAXQDA following the

methodology outlined by Kuckartz and Rädiker (2022). One researcher coded the interviews using deductive and inductive codes, the coding system and the assignment of text passages were discussed and evaluated by the research team. Changes and interventions were coded and clustered into strategies. Further information on the changes was gathered (e.g., points in time, cause, goal, evaluation by nurse leaders, area of implementation, level of decision-making).

Regarding the overall study aim, data saturation was adequately achieved at approximately 80 % of interviews, with no noteworthy interventions emerging in the intervention main category. Still, three aspects need to be mentioned here. First, participants of interviews carried out at the end of the collection phase, where the COVID-19 pandemic was coming to its end, were partly focusing on interventions implemented on recovery. This information is missing in earlier interviews. Data saturation regarding this category seems to be insufficient. Second, data saturation was greater at operative management level as two interviews were conducted per hospital. Third, due to sample heterogeneity and the focus on areas strongly affected by the COVID-19 pandemic, in-depth data saturation may be insufficient for interventions in psychiatry clinics ( $N = 1$ ), in non-COVID-19 areas and for hospitals of level of care 1 ( $N = 1$ ). The conduct of more interviews to increase data saturation for the mentioned areas was restricted due to study funding.

Thirty-one nurse leaders were interviewed; however, one interview was excluded due to poor quality of interview conduct, leaving 30 interviews from nine hospitals in the final analysis. Table 1 presents the sample composition. A high degree of heterogeneity was achieved regarding hospital characteristics (region, ownership, level of care, hospital size) and participant characteristics (sex, age group, hierarchical level).

## 2.6. Quality criteria of qualitative research

According to the Consolidated Criteria for Reporting Qualitative Studies (COREQ; Tong et al., 2007), qualitative studies must consider the research team, reflexivity, study design, analysis, and findings. An interview guide was used to ensure comparability between interviews (Supplementary File 1). This questionnaire was developed in collaboration with the interviewers and finalized after two pilot interviews. To standardize its use across three interviewers (one male, two females), interviewer training and mutual observations were conducted. All three interviewers had prior experience conducting semi-structured interviews. During the analysis phase, multiple researchers discussed the coding system (three researchers) and results (five researchers). Several quotes (following content equivalent translation by authors using back-translation) are reported to illustrate the findings (Supplementary File 3); an overview of found interventions and a more detailed summary of data is provided (Supplementary File 4 and 5). Moreover, the frequency of mentions per strategy theme and the respective main and sub categories are tabulated in Supplementary File 6. The COREQ checklist is provided in Supplementary File 7.

## 3. Results

### 3.1. General description of interviews

Participants were open and highly motivated to share their experiences with the interviewers. The focus of the reported work on organizational changes, interventions, and strategies varied depending on the respondents' hierarchical level: higher hierarchical levels emphasized strategic approaches and changes affecting the entire organization, while lower hierarchical levels focused more on

**Table 1**  
Characteristics of hospitals and participants.

Hospital					
Ownership	public		private	charitable	Total
N	4		3	2	9
Level of care	level 1	level 2	level 3	specialist hospital	Total
N	4	2	1	2	9
Regional distribution	metropolitan		non-metropolitan		Total
N	5		4		9
Hospital size	min	max	M	SD	Total
nurses	120	2000	666.7	607.3	8
beds	165	1451	506.7	506.6	8
Participants					
Management level	strategic		middle management	operative	Total
n (%)	5 (16 %)		8 (27 %)	17 (57 %)	30 (100 %)
Assigned area	non-COVID-19 unit		general isolation unit	intensive care unit	Total
n (%)	5 (26 %)		10 (53 %)	4 (21 %)	19 (100 %)
Education	vocational degree		college/university degree	other	Total
n (%)	11 (48 %)		8 (30 %)	6 (22 %)	27 (100 %)
Age group (in years)	26–35	36–45	46–55	56–65	Total
n (%)	4 (13 %)	12 (40 %)	8 (27 %)	6 (20 %)	30 (100 %)
Sex	female		male		Total
n (%)	21 (70 %)		9 (30 %)		30 (100 %)

Note. n = number of participants; N = number of hospitals; M = mean; SD = standard deviation.



unit operations and direct patient care. At the unit management level, participants reported the impact of strategic decisions and organization-wide interventions, as well as how these were implemented on their unit.

Participants recalled changes and interventions over a prolonged period, with most remembering many details, and the graphic depicting various pandemic-related events was perceived as a helpful memory aid. However, due to memory gaps, the multitude of changes and interventions, and the limited interview time available, only a few changes and interventions were comprehensively described. Consequently, some columns in the tables of Supplementary File 4 may lack information.

A clear distinction between reactive work organizational change and planned work organizational intervention could not be made. To avoid confusion between the terms (work organizational) changes and pandemic-related effects, modifications, or challenges, the term “intervention” will be used in the following to represent both work organizational changes and interventions.

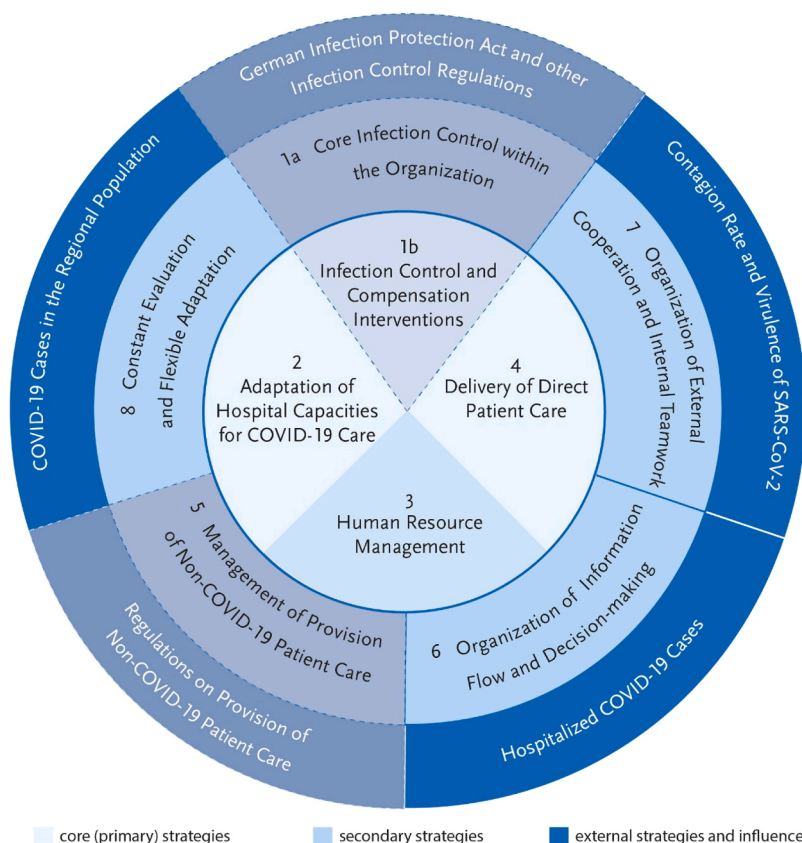
### 3.2. Work organization in different phases of the pandemic

*“But clearly, when you look at it with some distance, it was actually the most significant change in processes and working conditions that I’ve experienced in my 12 years in this position. And it was something that was unimaginable beforehand.”*

(Nurse leader in strategic management - KH12PD23, Pos. 6) [translated by authors]

Participants vividly described their different work situations during the pandemic, characterized by pandemic management based on limited resources (time, personnel, materials, finances). Numerous impacts of the pandemic have become apparent in highly complex work systems. Hospitals’ primary task was to prevent a COVID-19 outbreak within the hospital while also treating patients with COVID-19 alongside regular patients, resulting in increased patient loads. This surge in patient load required enhanced infrastructural and personnel resources and often forced hospitals to make difficult decisions regarding patient care prioritization while facing economic risks. The already scarce personnel resources were further strained by high staff absences due to SARS-CoV-2 infections, often with short notice times.

Three phases (pandemic preparation, high patient load, pandemic’s end) were evident in the descriptions of work situations. In all hospitals, the *preparatory phase* was described at the pandemic’s onset. This phase was marked by the implementation of initial interventions before the first patients with COVID-19 were admitted. This phase’s duration varied depending on the region and the hospital’s integration into the regional COVID-19 care system. Larger urban hospitals dealt with patients with COVID-19 earlier (March–April 2020), resulting in a short preparation phase and ongoing demands throughout the pandemic. Smaller urban or rural



**Fig. 1.** Pandemic management strategies of hospitals as reported by nurse leaders and their influences on the external environment.

hospitals either prepared early but were not confronted with COVID-19 care before the second wave's onset or prepared for COVID-19 care only at the second wave's onset. In some of these hospitals, the extended preparation phase sometimes led to an underestimation of the pandemic's impact during the second wave.

*"[In the second wave], we were all surprised by it. Sure, it was becoming apparent in the surroundings, but no one really believed it after [low patient with COVID-19 load in] the first wave."*

(Nurse leader in middle management - KH09PDL02, Pos. 30) [translated by authors]

The subsequent *phase of high patient load* was described in all hospitals and lasted until the end of the fifth wave (02/2022), even though patient admissions had already started to decline. This peak phase occurred when the pandemic's effects were most strongly felt. Especially during the second and third waves (Fall 2020–Winter 2021), the number of severely ill patients was very high, necessitating infrastructural adjustments to centralize COVID-19 patient care in COVID-19 intensive care units and general isolation units. The number of severely ill individuals had decreased by the end of the fifth wave. Simultaneously, widespread infections within the general population increased the number of patients with primary and secondary COVID-19 in interdisciplinary general isolation units. Nursing staff were also exposed to the virus, leading to staff shortages during this phase.

In the *pandemic's final phase*, the number of severely ill patients with COVID-19 and those with COVID-19 as their primary diagnosis decreased to levels that no longer required centralized care. These structures were dismantled, and non-COVID-19 care structures were reestablished. Care of patients with COVID-19 was decentralized and isolated within relevant departments based on their primary diagnosis. With this shift in patient demographics (decrease in illness severity and patient numbers), many hospital processes normalized, and a return to pre-pandemic routines began to take shape.

### 3.3. Pandemic management: changes, interventions, and strategies

The pandemic's impacts were addressed at the hospital and unit levels using a complex pandemic management approach. Based on the interviews, numerous work organizational interventions dependent on the hospital, context, and pandemic phase were identified and categorized into the following eight strategies (Fig. 1):

A. Four *core (primary) strategies* central to the hospital's pandemic management (Fig. 1, inner circle): 1. (Core) Infection control and compensation interventions within the organization; 2. Adapting hospital capacities for COVID-19 care; 3. Human resource management; and 4. Delivery of direct patient care

The first of these strategies, infection control, holds a special position across the outer, middle, and inner circles (Fig. 1). Hospitals were required to comply with political regulations for infection control (Fig. 1, outer circle), significantly influencing their internal core infection control strategies (S1a in Fig. 1, middle circle). Additionally, hospitals and units had to implement context- and phase-dependent infection control interventions to meet core infection control requirements and mitigate their consequences (S1b in Fig. 1, inner circle).

B. Four *secondary strategies* that provide the framework for the success of the core strategies (Fig. 1, middle circle): 5. Management of the provision of non-COVID-19 patient care; 6. Transparent organization of information flow and decision-making; 7. Organization of external cooperation and internal teamwork; and 8. Constant evaluation of pandemic management and flexible adaptation to the pandemic's changing dynamics

The interventions implemented according to these strategies were influenced by political directives for infection control and regulations on the provision of non-COVID-19 care, contagion rates and virulence of SARS-CoV-2, the prevalence of COVID-19 cases in the regional population, and hospitalized COVID-19 cases (Fig. 1, outer circle).

Identified interventions either were implemented during certain pandemic phases or throughout the entire pandemic period. The pandemic phases (pandemic preparation, high patient load, the pandemic's end) are reflected within strategies 1–7, each associated with different interventions. However, phase-independent interventions applicable throughout the pandemic period were identified within strategies 1, 3, 6, 7, and 8. The following section briefly introduces each strategy and provides examples of work organizational interventions in Table 2 (for an overview of all strategies, see Supplementary File 5, for a detailed description, see Supplementary File 4). Fig. 2 visualizes the number of main intervention categories, their respective subcategories, and the frequency with which participants mentioned interventions within each strategy theme (for more details, see Supplementary File 6).

#### 3.3.1. Core (primary) strategies

##### Strategy 1. (Core) Infection control and compensation interventions within the organization

###### 1a Core Infection Control

This strategy aimed to prevent infection transmission within the hospital by implementing and adjusting work organization to comply with legal requirements. This strategy was phase-independent.

###### 1b Infection Control and Compensation Interventions

**Table 2**

Examples of organizational interventions for each strategy, categorized by pandemic phase and throughout the entire pandemic.

	Throughout the entire pandemic	During pandemic preparation	During high patient load	During the end of the pandemic
<b>S1a Core infection control</b>	<i>Throughout the entire pandemic</i> - spatial isolation of patients with COVID-19 (in single rooms or isolation units) - organization and use of hygiene materials and tests - administration of vaccinations and hygiene training - monitoring of the implementation of infection control interventions - reduction of social contacts within the hospital and with relatives - ensuring optimal infection control by incorporating the expertise of other actors, particularly the hygiene department			
<b>S1b Infection Control and Compensation Interventions</b>	<i>Compensatory interventions due to social restriction, e.g.:</i> digital delivery of training and meetings - enabling relatives to stay connected despite access controls	- implementation of strict visitation bans according to legal regulations - stocking protective materials - usage of fabric masks due to material shortage	- maintenance of strict visitation bans - prevention of transmission through contaminated materials <i>Intersection between infection control and patient care:</i> minimization of access to personnel on COVID-19 units and within COVID-19 patient rooms - reorganizing diagnostics for patients with COVID-19: separate transport routes - establishing fixed time slots - having diagnostics performed by nursing staff on the unit <i>Intersection of infection control and human resource management:</i> separation of staff involved in COVID-19 areas and non-COVID-19 areas during daily routine, internal and cross-departmental staffing - execution of non-nursing tasks by staff on COVID-19 general isolation units due to contact restrictions: administrative tasks (managing inventory) -service tasks (meal organization, cleaning) -medical tasks (laboratory tasks, blood draws)	- availability of voluntary testing for staff <i>Intersection between infection control and adaption of infrastructural capacities:</i> decentralized isolation in the department corresponding to the primary diagnosis - storing of hygiene materials on the units to be available if an infectious patient was admitted <i>Intersection between infection control and patient care:</i> ensuring patients with COVID-19 were seen last by nursing and medical staff - minimization of personnel access to COVID-19 patient rooms - loosening access controls for relatives - maintenance of testing requirements upon patient admission
<b>S2 Adaptation of Hospital Capacities for COVID-19 Care</b>		- setting up and preparing small COVID-19 general isolation units and isolation areas on general and intensive care units - installing a sluice system for donning and doffing personal protective equipment on isolation units - reserving an empty unit that could be converted into a COVID-19 general isolation unit	- infrastructural adjustments on the isolation units -creating storage or X-ray rooms -provision of medical equipment - infrastructural adjustments in the non-COVID-19 areas Consolidation of several units on one unit to keep other units available for COVID-19 care - general increase in the number of available medical devices - monitors, ventilators <i>Intersection of adaption of capacities and infection control</i> - expanding and adjusting infrastructure for the centralized care of patients with COVID-19 - establishing isolation areas, opening COVID-19 general isolation units, or	<i>Depending on the hospital level of care, region, and associated load of patients with COVID-19:</i> dismantling of centralized COVID-19 units and reopening of units for non-COVID-19 care - retaining centralized care but reducing its capacity - keeping one empty unit available in case of a renewed patient surge

(continued on next page)



Table 2 (continued)

	Throughout the entire pandemic	During pandemic preparation	During high patient load	During the end of the pandemic
<b>S3 Human resource management</b>	<p><i>Training</i> in addition to the hygiene training; Provide training in reporting procedures, COVID-19-specific topics, and treatment options</p> <p><i>Employee support:</i></p> <ul style="list-style-type: none"> <li>conversation offers between nursing staff and their leaders</li> <li>- expressions of appreciation from nursing management</li> <li>- psychological interventions: supervision</li> <li>-access to psychologists</li> <li>-reintegration of COVID-19-recovered but performance-impaired individuals: working in less demanding areas</li> <li>-assigning lighter duties</li> <li>- ensuring fixed shift changes for working in full protective gear</li> <li>- ensuring that FFP2 masks were never worn for more than two hours at a time</li> <li>- provision of relaxation opportunities within (e.g., massage chairs) and outside the workplace (e.g., wellness vouchers)</li> <li>- provision of childcare support: financial assistance</li> <li>- on-site childcare options</li> </ul>	<ul style="list-style-type: none"> <li>-mentally preparing staff for the pandemic and its potential impacts</li> <li>- provision of training:in intensive care competencies</li> <li>-preventively increasing shift durations to 12-h shifts</li> </ul>	<p>restructuring intensive care units or intermediate care areas into COVID-19 intensive care units.</p> <ul style="list-style-type: none"> <li>- designating the COVID-19 unit as a fully contaminated area and reducing the strictness of infection control (in consultation with the hygiene department)</li> </ul> <p><i>See full text Strategy 3</i></p> <ul style="list-style-type: none"> <li>- Adjustment of staffing to meet (higher) care demands</li> <li>-employee support</li> <li>Sub-strategies</li> <li>- meeting staffing needs through internal and external recruitment</li> <li>- meeting staffing needs through training and redeployment of nursing staff within the hospital</li> <li>- appropriate staffing based on qualifications</li> <li>- extension of work hours in duty planning</li> <li>- flexible and rapid adaptation to staff shortages</li> <li>- coordination of cross-unit staffing</li> </ul>	<ul style="list-style-type: none"> <li>- ensuring the preservation of gained competencies during the peak phase: maintaining staff rotation between departments</li> <li>- practicing skills such as prone positioning</li> </ul> <p><i>Employee support:</i>organization of an interdisciplinary large-scale event where employees could share and reflect on their experiences</p>
<b>S5 delivery of direct patient care</b>	<p><i>During high patient load:</i></p> <p><i>COVID-19 general isolation units:</i>Optimization of prone positioning sets to make the process simpler and less time-consuming</p> <ul style="list-style-type: none"> <li>- shifting the nursing system to functional care, allowing nursing tasks to be assigned according to the qualifications of the nursing staff</li> <li>- adjusting shift schedules to meet the care demands and the needs of the patients</li> </ul> <p><i>Intersection between patient care and control interface</i></p> <ul style="list-style-type: none"> <li>-runner services were established in the unit hallways: one nursing staff member remained in full protective gear at the patient's bedside, while another person could relay information or materials as needed without requiring continuous donning and doffing of protective equipment</li> <li>- similar approach for nursing support during medical rounds: the nurse stayed in the hallway during the round and documented the visit</li> <li>- alternative organization of medical visits: no nursing support but discussions with medical teams before medical rounds</li> <li>- providing digital tools for patient-relative-communication (via phone or video call)</li> </ul>			
<b>S5 management of provision of non-COVID-19 patient care</b>		<ul style="list-style-type: none"> <li>-reduction or cessation of elective procedures to prepare for the anticipated high load of patients with COVID-19 dictated by political regulations</li> <li>-internal coordination through meetings to adjust the number of elective procedures according to capacity and the pandemic situation</li> </ul>	<p><i>To accommodate the extensive redeployment of staff and to manage COVID-19 patient loads:</i>closing of non-COVID-19 general units were closed during this phase (in some cases, up to three units)</p> <ul style="list-style-type: none"> <li>- reduction of elective procedures (typically voluntarily by the hospitals, as maintaining adequate care would otherwise have been</li> </ul>	<p>Care gradually normalized, and the care of patients with COVID-19 was integrated into the care of non-COVID-19 patients: no more bed closures</p> <ul style="list-style-type: none"> <li>- no more unit shutdowns</li> <li>- no restrictions on non-COVID-19 patient admissions</li> </ul>

(continued on next page)

Table 2 (continued)

	Throughout the entire pandemic	During pandemic preparation	During high patient load	During the end of the pandemic
			impossible) <i>Intersection between the management of non-COVID-19 care and infection control</i> Toward the end of this phase, one hospital provided decentralized care for patients with COVID-19 alongside centralized care:decisions on how to handle elective procedures for infectious patients on non-COVID-19 units: some infectious patients were not admitted or were discharged early after surgery	
<b>S6 transparent organization of the flow of information and decision-making</b>	<ul style="list-style-type: none"> <li>- maintaining networking with regional hospital management</li> <li>- maintaining crisis committee</li> <li>- division into several task groups, each responsible for decisions in specific areas, in larger hospitals</li> <li>crisis committee held phone meetings on Friday evenings after new COVID-19 regulations were announced to adjust the interventions accordingly</li> <li>Facilitation of information exchange at the team level</li> <li>- increasing the frequency of team meetings</li> <li>- introducing additional handovers at midday</li> <li>- immediate dissemination of information due to the cancellation of team meetings</li> <li>Facilitation of information exchange with external stakeholders</li> <li>- video conferences within the hospital network</li> <li>- video conferences between regional hospitals</li> <li><i>Different types of information flow</i></li> <li>top-down communication: <i>at the hospital level</i></li> <li>- procedural instructions</li> <li>- protocols</li> <li>-COVID-19 hotline</li> <li>- emails or newsletters from the crisis committee via the intranet</li> <li>- verbal communication from strategic management to lower hierarchy levels</li> <li><i>at the unit level</i></li> <li>-information folders on the unit</li> <li>Bottom-up communication: feedback mechanisms</li> <li>-open, multi-professional communication formats</li> <li>Both top-down and bottom-up communication:meeting</li> </ul>	<ul style="list-style-type: none"> <li>- establishing a crisis committee that held decision-making responsibility throughout the pandemic and played a key role in managing the flow of information</li> <li>- networking with regional hospital management to allocate resources and evenly distribute the burden on hospitals</li> </ul>		

(continued on next page)

Table 2 (continued)

	Throughout the entire pandemic	During pandemic preparation	During high patient load	During the end of the pandemic
	formats for exchanges between different nursing management levels -physical presence of management on the units to share information or solve problems			
<b>S7 cooperation and teamwork</b>	<i>Throughout the entire pandemic:</i> increasing the autonomy of nursing staff (especially in COVID-19 general units) participatory approach in decision-making, scheduling Organization of support at various levels - mobilization of resources across different professional groups - mobilization of resources within the corporate structure		<i>During high patient load:</i> intensification of working relationships with hygiene experts organization of teamwork with medical staff - Assigning one physician to the COVID-19 general unit -Assigning an entire interdisciplinary medical team	
<b>S8 Evaluation and flexible adaption</b>	<i>Throughout the entire pandemic:</i> - managing patients according to current capacities - establishing both centralized and decentralized care and adapting to illness severity, and changing the assignment of COVID-19-positive patients to units based on their primary illness - adjusting infrastructural capacities based on the volume of patients with COVID-19, repeatedly expanding or reducing capacities -through the opening and closing of units -expansion or reduction of isolation areas - repeated adaption to changing legal regulations, adjusting (e.g., frequency of employee testing, access controls) - managing staffing on a day-to-day basis, flexible deployment of employees needed - developing a tiered concept to ensure a flexible response - constant evaluation (e.g., feedback of employees, reflection by nurse leader) - large-scale evaluation in the form of a moderated dialogue between all professions of the hospital after the end of the COVID-19 pandemic			

Note. S1 - 8: Strategy 1 - 8.

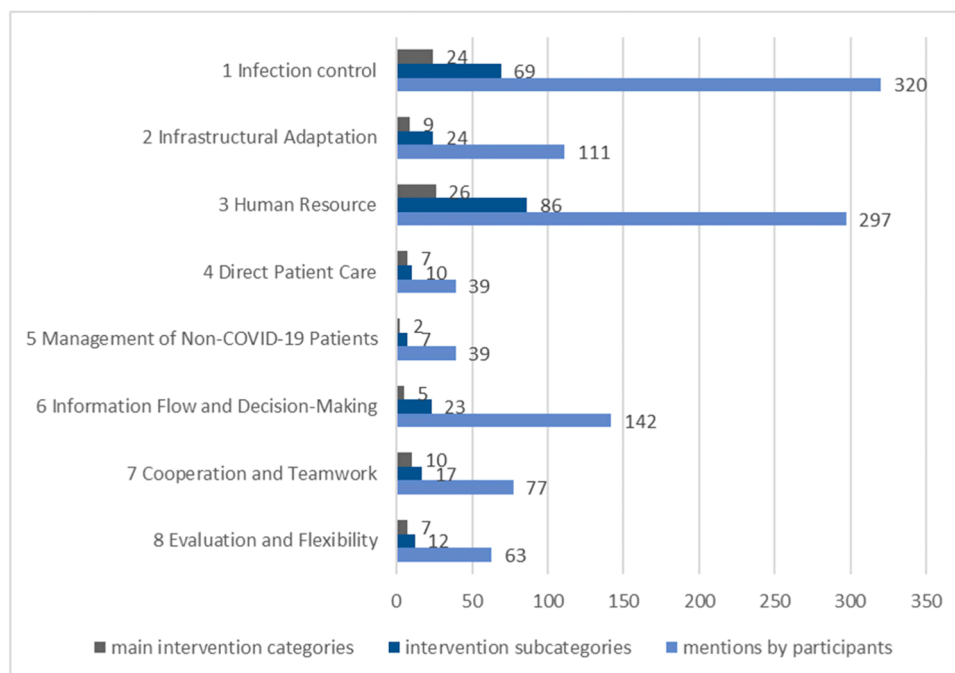


Fig. 2. Number of main intervention categories, respective subcategories, and the frequency of mentions by participants for each strategy theme.

Adherence to core infection control interventions (e.g., reduction of social contact usage of personal protective equipment) impacted many processes within the hospital. This strategy aimed to ensure infection control through various processes and compensate for the consequences of infection control interventions throughout the pandemic. Phase-independent interventions have also been reported.

Some interventions were implemented due to infection control but affect direct patient care (intersection to S4), human resource management (intersection to S3), or adaptation of hospital capacities (intersection to S2).

### Strategy 2. Adaptation of hospital capacities for COVID-19 care

This strategy aimed to adjust hospital capacities for COVID-19 care. It also aimed to ensure infection control and optimize internal processes while considering the provision of care for non-COVID-19 patients (intersection with S5). Interventions that affected infection control were reported (intersection S1). In this strategy, only interventions throughout all the phases were reported.

### Strategy 3. Human resource management

Human resource management was one of the greatest challenges faced during the pandemic. The overarching goal of human resource management was to ensure patient care and maintain the highest possible quality of nursing care by efficiently deploying limited personnel resources in appropriate places. Employee health and motivation were also prioritized through employee support interventions. To increase the available workforce, internal and external recruitment and continued education were pursued. Phase-dependent and phase-independent interventions were reported.

*“Every day was like a puzzle—just when you had the rosters set, everything would collapse like a house of cards because more staff reported sick. I think that staffing was actually the biggest challenge, at least for me as a nurse leader [...]. We organized the units, we got the materials sorted out, even with many compromises, but eventually, that was all in place. But human resource management, that was truly the biggest challenge for me, because it changed by the hour.”*

(Nurse leader in middle management; KH14PDL15, Pos. 24) [translated by authors]

Particularly during the phase of high patient load, various interventions, clustered in sub-strategies, were reported and are explained briefly in more detail:

**During high patient load:** In this phase, various interventions were implemented to ensure adequate staffing. The process unfolded in the following stages:

#### a. Baseline: Adjustment of staffing to meet (higher) care demands:

Implementing hygiene interventions and providing patient care under infection control conditions required additional time from nursing staff, especially during the high patient load phase and in COVID-19 care, which was highly time-consuming. Simultaneously, staff absenteeism was significantly high, and nursing staff were personally burdened by the pandemic. To staff a COVID-19 general isolation unit, management had to allocate 2.5 to 3 times more nursing staff than for a regular unit.

#### b. Meeting staffing needs through internal and external recruitment:

To achieve this and ensure a higher staff-to-patient ratio that would maintain care quality and ease the burden on nursing staff, additional personnel had to be reassigned to COVID-19 areas. Additional personnel were sought in two ways:

- Recruitment of external non-nursing and nursing staff.
- Recruitment of internal non-nursing staff.

#### c. Meeting staffing needs through training and redeployment of nursing staff within the hospital:

The number of available nursing staff was increased in two ways:

- Through nurse training programs.
- By redeploying nursing staff across responsibilities and departments.

#### d. Appropriate staffing based on qualifications:

Despite the aforementioned interventions to increase available staff, a shortage of adequately qualified staff has persisted owing to high absenteeism. Additionally, the mix of qualifications in the units increased due to extensive recruitment and redeployment efforts. Management addressed this by planning work assignments and duty rosters based on staff qualifications to ensure adequate care quality and avoid overwhelming employees.

#### e. Extension of work hours in duty planning:

When interventions to increase available staff and deploy staff based on their qualifications were insufficient to ensure shift coverage and care provision, management had to extend the work hours of existing staff or assign them more frequently (e.g., no vacation options, extended shift durations).

#### f. Flexible and rapid adaptation to staff shortages:

If the interventions from stages b-e failed to ensure shift coverage despite high and spontaneous staff shortages, on-call and standby plans were implemented. In the case of further failure, more flexible interventions were implemented, such as having management step in or redeploying staff from other departments. If adequately qualified personnel were unavailable to fill shifts, staffing ratios were adjusted to below minimum levels, work intensity was further increased, or nursing duties were adjusted or extended beyond typical working hours.

Furthermore, to coordinate cross-unit staffing, certain changes were implemented and interviewees reported additional interventions to support employees during that phase:

**Coordination of cross-unit staffing:** Appropriate organizational structures were established to coordinate the aforementioned staffing mechanisms. These included monitoring work hours and areas, implementing an emergency staffing plan, coordinating among nurse unit managers, and utilizing a nursing pool.

**Employee support:** Employee care interventions intensified during this phase of the pandemic. Management described adjusting their leadership styles and paying particular attention to psychological support for employees (e.g., increased mindfulness, offering conversations, advocating for own nursing team with higher management levels, and physical presence in COVID-19 units). Additionally, interventions that would have further increased staff burden (e.g., 12-h shifts) were avoided. Services such as meal

delivery, beverage provision, and high-quality protective materials were provided. Team-building activities (e.g., joint activities) and recognition efforts (e.g., company events, gifts for employees) were also implemented.

#### **Strategy 4. Delivery of direct patient care**

This strategy aimed to organize unit operations and nursing activities under infection control conditions to ensure the best possible patient care during centralized COVID-19 care. Therefore, interventions have only been reported during high patient loads.

*“A nurse came to me, someone who has been in the profession for 20 years and is [...] very intensively trained in palliative care. I believe she has a lot of experience. She approached me and said, ‘Ms. XX [referring to her own name], what I’m experiencing here has never before affected me psychologically as much as it does now in my career. The helplessness towards the patients—seeing that beyond a certain point, there’s nothing more we can do. The relatives aren’t there, and the patients are alone.’”*

(Nurse leader in strategic management; KH14PDL15, Pos. 50) [translated by authors]

### **3.3.2. Secondary strategies**

#### **Strategy 5. Management of provision of non-COVID-19 patient care**

The goal of the strategy for managing non-COVID-19 care was to create personnel and infrastructural capacities for COVID-19 care as needed while simultaneously ensuring the care of non-COVID-19 patients. This was accomplished through two primary mechanisms: operating or closing general units and managing patient admissions. Only phase-dependent interventions have been reported. At the beginning of the pandemic, this strategy was highly affected by federal and state regulations that dictated the admission of elective patients.

#### **Strategy 6. Transparent organization of the flow of information and decision-making**

Owing to the manifold impacts of the pandemic and the continuous changes resulting from its dynamics, a multitude of decisions had to be made, and there was a significant influx of information regarding the decisions made and interventions to be implemented, which intensified communication within the hospital. This strategy aimed to transparently organize the flow of information within the hospital to the staff. Simultaneously, organizing the flow of information is crucial for hospital management in decision-making. Interventions throughout the pandemic and during pandemic preparations have been reported. They can be distinguished as the top-down flow of information, bottom-up flow of information, and a mix of bottom-up and top-down exchange of information.

*“We would make a decision, and then three weeks later, due to numbers or who knows what, we had to make different decisions again. That was hindering / the communication remained the same, but there were times when employees would say, ‘Enough is enough.’ They understood, but they were simply frustrated. The energy / eventually, the battery, the capacity, gets empty, and they said, ‘I can’t do this anymore.’”*

(Nurse unit manager of a former COVID-19 general isolation unit; KH11TL0121, Pos. 86) [translated by authors]

#### **Strategy 7. Organization of external cooperation and internal teamwork**

To effectively address the impact of the pandemic, the hospital altered its collaboration with external actors, and staff modified their collaboration at both the hospital and unit levels. Interventions throughout the pandemic and during the high patient-load phase have been reported. The pandemic has rearranged working relationships with many relevant stakeholders within and external to the hospital and led to various challenges when cooperation and teamwork was not efficiently managed.

For example, two special cases in three hospitals were reported during the high patient load phase. In the first special case, in two hospitals, issues arose in collaboration with external stakeholders, such as patient transport by taxi companies and problems discharging infectious patients who did not need further hospital treatment. The hospitals had to reorganize patient transport (handled by the Red Cross transport service or a taxi driver personally known to the chief nursing officer) or needed to close an additional unit and allocate it to the care of patients with COVID-19 who were refused admission by care facilities or their families. In the second special case, one hospital experienced a significant wave of resignations among its nursing staff due to dissatisfaction with internal collaboration during the first year of the pandemic. This will be explained at the end of the Results section. An overview and detailed description of the interventions implemented in the context of the special cases is provided in Supplementary File 4 and 5.

#### **Strategy 8. Constant evaluation of the pandemic management and flexible adaptation to changing dynamics of the pandemic**

This phase-independent strategy aims to respond flexibly to changing pandemic-related challenges and continuously adapt and optimize the hospital’s pandemic management. In five hospitals, the implemented interventions were evaluated by management (e.g., evaluation processes) or in collaboration with staff (e.g., feedback mechanisms between management and staff). Only one hospital reported organizing a large-scale evaluation event (moderated dialogue between professionals and departments).

### **3.4. Nursing perspective on the hospital’s pandemic management and case example**

Although numerous impacts and challenges with negative effects on the nursing staff were described, and some were not addressed, most respondents conveyed a general sense of satisfaction with pandemic management. This is reflected in the evaluation of the interventions, with respondents rating more interventions positively than negatively (for more details on nurse leaders’ perspectives, see column 11, “Assessment by nurse leaders” in Supplementary File 4).

Internal hospital crisis management was criticized in four interviews. Three of these interviews were conducted in a single hospital

where “mismanagement” led to high voluntary turnover among the nursing staff. Following feedback discussions, hospital management improved collaboration with nursing staff as the pandemic progressed (e.g., involving them in the crisis committee) and implemented interventions that met nurses’ requests (e.g., access to crisis intervention teams or psychotherapists). After closer examination of these negative examples, we identified the following points relevant to pandemic management from the nursing staff’s perspective: participation in decision-making, internal and external support, transparent communication, and a management team that values the nursing personnel (for a detailed description of the case studies, see Supplementary File 8).

Two additional aspects of successful pandemic management are the ability to reflect on one’s own crisis management and a culture of learning from errors. After the mass voluntary turnover of the nursing staff, the hospital critically examined its own error management and worked through the pandemic management process in a participatory manner. As a result, improvements were initiated (e.g., expanding the task force and providing psychological support to the nursing staff). In contrast, a fourth respondent questioned the hospital management for explicitly rejecting the request for an open evaluation between the pandemic waves, thereby avoiding critical reflection:

*“There was never [an evaluation] [...]—because I said we urgently need to sit down after the first wave, at the latest after the second wave, to see what we did wrong, how we want to structure things, how we will do it differently. We have to do that with everyone involved. Back then, my medical supervisor said to me, ‘Then you also have to accept that you made mistakes.’ I said, ‘Of course, I want to know that. I want to know what I need to do differently. I don’t want to go through life blindly.’ But because of this [fear] that I might be told I made a mistake, it just wasn’t done.”*

(Former nurse manager of the department where the COVID-19 general isolation unit was assigned; KH15PDL0141 - Pos. 65)  
[translated by authors]

Another notable aspect is the organization of psychological support for nursing staff in the hospital of the second special case. This support was an explicit request from the nursing staff as part of the evaluation process but was hardly utilized. The desire to converse with psychologists who have been organized, but then not utilized by nursing staff, has also been reported in other hospitals.

## 4. Discussion

### 4.1. Pandemic management and main challenges

This study provides an overview of organizational interventions from the perspective of 30 nurse leaders working in German hospitals in the federal state of Saxony, a region extensively burdened by the COVID-19 pandemic.

Based on qualitative interview data, we described the work organization in the context of pandemic management. The following main challenges are derived from this, which can be partially found in other studies: limited resources (time, personnel, materials, and finances; e.g. Freitas et al., 2021; Hossny et al., 2022; Kraus et al., 2025), high patient load and structural adjustments, especially during the peak phase (Kraus et al., 2025), unequal preparation phases between hospitals, transition at pandemic’s end.

The focus of this study was to identify strategies and interventions as part of hospitals’ pandemic management. We derived eight strategies (four core and four secondary) for COVID-19 management in acute hospital care and gave examples of interventions: (core) infection control and compensation interventions, adaption of hospital capacities for COVID-19 care, human resource management, delivery of direct patient care, management of provision of non-COVID-19 patient care, transparent organization of the flow of information and decision-making, constant evaluation of pandemic management, and flexible adaptation to changing dynamics of the pandemic. Other studies partially identified similar interventions, strategies, or themes: e.g., changes in work schedules and staff allocation, training and education, material equipment, infrastructural changes, infection control, organizational support, communication and collaboration (Hossny et al., 2022); infrastructural changes, organization of patients with and without COVID-19, infection control, human resource management, information and communication, guidelines, pandemic plans and task force (Kraus et al., 2025); or human resources, physical structure, equipment, supplies preparedness, and adequacy of patient care (Freitas et al., 2021). The in-depth analysis and comprehensiveness of strategies and corresponding interventions is a unique feature of the study.

Because the study was conducted at the end of the COVID-19 pandemic, it was also possible to describe the evolution of interventions and strategies throughout the pandemic. Three distinct pandemic phases were identified: pandemic preparation, high patient load, and end of the pandemic. Also, interventions lasting throughout the entire pandemic were identified. This distinction of strategies and interventions across pandemic phases is another unique feature of this study. Furthermore, the complex challenges of the blurred lines between strategic and operative crisis management on national- and facility level, as discussed above and reported in other studies (e.g. Kraus et al., 2025; Leppäkoski et al., 2023), are depicted in interventions and strategies.

### 4.2. Aspects of successful crisis management

Based on our results, various aspects of successful pandemic management were identified. The central themes from the nursing service’s perspective were flexibility and creativity, participation in decision-making and transparent communication, leadership quality and a management team that values nursing personnel, internal and external support, and a culture of reflection and learning from mistakes. These factors are similar to those for the successful implementation of organizational interventions identified by Roodbari et al. (2022).



#### 4.2.1. Flexibility and creativity

A pandemic is characterized by prolonged duration and high variability. For almost 3 years, hospitals had to implement numerous organizational interventions with (most of the time) limited resources (staff, time, materials, finances), which varied depending on the pandemic phase and significantly changed their daily operations. The complexity of the crisis required a great deal of flexibility at the hospital level and among nursing staff. The results showed that the reported interventions were highly context-dependent. This requires creativity and a high degree of adaptability at all levels of nursing management. The importance of flexibility and creativity for successful COVID-19 pandemic management is supported by several studies in hospital settings (Dagenais et al., 2023; Hosny et al., 2022; Poortaghi et al., 2021; Troisi et al., 2022; van Heel et al., 2022) and other settings (Alzuod and Alqhaiwi, 2022; Arokodare and Falana, 2021).

#### 4.2.2. Participation and transparent communication

Participation and transparent communication were implemented in Strategies 6 (flow of information) and 7 (cooperation and teamwork) and were identified as relevant in the case study. Nursing service participation can be seen as genuine involvement in decision-making authority, engaging in general collaboration (e.g., nursing management as part of the task force), or as co-determination in decision-making (e.g., participation in patient admissions) (Wright, 2010).

As a prerequisite for participation, a transparent flow of information (Wright, 2010) must be ensured across all nursing management levels (e.g., leaders in middle management functioning as multipliers). Crisis communication became a central task during the COVID-19 pandemic, though it was challenging for many hospitals (Castro-Martínez et al., 2022; Gautier et al., 2023). For example, centralizing information management (ensuring everyone receives consistent information from a single source) and democratizing access to information (providing all employees with equal access) minimized information uncertainty and ambiguity. This reduces employees' fear and strain (Hayirli et al., 2023).

#### 4.2.3. Leadership quality and appreciation of nursing personnel

Crisis communication was part of hospital management during the pandemic and an important leadership responsibility (Jääski et al., 2024; Leppäkoski et al., 2023). For instance, leaders' physical presence, situational and flexible actions, and motivation enhancement played a central role in crisis management (Jääski et al., 2024; Poortaghi et al., 2021). In this case study, inadequate leadership quality (e.g., lack of appreciation of nursing service) led to high staff turnover. Following Strategy 3 (human resource management), leaders implemented various interventions to support their employees (e.g., physical presence, offering conversations). Support from strategic and middle management is an aspect of leadership quality during crises and is recognized by nurses as a sign of appreciation. Training leaders in crisis management and employee support competencies can improve their ability to respond to the many challenges nurse leaders face during crises and can enhance successful reactions to the manifold challenges nurse leaders face during crisis situations (Jääski et al., 2024).

#### 4.2.4. Internal and external support

In the case study and Strategy 3 (human resource management), psychological support (e.g., through psychologists, coaches, crisis intervention teams, supervision) was offered on an individual level. In several cases, nursing staff did not utilize these services. However, we were unable to identify the specific causal reasons for this lack of utilization. Halms et al. (2023) found that healthcare professionals rarely sought psychological support during the COVID-19 pandemic, potentially due to factors like shame, fear of negative consequences of seeking help, or reluctance to show mistakes or weaknesses. Implementing low-threshold services tailored to the target group and reflecting on the underlying norms of the hospital are recommended (Halms et al., 2023).

At the organizational level, external networks (e.g., within the corporate structure, regional hospitals) were perceived as supportive and helpful for sharing experiences and generating best practice examples (Strategy 7: Cooperation and teamwork). Sander et al. (2023) recommended expanding regional networks to enhance support and collaboration during crises, based on their study of long-term care facilities in Germany.

#### 4.2.5. Reflection and error culture

Successful pandemic management requires continuous evaluation and a culture of learning from mistakes to build on past experience (Frese and Keith, 2015; Kohn, 2009). Particularly in healthcare settings, a culture of "good errors" may be absent (Kohn, 2009). In this study, only five hospitals explicitly described interventions to evaluate their pandemic management (e.g., leader self-reflection and staff feedback sessions). One hospital implemented a comprehensive intervention to learn from experience (moderated dialogue among professionals). In one hospital, the lack of a culture of learning from error was criticized. To prepare for future crises, hospitals must establish more interventions to evaluate crisis management during crises and learn from their post-crisis experiences. Improving internal error culture is essential for achieving this goal.

In conclusion, various internal crisis management approaches have been identified. However, it should be noted that these representations are primarily descriptive, and a comprehensive analysis of the respondents' evaluation of the interventions is lacking. Thus, the described interventions may have been positive from a pandemic management perspective but negatively affected staff and their leaders (e.g., social distancing and high availability of nurse leaders). To enable health-promoting work organization during crises, the impact on nursing staff must be analyzed. The limitations of health-promoting work organization under crisis conditions must be recognized, and more interventions to mitigate these issues should be implemented. Specific examples derived from this study include reducing the workload by hiring additional staff, providing food, and organizing a massage chair.

#### 4.3. Limitations and strengths

This study provides a comprehensive account of the pandemic experiences of nursing services in hospitals within a particularly challenged region of Germany throughout the COVID-19 pandemic. This expands the current knowledge base and provides a foundation for further analyses to learn from this unique crisis situation in preparation for future crises.

The most significant limitation is the lack of detailed information on the impact of interventions and strategies on work stress among nursing staff and their leaders. Furthermore, only leaders were interviewed and the perspectives of frontline nursing staff were missing. Although team leaders often speak on behalf of team members, they may not fully represent them. Including frontline nursing staff could provide valuable insights into the operational implementation of interventions and strategies and provide a stronger voice in nursing practice.

Another limitation is the potential for recall bias. Despite using graphical memory aids, respondents reported that they could not recall certain details during the interviews. This may have affected the completeness of the information and the accuracy of the timeline.

#### 4.4. Practical implications

The findings offer a reference for relevant practitioners engaged in developing plans and action guidelines for hospitals in the aftermath of the pandemic. Detailed explanations and the overview in the electronic supplement 4 and 5 can help identify useful interventions for specific work contexts. Overall data saturation was satisfactory, although saturation may be insufficient for psychiatry clinics, hospitals of level of care 1, and for non-COVID-19 areas. This needs to be considered when using practical information on interventions.

Particular attention should be paid to involving nursing staff at all hierarchical levels in decision-making and communication processes. Support options (e.g., training, psychologists) should be made available to both staff and leaders. At the hospital level, opportunities for evaluating pandemic management during the crisis (e.g., through feedback sessions) and fostering a no-blame culture, especially during crises, should be considered (e.g., open, interdisciplinary, and moderated dialogues). During a pandemic, nursing staff are required to be highly flexible. Hospital management must prepare them for this (e.g., through crisis communication) and promote their flexibility before a crisis occurs (e.g., by enhancing professional competencies). Additionally, the hospital itself must be flexible and creative, which can be achieved, for example, through agile management practices (Tolf et al., 2015).

#### 4.5. Research implications

The COVID-19 pandemic management was characterized by limited resources (staff, time, space, materials, and, in some cases, financial resources). Hospitals independently organized external support through external recruitment (e.g., temporary workers, volunteers) or received state assistance (e.g., volunteers, military), and, in some cases, financial resources were provided to hospitals (Bundesamt für Soziale Sicherung, 2023). Further studies or analyses of existing text material are needed to determine what additional interventions external actors can offer to support hospitals during crises and help maintain care.

A retrospective assessment of the effects of interventions and strategies on nursing staff can be challenging. However, further analysis of this dataset on how leaders evaluate interventions could contribute to a deeper understanding.

Psychological support was not successfully implemented in any of the hospitals. Further research should investigate the conditions under which nursing staff accept or reject psychological support.

### 5. Conclusion

The study results provide comprehensive documentation of hospital pandemic management, which provides a basis for future research and practice. This study provides valuable insights into hospital organizational interventions and strategies from a nurse leader's perspective during the COVID-19 pandemic. These findings underscore the critical role of flexibility and creativity in managing prolonged crises with fluctuating demands. Furthermore, participation, transparent communication, internal and external support, leadership quality, and demonstrating appreciation of nursing staff are key factors contributing to successful crisis management.

However, this study also identified areas for improvement, particularly in fostering a culture of reflection and error management, learning from crises, and enhancing future preparedness. The involvement of nursing staff at all management levels in decision-making and providing psychological support is essential for maintaining staff well-being and ensuring the sustainability of healthcare services during crises. This study provides examples of organizational interventions through more in-depth research (e.g., implementation of psychological support and participatory interventions). These conclusions offer practical recommendations for hospitals and policy-makers to develop more resilient healthcare systems capable of effectively responding to future pandemics and similar large-scale crises.

#### Research data for this article

Research data within data protection requirements is available upon request. Please contact the corresponding author of this article.

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## CRediT authorship contribution statement

**Maria Zink:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Conceptualization. **Johannes Wendsche:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization. **Steffi G. Riedel-Heller:** Writing – review & editing, Supervision, Conceptualization. **Franziska Jung:** Writing – review & editing, Supervision, Conceptualization. **Marlen Melzer:** Writing – review & editing, Supervision, Project administration, Methodology, Funding acquisition.

## Declaration of competing interest

The authors 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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## Supplementary materials

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