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ORIGINAL ARTICLE

Metaphors of Health System Resilience as Tools for Preparedness Imagination

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Abstract

This article explores how metaphor-based frameworks can enrich understanding of health system resilience and stimulate preparedness imagination, a reflexive practice aimed at generating innovative approaches for facing unknown threats. Observing that uncertainty is narrowly defined in resilience discussions, this study uses an abductive research approach to navigate surprises and creatively adapt knowledge. We propose four metaphors—sailing turbulent seas, zen-like fencing, evolving species, and jazz orchestras—as lenses to view resilience, each bringing unique insights into managing unforeseen crises. In a two-stage process, we began with associative writing, drawing on diverse experiences to question how resilience might manifest in contexts outside healthcare. This was followed by theoretical interpretations, inspired by Dewey's pragmatist learning theory, complexity thinking, and resilience literature. To conclude, we argue that metaphors challenge conventional thinking, detaching from established concepts and definitions to reveal fresh perspectives. The article offers theoretical and practical suggestions for advancing health system resilience, with relevance for training professionals in crisis preparedness and leadership. By treating metaphor development as a form of abductive theorizing, the study positions creative reframing not as an artistic supplement but as a systematic mode of conceptual inquiry essential for advancing resilience scholarship. This conceptual contribution expands the theoretical foundations on which future empirical research, operational models, and preparedness assessments can be built, thereby strengthening the scientific understanding of how health systems can navigate profound uncertainty.

Keywords Health system resilience · Preparedness imagination · Crisis leadership · Preparedness training · Abductive research · Metaphors

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Introduction

The COVID-19 pandemic exposed limitations of traditional crisis management and pre-established preparedness plans, prompting new perspectives on handling ongoing crises. Described as a "creeping crisis" with successive waves [1], COVID-19 highlighted the need for adaptable responses. Despite the acute phase ending, societies struggle with post-crisis recovery, often defined as essential for learning and applying lessons [2]. Continuous challenges have since the pandemic led to discussions of polycrises, meaning interconnected global crises requiring systemic management [3]. Furthermore, viewing COVID-19 as a syndemic emphasizes the interconnectedness of various health and social issues, necessitating responses that address both medical and socioeconomic factors. The changing environment and increasing uncertainty expressed by these different perceptions of crises highlight why we need new ways to articulate preparedness and resilience.

This article focuses on managing uncertainty and preparing for unpredictability as crucial to health system resilience. We advocate for flexibility, imagination, and innovative solutions for proactive learning in and through crises. This includes preparedness imagination, which helps conceptualize emerging threats [4–6], enhancing resilience and flexible preparation for the unknown. Drawing on Dewey's pragmatist learning theory [7] and complexity theory, we seek to offer insights into building such frameworks for health crisis management and leadership. Pragmatism emphasizes experiential learning, problem-solving, and adaptation [8], while complexity theory highlights the dynamic nature of crises, requiring flexible responses [9]. Pragmatist theorisation is therefore central to our argument: it provides a framework for understanding how resilience emerges through situated inquiry, iterative problem-definition, and the continuous adjustment of habits and practices; dimensions that are often overlooked in conventional resilience models. Together, these theories can support a shift from rigid, top-down management to a flexible, evolving framework that considers scientific rationality without being limited by it [10]. At the same time, they enable the identification of new unconventional and even imaginative research subjects and methods [11, 12]. These particular theoretical lenses were chosen here because pragmatism and complexity theory have become increasingly influential in health systems and resilience research, offering productive reflection points for understanding uncertainty, learning, and adaptation. At the same time, we acknowledge that all theorisations carry limitations, which we address in more detail in the discussion section.

Below, we examine resilience in a health system context, exploring its historical roots and interdisciplinary influences. While the metaphors developed in this article are grounded in the empirical context of health systems, they are not intended to be exclusive to this domain. Rather, health care serves as a concrete and policy-relevant example through which broader insights about resilience in complex adaptive systems can be articulated and examined. Preparedness is discussed as a proactive dimension of resilience, emphasizing anticipation and flexibility. Working with metaphors is explored as a way to expand boundaries of knowing. Through combining pragmatism and complexity theory, we aim to enhance novel conceptualizations of crisis preparedness and resilience, acknowledging the ever-changing nature of crises

in a globalized and interconnected world. This kind of conceptual and imaginative work is increasingly recognized as a fruitful component of resilience scholarship, particularly in fields facing deep uncertainty and rapidly changing threat environments [13–16]. Metaphors have also long been recognized, also in research, as meaningful ways to conceptualize particularly complex phenomena [17]. When empirical regularities are unstable or unknown, theoretical reframing becomes an essential scientific activity for expanding the problem space and enabling new forms of inquiry. In this sense, preparedness imagination is not an optional supplement to empirical research but a prerequisite for identifying what should be studied empirically in the first place. The metaphors developed in this article are therefore not intended as a comprehensive typology or new model, but as alternative ways of structuring reflection that help move beyond the technically oriented roots of resilience thinking. By offering conceptual vantage points that foreground uncertainty, emergence, and situated action, they open space for interpretations better suited to the realities of complex social systems. In doing so, they seek to complement existing approaches by providing additional lenses through which the dynamics of learning, adaptation, and change can be understood.

The Roots of Resilience and Its Influences in a Health System Context

The roots of the term resilience come from scientific disciplines other than health system research. Yet even today, definitions and vocabulary of health systems resilience are largely based on these original frameworks. As needs to understand crisis management and learning in novel ways in the context of health systems have emerged, there is also a need to re-evaluate the frameworks and language through which we structure and approach health system resilience. Shedding light to historical backgrounds of resilience can provide useful perspectives and understanding of how its essential traits have originally been defined and what limitations these starting points might have considering current needs. Working with metaphors, then, can help in potentially re-imagining and re-defining these starting points.

Resilience originates from the Latin ‘re’ and ‘salire’, signifying ‘to jump back’. Francis Bacon described it as springing back. In the 18th century, resilience referred to elasticity in engineering. Psychological resilience initially meant recovering from severe stress, and further, resilience in politics and governance is originally linked to maintaining core societal functions during crises [18, 19]. Since the 1960 s, the concept of “resilience” has evolved significantly, gaining prominence in various academic disciplines such as ecology, climate change adaptation, and urban planning. Defined by Holling [20] as the ability to return to equilibrium after a disturbance, it has expanded to include social dimensions, emphasizing communities’ capacity to absorb, adapt, and transform in response to shocks and stresses. This broader understanding has made resilience central to development, influencing policies aimed at enhancing the stability and adaptability of vulnerable populations [21]. Definitions of resilience now include not only returning to pre-crisis states (bounce back) but also renewal after crises (bounce forward), and the work of combining these backward-looking and future-oriented definitions and aims of resilience is perceived essential for securing societal functions while fostering innovation and learning [22], and the

aspect of learning has gained prominence also in the literature regarding healthcare resilience [23]. This means that the forward-looking and transformative dimension is just as important in terms of resilience as maintaining core functions and thus preserving something existing. The balancing of maintenance and renewal reflects the fundamental nature of resilience. However, there is no consensus on whether resilience pertains to a process, an outcome, or a property of a particular entity [24]. Thus, in this article we define resilience as an emergent phenomenon, meaning a whole greater than the sum of its parts formed through the dynamic interaction of various factors, that arises under favorable conditions and prerequisites, and that supports both the preservation of core essence and adaptive renewal, both of which are essential for survival and maintaining functionality [25].

In health system research, resilience has gained prominence over the last decade, driven by crises, such as the COVID-19 pandemic. As referred to, initially drawn from fields like psychology and ecology, resilience was defined as a system's ability to absorb shocks while maintaining functionality. Over time, as this concept was adapted to health research, it has evolved into emphasizing adaptability and transformation in response to prolonged stressors such as financial crises or disease outbreaks. This shift reflects a broader understanding of resilience, encompassing not just immediate responses but also sustained capacity for adaptation and the importance of social factors and interactions within health systems. Overall, the evolution of resilience from a concept focused on returning to equilibrium to one that includes social dimensions and transformative capacities has broadened its use across various fields. This expanded understanding is crucial for developing policies and practices that enhance the stability and learning capacity of health systems and communities, especially in the face of ongoing and future crises.

Preparedness as an Anticipatory Approach to Resilience

The concept of preparedness has been considered relevant [26] yet inadequately defined in the context of crises and their management [27]. In general, preparedness can be defined as activities aimed at readiness, which in turn means the state in which one is able to respond to various emerging threats. Preparedness that supports resilience requires cross-sectoral cooperation (e.g., among travel, commerce, food security, education, social welfare, and healthcare) both horizontally [28] and vertically [29], highlighting preparedness as systemic action. The key is that preparedness-related actions are active, continuous, and anticipatory [27]. Ansell and Boin [8] suggest that it is important to differentiate between "unknown unknowns" and "known unknowns," or more typical emergencies. While preparedness aims to anticipate and react to the effects of disruptions and recover from them [4], it can be stated that contemporary phenomena are so interconnected and unpredictable that it is not possible to prepare for everything, emphasizing the need for resilience-like capabilities [25, 30]. Furthermore, resilience is centrally related to crises that are not foreseeable, that is, for which there is no prior information available [31]. This highlights the increasing complexity of the operating environment, which requires the ability to accept and confront 'not-knowing' instead of seeking a single all-encompassing answer or solution [32]. The wicked nature of contemporary crises requires systemic

resourcefulness, which has been attempted to be conceptualized through the idea of preparedness imagination [4]. The anticipatory temporal dimension of preparedness is centrally related to a future-orientation, not only in terms of modeling the possible future, but also in a more creative way to imaginatively envision it, particularly in order to perceive threats and disruptions that lie beyond our current understanding [27].

Essentially, preparedness can be understood as a balancing act between planning and flexibility and, as such, intrinsically linked to the idea of resilience. In other words, resilience involves finding a balance between learning from the old and innovating for the new [19], as well as the perspective of complexity thinking regarding positive balancing feedback and negative feedback that guides change [9]. Specifically, this means that while preparedness is primarily about creating various readiness and action plans, practicing, and preparing, it is also important to keep in mind that these can never cover all possible future events. Indeed, this applies also to the resilience of healthcare systems, as they aim for safety by proactively strengthening their ability to cope amidst unforeseen events and handle emerging surprises [23]. It has been suggested that the greatest vulnerability of preparedness is related to the belief that it is possible to identify the most dangerous threat [4], possibly leading to insufficient attention to the surprising nature of crises. Therefore, preparedness requires planning in a way that allows for flexibility and innovation in the best possible manner for the situation, utilizing but not strictly adhering to pre-established plans. It can be considered that by harnessing imagination for preparedness activities, the ability to create anticipation that enables the maintenance of this balance could be strengthened. In accordance, our core premise is that metaphors can be used as fruitful tools in this kind of work; an argument that we will next explore in more detail.

Expanding Boundaries of Knowing Through Metaphors

The unknown refers to something unfamiliar, making it impossible to know 'it' thoroughly [33]. Our understanding and associated ignorance of the unknown are, hence, inevitably and forever limited [34] Research on preparedness has found that an organizational culture unaccepting of this ignorance and not-knowing can hinder resilience [25] Conversely, an acceptance of the limitedness of our knowledge of the unknown can be seen as a pathway to enhance resilience, as it can be used to shift our attention to what, then, can be known.

Accordingly, what we can do is use familiar experiences in new ways as an attempt to expand the boundaries of knowing, for example, by transferring known concepts to new contexts or highlighting previously hidden traits with the help of cross-contextual differences. This can help us see familiar things in a novel light. In this vein, metaphors can help in providing fresh insights into phenomena, as they transfer concepts across contexts and, therefore, emphasize certain aspects while disregarding others [12]. This can help in better visualizing and structuring the phenomenon [13]. Previous research of complex phenomena such as resilience have found metaphors useful, as they have allowed detachment from existing ideas and opened new perspectives [12]. Metaphors help critically explore prevailing assumptions, build new vocabulary, and generate novel understandings, especially when they challenge and stretch

ways of examining reality [14, 15, 35, 36].The power of metaphors lies precisely in their ability to help form a coherent framework of thought, which aids in emphasizing certain features of a phenomenon while, on the other hand, concealing others [35]. The edge of chaos and the butterfly effect are examples of metaphors previously used in complexity thinking [16], meant to help in understanding challenging phenomena by bringing familiarity from concepts known in other contexts. In all, we posit that the development of metaphors is not merely a creative exercise but a recognized mode of conceptual inquiry in the study of complex systems [12–16, 35]. Metaphors can function as analytical tools that reorganize existing knowledge, reveal hidden assumptions, and generate new theoretical propositions. In fields characterized by uncertainty, such as crisis management, disaster studies, and health system resilience, metaphorical reasoning has been shown to support rigorous theorizing by enabling researchers to explore alternative ontologies and epistemologies that empirical data alone cannot disclose [13].

Method: Generating Metaphors in an Abductive Writing Process

In this study, we have used our past (i.e., known) experiences for generating metaphors of resilience, in an attempt to create new knowledge for developing health system resilience and preparedness. The process of creatively reframing and thinking about resilience through cross-disciplinary metaphors is seen here as fostering preparedness imagination [4] and potentially developing future health system resilience theories. Our approach addresses the recognized need to increase research literature that describes the development of tools facilitating the practical application of resilience [23].

The research process began with free-form associative writing and progressed as creative exploration, guided by principles of abductive research: embracing surprises, tensions, and doubts; using knowledge creatively to theorize; crafting through methodological bricolage; and iterating through the research process [51]. The overall aspiration was to enrich discussions about crisis management and preparedness in the face of unknown future crises. The writing was initiated with the help of the following guiding research questions:

1. What kinds of phenomena in fields other than health system resilience and preparedness could be thought of as having similarities with them?
2. How can metaphors help make sense of what preparing for the unknown requires?

The associative writing produced four metaphorical trails of thought, drawn from our personal and professional experiences, including researcher training, scientific publications, and other literary sources.

In all, our approach follows established traditions of abductive research [37–40], in which surprising observations, imaginative reasoning, and iterative reframing are treated as legitimate and systematic components of theory-building. Abduction, as developed by Peirce [39] and later elaborated in organizational and social science methodology [35, 41–44], explicitly includes creative inference, exploratory writ-

ing, and the generation of novel conceptualizations as methodological steps. The associative writing process used here is therefore not merely an artistic detour but a structured abductive research technique for producing theoretical insights that cannot be derived deductively or inductively from existing models. In abductive inquiry, the aim is not to verify hypotheses but to expand the conceptual repertoire through which phenomena can be understood. The metaphors developed in this study emerged through cycles of reflection, theoretical confrontation, and refinement, consistent with methodological accounts of abductive theorizing as a disciplined yet imaginative form of scientific reasoning. We therefore position this study as a conceptual and abductive inquiry rather than an empirical investigation. Conceptual research is widely recognized as a legitimate and necessary scientific contribution, particularly in fields where theoretical foundations are still evolving. By generating new metaphors and conceptual frames, this study advances the theoretical architecture of health system resilience and provides a basis for future empirical work. The value of the research lies not in data collection but in expanding the conceptual tools available for understanding and preparing for unknown crises.

Results are summarized according to the generated four metaphors, which are mirrored and discussed below against ideas inspired by pragmatist theory, complexity thinking and resilience literature.

Results: Exploring Four Metaphors of Health System Resilience and Preparedness

Resilience as sailing amidst turbulent seas

Sailing turbulent seas serves as a metaphor for resilience, emphasizing determining the current position, planning a safe course, and maintaining it while navigating amidst changing conditions. Essentially, the metaphor of sailing frames resilience as navigating unpredictability (e.g., responding to surprises and setbacks like headwinds or storms) while progressing towards more distant horizons (e.g., reaching a harbor). Focusing on the future highlights transparent communication, so that stakeholders understand why actions are taken and how they align with different goals and values [45]; interrelationships discussed both in complexity literature and studies applying pragmatic principles. A health system analogue would be the rapid reallocation of ICU capacity during the early phases of COVID-19, when hospitals had to continuously reassess their "position," anticipate surges, and adjust patient flows in response to shifting epidemiological conditions. Much like a crew navigating changing winds, health system leaders had to balance short-term operational pressures with longer-term goals such as maintaining essential services and protecting workforce wellbeing.

To exemplify, pragmatism encourages seeing values as contextual and valuation as a process [46]. Because of this, understandings and tensions should be assessed in terms of whose problems are being addressed [46, 47]. In this way, the pragmatist approach emphasizes the relationship of knowledge and values, underlining a collaborative process of communication and reflection on surfacing, understanding, and

negotiating values. This connects to complexity thinking, which posits that social systems are formed by various partially competing and cooperating subsystems [16]. These interactions create multiple possible and partly unpredictable outcomes [45, 48]. Negotiation is necessary because consensus could immobilize the system and prevent necessary change [49]. For example, during vaccine rollout planning, health authorities often had to negotiate between competing priorities (e.g., protecting high-risk groups, maintaining critical societal functions, and ensuring equitable access) illustrating how differing value commitments shape the "course" a health system chooses to follow. Notably, pragmatism and complexity thinking do not dissolve political conflict but can help shed light on beliefs, values, and interests.

Furthermore, in this metaphor, resilience includes maintaining balance despite changing conditions and emphasizing the balancing act related to resilience, where key functions are maintained while enabling new insights [19]. In relation to complexity literature, this connects to reinforcing and balancing feedback in complex systems [50, 51]. On the other hand, through the vocabulary of pragmatism [5], crises are seen as context-bound tensions that force us to doubt, re-evaluate, and reorganize habitual patterns of thinking and action. When the context is stable, habits save resources and help choose appropriate goals and strategies. Inquiry is emphasized during nonroutine events or crises, initiating reflexivity, deliberation, and experimentation [46]. Dealing with uncertainty requires decision-making based on trial and error and increasing local autonomy to adapt actions to the environment [52]. Pragmatism has been criticised for its emphasis on reflection and iterative inquiry, which some argue may sit uneasily with the time pressure and urgency characteristic of crisis situations. However, pragmatism does not see it as urgent to arrive at a final understanding as fast as possible, as situational definitions are always changing [46]. This connects to understanding crises as wicked problems, as referred to in complexity literature, that often require constant negotiation of options and impacts rather than finding definite answers [32]. In the health system context and during the COVID-19 crisis, this dynamic was visible, in the iterative adjustments to testing strategies during the pandemic, where health systems experimented with centralized versus decentralized testing, drive-through models, and targeted screening in response to emerging evidence and local constraints. These shifts exemplify how strategies "emerge through action" when perfect knowledge is unavailable.

Change in this metaphor is seen as interrelated and complex, requiring constant examination, flexible adaptation, and learning from situated experiences. Accordingly, tensions can function as opportunities for learning, and learning is seen as a continuous process. In crises, there is often no certainty about the right course of action, highlighting the need to make decisions amid incomplete information. In alignment, complexity thinking accepts that perfect knowledge is impossible, and not all questions can be answered in advance [53]. Strategies may emerge through action, which requires constantly figuring out what is possible and learning in situ [46]. The potential inapplicability of pre-prepared plans in their original form, which is common in preparedness, further highlights the need for flexibility in planning to create adaptive strategies that respond to changing circumstances [54]. A concrete illustration in the context of health systems is the breakdown of pre-existing pandemic preparedness plans that assumed influenza-like transmission dynamics; health

systems had to abandon parts of these plans and improvise new protocols for airborne transmission, supply chain disruptions, and prolonged crisis duration. This highlights how resilience requires the capacity to tack and adjust course when the original navigation charts no longer match the conditions at sea.

Resilience as Zen Training of Fencing Students

This metaphor draws from a Zen fencing story, where a master continuously surprises the student with a practice stick. Finally, the student, exhausted from continuously trying to anticipate attacks in vain, learns to react intuitively and calmly only when he stops trying. This flexible response has been the training's aim all along. The core lesson of the story and the fencing metaphor is that giving up some control is necessary to gain mastery and to be able to react successfully in surprising and unforeseen situations. This ties to the notion of 'sufficient control' in complexity thinking [50], highlighting the relationship between societal challenges, governance, and the imperfection of knowledge. The fencing story also underscores the importance of practical, hands-on training, as the partly unconscious muscle memory achieved from the repetitive and practical training served as one prerequisite of efficient handling of the sword. A comparable dynamic could be seen in health systems when clinicians and emergency teams train repeatedly through simulation exercises, developing tacit skills that allow them to respond calmly and effectively when real crises unfold, even when events deviate from expected scenarios.

In preparedness discussions, being surprised is often seen negatively, based on the assumption that more preparation means more tools for future crises. However, as referred earlier, threats can also be unpredictable and not align with plans. Complexity highlights that uncertainty and unpredictability are inherent in complex systems [48] portraying the security environment's inherent complexity by nature [33]. Resilience is crucial in unforeseen situations where preparedness and prior knowledge are insufficient [25, 31]. Hence, accepting ignorance can be part of relinquishing control. Although not typical in preparedness activities [30], acknowledging ignorance can help approach uncertainties constructively and allow space for innovation [25]. Relinquishing control challenges traditional leadership, emphasizing the leader's role in creating conditions for adaptation. Decentralizing control is often more effective, as local actors understand their context best and can adapt actions accordingly. For instance, during rapidly evolving outbreaks, local health units often must make immediate operational decisions, such as reorganizing triage flows or reallocating staff, before national guidance is updated, demonstrating how distributed autonomy enables faster and more context-sensitive responses.

Aligning with principles of pragmatism, Ansell and Boin [8] suggest that decision-makers avoid irreversible decisions during crises, understanding they can't know everything, and make small steps for robust strategies in different crisis trajectories. This resonates also with complexity thinking, where knowledge is limited, and planning has its limits [53]. In this scenario, each actor forms their view based on received clues, though no perspective is completely correct [16], which creates a tension between claiming to know things and acknowledging knowing very little [53]. Overall, planning and anticipation can never fully control conditions to prepare flaw-

lessly for future events [55]. The metaphor of fencing students, as well as using ideas of pragmatism and complexity theory in tandem can help view preparedness and planning in a new light, asking: If we can't prepare for everything, what can we learn about acting when being surprised? Importantly, relinquishing control doesn't mean arbitrary action but setting clear principles and goals for adaptation. Health systems demonstrated this during the early COVID-19 response, when decision-makers had to act on incomplete information, adjusting testing criteria, modifying PPE protocols, or reorganizing care pathways, while maintaining overarching principles such as patient safety, equity, and continuity of essential services. These examples illustrate how "sufficient control" operates in practice: leaders cannot script every move, but they can create conditions that enable frontline actors to respond with agility and informed judgment.

Resilience Competences as Aligning with the Evolution of Species

Evolution can signify new traits or the unfolding of potential [56] Viewing resilience capacities (absorption, adaptation, transformation) through the metaphor of species evolution highlights their dynamic interactions with changing environments [57, 58]. This involves environmental interaction for system survival [16] and co-evolution to adapt [51] Parallelly, also societal survival and evolvement can be seen as a process [49], where nonlinear dynamics from interactions necessitate adaptation [45, 48], and previous choices affect current and future situations [51]. Transformation, then, involves novel traits that alter an entity, and can be defined as non-linear and context-dependent [59], reflecting the idea of emergence [60, 61]. In health systems, such evolutionary dynamics can be observed when new service models, such as telemedicine or integrated care pathways, emerge in response to environmental pressures and gradually become stable features of the system, reshaping professional roles, patient expectations, and organizational routines.

In addition to highlighting dynamic interactions and transactions with the environment, the metaphor of species evolution can help in extending the temporal scope of crises conceptualizations, often framed as single crises [2, 62]. A broader time frame can allow more critical evaluation of resilience and change over time, shedding light also to smaller scale transformations that can be significant in the context of health systems [61]. While exploring change and learning in resilience and preparedness can be argued to be crucial [60, 61], many resilience discussions still overlook learning and renewal, focusing on preserving traits or returning to a previous state [19]. The COVID-19 pandemic highlighted the need to institutionalize lessons learned and creatively avoid returning to unbeneficial old habits and structures [30, 51]. From an evolutionary perspective, institutionalization itself represents a form of adaptive change: it involves selecting, retaining, and embedding new practices, routines, and governance arrangements that emerged during the crisis. Rather than implying a static return to equilibrium, this process reflects the gradual accumulation of novel traits, such as new coordination mechanisms, digital infrastructures, or cross-sectoral collaborations, that alter the system's future trajectory and constitute concrete examples of transformation within the evolutionary metaphor. For example, many health systems permanently expanded digital triage, remote monitoring, and cross-orga-

nizational data sharing after COVID-19, illustrating how crisis-driven adaptations can become "inherited traits" that shape long-term system evolution. These changes did not occur instantaneously but accumulated through iterative adjustments, policy decisions, and frontline experimentation; mirroring evolutionary processes of variation, selection, and retention.

Parallelly, from the perspective of pragmatism, learning can be defined as ongoing, context-dependent experimentation that accumulates as experience, identity, habit, skills, and knowledge [46]. This view aligns with evolutionary change, and emphasizes situated and creative problem-solving. Learning, according to this approach, occurs when different perspectives force actors to re-examine their prevailing [63], and collective behavior change emerges from individual interactions, leading to new structures [45, 51, 64]. Resilience viewed through the metaphor of species evolution emphasizes creative discovery and continuous rearrangement, strengthening resilience through experimentation, learning from failures, and quick adaptation. From a policy point of view, this can offer tools for examining opportunities and demands for action [46]. Further, highlighting experimentation can support innovation and resilience where traditional planning fails to anticipate complex consequences. This aligns with complexity thinking that focuses on interaction relationships and spontaneous organization [48]. Concrete examples in the health system context include the rapid development of new infection-prevention protocols, the emergence of hybrid care models, and the redesign of supply chains to reduce dependency on single suppliers, each representing adaptive shifts that accumulated over time and altered the system's structural "fitness" in the face of future shocks.

Resilient Collaboration as Playing in a Jazz Orchestra

In a symphony orchestra, every player has a strictly defined task, and the conductor leads the orchestra, telling others what to do. The music is based on pre-existing sheet music, producing a coherent but standardized result. According to Patrich Furu, director of Aalto EE (Aalto University Executive Education and Professional Development), this type of music has no potential to change. In contrast, a jazz band operates from a different logic: musicians listen to one another, react to what they hear, and explore new things courageously. If something doesn't work, it becomes an opportunity for learning. This aligns with complexity thinking, where the edge of chaos is the state in which the system is most creative and adaptable [50]. The end result is unpredictable, arising from interactions between interconnected actors [65], leading to unexpected changes in other parts of the system [45]. Complexity thinking emphasizes approaching the constantly changing world with humility, seeing uncertainty as a source of creativity and adaptation [16]. Health systems often mirror this jazz-like dynamic during crises, when multidisciplinary teams (i.e., clinicians, infection-control experts, logistics staff, and administrators) must rapidly coordinate without waiting for top-down directives, adjusting their actions in real time based on what others are doing and what the situation demands.

A culture that supports improvisation and experimentation combines preparing and planning with flexibility and new approaches [66]. This links resilience as both bouncing back and bouncing forward, connecting positive and negative feedback in

balancing between order and chaos. Complexity thinking acknowledges that systems can react unexpectedly to changes. From a resilience and preparedness perspective, it is crucial to consider what kinds of mistakes can be afforded in a crisis. Jazz bands offer lessons in handling unpredictable situations requiring agility and transformative capacity. Strengthening the collaboration of self-organizing individuals is significant for crisis resilience and management [50]. For example, during sudden surges in patient volume, hospital units often form ad hoc "pop-up" teams that redistribute responsibilities, share situational updates informally, and improvise new workflows; much like jazz musicians adjusting their performance in response to subtle cues from one another. These emergent collaborations can enable rapid problemsolving when formal structures are too slow or rigid to respond.

Pragmatism, on the other hand, can be seen as an approach that problematizes problems, viewing them as contextual and relative [46]. This recognition of context is essential for understanding and addressing problems [53, 67]. Solving uncertainties and dissonances, according to this view, becomes a skilled and creative endeavor, legitimizing multiple perspectives and interpretations. Problems are seen as necessary for learning, change, and growth, triggering reflexivity and critical evaluation of existing patterns of thinking and acting. This interpretation is in line with uncertainty as a source of creativity and adaptation, as in complexity thinking discussed above. Seeing problems as prerequisites for change shifts attention from problem-solving to problem definition, with policy consequences and effects in crisis management. Under complex and uncertain circumstances, defining problems is an iterative process of making sense of the situation. Dynamics, self-organization, and emergence are normal conditions of complex systems, and instead of trying to control them, one should aim to adjust their impact [50]. In health systems, this iterative sense-making is visible when frontline teams collectively reinterpret evolving challenges, such as supply shortages, new variants, or shifting patient needs, and adjust their shared understanding of "the problem" through continuous dialogue, much like jazz musicians renegotiating the direction of a piece mid-performance. These collaborative reframings can open space for creative solutions that would not emerge through hierarchical command-and-control approaches alone.

Discussion

This article explored how metaphor-based frameworks can enrich understanding of health system resilience and stimulate preparedness imagination [4], interpreted here as a reflexive practice aimed at generating innovative approaches for facing unknown threats. Four metaphors were developed in an abductive research process [37]:

1. **Sailing amidst turbulent seas** highlighted resilience as navigating towards more distant horizons, while continuously seeking balance amidst changing and unpredictable conditions. Achieving balance involves maintaining fundamental functions while aspiring for changes influenced by contextual factors, including resource distribution, efficacy, buffer effects, and flexibility [19]. This process

requires transparent communication and continuous value discussions, as it involves setting goals for action and change [46].

2. **Zen-training of fencing students** emphasized letting go of some control as a skill that enables flexibility and endurance in crisis responses and management. This metaphor further shifted the focus from defining future threats to accepting uncertainty and not-knowing as inevitable in crises [25, 68], thus, emphasizing the cruciality to support the development of skills needed amidst incomplete knowledge. In addition, the fencing metaphor underlined how processes can also be messy and unruly, highlighting the cruciality to acknowledge these wicked aspects of crises also in the training of key professionals and stakeholders.
3. **Evolution of species** directed attention to critically evaluating the temporal aspects of resilience capacities (absorption, adaptation, and transformation), including their changes over time [57, 58, 61]. It also highlighted that the emergence of new defining traits (i.e. transformational changes) can take place on various scales (i.e., from small changes to system level structures), and that incorporating evaluation of consequences is crucial to be included in health system resilience models [61, 68].
4. **Playing in a jazz orchestra** underscored the importance of improvisation, open-minded listening, and collaborative learning in crises. These were identified as targets for further reflection that can make the aims of change and transformation more visible as part of health system resilience and learning [61] and can provide seeds for thought for crisis management and leadership training.

We recognize that sailing is the least novel of the metaphors we have constructed, as it has to some extent been used in previous literature related to resilience [69]. The novelty of our sailing metaphor lies particularly in the fact that instead of resilience being about navigating a crisis or various unexpected situations, we see sailing as being connected to keeping in mind the target state on the horizon, that is, reaching the harbor. Our sailing metaphor is especially about recognizing the target state that one wants to achieve and move toward, even if, along the way, the direction must be changed due to unexpected reasons. At the same time, the metaphor highlights the emphasized perspective of renewal and transformation, as learning from disturbances and obstacles encountered along the journey and possibly changing course quickly is crucial for achieving the goal of the journey.

These metaphors were discussed against Dewey's pragmatist learning theory [7], complexity thinking [52, 53], and resilience literature [70, 71]. In sum, the results underscored the importance of creative approaches in developing new ways of thinking about crises, and especially their unforeseen elements; each metaphor helping in shifting focus and perspective and, thus, concentrating exploration of health system resilience in varying ways. Drawing on pragmatism, we emphasize that resilience depends not only on accumulated knowledge but on ongoing processes of knowing (i.e., situated inquiry, interpretation, and adjustment), which shape how actors make sense of evolving situations and respond within complex, uncertain environments. Theoretically, we argue that whereas Deweyan pragmatism typically explores one change cycle at a time, complexity theory tends to be more sensitive to simultaneous and interconnected change processes on multiple systemic levels. Here, complex-

ity theory can expand discussions of resilience to better fit multiple and interrelated crises, or polycrises. Conversely, pragmatism can complement the understanding of change and related learning in complexity research by introducing fresh vocabulary and ways to structure change and learning. Nevertheless, all theoretical frameworks have inherent limitations, and pragmatism and complexity theory are no exception; while they offer valuable insights into learning, adaptation, and systemic interdependence, they cannot fully capture the urgency, power dynamics, or operational constraints that shape real-world crisis decision-making.

In all, our aim was to support new ways to think about health system resilience beyond its traditional definitions or original metaphoric roots (e.g., a stretched string bouncing back to its original state when the pull is released or a person recovering to a normal healthy state after encountering a stressful or traumatic event). Theoretical foundations of complexity theory and pragmatism were used as counterpoints for reflection and inspiration for practical examples in this study, yet multiple theoretical perspectives are needed in the future due to the complexity of resilience and preparedness. A comprehensive theorization should recognize perspectives across individual views to whole system approaches, as well as their dynamic interrelationships, ensuring no inconsistencies when scaling up or down. Understanding of health system resilience should be complemented with models and visualizations beyond traditional levels, linear processes or frameworks limited to single crises. The four metaphors presented here illustrate the need to conceptualize resilience and preparedness from multiple worldviews. Essentially, we argue that playful and creative thought experiments using cross-contextual metaphors can foster preparedness imagination, and help critically evaluate core assumptions, including differing ontological and epistemological starting points. In other words, conceptual and metaphor-based theorizing plays a foundational role in scientific progress, particularly in emerging fields where empirical patterns are still poorly understood. By articulating new conceptual frames, this study provides scaffolding for future empirical research: the metaphors proposed here can guide operationalization, inform the design of empirical studies, and help identify variables, mechanisms, and relationships that have not yet been examined. In this sense, the contribution is not only theoretical but also methodological, offering a generative platform for subsequent empirical investigation. In addition, by reflecting on our own abductive research praxis, we suggest that metaphor inquiry itself represents a transferable competence; one that organisations could institutionalise to strengthen their capacity for collective learning, reframing, and adaptive problem-definition in the face of uncertainty.

Notably, the four metaphors in this article are not considered comprehensive but are suggested as examples for imagining unknown future threats, and for creating novel ways of thinking about health system resilience and preparedness. Although the analysis is situated within the health system context, the metaphors intentionally retain a level of generality that makes them applicable to other complex and uncertainty-laden domains. Positioning health care as an illustrative case underscores the practical relevance of the framework while acknowledging that the conceptual insights developed here extend beyond a single sector. Overall, working with metaphors is approached as a research method for both theoretical development work and practice-based resilience training. As cited earlier [12, 13, 17], metaphors can help us

see phenomena in a new light and critically assess existing presumptions, and they can facilitate cross-scientific and cross-sectoral understanding and knowledge transfer. However, metaphors should not be seen as tools that help solve all challenges, although they can include the potential for groundbreaking innovation. Examining interactions of multiple, interrelated and exacerbating health crises can further enrich our understanding of resilience and preparedness. Importantly, while using metaphors have many benefits, they also have limitations, and have previously been criticized for a lack of objectivity [53]. Although our position is that objectivity (and the dualism it creates) is also problematic, we acknowledge that reflexive estimation of potential weaknesses for each metaphor is important [17]. In addition, the metaphors presented here should be understood as a starting point for further empirical exploration rather than as a finalized framework. Future research could expand the abductive potential of this approach by involving a broader range of contributors or by examining how these metaphors support sense-making and decision-making among healthcare workers and leaders in real-world settings. Such empirical work would help assess whether and how metaphor-based inquiry can meaningfully enhance understanding, classification, or intervention in practice.

Conclusions

Preparing for future threats involves considering not only previously familiar crisis scenarios, but also developing skills to tackle the inevitable unpredictability in crises. Since knowing the unknown is not possible, metaphors can help us understand familiar themes in new ways and expand our preparedness imagination towards more flexible and versatile crisis management and leadership. Metaphors in this article are suggested as not only examples of different ways in which health system resilience can be conceptualised and framed, but also as a tool and an overall working method for stretching the boundaries of our current knowledge and critically evaluating prevailing assumptions. In this way, the article guides researchers, leaders and decision-makers in developing even more resilient health system preparedness strategies in the future. By positioning metaphor development within an abductive research tradition, the study demonstrates that creative reframing constitutes a systematic and rigorous mode of conceptual inquiry rather than an ancillary exercise. This form of theorizing provides essential groundwork for future empirical studies by expanding the conceptual space through which resilience and preparedness can be operationalized, examined, and strengthened.

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Declarations

Conflict of interest The authors declare no competing interests.

References

1. Boin, A., Ekengren, M., & Rhinard, M. (2020). Hiding in plain sight: Conceptualizing the creeping crisis. *Risks Hazards & Crisis in Public Policy*, *11*(2), 116–138. https://doi.org/10.1002/rhc3.12193
2. Thomas, S., Sagan, A., Larkin, J., Cylus, J., Figueras, J., & Karanikolos, M. (2020). *Strengthening health systems resilience: Key concepts and strategies*. World Health Organization. Regional Office for Europe.
3. Ansell, C., Sørensen, E., & Torfing, J. (2022). Public administration and politics meet turbulence: The search for robust governance responses. *Public Administration*, 1–20. https://doi.org/10.1111/padm.12874
4. Heino, O., Heikkilä, M., & Rautiainen, P. (2022). Caging identified threats – Exploring pitfalls of state preparedness imagination. *International Journal of Disaster Risk Reduction*, *78*, 103121. https://doi.org/10.1016/j.ijdrr.2022.103121
5. Heino, O., Takala, A., & Huotari, V. (2021). Unthinkable is not un-educable: New mindset for training preparedness. *International Journal of Disaster Risk Reduction*, *63*, 102470. https://www.sciencedirect.com/science/article/pii/S2212420921004313
6. Heino, O., Kihlström, L., Rautiainen, P., Viita-aho, M., Keskimäki, I., & Tynkkynen, L. K. (2024). Into the unknown-preparing for and learning from health system shocks. In *Handbook of Health System Resilience* (pp. 452–464). Edward Elgar Publishing. https://www.elgaronline.com/edcollchap/book/9781803925936/book-part-9781803925936-41.xml
7. Dewey, J. (1916 [1996]). Democracy and education. In J. A. Boydston, & L. Hickman (Eds.), The collected works of John Dewey, 1882–1953. The Middle Works of John Dewey, 1899–1924 (Vol. 9: 1916), Democracy and Education. An Introduction to the Philosophy of Education. InteLex Corporation. 2nd electronic ed., pp. 1–370.
8. Ansell, C., & Boin, A. (2019). Taming deep uncertainty: The potential of pragmatist principles for understanding and improving strategic crisis management. *Administration & Society*, *51*(7), 1079–1112.
9. Eppel, E., & Rhodes, M. L. (2018). Complexity theory and public management: A 'becoming' field. *Public Management Review*, *20*(7), 949–959. https://doi.org/10.1080/14719037.2017.1364414
10. Augustynowicz, A., Opolski, J., & Waszkiewicz, M. (2022). Resilient health and the healthcare system. A few introductory remarks in times of the COVID-19 pandemic. *International Journal of Environmental Research and Public Health, 19*(6), 3603. https://doi.org/10.3390/ijerph19063603
11. Alvesson, M., & Sandberg, J. (2021). *Re-imaginingthe research process. Conventional & alternative metaphors*. SAGE Publications Ltd.
12. Alvesson, M., & Sandberg, J. (2023). The art of phenomena construction: A frame work for coming up with research phenomena beyond 'the usual suspects'. *Journal of Management Studies*. https://doi.org/10.1111/joms.12969
13. Rossi, P. (2024). On music- and dance-related metaphors for organization and management. In A. Örtenblad (Ed.), *The Oxford Handbook of Metaphor in Organization Studies.* Oxford University Press. https://doi.org/10.1093/oxfordhb/9780192895707.001.0001

14. Fairhurst, G. T. (2010). Communicating leadership metaphors. In M. Alvesson & A. Spicer (Eds.), *Metaphors we lead by: Understanding leadership in the real world* (pp. 180–193). Routledge. https://doi.org/10.4324/9780203840122
15. Sandberg, J., & Alvesson, M. (2021). Meanings of theory: Clarifying theory through typification. *Journal of Management Studies*, *58*(2), 487–516. https://doi.org/10.1111/joms.12587
16. Heylighen, F., Cilliers, P., & Gershenson, C. (2007). Complexity and philosophy. In J. Bogg & R. Geyer (Eds.), *Complexity, science and society* (pp. 117–134). Radcliffe Publishing.
17. Spicer, A., & Alvesson, M. (2010). Metaphors for leadership. In M. Alvesson & A. Spicer (Eds.), *Metaphors we lead by: Understanding leadership in the real world* (pp. 31–50). Routledge. https://doi.org/10.4324/9780203840122
18. Birkland, T. A. (2016). Conceptualizing resilience. *Politics and Governance*, *4*(4), 117–120. https://doi.org/10.17645/pag.v4i4.823
19. Rajala, T., & Jalonen, H. (2022). Stress tests for public service resilience: Introducing the possible-worlds thinking. *Public Management Review*. https://doi.org/10.1080/14719037.2022.2048686
20. Holling, C. S. (1973). Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics, 4*, 1–23.
21. Saulnier, B., & Blanchet, K. (2024). Key ideas and future directions for health system resilience. In Thomas (Eds.), *Handbook of health system resilience*. Edward Elgar Publishing.
22. Duit, A. (2016). Resilience thinking: Lessons for public administration. *Public Administration, 94*(2), 364–380. https://doi.org/10.1111/padm.12182
23. Haraldseid-Driftland, C., Lyng, H., Guise, V., Waehle, H., Schibevaag, L., Dombestein, H., Ree, E., Fagerdal, B., Billett, S., & Wiig, S. (2024). Designing a learning tool for translating resilience in healthcare into practice: A qualitative mixed methods study. *Applied Ergonomics, 119*, Article 104314. https://doi.org/10.1016/j.apergo.2024.104314
24. Dagdeviren, H., Donoghue, M., & Promberger, M. (2016). Resilience, hardship and social conditions. *Journal of Social Policy*, *45*(1), 1–20. https://doi.org/10.1017/S004727941500032X
25. Rantamäki, A. (2024). Hallintaa epävarmuudessa: Informaatioresilienssi kriiseissä ja niihin varautumisessa. *Acta Wasaensia, 530.*
26. Ansell, C., Sørensen, E., & Torfing, J. (2021). The COVID-19 pandemic as a game changer for public administration and leadership? The need for robust governance responses to turbulent problems. *Public Management Review*, *23*(7), 949–960. https://doi.org/10.1080/14719037.2020.1820272
27. Staupe-Delgado, R., & Kruke, B. I. (2017). Developing a typology of crisis preparedness. In Cepin & Bris (Eds.), *Safety and reliability – Theory and applications.* Taylor & Francis Group.
28. Pouru-Mikkola, L., Minkkinen, M., Malho, M., & Neuvonen, A. (2023). Exploring knowledge creation, capabilities, and relations in a distributed policy foresight system: Case Finland. *Technological Forecasting & Social Change, 186*(1B), 1–14. https://doi.org/10.1016/j.techfore.2022.122190
29. Donahue, A., Eckel, C., & Wilson, R. (2014). Ready or not? How citizens and public officials perceive risk and preparedness. *American Review of Public Administration*, *44*(4S), 89–111. https://doi.org/10.1177/0275074013506517
30. Rantamäki, A. (2023). Informaatioresilienssin rakentumiseen vaikuttavien tekijöiden ilmentyminen varautumista koskevassa asiantuntijapuheessa. *Hallinnon tutkimus*, *42*(5), 492–510. https://doi.org/10.37450/ht.127936
31. Elston, T., & Bel, G. (2022). Does inter-municipal collaboration improve public service resilience? Evidence from local authorities in England. *Public Management Review*, *25*(4), 734–761. https://doi.org/10.1080/14719037.2021.2012377
32. Alford, J., & Head, B. W. (2017). Wicked and less wicked problems: A typology and a contingency framework. *Policy and Society, 36*(3), 397–413. https://doi.org/10.1080/14494035.2017.1361634
33. Jalonen, H. (2023). Ignorance in organisations - A systematic literature review. *Management Review Quarterly, 74*, 909–950. https://doi.org/10.1007/s11301-023-00321-z
34. Simon, H. A. (1955). A behavioural model of rational choice. *Quarterly Journal of Economics, 69*(1), 99–118. https://doi.org/10.2307/1884852
35. Lakoff, G., & Johnson, M. (2008). *Metaphors we live by*. University of Chicago Press.
36. Sander, E. (2025). *Metaphors for education*. Wiley.
37. Hulst, M., & Visser, L. (2024). Abductive analysis in qualitative public administration research. *Public Administration Review*. https://doi.org/10.1111/puar.13856
38. Tavory, I., & Timmermans, S. (2014). *Abductive analysis: Theorizing qualitative research*. University of Chicago Press.

39. Peirce, C. S. (1931–1958). Collected papers of Charles Sanders Peirce (C. Hartshorne, P. Weiss, & A. W. Burks, Eds.; Vols. 1–8). Harvard University Press.
40. Weick, K. E. (1989). Theory construction as disciplined imagination. *Academy of Management Review, 14*(4), 516–531. https://doi.org/10.5465/amr.1989.4308376
41. Cornelissen, J. P. (2005). Beyond compare: Metaphor in organization theory. *Academy of Management Review, 30*(4), 751–764. https://doi.org/10.5465/amr.2005.18378876
42. Jaakkola, E. (2020). Designing conceptual articles: Four approaches. *AMS Review, 10*(1–2), 18–26. https://doi.org/10.1007/s13162-020-00161-0
43. MacInnis, D. J. (2011). A framework for conceptual contributions in marketing. *Journal of Marketing, 75*(4), 136–154. https://doi.org/10.1509/jmkg.75.4.136
44. Suddaby, R. (2010). Construct clarity in theories of management and organization. *Academy of Management Review, 35*(3), 346–357. https://doi.org/10.5465/amr.35.3.zok346
45. Best, A., Berland, A., Herbert, C., Bitz, J., van Dijk, M. W., Krause, C., Cochrane, D., Noel, K., Marsden, J., McKeown, S., & Millar, J. (2016). Using systems thinking to support clinical system transformation. *Journal of Health Organization and Management, 30*(3), 302–323.
46. Ansell, C., & Geyer, R. (2016). Pragmatic complexity' a new foundation for moving beyond 'evidence-based policy making'? *Policy Studies*, *38*(2), 149–167. https://doi.org/10.1080/01442872.2016.1219033
47. Meinhart, M., Vahedi, L., Carter, S. E., Poulton, C., Mwanze Palaku, P., & Stark, L. (2021). Gender-based violence and infectious disease in humanitarian settings: Lessons learned from Ebola, Zika, and COVID-19 to inform syndemic policy making. *Conflict and Health, 15*(1), 84. https://doi.org/10.1186/s13031-021-00419-9
48. Gear, C., Eppel, E., & Koziol-Mclain, J. (2018). Advancing complexity theory as a qualitative research methodology. *International Journal of Qualitative Methods, 17*(1), 1–10.
49. Cilliers, P. (1995). Postmodern knowledge and complexity (or why anything does not go). *South African Journal of Philosophy*, *14*(3), 124–132.
50. Kljin, E.-H. (2008). Complexity theory and public administration: What's new? *Public Management Review, 10*(3), 299–317.
51. Mitleton-Kelly, E. (2003). *Complex systems and evolutionary perspectives on organisations: The application of complexity theory to organisations*. Emerald Publishing Limited.
52. Cairney, P., & Geyer, R. (2017). A critical discussion of complexity theory: How does 'complexity thinking' improve our understanding of politics and policymaking? *Complexity Governance & Networks*, *3*(2), 1–11. https://doi.org/10.20377/cgn56
53. Richardson, K. A. (2008). Managing complex organizations: Complexity thinking and the science and art of management. *Emergence, Complexity & Organization, 10*(2), 13–26.
54. Eriksson, K. (2010). Preparing for preparedness - Shaping crisis planning processes in local authorities. [Doctoral Thesis (compilation)]. Department of Fire Safety Engineering and Systems Safety, Lund University.
55. Stark, A. (2014). Bureaucratic values and resilience: An exploration of crisis management adaptation. *Public Administration*, *92*(3), 692–706. https://doi.org/10.1111/padm.12085
56. Juarerra, A. (2023). *Context changes everything. How constraints create coherence*. The MIT Press.
57. Blanchet, K., Nam, S. L., Ramalingam, B. (2017). Governance and capacity to manage resilience of health systems: Towards a new conceptual framework. *International Journal of Health Policy and Management, 6*(8), 431–435. https://doi.org/10.15171/ijhpm.2017.36
58. Foroughi, Z., Ebrahimi, P., Aryankhesal, A. (2022). Toward a theory-led meta-framework for implementing health system resilience analysis studies: A systematic review and critical interpretive synthesis. *BMC Public Health, 22*(1), Article 287. https://doi.org/10.1186/s12889-022-12496-3
59. Karreinen, S., Janhonen, K., Kihlström, L., Paananen, H., Viita-aho, M., & Tynkkynen, L. K. (2024). Resilience in local Finnish health systems: How are leaders' approaches to change manifested in organisational crisis responses? *Journal of Health Organization and Management*. https://doi.org/10.1080/17406315.2024.2432174
60. Janhonen, K., Viita-aho, M., Huhtakangas, M., Kihlström, L., Keskimäki, I., & Tynkkynen, L. K. (2024). Resilienssi terveysjärjestelmien tutkimuksessa: Kartoittava katsaus resilienssistä käsitteenä. *Sosiaalilääketieteellinen aikakauslehti*, *61*(2), 192–209. https://doi.org/10.23990/sa.128097
61. Kihlström, L., & Karreinen, S. (2024). Resilience: Now what? Comment on "Re-evaluating our knowledge of health system resilience during COVID-19: Lessons from the first two years of the pandemic." *International Journal of Health Policy and Management, 13*, Article 8563. https://doi.org/10.34172/ijhpm.8563

62. Schomaker, R. M., & Bauer, M. W. (2020). What drives successful administrative performance during crises? Lessons from refugee migration and the Covid-19 pandemic. *Public Administration Review, 80*(5), 845–850. https://doi.org/10.1111/puar.13280
63. van Buuren, A., & Gerrits, L. (2008). Decisions as dynamic equilibriums in erratic policy processes. *Public Management Review, 10*(3), 381–399.
64. Holland, J. (2000). *Emergence: From chaos to order*. Oxford University Press.
65. Eppel, E. (2017). Complexity thinking in public administration's theories-in-use. *Public Management Review*, *19*(6), 845–861. https://doi.org/10.1080/14719037.2016.1235721
66. Van der Wal, Z. (2020). Being a public manager in times of crisis: The art of managing stakeholders, political masters, and collaborative networks. *Public Administration Review, 80*(5), 759–764. https://doi.org/10.1111/puar.13245
67. Teisman, G. R., & Kljin, E.-H. (2008). Complexity theory and public management. An introduction. *Public Management Review, 10*(3), 287–297.
68. Karreinen, S., Paananen, H., Kihlström, L., Janhonen, K., Huhtakangas, M., Viita-aho, M., & Tynkkynen, L. K. (2023). Living through uncertainty: A qualitative study on leadership and resilience in primary healthcare during COVID-19. *BMC Health Services Research*. https://doi.org/10.1186/s12913-023-09223-y
69. Hale, A., & Heijer, T. (2017). Defining resilience. In E. Hollnagel, D. D. Woods, & N. Leveson (Eds.), *Resilience engineering* (pp. 35–40). CRC.
70. Gibbs Springer, C. (2012). Resilience in emergency management research. *Public Administration Review, 72*(4), 548–549. https://doi.org/10.1111/j.1540-6210.2012.02567.x
71. Linkov, I., & Trump, B. D. (2019). *The science and practice of resilience*. Springer Nature. https://doi.org/10.1007/978-3-030-04565-4

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