Discussion

This work defines individual and collective lessons learned during a two-year subsidiary civil-military pandemic disaster relief mission in Heidelberg/Rhine-Neckar involving 788 soldiers from 20 different military units between March 2020 and March 2022 guided by (1) a systems-based medical leadership and management process along the patient's journey, (2) analyzed with the openness-approach of semi-structured interviews engaging key actors, and (3) regarded through the holistically comprehensive focus of a community resilience lens. We identified 37 action items to enhance community resilience for future catastrophes in the nine areas of (1) local knowledge, (2) community networks and relationships, (3) communication, (4) health, (5) governance and leadership, (6) resources, (7) economic investment, (8) preparedness, and (9) mental outlook.

The methodological core elements proved to be extremely useful for the mission analysis. The first useful element was the **systems-based medical leadership and management process along the patient's journey** to inform and facilitate the medical coordination activities of the subsidiary mission in Heidelberg/Rhine-Neckar within the pandemic. Specifically, this perspective included the consideration of patients' experiences along their health journey throughout time with regard to SARS-CoV-2 related risks, care, and prevention within and across elements of local health-care settings (Table 5, Figure 12). In general, including patients' perspectives is considered a key factor in improving patient safety within an overall aligned multi-domain system which integrates real-life experiences and skills of people [6]. In a concept analysis and systematic review, Gartner et al. proposed a seven-point framework for fluid and effective pathways which included (1) the centricity of patients and caregivers, (2) the positioning of professional actors involved in the care pathway, (3) the operation management through the care delivery process, (4) the particularities of coordination structures, (5) the structural context of the system and organizations, (6) the role of the information system and data management and (7) the advent of the learning system [34]. Seminal systems-based steward questions (Table 5) that arose during the subsidiary mission did cover and address this seven-point framework.

The second useful element was **qualitative semi-structured interviews which did prove to be greatly beneficial though their openness to novel ideas** raised by the participants within the interviews. Specifically, it provided valuable thematic insights, because it captured comprehensive descriptions by the interviewees and allowed diving deeper into sponta-

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neously addressed phenomena through the possibilities of asking questions and engaging in a dialogue. This would not have been possible with a questionnaire-based study.

The third useful element of this work was the **analysis structure around the community resilience framework** elaborated by Patel et al. [71].This framework proved to be very beneficial in the sense of a holistic comprehensiveness around the ideas expressed in this work, because it overcame the heterogeneous resilience framework concepts that were previously reported in civil-military COVID-19 disaster relief missions around the globe, while, at the same time, these individual non-aligned concepts are being represented as a whole within in Patel's framework construct [71, 79].

Focus question 1: What was done in Heidelberg/ Rhine-Neckar?

Seven core issues with civil-military relevance arose in Heidelberg/Rhine-Neckar during the pandemic: (1) hospitals lacked PPE which exposed staff to infections. (2) There was risk of SARS-CoV-2 outbreak in a major regional refugee center. (3) Ongoing surges of COVID-19 patients overwhelmed ICU units. (4) The risk of uncontrolled spread of infections endangered the population (5). SARS-CoV-2 infections spread into vulnerable populations in nursing homes leading to casualties. (6) SARS-CoV-2 infections spread into vulnerable populations in nursing homes leading to surges of symptomatic infections among staff. (7) The swift roll-out of ambitious vaccine campaign in a short time was endangered by lack of staff. To strengthen perseverance in pandemic management, the military mainly provided workforce and, to a minor degree, equipment, overall, with good outcomes for the afflicted population (Table 6). The embedded proximity of local medical staff officers within liaison commands on both sides—the military medical service as well as the civilian health care system—was especially useful for eight community resilience elements out of nine, i.e., local knowledge, community networks and relationships, communication, health, governance and leadership, resources, preparedness; and mental outlook (Table 5, Table 6, Figure 14, Figure 15, and Figure 18). The liaison role provided little influence on economic investment.

The nature and extent of civil-military cooperation in Heidelberg, Germany, during the COVID-19 pandemic was essentially in line of what has been reported worldwide in the scientific literature [79]. In preparation for this study, we had previously analyzed 45 publications by means of a scoping review. This structured, mixed-methods scoping review analysis of the

scientific literature extracted from three databases (PubMed, Web of Science, and Cochrane Library) included the work of authors from 22 countries and covered five continents (Figures 19 and 20) [79].

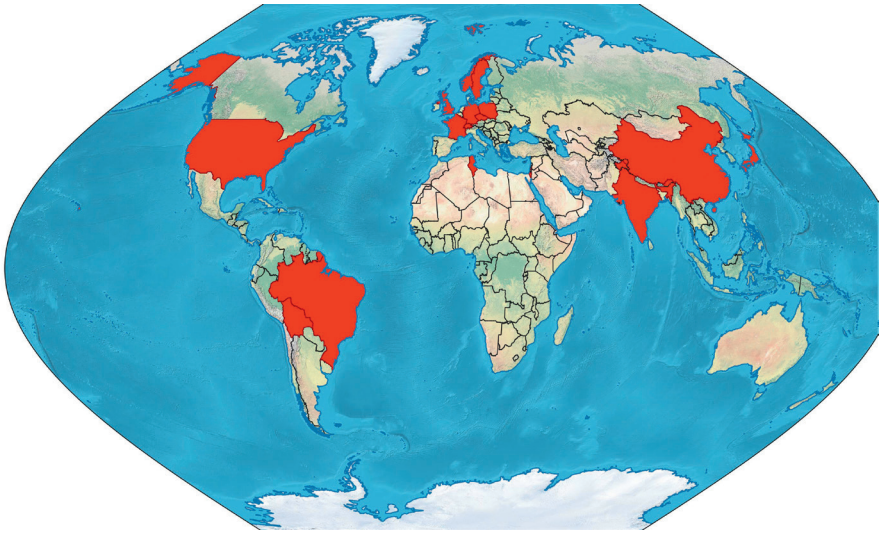

Figure 19. Countries of military (co-)authors' affiliations in medico-scientific civil-military publications during the COVID-19 pandemic (in red) [79]

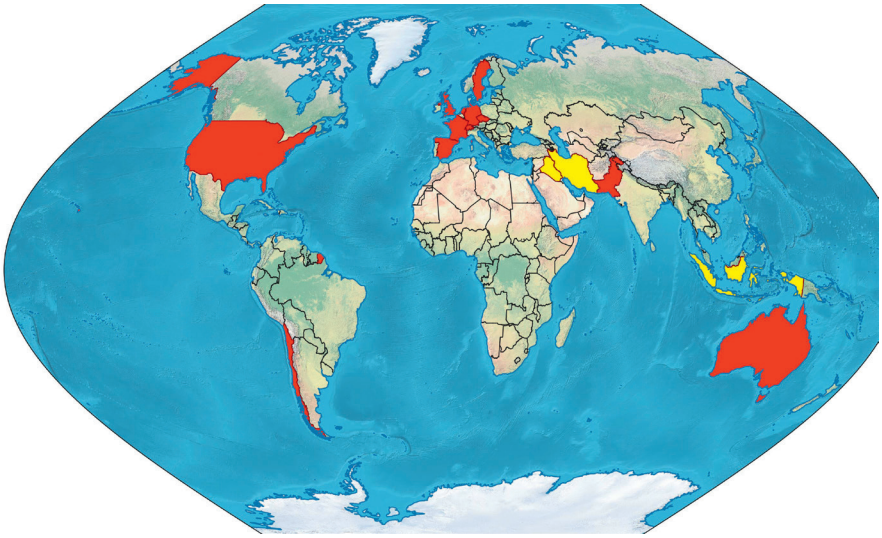

Figure 20. CIMIC field experiences and analyses during the COVID-19 pandemic. Red: first authors' countries of affiliation. Yellow: Countries in which CIMIC activities were analyzed by authors from other countries [79]

In general, civil-military cooperation worldwide was heterogeneous and could differ from country to country (for details, see [79]). In the scoping review analysis of the literature reports, we could, however, identify three thematic clusters which are described in the following sections in more detail as expanded contextual perspectives.

Expanded contextual perspective: Worldwide medico-scientific contributions with the participation of military medical personnel or institutions

Members of the military acted as subject matter experts, clinical and experimental (co-)investigators as well as co-founders for enabling COVID-19 relevant research [79] (Figure 21). Areas covered were relevant to the COVID-19 patient's clinical journey from prevention, exposure, diagnostics, and treatment and included pertinent fields such as digital health and telemedicine, global and public health, critical care, emergency and disaster medicine, radiology, neurology, as well as other medical specialties, i.e., respiratory care, pulmonology, burn medicine, and transfusion medicine, in addition to environmental and occupational sciences as well as materials science [79].

Expanded contextual perspective: Worldwide CIMIC field experiences or analyses

CIMIC field experiences or analyses reported in the literature included areas such as political framework, strategy, structure, nature of civil-military interaction and concrete mission reports in selected countries [79] (Figure 22). Although, in general, findings in scoping reviews tend to be more abstract and conceptual compared with individual studies like the present one, the themes identified in our scoping review nevertheless corroborated and expanded the local civil-military experience in Heidelberg/Rhine-Neckar during the COVID-19 pandemic by covering a broad spectrum of pandemic disaster management subjects such as capacity and surge capacity building, medical and pharmaceutical logistics, patient care under austere circumstances, SARS-CoV-2 testing support, intelligent and innovative information management, vaccination support, and disaster communication [79].

Some country reports were of specific relevance to the present study, because they dealt either with common motifs of the mission or they addressed issues raised by the participants in the present study [79]. These examples will be addressed in more detail in the next paragraphs.

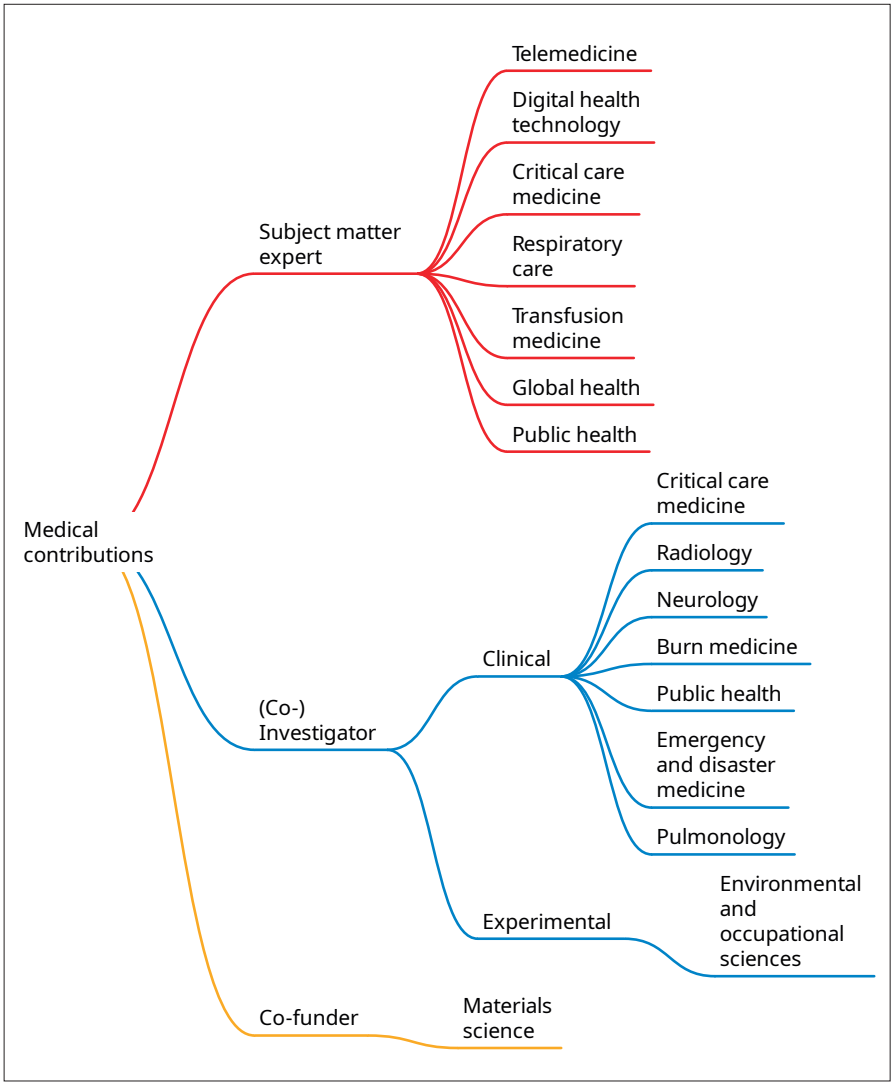

Figure 21. Worldwide medical contributions of the military during the COVID-19 pandemic [79]

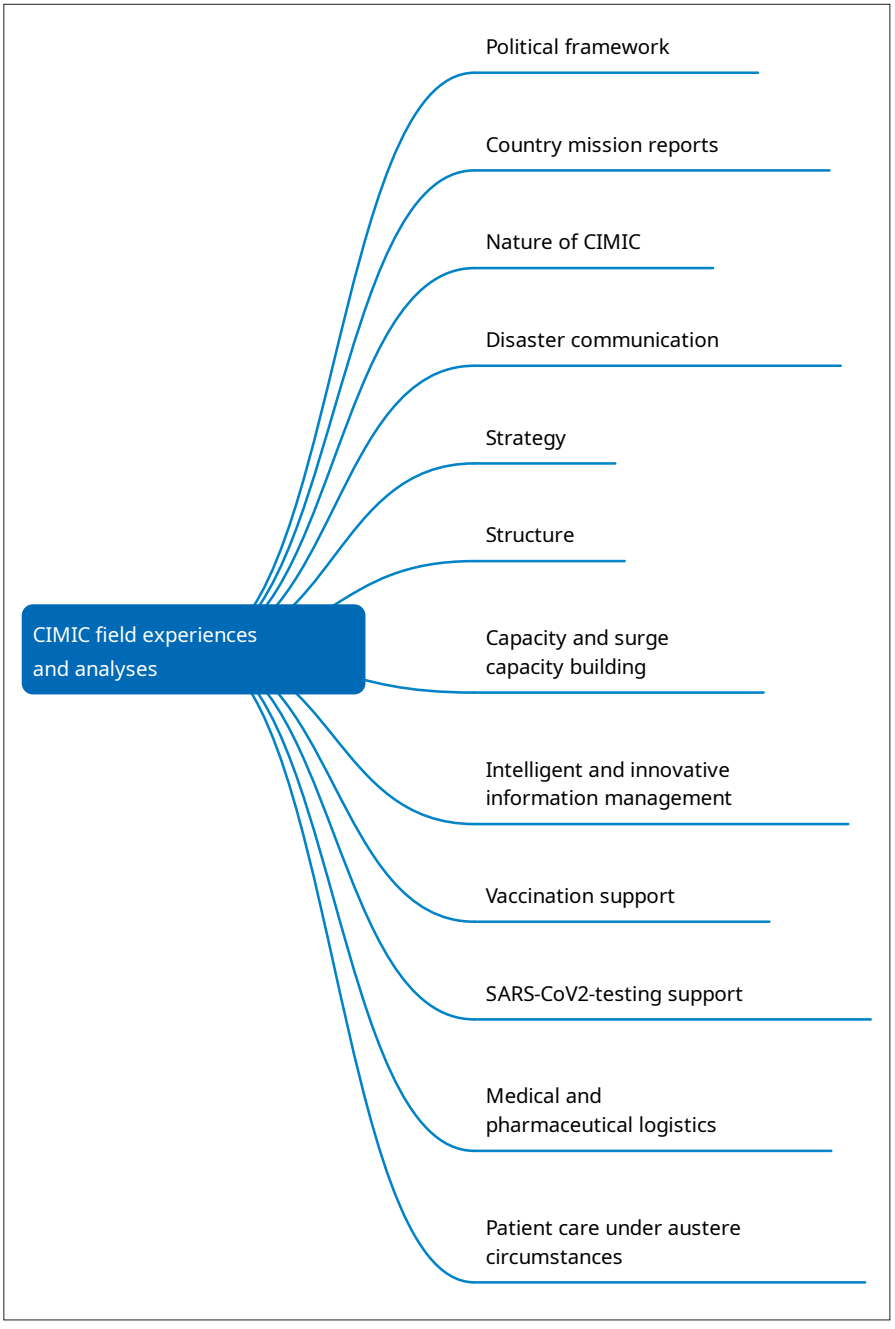

Figure 22. Themes of worldwide CIMIC field experiences during the COVID-19 pandemic [79]

Jabbar and Makki analyzed civil-military cooperation during the COVID-19 pandemic from a leadership perspective in Pakistan [48, 79]. They focused on four themes, i.e., (1) the significance of CIMIC in disaster management, (2) challenges associated with CIMIC during the COVID-19 pandemic, (3) the role of a common civil-military comment operation center, and (4) government policies and practices related to disaster management [48, 79]. Of interest, most funding is spent on measures responding to a disaster rather than on prevention [48, 79]. This is not an isolated phenomenon, but a frequent global shortcoming, which is being addressed by the Sendai Framework for Disaster Risk Reduction 2015–2030 [74, 79]. Tasks of the Pakistani army included support in SARS-CoV-2-testing, logistics (i.e., distribution of medical equipment including testing kits, ventilators, personal protective equipment and drugs), disaster response coordination, and information management [48, 79]. In Pakistan, overcoming a communication gap and fostering collaboration between civilian actors was important during the COVID-19 crisis [48, 79]. In the absence of international guidelines for CIMIC, a definition of the overall framework and guidelines are considered helpful [48, 79]. Joint training of civilian and military stakeholders improved functioning and mutual understanding, and increased trust, while previous military training of civilian actors proved to be beneficial in this regard [48, 79]. Of interest, the administrative structure of civil-military cooperation in Pakistan is similar to the one in Germany, where military entities mirror their civilian counterparts on the local, regional, and state levels [48, 89].

In the UK, Gad et al. analyzed civil-military cooperation from open-source grey literature in six European countries, i.e., UK, France, Spain, Italy, Belgium and Sweden, in the early phase of the COVID-19 crisis [32, 79]. For this analysis, they identified seven main analytical themes, i.e., (1) recognition of health security threat from coronavirus spread in Wuhan, (2) detection and announcement of first cases as reported through military health functions, (3) invocation or announcement of national crisis, plans and/or military involvement, (4) how military support was incorporated into national crisis response, (5) how the military modified its activities, (6) dealing with rumors/allegations related to COVID-19, and (7) other—military and COVID-19, and divided these themes into 19 categories of civil-military cooperation [32, 79]. The armed forces and the military medical service were key components of early disaster response and strengthened resilience, while Italy and Spain had the most intense and Sweden the least intense level of CIMIC within this group of countries [32, 79]. Gibson-Fall identified three different trends of national military involvement during the COVID-19 crisis worldwide: (1) minimal technical military support, (2) blended civil-military responses, and (3) military-led responses [45, 79]. The blended civil-military response was characterized by civilian leadership and military support in organization and logistics which could

include air repatriations, border controls, mobile testing, quarantine and lockdown enforcement, and emergency field hospitals [45, 79]. This trend model was practiced in countries such as Nigeria, Kenya, the US, France, the UK, China, Vietnam, South Africa, and Singapore [45, 79]. Subsidiary civil-military support in Germany during the COVD-19 pandemic followed this blended civil-military response trend model as well. A participant of the present study suggested considering the establishment of flexibly deployable disaster response modules within the administration to enhance resilience. In this context, an interesting example for enhancing crisis management capabilities in the public sector is the British stabilization unit, which facilitates cooperation between agencies, civilians and the military and could serve as a training and capacity building model [21, 79].

In Germany, Roßmann et al. focused on systems innovation, analyzing the dynamic challenges of the emerging COVID-19 pandemic through a Cynefin lens; remarkably similar crisis management problems were found in different areas of the public health service in Germany [79, 86]. They identified four key areas that necessitated systems innovation to strengthen disaster resilience, i.e., (1) information-management including crisis communication, (2) data- and information-visualization (dashboard), (3) training and education of supporting staff, and (4) a framework and evaluation concept ("scoring-matrix"), and developed novel tools to adapt, change, and innovate the public disaster management system [79, 86]. Similar challenges and difficulties were recognized and addressed in participant's own areas of responsibility, too, within the community resilience elements communication, health, resources, and governance and leadership (Table 12). In particular, the proven joint ability for coordination and patient allocation was considered a particular strength of the region Heidelberg/Rhine-Neckar for future catastrophes.

We previously summarized lessons learned during the SARS-CoV-2 emergency vaccination roll-out campaign in Heidelberg in the year 2020 [79, 90]. The following five strategic elements were important for success: (1) robust mandate, (2) use of established networks, (3) fast on-boarding and securing of commitment of project partners, (4) informed planning of supply capacity, and (5) securing the availability of critical items [79, 90]. Planning tools included (1) analyses through a VUCA lens, (2) analyses of stakeholders and their management, (4) possible failures, and (5) management of main risks including mitigation strategies [79, 90]. Lessons learned identified ten tactical leadership priorities and ten major pitfalls. We proposed that methods which comprised considerations of VUCA factors combined with analyses of possible failures, and management of stakeholders and risks could be adjusted to any public health care emergency anywhere across the globe in the future [79, 90]. Participants in this study considered the vaccine campaign a success because it saved lives. Post-hoc, participants stated that main challenges for the vaccination pro-

gram was building the vaccination center without prior experience, lack of time, planning around changing priorities, finding personnel, and the vaccine logistics. Misaligned communication was a main issue., but prioritized resource allocation, work-flow, and collaboration with diverse partners, including the military, in the vaccine centers was excellent (Table 12).

Consistent with the report by Gad, Lopez-Garcia from Spain observed a high degree of visibility of the military and other security institutions in the crisis communication strategy of the Spanish government [32, 57, 79]. The four key axes of the crisis communication in Spain were (1) continuous communication, (2) seriousness of the crisis, (3) feeling of control, and (4) unity [57, 79]. This highly visible presence was a result of the high degree of trust that the military was enjoying in Spain compared with other public, political, private, and religious institutions. Thus, an association with the military during the COVID-19 crisis had a protective function for Spanish politicians against critics from the opposition [57, 79]. The involvement of the German military in the crisis communication was lower than in Spain. Soldiers wore uniforms during the subsidiary mission in Heidelberg/Rhine-Neckar and generally enjoyed a large amount of gratitude from the population for their service, although the presence of the military led to questions in individual cases. Awareness of difference in civilian and military communication cultures and styles is important for future CIMIC missions.

Preparedness is of utmost importance for future catastrophes. Bacchus and colleagues emphasized the necessity of thorough inter-agency preparedness for disasters in advance [3, 79]. They reported civil-military experience with the rapid deployment—initially a high readiness exercise in January 2020—of a military mobile biological field analysis laboratory and the development of a polymerase chain reaction (PCR) test in order to facilitate the diagnosis of SARS-CoV-2 infections [3, 79]. This project was a collaboration of the Swedish Armed Forces, the Public Health Agency, and a civilian hospital [3, 79]. Assessment of military preparedness for civil-military cooperation in a disaster situation can be challenging and complex. Therefore, Tušer and colleagues from the Czech Republic developed a capacity and capability assessment procedure based on questionnaires and a mathematical model which includes Saaty's method [79, 99]. The goal was to determine the degree of preparedness of the Czech army for cooperation with civilian partners in disaster management including the COVID-19 crisis. and to identify specific areas for improvement [79, 99]. The four assessment criteria included (1) human resources, (2) technical security of allocated forces, (3) command and control of allocated forces, and (4) planning; these criteria were further subdivided into two or three indicators each [79, 99]. As preconditions for better future preparedness, participants in the present study emphasized the value of inter-institutional alignment, networking, transparent communication,

sufficient resources, realistic training, and an anticipatory, open mindset (Table 18).

In our area, there was some degree of *medical* military support, i.e., during quarantine support in the refugee center and on the intensive care units of the university hospital (Figure 16, Table 6). Despite the limited availability of medical military personnel in a large area situation for local circumscript support, both missions had beneficial impact on morale and public health. There were two remarkable project reports on civil-military cooperation from the US. First, Dutta et al. described the deployment of 500 Navy Reserve medical professionals to New York City [28, 79]. Some of these reservists supported eleven local hospitals that were overburdened with the COVID-19 surge which led to the exhaustion of the civilian staff. This civil-military mission was an example of successful rapid deployment of medical forces and cohesive cooperation in a diverse professional setting across all specialties [28, 79]. Likewise, the Army medical service supported New York City as well. They rapidly activated and operationalized a COVID-19 inpatient care facility in a civilian congress center in New York City, successfully integrating uniformed services, governmental agencies, and private healthcare organizations [61, 79]. Participants in the present study stated a wider participation of the medical corps including nurses and physicians of the federal armed forces in health protection tasks would be beneficial for better future preparedness which implies that the medical sector within the Federal Armed Forces should be further strengthened for better public health protection (Table 14).

Focus question 2: What impact did the Heidelberg/ Rhine-Neckar disaster relief mission have?

The pattern of answers provided by participants suggested that subsidiary civil-military support in Heidelberg during the pandemic overwhelmingly strengthened local resilience. Specifically, increased local resilience was reported in the domains (1) community networks and relationships, (2) health, (3) governance and leadership, (4) resources, (5) preparedness, and (6) mental outlook (Table 16). The overall positive impact was, however, limited in sub-segments, mainly due to the limited availability of medical military personnel (health), the fact that the availability of subsidiary support by the military impeded recruiting efforts and self-sufficiency in specific sectors on the civilian side (economic investment), and, finally, the appropriate use of skills was addressed as an issue (mental outlook) (Table 16). The method of the present study did not allow assessing quantitative effects on mortality. A recent study from the US established a quanti-

tative relationship between ICU surges and mortality. Specifically, each 1% increase in general ICU capacity was correlated with approximately 5 more weekly deaths from COVID-19 per 100,000 population [44]. Likewise, each percentage increase in the number of patients with COVID-19 admitted to the ICU resulted in approximately 10 more COVID-19 deaths per week per 100,000 population [44]. Therefore, limiting the spread of SARS-CoV-2 infections into the elderly (who had a higher risk for severe disease necessitating ICU care) by providing military personnel for SARS-CoV-2 antigen point-of-care testing of nursing home visitors highly likely contributed to lowering the overall mortality in the local population (Figure 17, Table 6).

Expanded contextual perspective: Role models for crisis management and mutual learning

Identified as the third thematic cluster in our scoping review of the worldwide literature, structure, function, and leadership culture in the military was previously discussed as a role model for crisis management [79]. Michael elaborated on the tradition of influence of military medicine to its civilian partners [62, 79]. Two examples in the COVID-19 pandemic corroborated this relationship and dialogue. As such, successful management of SARS-CoV-2 outbreaks on a ship and in a Marines boot camp delivered valuable insight into virus transmission, disease understanding, diagnosis, tracking and tracing as well as appropriate quarantine measures in the early phase of the pandemic that could be extrapolated into civilian community settings such as schools, dorms, or other shared living environments [62, 79]. Katz and colleagues considered items of military medicine such as preparedness, team-based care, echelons of care, augmenting the effort, effective triage, and servant leadership as important lessons learned for adaptation into cardiac critical care during the COVID-19 pandemic [51, 79]. In the present study advantages and limitations of either the military system or the civilian side within the local COVID-19 pandemic disaster management were addressed in a much more nuanced manner. Mutual learning opportunities for both sides were identified. In general, participants praised the military for its determination, reliability, clear language and structures as well as rapidly deployable resources for standardized tasks, whereas the civilian side was lauded for creativity, flexibility, and professional experience for specific tasks (Table 14). Of interest, some positive and negative characteristics were attributed for both sectors which could mean that certain features are probably just contingent upon the individual who is responsible for the deliverable, and whether this person is working within a civilian or a military environment would rather be a question of a secondary importance. One participant emphasized that leadership styles change over time on both sides. This phenomenon was also

addressed in our scoping literature on civil-military key concepts during COVID-19 [79]. Hierarchical top-down, command-and control structures in healthcare may have worked well in the past in military operations, crisis management, and certain healthcare settings, they do not meet today's standards due to generational value change and complexity issues in the operational environment [79, 91]. There has been a slow shift in healthcare leadership culture toward the emphasis on emotional intelligence in order to (1) foster respect and civility to empower teams, (2) lead with transparency and open communication to promote psychological safety, and (3) lead with compassion when tackling severe problems. This change process may now experience push-backs and regression into the old-school system because of the pressure during the pandemic [79, 91]. In this context, features attributed to key actors in the local pandemic management by the study participants could be regarded as characteristics for role models in disaster management situations and in general. These were: (1) exhibiting leadership, being a (2) diplomat, (3) communicator, (4) enabler, (5) demonstrating agility and a (6) supportive, robust, anticipative, focused, determined and ethical mindset (Figure 18, Table 10).

Results of this research and the information pattern detected in our scoping review of the literature suggest that civil-military cooperation during the COVID-19 pandemic contributed substantially to societal resilience in crisis management, both in Heidelberg/Rhine-Neckar as well as on a global scale in general [79]. Locally and globally, a broad spectrum of core abilities was covered by military support—presumably at a high cost, because if the health care system in a particular country or region is already overstretched before a crisis occurs, the mitigation potential may be limited whoever the health agent would be [79]. Therefore, from a holistic perspective, decisive measures to prevent the next pandemic should receive considerable attention in the future [79, 100]. In order to maintain trust within the population, the awareness of the military's potential of threat and intimidation is crucial to prevent abuse [79].

Participants reflected on the framework for civil-military cooperation and their civil-military experiences during the pandemic in Heidelberg/Rhine-Neckar. As stated above, the type of subsidiary disaster response in Heidelberg/Rhine-Neckar followed—as all over Germany—the blended civil-military trend model characterized by civilian leadership and military logistic as well as operational support [45]. Civil-military cooperation was in general perceived as very positive in terms of (1) community networks and relationships (2) communication, (3) health, (4) governance and leadership, and (5) resources. Principal areas for improvement—besides a few individual outliers—included timing and semantics in the communication domain between both sides as well as differences in working structures. Study participants made a variety of valuable suggestions for future missions in terms of what they would do the same or probably do

differently next time (Table 14). For an improved understanding of cooperative dynamics in civil military cooperation during infectious disease outbreak situations, Janse et al. recently conducted a qualitative scoping review that identified five recurring themes covering challenges and opportunities in civil-military cooperation [49]. These themes were (1) managing relations, (2) framework conditions, (3) integrating collective activities, (4) governance, and (5) civil-military differences [49]. They concluded that successful civil-military cooperation requires (1) sustainable relations, (2) binding agreements, (3) transparency, (4) a clear operational perspective, and (5) acknowledgment of organizational cultural differences, as well as (6) early and continuous engagement in order to avoid distrust and tension among stakeholders [49]. Our findings in the present study — both positive and negative (Table 14) — are essentially in line with these useful themes and helpful recommendations by Janse et al.

The vast majority of published articles analyzed in our scoping review about the role of the military during the COVID-19 pandemic was — like the insights provided by interview participants in the present study — reported in a neutral or positive perspective [79]. Positive experiences found in the scoping review included (1) the military contribution to the advancement of medical and scientific knowledge, and (2) providing medical care in austere circumstances [79]. Furthermore, (3) the use particular, sometimes even unique capabilities of the military such as leadership, technical, logistical, and organizational skills, innovative thinking, as well as (4) the availability of rapidly deployable workforce and equipment for the purpose of serving the population and resulting in tangible disaster relief were positive, and well-received examples that should be followed in the future [79]. As expected, there were also disapproving voices in some countries. As such, the political frameworks of civil-military cooperation in particular in Indonesia and Chile were discussed critically by other authors [27, 30, 79]. Likewise, Medeiros Passos and Acácio analyzed the impact of military involvement in Latin American countries, in particular policing missions in the Dominican Republic, Ecuador, El Salvador, Guatemala, Bolivia, Honduras, Chile, as well as Peru, and addressed the critical issue of short term-human rights degradation and aggravation of police violence [70, 79]. Furthermore, they concluded that the attribution of disaster management positions to military personnel in Brazil, Chile, Bolivia, and Peru may have weakened the civilian control of the armed forces in the future [70, 79]. Participants in the present study also addressed the possible intimidating perception of military uniforms in disaster relief operations that civil-military coordinators should be aware of.

Focus question 3: How well are we prepared for future catastrophes after lessons learned from the corona pandemic and what must be done to close this gap?

This work provides a deep insight into both strengths and weaknesses of the current local disaster management system. Moreover, lessons learned from participants' own areas of responsibilities are being identified, as well as experiences with civil-military cooperation, across a broad spectrum of community resilience core elements. This includes a reflection on what should be done in the future—either the same way or differently (Table 12, Table 14).

Most importantly, the present work identified as a main result 37 action items to be addressed to enhance community resilience for future catastrophes. These action items lie within the areas of (1) local knowledge, (2) community networks and relationships, (3) communication, (4) health, (5) governance and leadership, (6) resources, (7) economic investment, (8) preparedness, and (9) mental outlook (Table 18). Their 16 main themes included the **necessity for local alignment, continuous open-minded community networking, transparent communication internally and externally aligned, coordinated approach towards healthcare complexity, creation of personnel reserves including the acceptance of free resources in routine times, timely switching into disaster mode, reduction of bureaucracy, clear understanding of leadership, roles, and responsibilities, inclusion of volunteers, funding of novel ideas, prioritized planning and acquisition of material adapted to likely risk scenarios, improved disaster education including at schools, inclusion of practitioners, conducting frequent all-hands exercises, functioning as an anticipatory and learning organization, and promoting self-sufficiency within the population.**

Useful tools for better disaster preparation in Germany include the knowledge of past disasters [82] as well as the available risk analysis of the Federal Government which include natural disaster scenarios such as (1) extreme melting floods from the mid-mountains, (2) pandemic due to a SARS-like virus, (3) winter storm, (4) storm flood, (5) drought, (6) earthquake, and technological disaster such as (7) release of radioactive substances from a nuclear power plant, (8) release of chemical substances, as well as (9) central recurrent findings [96]. Nevertheless, despite the (theoretical) availability of these rather high-level framework tools, self-organization within or between institutions played a key role in the local disaster response in Heidelberg/Rhine-Neckar out of operational necessities within the situational evolution. Two successful local examples were the establishment of the interclinical staff crisis team and the common patient allo-

cation system (Figure 15). Self-organization is considered a typical need for successful disaster response, because situations change quickly and actors need to improvise and adapt, often beyond the comfort zone of their usual role [52, 64].

Lee at al. conducted a scoping review of 36 papers on public health emergency preparedness focusing on infectious diseases [55]. Framework for their analysis was the 11 elements all-hazards resilience framework for public health emergency preparedness [53]. They found that collaborative networks, community engagement, risk analysis and communication played an important role, in addition to planning to mitigate inequities, research and evidence-informed decision making, building vaccination capacity, building laboratory and diagnostic system capacity, building infection prevention and control capacity, financial investment in infrastructure, health system capacity, climate and environmental health, public health legislation and phases of preparedness [55]. Our findings—although elaborated under a more generalist framework of community resilience and taking into account all hazards beyond the pandemic—largely align with the results of the scoping review of Lee et al.

Cutting of red tape

Excessive, unnecessary bureaucracy—also known as "red tape"—during the COVID-19 pandemic was often criticized in the interviews [12]. This is a true concern, because red tape in public administration has a negative impact on organizational and employee performance as recently demonstrated in a meta-analysis by George et al. [35]. The phenomenon of red tape was stable across sectors and administrative traditions internationally. Of interest, excessive bureaucracy established by the institution itself was more destructive than externally imposed red tape, but is a correctable issue because it can be addressed by the public manager themselves [35]. The necessity for improvement on this subject was recognized by the participants in the present study as a factor that could strengthen future resilience in case of catastrophes.

Breaking the "panic-then-forget" cycle through sustainable preparedness

The pandemic has taught us valuable lessons on challenges faced in complex and dynamic societies. Results of the present study emphasize the imperative to break the recurrent "panic-then forget" cycle after disasters from a local perspective. This was seconded on a global level by the WHO at the occasion of the 75th Session of the United Nations General Assembly,

1 October 2020, advocating "for long-term, sustainable emergency preparedness through diplomacy, investments, capacity-building and health system strengthening", and for "applying a whole-of-society approach in countries for sustainable emergency preparedness through effective multisectoral collaboration and community engagement" [108]. In order to be better prepared for future catastrophes in terms of physician personnel, the public health sector in Germany will be strengthened. Specifically, medical students will be able to do part of their clinical training in form of electives or final year rotations periods in public health departments [26]. In Heidelberg, this is a joint project between the Faculty of Medicine, University of Heidelberg, and the Public Health Service Heidelberg/Rhine-Neckar district, which has sustainably evolved out of the close, common pandemic disaster management between these institutions. Proper civil protection addressing the real needs of a changing population and society requires alignment and adaptation towards the realities of today's society, such as migration, aging, and evolution of organizational structures of civil societies [60]. Participants of the present study mentioned the inclusion of spontaneous helpers—volunteers who are not organized in a disaster relief organization but nevertheless very motivated and willing to contribute—as an aspect of these evolving structures that provide opportunities for personnel resources, but need a structured conceptual approach for on-boarding. Another vital action point addressed in this societal context was the necessity of promoting self-sufficiency within the population and a realistic understanding within the public what limited services disaster management would be able to provide in a major, geographically extended scenario.

Achieving timely operational readiness

Timely switching from routine operations into crisis mode was recognized as an important item in our study. De Rooij et al. investigated this concept of achieving operational readiness—which is mainly defined "by the time dimension required to deploy the response to a specific threat"—in a qualitative study based on interviews with COVID-19 disaster responders from 11 European countries [85]. Critical factors for activation were time, overcoming information overload, and workforce [85]. Using the NATO Combat Readiness as a possible framework for readiness, the definition of time and stages of operational resource activation could address these challenges but further structural and sustainable investment in preparedness is necessary; these were items that our study participants addressed as well [85]. In our study, self-organization played a vital role.

Overcoming the next "infodemic" in a world of social media

Another important global issue with impact on the local situation as addressed by participants in the present study was the "infodemic" within the pandemic. The term "infodemic" was initially coined by Rothkopf in 2003 in a Washington Post article. This infodemic occurred in the wider context of a SARS outbreak and was defined by Rothkopf as "a few facts, mixed, with fear, speculation and rumor, amplified and relayed swiftly worldwide by modern information technologies [that] have affected national and international economies, politics and even security in ways that are utterly disproportionate with the root realities" [88]. The WHO definition of infodemic is "too much information including false or misleading information in digital and physical environments during a disease outbreak" [107]. The world-wide COVID-19 infodemic was indeed recognized as a multifaceted problem within the medical literature. It extended into global political spheres such as societal cohesion and security, the infodemic mechanisms involved specific factors related to the situation, sender, instrument, and recipient and had a substantial impact on human health, by causing stress, deception, violence, and harm [78]. Mixed-synergistic pre-impact, trans-impact, and post-impact countermeasures were recently summarized by us in a scoping review of reviews [78]. The most important infodemic countermeasure is building and maintaining trust; these two items were also addressed by interviewees in this study in the context of community resilience.

Limitations and directions for future research

This work is subjected to some especially important limitations that have to be considered for the appropriate interpretation and extent of generalizability of this study.

Modules 2 and 3 were methodologically based on a qualitative approach, based on semi-structured 1:1 interviews with local key players (N = 12), that were transcribed, coded and phenomenologically analyzed for significant statements. The limitation of this approach is the small sample size which requires caution regarding interviewer bias. On the other hand, the advantage of the present method lies in a high commitment though trusted settings in psychological safety, that were a priori expected to reveal deeper insights than for examples questionnaires in a wider audience with higher sample sizes, because the study population and the answers were a priori expected to be highly heterogeneous. A posteriori, the methodological approach of modules 2 and 3 with semi-struc-

tured qualitative interviews qualitative did prove to be greatly beneficial through its openness to novel ideas raised within the interviews. Specifically, it provided valuable thematic insights, because it captured comprehensive descriptions by the interviewees and allowed diving deeper into spontaneously addressed phenomena through the possibilities of asking questions and engaging in a dialogue. This would not have been possible with a questionnaire-based study. Therefore, the present method was judged sufficient and appropriate to meet the research goal, mainly because of the composition of the study population. The resources required were a priori considered feasible which, from a post-hoc view, could be confirmed. Out of 17 participants invited, 12 were enrolled (= 71%), and exceeded the a priori defined enrolment goal of N = 10 by 20%. This response rate of 71% in the present study is substantially higher than the recruitment achieved in a cross-sectional study conducted by our team assessing parental experiences in children with a rare neurogenetic disorder, which was based on questionnaires that were mailed to potential participants with support of a patients' organization. In that study, we achieved a response rate of only 13,8% [47]. The categorization of clusters of meaning into elements of resilience may be arbitrary in single cases, because one cluster of meaning could be attributed to more than one precise element of resilience. A best-fit-approach without adjudication was chosen within the pre-planned single rater design of this study; therefore, a subjectivity bias cannot always be completely excluded, although the single rater was a subject matter expert. Nevertheless, structuring the analysis along the nine core elements of community resilience elaborated by Patel et al. [71] proved to be greatly beneficial in the sense of a holistically comprehensive framework around the ideas expressed in this work. As in any qualitative study, the qualitative analysis within the present work was contingent on the researcher's characteristics and reflexivity. Therefore, subjectivity bias cannot be completely excluded. The study was a priori designed as a single rater research because it was an individual master thesis project. A multirater approach might have provided a broader perspective and an opportunity for insightful discussions. Translation of the German source data into English might introduce linguistic and/or cultural inaccuracies. Nevertheless, reporting this study in English widens the potential of knowledge dissemination in the worldwide disaster management community and enhances global opportunities for exchange and mutual learning. Modules 2 and 3 are to be understood as a bird's eye view from a diverse local key player perspective. These modules comprise key concepts derived from lessons learned. They were not intended to be and should not be understood as a comprehensive detailed disaster risk-analysis for the area. While some insights of this report (e.g., geography and structures) have a very strong local component and cannot necessarily be generalized, other topics, in particular networking, leadership, resilience, and—most impor-

tantly—disaster preparation are of universal nature, and may therefore be of interest to colleagues worldwide.

The part of this work containing the scoping review of word-wide key concepts of civil-military cooperation in the COVID-19 pandemic has several important limitations, too, as previously mentioned [79]. In order to avoid selection bias, a systematic and transparent literature search, screening, and inclusion was conducted. This approach probably underreported the spectrum and experiences of civil-military cooperation during the pandemic, because it is very likely that not all CIMIC experiences in the field were indeed published peer reviewed [79]. The inclusion of other databases or even gray literature may have provided further nuances [79]. Nevertheless, this report covered information from established, robust and credible medical and scientific databases which might result in higher specificity of findings [79]. Therefore, we consider the scoping review part informative because common global themes of the pandemic were identified, and we consider these data generalizable within the context of the above-described, important limitations [79]. To better address the needs and perspectives of children in disasters, future research should better capture pediatric data as previously suggested [82]. Future research should focus on the inclusion of vulnerable populations into disaster management or as suggested by one participant, on concepts for better preparedness of children, who could then act as multipliers for stronger resilience in their own families.