Deliverable D1.1 – Need Analysis

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Nature of the Deliverable		
R	Document, report (excluding the periodic and final reports)	X
DEM	Demonstrator, pilot, prototype, plan designs	
DEC	Websites, patents filing, press & media actions, videos, etc.	
OTHER	Software, technical diagram, etc.	

Dissemination Level		
PU	Public, fully open, e.g. web	X
CO	Confidential, only for members of the consortium (including the Commission Services)	

Quality procedure			
	Name	Partner	Date
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Project Summary

PREPSHIELD aims to foster a more holistic and citizen-centric approach to health crisis preparedness and management, by co-creating policy recommendations, methods and an AI-powered platform for crisis management to better prepare for and address health emergencies from a social and societal perspective. To reach this objective, PREPSHIELD will rely on the participation of public authorities, citizens (specifically from vulnerable and non-compliant groups), CSOs, DROs and healthcare institutions. Based on the needs of these groups, PREPSHIELD will develop recommendations for health crisis preparedness, management and communication as well as tools to simulate future crises through an iterative process, involving various pilots for their evaluation. These pilots will include a communication pilot, tabletop exercises and an online exercise, which will include all these stakeholders and take place at different scales in different countries: local (Hamburg, DE), regional (Piedmont, IT) and national (Romania). The online exercise will rely on a PREPSHIELD platform and app (built on the proven CRIMSON platform) to reproduce real-life crisis communication conditions and provide decision-makers with simulations and feedback on the behaviour, wellbeing, capacities, and resources of the other stakeholders. The project brings together a complementary consortium of five universities, two public authorities, one RTO, two non-profit organizations, one SME and two large enterprises from seven European Union countries (and Switzerland).

Document Objective and Executive Summary

This Deliverable identifies the needs of various actors, such as vulnerable and non-compliant groups, healthcare workers, policymakers, and healthcare authorities. These identified needs, which largely stem from challenges experienced during past health crises, will inform the development of preliminary recommendations presented in the subsequent Deliverables (D1.2 by UPO and D1.3 by UiO). By integrating empirical findings and insights from past crises, the document seeks to build an evidence base that supports more inclusive, effective, and resilient public health strategies across Europe. It addresses both individual and institutional dimensions of vulnerability, offering actionable insights for researchers, policymakers, healthcare professionals, and civil society actors.

The COVID-19 pandemic exposed deep-seated weaknesses in the preparedness and response capacities of public health systems across Europe. It also reaffirmed a critical reality: health crises do not affect all people equally. Vulnerable populations—including those with limited health literacy, pre-existing health conditions, or precarious socio-economic status—have disproportionately suffered from the pandemic in terms of health, social, and economic consequences. At the same time, institutions tasked with managing such emergencies—including healthcare professionals, policymakers, and civil society organizations—faced considerable challenges. Healthcare professionals contended with overwhelming workloads and resource shortages; policymakers were required to make urgent decisions under uncertainty while balancing competing societal needs; and civil society organizations struggled to maintain services and outreach under restrictive conditions. In this complex landscape, fostering public compliance with health measures, especially among vulnerable groups, emerged as a critical yet difficult goal, underscoring the need for more inclusive and adaptive preparedness strategies.

This Deliverable responds to the urgent question: **What are the most pressing needs of different actors, including vulnerable populations and institutions, in order to prepare for, and respond to, health crises?** Through a multidisciplinary and empirically grounded approach, this document investigates the perceptions, experiences, and needs of both individuals and institutions, fostering a “whole-of-society” approach to crisis management. Specifically, the analysis focuses on three core areas:

1. The perceptions and needs of vulnerable and non-compliant groups in terms of preparedness and management of health crises;
2. The operational and structural needs of healthcare institutions and public authorities;
3. The development of working recommendations to develop inclusive crisis preparedness and response practices.

By identifying key gaps and proposing evidence-based solutions, this Deliverable supports the development of more robust and inclusive health crisis policies. It also serves as a foundation for future academic research and policy innovation. Results will be disseminated through peer-reviewed publications, stakeholder workshops, and interdisciplinary events. Importantly, co-creation workshops with health professionals, local authorities, and civil society organizations will validate and enrich the findings, ensuring that recommendations are rooted in practical expertise and real-world experience.

List of Partners

N°	Participant organisation name	Acronym	Country
1	UNIVERSITA DEGLI STUDI DEL PIEMONTE ORIENTALE AMEDEO AVOGADRO	UPO	IT
2	RIJKSUNIVERSITEIT GRONINGEN	UG	NL
3	UNIVERSITETET I OSLO	UiO	NO
4	TECHNISCHE HOCHSCHULE KOELN	THK	DE
5	CS GROUP-FRANCE	CSG	FR
6	SOPRA STERIA GROUP	SSG	FR
7	EREVNITIKO PANEPISTIMIAKO INSTITOUTO SYSTIMATON EPIKOINONION KAI YPOLOGISTON	ICCS	EL
8	MINISTERUL AFACERILOR INTERNE	DSU	RO

9	SOCIETATEA NATIONALA DE CRUCE ROSIE DIN ROMANIA	RRC	RO
10	FREIE UND HANSESTADT HAMBURG	FHH	DE
11	EV.-LUTH. MARTIN LUTHER KING-KIRCHENGEMEINDE STEILSHOOP	MLKS	DE
12	EUROQUALITY SAS	EQY	FR
13	UNIVERSITAT ZURICH	UZH	CH

List of Definitions

Concept	Definition	Key References
Vulnerability	The degree to which an individual or group is susceptible to harm due to exposure to risk factors and limited capacity to cope or recover.	WHO (2022); UNDRR (2017)
Compliance	The extent to which individuals adhere to recommended health behaviors or follow public health guidance and regulations.	WHO (2022)
Health Literacy	The ability of individuals to access, understand, appraise, and apply health information to make appropriate health decisions.	WHO (2022)
Best Practice	An approach or procedure that has been identified as effective and adaptable across different settings.	OECD (2017)
Integrated Reviews	A form of literature review that includes diverse methodologies (quantitative, qualitative, theoretical) to provide a comprehensive understanding of a topic.	Whittemore & Knafl (2005); Torraco (2005)

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NPI	Public health measures used to control the spread of infectious diseases without relying on medications or vaccines, e.g., lockdowns and stay-at-home orders, social distancing measures, mask mandates, travel restrictions and so on.	Non-Pharmaceutical Interventions

Contents

Introduction

The COVID-19 pandemic has revealed profound structural weaknesses in the governance of health crises, exposing a limited and fragmented understanding of societal preparedness for large-scale health emergencies (Kuhlmann et al., 2021; Vampa, 2021). While much of the initial response centered on the biological transmission of the virus, it soon became evident that the pandemic was not merely a biomedical event but a deeply social phenomenon. COVID-19 has functioned as what Trout & Kleinman (2020) term a "social disease", with its impacts rippling far beyond individual infections to disrupt economies, exacerbate social inequalities, and strain the very fabric of communities.

A growing body of research underscores how the pandemic disproportionately affected those already marginalized, revealing and intensifying pre-existing vulnerabilities across Europe (Maestripieri, 2021; Liu et al., 2023). These disparities are particularly apparent in the realm of public health compliance. Although widespread adherence to measures such as mask-wearing, physical distancing, and vaccination was crucial for containing the virus, not all population groups were equally able to comply. For vulnerable groups—such as older adults, migrants, individuals with low socioeconomic status, or those with chronic health conditions—structural, informational, cultural, and psychological barriers significantly impeded their ability to follow public health recommendations. It is worth mentioning, however, that not all vulnerable individuals are non-compliant, and not all those who are non-compliant can be classified as vulnerable.

This growing recognition of unequal compliance challenges calls for a systematic examination of the specific barriers faced by vulnerable populations during the pandemic. To address this gap, UG has conducted a multi-method study to answer the following overarching question: "**What were the needs of vulnerable individuals in Europe and the barriers to compliance with health recommendations in the context of health crises?**".

We conducted a literature review, an online survey and qualitative interviews in the three pilot sites (Hamburg, Piedmont and Romania) to identify the main barriers to compliance with institutional recommendations during health crises. Given the recency and unprecedented global disruptions caused by COVID-19, the focus of this set of studies

will be on the COVID-19 pandemic. The results of these three studies are summarized as key findings and recommendations in the first part of the Deliverable. The presentation of the findings is structured around the following questions:

- Who has what needs?
- Were the needs of vulnerable individuals met during the pandemic?
- How did these unmet needs influence individual compliance with public health measures?
- What lessons can be drawn to inform more effective and inclusive strategies for pandemic preparedness and response?

The second part of the Deliverable offers a detailed overview of three studies focusing on vulnerable groups (conducted by UG) and two studies investigating challenges and related needs experienced by healthcare institutions, policymakers, healthcare professionals (conducted by UPO). In the second part we outline the methodologies employed and summarize the main findings of each study, offering evidence-based insights into the interplay between vulnerability, communication, compliance, and health crisis management. Figure 1 below shows the research framework of this report.

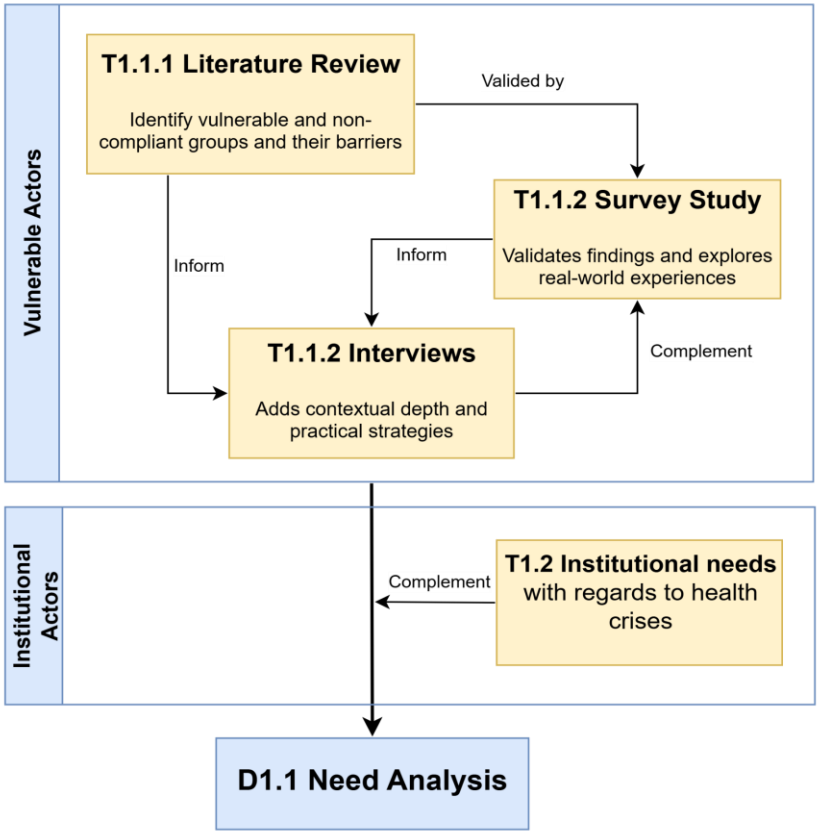


Figure 1: Integrated Multi-Method Need-Analysis Framework for Vulnerable Populations and Institutional Actors in Health-Crisis Preparedness

Key findings and recommendations

1. Who has what needs?

According to the analysis of the Task 1.1 and Task 1.2, the following categories were more often reported as suffering from the greatest vulnerabilities:

- Older adults, especially those in socioeconomically disadvantaged areas, who faced heightened health risks due to aging, chronic conditions, and social isolation.

- Women, particularly pregnant women, mothers of young children, and those in frontline jobs, who encountered increased caregiving burdens, stress, and job insecurity.
- People with low socio-economic status, who struggled with access to essential resources, from sanitation to self-protective measures, and stable housing.
- Migrants and refugees, whose legal status, language barriers, living conditions (in overcrowded facilities) and limited access to healthcare services amplified their vulnerability.
- Informal caregivers (relatives supporting people with dementia or terminal illness, single mothers with young children) reported high levels of psychological distress.
- People with mental or physical disabilities, who were severely affected by service disruptions and social isolation, often facing greater challenges from public health measures than from the virus itself.
- Children from low-income or marginalized backgrounds, who experienced negative impacts on education, physical activity, and mental well-being due to lockdowns and overcrowded living conditions.
- Ethnic minorities, who faced disproportionate health risks, limited healthcare access, and increased exposure due to their employment in high-contact sectors.
- People working in healthcare and volunteers needed institutional support (financial and practical) to provide continuity of care.

Although apparently heterogeneous, vulnerable individuals had a core need in common, as emerged from our analysis. This was the need for tailored information about the virus, its consequences and the necessary protective measures. With regard to this need for information, our studies highlight structural barriers, due to pre-existing conditions, and contextual failures, arising from the pandemic response. Structural barriers are those that vulnerable populations—such as older adults, people with disabilities, migrants, and those with low health literacy—are constantly facing because they are already disadvantaged due to long-standing social determinants of health (e.g., limited education, chronic illness, or socio-economic hardship). These pre-existing factors hindered their ability to access, understand, or act on public health information effectively. Contextual failures refer to the pandemic response and how it exacerbated vulnerability through communication breakdowns and service disruptions. Social isolation, lack of accessible communication

formats, and reduced contact with health and social services disproportionately impacted individuals with vulnerabilities. In some cases, the policy measures themselves—such as the closure of support services—caused more harm than the virus, especially when alternative communication and outreach strategies were not put in place.

2. Were the needs of vulnerable individuals met during the pandemic?

Pandemic management mostly focused on reducing viral transmission via lockdowns, social distancing and the use of Non-Pharmaceutical Interventions (NPI). A constant flow of information was supposed to provide citizens with useful knowledge about the virus and its transmission, therefore promoting compliance. However, the communication and service needs of vulnerable individuals were often unmet during the pandemic. Our findings suggest that communication efforts were insufficiently inclusive and responsive to the needs of the most vulnerable. In particular, people with disabilities suffered from poorly adapted communication and service systems, highlighting a systemic failure to account for their specific needs in both messaging and support. Our results also highlight some more informational and communication needs that were felt by the larger population, like the need for centralized and reliable information, or the need for balanced media use and for reduced information overload. These were complemented by needs that were specific to the people in vulnerable conditions, like:

- **Need for simplified communication**: Respondents often found public messaging too technical. They suggested clearer, jargon-free explanations using infographics, videos, SMS updates, and concise daily bulletins.
- **Need for targeted and proactive outreach**: Many emphasized the need for communication tailored to the different cognitive abilities of vulnerable groups, through trusted figures like doctors and by offering examples on how to do things (wearing face masks, finding information about comorbidities, etc.).
- **Support beyond digital channels:** Vulnerable individuals—especially older adults and those with low digital literacy—called for community-level outreach, printed materials, and basic health education.
- **Trust in professionals and institutions:** Trustworthy, transparent communication from healthcare providers was seen as crucial, though some expressed skepticism toward institutional messaging.

These findings underscore that beyond access, the format, clarity, and credibility of information were critical needs—especially for vulnerable populations who faced additional barriers to understanding and acting on public health guidance.

3. Were these needs interacting with compliance, reducing it?

Key barriers to compliance included poor communication, inaccessible services, socioeconomic hardship, psychological stress, and conflicting cultural or ideological beliefs. These factors, alone and in interaction, affected individuals' ability or motivation to follow public health measures, underscoring the importance of addressing underlying vulnerabilities in crisis response planning. Several vulnerable groups were less compliant with public health recommendations during the pandemic, largely due to unmet needs and structural constraints. These included individuals with cognitive or mental health conditions who struggled to understand or follow rules consistently, as well as those with physical disabilities who faced environmental barriers that limited their ability to adhere (face masks were commonly reported as creating issues). Migrants, refugees, and ethnic minorities encountered language barriers and limited access to trustworthy information, while economically disadvantaged individuals often lacked the resources to comply, such as space to isolate or funds to purchase protective equipment. Socially isolated individuals, including many elderly people, were also less likely to comply due to weakened social norms and reduced exposure to peer influence.

In many cases, non-compliance was not a matter of unwillingness, but reflected constrained agency and limited capacity to act. In cases of deliberate non-compliance, our evidence (which is obviously limited due to the difficulties in approaching people who do not trust science) shows that its main determinants were a lack of trust in institutions, lack of trust in science and the belief that the information was manipulated and unreliable.

4. What are the most relevant working strategies?

Here we list a set of key messages from the literature review, the online survey and the qualitative interviews, highlighting the needs that emerged across these studies. These

findings are complemented by actionable recommendations designed to address those needs and improve preparedness and response in health crises[1].

Vulnerability is a Dynamic and Complex Category. Evidence from the three studies conducted within Task 1.1 indicates that vulnerability is not a clear-cut category. Rather, it results from the interplay between structural factors (such as age, gender, socioeconomic status, and migration background) and contextual factors (such as living conditions, family support, and access to institutional resources), and it changes across national and local contexts. **Recommendation:** The complexity and intersectionality of vulnerability should be accounted for when designing pandemic preparedness and response measures. Close coordination with Non-Governmental Organizations (NGOs), religious organizations, local healthcare providers can provide an overview of different vulnerabilities and their intersections, thus offering a clear picture of the diversity of needs, even for people apparently belonging to the same category.

A. **Pandemic Measures Widely Amplified Existing Vulnerabilities.** Findings from both the literature review and the interviews highlight how lockdown measures often amplified pre-existing vulnerabilities. Key consequences included:

    - **Loneliness and Isolation.** Many individuals experienced prolonged feelings of loneliness and social isolation. Due to underlying medical conditions and a lack of clear information about how the virus could affect their health, some people felt safer continuing self-isolation even after lockdowns ended, with dire psychological consequences. **Recommendation:** Provide financial support and training to local NGOs and communities to enable them to maintain regular contact with vulnerable individuals during lockdowns.

[1] It should be noted that these recommendations are partial and respond only to the needs identified in these specific studies. These recommendations, however, contribute to and inform the preliminary recommendations covering the entire WP1–divided into crisis management, healthcare governance, risk communication, and health literacy– that will be presented in Deliverables D1.2 and D1.3.

- **Disruption of Daily Routines.** The inability to attend places like daycare centers led to cognitive and physical decline in various groups, including the elderly, persons with disabilities, children, and migrants learning the host country's language.
  Recommendation: Ensure that safe social interactions remain possible during lockdowns. Prepare and update a list of large public spaces, indoor or outdoor, that can be used to offer support activities for vulnerable groups and coordinate with local communities and support organizations to use them.

- **Work-Related Challenges.** Economically disadvantaged individuals were often unable to work remotely and were more likely to break restrictions to commute to work. Many lost their jobs or, in the case of newly arrived migrants, could not secure employment, leading to social isolation and poor integration.
  Recommendation: Develop financial assistance programs for those unable to work, ensuring they are accessible to non-native speakers and developed in collaboration with local NGOs. Provide both technological (devices, internet) and human (trained teachers) support for online language learning and skills development.

- **Reduced Access to Healthcare and Psychological Strain.** Limited access to healthcare services and the absence of tailored healthcare information led to severe anxiety, sleep disturbances, and other psychological issues.
  Recommendation: Ensure continuity of care by strengthening healthcare systems and training volunteers to help vulnerable individuals access appropriate services during a pandemic.

B. **Health Literacy Played a Major Role in Fostering Compliance.** All three studies conducted within Task 1.1 highlight the central role of health literacy in fostering understanding and compliance. The Deliverables prepared by UPO (D.1.2) and UiO (D1.3) will provide practical recommendations on crisis preparedness, management, and communication to address this issue. The literature review

showed that individuals with cognitive impairments often misunderstood measures, reducing their compliance. Interviews confirmed that both caregivers and vulnerable individuals needed to receive or give explanations about preventive measures and their intended effects. Survey data also showed a significant correlation between health literacy and compliance, especially in two pilot sites: Hamburg (Germany) and Piedmont region (Italy). **Recommendation:** 1) Develop and pre-test culturally appropriate visual aids (e.g., illustrated instructions, infographics) as part of emergency preparedness materials, ensuring they are accessible to individuals with low literacy or limited language proficiency. 2) Integrate the principle of "universal precautions" approach into health communication planning by assuming that all people have limited health literacy. 3) Establish collaboration between public authorities and community actors and train community local actors, health volunteers, or workers to assist individuals in understanding medical information, and completing health-related forms. 4) Use trained science communicators, in collaboration with health professionals, to simplify information for lay audiences.

C. **Information Overload Represented a Significant Challenge**, particularly for vulnerable individuals and their caregivers. Scaremongering and conflicting information, often coming from the same institutional source but changing over time, were mentioned as two main challenges. **Recommendations:** 1) Developing alternative risk communication strategies in collaboration with media professionals. Positive and constructive messages, including examples of protective behavior, were seen as helpful. 2) Implement a two-pronged communication approach: a centralized online platform (with landline access) offering reliable and accessible information, and a decentralized system involving trusted local figures (e.g., mayors, religious leaders) to disseminate messages via social media and local news. 3) Reduce the volume of information, especially when it is provisional, and prioritize accuracy and clarity.

D. **Accessibility of Information and Compliance.** All three studies emphasized that inaccessible information was a key barrier to compliance. The survey showed a positive correlation between understanding COVID-19 measures and compliance among the general population. In general, information was too technical and

difficult for many to comprehend, but vulnerable groups faced specific obstacles, especially non-native speakers and people with cognitive limitations. **Recommendations:** 1) Add subtitles in the host country language to TV news broadcasts, as reading is often easier than listening for language learners. 2) Offer short news segments in multiple languages to communicate key messages. 3) Collaborate with religious organizations, which are effective channels of multilingual information. 4) Train personnel to understand and meet the information needs of these groups, thereby supporting their compliance.

In the following sections, we present the findings from different strands of research, that is the literature review, survey, and in-depth interviews conducted under Subtask 1.1.2. We also summarize the results of Subtask 1.2 (performed by UPO), which examines the institutional needs related to health crisis preparedness and response.

Task 1.1 Needs and perceptions of vulnerable and non-compliant groups with regards to health crises

Subtask 1.1.1: Literature reviews to identify vulnerable and non-compliant groups and their barriers, M1-M4

Description of the subtask from the proposal:

UG will conduct a literature review, expanded to non-academic papers (grey policy literature), to identify vulnerable and non-compliant groups in health crises. The literature review will also serve to understand the psychological barriers to engagement with health recommendations during emergencies.

The aim of this integrative review is to better understand the limitations in public health compliance faced by vulnerable populations during the health crises. The research question we formulated is: "**What were the barriers to compliance with health recommendations for vulnerable individuals, neighborhoods and communities in Europe?**". Previous research has investigated the impact of COVID-19 on vulnerable populations[2], but this integrative review used multi-disciplinary and multi-method literature to identify useful recommendations to improve preparedness for future outbreaks. Given the recency and unprecedented global disruptions caused by COVID-19, the overarching majority of reviewed papers refer to the COVID-19 pandemic, but in our search (see Methods section) we used broader search terms. In addressing this overarching question, the review explores several interrelated sub-questions:

- **Identification and underlying causes of vulnerability:** Which groups were identified as vulnerable during health crises in Europe, and what were the underlying factors—social, economic, health-related, or institutional—that contributed to their vulnerability?
- **Patterns and determinants of compliance and non-compliance:** Which population groups—both vulnerable and non-vulnerable—demonstrated compliance or non-compliance with public health recommendations, and what structural, cognitive, and contextual factors explain these patterns of behavior?
- **Barriers to compliance among vulnerable groups:** What structural, psychological, cultural, and social barriers hindered compliance with health guidelines among vulnerable populations?
- **Working strategies:** What interventions or strategies were implemented to engage and support vulnerable groups, and how effective were these approaches in improving compliance?

Methods

[2]https://www.frontiersin.org/research-topics/30821/the-impact-of-covid-19-on-vulnerable-populations/magazine

Given the rich and diverse research landscape about COVID-19, we chose to conduct an integrative review because it is particularly well-suited for addressing complex research questions that span diverse methodological traditions (Whittemore & Knafl, 2005). By assimilating data from both qualitative and quantitative studies, integrative reviews allow for a comprehensive synthesis of findings across disciplines and epistemological paradigms. We employed the SPIDER template (Cooke et al., 2012) to structure and summarize our research questions and inspire the search strategy (Table 1). SPIDER is an acronym that stands for Sample, Phenomenon of Interest, Design, Evaluation, and Research type.

Table 1: The SPIDER template for summarizing research questions (Cooke et al., 2012; Dhollande et al., 2021).

SPIDER	**Justification**
Sample	Vulnerable populations
Phenomenon of **I**nterest	Identify needs and compliance barriers
Design	Integrative
Evaluation	Compliance status and vulnerability
Research Type	Quantitative, qualitative, and mixed-methods studies

We selected three major multidisciplinary and health-focused databases: Web of Science, Scopus, and PubMed. These databases were chosen for their broad indexing of peer-reviewed journals across the social sciences, public health, and biomedical fields. The search strategy was developed to identify studies examining the intersection of epidemics or pandemics with issues of vulnerability and noncompliance, both at the individual and community levels.

Keywords were grouped into four conceptual domains:

- **Epidemic or pandemic context** (e.g., “COVID-19”, “pandemic”, “epidemic”) **Health crisis context**: Captures a wide range of acute public health threats, including epidemics, pandemics, and disease outbreaks (e.g., *"epidemic*", *"pandemic*", *"health emergency", "COVID-19", "SARS-CoV-2", "Monkeypox", "H1N1", "measles", "disaster"*, *"cris**"*).
- **Vulnerability**: Focuses on populations experiencing disadvantage or heightened exposure to risk, using a wildcard to capture variations (e.g., *"vulnerab**"*).
- **Norm compliance**: Refers to behaviors related to rule-following or adherence to public health recommendations (e.g., *"complian*", *"adheren"*, *"obey*", *"obedien"*, *"conform*"**).
- **Socio-ecological level**: Limits the scope to studies focusing on individual, community, or social contexts (e.g., *"community"*, *"individual"*, *"social"*, *"neighborhood"*).

Search strings were adapted for each database’s syntax using Boolean operators and truncation as appropriate. Appendix 1 provides the detailed search strings used for each database**.** To ensure greater precision and focus in addressing the research question, we applied the following restrictions to the search.

- **Time Frame**: studies published between 2009 and 2024, to capture both the H1N1 pandemic and more recent events such as COVID-19 and Monkeypox outbreaks.
- **Location**: studies focusing on Europe, to ensure geographical relevance to the policy and social context of interest.
- **Language**: articles published in English.
- **Publication Type**: The search includes a broad range of publication types, encompassing peer-reviewed review articles, empirical studies (both qualitative and quantitative), and grey literature such as reports and non-indexed publications from WHO and OECD. This inclusive approach was adopted to ensure a comprehensive understanding of the topic and to capture evidence that may not be available through conventional academic channels.

In total, 426 records were retrieved across the three selected databases: Web of Science (n = 119), PubMed (n = 63), and Scopus (n = 244). Following the removal of duplicates and a multi-stage screening process, based on title/abstract and full-text eligibility, 373 records were excluded for not meeting the inclusion criteria. Ultimately, **51 studies** were retained for qualitative synthesis. Appendix 2 shows the PRISMA flow diagram of the literature review process.

Results

Table 2 presents the descriptive findings from the 51 reviewed papers. We performed a thematic analysis to identify, organize, and interpret patterns of meaning across the selected studies. This approach enabled the construction of a conceptual framework that links the empirical content of the literature to broader categories of vulnerability and compliance behavior.

Table 2: Summarizes the main descriptive findings from the 51 reviewed papers.

Dimension	**Key Findings**
Location	Southern and Western Europe dominate: Spain (6), Italy (5), Germany (4); moderate coverage in UK, France, Switzerland (3 each); minimal in Eastern Europe (e.g., Romania 2) and Balkans.
Method	Quantitative (34): Web surveys (29), Machine Learning (2), sentiment analysis (1); Qualitative (8): Interviews (6), expert input (2); Reviews (6): Scoping (3), narrative (2); Mixed/unclear (3).
Kind of health crisis	48 studies focus on COVID-19; 3 address other outbreaks (Ebola, Flu, Monkeypox).

Key findings from the thematic analysis

A central finding of this review is the diversity and intersectionality of vulnerable groups.

The elderly, individuals with low health literacy, women (especially pregnant), socioeconomically disadvantaged populations, refugees and migrants, people with disabilities (mental and physical), caregivers, and children were repeatedly identified as at risk. While many studies focused on specific subpopulations, they also acknowledged that these vulnerabilities often overlap, creating compounded disadvantages.

Second, this review confirms that vulnerability is multifactorial, arising from both individual-level and contextual factors. The former sources of vulnerabilities—such as age, gender, disability, low education, low socio-economic status, or migration background—were exacerbated by the pandemic and were deeply embedded in social and health systems. Contextual vulnerabilities, on the other hand, emerged or intensified due to pandemic-specific conditions, including restrictive public health measures and information overload, further marginalizing already at-risk populations.

With respect to compliance behaviors, a range of psychological and sociodemographic determinants emerged. High perceived risk of infection, empathy, and trust in authorities (including scientists and public health institutions) were consistently associated with greater adherence to protective behaviors. Women and older adults were particularly compliant, a pattern attributed to their heightened risk perception and prosocial tendencies. Similarly, people with disabilities often adhered strictly to recommendations, particularly when they perceived themselves to be at greater risk.

However, barriers to compliance were profound and varied, often closely linked to the specific forms of vulnerability. For instance, people with cognitive or intellectual disabilities faced significant challenges in accessing and understanding public health information. Socioeconomic disadvantage emerged as a particularly pervasive barrier, affecting the feasibility of measures such as remote working, physical distancing, or home isolation. Discriminatory practices, limited access to healthcare and digital tools, and systemic exclusion further hindered compliance for these groups. Psychological barriers also played a critical role, including low risk perception, distrust in authorities, rejection of collective norms, and belief in conspiracy theories. Traits associated with the Dark Triad—narcissism, psychopathy, and Machiavellianism—further reduced motivation for prosocial behavior, while mental health conditions such as bipolar disorder, particularly during manic episodes, could impair judgment and self-regulation.

Thematic Synthesis

Here we present the thematic synthesis in a more detailed and step-by-step manner. For each theme we refer to the literature reviewed.

Theme 1. **Identification and underlying causes of vulnerability**

COVID-19 acted as an amplifier of existing vulnerabilities in several respects. Pre-existing physical and mental issues were magnified either by the disease itself, or by the pandemic conditions designed to prevent the spread of the disease. Lockdown measures, including travel and work restrictions, led to social isolation, reduced income (especially for migrants and people in jobs that could not be performed online) and insufficient access to health care. Lockdown restrictions resulted in severely reduced opportunities for receiving care by people with mental and physical disabilities, but it also affected elderly's access to social contacts. Living conditions (overcrowded houses, closing of residential facilities for people with disabilities or psychiatric disorders) were affected by the lockdown, with further amplification of vulnerability. Most of the reviewed papers focus only on one of these categories, but they often mention that there are overlaps between vulnerable groups. The key vulnerable groups include:

- **Elderly adults.** Older adults, particularly those residing in economically deprived neighborhoods, are recognized as a vulnerable population. This vulnerability stems from multiple, intersecting factors (Bearth et al., 2021; Cantarero Prieto et al., 2023; Haag et al., 2020; Mendoza-Jiménez et al., 2021; Poroes et al., 2022).
- **Women.** Women are disproportionately represented in healthcare and other frontline roles and often bear significant caregiving responsibilities, all of which contribute to their heightened vulnerability during crises. This vulnerability is particularly evident among subgroups such as pregnant women, mothers with children under five, and working women (Arzamani et al., 2022; Ilska et al., 2021; Stănculescu et al., 2022). Working women often encounter job insecurity and greater exposure to occupational hazards, further compounding their vulnerability (Padrosa & Bolíbar, 2023; Profeta, 2020).

- **People from low socio-economic status.** Communities with low incomes—and individuals without stable housing—face considerable challenges in accessing essential resources during emergencies, a fact that has been starkly revealed during the COVID-19 pandemic (Arora et al., 2022; Arzamani et al., 2022; Medrano et al., 2021).

- **Migrants and refugees.** They face vulnerabilities related to insecure immigration status and limited access to resources, and these challenges have been exacerbated during the COVID-19 pandemic in Europe (Aragona et al., 2020; Arora et al., 2022; Mellou et al., 2022; Rubio González et al., 2023; Van Den Muijsenbergh et al., 2022). Many migrants encountered significant barriers to accessing healthcare and COVID-19 testing due to language obstacles, fears of legal repercussions, and limited public health outreach.

- **Caregivers**. Research on previous epidemics has demonstrated that outbreaks can have wide-ranging psychological consequences, particularly for informal caregivers. During the COVID-19 pandemic, caregivers—especially those supporting persons living with dementia (PLWD)—experienced significantly elevated levels of psychological distress (Buonaguro & Bertelli, 2020; García Santelesforo et al., 2022). These stressors highlight caregivers as a distinct vulnerable group whose mental health and well-being require targeted support during public health crises.

- **People with mental or physical disabilities.** Persons with disabilities—including those with intellectual, developmental, and physical impairments—are particularly vulnerable due to a complex interplay of biological, social, and economic factors (Arzamani et al., 2022; Basili et al., 2025; Buonaguro & Bertelli, 2020; Chevance et al., 2020; Dalkner et al., 2022; Doody & Keenan, 2021; García Santelesforo et al., 2022; Kang & Goodwin, 2022; Martinelli et al., 2021; Taggart et al., 2022). Epidemiological evidence from the COVID-19 pandemic consistently demonstrates that people with these health challenges face significantly higher rates of hospitalization, intensive care admission, and mortality.

- **Children**. While children were less likely to experience severe clinical outcomes from COVID-19 infection, the broader consequences of pandemic-related

confinement measures disproportionately affected children from low-income families or marginalized communities who often live in overcrowded housing conditions. Limited access to indoor space, recreational equipment, or reliable internet connectivity severely constrained their ability to engage in physical activity and maintain educational routines during lockdowns (Medrano et al., 2021).

- **Ethnic minority.** During public health emergencies, members of racial and ethnic minority groups have higher rates of both illness and death (Templeton et al., 2020). They often experience higher infection rates, limited access to quality healthcare, and discriminatory practices.

Vulnerability during the COVID-19 pandemic arises from a complex interplay of structural disadvantages and contextual stressors that either predated the crisis or emerged as a consequence of pandemic-related policies. Structural factors refer to long-standing social determinants of health that predispose individuals and groups to greater harm in times of crisis. These include older age, gender disparities, disability (physical or mental), chronic health conditions, low health literacy, limited education, low socio-economic status, and migration or minority background. These conditions often intersect, compounding disadvantage and limiting individuals' capacity to protect themselves or access care (Arzamani et al., 2022; Buonaguro & Bertelli, 2020; Chevance et al., 2020; Profeta, 2020). Contextual factors, by contrast, refer to vulnerabilities that emerged or were amplified by the pandemic and the public health measures enacted to control it. Social isolation and loneliness—intensified by lockdowns, travel restrictions, and limits on interpersonal contact—are well-established risk factors for anxiety, depression, and other adverse mental health outcomes (Arzamani et al., 2022; Basili et al., 2025; Doody & Keenan, 2021; García Santelesforo et al., 2022; Martinelli et al., 2021; Rubio González et al., 2023). Public health actions intended to prevent viral transmission thus inadvertently increased the psychological burden on many individuals, particularly those already at risk.

People with disabilities were especially affected by the disruption of services and routines. The closure of day care centers, reduced access to health and social services, and restrictions on mobility and communication significantly impacted their well-being and autonomy. These disruptions not only worsened underlying physical or mental health conditions but also heightened the strain on caregivers. Several studies highlight that, in

some cases, the consequences of policy responses were more detrimental to people with disabilities than the virus itself, revealing a systemic failure to consider the disabling impact of social and institutional barriers (Basili et al., 2025, 2025; Cantarero Prieto et al., 2023; Chevance et al., 2020; Doody & Keenan, 2021; Taggart et al., 2022).

In sum, vulnerability in the context of COVID-19 is not only a matter of individual health status, but also a product of structural inequality and policy-induced exclusion. Recognizing and addressing both dimensions is essential for equitable and inclusive crisis response and recovery planning.

Theme 2. **Compliance and non-compliance**

The reviewed literature revealed a wide range of factors contributing to individuals' compliance or non-compliance with public health recommendations, including psychological motives, structural conditions, and sociocultural dynamics. Compliance was typically operationalized in terms of adherence to specific NPIs such as hand hygiene, wearing face masks, social distancing, and isolation practices. However, the ability and willingness to comply varied widely across populations due to both personal and contextual constraints.

Compliant and non-compliant groups

Some of the papers focused on specific groups of compliant or non-compliant individuals. Those who perceived a high risk of infection tended to strictly follow guidelines such as mask-wearing and physical distancing, motivated by a desire to protect themselves and others (Bakkeli, 2023; Bish & Michie, 2010; Gogola et al., 2021; Mendoza-Jiménez et al., 2021; Nerini et al., 2022; Nese et al., 2022; Sattler et al., 2022; Velikonja et al., 2020). The perception of risk and fear have been repeatedly shown to drive compliance: individuals who perceive COVID-19 as a serious personal threat are more likely to adopt protective behaviors (Bakkeli, 2023; Bearth et al., 2021; Hanna et al., 2023; Hills & Eraso, 2021; Kaspar & Nordmeyer, 2022; Kypta-Vivanco & Fairchild, 2022; Nerini et al., 2022; Sattler et al., 2022). However, this relationship is mediated by health literacy and knowledge about the pandemic. Personal characteristics and personality such as conscientiousness are often associated with higher compliance, while impulsivity or sensation-seeking may correlate with risk-taking and rule-breaking behavior (Gogola et al., 2021; Otterbring et al.,

2021). Empathetic individuals, similarly, demonstrated strong adherence to public health advice, often acting out of concern for the well-being of vulnerable groups (Lilleholt et al., 2024). Trust in authorities also played a critical role; people who had higher trust in government, scientists, or health institutions were more likely to adopt recommended protective behaviors (Bearth et al., 2021; Gogola et al., 2021; Templeton et al., 2020).

Women were consistently found to be more compliant than men, likely due to stronger health risk perceptions and prosocial orientations (Cantarero Prieto et al., 2023; Nese et al., 2022; Roccato et al., 2022). Older adults (the elderly) adhered more strictly to guidelines, possibly due to their higher vulnerability to severe illness (Bearth et al., 2021; Bish & Michie, 2010; Clark et al., 2020; González-Castro et al., 2021; Kaspar & Nordmeyer, 2022; Poroes et al., 2022; Velikonja et al., 2020). Married individuals were more likely to comply, potentially influenced by a sense of responsibility toward household members (Borau et al., 2022). People with disabilities (particularly those with higher perceived vulnerability) demonstrated cautious behavior and a higher tendency to comply (Doody & Keenan, 2021; Kang & Goodwin, 2022; Mendoza-Jiménez et al., 2021). Findings about education levels are contradictory, with some papers referring to highly educated people as being more likely to comply, whereas others report an opposite effect of education (Bish & Michie, 2010; Mendoza-Jiménez et al., 2021). Social roles shaped by professional or community responsibilities also mattered. Health professionals, as expected, adhered strictly to guidelines due to both professional norms and deeper medical knowledge (Doody & Keenan, 2021). Similarly, key individuals in communities, such as local leaders or organizers, often modeled compliance and actively encouraged others to follow suit (Kolner et al., 2022).

Several groups were found to be less compliant with public health recommendations. Among these, individuals with certain health conditions or personality traits were notably at risk. People living with dementia struggled to follow rules due to cognitive limitations (García Santelesforo et al., 2022). Those with bipolar disorder, especially during manic episodes, found it difficult to adhere consistently to guidelines (Dalkner et al., 2022).

Individuals with Dark Triad traits[3]—narcissism, Machiavellianism, and psychopathy—demonstrated lower levels of compliance, often driven by low empathy, risk-taking behavior, and defiance of social norms (Blanchard et al., 2023; Gogola et al., 2021; Kaspar & Nordmeyer, 2022; Kypta-Vivanco & Fairchild, 2022). Narcissistic individuals, in particular, tended to dismiss risk and prioritize personal freedoms over collective safety. Closely tied to personality are intentional acts of non-adherence, which reflect a deliberate choice to reject rules, often motivated by ideological beliefs, a desire for autonomy, or mistrust of authorities (Hills & Eraso, 2021; Kolner et al., 2022). Moreover, individuals who routinely engage in behavioral risk factors, such as heavy socializing, alcohol consumption, or disregard for preventive behaviors, may be less likely to comply with health guidelines (Mendoza-Jiménez et al., 2021). When the costs of compliance—economic, psychological, or social—are too high, individuals may opt for non-compliance despite understanding the risks (Cantarero Prieto et al., 2023; Farjam et al., 2021; Lilleholt et al., 2024; Rubio González et al., 2023). Furthermore, compliance tends to wane over time as people experience fatigue, habituation, or diminished perception of threat, a phenomenon documented across multiple stages of the COVID-19 pandemic (Kang & Goodwin, 2022; Nese et al., 2022).

Migrants, refugees, and immigrants often encountered language barriers, mistrust in government, or lack of access to timely information, all of which undermined their ability or willingness to follow public health guidance (Rubio González et al., 2023). Similarly, economically disadvantaged individuals, especially in dense urban areas, had limited capacity to socially distance or access protective resources (Stănculescu et al., 2022). In these cases, non-compliance was often not a matter of choice, but a result of constrained agency.

At the macro level, cultural and political contexts are highly relevant. In cultures characterized by high masculinity, as described in Hofstede's cultural dimensions theory, individuals may place greater value on autonomy, strength, and performance, potentially clashing with collective health imperatives (Roccato et al., 2022). Similarly, political

[3] The Dark Triad is a concept in psychology that refers to a cluster of three socially aversive personality traits: narcissism, Machiavellianism, and psychopathy. These traits are distinct but interrelated, and individuals who score high on them tend to display manipulative, callous, and self-centered behavior.

orientation significantly affects compliance (Hills & Eraso, 2021); for example, individuals who lean toward libertarian or anti-establishment ideologies may reject mandates and perceive public health policies as governmental overreach.

Theme 3. **Barriers to compliance among vulnerable groups**

In general, our review suggests that many barriers were structurally linked to the specific vulnerability, such as people with cognitive disabilities who could not access and understand the information about health regulations. We identified different kinds of barriers and, even if we expected psychological ones to be especially relevant, the analysis of the literature suggests that contextual conditions and structural barriers were more relevant. While personality traits (e.g., the Big Five) were found to have only minor predictive value in explaining compliance, specific psychological factors showed stronger associations (Arzamani et al., 2022; Bearth et al., 2021; Velikonja et al., 2020). Most notably, belief in conspiracy theories was repeatedly associated with Dark Triad traits, especially subclinical psychopathy (Achimescu et al., 2021; Blanchard et al., 2023; Kaspar & Nordmeyer, 2022, 2022). Although these traits played only a modest role in regression models, bivariate correlations indicated consistent negative associations with protective measures. Importantly, individuals with certain psychopathologies (e.g., narcissistic traits) were less likely to perceive risk and more likely to reject public health recommendations. However, broad generalizations about personality and compliance must be treated cautiously, as context-specific variables (such as trust in authorities and perceived threat) often moderate these effects.

A large body of literature identifies structural inequalities as foundational to understanding non-compliance among vulnerable groups (Chevance et al., 2020; Kolner et al., 2022; Padrosa & Bolíbar, 2023; Stănculescu et al., 2022; Templeton et al., 2020; Van Den Muijsenbergh et al., 2022). Individuals with cognitive disabilities, for example, often lacked access to information in formats they could comprehend, thus undermining informed adherence to regulations (Basili et al., 2025; Buonaguro & Bertelli, 2020; Taggart et al., 2022). Similarly, older adults, people with chronic illnesses, and those with low SES encountered compounded barriers due to their dependency on public services or limited access to digital information platforms. Socio-economic disadvantages specifically reduced people's ability to engage in protective behaviors (Arora et al., 2022; Arzamani

et al., 2022; Stănculescu et al., 2022; Taggart et al., 2022; Van Den Muijsenbergh et al., 2022).

A significant number of papers referred to language barriers as a critical issue, especially for migrants and non-native speakers (Arora et al., 2022; Mellou et al., 2022; Van Den Muijsenbergh et al., 2022). The lack of translated or culturally adapted materials limited the reach of essential health information. In addition, stigma and discrimination were cited as indirect deterrents to compliance (Taggart et al., 2022; Van Den Muijsenbergh et al., 2022). Some groups, particularly marginalized ethnic minorities, faced public blame and institutional neglect, which in turn fueled mistrust and disengagement (Kolner et al., 2022). Lastly, previous qualitative research has identified "alert fatigue" where individuals could not follow frequently changing rules, thus resulting in substantial non-compliance (Hanna et al., 2023; Padrosa & Bolíbar, 2023; Poroes et al., 2022).

Theme 4. **Working strategies to engage and support vulnerable groups**

Although many studies conclude with recommendations for improving compliance among vulnerable groups during pandemics, a consistent finding across the literature is the absence of tested and empirically validated interventions. Instead, the proposed strategies often remain broad and unspecific, underscoring the need for tailored, group-specific approaches. The demographic patterns observed—such as lower compliance among men, younger individuals, and those with lower educational attainment—suggest that public health strategies should be demographically differentiated and context-sensitive. A recurring recommendation concerns the improvement of communication strategies. The literature underscores the importance of multi-level, inclusive, and adaptive interventions—encompassing communication, digital equity, social support, community engagement, and structural policy changes—as essential components of an effective response to health crises that seeks to support compliance among vulnerable groups. While various strategies were implemented to support vulnerable populations during the pandemic, their effectiveness was often constrained by deeper, pre-existing structural inequalities.

PREPSHIELD

Subtask 1.1.2: Survey study on the needs and barriers of vulnerable and non-compliant groups, M5-M12

Description of the subtask from the proposal:

UG will prepare and conduct a survey study to empirically validate the insights from the literature review (especially focusing on who the most relevant vulnerable groups present in the case studies are and how to reach them). The survey will include questions on health literacy. The survey will be complemented by interviews with vulnerable individuals, care providers and health professionals to identify working strategies to improve access to health information and to remove compliance barriers. The findings will be integrated into D1.1 and feed into T.1.4 and T1.5.

Methods

The general picture offered by the integrative review was further tested in the three PREPSHIELD pilot sites (Hamburg, Piedmont region, Romania) by means of an online survey. The selection of these three pilot sites enables the project to test and refine its crisis preparedness strategies across diverse social, cultural, and economic contexts, ensuring adaptability and effectiveness in varying governance settings.

Hamburg, Germany's second-largest city and a major international logistics hub, has a population of approximately 1.78 million. Within **Hamburg**, the neighborhood of Steilshoop stands out for its high proportion of migrant residents and above-average unemployment rates. Despite these challenges, Steilshoop benefits from strong social cohesion supported by tight-knit families, active community organizations, and religious networks. Hamburg's dual role as a city and a federal state (Länder) with substantial decision-making authority adds to its relevance as a pilot site. **Piedmont**, an upper-middle-income region in northwest Italy with around 4 million residents, has faced

significant strain on its healthcare system due to COVID-19 and Mpox. In response, the region has invested in hospital capacity, workforce resilience, and outbreak preparedness. Italy's moderate to low level of trust in national institutions—ranked 32nd out of 41 OECD countries—provides a context where regional governance becomes especially significant. Piedmont thus serves as an intermediary case between local and national scales in a low-trust environment. Romania, the third pilot site, is addressed at the national level. As an emerging economy with a specialized workforce, Romania was classified as a high-income country by the World Bank in 2020 and 2022. Emergency management training is ongoing and involves both national and international cooperation. A 2023 survey shows relatively low public trust in government institutions—17.4% for the government and 29.8% for the president—compared to higher trust in the Army (70.4%) and the Church (62.5%)[4]. **Romania** complements the other sites by offering a national perspective in a transitioning governance and trust landscape.

The questionnaire collected socio-demographic information as well as quantitative data on health literacy, compliance, and preferences and perceived barriers regarding the accessibility and use of digital tools, such as health-related mobile applications. The questionnaire consists of a combination of closed- and open-ended questions, including Likert-scale items, multiple-choice questions, and optional open responses. The survey contained 59 questions, all of them based on established constructs in the literature. On average, participants required approximately 15 minutes to complete the survey.

Target sample

The study aimed to reach a broad population in the three pilot sites, with a focus on vulnerable groups. To ensure their sufficient representation, the survey was disseminated through the networks of institutional and community partners, which include organizations with access to vulnerable populations (e.g., RRC, MLKS). This targeted distribution strategy was intended to facilitate engagement with both the general public and those populations most relevant to the study's objectives. The target sample size was approximately 50-150 participants per country, but the actual number of participants ranged from 88 in Germany, to 112 in Romania, and 198 in Italy.

[4] https://www.statista.com/statistics/1101030/trust-in-romanian-institutions/

PREPSHIELD

Sections

The survey instrument was structured into five sections, each designed to capture key constructs relevant to the study of norm compliance and vulnerability in health crises.

1) **Health Literacy**. This section assessed participants' health literacy, which is recognized as a fundamental factor influencing individuals' capacity to access, understand, and act upon health information (Nutbeam, 2000). Lower health literacy, often linked with social vulnerability, can hinder individuals' ability to interpret institutional recommendations and navigate health systems (Rowland et al., 2017; Sentell et al., 2020).
2) **Experience during the COVID-19 pandemic**. This section captured participants' personal experiences during the COVID-19 pandemic, with a focus on how they perceived the accessibility of information and the feasibility of complying with public health recommendations. Understanding these experiences provides insight into the situational and structural barriers individuals may have faced when attempting to adhere to health measures.
3) **Trust and risk perceptions**. This section examined participants' perceptions of risk and their level of trust in institutions, information sources, and others in society—factors that are known to shape individuals' responses to public health crises. Trust and risk perception influence not only how people evaluate threats but also how likely they are to comply with health-related guidelines and recommendations.
4) **Technology acceptance**. This section explored participants' attitudes toward the use of digital technologies in the context of a public health crisis, with a particular focus on the potential development of a mobile application designed to provide tailored pandemic-related recommendations. This section is especially relevant for the work carried out in WP2, which focuses on developing tools for collaborative crisis preparedness and management. Understanding users' acceptance of such technology is critical for informing the design, implementation, and communication strategies of digital health interventions.
5) **Demographic questionnaire**. The demographic questionnaire was developed to collect essential background information about participants, enabling analysis of how individual characteristics may relate to responses across the other survey

sections. Participants were given the possibility to provide details on key sociodemographic variables, including sex, age, educational level, employment status, relationship status, and migration background.

Survey dissemination

The survey was conducted between April 14 and May 25, 2025. It was originally developed in English through collaborative efforts among research partners (Fig.2 shows the timeline of survey development. Local partners (MLKS, UPO, RRC) handled translation and cultural adaptation at each pilot site. The preliminary version of the survey was tested within local partners' networks to identify and address linguistic and interpretative issues, leading to minor revisions to improve comprehensibility and accessibility. All partners involved in the pilot sites received training on the ethical procedures for data collection, including informed consent and confidentiality protocols. Appendix 4 shows the survey flyers used for dissemination.

Ethical Considerations

This study received ethical approval from the Ethics Committee of the University of Eastern Piedmont (UPO). Participation was entirely voluntary and based on informed electronic consent. Before starting, participants received information regarding the purpose of the study, data handling procedures, and their rights as participants. Only those who selected the option "Yes, I agree to participate" could proceed with the survey. Only responses from individuals who explicitly provided consent were included in the analysis.

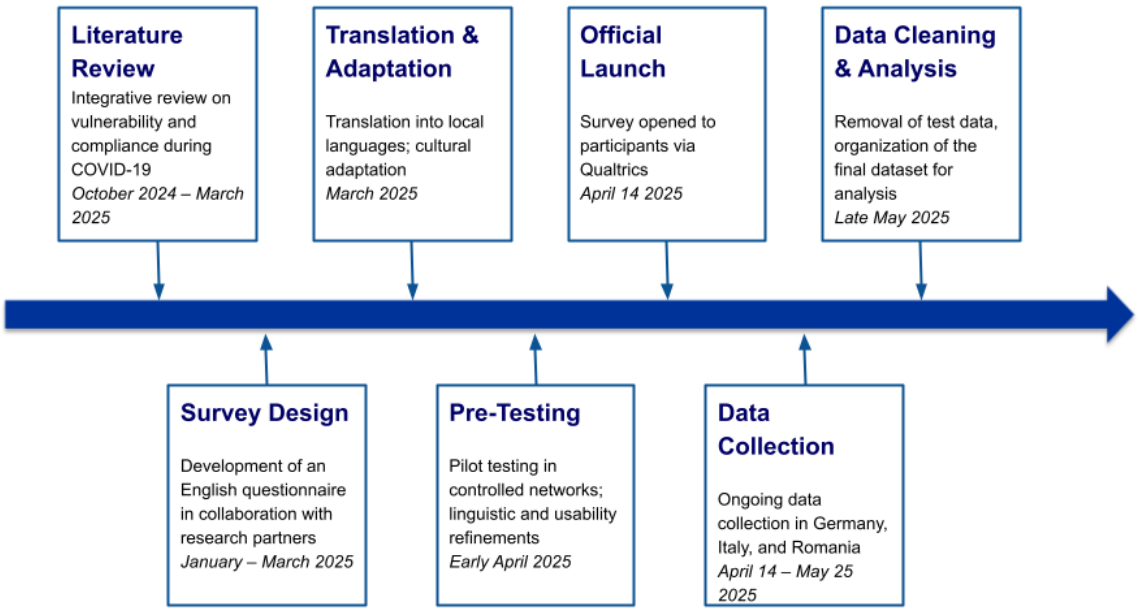


Figure 2: Survey Process Timeline Infographic

Results

Demographic Information of Respondents

To provide context for the survey findings, we first summarize the demographic characteristics of the participants. The demographic section included age, gender, education level, household composition, employment status, caregiving responsibilities, and self-reported physical and mental health status. The summary below presents key findings, with additional details provided in Appendix 3. The demographic characteristics of the participants reflect the purposive sampling strategy adopted, with an overrepresentation of certain categories in the different pilot sites (for instance, highly educated people in Piedmont because of UPO's academic status).

Table 3: Summary of Demographic Characteristics

Category	**Key Findings**
Age	Most participants in Hamburg and Piedmont were between 45–64 years, while Romania had a younger sample with a majority aged 18–44. Older adults (65+) were more represented in Hamburg (20%) and Piedmont (17%) than in Romania (4%).
Gender	Women made up the majority across all countries (59–66%). Men accounted for 32–40%, and non-binary/other identities were reported by a small percentage (especially in Romania, 6%).
Education	Participants in Piedmont and Romania reported high education levels (50%+ with master's or higher), while in Hamburg, vocational education was more common (31%).
Household Composition	Single-person and partner-only households were more common in Hamburg. Households with minor children were most prevalent in Piedmont (43%) and Romania (40%).
Household Size	Households in Hamburg were generally smaller (1–2 persons, 67%), while Piedmont and Romania had more variation in household size.
Country of Origin and Migration	Most participants were born and raised in the country of residence. Hamburg had a higher share of participants with a migration background (16%) compared to Piedmont and Romania (both <5%).
Employment Status	Full-time employment was most common in Piedmont (67%) and Romania, while Hamburg had higher proportions of part-time workers and unemployed individuals.

Care Responsibilities	Romanian participants reported more responsibility for children (41%), while German participants more often cared for older adults (23%). Piedmont showed a more balanced pattern.
Health Status	Participants in Hamburg reported the highest prevalence of chronic diseases (39%), physical limitations (37%), and psychological limitations (33%), whereas these issues were much less reported in Italy and Romania.

Health Literacy

Health literacy is a critical factor influencing an individual's ability to understand and act on health-related recommendations. Piedmont shows the highest levels of functional health literacy, meaning that individuals are generally well-equipped with the basic reading and comprehension skills needed to understand and follow health information and instructions. However, the proportion of respondents expressing only "somewhat" or lower confidence in filling forms (especially for others) remains substantial, indicating areas where support could be enhanced. In Hamburg we recorded the highest proportions reporting no difficulties in understanding medical information (35%) and no need for help in reading documents (43%). Furthermore, nearly 80% of respondents from Hamburg report feeling confident in completing medical forms for themselves. Romania shows significantly lower health literacy across all indicators compared to the other pilot sites. Many respondents report difficulties understanding written health information and often require help reading medical documents. Confidence in completing healthcare forms—both for themselves and for others—is also notably limited. These findings indicate a heightened vulnerability among Romanian respondents when it comes to navigating written health information and dealing with healthcare-related bureaucracy.

Accessing and Understanding COVID-19 Information

This section explores respondents' access to, comprehension of, and compliance with COVID–19–related information and regulations. It also examines the influence of social contacts on health-related decision-making, as well as respondents' qualitative reflections

and suggestions. All countries used a 5-point Likert scale ranging from 1 (Very Easy) to 5 (Very Difficult). Across all three pilot sites, information about preventive measures was perceived as more accessible and easier to understand than information about health consequences. The findings point to a common pattern: while basic preventive guidance was widely disseminated and understood, more complex medical information regarding COVID-19's health consequences was less accessible, especially in Hamburg.

Compliance with COVID-19 Measures

Participants also reported on the ease or difficulty of adhering to public health recommendations such as mask-wearing, handwashing, and social distancing. Responses were recorded on a 5-point Likert scale (1 = Very Easy, 5 = Very Difficult). The results show that, in Hamburg, just over half of the respondents found it easy to follow public health measures, but a substantial minority experienced difficulty; particularly notable is the relatively high share who found it very difficult, the highest among the three countries. In Piedmont, most respondents reported that compliance with public health guidelines was relatively easy. In Romania, the level of ease in following public health recommendations falls between the two other sites. While a majority found compliance manageable, a notable portion still reported difficulties, suggesting moderate challenges in implementing and understanding public health guidance.

Qualitative Insights on Compliance

We used several open questions in the survey to ask participants about their own experience with the different themes, but also to collect suggestions about possible improvements in preparedness and management of health crises. Respondents in all three countries mentioned that clear, accessible, and widespread information made it easier to follow the rules. On the other hand, when information was perceived as contradictory, confusing, or inconsistently delivered, it became a major obstacle. Trust in institutions and internalization of civic responsibility were repeatedly mentioned as reasons for ease of compliance and, as a mirror image, mistrust in government or perceived illegitimacy of measures were reported as reducing willingness to comply. Similarly, emotional burdens such as loneliness, anxiety, and perceived loss of freedom were prominent in all countries as barriers to compliance. Physical discomfort, health

issues, or unsuitable personal circumstances (e.g., caregiving responsibilities or living in overcrowded housing) made compliance difficult. Among the factors facilitating compliance we have access to the right conditions (e.g., remote work, home space, local support), but also individual characteristics or ethical beliefs aligned with public measures helped ease compliance.

Across the three pilot sites, compliance with public health measures was shaped by a combination of informational clarity, institutional trust, psychological resilience, and material conditions. The qualitative data highlights that perceived ease or difficulty was rarely due to a single factor. Efforts to enhance public health compliance should therefore address not only the content and delivery of rules but also emotional support, trust-building, and access to resources, especially for vulnerable groups.

Key Emerging Needs and Suggestions for Improvement and Engagement

Two open-ended questions invited participants to reflect on what could have improved their experience during the pandemic. A substantial number of participants emphasized the need for a single, authoritative, and regularly updated source of information. Respondents commonly were in favor of the creation of an official platform—ideally managed by national or regional health authorities—where all essential updates, including rules, symptoms, vaccines, and testing procedures, would be consolidated. Several participants felt the need for more balanced coverage and greater use of digital tools, including dedicated apps and official SMS or WhatsApp messages for timely updates. Respondents expressed a desire for more proactive outreach efforts, especially through mass media and social media campaigns featuring trusted medical experts rather than social influencers. A notable subset of responses, often from participants likely to belong to vulnerable groups, indicated that digital information alone was insufficient. These individuals called for additional human support and community-based outreach. Some participants stressed the importance of increased transparency and availability from health professionals, particularly general practitioners and public health services. Clear, consistent messaging from these trusted sources was seen as crucial. However, a few respondents also expressed skepticism or distrust toward health institutions, citing perceived opacity or intentional withholding of information.

The second open question asked about how to improve engagement of institutions and healthcare professionals. Many responses revealed frustration with fragmented messaging, perceived detachment from community needs, and a lack of preparedness. Yet, despite this critical tone, respondents also offered constructive insights grounded in their everyday experiences. The responses reveal a clear desire for improved communication practices, stronger community engagement, and better preparedness.

Trust and Risk Perceptions

Respondents rated several factors that may affect their willingness to follow public health measures in a future pandemic, like concern about the impact on daily life, religious influence on compliance, scientific beliefs and social conformity. Concern about the impact on daily life was evident across the sample, with German respondents expressing the highest levels of concern, Italians the lowest, and Romanians falling in between, suggesting a general awareness of the personal sacrifices involved in compliance. Religious influence on compliance was minimal in all three contexts, particularly in Piedmont (Italy), indicating that religious beliefs are unlikely to significantly shape health-related behaviors during a pandemic. Conversely, scientific beliefs emerged as an important motivator for compliance, especially among Italian respondents, highlighting the role of trust in science in shaping adherence to public health guidelines. Social conformity or peer influence played a moderate role in Romania and Germany, while it appeared to be less influential in Italy. A key dimension of compliance is usually trust, and we investigated the role of three different dimensions of trust. Across all three pilot sites, local health professionals were perceived as the most credible source of pandemic-related information, whereas social media influencers and online media were the least trusted. Institutional trust was weakest in Hamburg, more favorable in Piedmont, and neutral in Romania. In terms of general social trust, all countries scored around the midpoint of the 0–10 scale, reflecting a cautiously trusting public with significant interpersonal variability. These findings underscore the importance of trusted local actors and expert institutions in public health communication, particularly during crises.

Technology Acceptance

This section assesses respondents' digital literacy, access, social influences, and attitudes toward pandemic-related apps. Understanding users' needs and potential barriers to adoption is essential for ensuring these digital solutions are inclusive, effective, and widely adopted during future crises.

Across all three pilot sites, facilitating conditions—specifically access to smartphones and reliable internet—were consistently high. This suggests that technical infrastructure is not a major barrier to adoption in these contexts. Similarly, self-efficacy scores indicate strong digital competencies. Ease of use was rated positively across countries, with Romania again leading. German respondents also reported reasonably high ease of use, though slightly lower than their Italian and Romanian counterparts. These findings indicate that user interface design is unlikely to pose a significant obstacle to adoption. Differences in perceived usefulness were more pronounced. Romanian respondents rate apps as moderately useful for staying informed and making decisions, while Italian respondents reported slightly higher usefulness, especially for understanding the pandemic context and decision support. German respondents, in contrast, exhibited lower scores, signaling skepticism regarding the functional value of pandemic apps, particularly in decision-making contexts. Social influence appeared weak in all three pilot sites. This suggests that peer or familial encouragement plays a limited role in shaping app usage intentions. Attitudes toward pandemic-related apps revealed a mixed picture. Italian and Romanian participants expressed relatively more favorable intentions, while German respondents showed lower enthusiasm. The findings indicate that technical barriers were minimal, while perceived usefulness and attitudinal factors are the primary determinants of app adoption. Policymakers and public health communicators should thus prioritize evidence-based messaging, user-centric design, and direct engagement with users' informational needs, rather than relying on social diffusion mechanisms.

Regression analysis

To examine the factors, including key psychological and sociodemographic variables, influencing compliance with COVID-19 health measures (ComP), both bivariate correlation and multiple linear regression analyses were conducted. This approach allows for assessing the unique contribution of each predictor while controlling for the effects of the others. The analysis focused on the relationship between compliance (ComP) and

several psychological and sociodemographic variables: health literacy (HeaL), risk perception (RiskP), social influence (SocI), trust (in authority), age, gender, education level (Edu), and disability status (Disa). A multiple linear regression was conducted to examine the combined effect of the independent variables on compliance behavior. The linear regression equation can be expressed as follows:

$$\mathrm{ComP}_i = \beta_0 + \beta_1 \mathrm{HeaL}_i + \beta_2 \mathrm{RiskP}_i + \beta_3 \mathrm{SocI}_i + \beta_4 \mathrm{Trust}_i + \beta_5 \mathrm{Age}_i + \beta_6 \mathrm{Gender}_i + \beta_7 \mathrm{Edu}_i + \beta_8 \mathrm{Disa}_i + \varepsilon_i$$

Where:

ComPi: Compliance score of individual i
β0: Intercept (baseline compliance level when all predictors are zero)
β1 to β8: Regression coefficients estimating the influence of each predictor
εi: Error term capturing unobserved influences on compliance

The analysis showed that, in **Hamburg**, people with higher health literacy were more likely to follow public health guidelines. Health literacy was the strongest and most consistent factor associated with compliance. Individuals with higher health literacy also tended to be better educated. People with higher education levels reported higher levels of compliance and also expressed more trust in authorities. Trust itself was positively linked to compliance, showing that people who had more confidence in public institutions were more likely to follow recommended measures. Gender also played a role. Women reported higher levels of compliance than men. While age showed only a weak connection to compliance, it was related to disability status—older individuals were more likely to report a disability. Some factors, such as disability status, perceived risk of infection, and social influence, did not show a significant link to compliance in this sample.

In **Piedmont**, the analysis revealed several important relationships that help explain compliance behavior. Health literacy stood out as the strongest factor linked to compliance, reinforcing its role as a key influence. People with higher health literacy were more likely to follow public health guidelines. Trust in authorities also played a positive role—those who trusted institutions more tended to comply more with health recommendations.

Education showed some connection to compliance in simpler analyses, but this effect disappeared when health literacy was taken into account. This is likely because education

and health literacy are closely related; people with more education tend to have better health literacy, so the effect of education is largely captured through health literacy. Interestingly, the influence of social networks on compliance was somewhat complex. Stronger social influence showed a tendency to reduce compliance, which might reflect situations where social groups provide mixed messages or discourage strict adherence to health measures. On the other hand, perceptions of risk related to the burden of following public health rules did not independently predict whether people complied once other factors were considered. Other factors such as age, gender, and disability status did not have a significant direct impact on compliance in this analysis. Notably, older individuals reported feeling less influenced by their social circles.

In **Romania**, two key patterns stood out. First, people who perceived the health measures as more burdensome or risky were actually less likely to follow them. This suggests that when protective measures are seen as too demanding or costly, they may discourage compliance. In contrast, trust in public authorities emerged as a strong positive factor—those who trusted institutions were much more likely to follow health guidelines. When looking at all factors together in a regression analysis, trust in authorities remained the only strong and reliable predictor of compliance. Gender differences also appeared: in this sample, men reported slightly higher compliance than women. Other factors such as education and age showed small positive links to compliance, but these relationships were not strong enough to be considered meaningful in this analysis. Health literacy, however, was closely related to education, as people with more education generally reported higher levels of health literacy.

Overall, health literacy emerged as a central predictor of compliance across all three countries, consistent with existing literature emphasizing its critical role in enabling individuals to navigate health information and make informed decisions (Sørensen et al., 2012; Paakkari & Okan, 2020). However, cross-national disparities were marked. This finding highlights a need for improved health literacy, which would increase the proportion of people expressing confidence in independently handling medical documents. A need for clear, unambiguous and widespread information about the pandemic and its regulation emerged from the answers to open questions, as well as a need for tailored communication and continuous support from healthcare professionals. Participants expressed a clear need for a shift from reactive and fragmented crisis communication to

a more proactive, inclusive, and human-centered approach. The responses indicate that effective engagement requires not only clear and accurate messaging, but also empathy, trust, and meaningful participation at all levels—from national institutions to neighborhood networks. While many acknowledged the difficulty of navigating an unprecedented crisis, there was a clear emphasis on the need to learn from these experiences to improve institutional readiness and societal resilience for the future.

In-depth interviews with vulnerable individuals, care providers and healthcare professionals

As a complement to the quantitative evidence gathered through the survey, we conducted interviews with vulnerable individuals and caregivers in the three pilot locations in close collaboration with partners from the pilot sites. The aim was to gain an in-depth and richer understanding of the needs of vulnerable populations during a pandemic and the possible barriers to compliance with health recommendations.

Methods

The interviews were conducted by research teams with experience in qualitative research, each composed of native speakers of the local language in the three countries. The interviewees were recruited within the network of the partner organizations, more specifically UPO for Italy, the Red Cross for Romania and the Steilshoop parish for Germany. The sample consisted of 5 people in Romania (4 vulnerable and 1 caregiver), 7 in Germany (6 vulnerable and 1 caregiver) and 8 in Italy (5 vulnerable and 3 caregivers). Physical disability, poverty, migration background, old age and gender were the root causes of vulnerability in the sample.

Ethics approval for the interviews was received from the University of Eastern Piedmont (UPO). The interviews were conducted in person, online, and on the phone.

The interview guide was developed by UG and reviewed by WP1 partners, especially by those in contact with potential participants, to make sure to remove cultural differences, language inconsistencies, and any element that could offend the participants. Partners translated it into national languages, and the interviewers checked the wording before proceeding with the interviews.

All interviews were audio recorded, transcribed, and anonymized during transcription. The interviews were recorded and uploaded in Amberscript (https://www.amberscript.com/en/) that was then used for automatic transcription and translated in English. All the translations were revised by the interviewers, and amended when the translation was not accurate.

The translated transcriptions were analyzed using Atlas.ti, a software for qualitative data analysis. The data was analysed using the Reflexive Thematic Analysis (Braun and Clarke, 2022) approach.

Results

The interviews revealed a wide range of pandemic experiences among participants, ranging from profound and devastating changes to positive experiences of personal growth. These differences stem from heterogeneity among individuals, but also from the institutional and cultural differences between the three contexts (Hamburg, Piedmont, and Romania), and from the country of origins and circumstances of the interviewees. This range of diverse experiences underscores the need for differentiated forms of support, rather than assuming homogeneity across vulnerable groups—a critical point for both policy makers and researchers in the design of future preparedness measures.

Divergent Experiences, Common Themes

Despite notable differences in personal circumstances, coping abilities, and challenges faced, several recurring themes emerged across interviews.

Information fatigue and distrust. Participants from all three pilot sites reported that the flow of pandemic-related information was excessive, contradictory, and often fear-inducing. Television news, in particular, was seen as promoting fear rather than understanding, which led some individuals to stop following official updates altogether. Instead, many sought information from alternative sources or relied on personal networks for clarification. People reported making an active effort in searching for information through different channels (websites, YouTube, social media, broadcast media, newspapers), integrating and understanding it, therefore showing an active approach towards pandemic information. Language barriers further compounded confusion, particularly among migrants, who often depended on family members, caregivers, or institutional intermediaries (e.g., NGOs, religious leaders, daycare staff) to translate and explain health guidelines and regulations.

Barriers to compliance. The majority of participants reported a strict adherence to the preventive measures due to fear of negative health consequences (that could be worsened by existing conditions), concern for others (both in general and for relatives and people in their care), or a desire to follow the rules. Among the barriers to compliance there were confusing information, lack of access to face masks and other NPI, and living conditions.

Perceptions of preventive measures. Lockdowns, social distancing, and mask mandates were generally perceived as burdensome but ultimately necessary. While these measures were described as wearying, most participants acknowledged their utility in controlling the spread of the virus. The time span in which these measures were active and had to be followed was reported as a challenge. Some participants lamented the lack of compliance of other people and the resulting conflict as a negative side of preventive measures.

Suggestions for improved communication. Participants consistently recommended the establishment of a single, trusted source of information during public health emergencies. Ideal communicators were described as reputable, clear, and embedded in the local context - a positive example frequently mentioned by the Italian interviewees was the mayor of Novara (Piedmont region), who organized daily livestreams to update his citizens on the local situation in a competent but reassuring manner. There was a strong consensus on the need for communication in multiple languages, and for content to be delivered in an engaging and accessible format. Religious organizations having information translated into multiple languages were reported as positive examples of accessible communication.

Polarized views on vaccination. Vaccination was a highly divisive issue. Some participants described vaccines as necessary and beneficial, while others viewed them as ineffective or harmful. Nonetheless, even those who were skeptical often complied with vaccination requirements due to social pressure or institutional obligations, rather than personal conviction. Difficulties in understanding vaccine-related information were widespread and contributed to vaccine hesitancy.

Vaccine hesitancy. Only a minority of the interviewees reported lack of compliance with vaccines, ranging from having strong anti-vaccination positions rooted in the belief that COVID-19 was not a threat, to a general distrust in healthcare and institutional messages. The personal circumstances of these individuals were not homogeneous, suggesting that there are multiple paths leading to lack of compliance.

Enhancing Pandemic Preparedness

Based on the different actors' needs, suggestions for future preparedness coalesced around three main areas:

- **Continuity of essential services.** Participants emphasized the need for trained personnel and facilities that can continue offering essential services (e.g., daycare for the elderly and children, language classes) in any circumstances. Suggestions for increased preparedness included availability of large public spaces - to be used as an alternative to smaller care facilities in case of lockdown; trained volunteers to provide targeted and specific information - both about preventive measures and about available resources.
- **Digital inclusion.** There are different forms of inclusion needed. First, the development of a multi-lingual portal offering trusted and verified information about the pandemic and its development, along with clear explanations about health consequences. Second, providing access to digital tools and devices, including tablets and computers, but also SIM cards and stable internet connections. Third, preparing plans to move services online in a smooth and fast manner, taking into account the specific needs of the people using these services.
- **Targeted support personnel.** Training and hiring additional healthcare and non-healthcare workers (e.g., hotlines, community caregivers) for supporting vulnerable individuals, especially those with chronic illnesses, but also to avoid family caregivers to be left alone with excessive responsibilities.

Country-Specific Observations

German participants frequently mentioned societal polarization, especially between vaccinated and unvaccinated groups, which often manifested as a divisive "us vs. them"

dynamic. Information overload was a recurring concern, particularly regarding the ambiguity of what rules applied in different regions and why. Several participants acknowledged the utility of a centralized app for information dissemination. Challenges related to co-housing—especially among refugees—were also reported, including heightened fear of contagion and interpersonal conflict. A noteworthy case involved an unvaccinated individual who felt stigmatized, yet remained emotionally supported by family.

Italian interviews revealed that strong family support was a key coping mechanism throughout the pandemic. While participants were critical of fear-inducing media coverage—especially citing Bergamo as an example (referring to images of army trucks transporting piled-up coffins out of town)—they praised the proactive efforts of local figures, such as the mayor of Novara, whose familiarity and accessibility increased trust. Vaccination was generally accepted among both elderly participants, who related it to past experiences with polio and war, and migrants, who complied due to host country requirements. Interviewed caregivers reported their struggles to stay in touch with people they assisted, especially during the lockdown. Many of them relied on personal efforts (in terms of time and money) and went above and beyond their official roles, even during layoff periods, to provide continuous support. Migrants frequently needed translation services to understand and comply with public health guidelines.

Romanian participants displayed a general reluctance to share personal information, possibly reflecting low institutional trust. Many reported coping with the pandemic without any external support, with little concern for others outside their immediate family. Fearmongering by the media was noted, echoing patterns observed in other contexts. Several participants—particularly those with lower educational backgrounds or higher vulnerability—exhibited limited understanding of the pandemic's developments and relied heavily on Red Cross support. Although this raises potential concerns about selection bias due to recruitment through the Red Cross, it also highlights the centrality of this organization in supporting underserved populations. Specific cases included a single mother of a child with behavioral disorders who found information incomprehensible, viewed vaccination as useless, and experienced significant difficulty accessing healthcare services.

Task 1.2 Institutional needs with regards to health crises

Description of the subtask from the proposal:

Task 1.2: Institutional needs with regards to health crises; Leader: UPO; Participants: UG, UiO, UZH, CSG, DSU, RRC, FHH, MLKS; Duration: M1–M12

Subtask 1.2.1: Learning from past experiences of healthcare institutions and policymakers. With support from UZH, UPO will conduct a literature review, historical overview, and a qualitative document analysis to identify gaps in healthcare facilities response in previous health emergencies (epidemics and pandemics) in Europe.

Subtask 1.2.2: Challenges to overcome for healthcare institutions and policymakers. UPO will conduct several in-depth interviews with key stakeholders from the pilot sites and other European countries to identify, according to their experience, the challenges they faced during the management of previous health crises (focusing on epidemics and pandemics), including health literacy and data collection issues.

Subtask 1.2.3: Improving governance of healthcare institutions and policymaking in the future. UPO will organize one or more focus group discussions with relevant stakeholders from the pilot sites and other European countries to brainstorm about solutions to better manage and improve healthcare governance in future health emergencies (epidemics and pandemics). The findings will be integrated into D1.1 and feed into T.1.4 and T1.5.

This Task aimed at understanding the needs and challenges of healthcare facilities as well as those of professionals engaged in the response to past health emergencies. To identify critical gaps in healthcare facility responses during past health emergencies, UPO conducted a literature review, supported by UZH. This included a historical overview and an assessment of grey literature focused on healthcare preparedness and response in the context of epidemics and pandemics in Europe.

Methods

Given the surge in publications during the COVID-19 pandemic, UPO carried out a systematic review of reviews to synthesize existing evidence on healthcare facility-level challenges. The review focused on European contexts and included 22 peer-reviewed articles published in English between 2009 and 2024. Eligible reviews examined gaps in healthcare facility responses to COVID-19, H1N1, measles, influenza or seasonal flu, and Mpox. Literature searches were conducted in PubMed, Scopus, and Web of Science. Search strings used in the different databases can be found in Appendix 5. Data from the selected reviews were thematically analyzed using the 4S Framework (Stuff, Staff, Space, and System) (Anesi et al., 2022), which provides a structured lens for understanding core components of healthcare system resilience during crises. Operational definitions used in the review include:

- **Staff:** personnel involved in care delivery and hospital operations.
- **Stuff:** physical equipment required to deliver care and support care delivery.
- **System:** planning and leadership activities implemented to operationalize and optimize a response effort. For the purpose of the present study, “system” entails different aspects such as guidelines, clinical protocols, training, communication, and patient-centered care (e.g., introduction of telemedicine and new procedures for managing and treating patients within health care facilities).
- **Space:** physical spaces for patient care.
- **Health facility:** encompassed hospitals (general and specialized, district or first-level referral hospitals, including pharmacies situated within hospitals), primary health center (PHC) facilities.
- **Gaps or challenges in the response:** they were conceptualized as only related to the response to outbreaks at the health facility level. Namely, challenges solely provoked by the pathogen itself and not related to its management were not included.

In parallel, UZH conducted a historical review to examine healthcare facility responses to major respiratory pandemics in Europe prior to 2009. The aim was to identify recurring

system-level stressors, adaptive practices, and context-specific lessons applicable to contemporary preparedness efforts. The analysis covered pandemics such as the 1918–1920 influenza, the 1889–1890 “Russian Flu,” the 1957 “Asian Flu,” the 1968–1970 “Hong Kong Flu,” and the 1977 “Russian Flu.” The search, limited to peer-reviewed literature in English, was conducted via PubMed, Scopus, and Web of Science. More information on the Search string employed in the historical overview can be found in Appendix 6.

UZH also conducted a grey literature review focusing on reports published by governmental agencies in Europe describing the burden on healthcare system during historical and recent outbreaks. Platforms screened, included websites of the European Centre for Disease Prevention and Control (ECDC), WHO Europe, OECD, the European Commission, European Observatory on Health System and Policies, European Health Management Association (EHMA), European Public Health Alliance (EPHA), Standing Committee of European Doctors (CPME), European External Action Service (EEAS), Health Emergency Preparedness and Response (HERA), and Global Research Collaboration for Infectious Disease Preparedness (GloPID-R). On portals such as Google Scholar and OpenGrey, structured search queries were used. For most institutional websites, manual searches were conducted using basic terms such as “Influenza”. All web pages and subpages were carefully scanned for documents that met the inclusion criteria, even partially. However, despite extensive efforts, very few documents were found, and most of those only partially matched the scope of this task. No detailed information on challenges or lessons learned at the healthcare facility level was available, and for this reason, the review did not result in findings that could be meaningfully analyzed.

To complement the literature-based insights, UPO also conducted ten in-depth, semi-structured interviews with key stakeholders from the pilot sites (Piedmont, Romania, Hamburg) and from other European countries (Slovenia, France). This study was conducted in compliance with ethical standards as reported in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards and received ethical approval from the Ethics Committee of the A.O.U. “Maggiore della Carità” di Novara (protocol number 248/CE, March 2025). All participants were required to give written informed consent prior to data collection. Before starting the interviews, the participants were reminded of information about the aim of the study and the interview process. The

data collected was anonymized and access to the data was restricted to the research team. The interviews, held online in English or Italian, between April and May 2025, explored professionals' experiences and reflections on challenges and lessons learned. Topics included material resources, human resources, service provision, logistics, health literacy and communication, and data collection. After obtaining consent, interviews were recorded, transcribed verbatim using software Amberscript and thematically analyzed using Atlas.ti.

Building on the key challenges identified through literature and interviews, UPO facilitated a focus group discussion with seven stakeholders from the pilot sites (Hamburg, Piedmont, Romania) and other European settings (Germany, Spain, Sweden). Advisory Board members were also invited to participate. The focus group aimed to collaboratively reflect on the findings and develop actionable strategies to improve healthcare facility governance and resilience in future health emergencies.

Results

Literature review

Staff (n = 18 reviews)

Healthcare facilities faced widespread staff-related challenges during the past outbreaks, particularly the COVID-19 pandemic. These challenges spanned availability, mental health, work conditions, and legal concerns:

- Specialized Staff Shortages: Many facilities lacked critical care professionals due to illness, redeployment, or personal circumstances (e.g., pregnancy), impacting ICU and emergency services.
- Increased Workload and Burnout: Surges in patient volume and prolonged hours resulted in physical and mental strain. COVID-19 hotlines and screening staff were particularly affected. Burnout risk was amplified by high-complexity cases and insufficient staffing.
- PPE Usage and Team Rituals: While donning and doffing PPE was physically exhausting, it also functioned as a team bonding and mental health check activity.

- Mental Health Impacts: Staff reported widespread stress, anxiety, depression, and burnout, exacerbated by fear of infection, chaotic working conditions, lack of recognition, and witnessing suffering among colleagues.
- Patient–Provider Relationships: Staff often acted as intermediaries between isolated patients and families. However, interactions became depersonalized. Maintaining meaningful communication was considered a best practice despite challenges.
- Concerns Over Care Quality: Fear of delivering suboptimal care under pressure, especially during peak outbreaks, negatively affected staff morale and mental health.
- Medico-Legal and Ethical Issues: Staff were concerned about legal liability when prioritizing care and using telehealth tools with limited diagnostic reliability.
- Telehealth Challenges: Although widely adopted, telehealth raised concerns about care quality, increased time demands, provider inexperience, and cybersecurity risks.

Stuff (n = 14 reviews)

The "Stuff" dimension focused on the shortages of essential medical supplies and equipment during the COVID-19 pandemic and the adaptation strategies deployed in response.

- Widespread Shortages: Critical deficits were observed in PPE, medications, ventilators, medical supplies, and radiopharmaceuticals. These shortages were reported across all care settings: hospitals (especially ICUs and EDs), primary healthcare (PHC), prehospital emergency services, and field hospitals.
- Resource Reallocation Strategies: Ventilators were redistributed—portable and neonatal units were prioritized for children, freeing standard units for adults. PICUs were adapted to treat adults either alongside pediatric patients or exclusively, requiring layout and equipment modifications. These transitions, while effective, often disrupted routine operations and staff workflows.
- Technology and Support Limitations: Limited availability of mobile health technologies and inadequate technical support impeded digital health implementation, as noted in outpatient and primary care settings.

- Non-Hospital Settings Affected: Resource constraints extended beyond hospitals. For instance, PHC and outpatient services saw disruptions in non-COVID care delivery. Prehospital emergency response was compromised due to inaccessibility of AEDs in locked-down public spaces, prompting protocol revisions (e.g., in Paris).

Space (n = 7 reviews)

The "Space" dimension highlighted significant challenges in the physical capacity and configuration of healthcare facilities during the COVID-19 pandemic:

- Overcrowding and Limited Capacity: Hospitals in countries such as the UK, France, Spain, Türkiye, the Czech Republic, and Italy struggled to accommodate surges in patient numbers, particularly in Intensive Care Units (ICUs) and Emergency Departments (EDs). Some were even forced to restrict ICU access due to equipment shortages.
- Engineering and Infrastructure Challenges: Efforts to create new ICU spaces faced difficulties related to ventilation, medical gas systems, vacuum lines, and emergency power infrastructure.
- Zoning and Infection Control: Many hospitals had inadequate separation of patients by infection risk, especially in EDs in Türkiye and Italy. Common areas like break rooms and corridors also became sites of potential infection due to insufficient separation of clean and contaminated zones.
- New Spatial Needs for PPE Use: Facilities had to integrate dedicated donning and doffing stations into existing hospital layouts, necessitating additional construction and workflow redesign.
- Field Hospitals and Temporary Solutions: To relieve pressure on traditional hospitals, public spaces (e.g., exhibition centers, sports arenas) were converted into temporary field hospitals in countries like Italy and Romania. While cost-effective, these facilities often lacked appropriate infrastructure for infection control, particularly the isolation rooms necessary for managing contagious patients.

System (n = 20 reviews)

System-level challenges during the COVID-19 pandemic, highlighted across 20 studies, centered around clinical protocols, patient-centered care, training, and communication.

- Unclear or missing clinical guidelines and protocols lead to uncertainty, stress, and inconsistent care.
- Organizational strain includes poor preparedness for mass casualty events, rapid structural changes, and unclear command structures.
- Communication breakdowns, both internally (among staff) and with patients/families, are exacerbated by PPE use and telemedicine limitations.
- Telemedicine adoption introduced workload increases, ethical and data privacy concerns, technological literacy barriers, and risks of dehumanized care.
- Training gaps, especially in ICU protocols and digital health tools, hinder effective care.
- Cybersecurity vulnerabilities are due to rushed digital transitions.
- Access inequities in virtual care for marginalized groups.

Interviews

Different needs emerged from interviews with health care professionals and policy makers. These will be presented here in 5 macro themes: provision of health services, decision making and management, health literacy/communication, data collection, and logistics, resources and human resources.

Provision of health services:

- In terms of challenges, COVID-19 leads to services disruption in terms of preventative medicine, whereas health professionals highlighted the need for continuity of care especially for chronically ill patients.
- In order to guarantee continuity of care, health care professionals suggested the use of telemedicine, and accelerating digital transition of the system to facilitate this, as it was done partly in the previous pandemic.
- Another need that emerged was surge of capacity and the need to convert services and departments into intensive care unit departments, as well as the deployment of field hospitals.

Decision making/management:

- The need for a clear chain of command and the setup of a coordinated system emerged from the interviews. Some positive examples implemented in the three

pilot sites were reported, such as the creation of a regional crisis unit to facilitate the management of the crisis.

- It was highlighted that because of the lack of a coordinated system, there were a lot of challenges to collaboration, especially in decentralized countries such as in Germany. This reinforced the need for a coordinated and centralized system that considers also the realities on the ground.
- Most of the interviewees highlighted the need for clear guidance during a health crisis due to the high uncertainty they have experienced during the past crisis.
- The past management was defined as mostly top-down. Given the increased vulnerability of marginalized groups, many interviewees advocated for a more inclusive and bottom-up management approach, involving representatives of marginalized communities in planning and response.
- The need for preparedness was emphasized as crucial given the limited preparedness revealed in the past pandemic.

Health literacy/communication:

- Several healthcare professionals highlighted the need for clear and univocal communication, noting that the frequent changes in messaging created challenges in delivering appropriate treatment to patients, and provide them with guidance.
- Unclear communication also was highlighted as a challenge for the general public but particularly, as it contributed to the spread of misinformation and non-compliance. This highlights the need for targeted, culturally sensitive, and multilingual communication.
- The need for communication facilitators, especially for vulnerable groups, was highlighted both by healthcare professionals and policymakers as essential to bridge the gap and tailor the communication to the needs of the vulnerable ones.

Data collection:

- During the COVID-19 pandemic, multiple challenges emerged in terms of collection of data regarding resources available, ICU bed occupancy rate, and infection rates. These gaps hindered effective data analysis and collaboration with other healthcare institutions within the same region or nation. This highlighted the need for a unified reporting system for data collection.

- The need for a unified reporting system was highlighted as essential also for timely information data exchange between health care institutions to support decision-making.
- During the interviews, a clear need emerged for establishing such a system during the preparedness phase, allowing personnel to be trained and become familiar with it before a crisis occurs.

Logistics, resources and human resources:

- The need to establish alternative supply chains was highlighted, as the reliance on a single supplier – often severely affected by the health crisis – led to significant shortages and an inability to meet increased demand (e.g., masks from China).
- The interviewees disclosed the need for establishing a clear distribution system of resources depending on the context.
- The need for stockpiling was highlighted as a critical component of preparedness, with many pointing to the lack of materials in the early stages of the pandemic as a major challenge.
- Staff shortage experienced during the past pandemic highlighted the need for establishing clear staff redeployment routines, including training for emergency roles.
- Policy-makers highlighted the need to streamline bureaucratic procedures for extra staff recruitment in case of a crisis.
- Staff burnout during the past pandemic underlined the need for creating mental health support for staff psychological well-being.

Conclusion

This Need Analysis provides a multi-dimensional, empirically grounded understanding of how vulnerability intersects with compliance to public health recommendations during health crises, with a specific focus on the COVID-19 pandemic. A mixed-methods design is employed to identify unmet needs and barriers experienced during health crises by two key stakeholder groups: vulnerable individuals and institutions. Task 1.1 includes an integrative literature review that delineates vulnerability profiles, patterns of non-compliance, and structural impediments. These findings inform an online survey, which empirically validates the review's insights while capturing respondents' lived experiences. Semi-structured interviews add contextual depth and help generate actionable strategies to address identified barriers. In parallel, Task 1.2, led by UPO, focuses on institutional stakeholders through a complementary literature review and interviews, aimed at diagnosing organisational needs and capacity gaps.

The convergence of insights from the literature review, survey data, and interviews underscores several key themes. First and foremost, one of the most pervasive and consequential challenges identified in this study was the failure to effectively communicate with vulnerable groups. While the general population struggled with information overload, frequent updates, and unclear institutional responsibilities, these issues were significantly magnified for individuals with cognitive impairments, low health literacy, disabilities, or limited language proficiency. The consequences of these communication barriers were far-reaching. In many cases, non-compliance with public health measures was not due to unwillingness, but rather to constrained agency and reduced capacity to act. Second, beyond communication, the pandemic response revealed significant shortcomings in service continuity and inclusiveness. Third, health literacy consistently emerged as a central determinant of compliance. Limited health literacy—often a reflection of broader socio-economic and structural inequities—was found to impede individuals' ability to understand, evaluate, and act upon health guidance. This finding was not only prominent in the literature but also strongly supported by survey data from Germany and Italy, where higher functional health literacy predicted greater adherence. Fourth, our findings emphasize that vulnerability cannot be understood as a static or singular condition. Rather, it arises from the intersection of structural disadvantages (such as age, socioeconomic

status, gender, disability, or migration background) and contextual factors (including living conditions, family support, and institutional access).

Lastly, the analysis revealed that trust in authorities and risk perception are critical psychological facilitators of compliance, but always in interaction with other factors.

The findings from the interviews with health care professionals revealed a complex set of interrelated needs that span service continuity, inclusive crisis governance, communication, data infrastructure, and operational logistics. While challenges during the COVID-19 pandemic exposed systemic vulnerabilities, particularly in coordination, preparedness, and support for vulnerable groups, the insights gathered point to clear pathways for improvement, including digital transformation, integrated reporting systems, culturally tailored communication, and proactive workforce planning. A cross-cutting message is the importance of shifting from response to preparedness, grounded in inclusivity, collaboration, and local adaptation.

Limitations

Some limitations need to be acknowledged to contextualize the findings from the studies presented in this deliverable.

- **Sampling constraints** affect the representativeness of the survey data. Recruitment methods varied by country, and reliance on local organizations or informal networks likely resulted in the exclusion of some harder-to-reach populations. This limits the generalizability of the findings to the broader population. This also applies to the qualitative study, in which recruiting people belonging to vulnerable groups in the three countries proved especially challenging.
- **Cultural and linguistic nuances** may have introduced variability in how respondents interpreted survey and interview questions. Despite careful translation and localization, key constructs such as risk perception or confidence in institutional messaging may not be directly comparable across national settings. Having native speakers interviewing people in the three pilot sites allowed us to overcome linguistic barriers with native speakers, but it was not sufficient to communicate fully with non-native speakers.

- **Response bias** poses a concern, particularly social desirability and self-selection bias. Participants with higher concern or awareness about public health measures may have been more likely to engage with the survey, potentially skewing the sample toward more compliant or health-literate individuals.
- **Analytical limitations** include the exploratory nature of the regression models. The analyses do not account for potential nonlinear relationships, interactions between predictors, or broader structural variables, such as healthcare access or regional policy differences. Moreover, geographic scope varied across countries—local in Germany, regional in Italy, and national in Romania—limiting the granularity of cross-country comparisons.
- **Positionality of the interviewers**. The interviewers were all trained in qualitative in-depth interviews, they were familiar with the project and its goals, and they back translated the interviews from the native languages to English to check for potential misunderstandings. However, they brought their own biases in the interviews, as it is normal in this kind of research.

Appendix

Appendix 1: Search strings used for literature review.

Database	Search String
Web of Science	TS = ("epidemic*" OR "pandemic*" OR "health emergency" OR "outbreak*" OR "disease outbreak*" OR "disaster*" OR "crisis*" OR "covid*" OR "COVID-19" OR "SARS-CoV-2" OR "influenza" OR "seasonal flu" OR "seasonal influenza" OR "Mpox" OR "Monkey pox" OR "Monkeypox virus" OR "Monkeypox virus" OR "Monkeypox" OR "measles" OR "morbilli" OR "rubeola" OR "red measles" OR "H1N1" OR "A(H1N1)") AND ("vulnerab*") AND ("complian*" OR "adheren*" OR "obey*" OR "obedien*" OR "conform*") AND ("community" OR "individual" OR "social" OR "neighbo?rhood") Manually add: (PY=2009-2024) AND (LA=English) AND (CU=Europe (Europe OR "European Union" OR "United Kingdom" OR "France" OR "Germany" OR

	"Netherlands" OR "Italy" OR "Spain" OR "Sweden" OR "Denmark" OR "Norway" OR "Finland"))
Scopus	TITLE-ABS-KEY (TITLE-ABS-KEY ("epidemic*" OR "pandemic*" OR "health emergency" OR "outbreak*" OR "disease outbreak*" OR "disaster*" OR "crisis*" OR "covid*" OR "COVID-19" OR "SARS-CoV-2" OR "influenza" OR "seasonal flu" OR "seasonal influenza" OR "Mpox" OR "Monkeypox" OR "Monkeypox virus" OR "measles" OR "morbilli" OR "rubeola" OR "red measles" OR "H1N1" OR "A(H1N1)")) AND (TITLE-ABS-KEY ("vulnerability" OR "vulnerable")) AND (TITLE-ABS-KEY ("compliance" OR "compliant" OR "comply" OR "obey" OR "obedience" OR "conform")) AND (TITLE-ABS-KEY ("community" OR "individual" OR "social" OR "neighborhood" OR "neighbourhood")) AND PUBYEAR > 2008 AND (LIMIT-TO (LANGUAGE, "English")) AND (AFFILCOUNTRY ("United Kingdom" OR "Germany" OR "France" OR "Italy" OR "Spain" OR "Netherlands" OR "Sweden" OR "Norway" OR "Denmark" OR "Finland" OR "Belgium" OR "Austria" OR "Switzerland" OR "Poland" OR "Czech Republic" OR "Hungary" OR "Portugal" OR "Ireland" OR "Greece" OR "Slovakia" OR "Slovenia" OR "Romania" OR "Bulgaria" OR "Estonia" OR "Latvia" OR "Lithuania"))
PubMed	("epidemic*" [Title/Abstract] OR "pandemic*" [Title/Abstract] OR "health emergency" [Title/Abstract] OR "outbreak*" [Title/Abstract] OR "disease outbreak*" [Title/Abstract] OR "disaster*" [Title/Abstract] OR "crisis*" [Title/Abstract] OR "covid*" [Title/Abstract] OR "COVID-19" [Title/Abstract] OR "SARS-CoV-2" [Title/Abstract] OR "influenza" [Title/Abstract] OR "seasonal flu" [Title/Abstract] OR "seasonal influenza" [Title/Abstract] OR "Mpox" [Title/Abstract] OR "Monkeypox" [Title/Abstract] OR "Monkeypox virus" [Title/Abstract] OR "measles" [Title/Abstract] OR "morbilli" [Title/Abstract] OR "rubeola" [Title/Abstract] OR "red measles" [Title/Abstract] OR "H1N1" [Title/Abstract] OR "A(H1N1)" [Title/Abstract]) AND ("vulnerability" [Title/Abstract] OR "vulnerable" [Title/Abstract]) AND ("compliance" [Title/Abstract] OR "compliant" [Title/Abstract] OR "comply" [Title/Abstract] OR "conformity" [Title/Abstract] OR "adherence" [Title/Abstract] OR "obedience" [Title/Abstract] OR "obey*" [Title/Abstract]) AND ("community" [Title/Abstract] OR "individual" [Title/Abstract] OR "social" [Title/Abstract] OR "neighborhood" [Title/Abstract] OR "neighbourhood" [Title/Abstract]) AND ("2009"[Date - Publication] : "2024"[Date - Publication]) AND

	("english"[Language]) AND ("Europe"[Title/Abstract] OR "European Union"[Title/Abstract] OR "United Kingdom"[Title/Abstract] OR "Germany"[Title/Abstract] OR "France"[Title/Abstract] OR "Italy"[Title/Abstract] OR "Spain"[Title/Abstract] OR "Netherlands"[Title/Abstract] OR "Sweden"[Title/Abstract] OR "Norway"[Title/Abstract] OR "Denmark"[Title/Abstract] OR "Finland"[Title/Abstract] OR "Belgium"[Title/Abstract] OR "Austria"[Title/Abstract] OR "Switzerland"[Title/Abstract] OR "Poland"[Title/Abstract] OR "Czech Republic"[Title/Abstract] OR "Hungary"[Title/Abstract] OR "Portugal"[Title/Abstract] OR "Ireland"[Title/Abstract] OR "Greece"[Title/Abstract] OR "Slovakia"[Title/Abstract] OR "Slovenia"[Title/Abstract] OR "Romania"[Title/Abstract] OR "Bulgaria"[Title/Abstract] OR "Estonia"[Title/Abstract] OR "Latvia"[Title/Abstract] OR "Lithuania"[Title/Abstract])

Appendix 2: PRISMA flow diagram

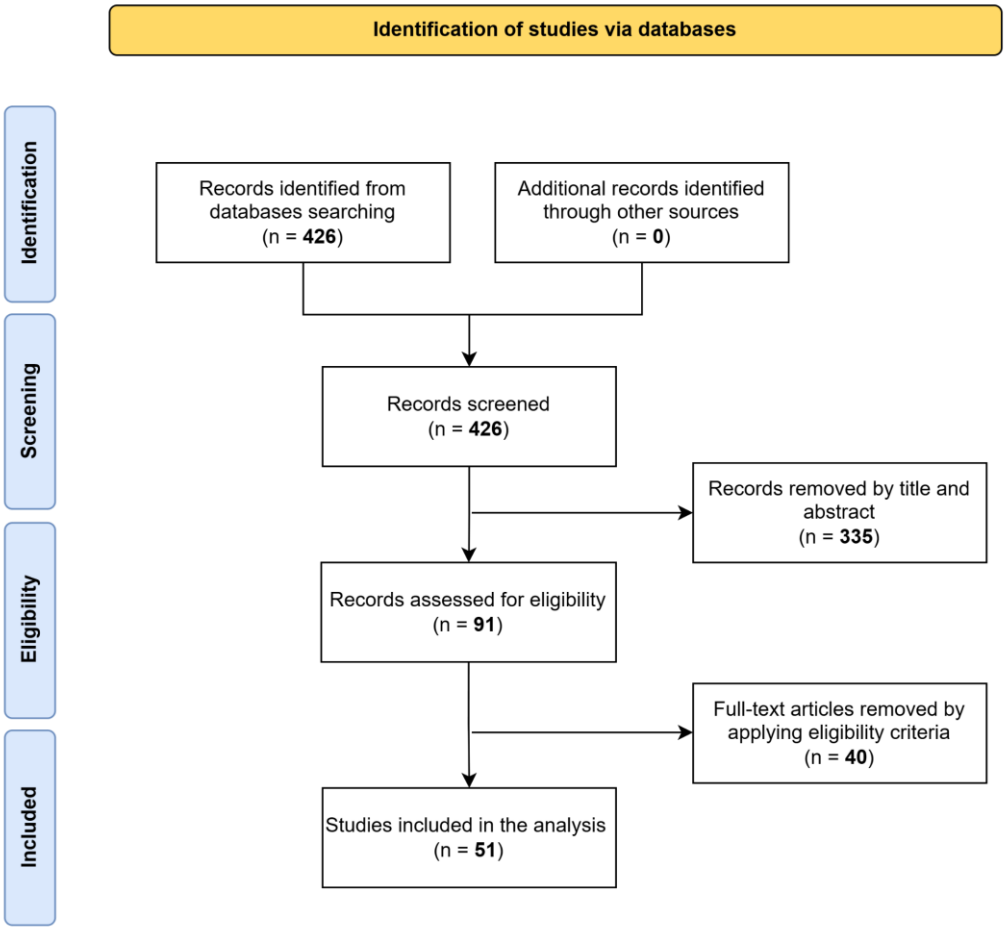


Figure A1: Extended PRISMA flow diagram of the literature review process.

Appendix 3: Survey details

Survey Dissemination Strategy

Germany (Hamburg – Steilshoop)

In Germany, the survey dissemination was concentrated in the Steilshoop neighborhood of Hamburg, a district known for its socio-economic diversity. The distribution strategy was implemented in collaboration with **MLKS (Mit Leben. Kompetenz. Steilshoop.)**, a well-established local social network composed of approximately 30 organizations operating in the area.

Main Distribution Channels:

- **Local Social Network (MLKS).** MLKS served as the primary platform for survey dissemination, leveraging its extensive network of community-based organizations. These included social service providers, educational initiatives, and cultural associations, all of which have established trust and access within the community.
- **Newsletters.** The survey was shared through digital and printed newsletters, particularly those targeting **parishioners** and members of the **regional church network**. This approach ensured outreach to faith-based communities and those regularly engaged with church-affiliated services.
- **Medical Partners.** Distribution also occurred through medical touchpoints, including **pharmacies, general practitioners, and clinics**. These health-related venues were chosen to reach residents through familiar and trusted sources.

Modes of Communication:

- **Direct Contact and Phone Calls.** Members of the MLKS network engaged in direct outreach, including telephone calls, to personally invite residents to participate.
- **Email Distribution.** The survey link or QR code was sent via email to local organizations and community members.
- **Flyers.** Printed flyers containing the survey information were distributed in relevant community locations, supporting visibility for those who might not be reached digitally.

This targeted and multi-modal strategy helped ensure inclusive participation from a diverse range of residents in Steilshoop, especially those from marginalized or hard-to-reach groups.

Italy (Piemonte Region)

In Italy, the dissemination of the survey was coordinated by the University of Eastern Piedmont (UPO) and conducted across a diverse range of community settings within the Piemonte region.

The strategy aimed to reach a broad and heterogeneous population, including students, healthcare users, migrants, and members of religious and ethnic minority communities.

Main Distribution Channels:

- **Educational Institutions.** The survey was distributed within university buildings, libraries, and through institutional newsletters. Additionally, it was promoted through the "Aging Project," a local academic initiative focused on aging and health. These channels were instrumental in engaging university students, staff, and affiliated community members.
- **Healthcare Facilities.** Questionnaires were made available in hospitals, general practitioners' (GP) offices, and through the Local Health Authority. This approach facilitated the inclusion of individuals in contact with the healthcare system, including patients and frontline workers.
- **Social Organizations.** Non-governmental organizations (NGOs) were mobilized to share the questionnaire among their networks, particularly those serving vulnerable populations, migrants, or individuals at risk of social exclusion.
- **Religious Buildings.** Outreach efforts included the distribution of surveys in mosques, Orthodox churches, and synagogues. These religious spaces served as culturally appropriate venues to engage individuals from diverse ethnic and religious backgrounds.
- **Public Places.** The survey was also shared in high-footfall public locations such as supermarkets, train and bus stations, ethnic shops, pharmacies, and money transfer shops. These points of contact enabled access to a wide demographic, including transient and working populations who may not be reached via institutional channels.

This multi-site and community-focused distribution strategy was designed to ensure maximum inclusivity and geographic coverage within the Piemonte region, while also addressing potential barriers to participation among marginalized or mobile populations.

Romania

In Romania, the distribution of the questionnaire was conducted through a multi-channel strategy, with a strong emphasis on reaching vulnerable and underserved populations. The primary partner for dissemination was the Romanian Red Cross, which operates 47 local branches across the country. These branches acted as the main intermediaries for reaching target respondents in both urban and rural settings.

Main Distribution Channels:

- **Romanian Red Cross Branches.** The local branches of the Romanian Red Cross were leveraged to distribute the questionnaire through both digital and physical formats. Depending on the needs and communication infrastructure of each branch, the survey was shared via email (including a clickable link or QR code) or handed out in printed form. Special focus was placed on branches involved in social support projects for vulnerable groups, such as the Red Cross Buzău branch, which has a strong engagement in social assistance activities.
- **E.G.A.L. Centers (Equality, Generosity, Access, and Learning).** The survey was also disseminated through E.G.A.L. Centers located in Babadag, Botoșani, Craiova, Alexandria, and Lupeni. These centers work with children and families from disadvantaged backgrounds, including Roma communities. Questionnaires were distributed directly to families receiving support from the centers, with coordination from local staff and volunteers. This channel was crucial in accessing populations typically underrepresented in mainstream surveys.
- **Community-Based Distribution.** To further enhance reach and trust, the survey was also distributed via respected community actors such as Red Cross volunteers, local clergy, members of humanitarian NGOs, and other trusted figures. This grassroots approach was particularly useful in building rapport with communities facing social and economic marginalization.

This tailored and collaborative approach ensured broader geographic and demographic coverage, while maintaining sensitivity to the challenges faced by vulnerable communities in Romania.

Age Distribution

A total of **398 respondents** from Germany (n = 88), Italy (n = 198), and Romania (n = 112) completed the age-related question in the survey. The age distribution varies across the three countries, reflecting differences in respondent composition and possibly digital accessibility or engagement levels among older populations.

Table A1: Age Distribution of Respondents by Country

Age Group	**Germany**	**Italy**	**Romania**
Under 18	–	–	1 (1%)

18–44	28 (32%)	78 (39.39%)	74 (66%)
45–64	42 (48%)	86 (43.43%)	32 (29%)
65+	18 (20%)	34 (17.17%)	5 (4%)
Total	**88 (100%)**	**198 (100%)**	**112 (100%)**

Among the 88 German respondents, the 45–64 age group constituted the largest share of the sample. Respondents aged 65 and above—who are often classified as a vulnerable group in public health research due to heightened risks during health crises—comprised 20% of the sample. While this represents a meaningful share, it remains smaller than the younger age groups, which may reflect general patterns of lower survey participation among older adults, potentially due to digital access barriers or reduced online engagement.

In the Italian sample, similar to Germany, the 45–64 age group represented the largest proportion. The older adult group (65+), which is particularly relevant for public health planning due to their increased vulnerability to pandemic-related risks, made up 17% of the respondents. This relatively low proportion may again reflect participation barriers among older individuals.

In Romania, a total of 112 respondents provided their age group. Unlike Germany and Italy, the 18–44 age group dominated the Romanian sample, making up two-thirds of respondents. Only 4% of respondents were aged 65 or older—the lowest proportion among the three countries. This may suggest even more pronounced barriers to participation among older adults in Romania, particularly in online or digitally mediated surveys.

Gender Identity

Table A2: Gender Identity of Respondents by Country

Gender Identity	**Germany**	**Italy**	**Romania**
Man	28 (32%)	80 (40%)	39 (35%)

Woman	57 (66%)	116 (59%)	66 (59%)
Non-binary	1 (1%)	–	1 (1%)
Other	–	–	3 (3%)
Prefer not to answer	1 (1%)	2 (1%)	3 (3%)
Total	**87 (100%)**	**198 (100%)**	**112 (100%)**

Across all three countries, the majority of respondents identified as female, accounting for 66% in Germany, and 59% in both Italy and Romania. Male respondents made up a smaller but still substantial portion of each national sample, ranging from 32% (Germany) to 40% (Italy). Gender-diverse identities—including non-binary, other, or those who preferred not to answer—were minimally represented, particularly in Germany and Italy, where such categories accounted for 1–2% of responses. Romania showed slightly higher diversity in responses, with 1% identifying as non-binary, 3% selecting "other," and another 3% preferring not to disclose their gender identity.

Educational Attainment

Table A3: Educational Attainment of Respondents by Country

Educational Level	**Germany**	**Italy**	**Romania**
Primary school only	2 (2%)	2 (1%)	–
Secondary school (e.g., 10th grade / high school)	24 (27%)	38 (19%)	8 (7%)
Vocational/Technical training	27 (31%)	11 (6%)	3 (3%)

Abitur / General university entrance	12 (14%)	–	–
Bachelor's degree	5 (6%)	29 (15%)	42 (38%)
Master's degree or higher	18 (20%)	118 (60%)	59 (53%)
Total	**88 (100%)**	**198 (100%)**	**112 (100%)**

Germany: The educational distribution is centered on vocational and mid-secondary levels.

- The largest group (31%) completed vocational or technical education, followed by secondary education (27%) and Abitur (14%).
- Only 26% hold academic degrees (Bachelor's: 6%, Higher education: 20%).

This distribution can be typical of the German dual education system, which emphasizes non-academic professional training.

Italy: The sample is highly skewed toward academic qualifications.

- A clear majority (60%) completed a Master's degree or higher, and 15% hold a Bachelor's degree.
- Combined, 75% of respondents have a university-level education.
- Lower educational levels (secondary or vocational) account for only 26% of the sample, suggesting a highly educated group.

Romania: Like Italy, Romania's sample is dominated by university-educated individuals.

- 53% hold postgraduate degrees, and 38% a Bachelor's degree — meaning 91% completed higher education.
- Secondary (7%) and vocational (3%) levels are sparsely represented.

This points to a selective and well-educated respondent group, which may influence perceptions of health information and compliance behavior.

Household Composition

In Germany, a total of 86 German respondents provided information about their household composition during the pandemic. The most frequently reported arrangement was living alone,

with 31% (n = 27) indicating they resided in a single-person household. Couples without children—both married/partnered (24%, n = 21) and cohabiting (8%, n = 7)—also comprised a substantial portion of the sample. Households with dependent children were less common: 16% (n = 14) lived in a married or partnered household with children, 6% (n = 5) in cohabiting households with children, and a small proportion were single parents with dependent (2%, n = 2) or non-dependent children (3%, n = 3). An additional 8% (n = 7) reported other forms of household arrangements. These findings suggest a sample composition skewed toward individuals living alone or in childless households, with limited representation of households responsible for the care of dependent children.

In Italy, among the 198 Italian respondents, the predominant household type was that of married or civil-union couples with dependent children, reported by 43% (n = 86). Single-person households and couples without children each accounted for 11% (n = 21). A notable share (15%, n = 29) selected “other” as their household category. Compared to the German sample, Italian respondents were more likely to live in family households with dependent children, suggesting a more family-oriented living context with potential implications for caregiving responsibilities and exposure to pandemic-related stressors.

In Romania, of the 111 Romanian respondents who answered this question, 40% (n = 44) reported living in a household with a married or civil partnership couple and dependent children, making it the most common arrangement. Couples without children comprised 18% (n = 20), while 15% (n = 17) lived alone. Other household structures included unmarried couples without children (10%, n = 11), unmarried couples with children (3%, n = 3), single parents with dependent (7%, n = 8) or non-dependent children (1%, n = 1), and other living situations (6%, n = 7). The Romanian sample, similar to the Italian one, reflects a greater prevalence of family households with dependent children, contrasting with the more individualistic household patterns observed in Germany.

Household Size

Across all three countries, the majority of respondents reported living in relatively small households during the COVID-19 pandemic, though national patterns varied slightly. Overall, household sizes in Germany tended to be smaller, while Italy and Romania showed more diversity in composition, with Italy in particular having a notable proportion of larger households.

In Germany, most respondents lived in either two-person (36%, n = 31) or single-person households (31%, n = 27), indicating a predominance of small household units. Larger households—with three or more members—were less common, comprising less than one-third of the sample.

In Italy, household sizes were more evenly distributed. The most common arrangement was three-person households (30%, n = 59), followed closely by two- and four-person households (each 26%, n = 52). Only 10% (n = 19) lived alone, and 9% resided in households with five or more members, possibly reflecting multigenerational living or caregiving responsibilities.

In Romania, two-person households were the most frequently reported (41%, n = 45), followed by three-person (23%, n = 25) and four-person households (14%, n = 16). Single-person households were less common (13%, n = 14), and only 10% (n = 11) lived in households with five or more people.

Background Characteristics

Across Germany, Italy, and Romania, the data suggest that all three national samples are predominantly composed of individuals with deep local roots, especially in Italy and Romania, with limited representation of individuals with migration or refugee backgrounds.

In Germany, 84% (n = 73) of respondents reported being German citizens born and raised in the country. The remaining 16% comprised a mix of German-born individuals raised elsewhere (6%), immigrants who arrived as minors (3%), or as adults (5%), and a small number of recent refugees or those identifying as “other” (1% each). This reflects moderate diversity within the German sample, particularly compared to Italy and Romania.

In Italy, 96% (n = 191) were Italian citizens born and raised in Italy. Only 2% reported arriving after age 18, and another 2% selected “other.”

Similarly, in Romania, 95% (n = 106) of respondents were born and raised in the country. Very small proportions reported backgrounds involving migration—either as minors or adults—or refugee status. Only 4% of the sample reported any non-native background.

Employment Status

Employment patterns varied across the three countries, with marked differences in the prevalence of full-time employment and non-standard work arrangements. Romanian and Italian respondents reported significantly higher levels of full-time employment than their German counterparts. The German sample shows more variation, with a larger share of respondents either unemployed or outside the standard labor force.

In Germany, only about half (52%, n = 46) of the respondents reported being currently employed—34% full-time and 18% part-time. A considerable share (30%, n = 26) selected “other,” which includes retirees, those in temporary jobs, or other unspecified arrangements. Additionally, 16% were unemployed and 1% not actively seeking work.

In Italy, employment was more prevalent, with 67% (n = 133) reporting full-time work and an additional 8% (n = 16) employed part-time. Only 5% were unemployed, and 18% fell into non-standard employment categories.

Caregiving Responsibilities

In Germany, 59% of respondents reported having regular caregiving responsibilities. The most common form was caring for older adults (23%, n = 20), followed by caring for children under 18 (15%, n = 13), and individuals with disabilities or impairments (8%, n = 7). Another 13% (n = 11) engaged in other forms of caregiving. In contrast, 41% (n = 35) reported no caregiving duties.

In Italy, slightly less than half of respondents (47%, n = 93) reported caregiving duties. The most frequently reported type was elder care (22%, n = 44), followed by care for children under 18 (16%, n = 32), and disabled family members (5%, n = 9). A slight majority (53%, n = 105) had no caregiving responsibilities.

In Romania, caregiving responsibilities were most concentrated around childcare, with 41% (n = 45) of respondents caring for minors. Fewer reported caring for older adults (9%, n = 10) or persons with disabilities (5%, n = 5). A notable 39% (n = 43) indicated no caregiving role, while 7% (n = 8) chose “other.” Overall, 61% of respondents reported providing some form of care, indicating a relatively high caregiving burden, especially among parents.

In summary, while all three samples show a significant portion of respondents with caregiving responsibilities, Romania stands out for its focus on childcare, Germany for elder care, and Italy for a more balanced caregiving profile.

Health Conditions and Daily Activity Limitations

This part examines three indicators of individual health vulnerability that may shape compliance with public health measures: diagnosed chronic illness or impairment, physical limitations affecting daily functioning, and mental health conditions that impair daily activities.

Table A4: Health Status of Different Countries

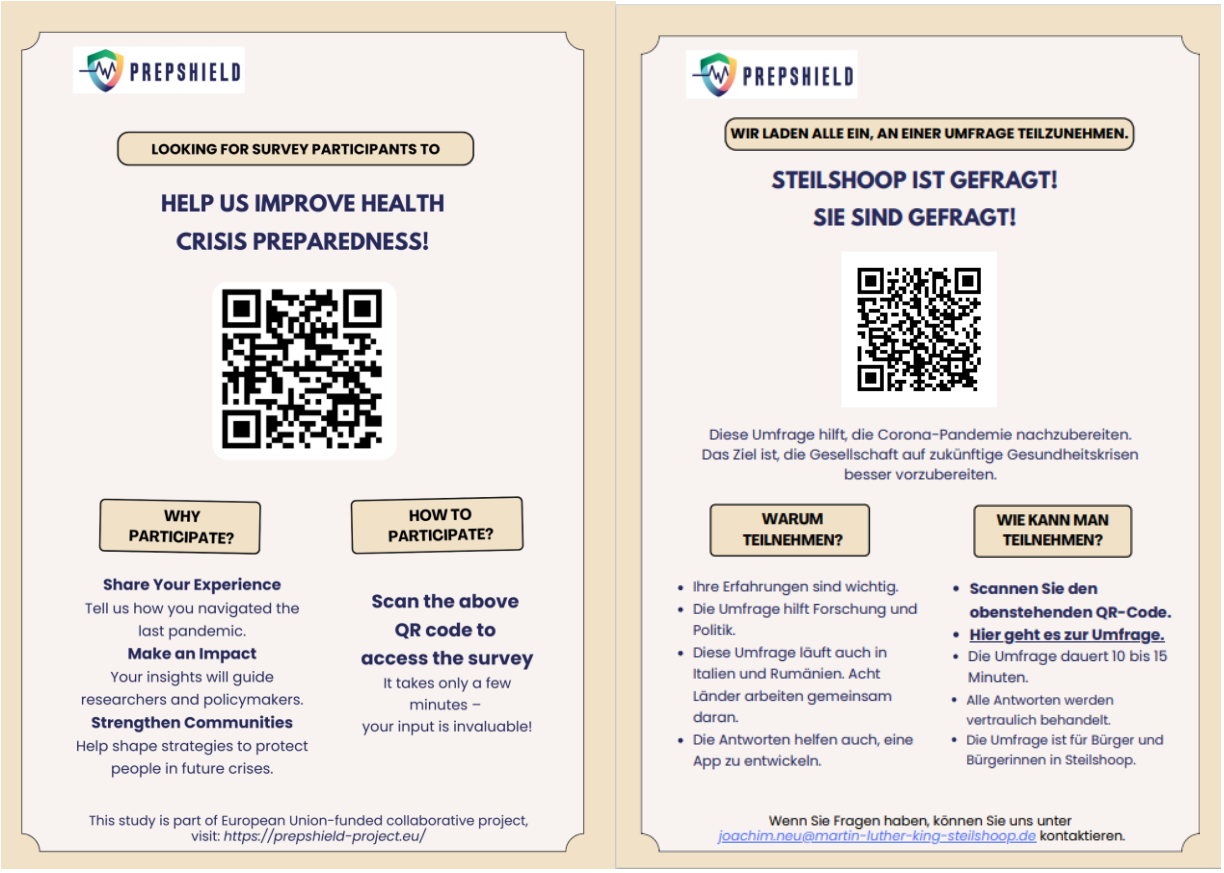
Health Indicator	**Germany (n = 87)**	**Italy (n = 196)**	**Romania (n = 111)**
Chronic illness/impairment	39%	18%	21%
Physical limitations (daily activities)	37%	10%	8%
Mental conditions (daily activities)	33%	4%	2%

In Germany, among 87 respondents, 1) 39% reported a diagnosed chronic illness or impairment. 2) 37% reported physical limitations affecting daily life. 3) 33% reported mental health conditions impacting daily functioning. These figures suggest that a substantial proportion—approximately one-third to two-fifths—face health-related challenges, with many potentially managing multiple vulnerabilities.

In Italy, among 196 respondents, 1) 18% reported a chronic illness or impairment. 2) 10% reported physical limitations. 3) 4% reported mental health-related limitations. Compared to Germany, Italy's respondents report significantly lower rates of health-related limitations. The sample appears to be healthier on average, both physically and psychologically.

In Romania, among 111 respondents, 1) 21% reported a chronic illness or impairment. 2) 8% reported physical limitations. 3) 2% reported mental health conditions affecting daily life. Romania's sample presents an intermediate prevalence of chronic illness but low levels of reported functional limitations, especially regarding mental health. Only a very small proportion acknowledges mental health-related challenges.

Appendix 4: Survey flyer for dissemination



PREPSHIELD

LOOKING FOR SURVEY PARTICIPANTS TO

HELP US IMPROVE HEALTH CRISIS PREPAREDNESS!

WHY PARTICIPATE?

Share Your Experience
Tell us how you navigated the last pandemic.
Make an Impact
Your insights will guide researchers and policymakers.
Strengthen Communities
Help shape strategies to protect people in future crises.

HOW TO PARTICIPATE?

Scan the above QR code to access the survey
It takes only a few minutes – your input is invaluable!

This study is part of European Union-funded collaborative project, visit: *https://prepshield-project.eu/*

PREPSHIELD

WIR LADEN ALLE EIN, AN EINER UMFRAGE TEILZUNEHMEN.

STEILSHOOP IST GEFRAGT!
SIE SIND GEFRAGT!

Diese Umfrage hilft, die Corona-Pandemie nachzubereiten. Das Ziel ist, die Gesellschaft auf zukünftige Gesundheitskrisen besser vorzubereiten.

WARUM TEILNEHMEN?

- Ihre Erfahrungen sind wichtig.
- Die Umfrage hilft Forschung und Politik.
- Diese Umfrage läuft auch in Italien und Rumänien. Acht Länder arbeiten gemeinsam daran.
- Die Antworten helfen auch, eine App zu entwickeln.

WIE KANN MAN TEILNEHMEN?

- **Scannen Sie den obenstehenden QR-Code.**
- **Hier geht es zur Umfrage.**
- Die Umfrage dauert 10 bis 15 Minuten.
- Alle Antworten werden vertraulich behandelt.
- Die Umfrage ist für Bürger und Bürgerinnen in Steilshoop.

Wenn Sie Fragen haben, können Sie uns unter joachim.neu@martin-luther-king-steilshoop.de kontaktieren.

Appendix 5: Search string used for the literature review conducted within Subtask 1.2.1

Database	Search string
PubMed	(("epidemic*" [Title/Abstract] OR "pandemic*" [Title/Abstract] OR "health emergency" [Title/Abstract] OR "outbreak*" [Title/Abstract] OR "disease outbreak*" [Title/Abstract] OR "disaster*" [Title/Abstract] OR "crisis*" [Title/Abstract] OR "covid*" [Title/Abstract] OR "COVID-19" [Title/Abstract]

	OR "SARS-CoV-2" [Title/Abstract] OR "influenza" [Title/Abstract] OR "seasonal flu" [Title/Abstract] OR "seasonal influenza" [Title/Abstract] OR "Mpox" [Title/Abstract] OR "Monkeypox" [Title/Abstract] OR "Monkeypox virus" [Title/Abstract] OR "measles" [Title/Abstract] OR "morbilli" [Title/Abstract] OR "rubeola" [Title/Abstract] OR "red measles" [Title/Abstract] OR "H1N1" [Title/Abstract] OR "A(H1N1)" [Title/Abstract])) AND ("health system*" [Title/Abstract] OR "health facility*" [Title/Abstract] OR "hospital*" [Title/Abstract] OR "ICU" [Title/Abstract] OR "intensive care unit" [Title/Abstract] OR "ED" [Title/Abstract] OR "ER" [Title/Abstract] OR "emergency department*" [Title/Abstract] OR "emergency room*" [Title/Abstract] OR "primary care" [Title/Abstract] OR "PHC" [Title/Abstract] OR "primary health care" [Title/Abstract] OR "primary healthcare" [Title/Abstract]) AND ("response*" [Title/Abstract] OR "effect*" [Title/Abstract] OR "challenge*" [Title/Abstract] OR "gap" [Title/Abstract] OR "difficulty*" [Title/Abstract] OR "impact*" [Title/Abstract] OR "disruption*" [Title/Abstract] OR "discontinuity" [Title/Abstract])
Scopus	(TITLE-ABS-KEY (epidemic* OR pandemic* OR "health emergency" OR outbreak* OR "disease outbreak*" OR disaster* OR crisis* OR covid* OR "COVID-19" OR "SARS-CoV-2" OR influenza OR "seasonal flu" OR "seasonal influenza" OR mpox OR "Monkeypox" OR "Monkeypox virus" OR measles OR morbilli OR rubeola OR "red measles" OR h1n1 OR "A(H1N1)") AND TITLE-ABS-KEY ("health system*" OR "health facility*" OR hospital* OR icu OR "intensive care unit" OR ed OR er OR "emergency department*" OR "emergency room*" OR "primary care" OR phc OR "primary health care" OR "primary healthcare") AND TITLE-ABS-KEY (response* OR effect* OR challenge* OR gap* OR difficulty* OR impact* OR disruption* OR discontinuity)) AND PUBYEAR > 2008
Web of Science	TS=("epidemic*" OR "pandemic*" OR "health emergency" OR "outbreak*" OR "disease outbreak*" OR "disaster*" OR "crisis*" OR "covid*" OR "COVID-19" OR "SARS-CoV-2" OR "influenza" OR "seasonal flu" OR "seasonal influenza" OR "Mpox" OR "Monkey pox" OR "Monkeypox virus"

	OR "Monkeypox virus" OR "Monkeypox" OR "measles" OR "morbilli" OR "rubeola" OR "red measles" OR "H1N1" OR "A(H1N1)") AND (TS=("health system*" OR "health facility*" OR "hospital*" OR "ICU" OR "intensive care unit" OR "ED" OR "ER" OR "emergency department*" OR "emergency room*" OR "primary care" OR "PHC" OR "primary health care" OR "primary healthcare")) AND (TS=("response*" OR "effect*" OR "challenge*" OR "gap*" OR "difficulty*" OR "impact*" OR "disruption*" OR "discontinuity"))

Appendix 6: Search strings used in the historical overview conducted as part of Subtask 1.2.1 by UZH.

Database	**Search string**
PubMed	((("influenza*" [Title/Abstract] OR " Russian flu*" [Title/Abstract] OR " Spanish flu*" [Title/Abstract] OR "Asian flu" [Title/Abstract] OR "Hong Kong flu" [Title/Abstract]) AND ((("1889" [Title/Abstract] OR "1890" [Title/Abstract] OR "1918" [Title/Abstract] OR "1919" [Title/Abstract] OR "1920" [Title/Abstract] OR "1957" [Title/Abstract] OR "1958" [Title/Abstract] OR "1968" [Title/Abstract] OR "1969" [Title/Abstract] OR "1970" [Title/Abstract] OR "1977" [Title/Abstract]) AND ("pandemic*" [Title/Abstract] OR "outbreak*" [Title/Abstract] OR "crisis*" [Title/Abstract] OR "disaster*" [Title/Abstract])) AND

	("health system*" [Title/Abstract] OR "health facility*" [Title/Abstract] OR "hospital*" [Title/Abstract] OR "ICU" [Title/Abstract] OR "intensive care unit" [Title/Abstract] OR "ED" [Title/Abstract] OR "ER" [Title/Abstract] OR "emergency department*" [Title/Abstract] OR "emergency room*" [Title/Abstract] OR "primary care" [Title/Abstract] OR "PHC" [Title/Abstract] OR "primary health care" [Title/Abstract] OR "primary healthcare" [Title/Abstract]) AND ("response*" [Title/Abstract] OR "effect*" [Title/Abstract] OR "challenge*" [Title/Abstract] OR "gap*" [Title/Abstract] OR "difficulty*" [Title/Abstract] OR "impact*" [Title/Abstract] OR "disruption*" [Title/Abstract] OR "discontinuity" [Title/Abstract])) AND (("European Union" [Title/Abstract] OR "EU" [Title/Abstract] OR "United Kingdom" [Title/Abstract] OR "UK" [Title/Abstract] OR "Switzerland" [Title/Abstract] OR "Ukraine" [Title/Abstract] OR "Serbia" [Title/Abstract] OR "Austria" [Title/Abstract] OR "Belgium" [Title/Abstract] OR "Bulgaria" [Title/Abstract] OR "Croatia" [Title/Abstract] OR "Cyprus" [Title/Abstract] OR "Czech Republic" [Title/Abstract] OR "Denmark" [Title/Abstract] OR "Estonia" [Title/Abstract] OR "Finland" [Title/Abstract] OR "France" [Title/Abstract] OR "Germany" [Title/Abstract] OR "Greece" [Title/Abstract] OR "Hungary" [Title/Abstract] OR "Ireland" [Title/Abstract] OR "Italy" [Title/Abstract] OR "Latvia" [Title/Abstract] OR "Lithuania" [Title/Abstract] OR "Luxembourg" [Title/Abstract] OR "Malta" [Title/Abstract] OR "Netherlands" [Title/Abstract] OR "Poland" [Title/Abstract] OR "Portugal" [Title/Abstract] OR "Romania" [Title/Abstract] OR "Slovakia" [Title/Abstract] OR "Slovenia" [Title/Abstract] OR "Spain" [Title/Abstract] OR "Sweden" [Title/Abstract]) OR ("European Union"[MeSH] OR "United Kingdom"[MeSH] OR "Switzerland"[MeSH] OR "Ukraine"[MeSH] OR "Serbia"[MeSH] OR "Austria"[MeSH] OR "Belgium"[MeSH] OR "Bulgaria"[MeSH] OR "Croatia"[MeSH] OR "Cyprus"[MeSH] OR "Czech Republic"[MeSH] OR "Denmark"[MeSH] OR "Estonia"[MeSH] OR "Finland"[MeSH] OR

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Scopus	TITLE-ABS("influenza*" OR "Russian flu*" OR "Spanish flu*" OR "Asian flu" OR "Hong Kong flu") AND (TITLE-ABS("1889" OR "1890" OR "1918" OR "1919" OR "1920" OR "1957" OR "1958" OR "1968" OR "1969" OR "1970" OR "1977") AND TITLE-ABS("pandemic*" OR "outbreak*" OR "crisis*" OR "disaster*")) AND TITLE-ABS-KEY("health system*" OR "health facility*" OR "hospital*" OR "ICU" OR "intensive care unit" OR "ED" OR "ER" OR "emergency department*" OR "emergency room*" OR "primary care" OR "PHC" OR "primary health care" OR "primary healthcare") AND TITLE-ABS-KEY("response*" OR "effect*" OR "challenge*" OR "gap*" OR "difficulty*" OR "impact*" OR "disruption*" OR "discontinuity") AND TITLE-ABS-KEY("European Union" OR "EU" OR "United Kingdom" OR "UK" OR "Switzerland" OR "Ukraine" OR "Serbia" OR "Austria" OR "Belgium" OR "Bulgaria" OR "Croatia" OR "Cyprus" OR "Czech Republic" OR "Denmark" OR "Estonia" OR "Finland" OR "France" OR "Germany" OR "Greece" OR "Hungary" OR "Ireland" OR "Italy" OR "Latvia" OR "Lithuania" OR "Luxembourg" OR "Malta" OR "Netherlands" OR "Poland" OR "Portugal" OR "Romania" OR "Slovakia" OR "Slovenia" OR "Spain" OR "Sweden"))

	AND (LIMIT-TO(LANGUAGE, "English"))
Web of Science	(TS=("influenza*" OR "Russian flu*" OR "Spanish flu*" OR "Asian flu" OR "Hong Kong flu") AND TS=("1889" OR "1890" OR "1918" OR "1919" OR "1920" OR "1957" OR "1958" OR "1968" OR "1969" OR "1970" OR "1977") AND TS=("pandemic*" OR "outbreak*" OR "crisis*" OR "disaster*")) AND TS=("health system*" OR "health facility*" OR "hospital*" OR "ICU" OR "intensive care unit" OR "ED" OR "ER" OR "emergency department*" OR "emergency room*" OR "primary care" OR "PHC" OR "primary health care" OR "primary healthcare") AND TS=("response*" OR "effect*" OR "challenge*" OR "gap*" OR "difficulty*" OR "impact*" OR "disruption*" OR "discontinuity") AND TS=("European Union" OR "EU" OR "United Kingdom" OR "UK" OR "Switzerland" OR "Ukraine" OR "Serbia" OR "Austria" OR "Belgium" OR "Bulgaria" OR "Croatia" OR "Cyprus" OR "Czech Republic" OR "Denmark" OR "Estonia" OR "Finland" OR "France" OR "Germany" OR "Greece" OR "Hungary" OR "Ireland" OR "Italy" OR "Latvia" OR "Lithuania" OR "Luxembourg" OR "Malta" OR "Netherlands" OR "Poland" OR "Portugal" OR "Romania" OR "Slovakia" OR "Slovenia" OR "Spain" OR "Sweden") AND LA=(English)

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