
# BUILDERS D4.4 REDUCING SOCIAL VULNERABILITY BY INNOVATIVE DATA FUSION FOR MORE-INFORMED RESCUE PRIORITISATION

**Project acronym:** BuildERS

**Project title:** Building European Communities' Resilience and Social Capital

**Call:** H2020-SU-SEC-2018-2019-2020/H2020-SU-SEC-2018

# Disclaimer

The content of the publication herein is the sole responsibility of the publishers and it does not necessarily represent the views expressed by the European Commission or its services.

While the information contained in the documents is believed to be accurate, the authors(s) or any other participant in the BuildERS consortium make no warranty of any kind with regard to this material including, but not limited to the implied warranties of merchantability and fitness for a particular purpose.

Neither the BuildERS Consortium nor any of its members, their officers, employees or agents shall be responsible or liable in negligence or otherwise howsoever in respect of any inaccuracy or omission herein.

Without derogating from the generality of the foregoing neither the BuildERS Consortium nor any of its members, their officers, employees or agents shall be liable for any direct or indirect or consequential loss or damage caused by or arising from any information advice or inaccuracy or omission herein.

This project has received funding from the European Union's Horizon2020 research and innovation programme under grant agreement No. 833496

| | |
|---|---|
| **Project no.** | 833496 |
| **Project acronym:** | BuildERS |
| **Project title:** | Building European Communities' Resilience and Social Capital |
| **Call:** | H2020-SU-SEC-2018-2019-2020/H2020-SU-SEC-2018 |
| **Start date of project:** | 01.05.2019 |
| **Duration:** | 36 months |
| **Deliverable title:** | BuildERS D4.4 integration of public data bases for identifying highly vulnerable people in need of relief prioritisation by the Estonian Rescue Board |
| **Due date of deliverable:** | 30 April 2021 |
| **Actual date of submission**: | 02 May 2021 |
| **Deliverable Lead Partner**: | University of Tartu |
| **Work Package**: | WP4 |
| **No of Pages**: | 84 |
| **Keywords**: | BuildERS, vulnerability assessment, vulnerability, data-sets, participatory decision-making, preparedness planning, crisis |

Authors and Contributors

| Name | Organisation |
|---|---|
| **Kati Orru** | University of Tartu |
| **Margo Klaos** | Estonian Rescue Board |
| **Kristi Nero** | University of Tartu |
| **Friedrich Gabel** | University of Tübingen |
| **Priit Saar** | Ministry of Economics |
| **Sten Hansson** | University of Tartu |
| **Sten Torpan** | University of Tartu |
| **Edit Tammepõld** | Estonian Rescue Board |
| **Anni Alev** | Estonian Rescue Board |
| **Eva-Johanna Võik (general review)** | Positium Ltd |
| **Johanna Ludvigsen** | TOI |

Dissemination level

| | |
|---|---|
| **PU** | Public |

This project has received funding from the European Union's Horizon2020 research and innovation programme under grant agreement No. 833496

Version History

| Version | **Date** | **Reason** | **Revised by** |
|---|---|---|---|
| 01 | 22.07.2020 | First draft of the case study concept | KO & MK |
| 02 | 22.09.2020 | Ethical revision of the concept | FG |
| 03 | 30.09.2020 | Theoretical overview | KO, KN, ET |
| 04 | 30.09.2020 | Testing of the initial tool, table-top exercise | MK, KO, SH, ST, KN, PS |
| 05 | 01.12.2020 | Analysis of the state of the art in vulnerability assessment in Estonia, interview analysis | KO, MK, KN, ET, AA, PS |
| 06 | 01.02.2021 | Elaboration of the tool, interview analysis | KO, MK, KN |
| 07 | 22.03.2021 | Establishment of Deliverable Structure | KAA & JKE |
| 08 | 30.03.2021 | Writing up the report | KO, KN, MK |
| 09 | 02.04.2021 | Ethical Review | FG |
| 10 | 14.04.2021 | General review | EJV |
| 11 | 30.04.2021 | Final version | KO, MK, KN, FG, SH |
| **Final** | 02.05.2021 | Submitted version | AMH |

This project has received funding from the European Union's Horizon2020 research and innovation programme under grant agreement No. 833496

# Executive Summary

BuildERS Task 4.4. aimed at building a vulnerability assessment tool that brings together the varied factors of vulnerability and their representations in public datasets. To meet this goal, we used Estonian crisis management system as a case study. The vulnerability assessment tool co-created with practitioners in crisis management and social care, follows the dynamic and intersectional perspective on vulnerability and guides relevant stakeholders to systematically think through the possible hazard scenarios, the related factors of vulnerability and the sources of information on these vulnerabilities.

The experiences with a large-scale disruption of electrical supply, COVID-19 pandemic, and a cyber-incident demonstrated how the factors of vulnerability intersect and their impact may be amplified or attenuated by the situational characteristics. The table-top exercise, interviews, and focus groups indicated that the tool effectively broadened the scope of factors considered inducing vulnerability and enabled to narrow the circle of individuals burdened by certain vulnerability mixes. The analysis demonstrates that the tool could be applied to different types of crises and the results can be utilized to enhance preparedness, demand-driven relief and rescue during critical events.

The exercise of matching the vulnerability factors with the relevant indicators in databases indicated that due to the problems with availability and accuracy of data, datasets cannot be relied on for all the relevant information to judge individual capacities to cope in crisis. Nevertheless, the use of databases in interaction carries the potential in obtaining nuanced information to target preparedness building and for planning response to support vulnerable people.

In the application of the tool some key considerations need attention:

- The tool introduces a requirement for a participatory process in the vulnerability assessment to meet the need for diverse society to inscribe their interests and needs into crisis planning. Even with the integration of objective information from datasets, to mitigate subjectivity, vulnerability assessments should be validated among the relevant stakeholders. The frames of who should be engaged at which point need to be elaborated before the adoption of the tool.

- Clarification of institutional mandates and collaboration principles between different authorities and the representatives of diverse society, as well as proper guidance and training is necessary for adopting the vulnerability assessment tool.

- Ethical principles and legal bases need to be established for the processing of personal data (synthesised from different datasets) in vulnerability assessment to safeguard the rights and freedoms of the data subjects, including clarification of the purposes of legitimate data use, access and sharing conditions, user accountability and monitoring criteria.

This project has received funding from the European Union's Horizon2020 research and innovation programme under grant agreement No. 833496

# TABLE OF CONTENTS



This project has received funding from the European Union's Horizon2020 research and innovation programme under grant agreement No. 833496

# LIST OF ACRONYMS

| | |
|---|---|
| AB | Advisory Board |
| BuildERS | Building European Communities Resilience and Social Capital project |
| D | Deliverable |
| DoA | Description of Action |
| WP | Work Package |

This project has received funding from the European Union's Horizon2020 research and innovation programme under grant agreement No. 833496

# LIST OF FIGURES



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

# LIST OF TABLES



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

# 1. INTRODUCTION

The overall focus of the BuildERS project is to help improve government policies aimed at enhancing the disaster resilience of European populations, with a focus on vulnerable people. Improving our understanding of risks and vulnerabilities is one of the cornerstones of resilience building, since knowing about the sources of vulnerability will allow for measures to improve the societal resilience. This report demonstrates the tool that guides crisis managers in collaboration with relevant stakeholders to systematically consider and map out the possible hazard scenarios, the factors of vulnerability, the sources of information on these vulnerabilities, and the possibilities for integrated use of various information sources for identifying vulnerable people in need of support.

This report D4.4 contributes to the following objectives foreseen in Grant Agreement Part B, p. 28: development of tools and guidelines, including field-testing; demonstrations of the tools, techniques or technologies; innovation identification and proof-of-concepts. In particular, the report fulfils T4.4, which aims at elaborating a vulnerability assessment tool that brings together the varied factors of vulnerability and their representations in public datasets. We thus carry out the following tasks:

1. analysis of the need for the vulnerability assessment tool;
2. developing the tool in cooperation with its potential users;
3. empirical testing of the tool's applicability;
4. assessing the tool's suitability to existing crisis management system.

The report introduces the possibilities for combining data from various national registries and existing survey data (and other) to identify vulnerable people with the help of the elaborated vulnerability assessment tool. The tool could be applied to different types of crises and the results can be utilized to enhance preparedness, demand-driven relief and rescue during critical events. The tool can be applied to increase the transparency of decision-making concerning vulnerabilities by laying out which parameters are included in the analysis and which information is involved in the assessment. By foregrounding the principles of engaging the representatives of diverse society including those most affected by vulnerability, the tool can be used to increase the fairness of crisis planning.

The need for a vulnerability assessment tool became clear in BuildERS D2.2 and D2.5 (Orru et al., 2021), which demonstrated the lack of systematic analysis of social vulnerability factors in crisis management and guidelines as one of the key impediments in preparing for and organising recue and support in crisis in many European countries. In elaborating the tool, we have used the Estonian crisis management system and three recent crises caused by man-made and natural hazards as reference conditions, but we suggest that the assessment tool and procedure described in this document can be usefully applied in other European countries, too. The designing of the tool was user-centred and participatory: the future users of the tool, professionals in crisis management and social care, were engaged in the development of the tool and evaluating its usability. To clarify the users' needs and design the tool, we followed the research questions presented in Figure 1. In finding answers to the research questions, we conducted document analysis, expert interviews, table-top exercise and focus groups with actual users or beneficiaries during various stages of the tool elaboration process.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

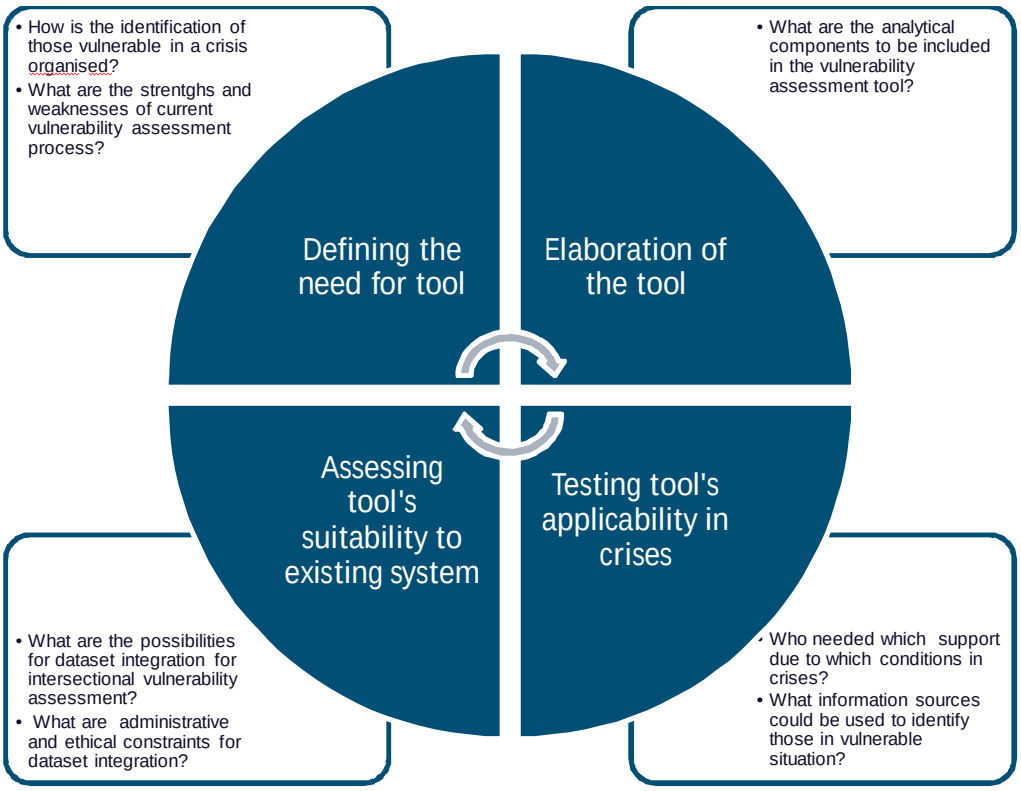


*Figure 1. Elaboration of the tool and the related study questions.*

The D4.4 report will serve as a basis for the subsequent WPs, in particular, the policy recommendations in WP5 and further validation nationally and internationally in WP6.

The report is structured as follows: Section 2 outlines the founding principles of the vulnerability assessment tool. Section 3 summarises the methods that were used in analysing the need for the vulnerability assessment tool; its co-creational development through interviews, case studies, and scenario analyses. Sections 4, 5, and 6 present the results of the study and demonstrate the applicability of the vulnerability assessment tool. We conclude by discussing the innovation potential of the new tool.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

# 2. TARGET: BUILDING A VULNERABILITY ASSESSMENT TOOL

The aim of developing a new vulnerability assessment tool is to systematically identify individuals who may need external support during crises and to use this information to improve the planning and provision of emergency, medical, and social care resources prior, during, and after crises. The tool combines crisis-situation-specific understandings of the vulnerability factors, and the representations of these vulnerability factors (indicators) in different datasets and other sources of information (see process logic in Figure 2).


*Figure 2. Process logic in the elaborated vulnerability assessment tool.*

In the following we will introduce some of the theoretical underpinnings of the vulnerability assessment tool and respond to the second research question on the analytical components to be included in the vulnerability assessment tool.

## 2.1. Theoretical foundations

### 2.1.1 The concept of 'vulnerability'

Vulnerability is generally interpreted as being prone or susceptible to damage or injury (Wisner et al., 2004: 11). Vulnerability refers to an understanding of disasters as not just being the result of an extreme event, but of an extreme event interacting with a vulnerable society (Wisner et al., 2004). BuildERS framework differentiates between two main perspectives on vulnerability.

On the one hand, vulnerability may be seen as an **intrinsic and stable characteristic of an individual, a group or a community**. In this 'vulnerable groups' narrative, vulnerability is cast as a characteristic attribute of certain societal groups due to their specific conditions (Sparf, 2016; Tierney, 2019). According to this view, groups such as disabled persons, elderly or those living in poverty are considered vulnerable and tend to be seen as such not only in specific events but in general. There are also strong arguments against taking such an approach due to its tendency of vulnerability determinism (Gabel, 2019). This approach tends to overlook that those who are often not considered vulnerable might become vulnerable due to certain situations they are in.

On the other hand, vulnerability may be seen as **situational and relative, and thus dynamic**, phenomenon (Hilhorst & Bankoff, 2004; United Nations, 2015). This view argues that vulnerability is often in flux and cannot be reduced to a single metric to classify (Adger, 2006). This dynamic perspective of vulnerability reveals two important aspects of vulnerability: (a) vulnerability is dependent on the exposure to the crisis, the interplay of circumstances and individual conditions including abilities to respond without suffering, and (b) the interplay of different disadvantages which lead to a person being vulnerable, and how these factors of vulnerability change over time (Tierney, 2019). Vulnerability involves "a combination of factors that determine the degree to which someone's life, livelihood, property and other assets are put at risk by a discrete and identifiable event (or series or 'cascade' of such events) in nature and in society"

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

(Wisner et al., 2004: 11). As such, vulnerability can better be understood as a result of intersectional and interdependent factors that produce socially differentiated impacts (Estonian Government Office, 2018). In the elaborated tool, we refer to this situational character of vulnerability.

### 2.1.2 Factors of vulnerability

To reduce vulnerability, it is important to identify what the sources of vulnerability are and how they play out in particular crises. Recent literature suggests that to understand the dynamic nature of vulnerability, the focus should be on the interactions between individual, social-structural, and situational factors that may change over time (Gabel, 2019; Hilhorst & Bankoff, 2004; Wisner, 2016).

- *Individual* factors arise from personal physical, mental, emotional or behavioural conditions that could make it difficult or impossible for individuals to react upon hazards. These also concern the personal conditions like education, previous experiences, social networks and societal status. For example, communication-related individual factors of disaster vulnerability may include sensory impairments which impede hearing or seeing warning messages, and limited skills such as inability to follow the language in which crisis info is shared (Hansson et al., 2020). These aspects influence vulnerability, but not necessarily lead to it, and intertwine with other factors.

- *Social-structural* factors arise from various historically, politically and culturally constructed forms of social inequality, and configurations of policies that exacerbate (or fail to mitigate) these vulnerabilities. These may include factors like the social context of discrimination, but also institutional systems as well as societies' critical infrastructures that are insufficiently equipped to withstand a negative event. For example, communication-related structural factors of disaster vulnerability may include poor communication infrastructure that does not reach all areas, or crisis information provided in a language that some individuals cannot understand (Hansson et al., 2020).

- *Situational* factors are complications that emerge in the specific context of a particular disaster due to a higher risk of being or becoming vulnerable due to the degree of exposure and/or lack of possibilities to mitigate the effects. For example, communication-related complications may occur due to information channels being disrupted in power-cuts caused by storms or wildfires (Hansson et al, 2020), or when people are exposed to false and harmful information, as was the case during the COVID-19 crisis (Hansson et al., 2021).

An i**ntersectional approach** (BuildERS D1.3; Kuran et al., 2020) to vulnerability assessment is needed as one's exposure and the interplay of different disadvantages may lead to a person being differently vulnerable at different points in time and space. This approach helps to differentiate between the specific ways in which structural factors such as socio-economic inequality, inadequate preparedness policies as well as situational and temporal aspects may exacerbate vulnerabilities in, for instance, specific socio-demographic groups. To what extent a person with a certain impairment becomes vulnerable depends on the specific situation (hazard, strength, point in time, duration) but also on existing social structures and the extent to which those empower these persons (Gabel, 2019; Mechanic & Tanner, 2007; United Nations, 2015; Wisner et al., 2004).

BuildERS D1.2 and D1.3 divide factors of vulnerability between primary and secondary (D1.2, 2020: 21 – 25): primary factors of vulnerability those factors which affect directly vulnerability (e.g. sensitivity, exposure), while secondary factors have an impact on primary factors (e.g. age, income, spoken languages). As argued in D1.2, this differentiation can be difficult to be provided empirically. Our vulnerability assessment tool is meant to operationalise these categories following specific crisis circumstances. The tool helps to map out the interaction of individual characteristics, social structures,

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

existing crisis management strategies, and the ways in which they affect the individual capacity to cope with hazards and crises. To systematically consider the multiplicity of factors that may affect the vulnerability, the tool applies the **framework proposed in BuildERS D2.5** (Orru et al., 2021). Based on the analysis of crisis cases, the framework explicates different understandings of vulnerability along the dimensions of human agency and technological structures as well as social support through private relations and state actors (Figure 3).

The model suggests that for a more systematic understanding (assessment and response), the factors of social vulnerability could be categorised across two spectrums: (1) are these primarily stemming human agency and capacities as well as the functionality of the surrounding technological and political structures, and (2) are these a function of the availability of social (material, psycho-social and informational) support through private relations and/or through societal provision (institutional care). In crisis situation, these two spectrums of vulnerability intersect and their impact is amplified or attenuated by the situation characteristics (e.g. individual proximity to hazard area, measures applied in specific situation) (Orru et al., 2021). In the intersecting of two spectrums, four conceptual dimensions of vulnerability factors can be distinguished.

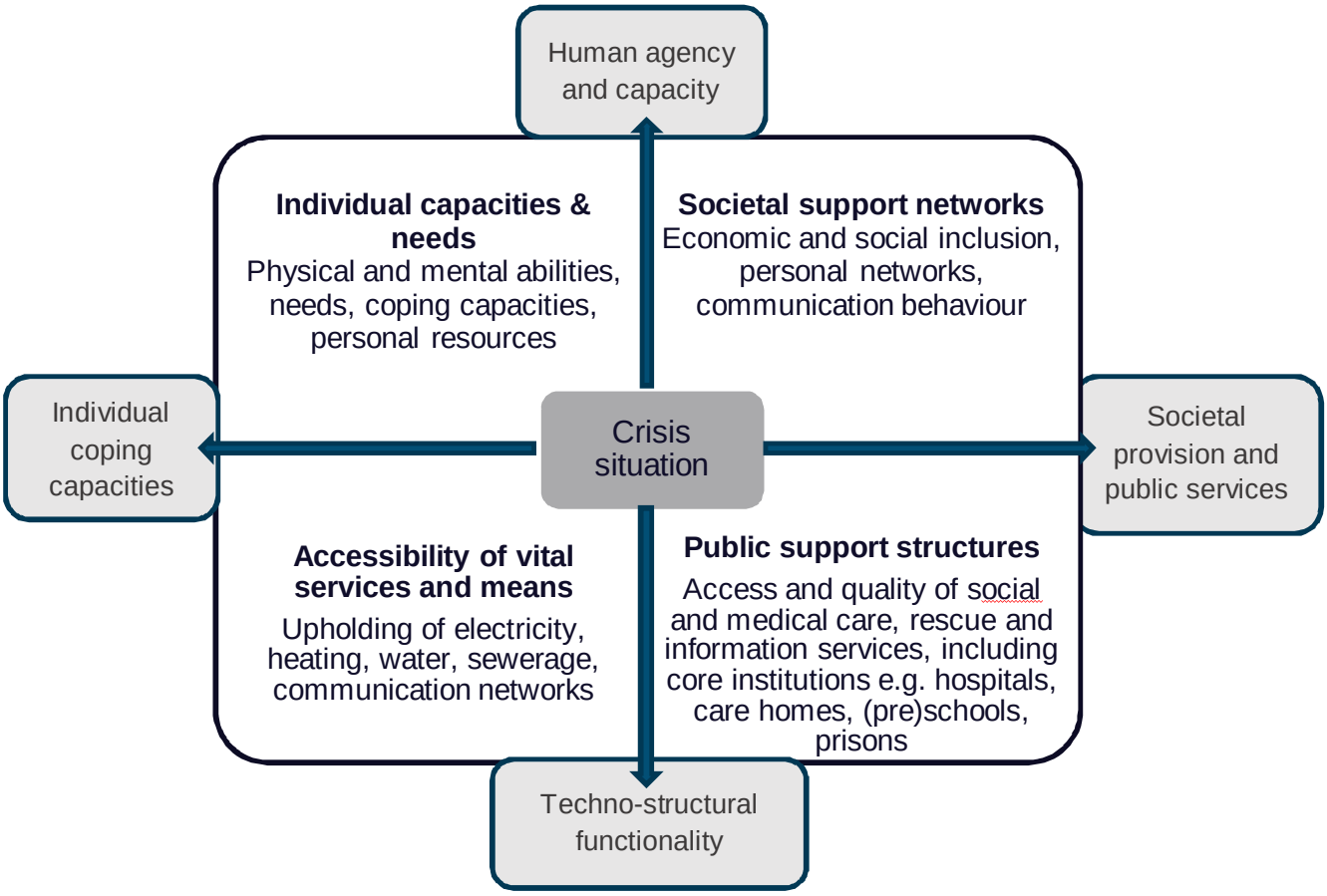


*Figure 3. Conceptual dimensions of 'social vulnerability' in disaster management (Orru et al., 2021).*

The first conceptual dimension of Orru et al. (2021) is the *Individual capacities & needs-dimension*, which focuses on the "The physical, emotional and mental condition, skills and personal resources" of individuals and is characterized by combining the level of "human agency and capacity" as well as the "individual coping capacities" present in a person.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

The second dimension is the *Social support networks-dimension*, which refers to the "Economic and social inclusion, personal networks, communication behaviour". It combines the tiers of both "human agency and capacity" and "societal provision and public services" an individual has access to.

Third dimension, the *Accessibility of vital services and means* describes the capability to uphold "electricity, heating, water, sewerage and communication networks" is located at the intersecting point of "Individual coping capacities" and "Techno-structural functionality" of a society.

The fourth conceptual dimension, the *Public support structures,* is concerned with the "Access and quality of social and medical care, rescue and information services, including core institutions e.g. hospitals, care homes, (pre)schools, prisons…" is placed at the intersection of the "Techno-structural functionality" of a society and its "Societal provision and public services". The vulnerability assessment tool takes the configurations of these dimensions at certain point in time and place as a point of departure in determining the factors of vulnerability in crisis.

### 2.1.3. BuildERS key concepts and the vulnerability assessment tool

The tool stems from the BuildERS framework and most importantly relates to its approach to vulnerability as dynamic and intersectional. It also addresses the key concepts of resilience, social capital and risk awareness.

***Resilience***

BuildERS framework sees resilience as the processes of proactive and/or reactive patterned adjustment and adaptation to crises. As for the resilience that state or organisations can enable, there are important considerations if individuals can expect that the state deals with crises on behalf of the individual or that the state just enables individuals' ability to deal with their own risks. This discussion becomes crucial when the state or an organisation aims at helping vulnerable groups. (D1.2, p.65)

In the process of elaborating the tool, we scrutinise existing measures regarding the equal opportunities of citizens to benefit from the measures to improve resilience (Section 4.1.) and critically examine the benefits of the elaborated vulnerability assessment tool (Section 2, 6 and 7). In analysis of the application of the tool in crisis cases, by understanding circumstances that lead to being vulnerable, we explore what are the circumstances that make people resilient (Section 5). In addition to factors of vulnerability, as one of its analytical components, the tool draws out resilience factors that may mitigate individual vulnerabilities on the community level (e.g. municipal crisis preparedness index).

***Social Capital***

There is a strong linkage between social capital, other types of capital and disadvantaged positions and hierarchies in the social spaces. The outcome of different dimensions of social capital is highly contextual, and outcomes vary, depending on the situation in question and the interaction between specific aspects of social capital with other important socio-economic factors. (D1.2, p. 46)

In the elaborated tool, we address social capital as one complex that shapes resilience and the risk of becoming vulnerable. Social capital, the various forms of private and institutional support networks is what we explore as relevant vulnerability factors in crisis cases. Based on the manifestations of crisis experiences, we define indicators that could depict individuals' social capital in public databases.

***Risk Awareness***

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

BuildERS framework distinguishes risk awareness as a) a collective (groups and communities) acknowledgment about a risk and potential risk preventing and mitigating actions, fostered by risk communication.

In the elaborated tool, risk awareness is considered an aspect of resilience and risk of vulnerability. We address the ways in which information is received, whether and how it is interpreted and acted upon. Access to reliable information, ways of processing it and possibilities to react on it are important from the point of view of an individual at risk of vulnerability as well as from the perspective of informed decisions in institutional response. Risk awareness at all levels is strengthened when information on individuals' vulnerabilities is known or at least approximated, including with the help of the elaborated tool.

### 2.1.4 Approaches to vulnerability assessment

Social vulnerability assessments are used as input to developing mitigation strategies and promoting disaster resilience. There are two key approaches to measuring vulnerability: 1) integrating various quantifiable data into compound indexes, and 2) a more qualitative approach that highlights the temporal and spatial dynamics in the multiple sources of vulnerability and the need for engaging various stakeholder views in assessing vulnerabilities (Wisner et al., 2004). We will briefly introduce these approaches, without attempting to give an exhaustive list of applications.

First, when it comes to more **quantified approaches**, The Hazard-of-Place-Model and the Social-Vulnerability Index (SoVI) are examples of multi-dimensional compounds aimed at identifying the characteristics and experiences of communities and individuals that facilitate responding to and recovering from environmental hazards (Cutter et al., 2003). To quantity and explain social vulnerability, these models consider a variety of variables, such as age, individual economic status, presence of single-sector economy, density of the built-environment, forms and amounts of housing stock and tenancy, race and ethnicity, occupation and infrastructure dependency (Morsut et al., 2020).

As for recent examples of measuring social vulnerability to **particular hazard types**, an index has been elaborated in relation to toxic substances and diseases (Centre for Disease Control and Prevention, USA). The integrated map and CDC Social Vulnerability Index use 15 social factors from census data, including poverty, lack of vehicle access, and crowded housing. The tool is available for the emergency response planners to estimate the requirement of supplies and personnel, plans to evacuate people, accounting their special needs (Agency for Toxic Substances and Disease Registry, 2020).

Social vulnerability indexes have been used to evaluate and **map regional vulnerability** in variety of areas from specific coastal landscape to densely populated cities and nationwide scope (Marzi et al., 2019; Shao et al., 2019; Sherly et al., 2015). A comprehensive disaster resilience index has been compiled on the municipal level across Italy, including indicators like access to services, institutions, housing conditions, cohesion of the community, education, economic resources and environment (Marzi et al., 2019). Such social vulnerability maps can be overlapped with other information on disaster risks. For example, flood zone map and hurricane wind zone map were overlapped with social vulnerability map to assess community vulnerability to floods and hurricanes along the Gulf Coast of the United States (Shao et al., 2019). Data for these analyses is pulled from multiple datasets: from censuses, community surveys, hazard exposers and service providers (Marzi et al., 2019; Shao et al., 2019; Sherly et al., 2015).

Second, more **qualitative approaches** highlight the temporal and spatial dynamics in the multiple sources of vulnerability and the need for **engaging various stakeholder views** to ensure the sensitivity of the assessment to particular contextual factors (Wisner et al., 2004). This approach raises important questions about the possibilities of the representatives of diverse society to inscribe their interests and needs into crisis planning (Hansen, 2000). For example, due to deviant needs and/or impairments people may be

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

marginalised and their interests less heard in planning for disasters (Krüger, 2019). Since crises and disasters amplify discrimination that already exist in daily life, these exclusionary mechanisms cumulate in their effects due to the intersectionality of different but interrelated pattern of discrimination (see also D4.5).

It is therefore important to open up the vulnerability assessment process to individuals with varied experiences. Participatory vulnerability assessment methodologies foresee the need to consider the multiplicity of parameters: the various exposures, sensitivities, and adaptive capacities that may be changing over time, depending on the evolution of the hazards (Wisner et al., 2004). The Sendai Framework dedicates a section on the "Role of Stakeholders" highlighting the need for synergies between different actors in identifying the sources of vulnerability as well as its mitigation strategies. As for the mechanisms of inclusion, community participation discussions have been highlighted in disaster literature (see e.g. Raju & da Costa, 2018).

The vulnerability assessment tool that we propose highlights the value of both the quantified as well as qualitative approaches of vulnerability as basis of assessment.

## 2.2. Components of the vulnerability assessment tool

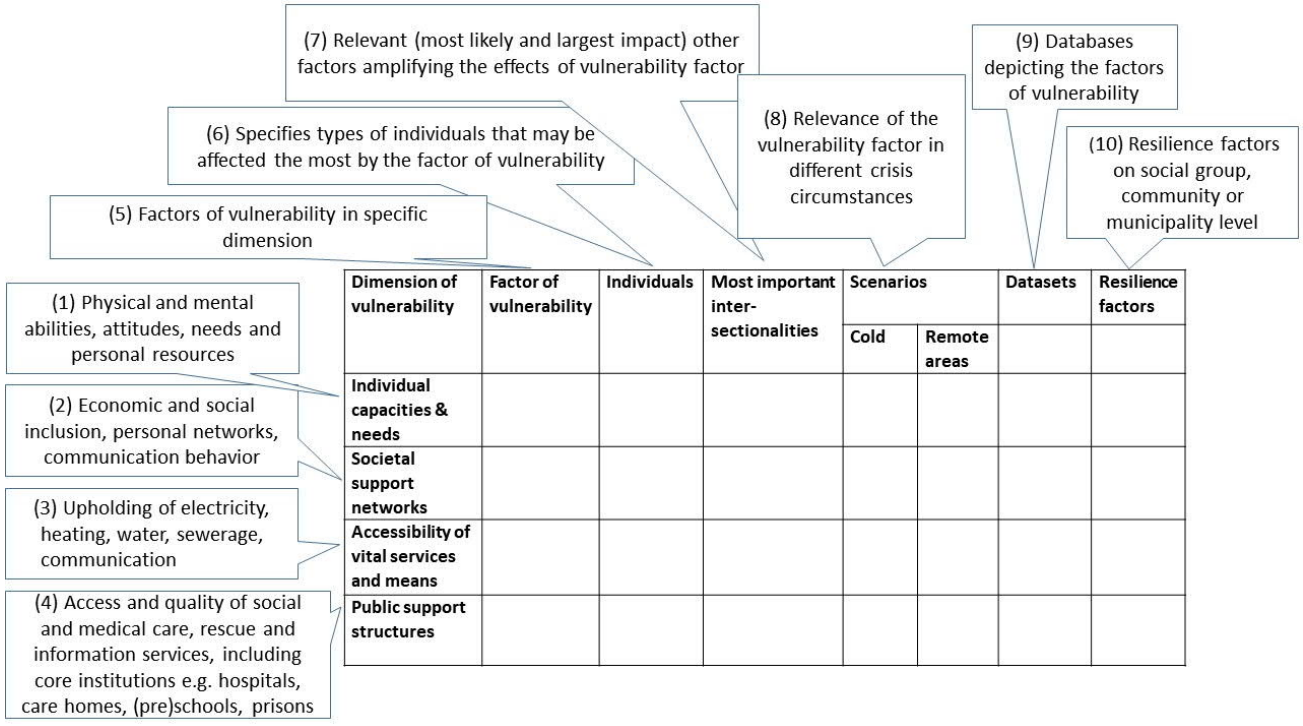


*Figure 4. Parts of the vulnerability assessment tool.*

The following describes the way the vulnerability assessment tool is programmed and the parameters and factors that are taken into account in the process. The tool is a result of synthesis of the theoretical work done in BuildERS, explorative studies in T2.2 (Orru et al. 2021) and the refinement through empirical testing and co-creation with relevant stakeholders (see Methodology chapter). As the tool is still going through the validation in BuildERS WP6, we outline its premises while remaining open for further discussion concerning its analytical components and the information (data) that is fed into decision-making with the help of this tool.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

### 2.2.1 Hazard situation

The tool takes a particular crisis situation as the starting point. The tool may be applied in:

(a) a factual hazard situation with its real-life parameters determining the exposures, sensitivities, coping/adaptive capacities;

(b) a hypothetical hazard situation that evolves into a crisis with the specific circumstances foreseen by the "worst case scenarios" often used in crisis planning.

Be it real-life circumstances or the scenario-based modelling, the particular circumstances shape the configurations of hazard exposure, coping and/or adaptive capacities in individuals. These situational characteristics determine which factors of vulnerability play which role in inhibiting individuals' resilience, and thus, which factors need to be taken into account in the vulnerability assessment tool. With the help of this tool, crisis managers in collaboration with relevant stakeholders are guided to systematically think through the possible hazard scenarios, the considered factors of vulnerability and the sources of information on these vulnerabilities. This preparedness work (b) is a precondition for updating the vulnerability assessments *in situ* (a). To improve the representation of situational components, representatives of various stakeholders with their information on the geospatial, physical, as well as socio-structural conditions need to be involved in crisis management decision-making during the planning phase as well as in times of disaster. The tool can be incorporated into risk analysis for crisis management plans as well as into (table-top) exercises and simulations that involve vulnerability assessment.

The tool aims to bring more transparency to the process of identifying (most) vulnerable by laying open which information sources and whose perspectives are included in crisis-related decision-making. This transparency allows for an identification of limitations and necessary adjustments to fulfil the aim for the tool. For fair representation of possible impacts on varied groups, the perspectives of those most vulnerable should be included in the assessment process. Disaster management view is not able to cover the variety of lived experiences. The decision-making should be opened up to the members of a diverse society, particularly those who might be most affected by specific vulnerability factors.

The hazard situation and its derivations in scenarios define which factors of vulnerability may appear, which individuals these may burden, and what could be the sources of information on these affected individuals.

### 2.2.2 Four dimensions of vulnerability factors

Following the definitions of vulnerability and its shaping factors laid out in Section 2.1., the tool uses the categorisation of factors of vulnerability provided by Orru et al. (2021). The tool guides users in distinguishing following dimensions of vulnerability factors (as also depicted on Figure 4):

(1) **Individual capacities & needs** including physical and mental abilities, training/education, attitudes, needs, coping capacities and personal resources. This dimension refers to physical and mental abilities to take care of one-self on everyday basis as well as in a situation, when the person is cut away from usual supportive structures (e.g. electricity, communication, care provision) or when it is necessary to evacuate. This may also relate to abilities to follow risk information (literacy and language skills), risk awareness and attitudes, including trust in authorities, crisis management skills, and the implemented preparedness measures.

(2) **Societal support networks** involving economic and social inclusion, personal networks, communication behaviour. This dimension addresses the social and economic capital held by a

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

respondent (Bourdieu, 1997; BuildERS D1.2) the factors that concern the individual ties with family and friends, with community or even representatives of authority; the engagement in economic and social life in various ways reflecting the status of a person in society. This also concerns the routines of communicating: the ways and sources of receiving and sharing information and interpretations with close community or society at large.

(3) **Accessibility of vital services** including upholding of electricity, heating, water, sewerage, communication networks as well as private means (e.g. car, secondary home). This dimension concerns the technological capacities and infrastructures that support everyday life and the disruption of which may lead to a disaster or further complicate a multi-crisis event. Both public provision of this technological support as well as private material and technological means for self-sufficiency (e.g. alternatives to electricity-dependent heating) or being able to receive support (e.g. radio with batteries to stay informed) are relevant here.

(4) **Public support structures** that grant access and quality of social and medical care, rescue and information services, including core institutions e.g. hospitals, care homes, (pre)schools, prisons. This dimension concerns the official reaction of the institutions tasked with offering support during disasters (or also on everyday basis). This concerns the accessibility of the public services aimed at providing medical care and rescue services, social and psychological care, public information services, appropriate provisions to people that are under care, supervision or curfew. The dimension also refers to how the services are tailored taking into account the various needs of individuals.

The four dimensions of vulnerability factors intersect in unique ways in particular situation. For example, the vulnerability factors stemming from “Individual capacities & needs”, may be aggravated (or also compensated in case of strong resilience in this factor) by the vulnerability factors in e.g. “Public support structures” and *vice versa*. Depending on the crisis situation or the scenario, each of the dimensions and the underlying vulnerability factors need to be carefully considered. The tool guides in scrutinising the relevance of a multiplicity of factors and their interrelations in order to avoid blind-spots and to get a comprehensive overview of the possible sources of vulnerability.

### 2.2.3 Individuals affected by vulnerability factors

The key analysis unit in the tool is the individuals affected by particular factors that influence vulnerability. Therefore, each row in the tool depicts one factor of vulnerability and the individuals that are burdened with this vulnerability factor (see Table 1). For example, in case of the disruption of electrical supply, in the “accessibility of vital services and means” dimension, one of the vulnerability factors is the electricity-dependent heating. The particular individuals that may be hampered due to this factor involve the clients of central heating and users of private electricity-dependent heating systems. Following the same row concerning particular individuals, next, most important intersectionalities are brought out to specify other key factors that may aggravate these individuals’ conditions (abilities to cope). Next, these individuals’ coping capacities in scenarios are assessed. In the final cell of the row, the possible information sources depicting the vulnerability factor are brought out.

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No. 833496

*Table 1 . Example of the operationalisation of the factors of vulnerability under the dimension "Accessibility of vital services and means"*

| Dimension of vulnerability | Factors of vulnerability | Individuals | Most important inter-sectionalities to be considered | Scenarios | | Datasets and other information sources | Resilience factors |
|---|---|---|---|---|---|---|---|
| | | | | Cold | Remote areas | | |
| Accessibility of vital services and means - Upholding of electricity, heating, water, sewerage, communication networks | Electricity-dependent heating | Clients of central/communal heating | External help needed on everyday basis; Families with small children; Availability of means to evacuate | ↑ | ↓ | Client list of service providers | |
| | | Users of private electricity-dependent heating systems | | ↑ | ↑ | Register of Construction Works | |
| | … | | | | | | |

### 2.2.4 Intersecting factors of vulnerability

**Factors of vulnerability (5)** column depicts the factors of vulnerability distinguished among multiplicity of factors in the broader vulnerability dimension in a particular (hypothetical) crisis situation. The users of the tool are guided to estimate the relevance of these factors by the likelihood and magnitude of the factor's effect on individuals. The factors with the highest risk score should be involved as the vulnerability factor. The vulnerability factor's effect may appear particularly in individuals in circumstances determined by other factors. Therefore, the tool guides in bringing out most significant intersecting factors (7) that help to specify the impacts and narrow the circle of the most burdened people.

The factors of vulnerability concern anyone, but the degree to which each individual is affected by the vulnerability factor may differ to a large extent. The tool guides its users to consider which **individuals (6)**, are burdened with specific factors stemming from the circumstances where the individual lies**.** Specifying the types of individuals that may be affected the most by these factors of vulnerability in particular crisis enables to harness the tool in responding to the needs of individuals, whose coping is most hindered due to the factor.

The tool takes into consideration the factors which are assessed to be the **most important intersecting factors** that aggravate the conditions created by the vulnerability factor in case of certain individuals **(7).** As indicated above, the factors of vulnerability intersect in concrete crisis situations in individual configurations. However, as with the vulnerability factors, not all the dimensions and intersecting factors are equally relevant for the specific types of individuals. The tool guides users in estimating the relevance of these intersecting factors by the likelihood and magnitude of the factor's effect in amplifying the primary vulnerability factor in certain individuals. The factors with the highest relevance should be involved when combining (intersecting) various factors of vulnerability in the assessment process.

In the example given in Table 1, "Electricity-dependent heating" is the primary factor, and other key factors that amplify the effect of this primary factors could be:

- "The need for external help on everyday basis" - their abilities to cope are further impeded, when their home starts to cool down;
- "Families with small children" - whereas a family may be well-functioning on everyday basis, the conditions may become health-threatening without heating;

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

- "Availability of means to evacuate" - the person has no means (access to car) to evacuate or nowhere (e.g. a second home/summerhouse) to leave for instead of the cooling home.

Combining the primary and the intersecting vulnerability factors allows for narrowing the circle of people that correspond to these vulnerability parameters.

### 2.2.5 Scenario analysis

The relevance of the vulnerability factors may change if the **base scenario changes and different crisis circumstances come into play (8).** Therefore, the tool helps to assess the dynamics in vulnerability factors in case certain contextual parameters are changed. The scenario conditions may be selected based on risk analyses ("the worst-case scenario") and/or the experiences of these conditions posing hazard exposures and exceeding coping capacities. Stakeholders from different spheres of crisis management, including those who might be most affected by specific vulnerability factors, should be involved in evaluating the relevance of the specific scenario conditions.

In our case study validation for the disruption of electrical supply and Covid-19 pandemic, for example, we used scenarios where the crises would have taken place in cold weather conditions (-10˚C) and in a remote area.

Following an example given in Table 1, the coping capacities of "Clients of central/communal heating" or the "Users of private electricity dependent heating systems" drastically decrease in cold weather. However, compared to more central geographic locations, in remote areas, the "Clients of central/communal heating", would be more affected as these house-unions are less likely to have gasoline-based electricity generators to keep up the heat circulation.

Depending on the type of hazard, its particular geo-spatial, physical and socio-structural context, the relevant scenario conditions may differ. For example, the time of the day may be an important consideration as it significantly affects the conditions in transport emergencies involving trucks with hazardous substances during rush hour, or in case of need for speedy warning at night-time, when individuals are asleep and do not follow news.

### 2.2.6 Sources of information on vulnerability

The tool guides connecting the factors of vulnerability, the affected individuals with **specific databases, other information sources and their represented indicators depicting the factors of vulnerability (9).** For example, in our case study presented in Chapter 4 below, we identified the datasets and information sources used in Estonian crisis management system and point out some sources that are currently under-utilised. Similar information sources could be identified in other countries. The selection of information sources, including datasets to depict vulnerability, should be carried out in co-operation with affected stakeholders beyond crisis managers.

For each individual at risk of falling into vulnerable situation according to certain (intersected) parameters, **resilience factors can be connected on a social group, community-level or municipality level (10).** The information on crisis-preparedness in communities and municipalities (e.g. crisis-preparedness index compiled in Estonia) indicate the community-level or administrative resilience, which may alleviate the effect of vulnerabilities in certain individuals (see Section 4.3).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

## 2.3. Benefits and risks of using the vulnerability assessment tool

### 2.3.1 Better identification of vulnerable people

The vulnerability assessment tool enables attaining at least three types of information that can be used in different stages of crisis management.

1. First, the intersecting of vulnerability factors allows for specifying who needs what kind of support. This information gives qualitative guidance on the **types of individuals** to whom the resilience building activities and support in crisis response or recovery could be targeted. Rescue, medical, and social care providers can use this information to plan their emergency response capacities, while policy makers can feed this into tailoring policy measures that would empower vulnerable individuals. For instance, the application of the tool may indicate areas where people might not understand evacuation guidelines, and this information could be used to adjust the content and/or form of the guidelines to meet the needs of these people.

2. Second, if the qualitative understanding of vulnerability factors is further linked to specific datasets, it will become possible to **estimate the number of people** affected by some factors of vulnerability. By including geo-physical information on hazard and the population location data (e.g. mobile positioning data), situation-specific estimates can be attained. This analysis can also feed into predicting the resource needs for rescue and care organisations prior crisis (e.g. means for evacuation). To organize help and support to the vulnerable individuals (possible victims), the tool enables to assess vulnerability factors and set priorities for (over)burdened individuals during the preparedness phase. This may also speed up decision-making during crisis response.

3. Third, in case the information in datasets is connected to **identifiable individuals**, this personalised data can be used for reaching out to certain individuals. This personalised information may be useful in crisis situations when scarce resources need to be targeted promptly. The use of personalised information raises several ethical and law concerns, which we will address later in Sections 6.3 and 6.4.

### 2.3.2 Fairness and transparency of vulnerability assessment

The application of the tool improves the transparency and fairness of vulnerability assessment.

First, the tool aims to increase the **transparency of decision-making** concerning vulnerabilities. As we will show in our analysis in Section 4.1, the assessment of vulnerability may be often confined to a small circle of officials who happen to be on duty at the time of a crisis. The information sources they use while making decisions concerning the individuals in need of support are often not clear. Thus, there is a need for more clarity in the decision-making process over which parameters to include in the analysis and which data to involve in the assessment.

We propose our assessment tool in response to the Sendai Framework's call for more transparency in the information-basis for decisions "to address existing challenges and prepare for future ones by focusing on monitoring, assessing and understanding disaster risk and sharing such information and on how it is created; strengthening disaster risk governance and coordination across relevant institutions and sectors and the full and meaningful participation of relevant stakeholders at appropriate levels" (UN, 2015: 11).

Second, the application of our proposed tool could ideally improve the **possibilities for individuals and diverse societal groups to participate** in decision-making concerning risks and crises. The lack of

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

inclusivity in disaster management has been pointed out as one of the causes for vulnerability of people with disabilities (Alexander, 2015). More inclusive crisis planning is one way to mitigate vulnerability. As a result of more inclusive decision-making process, broader validation of the vulnerability factors is reached compared to what is achieved based on the expertise from single field (e.g. a social worker with her routine client list). Thus, in addition to increasing the procedural fairness in decision-making, the application of the proposed tool could lead to a fairer allocation of resources for mitigating vulnerabilities.

Regarding fairness, the two key considerations are:

1. Who defines the vulnerability factors pertaining to vulnerability dimensions and the intersecting factors?
2. Who determines which data should be used to represent the vulnerability factors?

The tool foresees that vulnerability is assessed as a participatory process, engaging also the representatives of those considered to be the most vulnerable and those who might be most affected by specific vulnerability factors. The Sendai Framework highlights the need for engagement of women, children and youth, persons with disabilities and their organisations, the elderly, indigenous peoples, and migrants (United Nations, 2015). However, this should include a diverse society because disaster management personnel cannot possibly have a comprehensive view on the exposures, sensitivities and adaptive capacities in various situations. The disaster managers should guide the process but open up the decision-making also to affected stakeholders. Some of the key steps in the process of analysing vulnerability and enabling to participate in the related decision-making are laid out in D1.3. Based on the experiences from our case study, we discuss some of the opportunities table-top exercises may offer with regard to engaging stakeholders from diverse backgrounds (Section 3; 7; more in-depth analysis is forthcoming by Orru et al in a separate publication).

### 2.3.3 More targeted crisis management

The elaborated vulnerability assessment tool offers several opportunities for more targeted crisis management in its various phases.

1. In planning and preparedness building, the tool addresses the issue of lacking guidance for assessing vulnerability and the evidence-based planning for means (no overview of the vulnerable; no resources to offer support) to prepare for crisis on the individual as well as on the responsible institutions' level. With better understanding based on the vulnerability assessment tool, the concerned individuals can take precautionary measures, and support can be provided accordingly. On the responsible institutions side, auxiliary resources can be made available in an integrated manner,
2. During a crisis, vulnerable people need special protection. The assessment allows for better planning and targeted allocation of resources to rescue or evacuate individuals in need of support. Improved understanding of individuals in vulnerable situation facilitates coordination of efforts between governmental first responders' agencies, NGOs and the individuals.
3. In the recovery phase, people who have higher social vulnerabilities need more support in the recovery phase. It is important to analyse which groups suffered more and what were the reasons for this. That helps to find the main determinants that cause greater vulnerability (fragile physical environment, poor living conditions etc.).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

### 2.3.4 Risks related to applying vulnerability assessment tools

Next to these important opportunities, some key aspects need careful consideration when applying the tool:

- Due to the unpredictability of crises, prior assessment of vulnerabilities cannot be complete and involve all possible scenarios. However, matrix design of the tool enables fast, comprehensive and easy to grasp overview of the factors that need to be considered as potential sources of vulnerability. The speed of identification of people in need of support depends on the quality of preparedness-work.

- The quality of vulnerability assessment achieved by using the tool is affected by the quality of information that is used in the decision-making. To address the questions on accuracy and timeliness of information, engaging multiple sources of information is necessary.

- Considering individuals' legal and ethical rights is essential in every phase of implementing the vulnerability assessment tool. The possible infringement of privacy in using personal information in crisis response must be proportionate to the degree of risk to life.

- Even with the integration of objective information from datasets, assessing persons' need for assistance remains somewhat subjective and dependent on the range of stakeholders (and their experiences and capacities) engaged in the decision-making process. The round of relevant stakeholders may depend on the crisis where the tool is used (e.g. timeframe, type of crisis). The frames of reaching decisions on who should be engaged at which point need to be elaborated before the adoption of the tool.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

# 3. METHODS

In the following, we introduce the methods applied in the iterative process of elaborating and testing the vulnerability assessment tool.

In the elaboration of our tool, we have taken as a case study Estonia - a former 'Eastern bloc' democratic state, with relatively high socio-economic inequality (OECD, 2020) and recent experiences with several man-made and natural disasters. The decentralised crisis management system in Estonia, like in many other EU countries, lacks applications for social and societal vulnerability assessment (Orru et al., 2021).

In the development of the vulnerability assessment tool we have taken a user-centred and co-creational design approach. The user-centred design is based on the understanding of the users' needs, priorities and experiences in order to increase the application's usefulness and usability. Therefore, in the design of the tool, the usability goals, application context, and workflow of a product or process are given extensive attention.

In the co-creative design, the future users are invited to cooperate with designers, researchers, and developers during an innovation process (Trischler et al., 2018). Professionals from authorities and organisations involved in crisis management and social care participated throughout several stages: the initial exploration and problem definition, proposing ideas for solution, and evaluating suggested solutions. To gain a better understanding of the use and usability of the tool, we have conducted investigations in the form of document analysis, expert interviews, table-top exercise and focus groups with actual users or beneficiaries during each stage of the tool elaboration process. An overview of study methods used in various stages of tool elaboration is given in Table 1.

*Table 2. Study methods used in various stages of tool elaboration*

| **Tool development phase** | **Study questions** | **Methods** |
|---|---|---|
| **Defining the need for vulnerability analysis tools** | How is the identification of those vulnerable in a crisis organised in Estonia?<br>- Definitions, responsibilities, coordination.<br>- Experiences from past crises | Document analysis<br>Expert interviews |
| **Elaboration of the initial tool** | What are the analytical components to be included in the vulnerability assessment tool?<br>- Factors of vulnerability<br>- Intersectionality<br>- Information sources, including datasets where indicators of vulnerability could be found | Literature review<br>Expert interviews |
| **Testing the applicability of the tool in various crisis cases** | Which individuals need support due to which factors?<br>- Change in factors of vulnerability in different scenarios<br>- Sources of information, including datasets to identify those in vulnerable situation | Expert interviews<br>Crisis case analyses<br>Scenario analysis<br>Table-top exercises |
| **Assessing the suitability of the tool for the crisis management system** | What could be the role of the tool in crisis management system?<br>- Applicability of information sources, databases<br>What are the possibilities for dataset integration for intersectional vulnerability assessment?<br>- Ethical, judicial, administrative constraints and opportunities? | Document analysis<br>Expert interviews in government agencies<br>Focus groups |

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

## 3.1 Desk research

Data for the document analysis included legal acts and regulatory documents, official policies/strategies, reports produced by think-tanks, research institutions, and NGOs as well as news media reports. We scoped for documents concerning crisis management. We scrutinised them for the following three study themes:

a) sources of vulnerability: the factors that have made individuals more vulnerable and how these may have varied in different scenarios;

b) obligation to identify those in need: whose task is it to take care of those in need of support; strengths and weaknesses in current arrangements in identifying and responding to those in need of support;

c) information sources used to find out about those in need of support; application of datasets to find out about those in need of support; strengths and weaknesses of using merged databased for identifying those in need of support.

As part of the document analysis we also explored various databases that could be used as sources of indicators of vulnerability. In selection of the databases we based on Research Team's expert understanding and interviews with practitioners. We analysed the accessibility and user conditions for using the information stored in datasets.

## 3.2 Expert interviews

22 semi-structured interviews and two focus groups with practitioners and experts in the fields of crisis management, data protection and social/ medical vulnerabilities were carried out to complement the data gathered via desk research, addressing the same analytical themes as in document analysis. Interviews were conducted with public officials working in national government bodies tasked with disaster management, managing state information systems, data protection and social/ medical vulnerabilities as well as representatives of non-government organisations involved in crisis management. Interviewed stakeholders include e.g. municipalities, Estonian Rescue Board, medical care, Health Board, Police, Social Protection Agency, Statistics Board, State Information Agency, Data Protection Inspection etc. Interviews were conducted from May 2020 to February 2021. The interview guide is provided in Annex 1 and the list of interviews in Annex 2.

Conducting an expert interview is often the most effective way for obtaining information about decision makers and decision-making processes when the respondent is the expert in the topic at hand (Burnham et al., 2008). Interviewees were determined according to their specialisation and professional status. Interviewees were selected based on document analysis and by applying the 'snowballing' technique whereby informants guided researchers on to other relevant informants (Brace-Govan, 2004).

During the interviews, we aimed to avoid the term 'vulnerability' as much as possible to reduce the possible effects of prejudices, stereotypes and biases, and focused on specific situations and challenges people have had to overcome. Interviews generally lasted for an hour or up to 90 minutes. Interviews were fully transcribed. We then conducted qualitative thematic content analysis (Nowell et al., 2017) along the ways in which vulnerabilities were defined and treated, and if and how information sources, including (merged) datasets could be employed in crisis preparedness as well as response.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

## 3.3 Crisis cases

We tested the tool in three crises that illustrate how the factors of vulnerability have played out, and what are sources of information to identify those in need of extra support. We considered recent natural as well as man-made crises that exemplify the variety of sources of vulnerability.

First, we looked at the **disruption of electrical supply** due to a major storm in South-Eastern Estonia in October 2019. The case exemplifies the extreme weather event caused loss of vital services. The focus on this type of events is highly relevant as it exemplifies the pervasive effect of the power-cut on all the electricity-dependent vital services like heating, drinking water and sewerage, gasoline supply. Such repercussions are particularly relevant when they coincide with cold weather conditions (e.g. -10°C). The power-cut during a storm also exemplifies the increasing vulnerabilities to slow onset extreme weather events (e.g. storm surges, flash floods, heatwaves) that lead to high costs on human health and well-being (Grafakos et al., 2020; Hunt & Watkiss, 2011).

Second, we explored the **COVID-19 pandemic** in Estonia. While primarily a health-care crisis, the broader impacts of social distancing measures led to a perpetuating multi-crisis. It has clearly demonstrated that the pre-existing systemic inequalities in societies are proliferated during crises: e.g lower income segments have had higher infection rates due to fewer possibilities to work from home or poorer access to tests (Chang et al., 2021; Shadmi et al., 2020). Even in countries with a strong welfare system, risk information and official warnings have not been accessible to homeless, non-native language-speakers or individuals with mental disorders, and novel telehealth and online learning services are not accessible to everyone either (Shadmi et al., 2020).

Third, we studied a **cyber-incident** in Estonia in November 2020. We look at the vulnerabilities brought along with a cyber-incident on government ministries. The hackers obtained personal data via the attacks, including infectious diseases information hacked from the Health Board's information system. The e-services is described as an increasing and all-encompassing source of vulnerability in Estonia (Estonian Government Office, 2017). In the world as a whole, the trend of intentional disruptions of service availability that may result from overloading or otherwise damaging the system or network connection-denial-of-service attacks in 2020 rose tremendously, both in terms of numbers and impact (Interview at Social Insurance Board, 2020).

The elaborated tool incorporates the scenario analysis. Also in the analysis of crisis cases we combined scenario analysis. Scenario analyses are used to consider developments and impacts in a hypothetical situation, to explore the effects on specific aspects of the developments (Hassani, 2016). To model the evolvement of vulnerabilities in various situations, we used scenario analysis during expert interviews, the table-top exercise and in the analysis of crisis cases. For the cases of disruption of electrical supply and Covid-19 pandemic, we tested out two scenarios: a crisis unfolding (a) in cold weather (-10°C) and (b) in remote sparsely populated rural areas. These scenarios were selected on the basis of high relevance in Estonian context (see more for the selection of scenarios in Section 2.2.).

In case of the cyber-attack, where the personal data of Covid-19 infected and close contacts were obtained by the hacker, we tested scenarios where (a) the stolen data was used for blackmailing and (b) where the content of the data was changed (attack on integrity). Hackers could possibly sell the health data on the dark web or just leak it openly for creating confusion. This means that the potential circle of people, who could use the personal data for malevolent purposes, increases significantly. For the rightful owners of the health data, this could lay the basis future blackmailing or harassment (Floyd et al., 2016; Khan & Hoque, 2016). Another way of harming the data owners (former or current patients) is damaging the medical data integrity (Pandey et al., 2020). If not discovered immediately, altered or deleted data could lead to loss of

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

valuable knowledge and experience, and in worst cases to loss of life or harm to health (e.g., altered blood type or allergy data).

## 3.4 Table-top exercise

We explored the process of engaging various stakeholders in the vulnerability assessment through a table-top exercise. On the 30th of September 2020, a large-scale table-top exercise was organized by the research team and Estonian Rescue Board. The focus of the exercise was on identifying possible vulnerable people in emergency situations and determining possibilities to identify them using various information sources, including databases. More than 40 participants were divided into 5 groups depending on their field of expertise: Groups combined experts from the fields of crisis management, social protection, health care and information systems, as well as local government representatives (see groups in Annex 3).

Table-top exercise played through an emergency situation caused by disruption of vital services (electricity and other services dependent on it: water supply, central heating) in extraordinary weather conditions. The focus throughout the process was on defining the most vulnerable people, determining the ways to get information about their numbers, location etc. using available databases (including mobile positioning). The preliminary version of the vulnerability assessment tool was included to structure the discussion around three key themes:

- how could the profile of vulnerable groups change over time when the disruption of vital services is long-term (Scenario analysis),
- how to take into account factors such as seasons/weather conditions, population density, people's language skills, and other factors,
- how all this affects crisis managers' need for data on vulnerability factors and the affected individuals.

Furthermore, the order of priority of support provision and evacuation of vulnerable people and notifying them about the situation without the possibility to use usual official information channels. As a result, participants put forward practical solutions and policy recommendations for enhancing approaches and tools for reaching vulnerable groups.

In the process of developing the tool, the methods laid out have been used iteratively in elaborating and testing the vulnerability assessment tool. Whereas we started out with the initial testing of the tool in the Table-top exercise, we gained further feedback on its relevance and the incorporated parameters via expert interviews. The document analysis, table-top exercise and interviews with crisis managers on regional and local level fed into the assessment of the tools applicability to various crises. In the analysis of the information sources on vulnerability factors and the possibilities of their integrated use, we relied on document analysis and interviews with representatives of government authorities.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

# 4. RESULTS: TOWARDS A MORE COMPREHENSIVE UNDERSTANDING OF VULNERABILITY

In this chapter, we explore why a better vulnerability assessment tool might be needed in crisis reduction and management. Based on the document analysis and expert interviews carried out in Estonia, we seek answers to two questions: How is the identification of those vulnerable in a crisis organised and what are the strengths, weaknesses of the current practices? Which information sources could be further employed in identifying vulnerable individuals?

## 4.1. How is the identification of vulnerable individuals organised

In Estonia, the pre-crisis identification of risks and possible consequences, and preparing for the emergency, are currently organized using risk assessments and response plans. Whereas the municipal authorities focus on the continuity of local vital services and coordinating the resolution of an emergency in their area, the state authorities focus on events that can lead to the development of the state-wide crisis and discontinuity of vital services, and the respective coordination of the resolution of an emergency. The emergency risk assessment and emergency response plans foresee, based on prior assessments, which could be the effects on local vital services and how to overcome these effects (Emergency Act, 2020). Risk analysis methodologies provide estimates of the number of fatalities and injuries and the number of people in need of evacuation (Interview at Estonian Rescue Board, 2021).

However, according to the Emergency Act (2020), risk analyses and emergency management plans do not foresee the need for assessment of social vulnerabilities or the factors leading to it. The lack of clear responsibilities and guidelines for vulnerability assessment that could feed into the prioritisation of support needs was problematized in interviews for several reasons:

- Lack of comprehensive overview of what could be the possible sources of vulnerability in various hazard situations (Interviews at City government, 2020; Police and Border Guard Board, 2020; Rescue Board, 2020b). Local government specialists are expected to know about social vulnerabilities of their residents. However as described by the Tartu City Government representative, defining vulnerable individuals is “an almost insurmountable task” as described by the member of, “I do not dare to say that we will reach all in the lack of overview of who could be vulnerable in particular situation”.

- Support provision primarily relies on individuals’ requests for help. In crisis response, this undermines the equal opportunities for lawful right of support among those individuals who may no longer be able to call for help (Interviews at City government, 2020; Police and Border Guard Board, 2020; Rescue Board, 2020b).

- During emergencies, there is little time to explore what kind of support different groups may need and whose responsibility is to identify and reach out to them (Interview at Health Board, 2021). Estimates of how many people are in the region and what is their profile in terms of support needs are crucial for rapid response.

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No. 833496

Interviewed professionals brought out three main **reasons for the lack of vulnerability assessments**.

1. Crisis planning, including the mapping of those who might become vulnerable is impeded due to unclear division of responsibilities and collaboration principles between the state and municipal authorities (Interview at Health Board, 2021). The Local Government Organisation Act (Burnham et al., 2008) stipulates that municipal government is responsible for social care. According to the Emergency Act (Emergency Act, 2020) these responsibilities are carried on to the times of crisis. However, the local governments' responsibilities are not operationally tied to preparing or handling crisis. "The letter of law itself has not given enough incentives to build up a system for the times of crisis in municipalities. The current Covid-19 crisis highlights that the people on their territory are the concern of municipal authority during crisis" (Interview at Rescue Board, 2021).

2. There is an issue of expert resources to carry out such assessments as in current state authorities and municipal arrangements, there is no official position designated for social vulnerabilities in crisis planning (Interview at Police and Border Guard Board, 2020). Local governments do not always possess sufficient information about their residents as their access to national databases is limited. This restrains detection of vulnerable people who have not been on the radar of social workers but need help or prompt evacuation in crisis situation.

3. The lack of major crisis events (until the crisis events under consideration in this analysis) as practical experience was mentioned in the interviews as undermining the motivation for better mapping the social vulnerabilities in crisis.

In conclusion, current crisis management regulations in Estonia, including risk assessments and response plans, do not address social vulnerabilities. Lack of clear responsibilities, guidelines, capacities and information hinder identification of individuals in need of support in emergencies.

## 4.2. Which information sources are currently used

In the lack of vulnerability assessments, various information sources are used in practice in crisis. We could identify the individual "who shouts the loudest", local support networks, social workers, and other state institutions as the most relevant information sources. We bring out strengths and weaknesses for the information sources described by the interviewed experts.

### 4.2.1 Individual requests for help

In practical crisis management, the prioritisation on to whom to offer help is based on the individuals' requests for help. This reflects the individual self-assessment of their capacities to handle the situation. The logic of offering help when it is asked for is substantiated with the principle prevailing in the social care: it is individual's responsibility to ask for help – no one should impose it (Interview at City government, 2020). Two key issues with offering help only to those who are able to ask for it were mentioned:

- The individual self-assessment of the capacities to cope, may not reflect the actual needs. "It is a general rule in accidents, the ones that cry out loudest, might not be in the greatest need, and vice versa, the ones that really need help, we never reach in time" (Interview at Police and Border Guard Board, 2020). This principle of the individual calling for help was considered problematic since it allows for selective attention to those who are more outspoken.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

- Not everyone knows and feels that he/she is entitled to receive support. It takes individual courage and understanding that asking for help is not a shameful deed. The individuals desire to be self-sufficient undermines the readiness to let know of the need for help. “Individuals try to cope on their own till they are on the edge - and they find themselves in a situation where help should have been provided a long ago,” (Interview at City government, 2020). The perceived risk for stigmatisation as of “being needy” was pointed out particularly for smaller settlements.

### 4.2.2 Local support networks

Another set of information sources on individual vulnerabilities that was brought up in the interviews was the social support networks. These may involve the community organisations (village associations), societies and support groups, such as societies for disabled individuals. The downside here is that such organisations are not available in all communities.

Also, the persons that provide services to the individuals eligible for support services (e.g. sign language interpreters) can be sources of information on their needs. However, not all the individuals with hearing impairments use these services (and therefore might be off the radar of service providers). Furthermore, unions like Society for Blind People bringing together persons with impairments may not be a fully representative information sources as individuals are not willing to assign to these groups due to possible stigmatisation. Also, through the “disability” societies it is possible to reach only elderly, as younger people tend not to define themselves through their impairment and thus do not attend these societies (Interview at City government, 2020).

### 4.2.3 Social workers

Social workers are generally expected to have a good local understanding of the individuals in the area, where they work, including on the people that might need extra help during crises. ”Information about vulnerable people should be available from the local government to share with crisis responders,” (Interview at Rescue Board, 2021). However, the technical as well as data protection requirements have so far impeded social workers’ access to general databases of individuals with e.g. specific care needs in their region (Interviews at Ministry of Social Affairs, 2021; Social Insurance Board, 2020).

In lack of a more general overview, the existing understanding is primarily based on local officials own records (individual case files, knowing their clients by heart, lists of recipients of Christmas cards for the elderly etc.) (Interviews at Rural municipality, 2020b; Social Insurance Board, 2020).

Second, the interviewed experts stressed a certain habituality in the social workers’ understanding of the people that would need help (Interview at Rescue Board, 2020b). It was, though, emphasised that such „habitual round of people“ may be problematic as it is selective and based on the support receiver’s or his social network’s activeness in calling for help and claiming for support. Furthermore, such experience-based overview may only exist in smaller municipalities (less people).

### 4.2.4 State authorities and databases

In practical crisis management, primarily Population Register (the amount of people in the area, their age, address) is used (See 4.3 for more datasets that are used less frequently). In addition, institutions responsible for crisis management primarily rely on their own expert knowledge and domain specific

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No. 833496

databases they possess (e.g. Rescue Board works with their fire prevention register). There is generally very little understanding on the existing databases that could provide information on social aspects of vulnerable (Interview at Health Board, 2021). As the caveat of single data-base based approach, the datasets only cover limited aspects of individuals' social or economic conditions or capacities - the information necessary in organising crisis response (Interview at Police and Border Guard Board, 2020). A medical crisis management expert explained by an example of determining evacuation needs based solely based on age: "One or few datasets do not allow going into full details. When a person is 80 or 85+ and drives her car, then she is the first one that very happily can evacuate herself" (Interview at Health Board, 2021).

As for the arrangements for exchange of information on the social vulnerabilities, information on potentially affected individuals comes on ad hoc basis with the experts and their experiences and knowledge of the domain. Primarily, the municipal social care officials are expected to provide their expert knowledge to the crisis response (Interview at Police and Border Guard Board, 2020). The accessibility of this social vulnerability information on an ad hoc basis is problematic though. Due to the lack of human resources in municipal government, the number of experts that could represent the issues of social vulnerability and the individuals in need is limited. „If there is a crisis, and in municipal government, there is only 1-2 individuals who handle this information, and if these officials are on vacation or on sick leave, then we have a real crisis" (Interview at Police and Border Guard Board, 2020).

### 4.2.5 Surveys on public and institutional resilience

At the state level, crisis policy making relies on the Estonian Rescue Board's surveys on the public preparedness for crises (Kantar Emor, 2019). The survey results reflect aspects of public resilience regarding residents' awareness (risks in their area, critical stocks and appropriate behaviour), beliefs (expected coping with the crisis) and behaviour (actions taken to be prepared). These survey results offer valuable information (and statistical probabilities) of preparedness on a group level (e.g. age or language groups). However, they do not enable more detailed reflection on individual sensitivities and adaptive capacities that are crucial in crisis preparedness and response.

In addition, a systematic overview of the crisis preparedness of local government services is under preparation (Ministry of Finance, 2019). The Local Government Crisis Preparedness Index includes almost 40 monitored topics pertaining to different crisis management phases. In order to achieve an advanced or exemplary level, the local government must, in addition to what is required by law, develop higher level of crisis preparedness, taking into account the recommendations of the Rescue Board, the Civil Protection Concept etc. This crisis preparedness index gives a good indication of resilience in the region, and may thus predict the potential systemic vulnerabilities (e.g. availability of social care), which shape individual conditions in crisis. In the elaborated tool this information could fed into the resilience factors that may alleviate vulnerability factors.

In conclusion, in the absence of prior assessment of vulnerabilities that may emerge in particular crisis situations, identification and prioritisation of people in need of help is based on *ad hoc* solutions. Requests for help from individuals or their relatives/neighbours, local support networks, community or other groups associations, social workers records, state databases, and survey results are possible sources to work with. However, there are serious shortcomings in the usability of this data, both in terms of availability and quality. Most importantly, databases reflecting vulnerabilities are not accessible to social care departments of local governments, leaving them using their own case files and other sources, such as lists of Christmas card addressees, for detecting people in need.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

## 4.3. Which information sources could be further employed

Via document analysis and interviews, we identified several databases that contain indicators of potential vulnerability factors. The databases with indicators of vulnerability relevant in particular crisis could be employed in vulnerability assessment tool (Table 2).

*Table 3. Databases involving indicators of vulnerability*

| Register, statute | Content of the data | Terms of use |
|---|---|---|
| **The Health Information System** https://www.riigiteataja.ee/akt/118072020009 | Data collected in the course of healthcare provision: general data, employment, contacts, guardian or representative, medical records, digital history of treatment, etc. | The Health Information System belongs to the national information system.<br>The controller of the Health Information System is the Ministry of Social Affairs.<br>The data can be accessed by authorized persons only. |
| **The Health Insurance Fund Database** https://www.riigiteataja.ee/akt/112032019019?leiaKehtiv | - costs of medical devices<br>- covering costs of home nurse services<br>- diagnostic codes<br>- prescriptions | The data can be accessed by authorized persons only.<br>To perform a public task and in the case of a legitimate interest, both state and local government agencies have access to population register data by submitting an application. |
| **The Rescue Information System** https://www.riigiteataja.ee/akt/118092018004 | - operations related to resolving a rescue event<br>- buildings and building fires<br>- fatalities and injuries in fires and other rescue events<br>- safety consultations, training and communication activities | The rescue information system is a database included in the state information system<br>The data can be accessed by employees of the Rescue Board, for internal use only. |
| **The Social Services and Benefits Registry STAR** - https://www.riigiteataja.ee/akt/112032019055 | - clients' case files (special need, disability, work ability, guardianship, income, housing etc.)<br>- benefits paid<br>- services provided<br>- pensioners | The chief processor is the Social Insurance Board.<br>The authorized processors of the registry are Health and Welfare Information Systems, local authority and provider of social service.<br>Data can be released to other databases or to other institutions only in legal basis. |
| **The Population Register** https://www.riigiteataja.ee/akt/131012020016 | - personal name, sex, birth data<br>- personal identification code, citizenship<br>- residence, additional addresses,<br>- parents, spouse, child<br>- testimony-based data on ethnic nationality, mother tongue | To perform a public task and in the case of a legitimate interest, both state and local government agencies and natural and legal persons have access to population register data by submitting an application in the information system for processing access to population register data. |
| **The register of unemployed or job-seekers, and of provision of labour market services (Estonian Unemployment Insurance Fund)** https://www.riigiteataja | - personal data of the unemployed persons and job seekers<br>- provision of labour market services<br>- labour market benefits<br>- client's health conditions contraindicating work, special status (international protection, asylum seeker) | A national register established by the Government of the Republic.<br>The chief processor of the register is the Estonian Unemployment Insurance Fund. |

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

| | | |
|---|---|---|
| ja.ee/akt/112032019016 | | |
| **The social protection information system SKAIS** https://www.riigiteataja.ee/akt/101022019018 | - general data of the person<br>- data on the granting and payment of state support, pension, benefit, maintenance allowance and service to the person<br>- details of the social service provider<br>- personal tax information<br>- information on the person's state of health and disability<br>-data on the person's employment | Data can be released to other databases or to another institution only if it is intended for the performance of tasks prescribed by law, an international agreement, the Council of the European Union or a directly applicable legal act of the European Commission. |
| **Registries of vital service providers** | - contact information of clients (owner of the building, technician etc.) | No legal restrictions to cooperate during the crisis. Vital service providers need to be contacted to ask for the data of their clients. MS Excel, digital consumer portal |
| **Mobile Positioning Data (MPD)** www.positium.com | Population statistics<br>- Timestamp (date, daily or hourly view)<br>- Local administrative unit (e.g. county, municipality)<br>- Subscriber type (living in the area, working in the area, regularly visiting the area, domestic tourist, inbound tourist, transit)<br>- Subscriber count<br>Origin-destination matrices<br>- timestamp (date, daily or hourly view)<br>- movement's starting county or municipality<br>- movement's destination county or municipality<br>- count of movements between these counties or municipalities<br>Secondary home layer:<br>- timestamp (date, daily view only)<br>- local administrative unit (e.g. county, municipality)<br>- count of home as evacuation location<br>- count of secondary home as evacuation location<br>- distance of primary/secondary home from area border | - Permission and access to data from a mobile network operator. Operators have to hash all ID-s before sending data to the analysts. The data is kept in well protected servers and according to all laws on data protection. |

The data in the datasets presented above can only be accessed on request and the reason must be well justified. For the most part, the data is only available to authorised persons and for internal users. Data sharing is restricted by the Public Information Act (Public Information Act, 2001) and applicable personal data protection legislation. Data shall be released to other databases or to another institution only if it is intended for the performance of tasks prescribed by law, an international agreement, the Council of the European Union or a directly applicable legal act of the European Commission, and when appropriate measures for data protection on personal data are ensured. Especially due to the high potential of stigmatisation and discrimination is not only about justified reasons to access but ensuring appropriate measure to keep these data protected. Data formats depend on internal databases and their structures, there is no common format.

**The Population Register** is the main national register. It is maintained to collect reliable information of personal data to enable state and local government agencies and other natural and legal persons perform

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

their public duties. For many other national information systems this is the source for general information about individuals name, sex, birth data, marital status, address and contacts, that may prove relevant factors of vulnerability in certain crises etc. The legitimate interest to apply for releasing this data includes the protection of the life, health, rights and freedoms of the applicant or another person.

**The Health Information System** collects all data entered while providing healthcare services. Covering costs of medical aids and services and drug prescriptions linked to the diagnostic codes are of main interest in this dataset. Together, these databases provide wide range of information on health induced vulnerabilities from chronic physical and mental illnesses to the need for continuous use of medical devices. These health determinants can be highly relevant vulnerability factors in many crisis situations.

**The Social Services and Benefits Registry**, **The Social Protection Information System** and **The Register of Unemployed or Jobseekers, and of Provision of Labour Market Services** gather comprehensive information on individuals' coping in general, their special needs, ability to work and employment, economic situation and family relations. Decreased level of independent coping with everyday life as well as conditions contraindicating work and economic difficulties provide information for crisis managers and social services to ensure necessary assistance.

Interviewees pointed out various other databases that could be useful for detecting individuals who is likely to become vulnerable in a particular crisis. For example, the **registry compiled by the Rescue Board** based on their home visits made as a part of prevention activities. This dataset highlights addresses where people live in physically insecure housing which makes them more vulnerable for fires, but also for larger crises. These homes may become unsafe for the residents, who are often materially unsecured and less able to cope without assistance in this situation.

**Providers of vital services** possess various information on their clients like contact information of the buildings' owners (and maybe person dealing with the technical side). This can time-efficiently provide crisis managers with contact details of persons they can communicate about the alternative ways to provide heating during the power-cut. It is especially useful when it is cold outside and evacuation, if necessary, must be organized in a matter of hours.

**Register of Construction Works** includes data on alternative heating, water and sewerage systems. This enables quickly evaluate approximate number of households in the area concerned, who will need assistance with provision of drinking water or even evacuation in cold weather. In the rural areas, where many households have furnaces and wells, this number may vary greatly affecting the need of resources to be planned. Collaboration with the **electricity companies** can provide information on where it is possible to use generators for power supply. They can also assist with providing the addresses where energy consumption takes place and therefore can be assumed that someone lives. Integration of these databases would provide valuable input to management of crisis affecting vulnerability caused by the loss of vital services.

**Traffic register** managed by The Estonian Transport Administration registers details of all power-driven vehicles authenticated with a registration certificate and combines these with the general information and contact details of vehicle's users, owners and representatives of the latter. This data enables to establish whether means of transport are available in the household for the evacuation if needed.

In addition to the mobile positioning data, **Employment Register** managed by Tax and Customs Board and/or **Police and Border Guard Board** can assist with detecting migrant workers in crisis situation. All seasonal workers and short-term workers are obliged to register with these authorities to work in the country. Data on tourists can be obtained from **tourism businesses**, especially those that provide accommodation.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

**The Estonian Education Information System** contains information on schools, teachers and students of all educational levels and their contact details that can be used when there is a need to approach these groups in the crisis.

**Life-marks.** In the matter of detecting people's residences that are not reflected in the Population Register, electricity companies and waste shipment providers are alternative sources of information to turn to. In addition to the energy consumption, agreement on shipment of waste is a sign of the household being used for living. This data can be useful especially in the sparsely populated areas where newcomers are not always known to the social services. If an elderly person lives alone in remote area, the fact that she or he does not make any calls with mobile phone registered on their name may indicate on lack of social circle – family or friends, who could assist them in the crisis.

**Mobile positioning data** (MPD) is mainly based on passive mobile positioning data (Silm et al., 2020). The data is automatically stored by the mobile network operator (MNO) based on customer billing, network maintenance and performance monitoring. The MPD also enables to determine the tourists (Saluveer et al., 2020). MPD in BuildERS T4.3 includes domestic data (Estonian SIM-cards) and inbound data (foreign SIM-cards linking to Estonian cell towers) from the whole 2019. The data enable determining the main mobility patterns in Estonia and in different time periods (daily, weekly and seasonal patterns). This information could be used for estimating the number of people that could be in the hazard area at certain time based on historical records. MPD also enables to determine whether a person has a second home – as an indication of potential place to evacuate from the region.

In conclusion, the analysis revealed several databases that could be employed in determining persons in vulnerable situation. Managed by state authorities, these datasets reflect wide range of characteristics that affect individuals' coping in extreme circumstances and enable to assess the number of people in need of assistance in the region. In what follows we present crisis case analysis and indicate the vulnerability factors that could be linked with specific indicators in these datasets.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

# 5. RESULTS: TESTING THE VULNERABILITY ASSESSMENT TOOL IN THREE CRISIS CASES

In this chapter, we turn to the results of testing the tool in various crisis cases to explore which factors of vulnerability appeared in certain cases and what kind of datasets could provide useful indicators for these vulnerabilities.

We explored three recent crises in Estonia caused by a power-cut during a storm in 2019, COVID-19 pandemic in 2020, and a cyber-attack in 2020. An overview of the official arrangements for responding to such crises based on crisis management plans is presented in Annex 3.

For each crisis case we first report the crisis circumstances and the institutions involved in resolving the crisis. We then turn to the question of which vulnerability factors appeared relevant in these crises and how these would have altered in alternative scenarios: if the weather had been cold, or if it had happened in a remote area. Last, we show the application of the vulnerability assessment tool and connect the particular vulnerabilities with the representations of these in datasets available in Estonia.

## 5.1. Disruption of electrical supply in South-Eastern Estonia, October 2019

### 5.1.1 Case description

On 27 October 2019, a storm brought an exceptionally strong wind to Võru County, blowing 26 m/s (Paljak, 2019). Throughout the south-eastern part of Estonia, trees fell onto roads and power lines, causing extensive power outages, road closures, and fires in power stations. The Rescue Board appointed a regional crisis and command team to co-ordinate the rescue resources and cooperate with other partners (Figure 5).

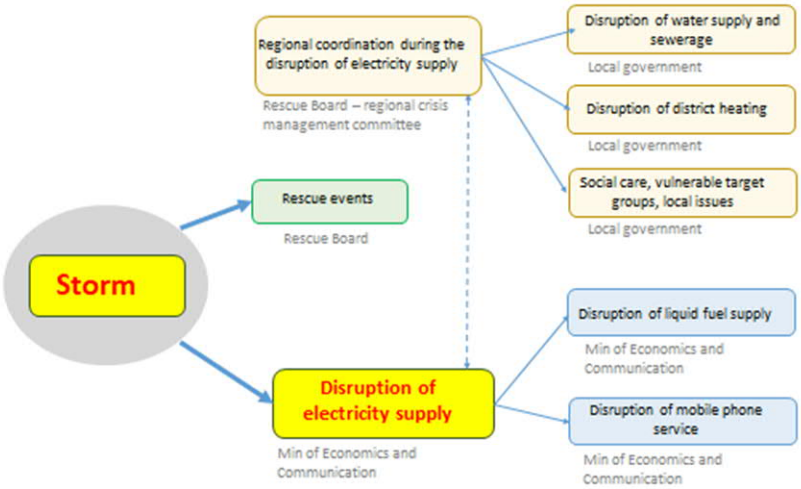


*Figure 5. Institutions responsible for resolving the storm impacts and the related disruption of electrical supply.*

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

At 16:32, Võru city and surrounded area experienced a power-cut caused by storm damage to the high voltage electric power substation. Due to the power-cut, the South Estonian Hospital was left without electricity, but all the vital services were quickly ensured with local generators and people's lives were not endangered. Due to the outage, several vital services were interrupted in the area: the operation of fuel stations, mobile and data communications, water and sewerage, and central heating (Hindre, 2019).

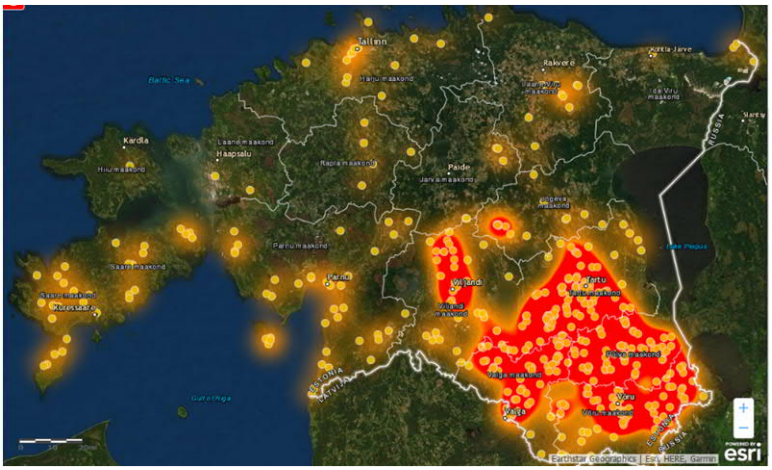


*Figure 6. Density of emergency calls for rescue Oct 27 evening (Klaos, 2019b).*

The biggest problem was the communication because the use of mobile phones and data transmission was disrupted. The transmission system operator repaired the fault at Võru power station late night, and electrical supply was restored to most customers in the city of Võru at 11.37 pm. In the next few hours, the operation of vital services in the city of Võru and the surrounding area was restored, and the hospital also received electricity (Rapp & Loim, 2019).

However, on 28 October, there were still about 32.000 households without electricity throughout south-eastern Estonia. The exact restoration time of electrical supply in different areas could not be predicted. As a result, it was not possible to give a clear message to the public for how long they should be able to cope without electricity. In the morning of 29 October, there were 13.000 households still without electricity and cold nights were expected with temperatures falling down to -6ºC. Based on this information, the Rescue Board gave local governments a course of action to prepare for a situation where residents may need more assistance: a warm environment, drinking water, hot food, opportunity to charge mobile phones, etc. (Klaos, 2019a).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

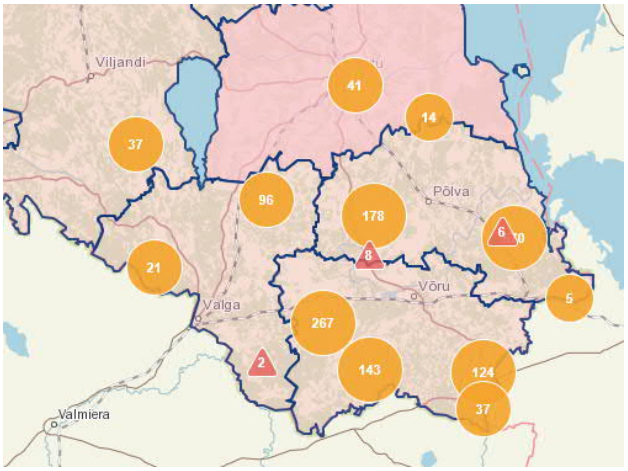


*Figure 7. The households without electricity Oct 31 at 12:26 (Elektrilevi, 2019).*

### 5.1.2. Vulnerability factors

***1) Individual capacities & needs***

In power-cut, elderly people living alone, particularly the ones with some chronic disease or physical disabilities, were considered as most vulnerable (Interviews at City government, 2020; Rescue Board, 2020b; Rural municipality, 2020a, 2020b; Social Insurance Board, 2020). This shows an intersectional complex group combining age, social context and medical condition. Most critical vulnerabilities are derived from health issues that need support of electric medical devices e.g. for breathing or feeding (Interviews at City government, 2020; Police and Border Guard Board, 2020; Rescue Board, 2020a, 2020c; Rural municipality, 2020b; Table-top exercise, Group 2). Many people need **external help (social care) also on everyday basis.** Some of them are **users of social care services** of local government and are paid regular visits by social workers to assist with keeping their home warm and getting drinking water, food, and medicine. During the power-cut, social workers started home visits to check upon their clients (Interviews at Rural municipality, 2020a, 2020b; Table-top exercise, Group 5).

Also, families with small (or many) children in a family were considered as more vulnerable due to their greater need for electrical supply, running water and warm food even in everyday life. **Material insecurity, physical and mental health problems of living alone** may affect also working-age people, who are expected to cope the best. Therefore, social workers aimed to provide information about possibilities to reach for help to all people and households in their area (Interviews at City government, 2020; Rural municipality, 2020b).

**In scenario analyses**, we considered further complications that cold weather and living in remote areas could pose to the crisis situation. **In case the outside temperature is -10°C** or less the disruption of electrical supply especially when combined with loss of heating can rapidly evolve to a health-threatening situation (Interviews at Rescue Board, 2020a, 2020c; Rural municipality, 2020b). **People living in remote areas** were better prepared as they are more accustomed to manage power-cuts. In addition to having stocked necessary supplies, they have analysed possible situations and feel ready to cope independently (Interviews at Rescue Board, 2020b; Rural municipality, 2020a).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

***2) Societal support networks***

During the power-cut social relations and previous arrangements with neighbours, families and village communities became important support for people living alone, who were not clients of social care services. Relatives or other **close contacts**, who were far away from the area, called local governments asking to check on their family members (Interviews at Rescue Board, 2020b; Rural municipality, 2020b). However, in many **communities with less active social networks** may have been unable to inform someone about their needs and missed support (Interviews at City government, 2020; Rescue Board, 2020b). One group pointed out that they were potentially "out of the radar" for neighbours as well as local crisis managers as they are newcomers to the area who haven't had contact with local government and who's households are therefore unknown to social workers (Interview at Rural municipality, 2020b).

Communication with social networks as well as officials was impeded and those affected were not able to report their needs for help. Reaching out to people to ask for assistance and talk about their problems was complicated (Interviews at City government, 2020; Rescue Board, 2020b, 2021; Rural municipality, 2020a).

Phones and computers could not be charged and many could not follow news due to the lack of batteries and no access to television leaving people without general knowledge about what is going on, what has happened and why there is no electricity. (Interviews at City government, 2020; Rescue Board, 2020a, 2020b; Rural municipality, 2020b). In the lack of access to the usual online media and broadcasting due to the power-cut, local social networks and social workers were important information sources.

**The scenario analysis** indicated that **cold weather** would not pose any special factors of vulnerability. Individuals living in **remote areas**, particularly the areas/communities with less active social networking, may have missed support, yet were unable to let know about their needs (Interviews at City government, 2020; Rescue Board, 2020b). Although it may be challenging to detect vulnerable people living in both densely and sparsely populated areas, question of having sufficient information can become even more vital in remote areas with less contacts. There was one case where 4-5 days into the power-cut social worker came to visit one person who didn't have any idea about what was happening and felt very afraid.

***3) Accessibility of vital services***

64.717 households were affected by the power-cut, which involved about 10% of the whole population of Estonia. The majority of these households were reconnected to the power network within 24 hours, while around 8.000 remained without electricity for five or more days (Kuusk, 2019). Regional centre Võru was one of the cities, where the vital services (drinking water, sewerage system, mobile connection, gas supply as well as retail stores etc.) were affected, yet these services were restored in 8 hours.

Many of the households were located in blockhouses, where **alternatives to central/communal heating, water and sewerage systems were not available**. In blockhouses where the electricity was off more than 2-3 days, the temperatures in house decreased (to 11°C). In these regions even if the heating was provided, it was not possible to keep up the heat circulation due to the lack of generators in houses. Therefore residents of blockhouses were considered as in highly vulnerable situations (Interviews at City government, 2020; Rescue Board, 2020a, 2020b, 2020c; Rural municipality, 2020a; Table-top exercise, Group 4)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

Due to the **halting of the gasoline supply**, the flow of fuel to electric generators was impeded. The halting of the gasoline supply hindered also the work of some emergency operators (Estonian National Broadcast, 2019).

**Phone and internet services were interrupted**, as the telecommunication masts in the region were disrupted or down altogether and there was no access to television, internet and mobile connection. This affected individuals' possibilities to receive and exchange information. Most critically this also meant that individuals could not reach rescue services on the phone or send information about their need for help (Interviews at City government, 2020; Rescue Board, 2020a, 2020b).

Very often citizens' **phone batteries drained** and even when mobile networks came back in operation, citizens did not have the possibility to get or share information. Nonetheless, in local government office, in regional fire stations or in other public buildings like community houses, it was possible to charge the mobile phone battery and gain information. However, not everyone was able (lack of means of transportation, physical disabilities) to reach these stations for charging their batteries (Interview at Rural municipality, 2020b).

The **electricity distribution company did not provide enough prognosis for the return of electricity** (Interview at Rescue Board, 2020c). Therefore, also the radio and television did not receive enough operational information and the news were descriptive. In lack of knowledge of how extensive and long-term the disruption of electrical supply was, the individuals did not start preparing for longer self-sufficiency.

**Scenario analyses** demonstrated that if the weather had been **colder**, the number of vulnerable people would have been considerably greater. In Estonian context, it is life-critical to maintain the heating system and running water in cold weather. Particularly the inhabitants of the houses with central heating, would have needed external help. In colder weather, evacuation would have been necessary (Interview at Rural municipality, 2020a).

**In remote (sparsely populated) areas,** people are commonly better prepared for the consequences of a power-cut – they are often equipped with generators, furnace heating and water systems (wells), supplies of food etc. (Interviews at Rescue Board, 2020b; Rural municipality, 2020b). Smaller communities are also more flexible, for example local shop can supply villagers with food by taking notes of payments or debts while supermarkets are unable to use their cash register systems and even open the doors without electricity (Interviews at Rescue Board, 2020b; Rural municipality, 2020b). However, the tendency is that more and more houses in remote areas and new real estate developments also rely on electricity in both heating (heat pumps) and water systems (Interview at Rural municipality, 2020a). Remote areas were also struggling with longer power-cuts as cities enjoy the priority in restoration of electricity (Interviews at City government, 2020; Rescue Board, 2020c).

***4) Public support structures***

Due to the power-cut, the most critical situation was in Southern Estonian **Hospital** in Võru city. With the help of power generators, the most critical services in the hospital were maintained, though.

The most vulnerable population group was the clients of **care homes**. Mostly care homes lacked electric generators, the houses started cooling down and no warm food supply could be provided to the clients (Interview at City government, 2020; Table-top exercise, Group 1).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

As the **schools and pre-schools** could not operate (no heating or hygiene conditions), parents had to stay at home. This made families with children vulnerable.

**Municipal crisis centres** were opened in local government centres and libraries (warm room). These centres were mainly used by the inhabitants of blockhouses (to load batteries, stay warm and receive warm food (Interview at Rural municipality, 2020b). However, the speed of forming these crisis centres differed and not everyone was able to reach it due to physical impairments or lack of car.

Also, the vulnerability of the **municipalities' digitalised information systems** became apparent due to the power-cut and may have led to further social vulnerabilities. Digitalised information on e.g. clients of critical or social work services could not be accessed. The exchange of information with the state information system was halted, the payments of social benefits was delayed (Interview at Rescue Board, 2020a).

The **availability of public communication** in from of national news broadcasting was impeded as the radio and television did not receive enough operational information due to lack of predictions from the electricity distribution company side (Interview at Rescue Board, 2020c). In the beginning of the crisis, many radio and TV news were descriptive, and did not sharing information about how to cope without electricity and communication possibilities. At the end of the crisis, information sharing became significantly better. A local reporter for national broadcasting (TV/radio) made a major contribution for that development, because she had access to news stations and knowledge of local circumstances (Kivi, 2019). A number of local authorities used national broadcasting radio news to transmit the information to the population. Nevertheless, this information did not reach everyone due to the power-cut and lacking access to radio and TV news to many households.

**In our scenario analyses,** no special factors of vulnerabilities were pointed out in relation to **cold weather**. In case of snowstorm rescue vehicles' access to people's homes and ability to evacuate may be limited due to the roads and driveways blocked by snow and/or fallen trees. For social departments of local governments providing support is more challenging in **remote areas** due to long distances between households and villages. It can be tens of kilometres to deliver food to remote farms or to reach by medical care (Interview at Rural municipality, 2020b).

### 5.1.3 Conclusions

The application of the vulnerability assessment tool in case of disruption of electrical supply is summarised in Table 4. Main factors of vulnerability induced by power-cut stemmed from the interruption of vital services like electricity, heating and communication network, particularly in households were alternatives were not present. Level of coping was however highly dependent from individual capacities, social support networks and availability of assistance from public social structures. Living alone was most important factor stressed by the interviewees followed by having a family member with special needs or small children. Relations with neighbours, relatives and community were vital in communicating the need for help and social workers of local governments played important role in reaching out and aiding. Cold weather was seen as exacerbating the crisis.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

*Table 4. Vulnerabilities in disruption of electricity, change of vulnerabilities in scenarios and information sources*

| Dimension of vulnerability | Factors of vulnerability | Individuals | Most important intersectionalities to be considered | Scenarios | | Dataset in Estonia |
|---|---|---|---|---|---|---|
| | | | | Cold | Remote areas | |
| Individual capacities & needs - Physical and mental abilities, needs, coping capacities, personal resources | Individuals living in the area of disruption of electrical supply | All | Electricity-dependent heating and water; Public communication; Interrupted phone and internet services | | | Population Register; Client lists of waste shipment providers; electricity companies |
| | External help needed on everyday basis | People using electrical medical device (electric respirators, food supply) | Lack of close contacts; Interrupted phone and internet services; Availability of social care; Electricity-dependent heating and water | | | The Health Information System; Health Insurance Fund Database |
| | | Health conditions | | | | The Health Information System |
| | | Clients of social care | | | | The Social Services and Benefits Registry |
| | | People in home care | | | | The Social Services and Benefits Registry; Health Insurance Fund Database |
| | Physical health problems | Individuals with chronic diseases, disabilities, but no need for external help on everyday basis | | | | The Health Information System; Health Insurance Fund Database |
| | Families with small children | Children | Electricity-dependent heating and water; Material insecurity; Pre-schools, schools | | | The Social Services and Benefits Registry; Estonian Education Information System |
| | Mental health problems | Individuals with mental health disabilities and disorders | Lack of social contacts; Availability of social care; Electricity-dependent heating and water | ↑ | ↑ | The Health Information System; Estonian Unemployment Insurance Fund's Register |
| | Material insecurity | Individuals with lack of means for everyday life | Availability of social care; Living in community with less active social networking; Pre-schools, schools operating | ↑ | ↑ | The Social Services and Benefits Registry; The Social Protection Information System |

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

| | | | | | | |
|---|---|---|---|---|---|---|
| Societal support networks - Economic and social inclusion, personal networks, communication behaviour | Lack of close contacts | Single households | Elderly; Physical health problems; Material insecurity; Electricity-dependent heating and water; Availability of social care | | | Population Register |
| | | Limited social network (no family, friends, colleagues) | | | | Life-marks e.g. mobile communication; Health Insurance Fund Database |
| | Temporary population in the area affected | Tourists | Public communication; Interrupted phone and internet services | | | Mobile positioning data; Client info from tourism businesses |
| | | Migrant workers | | | | Mobile positioning data; Employment Register; Police and Border Guard Register |
| | Individuals with less local knowledge and networks | Newcomers to the area | | | | Population register |
| | Living in community with less active social networking | All | Material insecurity; Elderly | | | Survey data (e.g. European Social Survey) |
| | Communicative capacities | Hearing impairment, speech disability | Public communication; Interrupted phone and internet services | | | The Health Information System; Health Insurance Fund Database |
| | | Language skills | | | | Population Register |
| Accessibility of vital services and means - Upholding of electricity, heating, water, sewerage, communication networks | Electricity-dependent heating | Clients of central/communal heating | External help needed on everyday basis; Families with small children; Lack of close contacts; Availability of means to evacuate | ↑ | ↓ | Client list of service providers |
| | | Users of private electricity-dependent heating systems | | ↑ | ↑ | Register of Construction Works |
| | Electricity-dependent water and sewerage system | Clients of communal water and sewerage | | ↑ | | Client list of service providers; Construction Register |
| | Interrupted phone and internet services | Anyone | Temporary population; Communicative capacities; Lack of close contacts | | ↑ | Client list of service providers; Mobile positioning data |
| | Physically insecure housing | Tenants | Lack of close contacts; Availability of social care | ↑ | | Recue Board's Register |
| | Availability of means to evacuate | Secondary home | Electricity-dependent heating and water | | | Population Register; Register of Construction Works; Mobile positioning data |
| | | Car owners in household | | | | Traffic Register |
| Public support structures - Access and quality of | Availability of emergency medical care | Anyone | Interrupted phone and internet services | | ↑ | No database |

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

| | | | | | | |
|---|---|---|---|---|---|---|
| social and medical care, rescue and information services, including core institutions e.g. hospitals, care homes, (pre)schools, prisons | Hospitals operating | Patients | Electricity-dependent heating and water | | | Hospital management |
| | Care homes operating | Clients | | | | The Social Services and Benefits Registry |
| | Private care homes operating | Clients | | | | No database |
| | Day centres for disabled individuals operating | Clients | | | | The Social Services and Benefits Registry |
| | Pre-schools, schools operating | Children | | | | Estonian Education Information System |
| | Availability of social care | Clients | External help needed on everyday basis; Availability of municipalities' digitalised information systems | | | The Social Services and Benefits Registry |
| | | All (need for crisis centres) | | | | |
| | Municipality's digitalised information systems availability (halted exchange with state information systems, banking) | Social benefits receivers, Schools, Pre-schools | | | | The Social Services and Benefits Registry |
| | Availability of public communication | All | Communicative capacities; Temporary population in the area affected | | | No database |

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

## 5.2 COVID-19 pandemic in Estonia, March 2020 onwards

### 5.2.1 Case description

A novel coronavirus was reported in Wuhan, China, on 31 December 2019 (World Health Organisation, 2020). Estonian Health Board as a leading authority of health crises activated their crisis procedures on 27 January and the first Covid-19 positive person in Estonia was diagnosed on 27 February. The Government of the Republic declared emergency situation on 13 March.

Health Board together with Government Office started to provide guidelines for the public and coordinate public crisis communication. Health Board's responsibilities were to monitor the situation with the spread of infections, to organize the testing, to organise the health care system to be focused on Covid-19 patients, etc. Throughout the emergency situation, the Government enforced restrictions and other measures to control spread of the virus. The freedom of movement was restricted for persons diagnosed with the coronavirus and members of their households; public spaces, commercial establishments, and social welfare institutions were closed (Riigi Teataja, 2020).

The end of the emergency situation was declared on 17 May. However, several restrictions remained in place because the spreading of the virus continued in Estonia. The Health Board and Government declared that appropriate risk behaviour is still necessary and certain at-risk groups need special attention(Government Communication Unit, 2020).

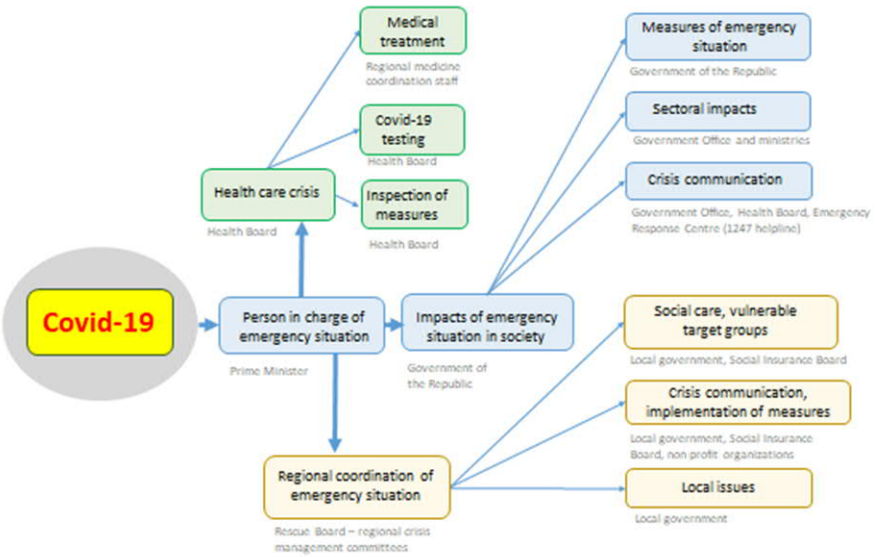


*Figure 8. Institutions responsible for resolving emergency situation of Covid-19 pandemic.*

### 5.2.2 Vulnerability factors

***1) Individual capacities & needs***

The COVID-19 virus affected people from different social backgrounds, physical and mental health conditions and coping capacities. However, among people that had **contracted COVID-19**, the highest risk of mortality lied in individuals with chronic diseases and in the elderly. People were affected not only

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

by the disease but also by the restrictions, social isolation regulations and other measures implemented by government to cope with the pandemic.

**Inhabitants of care homes** were one of the most severely hit as many of these facilities had high rates of infection among patients while also struggling with shortness of workforce when staff was infected and/or self-isolated (Interview at City government, 2020).

Due to restrictions, **limited movement and social interaction possibilities**, diseased people and their close contacts had to remain isolated and needed external help - home delivery of food, medicines and basic necessities. When contacting these people due to their positive Covid-19 tests, officials of the Health Board proposed to give their contacts to the local government who could provide such services (Interview at Health Board, 2021).

Since elderly were considered a risk group, they also had to isolate and needed similar care of home delivery of basic necessities (Interviews at City government, 2020; Rescue Board, 2020b; Rural municipality, 2020b). However, the challenge encountered was loneliness and fear of the disease due to being isolated from relatives, avoiding public spaces, being afraid to let in social workers providing home care (Interviews at City government, 2020; Rescue Board, 2020b; Rural municipality, 2020b).

People with health problems and families with small children also became vulnerable in pandemic situation (Interview at City government, 2020). Local governments started to contact them to check if any assistance is needed, especially delivery of medicines was pointed out as a concern (Interviews at Health Board, 2021; Rural municipality, 2020b).

Next to the direct impacts on health, during the constraints of the emergency situation as well as throughout the extended period of virus threat, the number of people in need of help due to **mental health problems** began to increase (Akkermann et al., 2020)

**The scenario analysis** indicated extra burden stemming from **cold weather.** In Estonia, the virus high season coincides with the period of cold weather, increasing the rate of infection. Psychologically, it was easier to bear the Covid-19 crisis and restriction when the spring began (Interview at City government, 2020). In **remote areas,** the individuals without their own cars were under greater threat, as they had to rely on public transportation to reach shops, pharmacies and other services. However, it was officially advised to avoid public transport due to the risk of contracting virus (Interview at City government, 2020).

***2) Societal support networks***

Due to the advice to stay home and limit social contacts with the potentially infected, **the access to societal support networks was restricted**. Those with health conditions and aged 65+, who were considered as a risk group, had to isolate. These often included individuals from single households, who had limited access to social networks. In a similar way, due to the risk of infection, restrictions on visits to care institutions were imposed. The mental effects of **social exclusion** due to the inability of the elderly to meet their loved ones have been identified as an indirect effect of the restrictions (Akkermann et al., 2020).

**Individuals without support networks** were also considered as in risk of not receiving necessary help when they are not able to reach for it and there is no-one aware of their situation (Interview at Police and Border Guard Board, 2020). Social workers saw considerable difference in coping levels between isolated elderly who had no support from others compared to those who had someone to contact them by phone,

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

teach how to order food online, communicate via e-mail, or bring firewood and groceries to their doorsteps (Interviews at City government, 2020; Social Insurance Board, 2020).

As a negative effect of families **staying together** over extended period, the number of cases of **domestic violence increased** (Interview at Police and Border Guard Board, 2020). The home violence cases could not always be reported as the perpetrator was also constantly at home. There was also no community (including school) supervision to detect cases of domestic violence against children, as children did not attend school and kindergartens thus being also cut off mental health services (e.g. school therapists).

The individuals' **economic engagement** proved as a risk factor in those occupations where the employee had to continue to provide vital services to society, involving many social contacts (medical professionals, salespeople, police, rescuers, social workers, teachers, public transport workers, etc.). To protect them, personal protective equipment was needed, yet this was not readily available during the first wave of the pandemic. Fear of the disease and stress of work overload was also described in these fields of work (Interviews at City government, 2020; Police and Border Guard Board, 2020)

Due to economic downturn, many of those that had become **unemployed** fell into financial difficulties (paying back loans, rents etc.). Transboundary economic engagement was restricted due to bans on movement across borders. This affected the economic well-being due to lost jobs; or mental well-being due to the need to work in isolation from their home families (Mälberg, 2020).

**Digital communication behaviour** appeared an important source of vulnerability, particularly due to the **activation of cybercriminals**. Cybercriminals used the interest and fear associated with the Covid-19 virus to spread malware as well as for various phishing and fraudulent activities (Hansson et al., 2021). Counterfeit invoices were used to catch home office workers and organisations directly involved in crisis management. Vulnerable target groups also include people with lower knowledge of cyber hygiene and more gullible people who do not distinguish enough fraudulent letters (more elderly people) (Kikerpill & Siibak, 2021)

Risk of becoming a victim of fraud laid also in lack of social interaction and communication with relatives and community when elderly people living alone are approached by **false "help providers"** who use the opportunity to come inside the house or promise delivery of food collecting the money and disappearing with it (Interview at City government, 2020).

Communication was pointed out as one of the key elements while trying to support vulnerable individuals (Interviews at City government, 2020; Police and Border Guard Board, 2020; Rescue Board, 2020c; Rural municipality, 2020b). How to reach the various information target groups was one of main issues according to the interviewees. Not only are **people speaking different languages but they are consumers of different information fields and channels** (Interviews at City government, 2020; Rescue Board, 2020c).

**Scenario analyses** indicated that in times of cold weather, people tend to be more stationary and interacting less, thus the overall virus threat could be smaller (Interview at Rescue Board, 2020c). As for the effect of living in **remote areas,** no special factors of vulnerability were pointed out.

***3) Accessibility of vital services***

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

For the maintaining vital services (rescue, medical care, social care, heating, electricity, shops), the **availability of expert staff** is essential, and provision of these services may become impaired if the virus would spread among them.

**The scenario analyses** showed that **cold weather** would not aggravate the vulnerabilities related to accessibility of vital services**.** When it comes to accessibility of vital services in **remote areas,** the volatility of the internet **communication networks'** was brought out as particularly problematic. As the communications (distance-school, distance-work, tele-health) moved to internet, good internet connection was of paramount importance (Interview at Rural municipality, 2020b). However, this is not granted in more distant areas.

***4) Public support structures***

As there is no specific treatment for the disease yet and only the symptoms can be relieved, the number of respiratory devices and the **capacity of (intensive) medical care** is a crucial limiting factor in care provision. In order to ensure the continuity of hospitals and to cope with the increase in the number of Covid-19 patients, scheduled treatment in hospitals was suspended during the emergency. This increased the likelihood of **delayed treatment of people with other health problems on the patient's waiting list,** with their medical condition worsening and leading to an increase in mortality in the long term. Furthermore, the planned vaccinations among children were delayed among 2-year olds and 6-7-year-olds (Liive, 2020).

There was also a **shortage of personnel in care homes** to replace the members of staff that had fallen sick or needed to stay in self-isolation (Interview at City government, 2020). Care homes also lacked personal protective equipment to support following the hygiene and safety requirements.

Restrictions in **care homes** (elderly, young people and adults with special needs) were accompanied by significant changes in routines, such as social activities and mental health counselling. The change in routines made it difficult for the inhabitants to cope with mentally difficult circumstances and added significant workload to the staff who had to explain and implement the restrictions (Orru et al., 2020)

In order to reduce the risk of infection**, care institutions also stopped accepting new clients**. This affected the quality of life of people who can no longer manage their daily activities on their own. Furthermore, this imposed additional restrictions on the relatives who had to take care of those that cannot cope by themselves (Chancellor of Justice, 2020).

The **day centres for disabled individuals** (including children) with disabilities was halted. In these situations, again, the family members had to stay home (away from labour market) to provide support to the person with disability.

Homeless people who regularly use the **homeless night shelters** were able to continue to sleep there with the exception of one shelter that was quarantined after one of the clients fell ill and tested positive with Covid-19. This shelter was quickly reorganised to provide 24/7 accommodation with warm meals served 3 times a day and other necessary services provided for 30 days. **Day centres**, where homeless get warm food, take care of their hygiene, get information or counselling, were closed to avoid the spreading of virus. **Soup kitchens** faced increasing numbers of clients while reorganising their services to comply with the implemented pandemic measures.

Due to the advice to limit social contacts, **the tasks of municipal social workers** were extended to delivering food and medicines to social welfare clients and the elderly. The extent to which this support reached all those in need raised doubts among interviewed experts (Orru et al., forthcoming).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

The transfer of **schools onto distance learning** put children and their families in a difficult situation. This affected particularly those students who needed professional support. The lack of traditional support services may have longer-term effects on these young persons' coping. The complexity of arranging children's leisure time, when socializing, joint trainings, musical schools were banned, also caused problems to children and their caregivers. Children from families financially struggling were affected by staying at home as they lost access to school lunch which in some cases was the only warm meal they got daily. Many municipalities arranged food packages instead. Still this was not always helpful as social workers described that many families in need do not know how to cook and the groceries are left unused due to lack of skills (Interview at City government, 2020).

**Public communication** to disseminate information about the situation and possibilities to ask for help was paid particular attention. Social media, newspapers, radio and tv, leaflets by mail, posters in bus stations and shops were used as channels. Attention was paid to provide information in Estonian, Russian and English, sign language interpreters were asked to contact and check on their clients as were support persons for people under international protection (Interviews at City government, 2020; Police and Border Guard Board, 2020; Rural municipality, 2020b). However, this process was somewhat delayed, as it was difficult to provide information to all language groups and communication outlets simultaneously.

Furthermore, it was also pointed out that there was an overload of information concerning the virus and the pandemic, so it was difficult for some people to make sense of it, to filter out relevant and correct from misinformation and rumours (Interviews at City government, 2020; Rescue Board, 2020b, 2020c; Rural municipality, 2020a)

**The scenario analysis** did not indicate any extra vulnerabilities related to public support structures due to cold weather and in remote areas.

### 5.2.3 Conclusions

The application of the vulnerability assessment tool in case of COVID-19 is presented in Table 5. As the individual capacities and needs like living alone or having (mental) health problems played important role in persons' ability to cope, decisive factors of vulnerability stemmed from societal support networks and efficiency of public support structures (e.g. social care, care homes, communication).

The pandemic put a long-term strain on people's emotional and economic well-being and raised the need to cope with isolation and moving restrictions, including becoming dependent on assistance offered by their social network or by social care departments of local governments. Heavy workload in combination with fear of disease or, in opposite, becoming unemployed affected many people the latter causing financial difficulties. Many vulnerability factors revealed in this crisis case cannot be linked with representations in datasets.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

*Table 5. Vulnerabilities in COVID-19 pandemic, change of vulnerabilities in scenarios and information sources*

| Dimension of vulnerability | Factors of vulnerability | Individuals | Most important intersectionalities to be considered | Scenarios | | Datasets in Estonia |
|---|---|---|---|---|---|---|
| | | | | Cold | Remote areas | |
| Individual capacities & needs - Physical and mental abilities, needs, coping capacities, personal resources | Exposure to virus | Diseased | Hospitals; Chronic diseases; Availability of Social Care; Lack of close contacts; Day centres for disabled individuals operating | | | The Health Information System |
| | | Covid-19 close contact | | | | The Health Information System |
| | Belonging to Covid-19 risk group | 65+ | | | | Population Register |
| | | Health conditions considered as risk group for Covid-19 | | | | The Health Information System |
| | External help needed on everyday basis | Health conditions | | | | The Health Information System |
| | | Clients of social care | | | | The Social Services and Benefits Registry |
| | | People in home care | | | | The Social Services and Benefits Registry |
| | Physical health problems | Individuals with chronic diseases, disabilities, but no need for external help on everyday basis | | | | The Social Services and Benefits Registry; The Health Information System; Estonian Unemployment Insurance Fund's Register |
| | (Large) families | Whole family | Pre-schools, schools operating; Availability of social care; Material insecurity | | | The Social Services and Benefits Registry; Population Register; Estonian Education Information System |
| | Mental health problems | Individuals with mental health disabilities and disorders | Lack of social contacts; Availability of social care | | | The Health Information System; Estonian Unemployment Insurance Fund's Register |
| | Material insecurity | Individuals with lack of means for everyday life | Availability of social care; Living in community with less active social networking; Pre-schools, schools operating | ↑ | | The Social Services and Benefits Registry; The Social Protection Information System |
| | | Homeless | | | | |

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

| | | | | | | |
|---|---|---|---|---|---|---|
| Societal support networks - Economic and social inclusion, personal networks, communication behaviour | Lack of close contacts | Single households | Diseased;<br>Covid-19 close contacts;<br>65+ | | ↑ | Population Register |
| | | Limited social network (no relatives, friends, colleagues) | | | | Life-marks e.g. mobile communication; Health Insurance Fund Database |
| | Temporary population | Tourists | Public communication | | | Mobile positioning data; Client info from tourism businesses |
| | | Migrant workers | | | | Mobile positioning data; Employment Register; Police and Border Guard Register |
| | Communicative capacities | Hearing impairment, speech disability | Public communication; Lack of close contacts | | | The Health Information System; Health Insurance Fund Database |
| | | Language skills | | | | Population Register |
| | Digital communication capacities | Tele-health; distance learning; digital social care service clients | Access to digital communication tools | | | No database |
| | Economic engagement | Occupations involving many social contacts | Belonging to Covid-19 risk group,<br>Material insecurity;<br>Pre-schools, schools operating;<br>Availability of social care | | | No database |
| | | Unemployment | | | | Estonian Unemployment Insurance Fund's Register |
| | Secure relations | History of domestic violence | Material insecurity;<br>Pre-schools, schools operating;<br>Availability of social care | | | The Social Protection Information System; The Police and Border Guard Board Information System |
| | | Victims of cyber-crime | Material insecurity | | | |
| Accessibility of vital services and means - Upholding of electricity, heating, water, sewerage, communication networks | Availability of personal transportation | Car owners in household | Material insecurity;<br>Digital communication capacities | | ↓ | Traffic Register |
| | Access to digital communication tools | | Material insecurity;<br>Digital communication capacities | | | No database |
| Public support structures - Access and | Hospitals | Patients | | | | The Health Information System |

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

| | | | | | | |
|---|---|---|---|---|---|---|
| quality of social and medical care, rescue and information services, including core institutions e.g. hospitals, care homes, (pre)schools, prisons | | Patients on the waiting list | | | | No database |
| | Care homes operating | Clients | | | | The Social Services and Benefits Registry |
| | | Clients on the waiting list | Availability of social care | | | No database |
| | Availability of social care | Clients | External help needed on everyday basis;<br>Material insecurity | | | The Social Services and Benefits Registry |
| | Day centres for disabled individuals operating | Clients | Mental health disabilities and disorders; people in home care | | | No database |
| | Day centres, soup kitchens for homeless individuals operating | Clients | Material insecurity;<br>Public communication | | | No database |
| | Pre-schools, schools operating | Children | Material insecurity;<br>Access to digital communication tools;<br>Digital communication capacities | | | Estonian Education Information System |

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

# 5.3. Cyber-attacks on Estonian state information systems, November 2020

### 5.3.1 Case description

In November 2020, the Estonian Information Systems Authority (RIA) identified three separate cyber-incidents on three different government ministries. The hackers obtained personal data via the attacks, including infectious diseases information hacked from the Health Board's information system. The Ministry of Economic Affairs and Communications, the Ministry of Social Affairs and Ministry of Foreign Affairs were the three ministries hit. The Ministry of Social Affairs attack saw the cyber criminals accessing data on the circumstances of the spread of infectious diseases on 9.158 individuals, via the Health and Welfare Information Systems Centre. The three attacks reportedly bore similarities to one another.

The Health and Welfare Information Systems Centre was able to block the hackers within eight hours. The public authorities affected determined in cooperation with Information Systems Authority the attack methods and took action to prevent further data theft. The RIA also shared information with public sector bodies, including the IT departments of local government and vital service providers in order to avoid further attacks. The Central Criminal Police launched criminal proceedings in relation to unlawful access to systems, with the proceedings being led by the Office of the Prosecutor General. (The Ministry of Economic Affairs and Communications, 2020)

The cyber-incident response measures were co-ordinated on political-strategical level by Ministry of Economics and Communication and on operational level by Estonian Information Systems Authority and its unit called CERT.EE (Cyber Emergency Response Team)[1]. Ministry of Economics and Communication and Estonian Information Systems Authority involved all the relevant agencies (Police and Border Guard, Office of the Prosecutor General, security agencies, agencies affected by the cyber-attacks) and IT security experts into cyber-incident response process and formed crisis teams on strategical and operational level (Figure 9).

[1] CERT-EE is an unit responsible for the management of security incidents in .ee computer networks. It is also a national contact point for international co-operation in the field of IT security. Goals of CERT-EE are:

a) monitoring of the state of information security in Estonia by using received reports and collecting information about information security incidents;
b) preventing security incidents and reducing security risks, mainly by raising awareness and through communication work;
c) assisting institutions regarding security incidents and advising them if they want law enforcement agencies to start an incident investigation.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

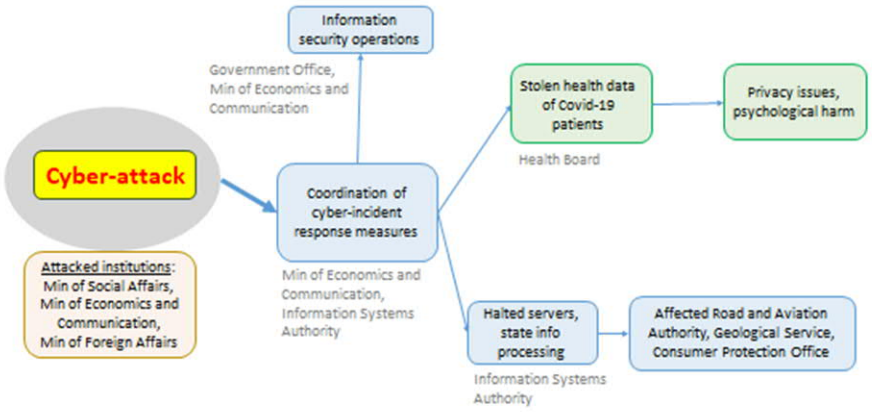


*Figure 9. Institutions responsible for resolving the cyber-attack.*

### 5.3.2. Vulnerability factors

***1) Individual capacities & needs***

People who became vulnerable due to the cyber-attack were all individuals whose personal data was obtained by cyber-criminals. This **violated the individual need for privacy**. The medical information contained in the dataset is particularly sensitive, as it reveals individuals' physical or mental conditions, which might be used for stigmatising. **Harming confidentiality** may cause discomfort or embarrassment for individuals whose data appeared in hands of a wrong person.

In addition to the health information personal details of people's whereabouts and relations with others were revealed. In some cases this **information is sensitive** if a person is not where he or she has allegedly been or is engaged in unofficial work (Interview at Health Board, 2021).

**The scenario analyses** showed that in the case when the data was used for blackmailing (e.g., urging unwanted action or extorting money or unwanted accords) the need for privacy suffered. When the blackmailer got hold of sensitive data that would quiet the vulnerable person, the situation could be even worse, because those cases could never be unveiled. Additionally, such extortion could lead to either swift or long-term mental damage or the depletion of personal resources. The latter, in turn, could in the worst case scenario lead to a quiet suicide. Main threat to misuse of this kind of data rises therefore in possible **blackmail** (Interview at Social Insurance Board, 2020).

In the scenario, when the **data was changed**, individuals with terminal urgent conditions suffered the most. Altered data or breach of data integrity may in worst case lead to misplaced treatments of patients whose blood-type, allergies or other vital traits were changed. This may lead to further damage to health or even death.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

***2) Societal support networks***

Effects on societal support networks may appear through **increased institutional distrust**. The distrust in services and fear of criminal web-behaviour may make individuals overly careful about using information systems and web-based communication.

The **scenario analyses** showed that in the case when the data breach resulted in blackmailing (e.g., urging unwanted action or extorting money or unwanted accords), individuals inclusion to personal social networks could suffer, either by prejudice from peers or the individuals' self-inflicted guilt/shame over the possibly exposed data. For this dimension, thus, blackmailing could have a detrimental effect.

In scenario, when the **data was changed**, it was considered vital that the institution, whose data was concerned, publicized the findings immediately. Withheld information created further distrust towards the leadership of state institutions and doubts about the professional capacity of officeholders.

***3) Accessibility of vital services and means***

No effects on the access to vital services.

***4) Public support structures***

The **Health Information System authority reacted** by sending all the people whose data was hacked an e-mail about the incident (Estonian National Braodcast, 2020). Since the motives of the attack remained unknown and people were advised to contact authorities immediately when contacted by cyber-criminals and not respond or provide any information (Liive, 2021)

Cyber-attack to state's information systems has wider effect to the way society views **credibility and trustworthiness of state and its institutions** (Interview at Information System Authority, 2021). State providing health care services failed to provide secure information systems as the stolen data was stored unencrypted and extra protection was missing (Liive, 2021). This understanding may have further degraded the trust in health authorities - the ones who are expected to provide support. Such degradation of credibility of services was particularly problematic due to the time of pandemic when the trust in medical care and information systems was particularly important.

The timing of the cyber-incident in the midst of the second wave of the pandemic aggravated the effects of distrust in digitalised health systems. Compared to the times of pandemic, a significant change in how public institutions work compared as "The role of the web-based interactions and work-style has sky-rocketed and situation management have "moved to internet" making it vulnerable to disruptions of internet connection," (Interview at Police and Border Guard Board, 2020).

**The scenario analyses** showed that in the case when the data was used for blackmailing (e.g., urging unwanted action or extorting money or unwanted accords), the persons who were approached, had received a prior private warning from the State Information Systems Authority. This showed that timely action and contact could help in preventing harm. Blackmailing of individuals did not aggravate the previous vulnerability factors of public support structures.

In scenario, when the **data was changed**, when discovered, data breaches could lead to temporarily shutting down access to vital databases – in case of Estonia, where almost all of the patients' data is stored in online databases, this could significantly hamper the regular work of hospitals (and also indirectly harm unconscious patients, whose correct treatment depends on the available data).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

The halted operations of vital databases may result in untreated illnesses or delayed medical reaction to time-critical conditions.

This also may put a strain on the public institutions communication teams, when they had to contact the persons whose data they believed to have been changed.

### 5.3.3 Conclusion

The application of the vulnerability assessment tool in the cyber-incident is presented in Table 6. This cyber-incident was problematic primarily due to the obtaining of confidential medical data by cyber-criminals. This violation of individual privacy harmed the mental well-being of individuals whose data appeared stolen. In case the criminals are not caught, the information could be used for blackmailing people. The increased distrust in state information systems may lead to distrust in health care system and state institutions more broadly, which is problematic amid a health care crisis like the pandemic.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

*Table 6. Vulnerabilities in the cyber-attack, change of vulnerabilities in scenarios and information sources*

| Dimension of vulnerability | Factors of vulnerability | Individuals | Most important intersectionalities to be considered | Scenarios | | Dataset in Estonia |
|---|---|---|---|---|---|---|
| | | | | Black-mailing | Changes to data integrity | |
| Individual capacities & needs - Physical and mental abilities, needs, coping capacities, personal resources | Need for privacy, confidentiality | Individuals whose data appeared in stolen dataset – (infected with Covid-19 and close contacts) | | ↑ | ↑ | The Health Information System |
| Societal support networks - Economic and social inclusion, personal networks, communication behaviour | Institutional trust | Individuals whose data appeared in stolen dataset | | ↑ | ↑ | |
| | | All | Belonging to Covid-19 risk group | | | |
| | Secure relations | Individuals whose data appeared in stolen dataset | | ↑ | ↑ | The Health Information System |
| Accessibility of vital services and means - Upholding of electricity, heating, water, sewerage, communication networks | | | | | | |
| Public support structures - Access and quality of social and medical care, rescue and information services, including core institutions e.g. hospitals, care homes, (pre)schools, prisons | State information system's security | Individuals whose data appeared in stolen dataset | | | | The Health Information System |
| | Halted database operations for deterring the criminal | Patients (active, non-active) | | ↑ | ↑ | |
| | Public communication (to maintain trust in info-systems and health care in times of pandemic) | All | Belonging to Covid-19 risk group | | ↑ | |

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

**Conclusions of testing the vulnerability assessment tool**

Using the tool proved to be very effective in broadening the understanding of factors inducing vulnerability and extending the scope of identifying individuals affected by these factors in specific crises. Placing the crisis to take place in remote areas and in cold weather influenced vulnerability factors caused by both the disruption of electricity and Covid-19, the former being much more intensely affected. Implementing the tool for assessment of cyber-attack which affected people whose personal health data was stolen by cybercriminals, bought up very different sets of vulnerability factors primarily concerning the distrust in public authorities at the times of crisis. The scenarios of blackmailing the individuals whose data was hacked and violating the content of the data revealed aggravating condition for such type of crises.

Important possibilities as well as shortcomings emerged when analysing which databases contain the necessary data and how this data can be obtained. This clearly indicates the need for accessibility and accuracy of datasets for vulnerability assessment, yet also confirms that databases cannot be relied on for all the relevant information to judge individual capacities to cope in crisis. Not all the vulnerability factors can be linked to indicators in datasets, and thus also other information sources need to be deployed in assessment.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

# 6. RESULTS: TOWARDS DATASET INTEGRATION FOR VULNERABILITY ASSESSMENT

In this section, we employ the analysis of interviews and document analysis to discern the possibilities for dataset integration for intersectional vulnerability assessment under prevailing administrative circumstances in Estonia. The analysis of legal and ethical circumstances applies for also other EU countries.

Interviewed experts shared an understanding that the possibility of using information from various databases and other information sources would enable a more nuanced understanding of those individuals that may fall into vulnerable situation in times of crisis (Interviews at Estonian Government Office, 2021; Police and Border Guard Board, 2020; Rural municipality, 2020a, 2020b; Statistics Estonia, 2021). They noted that information about potential sources of vulnerability, such as health issues, disabilities, ability to work, and so on, is fragmented between different authorities and their databases. Integrating data to see the bigger picture of person's capacities, his/her private or official support networks could improve crisis planning. Combining several indicators from several datasets, would enable a cross-sectional and more detailed depiction of vulnerabilities: an essential overview of the potential vulnerability mixes in specific regions. This could serve as a basis for overall planning of resources (Interview at Health Board, 2021).

Furthermore, the cross-use of datasets could give a more nuanced overview of the individuals for the prioritisation of preparedness as well as response activities. This issue is particularly relevant in case of limited resources to offer support and a need to be very. As one of the social workers explained by an example of individuals with medical care needs: "If we know the diagnoses, for example, the sickness that limits mobility, then we know their basic needs. However, to get an understanding of their possible need for support, we should know what is going on in the family, what is the physical and social environment around this person" (Interview at City government, 2020). The crossed databases could give some essential specifications of the needs to better target rescue, medical and social care resources.

However, interviewees highlighted that next to information from databases, other sources of information need to be engaged to validate the data-based judgements. Lived experiences of diverse society, multifaceted sensitivities and coping practices cannot be depicted in any databases, and the representatives of diverse vulnerabilities grasp these complexities fullest. In addition, relying too heavily on datasets might also leave alternative information-gathering and communication systems underdeveloped (Interview at Information System Authority, 2021). Nevertheless, in the following we focus on one practicable solution for getting a more nuanced depiction of vulnerabilities: the data-set integration.

## 6.1 How can datasets be integrated?

Merging different datasets requires a clear mandate and supporting institutional arrangements. It also concerns the technical feasibility to combine different datasets in their various formats. Furthermore, ensuring the quality and protecting the integrity of the information stored in these databases is the task of the authorities managing particular datasets. With the integration of datasets, the technicalities of guarding the stored information and the authorisation of access need to be revised.

### 6.1.1. Two key options

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

Two key options on how to safely make use of the datasets for identifying vulnerable individuals were revealed in document analysis and interviews:

1) **Anonymised data** from existing datasets could be used to provide the lead authority managing particular hazard or crisis (e.g. Rescue Board, Health Board) information on the profile of people in the hazard area. Such information could include e.g. how many elderly or families with small children are in the area, and how many of these households lack alternatives to electricity-dependent central heating. With this estimate it is possible to predict where it would be most necessary to e.g. purchase additional electrical generators for the times of electricity disruption. Anonymised group-level overviews of social vulnerabilities can take into consideration the factors from key dimensions of vulnerability described in Orru et al 2021 and in the elaborated social vulnerability assessment tool:

- Individual capacities & needs-dimension, which focuses on the physical, emotional and mental condition, skills and personal resources of individuals.

- Societal support networks- dimension referring to the economic and social inclusion, personal networks, communication behaviour

- Accessibility of critical services and means-dimension describing the capability to uphold electricity, heating, water, sewerage and communication networks, and personal possessions like car and/or alternative home necessary for evacuation.

- Public support structures-dimension capturing the access and quality of social and medical care, rescue and information services, including core institutions e.g. hospitals, care homes, (pre)schools, prisons.

Examples of the specific datasets that depict the vulnerability factors can be found in the crisis case analyses in Chapter 5 and in overview of relevant datasets in Section 4.3. The indicators (and datasets) of these social vulnerability dimensions could be matched with assessments for a region and for specific hazard type in concerned areas. Examples of analogous multi-dimensional compounds of vulnerability factors are provided in Section 2.3.1.

2) **Individualised data** from existing datasets would allow for even more nuanced consideration of individual sensitivities and coping capacities with regards to particular hazards. Individualised vulnerability assessments could take into account the same social, structural and hazard exposure parameters as described above on anonymised data processing. Such detailed information processing would allow for tailoring more personalised preparedness measures and planning for crisis response concerning particular hazards. Such personalised overviews could be overseen in crisis and detailed with situation-specific information on potential exposures and sensitivities.

Such individualised data processing would require informed consent from the concerned individuals. From a justice point of view, it is recommended to ask informed consent from everyone. Also practically informed consent of everyone is necessary, as individual conditions change and anyone can become vulnerable under certain conditions in any point in time. Following the principle of vulnerability as intersectional, it is necessary to have individualized data of all, otherwise it is not possible to find the effect of intersecting vulnerability factors on specific individuals. However, in case the informed consent is not given, this must not mean that individuals are provided less help. However, this may bring about the risk of support unintentionally arriving late due to a lack of information. When individualised data are used, data protection and access limitations need to be elaborated in detail (See section 6.3).

Using the **individualised data processing without the permission** from the individual may be feasible under certain crisis conditions upon the threat to health and/or life specified in the EU General Data

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

Protection Regulation (2016/679). See Section 6.3 for some analysis on the possibilities to use individual data under threat conditions.

### 6.1.2 Five preconditions

Five preconditions for integrated use of datasets were revealed in interviews and document analysis.

***1) Good situation awareness***

Making use of the integrated datasets in preparing for or at times of crisis, requires good understanding of various situational conditions (situation awareness). Conceptualising the use of the databases is a challenge, however. “There is high need for overview and practical analysis of what kind of data is valuable in what situation and how to obtain it. What are the search terms, what databases need to be linked etc.” (Interviews at City government, 2020; Estonian Government Office, 2021; Rescue Board, 2021; Rural municipality, 2020b).

Furthermore, the issue of data becoming ‘noise’ was also mentioned: Too much data can distract, lead to an information overload and thus decrease situation awareness. The usability of databases on social vulnerability was considered also as a matter of lack of knowledge and skills in authorities outside social work. “In local government we fill a lot of databases for other institutions but in case of a crisis nobody looks at them but my phone rings” (Interview at Rural municipality, 2020a). It is difficult to put the various information pieces together in a coherent picture on vulnerabilities.

Furthermore, even if information is obtained based on datasets, also the expert-judgment and sensitivity to situational conditions is essential in interpreting and making decisions based on the information from datasets. It was stressed that factors of vulnerability do not always mean that a person needs assistance and vice versa: “In social services we are always sewing a tailor-made suit” (Interview at City government, 2020).

***2) Availability of data on vulnerability factors***

Interviewees pointed out that not all factors of vulnerability are reflected in datasets. One example of missing data is the residents of nursing homes: a particularly fragile group, where many of the vulnerabilities, including being dependent on the quality of services provided by care homes, intersect. Missing information on these clients has hindered practical crisis response: see the disruption of electrical supply case in Section 5.1 and Covid-19 case in 5.2.

Information regarding different factors of vulnerability is fragmented between different authorities and these databases are often not compatible. A person might be in focus of different institutions at the same time or, to the contrary, “fall between” the different institutions’ attention scope and be left without assistance (Interviews at Ministry of Social Affairs, 2021; Rural municipality, 2020b). This issue also links to the accuracy of datasets.

***3) Accuracy of the datasets***

The problem with the accuracy of the data was primarily raised concerning the Population Register (living place) and the databases linked to it. Individuals may have incentives to provide wrong address to the

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No. 833496

Population Register to be eligible for local benefits and services, such as free public transport in a particular region(Interviews at City government, 2020; Rural municipality, 2020b; Statistics Estonia, 2021).

Furthermore, there is an issue of the actuality of data. Not all databases are actualized in the same time periods. This concerns particularly the Population Registry in Estonia, which is updated over the period of several years.

***4) Safety of databases***

The interviewed experts warned against relying too much on individual or integrated datasets because when access to databases is lost, other ways must be found to exchange information. Disruption of electrical supply can halt the use of databases as explicated in Section 5.1. Local governments have some backed-up data for these cases, but the renewal and management of these lists is laborious, and their usability is questionable (Interview at Rescue Board, 2020a).

The possible violations of the integrity of the databases are considered even bigger risk. Changing health data in the systems can become a serious problem if this data modification is done on a large scale and can affect consecutive steps or decisions (See scenario analysis in Section 5.3). In the context of integrity, databases reflecting the possessions (land register, bank accounts) might become problematic (Interview at Information System Authority, 2021).

Changing the information in one database that is used as a source for other (e.g. Population Register) was pointed out as especially problematic as it is difficult to detect where the violation effects have started and how they have spread. The problems with threats to truthfulness of information multiply when several databases are integrated. It is important to consider the risks derived from keeping lots of sensitive data in one place (Interview at Information System Authority, 2021).

***5) Administrative capacity***

Limited administrative capacity, including human resources, legal agreements and adopting technical solutions prevent access to data on various vulnerability factors even on the local level. In case of a need for evacuation such information e.g. physical impairments is not available even for local social workers. Even though they give input to this dataset daily, they are not permitted to access the full list of individuals with e.g. mobility impairments (Interview at Police and Border Guard Board, 2020).

Lack of combined expertise on crisis management and social care in local governments was also mentioned as a challenge when providing or interpreting information on social vulnerabilities (Interview at Police and Border Guard Board, 2020).

In conclusion, evaluating possibilities to integrate data managed by different state authorities and other sources in preparedness phase, and assessing vulnerabilities in context of particular crisis provides valuable understanding of factors influencing individuals' ability to cope and plan for better prevention and response. However, capacities to understand vulnerabilities and handle databases as well as availability, accuracy and vulnerability of data were main restrictions and challenges emerged.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

## 6.2. Which principles of data protection should be followed?

In use of datasets, the issue of protection of personal data raises. According to Article 8 of the European Convention for the Protection of Human Rights and Fundamental Freedoms, person's right to protection with respect to the processing of personal data forms part of the right to respect for private and family life, home and correspondence. Under the EU law, data protection has been acknowledged as a distinct fundamental right (European Union Agency for Fundamental Rights and Council of Europe, 2018). To adapt data protection rules to the digital age, the General Data Protection Regulation, **GDPR** became applicable in May 2018 (European Commission, 2021).

The GDPR specifies considerations on infringements upon the right to respect for private and family life in specific conditions. Recital 4 foresees that data protection should always be considered in relation to its purpose in society and weighed against other fundamental rights. More specifically, Article 23(1) GDPR allows Member States to restrict data subject rights, as well as the principles outlined in Article 5, by way of a legislative measure and respecting the essence of fundamental rights and freedoms. These restrictions, provided that they are embodied in necessary and proportionate measures of a democratic society, should aim to safeguard, among other things, 'important *objectives of general public interest […] including monetary, budgetary and taxation matters, public health and social security*'.

Article 6(1)(d) and (e) of GDPR allow to process personal data that are either a) necessary to protect the vital interest of individuals (i.e., to save lives) or to safeguard *the public interest* or in the exercise of *official authority* vested in the controller. Among the possible safeguards, controllers shall take measures aimed at: a) limiting the access to the data, b) establishing stricter retention times, c) training staff, d) minimizing the amount of processed data, e) keeping records of any related decision-making process. Furthermore, data security remains of paramount importance and special attention should be put in avoiding the identity of affected individuals being disclosed.

Article 9 of GDPR sets additional limits how to process the special categories of personal data. Some of these categories are especially important to the vulnerability analysis (i.e. data concerning the health etc.). The same article (art 9 (2)) gives also the exceptions when the limits shall not apply, including the need for social protection (b), protect vital interests (c), substantial public interests (g), purposes of preventive medicine and provision of health or social care or treatment (h), and public interest in the area of public health when protecting against serious cross-border threats (i). According to the GDPR many of these exceptions should be authorized by Union or Member State law providing for appropriate safeguards for the fundamental rights and the interests of the data subject.

The principle of the GDPR is that there must be a legal basis for any processing of personal data. In the articles of 6 and 9, the main principles are regulated. At the same time, the GDPR also leaves sufficient room for manoeuvre for Member States to provide a certain legal basis in their national law for the cases where the processing of data should be necessary in the public interest, including crisis preparedness.

In Estonia, the article 26 of the Constitution describes the rights of privacy, and sets necessary conditions and limits to the extent of processing of personal data. It must be provided for by law and must be necessary for the protection of morals, human health, public order, etc. Therefore, there must be a provision in national law for the processing of national databases for crisis preparedness and response. Estonian laws currently lack the bases of data processing that would meet the conditions of the GDPR. (Interview at Data Protection Inspectorate, 2021).

**Proportionality** remains a cornerstone in the application of data protection measures that should not be excessive or discriminatory (Ventrella, 2021). Proportionality means that authorities should keep in mind that the human dignity of individuals should always be safeguarded. Revealing the identity of a vulnerable

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

person is rarely necessary. On the contrary, divulging the name could lead to discrimination and long-term social exclusion. Therefore, it is important to ensure that such risks to individuals are carefully assessed when using personalised data in crisis management.

**Data minimisation**. GDPR Article 5 (1) (c) stats that personal data shall be: adequate, relevant and limited to what is necessary in relation to the purposes for which they are processed. Therefore, the amount of data processed or exchanged must be reduced to a necessary minimum. Therefore, it needs to be made clear what is the minimum amount of personal data that is necessary for identifying vulnerable individuals in crisis.

The **accountability** principle means that for the use of personalised data in crisis management it is necessary to demonstrate that appropriate processes have been undertaken to ensure that only personal information that is necessary for responding to vulnerabilities in crisis is collected and held. For each individual or a group of individuals sharing relevant characteristics, it is important to make clear why is their personal information necessary. The controller of any data processing (including for dataset integration) should be determined to ensure accountability.

**Maintaining integrity.** Adequate security measures should be put in place to make sure possible disadvantages and risks to individuals are mitigated. To secure the data stored in servers and applications, state-of-the-art cryptographic techniques must be implemented. The adoption of mutual authentication methods between servers and applications can be used to avoid impersonation and the creation of fake users. Furthermore, this includes access restrictions.

The European Data Protection Board holds a position that a decentralised solution is more in line with the data minimisation principle and that trust in a central server must be limited. Clearly defined governance rules must be determined to manage the central server and ensure its security, including making the access to all data stored in the central server restricted to authorised persons only. Nonetheless, according to research, decentralised infrastructures promoting individual privacy and autonomy can also become vulnerable to non-purposeful surveillance like their centralised counterparts (De Filippi, 2016).

Finally, since the processing of personal data resulting from dataset integration for identifying vulnerable individuals is likely to produce high risk to the rights and freedoms of data subjects, a **data protection impact assessment** should be carried out prior to their deployment.

## 6.3. Which ethical implications should be considered?

In addition to the legal considerations, the elaborated tool brings up discussions regarding ethical implications and questions to be considered with regard to shared values of European societies. In line with WP7, six dimensions were taken up here in which certain aspects of the tool must be scrutinized: (1) justice and participation, (2) responsibility and accountability, (3) freedom of choice and autonomy, (4) trustworthiness and transparency, (5) privacy and data protection, and (6) beneficence and non-maleficence. The following table outlines potential ethical issues the use of the tool may raise together with some possible ways of mitigating these. This table should be considered the starting point of more detailed discussion on ethical issues, which has to take place in the concrete application of the tool.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

*Table 7. Ethical principles and mitigation*

| Ethical dimension | Potential issues | Example | Ways of mitigating |
|---|---|---|---|
| **Justice and participation** | Inequality of different groups of people | Databases contain only data of certain groups, not all of society (#predefined groups) | The database should aim to include data of every individual/ community/ area |
| | The tool causes disadvantage for an individual person | An existing lack of data on certain groups becomes even more problematic due to reproduced negligence in disaster management. | Combine the implementation with such a tool to a more general initiative to identify those individuals in vulnerable situations This includes a correctional mechanism that scrutinizes the limitation of one's own perspective. |
| **Responsibility and accountability** | Responsibilities of using the tool are not clear. | Disaster managers use data without knowing about their responsibilities for instance to ensure data protection and secrecy. | Transparency of the rights and obligations in the use of the tool and with regard to promoting data protection. |
| | Responsibilities on who is supposed to update data is not clear | Data in the database is not up-to date as it was unclear who was supposed to do so. | Transparency of the rights and obligations in the use of the tool and with regard to rights and obligations of those who permitted data use (citizens). Provision of an ombudsman service. |
| **Freedom of choice and autonomy** | Citizens do not have a freedom of choice to opt-out of giving personal data | Individuals have to decide between privacy of their personal data and being protected (unavailability of a real opt-out option) | Transparency about the data use and protection. Aim for convincing through transparency rather than pressure and extortion on the basis of a vulnerable situation. |
| | Deprivation of personal autonomy of an individual person with regard to follow up measures | Data leads to special treatment that does not consider individuals consent to cooperate (evacuation against the will, due to a certain status) | In line with anti-stigmatisation aims, there should be an emphasis on providing data does not equate to being helpless or unable to make conscious decisions. People are still experts of their own living situations. |
| **Privacy and data protection** | Causing personal disadvantage for privacy/ Infringement of privacy | Misuse of data (especially personal data) | Data access should be limited by personal.<br>Data access should be limited by reasons.<br>Follow a data reduction narrative that aims to collect only those which are really needed. |
| **Trustworthiness and transparency** | Abuse of a relationship of trust | Data is insufficiently protected, data is accessed by unauthorized personnel, misuse is disguised. | Implement a transparent discourse on which data are needed for what purposes and what will happen with these data. Earn trust by openly investigate misuse. |
| | Lack of positive change of individual situations | Although personal data is provided, there is not improve of the individual situations in disasters. | Implement a transparent discourse on which data are needed for what purposes and what will happen with these data. Put special emphasis on activities to improve the situation of those who are most at risk for becoming vulnerable. |
| **Beneficence and non-maleficence** | Sanctioning those who do not provide data | Those who do not provide data or permit access are treated worse or purposely neglected. | Not giving data to this database must not lead to purposely worse treatment. Persons have to be informed about the potential unintended negative effects of not providing data (emergency personnel needs more time to find a person and give support due to pragmatic reasons). |
| | Discrimination of individuals | Negative influence of these data to other disaster procedures | Being identified as prone to become vulnerable must not been used as a reason to exclude those individuals from |

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

| | | | |
|---|---|---|---|
| | | (triage status, allocation of resources) | resources or allow for a lower triage status (grey triage). |
| | Stigmatisation of individuals | Individuals becoming stigmatized as they are in this database. | Being identified as prone to become vulnerable must not been used to support exclusionary tendencies in society. Include data of everyone not only pre-defined groups. |
| | Restriction of individual's life | Being considered especially prone to become vulnerable leads to restriction of individual freedoms (freedom of movement, obligations to report) | Being identified as prone to become vulnerable is not a sufficient reason for restrictions of individual freedoms. This has to be assessed with regard to the event, social support structures and so forth. These should aim to be case specific decisions. For instance, in the case of dementia a case assessment has to take place and which considers if restrictions of movement or use of coercive actions is appropriate. |

In conclusion, integrating data managed by different state authorities and other sources can improve evidence-based understanding of factors influencing individuals' ability to cope, and plan for better prevention and response. However, problems related to practitioners' capacity to understand vulnerabilities and handle databases as well as availability, accuracy and vulnerability of data may challenge the use of databases. Our document analysis and interviews indicated that processing the individualised data to identify individuals in vulnerable situation may be considered under crisis conditions. However, from the ethical perspective, using the argument of exceptional threats to legitimize the infringement of fundamental right for privacy is problematic.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

# 7. CONCLUSIONS AND POLICY RECOMMENDATIONS

## 7.1 Main conclusions

BuildERS Task 4.4. aimed at building a vulnerability assessment tool that brings together the varied factors of vulnerability and their representations in public datasets. To meet this goal, we used Estonian crisis management system as a case study and developed the tool in four consecutive stages.

**First, we** explored (a) how is the identification of those vulnerable in a crisis organised and what are the strengths, weaknesses of the current practices and (b) which information sources could be further employed.

Our analysis suggests that little consideration is given to social aspects of vulnerability risk assessments in the crisis management system in Estonia. This indicates a failure to understand disasters as not just being the result of an extreme event, but of an extreme event interacting with a vulnerable society (Wisner et al., 2004). The absence of strong stakeholder pressure, the lack of recognition of the need as well as clear institutional mandate, shortage of expertise and guidelines were brought out as the main reasons why vulnerability assessments have not been prioritised so far. Identification of vulnerable individuals is usually carried out on an *ad hoc* basis following the requests for help from individuals and social workers habitual records. Recent crises caused by major electricity disruptions and the COVID-19 pandemic have underlined the need for more systematic tool for understanding of who might become vulnerable in certain situations.

**Second,** we determined the analytical components to be included in the vulnerability assessment tool. An intersectional approach (BuildERS D1.3, Kuran et al., 2020) was taken to differentiate between the specific ways in which individual, structural factors as well as situational and temporal aspects affect vulnerabilities.

1) A **particular crisis situation** that shapes the configurations of hazard exposure, coping and/or adaptive capacities in individuals.
2) **To test the relevance of a multiplicity of factors** and their interrelations, while avoiding blind-spots and getting a comprehensive overview of the possible sources of vulnerability the four key dimensions of vulnerability established in D2.5 (Orru et al., 2021) need to be considered:
    - Individual capacities & needs,
    - Societal support networks,
    - Accessibility of vital services,
    - Public support structures.
3) The four dimensions of vulnerability **factors intersect in unique ways in particular situation and in specific individuals**. Considering which individuals are burdened with specific intersecting factors enables to better target resilience-building.
4) The tool guides in evaluating the dynamics in vulnerability factors in hypothetical conditions - scenario analysis. The scenario conditions may be selected based on risk analyses and pursuing the “worst-case scenario”.
5) The tool guides connecting the factors of vulnerability, the affected individuals with **indicators of vulnerability in specific databases and other information sources**.

In addition to factors of vulnerability, as one of its analytical components, the tool draws out resilience factors that may mitigate individual’s vulnerability on the community level (e.g. municipal crisis

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No. 833496

preparedness index). As the tool is still going through the validation in BuildERS WP6, this report outline its premises while remaining open for further discussion concerning its analytical components. For example, BuildERS D1.3 offers an alternative operationalisation of vulnerability assessment through explicating the primary and secondary vulnerability factors, which can be yet more difficult to follow in practice.

**Third**, we tested the applicability of the tool in three recent crises in Estonia. We examined who needed which support due to which conditions in crises and what information sources could be used to identify those in vulnerable situation.

The experiences with a large-scale disruption of electrical supply, COVID-19 pandemic, and a cyber-incident demonstrated how the factors of vulnerability intersect and their impact may be amplified or attenuated by the situational characteristics. Table-top exercise, interviews, and the focus groups indicated that the tool effectively broadened the scope of factors considered inducing vulnerability and enabled to narrow the circle of individuals burdened by certain vulnerability mixes. The mapping indicated the relevance of conceptualizing vulnerability factors, on the one hand, in terms of human agency and capacities as well as the functionality of the surrounding technological-political structures, and on the other hand, as a function of the availability of social support through private relations and/or institutional care (the framework proposed in Orru et al., 2021). The analysis confirms that both axes of factors need to be included in a comprehensive assessment of vulnerability.

The scenario analysis proved useful for considering the “worst-case” conditions that may aggravate the effect of some vulnerability factors for certain individuals (for instance, in case of a cyber-attack, the blackmailing of individuals whose health data was hacked could further undermine the public trust in health systems). This confirms the relevance of the dynamic understanding of social vulnerability that underlies the theoretical framework of BuildERS.

The exercise of matching the vulnerability factors with the relevant indicators in databases indicated that due to the problems with availability and accuracy of data, datasets cannot be relied on for all the relevant information to judge individual capacities to cope in crisis. Methodologically, the table-top exercise format proved a useful way of engaging multiple expertise to consider various scenarios and map out vulnerabilities and information sources following the vulnerability assessment tool.

**Fourth,** we assessed the tool’s suitability to existing crisis management system in Estonia and considered the possibilities for dataset integration for intersectional vulnerability assessment. The use of databases in interaction carries the potential in obtaining nuanced information to target preparedness building and for planning response to support vulnerable people. However, legal and ethical restrictions must be considered when processing the data.

Based on the above experiences, the vulnerability assessment tool co-created with practitioners in crisis management and social care can be recommended for practical use. The tool can be applied in other countries, on national and local level, and in various hazard contexts, as its analytical components remain sensitive to the situational dynamics of vulnerability. However, **5 key challenges need to be addressed upon the application of the tool**:

1. Prior assessment of vulnerabilities cannot be complete and involve all possible scenarios. However, high quality preparedness work foregrounds the speedy consideration of the situation-specific vulnerability factors.
2. The quality of vulnerability assessment depends on the quality of information used in applying the tool. To enhance the accuracy and timeliness of information, engaging multiple sources of information is necessary.
3. Ethical principles and legal bases need to be established for the processing of personal data (synthesised from different datasets) to safeguard the rights and freedoms of the data subjects,

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No. 833496

including clarification of the purposes of legitimate data use, access and sharing conditions, user accountability and monitoring criteria.

4. Even with the integration of objective information from datasets, to mitigate subjectivity, vulnerability assessments should be validated among the relevant stakeholders including the members of the diverse society that are often disregarded. The frames of who should be engaged at which point need to be elaborated before the adoption of the tool.
5. Clarification of institutional mandates and collaboration principles between different authorities and the representatives of diverse society, as well as proper guidance and training is necessary for adopting the vulnerability assessment tool.

## 7.2 Innovation potential

The vulnerability assessment tool proposed in this report supports the three innovation-related goals of BuilDERS: reducing social vulnerability, building social capital through improved social networks, and increasing risk awareness. We address these in turn.

### 7.2.1 Reducing social vulnerability

The elaborated tool helps to acknowledge the different aspects of vulnerability, creating basis for a more holistic view of factors of vulnerability and their intersecting factors that amplify or mitigate vulnerabilities. Better understanding of the vulnerability factors and intersecting factors with the tool enables to **identify the conditions to mitigate vulnerability**, including providing solutions to empower the capacities and tailor well-targeted support and assistance for the most vulnerable in crisis situations.

This tool provides the necessary input to be involved in the **preparatory phase** as well as a model in decision-making processes **during a real crisis**. Both **real-life circumstances (factual hazard situation with its real-life parameters) and the scenario-based modelling (a hypothetical hazard situation evolving to the "worst case scenario")** may be applied in using the tool. Combining the two in preparedness work, the crisis managers in collaboration with relevant stakeholders are guided to systematically think through the possible hazard scenarios.

The tool brings together different vulnerability factors and their interrelationships in a single model, **underlying the multidimensionality of the vulnerability**. This enables to **move from general categories (tourists, the elderly, etc.) to much narrower groups (e.g. becoming vulnerable in the event of a power outage in the cold season)**. Such a more detailed and in-depth analysis of vulnerable individuals will, among other things, help to move away from the current tendency for unjustified stereotyping (possible stigmatisation) stemming from the vulnerable groups-based thinking.

The tool helps crisis managers to **make explicit which information sources and whose perspectives are included** in crisis-related decision-making, brings **more transparency** to the process of identifying (most) vulnerable. This also contributes to the implementation of the ethical principles of justice and participation in crisis management.

### 7.2.2 Building social capital through improved social networks

The tool introduces a requirement for a **participatory process** in the vulnerability assessment to meet the need for diverse society to inscribe their interests and needs into crisis planning (Hansen, 2000; United

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

Nations, 2015). In this way it also aims to pull those currently overlooked or neglected into a discussion on **the varied experiences of vulnerability and its mitigation possibilities**.
The process of engagement in the vulnerability assessment process **introduces and strengthens social ties** between those in vulnerable situations and authorities. Furthermore, it creates the necessary preconditions to raise the awareness of first responders about the needs of vulnerable target groups and to increase their capacity to provide appropriate assistance.

### 7.2.3 Increasing risk awareness

Prior identification of vulnerable individuals enables to plan and build capacities to empower them and tailor **well-targeted risk communication messages**. It helps people to recognise their possible sources of vulnerabilities and understand the rights for and sources of help in crisis.

Contributing to the **broader situation awareness** in crisis management, the report provides a systematic analysis of the various sources of information for assessing social vulnerabilities, also when employing the tool:

- Individuals in need,
- local support networks, community or other groups associations,
- social workers' records,
- state databases,
- survey results.

We map the **risks and opportunities of using these information sources** as a valuable basis for identifying the best combination of sources where the authorities responsible for emergency response should get information about the vulnerable individuals.

The analysis provides a **comprehensive overview of datasets** in Estonia, which reflect a wide range of factors that affect individuals' coping with extreme circumstances and allow for assessing which assistance or information would be necessary to which individuals. Similar overviews could be established also in other countries. The vulnerability assessment tool foregrounds the principles of linking the vulnerability factors with the sources of information (including datasets) that could be employed.

Beyond determining the legal and ethical requirements for data use and protection, the analysis **reveals 5 key preconditions for the employment of (merged) databases** in determining persons in vulnerable situation prior and/or during crisis:

1. Good situation awareness for well-targeted data inquiries,
2. Availability of data on vulnerability factors,
3. Accuracy of the datasets,
4. Safety of databases,
5. Administrative and technical capacities to manage and share data

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

## 7.3 Policy recommendations

Stemming from the above analysis, we propose recommendations for establishing more nuanced and comprehensive vulnerability assessment with the elaborated tool. For the adoption of the tool propose recommendations to the authorities on EU, national, and local level as well as to NGOs and care organisations.

**EU level policy-makers**

1. Provide guidance to link the vulnerability assessment, and the elaborated tool to the risk assessment process in national regulations, and to complement the emergency plans accordingly.
2. Develop guidelines including a framework of ethical principles for involving representatives of vulnerable people in vulnerability assessment and emergency preparedness more broadly.
3. Address the need to align national legislation with the GDPR, ensuring the possibility and legal basis for the use of personal data to protect lives and health in emergencies.
4. Underline the need to develop the digital databases with the high standards of cyber protection, with the opportunity to use and integrate them to support the identification of vulnerable target groups in emergencies.

**National level authorities responsible for crisis management**

5. Include the analysis of social vulnerabilities in the national risk assessments and take it into consideration in crisis management plans. The elaborated vulnerability assessment tool provides the methodological basis for such analysis of situation-specific social vulnerabilities.
6. As a supplement to the elaborated vulnerability assessment tool, establish support prioritisation guidelines which are based on ethical evaluation and criteria as well as clearly defined with regard to their use scenarios for the various vulnerable people (e.g. permanent social care clients).
7. Establish guidelines and ensure resources for local authorities to use the vulnerability assessment tool. The guidelines should specify how to assess the number of people with greater needs living in their area and the potential need for assistance in different crisis situations.
8. Elaborate guidelines for engaging the members of diverse society, aiming at those who are often overlooked or neglected to be involved in vulnerability assessment at national and local levels.
9. Involve national level umbrella organisations of certain individual characteristics in vulnerability assessment (for instance, organisations related to specific impairments, age groups, socio-economic conditions, family structures, social service users).
10. Establish a better understanding of the various social databases as one source of information on vulnerabilities. Involve the managers of these databases in the process of conducting risk assessments to identify vulnerabilities.
11. Establish and implement ethical principles and legal bases for the processing of personal data (synthesised from different datasets) by the authorities preparing for or resolving the crisis, including specifying measures to safeguard the rights and freedoms of the data subjects, the purposes of legitimate data use, access and sharing conditions, user accountability and monitoring criteria.
12. Develop the substantive and technical readiness of the necessary databases for their deployment and integration in order to obtain high-quality information on potentially vulnerable individuals.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

13. Establish a corrective structure which allows to scrutinize included data against those data, which might be overlooked and to learn from previous and future shortcomings.

**Local authorities**

14. Apply the vulnerability assessment tool in municipal emergency planning to identify people with greater need for assistance to support their independent coping or prepare for the provision of information and assistance in a crisis situation.
15. Gather information about and strengthen cooperation with the representatives of a diverse society including organisations related to care, certain impairments, family arrangements, age groups, community organisations, cultural backgrounds to involve them in vulnerability assessment and emergency planning.
16. Provide guidance to the vulnerable individuals on how to recognise their vulnerabilities before and in crisis and how to inform responsible authorities on the needs for rescue, medical support and social care.

**NGOs, care organisations**

17. Facilitate discussions among the participants and/or clients of your organisation on the vulnerabilities that may occur in hazardous events and get involved in the vulnerability assessments and emergency planning process at national and local level to develop solutions to reduce vulnerability accordingly

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

# REFERENCES


Adger, W. N. (2006). Vulnerability. *Global Environmental Change*, *16*(3), 268–281. https://doi.org/10.1016/j.gloenvcha.2006.02.006

Agency for Toxic Substances and Disease Registry. (2020). *CDC Social Vulnerability Index*. https://www.atsdr.cdc.gov/placeandhealth/svi/index.html

Akkermann, K., Kõlljalg, M., Vainre, M., & Lai, A. (2020). *Kroonviiruse kriisi psühhosotsiaalsed mõjud ja sekkumisvalikud. Ekspertarvamus*. vatek.ee/covid-19-kriisi-psuhhosotsiaalsete-mojude-ekspertarvamus/

Alexander, D. (2015). Disability and Disaster: An Overview. In I. Kelman & L. M. Stough (Eds.), *Disability and Disaster* (pp. 15–29). Palgrave Macmillan UK. https://doi.org/10.1057/9781137486004_2

Bourdieu, P. (1997). The forms of capital. In *In A.H. Halsey, H. Launder, P. Brown and A. Stuart Wells (Eds.). Education, culture, economy and society* (pp. 46–58). Oxford University Press.

Brace-Govan, J. (2004). Issues in snowball sampling: The lawyer, the model and ethics. *Qualitative Research Journal*, *4*(1), 52–60.

Burnham, P., Lutz, K., Grant, W., & Layton-Henry, Z. (2008). *Research methods in politics*. Palgrave Macmillan. http://www.myilibrary.com?id=977207

Chancellor of Justice. (2020). *Chancellor of Justice Annual Review 2019/2020 'The Rule of Law in an Emergency Situation'*. https://www.oiguskantsler.ee/ylevaade2020/oigusriik-eriolukorras

Chang, S., Pierson, E., Koh, P. W., Gerardin, J., Redbird, B., Grusky, D., & Leskovec, J. (2021). Mobility network models of COVID-19 explain inequities and inform reopening. *Nature*, *589*(7840), 82–87. https://doi.org/10.1038/s41586-020-2923-3

Cutter, S. L., Boruff, B. J., & Shirley, W. L. (2003). Social Vulnerability to Environmental Hazards *: Social Vulnerability to Environmental Hazards. *Social Science Quarterly*, *84*(2), 242–261. https://doi.org/10.1111/1540-6237.8402002

De Filippi, P. (2016). The interplay between decentralization and privacy: The case of blockchain technologies. *Journal of Peer Production*, *7*(Alternative internets). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2852689

Elektrilevi. (2019). *Interruptions map*. https://www.elektrilevi.ee/katkestused/katkestuste-kaart

Estonian Government. (2014). *Regulation No. 108 of 07.07.2014 "Conditions and Procedure for Involving the Defense League in Ensuring Cyber Security".* Government of Estonia.

Estonian Government Office. (2018). *The Civil Protection Concept*. Estonian Government Office & Ministry of the Interior. https://www.riigikantselei.ee/sites/default/files/content-editors/organisatsioon/failid/rakkeryhmad/elanikkonnakaitse_kontseptsioon_15.02.2018.pdf

Estonian National Braodcast. (2020, January 12). *Cyber-attacks took place and data on 9,158 Covid-19 patients were obtained*. https://www.err.ee/1192309/riigi-vastu-toimusid-kuberrunded-katte-saadi-9158-koroonapatsiendi-andmed


This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

Estonian National Broadcast. (2019, October 28). *Storm shows Estonia not ready for crises yet*. https://news.err.ee/996815/storm-shows-estonia-not-ready-for-crises-yet

European Commission. (2021, January 28). *Joint Statement by Vice-President Jourová and Commissioner Reynders ahead of Data Protection Day*. An Official Website of the European Union. https://ec.europa.eu/commission/presscorner/detail/en/statement_21_208

European Union Agency for Fundamental Rights and Council of Europe. (2018). *Handbook on European data protection law* (2018th ed.). Luxembourg: Publications Office of the European Union. https://www.aki.ee/sites/default/files/inspektsioon/rahvusvaheline/juhised/fra-coe-edps-2018-handbook-data-protection_et.pdf

Floyd, T., Grieco, M., & Reid, E. F. (2016). Mining hospital data breach records: Cyber threats to U.S. hospitals. *2016 IEEE Conference on Intelligence and Security Informatics (ISI)*, 43–48. https://doi.org/10.1109/ISI.2016.7745441

Gabel, F. (2019). Chancen dynamischer Konzeptionen von Vulnerabilität für den Katastrophenschutz. In *Resilienz im Katastrophenfall. Konzepte zur Stärkung von Pflege- und Hilfsbedürftigen im Bevölkerungsschutz* (pp. 77–96).

Government Communication Unit. (2020). *Kriis.ee*. https://www.kriis.ee/et

Grafakos, S., Viero, G., Reckien, D., Trigg, K., Viguie, V., Sudmant, A., Graves, C., Foley, A., Heidrich, O., Mirailles, J. M., Carter, J., Chang, L. H., Nador, C., Liseri, M., Chelleri, L., Orru, H., Orru, K., Aelenei, R., Bilska, A., … Dawson, R. (2020). Integration of mitigation and adaptation in urban climate change action plans in Europe: A systematic assessment. *Renewable and Sustainable Energy Reviews*, *121*, 109623. https://doi.org/10.1016/j.rser.2019.109623

Hansen, L. (2000). The Little Mermaid's Silent Security Dilemma and the Absence of Gender in the Copenhagen School. *Millennium: Journal of International Studies*.

Hansson, S., Orru, K., Torpan, S., Bäck, A., Kazemekaityte, A., Sunniva, F. M., Ludvigsen, J., Savadori, L., Galvagni, A., & Pigree, A. (2021). COVID-19 information disorder: Six types of harmful information during the pandemic in Europe. *Journal of Risk Research*. https://doi.org/10.1080/13669877.2020.1871058

Hansson, Sten, Orru, K., Siibak, A., Bäck, A., Krüger, M., Gabel, F., & Morsut, C. (2020). Communication-related vulnerability to disasters: A heuristic framework. *International Journal of Disaster Risk Reduction*, *51*, 101931. https://doi.org/10.1016/j.ijdrr.2020.101931

Hassani, B. K. (2016). *Scenario Analysis in Risk Management*. Springer.

Hilhorst, D., & Bankoff, G. (2004). Introduction: Mapping vulnerability. In *Mapping Vulnerability: Disasters, Development, and People*. Earthscan.

Hindre, M. (2019, October 28). Torm näitas, et riik pole kriisideks veel valmis. *ERR*. https://www.err.ee/996779/torm-naitas-et-riik-pole-kriisideks-veel-valmis

Hunt, A., & Watkiss, P. (2011). Climate change impacts and adaptation in cities: A review of the literature. *Climatic Change*, *104*(1), 13–49. https://doi.org/10.1007/s10584-010-9975-6

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

Kantar Emor. (2019). *Elanikkonna hädaolukorraks valmisoleku alase teadlikkuse indeksuuring 2019*. https://www.rescue.ee/files/2019-12/1575733543_haedaolukorraks-valmisolek-2019-aruanne.pdf?5a87669beb

Khan, S., & Hoque, A. (2016). Digital health data: A comprehensive review of privacy and security risks and some recommendations. *Computer Science Journal of Moldova*, *71*(2), 273–292.

Kikerpill, K., & Siibak, A. (2021). Abusing the COVID-19 Pan(dem)ic: A Perfect Storm for Online Scams. In *In: Pollock, J. C.; Kovach, D. (Ed.) COVID-19 in International Communication: Responses to the Pandemic in Global Perspective*. Routledge.

Kivi, K. (2019, June 11). *Estonian National Broadcast's correspondent traveled to Latvia in search of a place to go on the air during the storm*. https://ekspress.delfi.ee/artikkel/87975307/erri-korrespondent-soitis-tormi-ajal-eetrisse-minemise-kohta-otsides-latti?

Klaos, M. (2019). *Järgmiseks kriisiks tuleb paremini valmis olla*. Lõuna-Eesti Postimees, 25.11.2019. https://lounapostimees.postimees.ee/6833804/jargmiseks-kriisiks-tuleb-paremini-valmis-olla

Klaos, Margo. (2019, December 12). *Storm in Southeastern Estonia*.

Krüger, M. (2019). Building Instead of Imposing Resilience: Revisiting the Relationship Between Resilience and the State. *International Political Sociology*, *13*(1), 53–67. https://doi.org/10.1093/ips/oly025

Kuran, C. H. A., Torpan, S., Hansson, S., Morsut, C., Naevestad, T.-O., Gabel, F., Segnestam, L., Kruke, B. I., Airola, M., Keränen, J., & Orru, K. (2020). *Vulnerability and vulnerable groups from an intersectionality perspective*. *International Journal of Disaster Risk Reduction*.

Kuusk, A. (2019). *Elektrilevi juht tormi tagajärgedest: Lahing on parim treening*. Estonian National Broadcast. https://www.err.ee/998393/elektrilevi-juht-tormi-tagajargedest-lahing-on-parim-treening

Liive, R. (2020, March 31). *Due to the emergency situation, vaccinations of children are partially delayed*. https://tervise.geenius.ee/rubriik/uudis/eriolukorra-tottu-lukkuvad-osaliselt-laste-vaktsineerimised-edasi/

Liive, R. (2021, September 12). *The Health Board began to inform people whose data fell into the hands of cyber attackers*. https://digi.geenius.ee/rubriik/uudis/terviseamet-hakkas-informeerima-inimesi-kelle-andmed-sattusid-kuberrundajate-katte/

Mälberg, M. (2020). *Septembri viimasest esmaspäevast pääseb piiranguteta Soome vaid tööle*. Estonian National Broadcast. https://www.err.ee/1137571/septembri-viimasest-esmaspaevast-paaseb-piiranguteta-soome-vaid-toole

Marzi, S., Mysiak, J., Essenfelder, A. H., Amadio, M., Giove, S., & Fekete, A. (2019). Constructing a comprehensive disaster resilience index: The case of Italy. *PLoS ONE*, *14*(9), 1–24. https://doi.org/10.1371/journal.pone.0221585

Mechanic, D., & Tanner, J. (2007). Vulnerable People, Groups, And Populations: Societal View. *Health Affairs*, *26*(5), 1220–1230. https://doi.org/10.1377/hlthaff.26.5.1220

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

Ministry of Economic Affairs. (2020). *Cyber Incident National Emergency Response Plan*. Ministy of Economic Affairs and Communication.

Ministry of Finance. (2019). *Minu omavalitsus*. https://minuomavalitsus.fin.ee/en

Morsut, C., Kuran, C. H. A., Kruke, B. I., Schobert, M., Gabel, F., Krüger, M., Orru, K., Hansson, S., Nahkur, O., Rhinard, M., Molarius, R., Savadori, L., & Naevestad, T.-O. (2020). *BuildERS D1.2. Final Report on the Unified Theoretical Framework on the Concepts of Risk Awareness, Social Capital, Vulnerability and Resilience and their Interdependencies*. BuildERS project.

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic Analysis: Striving to Meet the Trustworthiness Criteria. *International Journal of Qualitative Methods*, *16*(1), 160940691773384. https://doi.org/10.1177/1609406917733847

OECD. (2020). *Social Expenditure—Aggregated data*. https://stats.oecd.org/viewhtml.aspx?datasetcode=SOCX_AGG&lang=en

Orru, K., Hansson, S., Gabel, F., Tammpuu, P., Krüger, M., Savadori, L., Meyer, S. F., Torpan, S., Jukarainen, P., Schieffelers, A., Lovasz, G., & Rhinard, M. (2021). Approaches to 'vulnerability' in eight European disaster management systems. *Disasters*, disa.12481. https://doi.org/10.1111/disa.12481

Orru, K., Nero, K., Schieffelers, A., & Naevestad, T.-O. (2020, November 27). *Care organisations in times of Covid-19*.

Päästeamet. (2019). *PÄÄSTESÜNDMUSE HÄDAOLUKORRA LAHENDAMISE PLAAN: ÜLEUJUTUS TIHEASUSTUSALAL*. Päästeamet.

Paljak, T. (2019). *Atmosfäär käitus jõuliselt*. Postimees, 6.11.2019.

Pandey, A. K., Khan, A. I., Abushark, Y. B., Alam, Md. M., Agrawal, A., Kumar, R., & Khan, R. A. (2020). Key Issues in Healthcare Data Integrity: Analysis and Recommendations. *IEEE Access*, *8*, 40612–40628. https://doi.org/10.1109/ACCESS.2020.2976687

Raju, E., & da Costa, K. (2018). Governance in the Sendai: A way ahead? *Disaster Prevention and Management*, *27*(3), 278–291. https://doi.org/10.1108/DPM-08-2017-0190

Rapp, J., & Loim, T. (2019). *Torm tegi suurt kahju, Võru linn oli tormi tõttu tunde elektrita*. Lõuna-Eesti Postimees, 27.10.2019. https://lounapostimees.postimees.ee/6811513/fotod-ja-video-torm-tegi-suurt-kahju-voru-linn-oli-tormi-tottu-tunde-elektrita

Riigi Teataja. (2020). *Measures for preventing the spread of coronavirus SARS-CoV-2*. https://www.riigiteataja.ee/viitedLeht.html?id=8

Emergency Act, (2020). https://www.riigiteataja.ee/en/eli/516052020003/consolide

Public Information Act, (2001). https://www.riigiteataja.ee/en/eli/ee/514112013001/consolide/current

Saluveer, E., Raun, J., Tiru, M., Altin, L., Kroon, J., Snitsarenko, T., Aasa, A., & Silm, S. (2020). Methodological framework for producing national tourism statistics from mobile positioning data. *Annals of Tourism Research*, *81*, 102895. https://doi.org/10.1016/j.annals.2020.102895

Shadmi, E., Chen, Y., Dourado, I., Faran-Perach, I., Furler, J., Hangoma, P., Hanvoravongchai, P., Obando, C., Petrosyan, V., Rao, K. D., Ruano, A. L., Shi, L., de Souza, L. E., Spitzer-Shohat, S.,

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

Sturgiss, E., Suphanchaimat, R., Uribe, M. V., & Willems, S. (2020). Health equity and COVID-19: Global perspectives. *International Journal for Equity in Health*, *19*(1), 104. https://doi.org/10.1186/s12939-020-01218-z

Shao, W., Jackson, N. P., Ha, H., & Winemiller, T. (2019). Assessing community vulnerability to floods and hurricanes along the Gulf Coast of the United States. *Disasters*, *44*(3), 518–547. https://doi.org/10.1111/disa.12383

Sherly, M. A., Karmakar, S., Parthasarathy, D., Chan, T., & Rau, C. (2015). Disaster Vulnerability Mapping for a Densely Populated Coastal Urban Area: An Application to Mumbai, India. *Annals of the Association of American Geographers*, *105*(6), 1198–1220. https://doi.org/10.1080/00045608.2015.1072792

Silm, S., Järv, O., & Masso, A. (2020). Tracing human mobilities through mobile phones. In *In: Büschner M, Freudendal-Pedersen M, Kesselring S, Grauslund Kristensen N (eds). Handbook of Research Methods and Applications for Mobilities* (pp. 182–192). Edward Elgar Publishing. www.e-elgar.com/shop/gbp/handbook-of-research-methods-and-applications-for-mobilities-9781788115452.html

Sparf, J. (2016). Disability and Vulnerability: Interpretations of Risk in Everyday Life. *Journal of Contingencies and Crisis Management*, *24*(4), 244–252. https://doi.org/10.1111/1468-5973.12120

The Ministry of Economic Affairs and Communications. (2020, February 12). *Estonian Ministries Report Cybersecurity Incidents and Data Breach*. https://www.mkm.ee/en/news/estonian-ministries-report-cybersecurity-incidents-and-data-breach

Tierney, K., J. (2019). *Disasters: A Sociological Approach*. Polity Press.

Trischler, J., Pervan, S. J., Kelly, S. J., & Scott, D. R. (2018). The Value of Codesign: The Effect of Customer Involvement in Service Design Teams. *Journal of Service Research*, *21*(1), 75–100. https://doi.org/10.1177/1094670517714060

United Nations. (2015). *Sendai Framework for Disaster Risk Reduction 2015—2030*. United Nations.

Ventrella, E. (2021). *COVID-19 and Data Protection in Emergency Circumstances*. Trilateral research. https://www.trilateralresearch.com/covid-19-and-data-protection-in-emergency-circumstances-2/

Wisner, B. (2016). Vulnerability as Concept, Model, Metric, and Tool. In *Oxford research encyclopedias.* Oxford University Press. http://naturalhazardscience.oxfordre.com/

Wisner, B., Blaikie, P., Cannon, T., & Davis, I. (Eds.). (2004). *At risk: Natural hazards, people's vulnerability, and disasters* (2nd ed). Routledge.

World Health Organisation. (2020). *WHO Timeline: COVID-19*. https://www.who.int/news/item/27-04-2020-who-timeline---covid-19

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

# ANNEX 1

## Interview guide

1. Describe from your experiences and knowledge, who has been in need of support in this crisis? Why?
2. What has made these individuals in need of support?
3. Have there been individuals that have needed help unexpectedly from your or other organisations?
4. Could there have been individuals that have remained out of support? Whose responsibility would it have been to offer support to these individuals?

### Scenario analyses

5. How would the factors of need for support differ a) in densely populated areas (towns and cities) and b) in sparsely populated areas (villages)? What had made the individuals in these areas in need of support?
6. How would have the need for support differed when the crisis had happened during a) a cold period, e.g. -10C; b) on a warmer season? What had made these individuals in need of support?

### Information sources on vulnerability

7. What kind of sources of information you have relied on when finding out about the individuals in need?
8. Have you used any databases or registries to find out about the individuals in need? *(refer to the factors of vulnerability mentioned in question 2 with regards to the sources of vulnerability)*
9. What kind of databases could be used in times of crisis to identify individuals in need?
10. If it was possible to combine various databases, what could the responding organisations and the individuals in need gain? What do you see as benefits of merged database for identifying those in need?
11. What would be the weaknesses and/or threats of using such merged database for identifying those in need?

### The organisation of responding to individuals in need

12. Who should have an overview of individuals potentially in need of support in preparing for crisis? In response phase?
13. Based on the crisis experiences, how would you assess the capacities of your organisation/ other organisations in identifying and responding to those in need of support in crisis?
14. What are the strengths of current arrangements in identifying and responding to those in need in crisis? What are the weaknesses in current arrangements?

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

# ANNEX 2

## List of interviews

| Nr | Time | Institution/Organisation |
|---|---|---|
| 1 | 23.04.2021 | Data Protection Inspectorate, legal counsellor |
| 2 | 17.03.2021 | Estonian Association of Power Plants and District Heating, CEO |
| 3 | 05.02.2021 | Statistics Estonia, focus group interview with the managers |
| 4 | 03.02.2021 | Estonian Government Office, head of National Situation Centre |
| 5 | 29.01.2021 | Ministry of Social Affairs, representative of social welfare department |
| 6 | 27.01.2021 | Rescue Board, representative of emergency preparedness department |
| 7 | 12.01.2021 | Information System Authority, focus group interview |
| 8 | 04.01.2021 | Health Board, manager of the department of emergency medicine in time of the emergency situation in spring 2020 |
| 9 | 22.12.2020 | Police and Border Guard Board, representative of the Information Office |
| 10 | 16.12.2020 | Social Insurance Board, regional manager of Valga region |
| 11 | 03.12.2020 | Rural municipality, deputy mayor of Põlva County |
| 12 | 25.11.2020 | Rural municipality, mayor of Rõuge County |
| 13 | 24.11.2020 | Tartu city government, head of the social and health care department |
| 14 | 19.11.2020 | Rescue Board, representative of regional preparedness office of South Estonia |
| 15 | 18.11.2020 | Rescue Board, regional manager of Saaremaa County |
| 16 | 13.11.2020 | Rescue Board, regional manager of Võru region |
| 17 | 30.06.2020 | Tallinn Social Work Centre, resocialisation accommodation, manager |
| 18 | 17.06.2020 | Welfare Centre, night shelter and resocialisation unit, manager |
| 19 | 16.06.2020 | Department of social welfare, one of Tallinn district governments, senior specialist |
| 20 | 08.06.2020 | The Salvation Army day centre, coordinator |
| 21 | 29.05.2020 | The Salvation Army alcohol rehabilitation centre, manager |

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

# ANNEX 3

Table-top exercise discussion groups

1) “Social welfare” group (members from Social Insurance Board, Tartu City Government, AS Hoolekandeteenused (a welfare services company), Information System Authority, Estonian Rescue Board, University of Tartu, Baltic Defence College);

2) “Health care” group (members from Health Board, University of Tartu, The Tartu Ambulance Foundation, Social Insurance Board, Information System Authority, Estonian Red Cross);

3) “Internal Security” group (members from Estonian Police and Border Guard Board, Estonian Rescue Board, The Estonian Internal Security Service, Information System Authority, Emergency Response Centre, Estonian Red Cross);

4) “Vital services” group (members from Tartu City Government, Estonian Rescue Board, Information System Authority, electricity network operator Elektrilevi OÜ, Ministry of Economic Affairs and Communications, University of Tartu);

5) “Management of local communities” group (members from Võru Development Centre, Tartu Rural Municipality, Võru City Government, Põlva Rural Municipality, Naiskodukaitse (Women´s voluntary defence organisation), Positium OÜ (company developing methodologies to use mobile data).

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No. 833496

# ANNEX 4

In current analysis, we focus on the resolving of emergencies in three cases: disruption of electrical supply, pandemic and cyber-incident. The following gives an overview of responding to these events according to the national emergency response plans.

**Disruption of electrical supply**

Disruption of electrical supply mostly affects sewerage and water supply, mobile and data communication service, heating of buildings and other related services. Following the emergency response plan, the Ministry of Economic Affairs and Communications coordinates the activities of electricity supply service providers and state support in resolving emergencies. In disruption of electrical supply, electricity provision-company is responsible for the rapid restoration of electricity supply. Rescue Board manages the related emergency response and performs rescue work. Rescue Board supports the Ministry of EAC in coordinating the related partners in the regional and local level. Rescue Board also decides on the involvement of other authorities in the emergency management. Police and Border Guard Board participates in informing and warning people in the emergency area and directs the large-scale evacuation (Päästeamet, 2019). Local government advises the rescue service on local conditions. Other authorities for example Health Board, Defence League and Forces, Social Insurance Board involves resolving the emergency as far as possible and providing professional assistance needs on the basis of a mutual agreement on rescue work.

**Epidemic**

Epidemic is managed according to the emergency response plan for a health event (https://www.riigiteataja.ee/akt/106112020003?dbNotReadOnly=true). A health event has a direct and far-reaching impact on a person's life and health. This may include serious injury, burns, infectious diseases and poisoning. The event has far-reaching consequences for permanent injuries, complications and other health impairments, including psychosomatic in the context of mental health and post-traumatic disorders. Health emergencies can be caused by pathogens of different origins with outbreaks and epidemic potential. When various adverse risk factors appear or coincide, the spread of an infectious disease may be significantly more intense than usual and the outbreak may take the form of epidemic. A health event in an emergency has a significant impact on ambulances and hospitals as emergency care providers.

Health Board manages the resolution of a health event emergency, establishes an emergency management structure and decides on the involvement of other bodies and persons and coordinates the resources needed to deal with the emergency involvement and use {Citation}. Police and Border Guard Board mainly provides professional assistance in emergency situations to control the spread of the epidemic restraining orders and other restrictions on freedom of movement and public restrictions on holding meetings and events. Health Insurance Fund provides funding for health services in times of crisis. Other authorities for example Rescue Board, Defence League and Forces, Social Insurance Board and local government involves resolving the emergency as far as possible and providing professional assistance needs on the basis of a mutual agreement on rescue work.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

**Cyber-incident**

State and government institutions or any other service providers (e.g. emergency response, gasoline, banks, transportation and telecommunication, physical and judicial persons) are obliged to ensure the security of the network and information system[2], i.e. the ability of the system to resist any activity that compromises the availability, authenticity, integrity and confidentiality of the data processed in the system or of the services provided or accessed through the system Following the Cyber Security Act (§ 3). Cyber-incident means any event in the network and or information system compromising or having an adverse effect on the security of the system. Following the cyber-incident emergency response plan (Ministry of Economic Affairs, 2020), a large scale cyber-incident may involve a long-term cease of services or attack, this may also involve information leakages, compromised or halted functionality of service. Such large scale incident may jeopardize the information systems of state-wide services or institutions that threatens the state security, lives and health of numerous people or key infrastructures.

In case of a large scale cyber-incident, Information System Authority (ISA) manages emergency response to restore the security of network and information systems (Ministry of Economic Affairs, 2020). ISA also decides on the involvement of other authorities in the emergency management and the related mobilisation and use of resources. ISA directs the assessment of the impact of an emergency on other vital services. Security Police Board supports ISA in solving the cyber-incident threatens the constitutional order, territorial integrity or involves terror attack. Also the Police and Border Guard Board supports the ISA in resolving cyber-incidents and prevents and detects cyber-crimes. Furthermore the voluntary based Estonian Defense Forces Cyber Command, including The Estonian Defense League's Cyber Unit supports the ISA in resolving a cyber-incident, controlling and resolving information and communication technology infrastructure (Estonian Government, 2014).

[2] Network and information system means an electronic communications network within the meaning of subsection 2 (8) of the Electronic Communications Act, any device or group of interconnected or related devices, one or more of which, pursuant to a program, perform automatic processing of digital data, or digital data stored, processed, retrieved or transmitted by aforesaid elements for the purposes of their operation, use, protection and maintenance.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496

# CONTACT US


www.buildersproject.eu


@BuildERS_EU


https://www.facebook.com/Builders-2762442730463980/


https://www.linkedin.com/company/builders-h2020

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 833496