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When emergencies, disasters, or crises (are about to) occur, people in The Netherlands can be alarmed and informed by NL-Alert, the siren, radio, tv, social media, news websites, www.crisis.nl, the websites of the safety regions, and other people. Previous research on reach and effectiveness of these means of communication generally did not focus on certain groups of people. The research questions of the current investigation are:

1. Which vulnerable groups can be distinguished in the context of alarming and informing people in case of (looming) emergencies, disasters, and crises? Within which context(s) can these groups be considered as vulnerable?
2. To what extent and how can the safety of these vulnerable groups in the context of alarming and informing people in case of (looming) emergencies, disasters, and crises be increased with the existing means of crisis communication or are additional means needed? If so, which means?

These questions are investigated using different methodological instruments, that is: a) literature study vulnerable groups, b) interviews crisis communication professionals, c) focus groups vulnerable people, d) analyses websites, forums and social media and e) literature study crisis communication in other countries.

a) On the basis of the literature study several groups can be identified as vulnerable in the alarming and informing phase of a crisis situation: people with auditory, visual, and speech impairments, people with cognitive and/or neurological, and temporary disabilities, elderly, children (particularly younger than 12 years), people with language barriers (illiterates, people with low literacy, tourists, and migrants), people with low socioeconomic status, socially isolated people, and prisoners. The literature study also shows that the amount of time in which people can be warned, together with the nature of the disability, determines to what extent groups are vulnerable in different phases of a crisis situation.

b) The results of the interviews with crisis communication professionals are that the professionals mainly identify three groups as vulnerable: people with cognitive and/or

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neurological disabilities, elderly, and people with language barriers. The results also show that the safety of vulnerable groups can be increased by providing people with more information in advance. This can be done, for instance, with campaigns and evacuation practices on schools and in districts starting with a NL-Alert message. People can also be stimulated to increase their own safety in crisis situations, for instance by setting up NL-Alert and installing (smoke) detectors and sensors. The professionals also suggest to increase the safety of the vulnerable groups by developing a registration system for vulnerable people, by making use of people who are nearby (i.e., buddy system), and by sending a link to more information (websites) in a NL-Alert message.

c) The findings of the focus groups are that:

- children between the age of 12 and 18 years, people with cognitive and/or neurological disorders, and blind and visually impaired people will be reached by sufficient means of communication in a crisis situation;
- elderly, illiterates, and people with low literacy will mainly be reached by the siren and tv, elderly also by neighbours;
- deaf and hard of hearing people, tourists, and migrants will not be sufficiently reached by NL-Alert, the siren, radio, and other people;
- illiterates, people with low literacy, deaf and hard of hearing people, tourists, and migrants have a reduced or no understanding of warnings by NL-Alert and/or the siren;
- the educational level of participants within the groups strongly varied and most participants did not have a job. Therefore, no conclusions can be drawn about the role of socioeconomic status on alarming and informing in crisis situations;
- people who are more socially isolated do not differ in the number of means through which they will be alarmed and informed in crisis situations from people who are not or less socially isolated.

The majority of participants prefer to be alarmed and informed in crisis situations by a text message on their mobile phone which can interrupt the silence or vibrate mode. Elderly, illiterates, and people with low literacy prefer more traditional ways of warning, such as radio, tv, the siren, and other people. Additionally, the results of the focus groups show that participants

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would like to receive warnings and information presented by different channels adjusted to language and to language level.

d) The analyses of the websites, forums, and social media show that complaints and wishes on the subject of crisis communication of vulnerable groups is not a topic of frequent occurrence on websites, forums, and social media. Frequently discussed topics on the subject elderly in crisis communication are the siren and the preservation of the siren.

e) The findings of the literature study on how other countries alarm and inform people in a crisis situation show that many countries use a variety of communication channels, which increases the probability to reach vulnerable groups. Specific ways to increase the safety of vulnerable people are: informing people using training, website with video's in different languages and modalities, local people (door-to-door checks, buddy system), personal digital assistants, identification tags, and traditional methods, such as radio, tv, and sirens.

Taken together, the research shows that:

1. Groups that can be distinguished as vulnerable in the context of alarming and informing in case of (looming) emergencies, disasters, and crises are:

- Deaf and hard of hearing people
- People with language barriers (illiterates, people with low literacy, tourists, and migrants)
- Elderly (65 years and older)
- Children younger than 12 years
- People with a cognitive and/or neurological disorder
- People with low socioeconomic status

The factors amount of warning time, nature of the disorder, and people's location and activities at the time of the crisis situation determine to what extent people will be warned in time and whether they understand the communicated information. Due to the nature of the disorder of the groups deaf and hard of hearing people, people with language barriers, elderly, children younger

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than 12 years, and people with low socioeconomic status, these groups will be reached by a reduced number of communication channels and have difficulties understanding information. People with cognitive and/or neurological disorders have difficulties understanding information.

The research also shows that:

2. The safety of vulnerable groups in the context of alarming and informing in case of (looming) emergencies, disasters, and crises can be increased by:
 - Adjusting and/or expanding existing communication means:
 - offering warnings and information in different languages and modalities (sign language, braille, to be played by Voice over, subtitles, English and preferably own language) and adjusted to language level
 - interrupting silence and vibrate mode on mobile phone by NL-Alert
 - more often send link to further information in NL-Alert message
 - Informing people more (i.e., with trainings, campaigns, evacuation practices) and stimulating the use of (smoke) detectors and sensors
 - Additional means, such as registration or buddy system and e-mail messages

The additional value of the suggested means to increase the safety of vulnerable groups is not often systematically investigated in scientific research, but is partly supported by analyses of crisis situations (i.e., hurricane Katrina in 2005 and the earthquake and tsunami of Japan in 2011). Also, making use of a diversity in communication channels increases the probability to reach vulnerable groups.