Funded by
the European Union

eNOTICE-2
EU Network of Training Centres for preparedness to CBRN Events

D5.1: Existing methodologies for assistive devices decontamination

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Dissemination level

PU	Public - fully open (automatically posted online on the Project Results platforms)	X
SEN	Sensitive - limited under the conditions of the Grant Agreement	
EU classified	RESTREINT-UE/EU-RESTRICTED, CONFIDENTIEL-UE/EU-CONFIDENTIAL, SECRET-UE/EU-SECRET under Decision 2015/444	

Document Information

Grant Agreement n°	**101139905**
Project Title	EU Network of Training Centres for preparedness to CBRN Events
Project Acronym	eNOTICE-2
Project Coordinator	Université catholique de Louvain (UCLouvain)
Document Responsible Partner	Fire Department of Dortmund (FDDO)
Document Number	D5.1
Document Title	Analysis of the state of the art (decontamination of assistive devices)
Dissemination Level	PU
Date of Delivery	New date August 31, 2024

Partners involved in the Document

N°	Participant organisation name (short name)	Check if involved
1	Université catholique de Louvain (UCLouvain)	X
2	Campus Vesta APB (VESTA)	X
3	**Fire Department of Dortmund (FDDO)**	**X**
4	University of Rome Tor Vergata (UNITOV)	X
5	Joint CBRN Defence Centre of Excellence Vyškov (JCBRND COE)	X
6	Middle East Technical University (METU)	X
7	Fondazione SAFE	X
8	Associated partner: West Midlands Police (WMP)	X

Circulation list

- European Commission
- eNOTICE-2 Consortium

Executive Summary

The following deliverable sets the focus on the state of the art concerning the decontamination of assistive devices for vulnerable people. Here, to understand the challenge of the decontamination of assistive devices it is a prerequisite to articulate

a.) Understanding of the basic requirements of end user as well as patients with disabilities (intersection with WP6)

b.) Understanding of the available assistive devices

   a. Structure of selected devices

   b. Use of the devices

   c. Limitations of the devices / Aspects to consider

c.) Understanding of different decontamination processes

   a. Civil approach

   b. Military approach

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1. Available assistive devices

The term “disability”, as used in eNOTICE-2 D5.1, refers to a condition or function that significantly impairs a person's physical, mental, or sensory abilities and necessitates the use of an assistive device. In the following sections will describe the main assistive devices that the project addresses.

In the realm of emergency response, the decontamination of individuals is a critical process, especially in scenarios involving hazardous materials or biological threats. For people with disabilities, this procedure presents unique challenges that require specialized supportive devices to ensure their safety and well-being. The European project eNOTICE-2 aims to address these challenges by equipping first-responders, including firefighters, civil protection and emergency health responders, with the necessary tools and knowledge to effectively decontaminate individuals with disabilities and assistive devices.

According to the European Council[1], in 2022 27% of the EU population over the age of 16 had some form of disability. This is comparable to research in the UK[2], which estimates that 23% of adults of working age have a disability, rising to 45% in those over 65 years of age. According to Eurostat estimates, that equals to 101 million people, or one in four adults in the EU, and approximately 16 million people in the UK[3]. The percentage of people with a disability per country in the EU shows the countries that had the highest share of people with disabilities in 2022 were: Latvia: 38.5%, Denmark: 36.1%, Portugal: 34%. For the EU Member States of eNOTICE-2 consortium the figures are the following – Belgium: 25.6%, Czech Republic: 26.6%, Germany: 30.3%, Italy: 22.7%. The UK estimate is 24%.

The older the person gets, the more likely he/she is to have a disability. The share of people with disabilities by age group in 2022 is the following:

- From 16 to 19 years: 8%
- From 20 to 24 years: 9.5%
- From 25 to 34 years: 11.3%
- From 35 to 44 years: 14.7%
- From 45 to 64 years: 26.9%
- 65 years or over: 52.2% (45% in the UK).

[1] https://www.consilium.europa.eu/en/infographics/disability-eu-facts-figures/#:~:text=How%20many%20people%20have%20a,people%20adults%20in%20the%20EU [28.06.2024]

2 Commons Library Research Briefing 09602, UK disability statistics: Prevalence and life experiences, House of Commons Library, 23 August 2023.

[3] *Ibid*.

The population ageing largely influences the trends associated with people being registered as disabled. An increase in the proportion of older groups in the population tends to lead to an increase in primary disability. In addition to medical and biological factors, the negative socio-economic conditions contribute to the growth of disability, where disability is also linked to poverty and social exclusion: according to the WHO[4], disability primarily affects vulnerable groups: women – in average around 9% more women than men experiencing some form of disability, the elderly, the poor. As economic activities are paramount across the EU member states, it is also important to note that specific categories of workers are more exposed to accidents and health risks – and therefore face a higher likelihood of disabilities and the need for assistive devices - than the general population, often due to the nature of their work, the environments they operate in, or the tasks they perform. Examples include workers in the construction, healthcare, agriculture, manufacturing, transportation of goods, and even first responders themselves.

Among these individuals with some form of disability, a significant proportion require assistive devices to manage daily activities and emergencies. In fact, data from the Academic Network of European Disability experts indicates that nearly 60% of people with disabilities in Europe rely on at least one type of assistive device, ranging from mobility aids to communication tools.[5]

While the primary focus of decontamination (especially mass decontamination) is to save lives by processing as many people as quickly as possible, decontaminating assistive devices remains a significant challenge for emergency responders. This process requires additional expertise, human resources, and specialised equipment. It is also likely that a specific tracking procedure will need to be developed to ensure that the correct devices are reunited with their owners after decontamination. This is particularly challenging for small items, such as eyeglasses or hearing aids.

The necessity for specialized assistive devices becomes even more pronounced in emergency situations. Based on figures provided above (European Council[1]: 27% of the EU population over the age of 16) may have some form of disability, we can assume that in the event of a CBRN crisis, emergency responders could encounter 2 to 3 individuals with assistive devices that require decontamination.

Standard decontamination procedures often fail to account for the diverse needs of individuals with disabilities, potentially compromising their safety and the effectiveness of the response. Therefore, the development and implementation of specifically adapted decontamination procedures are paramount.

[4] https://www.who.int/news-room/fact-sheets/detail/disability-and-health [28.06.2024]

[5] Grammenos, S. (2020): European comparative data on Europe 2020 & People with Disabilities, Centre for European Social and Economic Policy (CESEP ASBL), Academic Network of European Disability Experts (ANED)

In this chapter, we will explore the various supportive devices used by people with disabilities. We will examine their design, functionality, and integration into emergency protocols. Additionally, we will discuss the ongoing efforts and innovations within the "eNOTICE-2" project, highlighting the advancements made to support firefighters and civil protection in their critical role of ensuring the safety of all individuals during decontamination procedures.

By focusing on the intersection of disabilities and emergency response, this chapter emphasises the importance of inclusive safety measures and the necessity of the decontamination of supportive devices of all citizens, ensuring no one is left behind in times of crisis.

1.1. Wheelchairs

The prevalence of severe walking disabilities increases significantly with age, leading to a higher demand for wheelchairs among older adults. Statistical data indicates that 30.9% of all people with severe disabilities in Europe are over the age of 75, while just approximately 4% are under the age of 25. A substantial 45% belong to the age group of 55-75 years. In Germany, it is estimated that there are approximately 1.6 million wheelchair users, while in the UK there were at least 586,000 wheelchair users registered in a survey in 2021/22[6], highlighting the critical need for effective decontamination procedures tailored to this population.[7]

In Italy, out of a sample of 11.8 million people aged age 15 and older with limitations in activities of daily living, 24,13% and 23,95% report having difficulty, respectively, in walking on a flat surface for 500 meters and to walk up or down a flight of stairs without the help of a person and the use of aids, such as canes and wheelchairs. Those aids, however, are not differentiated[8]. Therefore, the value shall be considered as reference also for the following paragraph referred to “Walking Aids” in general.

Wheelchairs come in various forms, each designed to meet specific needs and preferences (all prices are estimated due to current (2024) market research on several providers):

- Standard Wheelchair (€100): A basic, manual wheelchair suited for general use.
- Standing Wheelchair (ca. €800): Allows users to raise themselves to a standing position.
- All-Terrain Wheelchair (ca. €500): Designed for rough or uneven surfaces, providing greater mobility outdoors.
- Adaptive Wheelchair (ca. €250): Customized to fit the individual needs of the user.

6 wheelchair-economic-study-final.pdf (motabilityfoundation.org.uk)

[7] Rehdat (2015): Nur den Tag absitzen? Nichts für mich? Wie sich die berufliche Teilhabe von Rollstuhlnutzenden gestalten lässt. (=REHADAT-Wissen, Ausgabe 04). Köln. Online available: https://www.rehadat-wissen.de/ausgaben/04-rollstuhlnutzende/ [21.06.2024].

[8] Rapporto Osservatorio Salute 2022, p.257 and following, https://osservatoriosullasalute.it/wp-content/uploads/2023/06/ro-2022-disabilita.pdf (Accessed July 2024)

- Electric Wheelchair (ca. €400): Powered by batteries, offering enhanced mobility without manual effort.
- Commode Wheelchair (ca. €90): Incorporates a built-in toilet seat for convenience.
- Sports Wheelchair (ca. €350): Designed for athletic activities, featuring lightweight and durable construction.
- Multifunctional Wheelchair (ca. €450): Equipped with various features for versatility in use.
- Lightweight Wheelchair (ca. €200): Easier to manoeuvre and transport due to reduced weight.[9]

There are many challenges associated with a wheelchair DECON. As previously stated, this requires expertise, human resources, and specialised equipment, particularly to carry out the "dismantling-cleaning-reassembling" DECON cycle. Given the widespread use of water for decontamination, conventional cleaning cannot be directly applied to an electric wheelchair. Therefore, decontaminating an electric wheelchair requires careful attention to its various components to ensure thorough cleaning without causing any damage. The key parts to be decontaminated include:

- Frame: Made of aluminium, steel or titanium, the frame is the main structural component.
- Handles: Typically constructed from plastic, these are crucial for manoeuvring the wheelchair.
- Seat Cushion: Often made from foam, gel or air-filled materials, providing comfort and support.
- Covers: Usually crafted from nylon or polyester, these materials cover the seat and backrest.
- Wheels: Composed of rubber and/or polyurethane, they enable the wheelchair's mobility.

Electric wheelchairs, in particular, require specific care instructions during the decontamination process:

- Control Unit: Ensure that the control unit is switched off during cleaning to prevent accidental movement or activation of electric functions.
- Joystick Steering: Avoid touching the joystick steering during cleaning to prevent the wheelchair from starting to move.
- Batteries: Batteries contain acids that can pose health risks. Handle with caution to avoid leaks or spills.

[9] all prices are estimated due to current (2024) market research on several providers

- Cleaning Agents: Do not use organic solvents such as thinner, white spirit or turpentine, as these can damage the wheelchair. Also, avoid abrasive or harsh cleaning agents to prevent scratches.
- Cleaning Methods: Do not use high-pressure or steam cleaners as these can damage the electronic components and the overall structure of the wheelchair.

By adhering to these guidelines, emergency responders can effectively decontaminate wheelchairs, ensuring the safety and well-being of individuals with disabilities during emergency situations [10]. This approach not only enhances the effectiveness of the decontamination process, but also upholds the dignity and independence of wheelchair users.

1.2. Walking aids

In Europe, the need for walking aids is a significant concern, particularly among the elderly and those recovering from injuries. While comprehensive statistics on walking aid usage in Germany are lacking, data from Austria provides insight into the broader European context. A survey conducted in Austria in 2019 revealed that 2.3 % of respondents experienced great difficulty walking without the assistance of a walking aid. This statistic underscores the importance of accessible and effective walking aids to support mobility and independence[11].

The demand for walking aids is evident in the sales figures reported by manufacturers. For instance, in Germany over 550,000 rollators are sold on a yearly basis, highlighting the widespread reliance on these devices[12]. Walking aids encompass a range of devices beyond wheelchairs, each tailored to specific needs and mobility challenges.

- Walking sticks are one of the most common types of walking aids, for example, a UK survey in 2013 found that around 20% of the UK population used walking sticks to aid their mobility[13]. They help individuals maintain balance and make walking easier, particularly for those with joint problems. Walking sticks are crafted from various materials including wood, aluminium, carbon fiber, fiberglass, rubber, plastic and leather. Their simple yet effective design makes them a popular choice for enhancing stability and reducing the strain on joints.

- Crutches are primarily used after injuries or surgeries to support the recovery process. These aids help redistribute weight away from the injured limb, allowing for safer and more comfortable movement. Crutches are typically made from materials such as carbon, carbon fiber, aluminium, plastic, steel and rubber. Their design ensures

[10] Wie reinige ich meinen Elektrorollstuhl? | MC Seniorenprodukte (mc-seniorenprodukte.de) https://www.mc-seniorenprodukte.de/elektrorollstuehle-rollstuehle-elektrisch/ratgeber/wie-reinige-ich-meinen-elektrorollstuhl [21.06.2024].

[11] Bundesministerium Soziales, Gesundheit, Pflege und Konsumentenschutz (2019): 34ff. Österreichische Gesundheitsbefragung 2019 (statistik.at)

[12] Ärzte Zeitung (2017): Rollator der Zukunft; available: aerztezeituhttps://www.aerztezeitung.de/Politik/Rollator-der-Zukunft-305323.htmlng.de, [21.06.2024]

13 Use of mobility aids by gender in England 2013 | Statista

durability and adjustability to cater to different heights and weights. The 2013 UK survey referred to previously, found that around 1% of the UK population used elbow crutches to aid mobility.

- For individuals requiring more stability, a walking frame is often the preferred solution, for example, claimed to be used by around 6% of the UK population in the 2013 survey. Walking frames provide a stable support structure, making them especially useful for elderly people or those with significant mobility issues. They are constructed from materials like aluminium, steel, plastic and wood. The frame's design offers support, reducing the risk of falls and promoting confidence in movement.

Rollators represent another advanced type of walking aid, combining stability with additional features for convenience. These devices include a seating area and storage space, making them ideal for longer walks and shopping trips. Rollators are manufactured from materials such as aluminium, steel, plastic and rubber, ensuring both robustness and ease of use. The inclusion of wheels enhances mobility, allowing users to navigate their environment with greater ease.

Each type of walking aid serves a specific purpose, from providing basic balance support to offering comprehensive stability and additional functionalities. Understanding the diverse range of materials used in their construction (from lightweight aluminium and carbon fiber to durable steel and rubber) highlights the engineering behind these essential devices.

In conclusion, walking aids play a crucial role in enhancing the mobility and quality of life for many individuals across Europe. Whether through the use of walking sticks, crutches, walking frames or rollators, these devices help maintain independence and safety for those with mobility challenges. To be able to maintain the independence of contaminated citizens, emergency responders have to ensure a fast return or the provision of a substitutional aid as fast as possible.

1.3. Canes for the blind

The importance of decontaminating assistive devices for people with disabilities cannot be overstated, as these devices are crucial for maintaining their independence and safety. Among the various aids used by individuals with disabilities, canes for the blind and guide dogs play a pivotal role for those with visual impairments.

In Germany, statistics from 2019 highlight the significant number of individuals affected by visual impairments. There were 71,544 blind people, 46,858 people with a high degree of visual disability and 230,507 individuals with a minor visual disability.

In Italy ISTAT Data updated to 2023 report 108,416 people with blindness and partial blindness. Severe visual impairments affect 1.9% of the population from age 15 and up, with the percentage rising to 5% to those over 65 years old and 8% over 75 years old[14]

Canes for the blind are indispensable tools for navigation and safety. There are four main types of canes, each serving a specific purpose:

- The long cane for the blind is the most common type, used primarily for detecting obstacles in the environment. It extends from the ground to the user's chest or head and helps in navigating spaces by tapping or sweeping the ground ahead.

- The touch stick is designed for individuals who need minimal assistance. It provides a basic level of support and guidance, helping to detect obstacles at ground level.

- The signal stick serves as an identifier for people with visual impairments, alerting others to their condition. It is usually shorter and used to signal that the person may need assistance.

- The white cane is used by individuals who have both visual and walking impairments. It offers stabilization and support while also serving as a signal to others that the user has a visual disability. The materials used in the construction of these canes are chosen for their durability and light weight. The stick itself can be made from aluminium, plastic, wood, fiberglass and nylon. Handles are typically crafted from leather, rubber, plastic or wood, providing a comfortable and secure grip.

- In addition to canes, guide dogs are an invaluable resource for blind and visually impaired individuals. These specially trained animals offer mobility assistance, independence, and companionship. The process of training a guide dog involves rigorous and specialized training to ensure that the dog can safely navigate obstacles and respond to various environmental cues.

Decontaminating canes and guide dog harnesses is a critical aspect of maintaining the health and independence of visually impaired individuals. Canes, frequently in contact with various surfaces, can harbour contaminants that pose health risks. Proper cleaning of the cane involves using non-abrasive, non-toxic cleaning agents to avoid damaging the materials. Similarly, harnesses used by guide dogs need to be cleaned to prevent the build-up of dirt and bacteria, ensuring the comfort and safety of both the dog and its owner.

Overall, the effective decontamination of these supportive devices is essential in preserving their functionality and extending their lifespan. For the individuals who rely on them, these devices are more than just tools; they are lifelines that enable them to navigate the world with confidence and independence. By prioritizing the cleanliness and maintenance of canes and guide dog harnesses, we can help safeguard the health and autonomy of those with visual impairments, ensuring they can continue to live full and independent lives. One should not forget that the guide dog itself needs to be decontaminated. Especially breeds with longer

[14] Italian Ministry of Health, "La disabilità visiva in Italia", https://www.salute.gov.it/portale/prevenzioneIpovisioneCecita/dettaglioContenutiPrevenzioneIpovisioneCecita.jsp?lingua=italiano&id=2389&area=prevenzioneIpovisione&menu=vuoto (Accessed July 2024).

hair are to be decontaminated right away to avoid the unwanted spreading of the contamination.

1.4. Prosthetics

In Germany, a significant number of individuals rely on prosthetics to regain mobility and independence. In 2014 alone, there were 57,637 amputations recorded, with 48,561 of these being diabetes related. These amputations were categorized into 13,031 major amputations—those involving the lower extremity between the ankle and the body torso—and 35,530 minor amputations, which occur below the ankle. A gender breakdown of these statistics reveals that 25,855 minor amputations and 8,366 major amputations were performed on males, compared to 9,675 minor and 4,655 major amputations on females.[15]

Research published in 2023 in the UK found that 45,000 people rely on prosthetic limbs in the UK, with more than 5,000 people each year having new lower-limb amputations.

In Italy, available ISS data on amputations are updated to 2009. One of the major causes for amputation are complications related to diabetes. In that regard, more minor amputations are performed in the diabetic population than in the non-diabetic population while the frequency of major amputations is similar in the two populations. However, it should be noted that people with diabetes make up only 5 percent of the total population, so major amputation rates are more than 20 times higher than in the non-diabetic population. In 2009, amputations for diabetic patients were 9.3% per 100,000 residents on minor amputations and 3.8% on major amputations. For non-diabetic patients in 2009 minor amputations were 3.9% while major amputations were 3.8%. Amputations are twice as frequent in man compared to woman, and are strongly related to age, with values close to 0 under 40 and subsequently increasing as high as 50 per 100,000 residents in the population over age 70[16]. A 2022 report of the Italian Registry for Arthroprosthesis reported in year 2021 a total of 117.304 hip replacements, 81.992 knee replacements, 11.366 for shoulder replacements and 1,500 other types of replacements, with a median annual increment of 3.6% (based on data from 2001 to 2021)[17]. Prosthetics attach to a variety of body parts, including the face (nose and ear prosthetics), upper body (shoulder and chest prosthetics), arms (forearm, upper arm, full arm and elbow prosthetics), hands (partial hand, full hand, partial finger and full finger prosthetics), legs (below-knee, above-knee, whole leg and knee prosthetics) and feet (partial and full foot prosthetics). The decontamination of these devices is critical, especially for those that are partially or completely inside the body, such as nose, ear, shoulder, chest, and knee

[15] Kröger, K. et al (2017): Amputationen der unteren Extremität in Deutschland - Eine Analyse auf der Grundlage von Daten des Statistischen Bundesamtes im Zeitraum 2005 bis 2014, *Lower limb amputation in Germany — an analysis of data from the German Federal Statistical Office between 2005 and 2014*, Dtsch Arztebl Int 2017; 114: 130-6; DOI: 10.3238/arztebl.2017.0130

[16] Ospedalizzazione per amputazione dell'arto inferiore. Istituto Superiore di Sanità (https://www.epicentro.iss.it/igea/diabete/Amputazioni)
Registro Italiano ArtroProtesi, Report Annuale 2022 - Dati 2007-2021 https://riap.iss.it/riap/it/attivita/report/2023/11/07/report-annuale-riap-2022/ (Accessed August 2024).

[17] Registro Italiano ArtroProtesi, Report Annuale 2022 - Dati 2007-2021 https://riap.iss.it/riap/it/attivita/report/2023/11/07/report-annuale-riap-2022/ (Accessed August 2024).

prosthetics, which require specialized treatment during the decontamination process to prevent infections and other health complications.

Given the high incidence of lower extremity amputations, leg prosthetics are particularly common. These prosthetics are designed with several components, including the liner, the socket, the adapter between socket and knee fitting part, the knee fitting part, the adapter between knee and foot fitting part and the foot fitting part. Materials used in the construction of leg prosthetics include silicone, various foams and padding materials, polyethylene, carbon fiber, titanium and aluminium. These materials are selected for their durability, light weight and ability to withstand daily use. The decontamination of these various materials has to be determined and exercised while focusing on maintaining the prosthetics' complete functionality.

The costs associated with prosthetics can vary widely, reflecting the complexity and customization required. Arm prosthetics can range from €5,000 to €60,000,[18] hand and finger prosthetics from €1,600 to €60,000[19] and leg prosthetics from €150 to €20,000[20]. It is important to note that these prices are estimates and the actual cost of a prosthetic device can differ significantly depending on individual needs and specifications. In Germany, health insurance typically covers most of these costs, ensuring that necessary prosthetics are accessible to those who need them. However, due to high costs of manufacturing and the effort put into the fitment of prosthetics, the need for replacement due to damages by the decontamination process must be avoided at all costs.

Modern prosthetics often incorporate advanced technologies such as motion sensors and myoelectric systems. Motion sensors in leg prosthetics, for example, detect load and enable a natural walking pattern, with small connectors that are sometimes visible[21]. Myoelectric prosthetics, which use electrodes to detect muscle movements, allow for more precise control and functionality. These prosthetics are generally designed to be concealed under clothing and can be detachable or removable for ease of cleaning and maintenance.

The decontamination of prosthetic devices is essential for maintaining their functionality and preventing infections. External parts should be cleaned with gentle agents that do not damage the materials, while internal components, particularly those in contact with the body, require careful handling. Regular maintenance and proper hygiene practices are crucial for extending the lifespan of prosthetics and ensuring the health of the user.

[18] Armprothesen und Handprothesen (streifeneder.de) https://streifeneder.de/sanitaetshaus/produkte/prothesen/armprothesen/ [21.06.2024]

[19] Kein Anspruch nach Finger-Teilamputation | L 8 KR 171/07 (soziahttps://sozialversicherung-kompetent.de/krankenversicherung/leistungsrecht/281-finger-teilprothese-kein-anspruch-nach-finger-teilamputation.html#:~:text=Die%20Kosten%20f%C3%BCr%20die%20Finger [21.06.2024]

[20] Prothesen: Beine für die Dritte Welt - Medizin - Gesellshttps://www.planet-wissen.de/gesellschaft/medizin/prothesen/pwiebeinefuerdiedrittewelt100.htmlchaft - Planet Wissen (planet-wissen.de) [21.06.2024]

[21] Nach Informationen von Otto Bock: www.ottobock.de ;Universitätsklinikum Heidelberg/Klinik für Orthopädie und Unfallchirurgie: https://www.klinikum.uni-heidelberg.de/Myoelektrische-Prothese.110319.0.html ;Hoffmann KL, Dietl H: Handprothesen: Nach dem Vorbild der Natur. Dtsch Arztebl 2010

In conclusion, the decontamination of prosthetics is a vital aspect of care for individuals with disabilities. These devices significantly enhance the quality of life by providing essential support and mobility. Ensuring their cleanliness and proper functioning is crucial for maintaining the health and independence of those who rely on them, highlighting the importance of rigorous yet suitable decontamination protocols in emergency response.

1.5. Hearing aids

For people with hearing impairment, hearing aids are essential devices that enhance ability to communicate and interact with their environment, thereby improving their overall quality of life.

In Germany, there are 15.7 million individuals over the age of 14 who experience significant hearing disabilities, according to statistics from 1999[22].

In the UK, it is estimated that 1 in 6 of the adult population is affected by hearing loss, the majority being aged 60 and over, with around 2 million people using hearing aids[23].

In Italy, according to a 2022 research commissioned by the European Hearing Instrument Manufacturers Association (EHIMA) only 4.4% of the population uses hearing aids[24]. According to another dataset updated to 2019, 17.6% of the Italian population older than 15 years of age suffers from a moderate hearing loss, while 3.7% of the same reference group suffers from severe hearing loss[25].

The decontamination of hearing aids is crucial in maintaining their functionality and ensuring the health and well-being of the users, especially in the context of emergency situations where decontamination processes are critical. Moreover, without their hearing aids, individuals with hearing impairments may be unable to hear the orders or guidance of first responders, which could compromise their safety and the effectiveness of emergency response efforts. There are various types of hearing aids designed to accommodate different levels of hearing loss and user preferences. Behind-the-ear (BTE) hearing aids are suitable for those with up to 80-95% hearing loss and are known for their versatility and effectiveness. In-ear (ITE) hearing aids, on the other hand, are designed for individuals with up to 60% hearing loss and offer a more

[22] Statistiken | Deutscher Schwerhörigenbund e.V. (DSB) (schwerhoerigen-netz.https://www.schwerhoerigen-netz.de/statistiken/?L=0de) [21.06.2024]

23 Facts about hearing loss and deafness - British Academy of Audiology |British Academy of Audiology (baaudiology.org)

[24] Dispositivi acustici, cresce del 5% la popolazione che li utilizza. Confindustria Dispositivi Medici. 2022 (https://www.confindustriadm.it/comunicati-stampa/dispositivi-acustici-cresce-del-5-la-popolazione-che-li-utilizza-anche-per-la-pandemia/#:~:text=Confindustria%20Dispositivi%20Medici-,Dispositivi%20acustici%2C%20cresce%20del%205%25%20la%20popolazione%20che%20li,utilizza%20(anche%20per%20la%20pandemia)&text=Rimini%2C%204%20novembre%202022%20%E2%80%93%20Sebbene,4%25%20utilizza%20un%20apparecchio%20acustico.)

[25] Italian National Institute of Statistics, “Salute e ricorso a servizi sanitari, Italia e Ue - Anno 2019” https://www.istat.it/tavole-di-dati/condizioni-di-salute-e-ricorso-ai-servizi-sanitari-in-italia-e-nellunione-europea-indagine-ehis-2019/ (Accessed July 2024).

discreet option[26]. Hearing glasses, which integrate hearing aids into the frame of eyeglasses, provide a convenient solution for those who need both visual and auditory assistance. Hearing jewellery, such as earrings with embedded hearing aids, offers an aesthetically pleasing alternative for users. Additionally, hearing implants, which are surgically placed, provide a more permanent solution for severe hearing loss.

Maintaining and decontaminating hearing aids properly is vital to ensure their longevity and optimal performance. Users should always remove their hearing aids before showering, bathing or washing their hair to prevent water damage. It is also important to avoid applying makeup or cream near the hearing aid, as these substances can clog the device. Similarly, blow-drying the hearing aid should be avoided due to the risk of heat damage.[27]

For cleaning BTE hearing aids, users should wipe the housing with a cloth or gently rub it with a toothbrush to remove any debris. The plastic parts can be bathed in an alkaline solution made from a cleaning tablet to ensure thorough decontamination. ITE hearing aids require more delicate cleaning methods; users should employ special cloths, cleaning agents or brushes specifically designed for these devices and avoid using water, which can damage the internal components.

The materials used in hearing aids are selected for their durability and biocompatibility. These include acryl, photopolymers, “thermitec”, polyurethane, silicon and titanium for earmolds, while PVC is commonly used for sound tubes. These materials are designed to withstand daily wear and tear while providing a comfortable fit for the user[28].

In the context of decontaminating supportive devices for people with disabilities, hearing aids require careful attention. Proper decontamination not only maintains the functionality of the hearing aids, but also protects users from potential infections and health complications. By following recommended cleaning procedures and using appropriate cleaning agents, the emergency responders or the fire fighters can ensure the hearing aids remain in good working condition, thereby maintaining the independence and quality of life of the contaminated citizens.

In conclusion, hearing aids are indispensable for the millions of people with hearing disabilities. Ensuring their cleanliness through proper decontamination practices, whilst extremely challenging for emergency responders, is essential for the health and well-being of users. This is particularly important in emergency situations where exposure to contaminants may be higher. By adhering to cleaning guidelines and understanding the materials and types

[26] Hörgeräte Arten Übersicht: Welche Hörgeräte gibt es? (mobihttps://www.mobil-bleiben.de/hilfsmittel/hoergeraete/hoergeraete-uebersicht/l-bleiben.de) [21.06.2024]

[27] Hörgeräte Arten Übersichthttps://www.mobil-bleiben.de/hilfsmittel/hoergeraete/hoergeraete-uebersicht/t: Welche Hörgeräte gibt es? (mobil-bleiben.de) [21.06.2024]

[28] Hörgeräte Arten Übersicht: Welche Hörgeräte gibt https://www.mobil-bleiben.de/hilfsmittel/hoergeraete/hoergeraete-uebersicht/es? (mobil-bleiben.de) [21.06.2024]

of hearing aids, users can effectively maintain their devices and continue to benefit from their enhanced auditory capabilities.

1.6. Glasses

In Germany, glasses are a vital supportive device for a significant portion of the population. According to statistics from 2019, 41.1 million people aged 16 or older wear glasses, with 23.4 million of them wearing glasses permanently and 17.7 million using them casually[29]. A UK report in 2013 found that 69 percent (around 44 million) of people in the UK either wear corrective eyewear, or have had laser eye surgery to help them see better[30]. When it comes to Italy, 16.7% of the overall population suffers from for moderate limitations in vision. Overall 18.6 percent of the population suffers from some forms of visual impairments, a percentage that rises to 33.8 percent among those over 65 and 41.9 percent among those over 75[31]. In Italy, around 4 out of 10 people use corrective eyeglasses and/or contact lenses. 10.7% of children up to the age of 14 use prescription glasses; the value grows to 26.4% for people aged 15-19, 30% between 40 and 44 years, 50% from 44 and 49 years, and 67.6% from 75 to 79 years[32].

Visual aids are essential for ensuring that individuals can perform daily tasks effectively and safely, making their maintenance and decontamination especially important in emergency situations.

Glasses are composed of several components, each requiring specific attention during cleaning and decontamination. These components include lenses, nose pads, rims, bridge, hinges, temples and temple tips. The materials used in the construction of glasses can be broadly categorized into natural materials, plastics and metals. Natural materials such as wood, horn, leather, fabric and paper offer unique aesthetic qualities, but require special care. For instance, horn does not tolerate moisture or high temperatures and acetate, a type of plastic, can deform under high temperatures.[33]

Plastics used in glasses include acetate, polyamide and optyl (an epoxy resin). These materials are popular due to their versatility and durability. Metals such as titanium, stainless steel, nickel silver alloy and monel-alloy are also commonly used, providing strength and a sleek appearance. Each material has specific properties that influence how the glasses should be cleaned and maintained, especially under the stress of emergency decontamination.[34]

[29] Brillenstudie | ZVA https://www.zva.de/brillenstudie [21.06.2024]

30 beh_report_final_(1).pdf (wcb-ccd.org.uk)

[31] Italian Ministry of Health, "La disabilità visiva in Italia", https://www.salute.gov.it/portale/prevenzioneIpovisioneCecita/dettaglioContenutiPrevenzioneIpovisioneCecita.jsp?lingua=italiano&id=2389&area=prevenzioneIpovisione&menu=vuoto (Accessed July 2024).

[32] Social Security and Walfare. ISTAT (Accessed July 2024).

[33] Brillenfassung -Acetat, Titan..eine Materialübersicht | OPTIK-AKADEMIE https://www.optik-akademie.com/deu/info-portal/augenoptik/brille/fassungen/allgemein/materialien.html [21.06.2024]

[34] Pflegehinweise für Kunststoffgläser - Brillen, Lesebrillen, Kontaktlinsen hier bei ihrem Internetoptiker. (1a-sehen.de) https://www.1a-sehen.de/Pflegehinweise-fuer-Kunststoffglaeser:_:33.html [21.06.2024]

Lenses, the most crucial part of glasses, can be made from mineral or plastic materials. Plastic lenses can be further divided into duroplastics and thermoplastics. These lenses need careful handling to avoid scratches and maintain optical clarity. For plastic lenses, it is advised to clean them under lukewarm running water. Cleaning agents should not contain anionic surfactants and solvents, as these can damage the lens surface. While microfiber cloths are often used, they are not ideal for cleaning lenses. Instead, soft, lint-free cloths are recommended. It is important to avoid extreme temperatures and abrasive materials like paper towels or rough textiles, which can scratch the lenses. Household cleaners and washing-up liquids should be avoided as they can dissolve the protective coatings on the lenses. Exposure to temperatures above 65°C can cause cracks in the anti-reflective coating and temperatures above 50°C can lead to other forms of damage, permanently impairing visual comfort.[35]

In emergency situations where decontamination is necessary, these considerations become even more critical. Ensuring that glasses are properly cleaned without damaging them is essential for wearers being able to continue relying on their vision aids without interruption. Emergency responders must be aware of the different materials and appropriate cleaning methods to prevent inadvertently damaging these essential devices.

In conclusion, glasses are indispensable for millions of people in Germany, enhancing their quality of life and enabling them to perform everyday tasks. Proper decontamination and cleaning, especially in emergency situations, are crucial to maintaining the functionality and longevity of these devices. By understanding the materials and appropriate care methods, users and emergency responders can ensure that glasses remain effective and reliable aids for those who depend on them.

[35] Pflegehinweise für Kunststoffgläser - Brillen, Lesebrillen, Kontaktlinsen hier bei ihrem Internetoptiker. (1a-sehen.de) https://www.1a-sehen.de/Pflegehinweise-fuer-Kunststoffglaeser:_:33.html [21.06.2024]

2. Dealing with Decon of assistive devices

The topic of 'CBRN hazard defence' is very diverse and extensive. Describing all aspects and facets of dealing with a CBRN incident takes on very large dimensions and is not the focus of this deliverable. In the following sections, the focus is on the topic of decontamination and, in particular, the handling of assistive devices for vulnerable groups. In the following, examples of how the topic is dealt with in the respective countries are given based on the input of each partner involved. The aim here is not to provide a comprehensive description, but to show which initial approaches already exist and where they originated.

2.1. Germany

2.1.1. Fire Departments

A basic plan for German fire departments to be prepared for CBRN accidents is regulated by Fire Service Regulation 500 (*Feuerwehr-Dienstvorschrift - FwDV 500*). It includes a series of measures to ensure that the emergency services and their equipment are ready for action and adequately prepared for potential hazards. The relevant topics of the FwDV 500 consist of the following sections:

I. General guidelines

1. General information about hazardous substances
    - Risk due to hazardous substances
    - Preparatory measures
    - Special equipment (incl. Measuring devices)
    - PPE
    - Training
    - Operation
        - Reconnaissance
        - Gathering information
        - Situational assessment
        - Definition of areas
        - Decontamination (injured, equipment, staff)
    - Structure of units during CBRNe operation
        - Tasks of rescue units within the CBRN operation

II. Special guidelines

2. Special regulations concerning RN-Operations
    - Tasks of units
    - PPE
    - Measuring devices
3. Special regulations concerning B-Operations

- Tasks of units
- PPE
- Measuring devices

4. Special regulations concerning C-Operations
    - Tasks of units
    - PPE
    - Measuring devices

III. Attachments

- Glossary
- 4-A Rule for the CBRN-operation
- Decon matrix for the Fire Department
- Demarcation of risk areas
- …

One of the most important aspects of preparedness is the training of emergency responders. This training includes theoretical knowledge about different types of hazardous substances, their properties, risks and handling, as well as practical training in the use of specialized equipment and emergency decontamination procedures.

Process of decontamination:

The process of decontamination is divided into three levels. These are used for different scenarios, which are explained in the following section.

Level 1 – Instant decontamination:

The first of the three levels is instant decontamination. This level is used in the first phase of the operation and can be done with the help of any fire truck. For example, this level may be necessary if a person needs to be rescued without any advanced CBRN equipment. Setting up the decontamination equipment must be finished at the same time as the first rescue team enters the hazardous area.

The target of instant decontamination is to gross decontaminate injured persons as quickly as possible. To do this, the person is washed with water on a tarp and is undressed. This ensures that immediate life-saving measures can be carried out without endangering yourself or others.

Level 2 – Standard decon:

For the standard decontamination, the fire department uses advanced CBRN equipment. This is carried out by a special decon unit of the fire department. It must be set up after 15 minutes, from the time the first special team of CBRN-units enters the hazardous area. In contrast to the level 1, the standard decontamination is divided into a separate black and white area. The black area has separate stations for undressing and a shower, that is used for the decontamination. After the successful decontamination, the person can enter the white area.

Level 3 – Extended decon:

For contaminated persons without life-threatening injuries, decontamination level three is set up. This stage can also be necessary for special hazardous substances, large numbers of injured people or for adverse weather conditions. Some additional advantages of extended decontamination are the ability to use hot water and to collect large volumes of wastewater in the decon area. For this purpose, a container tent solution is set up in which both mobile and lying persons are professionally decontaminated. Hot water treatment, changing facilities and, depending on the hazardous substance, disinfection facilities are available for this purpose. If a person is not able to walk, they are pushed through the decontamination route lying on a spineboard with the help of a roller system.

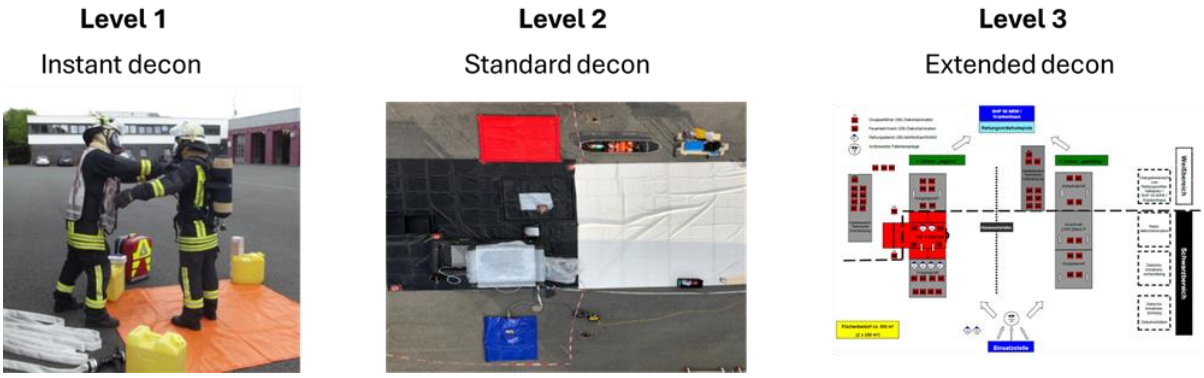


Figure 1: Process of decontamination (Source: FDDO)

In the first moments of a hazardous substance incident, emergency responders cordon off a radius of at least 50 meters around the accident site. This area is known as the hazardous area. Only those emergency personnel with special equipment who need to work there are allowed to be present in the hazardous area. However, these distances are only a rule of thumb and must be increased and modified if the hazardous substance spreads due to wind or topography. A radius of at least 100 meters around the hazardous area marks the shut-off zone. The equipment, specialized vehicles and personnel required for the operation are located inside the shut-off zone.

The decontamination area for the emergency services is located at the boundary of the two areas. The decontamination station for contaminated persons is located next to it or separately. The yellow area indicates the patient tray for people who will be decontaminated later.

Contaminated casualties with life-threatening injuries are still quickly and roughly cleaned via decontamination level 1 and transported to a hospital, as saving their life generally outweighs the remaining risk posed by small quantities of hazardous substances.

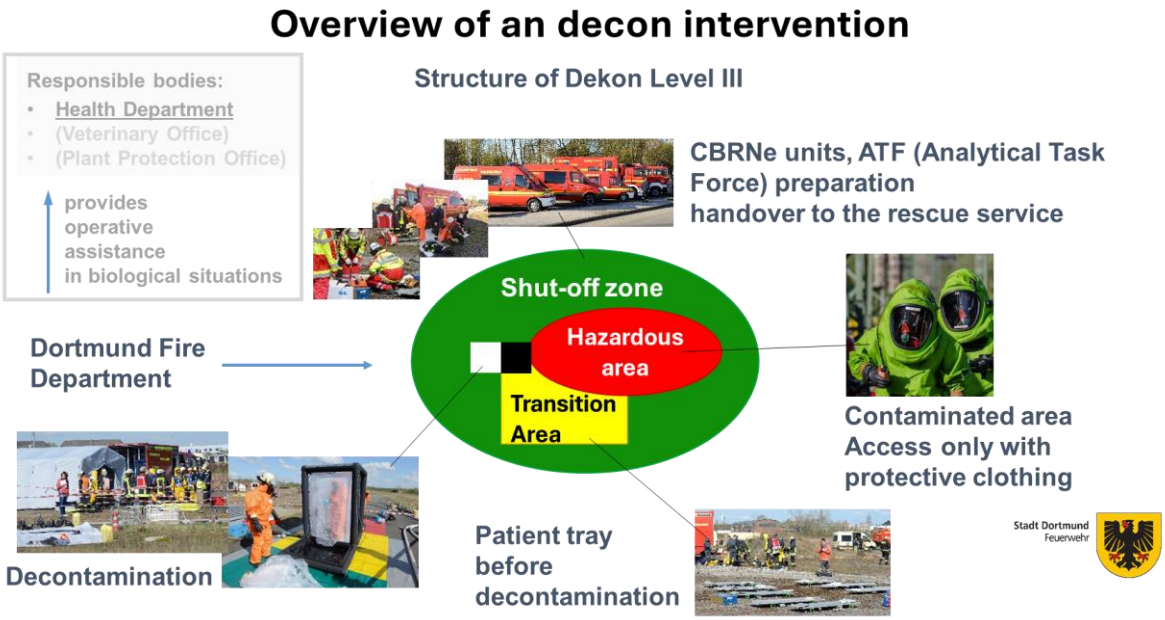
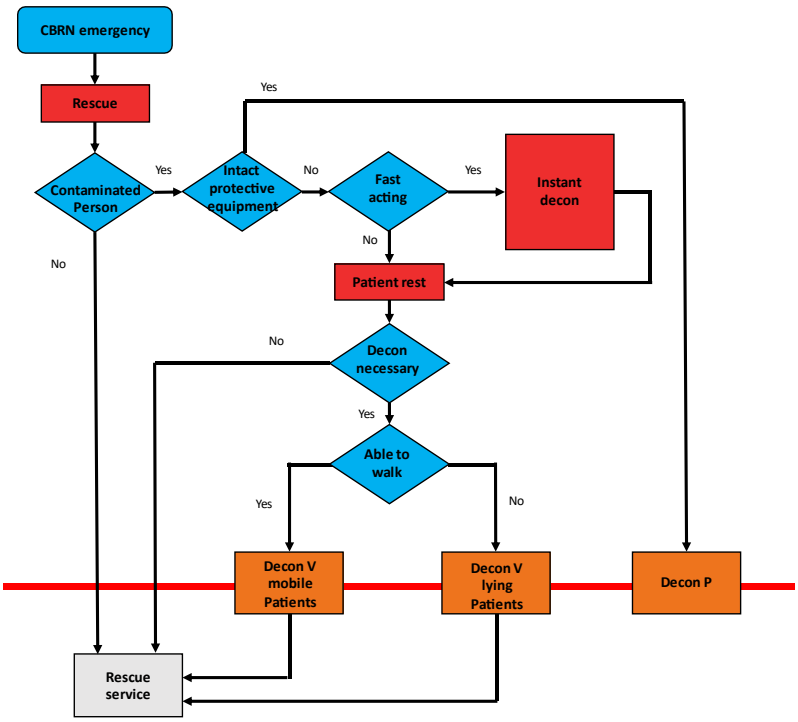


Figure 2: Decontamination areas (Source: FDDO)

Overall, the FwDV 500 ensures that the operation is carried out according to a structured and professional approach in order to effectively manage hazardous situations and ensure the safety of people, the environment and property. By adhering to these standards of the FwDV 500, emergency services can respond safely and effectively to dangerous situations and help to save lives and minimise damage.

Different decontamination lines

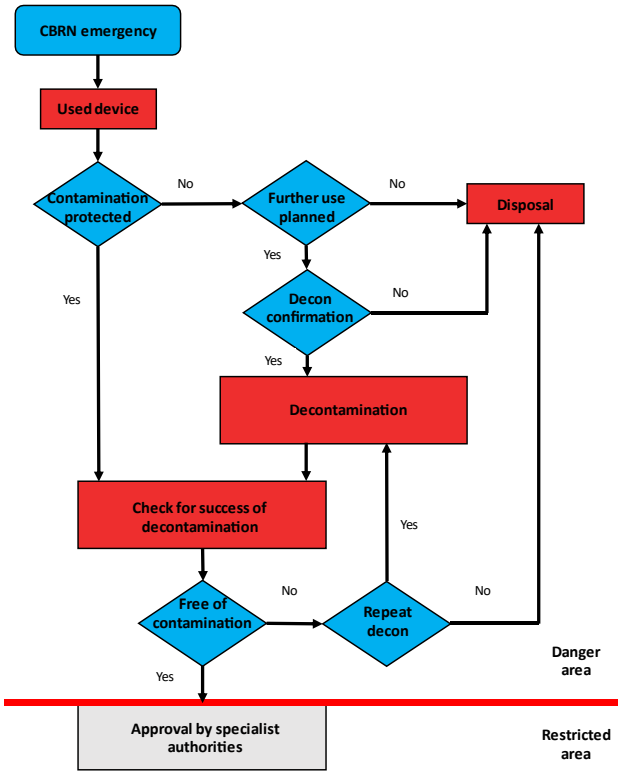
The following is a flow chart showing an example of a decontamination decision path.



Persons (P):
All persons who have worn intact protective equipment

Injured persons (V):
All persons who were unprotected in the contaminated area

Figure 3: decon of people (incl. injured people) (Source: FDDO based on Ehrmann et al. 2020[36])



Differentiation between:
- Robust devices (Tubes)
- Sensitive devices (Radio Comms)
- One-time-use devices (Disposable protective suits)

Procedure for sensitive devices:
- Remove adhering substances with binding cloths
- Wash carefully with wetting agent solution or solvent
- Final cleaning

[36] K. Ehrmann, A. Kühar: CBRN Schutz in der Gefahrenabwehr – 1.Auflage - ISBN 978-3-17-030975-3 – Kohlhammer, Stuttgart – 2020

Figure 4: Decon of devices (Source: FDDO based on Ehrmann et al. 2020[37])

The correct selection and use of specialised equipment and measuring devices is crucial for the success of operations. Training, provision of equipment and development of operational plans ensure that the emergency services have the necessary skills, knowledge and resources to successfully fulfil their tasks. FwDV 500 places great emphasis on the provision of specialised equipment, including measuring devices, to assist the emergency services in dealing with hazardous situations involving dangerous substances and goods. This equipment plays a crucial role in recognising, analysing and assessing hazards and in implementing emergency response measures. Some examples of measuring devices are:

Gas detectors:
Gas detectors are portable measuring devices used to measure the concentration of hazardous gases in the ambient air. They can detect various gases such as carbon monoxide, carbon dioxide, oxygen deficiency and combustible gases. Gas detectors enable emergency services to recognise potential hazards at an early stage and react appropriately, for example by determining the need for respiratory protection or the evacuation of people from contaminated areas.

Radiation detectors:
Radiation detectors are used to measure radiation levels in the environment. They can detect different types of radiation such as alpha, beta and gamma radiation and measure their intensity. Radiation detectors are particularly important in operations involving radioactive materials, such as accidents in nuclear power plants or the transport of radioactive substances.

Chemical analysers:
Chemical analysers are portable devices used to analyse the composition of chemical substances. They can be used, for example, to identify unknown substances or to determine the concentration of certain chemicals in the air or on surfaces. This information is important for assessing hazards and determining suitable protective measures.

2.1.2. Federal Police

In addition to the fire department, the federal police also possess a decontamination unit. It uses tents in a similar way to the fire department. In contrast to the fire department, this decon unit is only used for tasks during police operations. This includes the decontamination of emergency personnel and of injured persons. Other tasks are the decontamination of evidence and repackaging it in transport containers or the decontamination of persons who are subject to police measures.

[37] K. Ehrmann, A. Kühar: CBRN Schutz in der Gefahrenabwehr – 1.Auflage - ISBN 978-3-17-030975-3 – Kohlhammer, Stuttgart – 2020

For future operations the federal police is currently searching for better decon methods. The main reason being their current decon equipment requires too much set-up time. Further disadvantages are the high personnel approach and the dependence on the weather.[38]

Tasks during police operations:

- Decontamination of emergency personnel (also of injured persons)
- Decontamination of evidence and repackaging in transport containers
- Decontamination of Persons who are subject to police measures

Problems:

- Depending on weather conditions
- Set-up time
- Personnel approach

Figure 5: Decon-unit Federal Police[39]

To find a better solution the federal police is a member of the project funded by DG ECHO rescEU mechanism. The goal of this project is to create a supra-local CBRN-decontamination capacity that can be activated when the capacity of an EU Member State is insufficient.

The project leader is the Federal Agency for Technical Relief. The other project partner is the Federal Office of Civil Protection and Disaster Assistance. The rescEU decon unit in Germany is one of three projects which are funded by the EU for the time period May 2022 to 2026.[40]

- From May 2022 to 2026
- 100% EU funding with a total budget of 37.5 million euros

Technisches Hilfswerk
BUNDESPOLIZEI
BBK Bundesamt für Bevölkerungsschutz und Katastrophenhilfe

The unit will consist of 300 emergency personnel, 30 trucks and around 30 vehicles (trailers and minibuses)
It will consist of four modular parts:
1st unit - Decontamination of infrastructure (buildings and roads)
2nd unit – Decontamination of vehicles
3rd unit – Decontamination of small devices or packages containing evidence
4th unit – Decontamination of capable of walking and non capable of walking persons

[38] https://media.frag-den-staat.de/files/foi/850136/bpoldekon.pdf [21.06.2024]

[39] https://media.frag-den-staat.de/files/foi/850136/bpoldekon.pdf; https://www.bfs.de/SharedDocs/Kurzmeldungen/BfS/DE/2019/0520-zub-praxisschulung.html; https://www.ln-online.de/lokales/herzogtum-lauenburg/ratzeburger-bundespolizei-gut-geruestet-OMRGL3PW5QDX22EZQCEF6A36UA.html [21.06.2024]

[40] https://www.thw.de/DE/Im-Einsatz/Ausland/Internationale-Zusammenarbeit/Projekte/_documents/cbrnecon.html; https://www.bundespolizei.de/Web/DE/04Aktuelles/01Meldungen/2023/02/230221-cbrn.html; https://www.bbk.bund.de/SharedDocs/Pressemitteilungen/DE/2023/02/pm-21-resceu.html [21.06.2024]

2.2. Belgium

For as far as the legal framework for dealing with CBRNe (de)contamination is concerned, reference is made to the relevant documents in point 2.2.1.

It needs to be said that Belgium – on a federal level – is reviewing its approach to the CBRNe (de)contamination. The National Crisis Centre of the country is currently developing a CBRNe doctrine, that will form the framework for further operationalisation. This means moving away from regional and zonal SOPs and procedures towards national SOPs and procedures.

The information contained in this deliverable thus shows an example of how decontamination could be arranged in one region. In this, we tried to use as much information that is applicable to all or multiple regions.

Nonetheless, it is important to consider that this information is prone to change and adaptation.

2.2.1. Relevant documents

- Royal decree establishing a national emergency plan for tackling a criminal incident or a terrorist attack involving chemical, biological, radiological or nuclear agents (CBRNe)[41] (sensitive- not publicly available)
- Royal decree establishing a nuclear and radiological emergency plan on Belgian territory[42]
- Royal decree amending the royal degree of 10th of June 2014 determining the missions and tasks of civil security carried out by the emergency response zones and the operational units of Civil Protection and amending the Royal Decree of 16 February 2006 on emergency and intervention plans[43]

2.2.2. Working together

The two main governmental organisations dealing with decontamination, are the fire department and the civil protection.

The fire department in some regions (zones) is in possession of a decontamination unit/ shower that allows for small-scale decontamination.

The civil protection is responsible for the coordination of mass decontamination and is in possession of decontamination equipment with a larger capacity. In addition to that, possibilities of cooperation (amongst others within the scope of public private partnerships) are being looked at. The ratio of the latter is that private companies often have a more

[41] https://crisiscentrum.be/nl/documentation/wetgeving?search_documents=CBRN [21.06.2024]

[42] https://crisiscentrum.be/nl/documentation/wetgeving/1032018-koninklijk-besluit-tot-vaststelling-van-het-nucleair-en [21.06.2024]

[43] https://etaamb.openjustice.be/nl/koninklijk-besluit-van-20-september-2017_n2017013459.html [21.06.2024]

thorough knowledge and experience than the public organizations (e.g. in dealing with wastewater).

Apart from operational on-site decontamination, other guidelines exist for dealing with decontamination in e.g., hospitals.

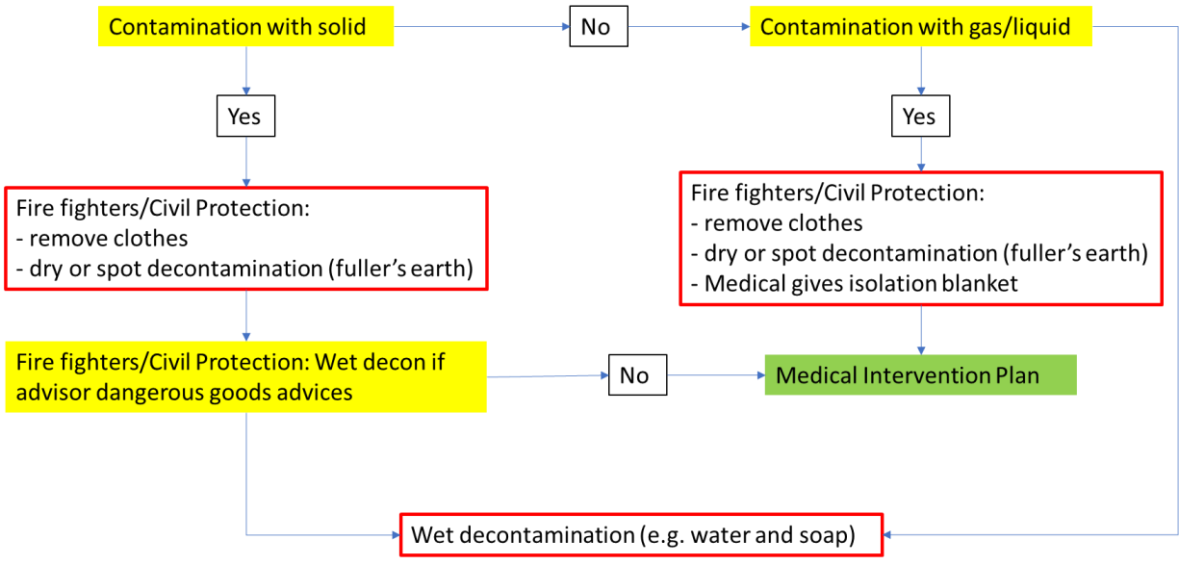


Figure 6: Flow of decontamination for the medical discipline[44]

Figure 6 shows the decision tree of decontamination as it is written down in the CBRNe guidelines for hospitals in Belgium. It describes the following steps.

- Reception of patient in the decontamination zone. A doctor performs a quick triage to see if immediate medical intervention is necessary. In the starting phase, this task can be performed by a firefighter paramedic.
- The patient is undressed in the undressing zone. For gas or vapor, this might be the only step necessary
- The advisor for dangerous goods decides whether wet decontamination is necessary. This could be when:
    - Contamination via a liquid or solid substance, inclusive powder and mist via the air.
    - Exposure to a gas or vapor if sufficient gas has remained or dissolved on sweaty skin. An indicator of this could be redness due to corrosive or irritating substances.
    - Exposure to gas, even with small exposure if there is still risk due to the high toxicity of the substance (e.g. CWA).
    - There is doubt whether the patient should be decontaminated.

[44] leidraad ziekenhuis: https://www.health.belgium.be/sites/default/files/uploads/fields/fpshealth_theme_file/crbn_znp_compressed_1.pdf [21.06.2024]

- Wet decontamination takes place in the shower rooms. This could be done laying on a stretcher. Armpits, skin folds and palms should be rinsed well.
- Drying the patient of and transporting them to a clean room
- Further medical treatment
- Descaling decontamination team

They also highlight that an external contamination should not transform into an internal contamination during the decontamination process and that communication with the victim is crucial. The privacy of the victim is also a point of interest.

The victims are also provided with clothing after they have gone through the decontamination.

2.2.3. Fire department

The fire department and civil protection both have – as stated before - decontamination equipment. They share the same SOPs with regards to IGS (incident with dangerous goods) and HAZMAT suits. On top of that, they share the same SOP with regards to setting up a decontamination field. The difference is that the fire department mostly works for improvised on site decontamination of a small-scale incident. This includes the decontamination of their own HAZMAT responders. The figure below shows the layout decontamination field.

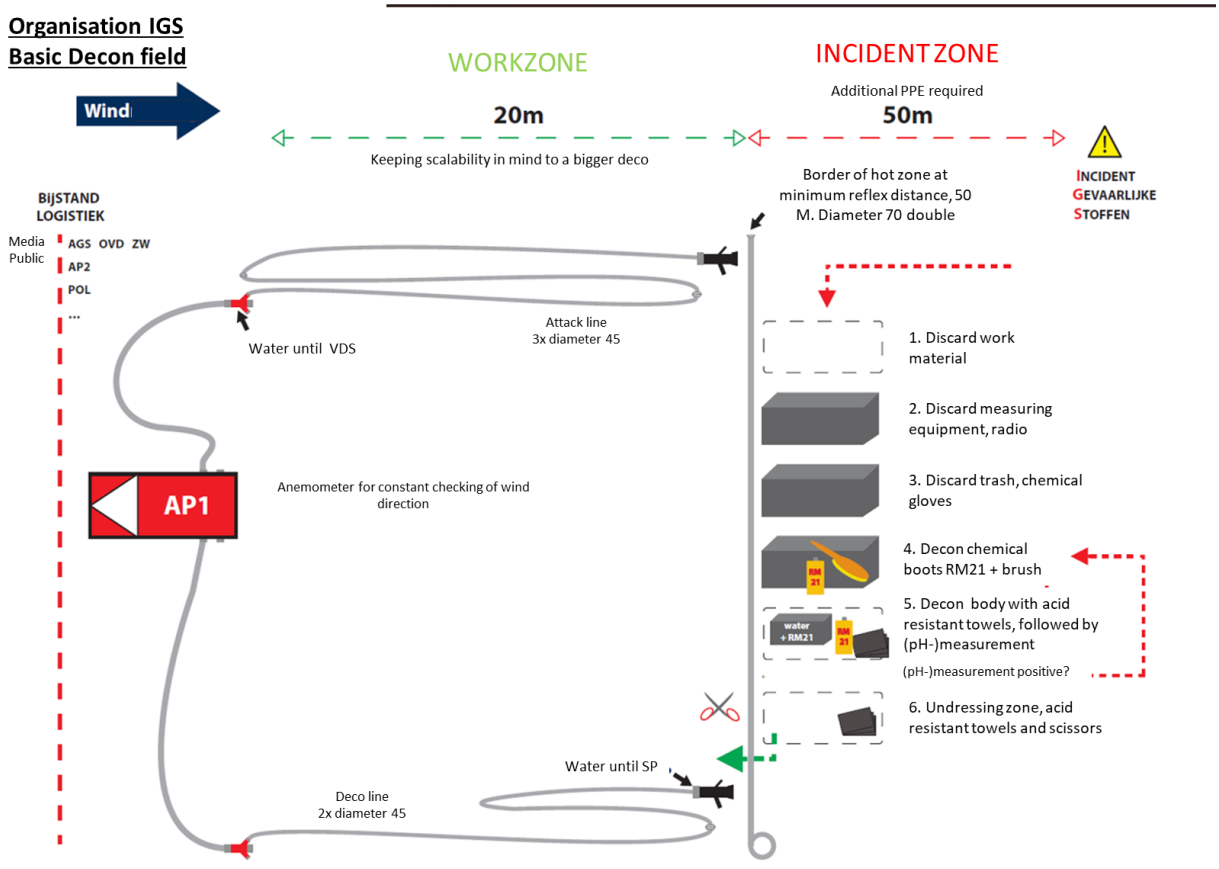


Figure 7: Basic decon field for dangerous goods, firefighters (Source: Vesta)

2.2.4. Civil protection

2.2.4.1. Levels of decontamination

Decontamination of personnel with a decontamination container[45]

This is a small mobile container or tent, mean to decontaminate personnel that have worked in the hotzone in HAZMAT suits.

Figure 8: Decontamination unit for Hazmat personel, civil protection (Source: Vesta)

Mass decontamination

There are two approaches towards mass decontamination. It is split up in a small mass decontamination and a large mass decontamination. The methodology for the large mass decontamination is being re-considered and being developed, but this deliverable will show some of the preliminary ideas.

For small mass decontamination, a mobile unit can be called. The Fig. 9, show the mobile mass decontamination unit that can be set up during an incident. It has two sides, one for people that can walk and one for people that cannot. For large mass decontamination, the idea is that stationary existing buildings will be used. In this case, these facilities have many showers

[45] https://www.civieleveiligheid.be/sites/default/files/explorer/partie_protection_civile/cataloguemodulepc_12_23_nl.pdf , p 35-39 [21.06.2024]

(some more than 60). It is either cut off from the sewers, or it can be cut of easily. The wastewater than get processed by a private company. Civil protection will coordinate in this case, but other organisations are still putting in effort. For example: the red cross for shelter of decontaminated victims, the municipality for fences and other logistic support etc.

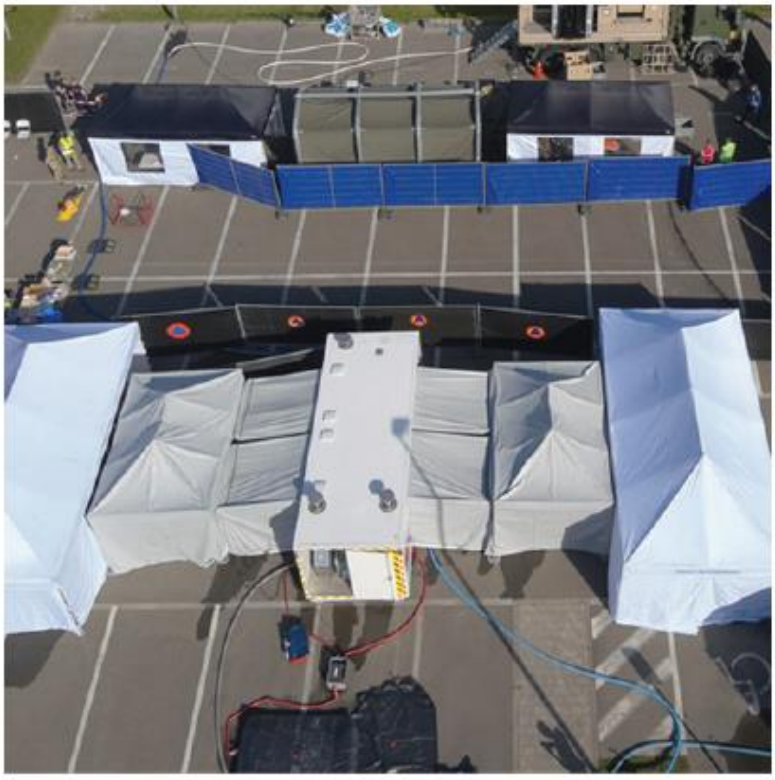


Figure 9: Mass decontamination mobile unit, civil protection (Source: Vesta)

<u>Decontamination of vehicles (high pressure and steam cleaning system, pool for water collection)</u>

The decontamination of vehicles can be done by placing the vehicle in a container and filling that container with 160 degrees of Steam. On top of that, there is a device (pictured below), that can be used outside of the container and that also produces 160 degrees steam. This method however is not safe for electronic devices or assistive devices that cannot withstand that heat. There is currently a discussion surrounding the decontamination of devices of the different disciplines. The outcomes of that discussion could also be of use for assistive devices of vulnerable people.

Figure 10: Equipment to decontaminate equipment and vehicles, civil protection (Source: Vesta)

2.3. United Kingdom

In the United Kingdom, whilst no specific decontamination procedures currently exist for disabled or neurodivergent people or groups of people, or any assistive devices they may use, the need to consider the specific needs of various vulnerable groups when responding to a CBRN event is set out in the guidance publication *Initial Operational Response (IOR) to Incidents Suspected to Involve Hazardous Substances or CBRN Materials*[46].

IOR recognizes that vulnerable people (not only those with disabilities or neurodivergence) can have different physical, communication, health, or cultural needs which need to be considered by emergency responders. IOR recommends considering the potential *functional* needs of vulnerable people, when planning for the management of IOR.

[46] National CBRN Centre, Coventry, UK, Version 1.1, June 2024

IOR separates peoples' functional needs into four broad areas:

- Impaired ability to physically react to a hazardous substance incident or undergo decontamination (e.g., any factors which make it physically challenging for individuals to undergo decontamination).
- Impaired ability to communicate during a hazardous substance incident or the decontamination process (e.g. any factors which make it difficult for individuals to hear, see, or understand instructions provided).
- Different social or cultural needs (e.g. cultural norms or religious norms).
- Pre-existing health factors or medical conditions (e.g. any factors which may make people more susceptible to the effects of contamination, or pre-existing conditions for which people need medication).

IOR emphasises the importance of understanding that the public perception of how the emergency services and other responder organisations interact, communicate and support vulnerable people, may be as significant as the impact of their actions themselves.

IOR also emphasises the importance of considering how responders and commanders identify, communicate and interact with vulnerable people during any response, ensuring that instructions are accessible, inclusive, actionable by all, timely and understood.

In relation to assistive devices, IOR recognises that there may be times when mobility equipment or assistance animals are present, and consideration should be given as to how they are managed during IOR. For example, IOR emphasises the significant, detrimental effect that the removal or retention of mobility equipment may have on users, necessitating responders to take a considered and pragmatic approach, supported by scientific advice, when dealing with such equipment.

IOR also recognises that the decontamination of service animals is a specialist activity requiring specialist resources and considerations. IOR again emphasises the importance of seeking scientific advice at the earliest opportunity in incidents where contaminated animals need to be managed.

2.4. Other (military sector)

The decontamination process involves reducing, neutralizing, or removing hazards from chemical, biological, radiological and nuclear (CBRN) substances that have accumulated on equipment and personnel. When prevention, precautionary and control measures fail to manage the hazard effectively, decontaminating personnel, equipment and materials becomes necessary. In certain cases, this may also extend to static installations and logistical facilities. Several principles guide the decontamination process:

- Timelines: Decontamination should occur as soon as possible to minimize exposure and spread of contaminants.
- Necessity: Only decontaminate what is essential, based on operational requirements.
- Proximity: Perform decontamination as close to the contamination site as possible to limit the spread of hazardous materials. The decon station must be installed at a toxic free, clean area.
- Prioritization: Prioritize decontamination efforts based on the level of threat and operational impact.
- Planning: decontamination plan should be developed (number and layout of decontamination stations, needed equipment, suitable decon method for CBR contamination, personal protective equipment, medical care, logistic support for decontamination material).

Decontamination may be either passive or active, depending on the urgency of the situation:

Passive Decontamination

Also known as 'Natural Decontamination' or 'Weathering,' passive decontamination relies on natural processes such as weathering or decay to mitigate hazards without human or mechanical intervention. While this method is time-consuming, it requires minimal manpower and logistical resources. Its effectiveness depends on environmental conditions like temperature, humidity, and wind, as well as the properties of the contaminated material and the type of contaminant. Items undergoing passive decontamination should be isolated and marked to indicate they pose a hazard.

Active Decontamination

Active decontamination involves using chemical, biological, or mechanical processes to remove or neutralize CBRN substances. This method is employed when contamination significantly impairs operational capabilities. Active decontamination is categorized into three levels:

Immediate Decontamination: Quick actions taken to save lives and prevent further contamination spread.

- Operational Decontamination: Measures that sustain operations by reducing the hazard to an acceptable level.
- Thorough Decontamination: Detailed decontamination that restores operational capabilities and ensures long-term safety.

Decontamination Procedures and Techniques

Military decontamination procedures typically **do not include specific techniques for assistive devices**. Standard decontaminants—comprising various liquids, slurries, foams and powders—are used to encapsulate, absorb, remove, neutralize or diminish CBRN hazards. These methods are applied, as much as possible, to assistive devices when necessary. While

decontamination is performed to protect health and safety, it can pose hazards under certain circumstances.

Civilian-Military Cooperation

Collaboration between civilian and military authorities is crucial for addressing the unique requirements of decontaminating assistive devices. Military authorities will evaluate the potential contribution of decontamination units in supporting these efforts, based on their capabilities and operational parameters.

Equipment Considerations

All equipment must be considered during decontamination. Some items may not be decontaminable and will need to be destroyed in a manner that minimizes waste. Alternatively, such items can be left in a designated weathering area to undergo natural decontamination processes.

Sensitive equipment (SE) includes items (e.g. computers and electronics) that cannot be decontaminated using standard methods, such as aqueous or organic-based liquid decontaminants, without compromising their performance, function. Sensitive equipment is also defined as material or equipment critical for military mission success, with functions essential to the system's effective operation.

Certain materials are deemed sensitive due to their chemical composition and their position within the system, such as interfaces between sensitive electronics. SE may not withstand exposure to CBRN substances or be suitable for common decontamination processes, potentially leading to degraded performance. Additionally, decontamination solutions or processes may not be effective if the decontaminant cannot reach the contaminants on or within the SE and a residual hazard remains.

When designing the system, it is crucial to identify sensitive equipment to plan for its operation in CBRN-contaminated environments. This approach ensures that SE is adequately protected and that effective decontamination measures are in place, preserving the functionality and safety of the entire system.

In summary, effective decontamination is essential to maintaining operational readiness and safety in environments where CBRN hazards are present. By adhering to established principles and leveraging both passive and active methods, military and civilian entities can work together to mitigate these threats.

Decontamination of sensitive materials in various environments, including military, industrial and emergency response settings, is a critical task that requires effective and reliable solutions.

Sensitive materials, such as electronic devices, medical equipment and communication systems, are crucial in many operational contexts. Their contamination by chemical, biological,

radiological and nuclear (CBRN) agents can lead to severe consequences, including equipment failure, data loss and health hazards. Effective decontamination ensures the functionality and safety of these materials, thereby maintaining operational integrity and safeguarding human health.

Some decontamination methods with the potential to decontaminate assistive equipment can be used in various decontamination systems:

- Gaseous methods (e.g., hydrogen peroxide).
- Enzymatic decontamination.
- Soft decontamination solution (peracid).
- Solvent-impregnated wipes.
- Thermal approaches.
- Vacuum techniques.
- pressurized multiphase (adsorbent, solvent/co-solvent and propellant) system.

The following chart provides a comprehensive overview of the existing decontamination methods and procedures.

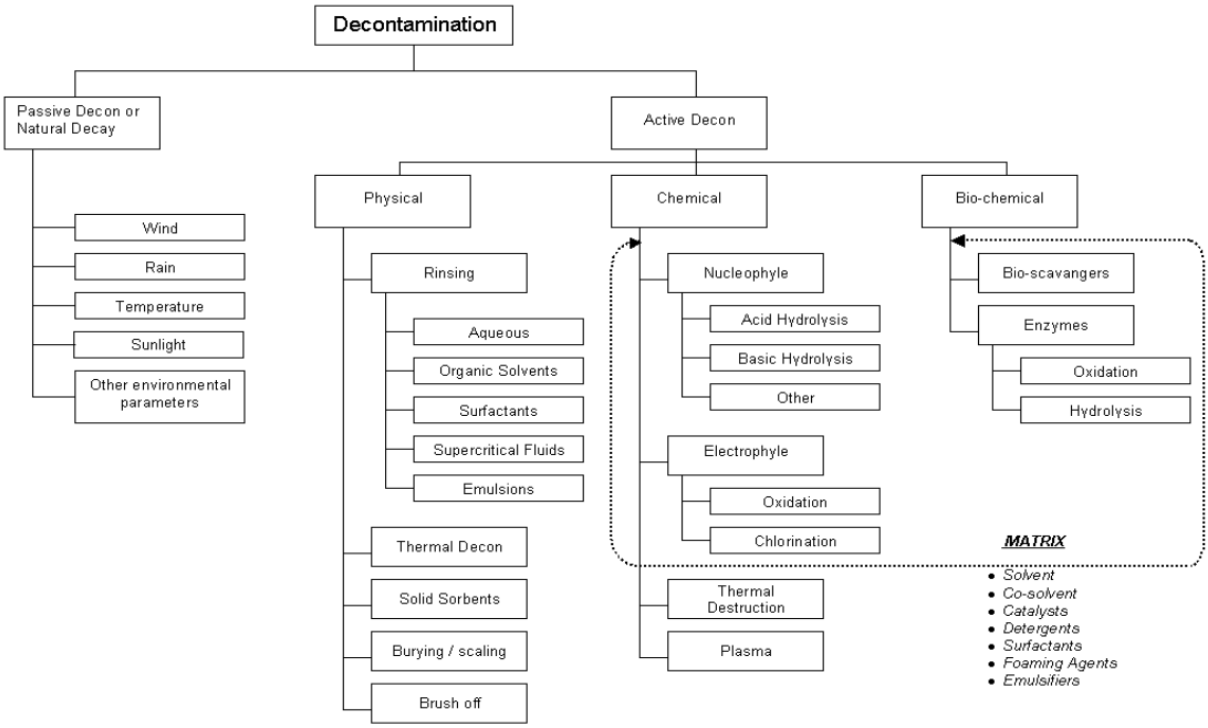


Figure 11: Decontamination methods and procedures chart (ANNEX A TO AEP-58, VOL 1)

Effective decontamination of sensitive materials involves using advanced formulations that combine both chemical and mechanical actions to neutralize contaminants. The process works through several key mechanisms.

Firstly, there's chemical neutralization. Decontaminating agents often contain active chemicals designed to react with CBRN contaminants, neutralizing their harmful effects. These chemicals break down complex contaminants into harmless substances without causing damage to sensitive materials.

Secondly, these formulations also facilitate the mechanical removal of contaminants. When applied, they form a protective layer that encapsulates the contaminants, making it easy to wipe or rinse them away.

Finally, compatibility with sensitive materials is crucial. Decontaminating solutions are specifically engineered to be non-corrosive and non-reactive with delicate materials. This ensures that electronic circuits, medical instruments and other sensitive components remain unharmed during the decontamination process.

Decontamination solutions are essential across various sectors, serving multiple critical purposes.

In the military and defence sector, equipment and communication systems often come into contact with hazardous substances. Decontaminating agents are crucial here, as they ensure that these critical assets are swiftly and effectively cleansed, maintaining operational readiness.

For emergency response teams, decontaminating agents are indispensable during chemical spills or biological threats. These agents cleanse protective gear and instruments, ensuring the safety of responders and the continued usability of essential equipment.

In healthcare settings, decontamination is vital to prevent the spread of infections. Reliable decontaminating solutions are used to cleanse sensitive medical devices, ensuring they remain functional and safe for use.

Finally, in industrial environments, where hazardous materials are frequently present, decontaminating agents play a key role in cleansing machinery and tools. This not only protects workers, but also helps maintain productivity by ensuring that equipment is safe to use.

Using effective decontaminating agents comes with several key advantages that make them invaluable in various situations.
Firstly, these advanced formulations are incredibly efficient. They provide rapid and thorough decontamination, which means minimal downtime and a quick return to normal operations. This efficiency is crucial in maintaining the flow of activities, especially in critical environments.

Safety is another major benefit. These decontaminating solutions are designed to be safe for both the user and the environment. By avoiding highly toxic chemicals, they ensure that the decontamination process does not pose additional risks, making them a responsible choice for various settings.

The versatility of these solutions is also noteworthy. They can be applied to a wide range of materials, which makes them suitable for different decontamination needs. Whether it's electronic devices, medical instruments or industrial machinery, these agents can handle the task effectively.

Lastly, the reliability of these decontaminating agents is backed by extensive research and field testing. Developed by experts in the field, they have been proven to perform consistently in critical situations. This reliability ensures that when decontamination is needed, these solutions can be trusted to do the job right.

Decontaminating sensitive materials is essential across many sectors. Effective, safe and versatile solutions neutralize and remove contaminants without harming delicate materials. These solutions are vital for maintaining the functionality and safety of critical equipment, safeguarding human health and ensuring operational integrity. As CBRN threats evolve, advanced decontamination solutions will continue to be crucial for protecting lives and maintaining readiness.

3. Requirements of end-users (vulnerable groups)

Decontamination is uncommon for the general population, including vulnerable and disabled individuals. People who are not familiar with it often do not know what to expect and how to handle this situation. This affects all sections of the population. It is a major challenge and a source of stress for everyone involved, both the emergency services and the people affected. This makes it all the more important to understand the needs and requirements of the various stakeholders for decontamination and the process itself. This applies both to the physical processes and to aspects such as communication. The following section focuses on these aspects.

Within the work on WP6, Task 6.1 – Mapping of end-users and stakeholders, gaps and needs analysis and Task 6.2 - End-users engagement and dissemination, UCLouvain approached patients, patient organisations and associations in Belgium with the aim to collect the user needs and requirements for the methodologies developed by eNOTICE-2. As of on 27.06.24, 22 interviews have been held in Belgium (conducted by UCLouvain) with a heterogeneous sample of participants connected to the field of handicap, either personally (patient representatives or relatives of persons living with handicap) or professionally (psychosocial manager for emergencies, director of a home for the elderly, nurse in childcare, specialised educators). Age ranged from 20 to 70 years old, participants lived or worked in the Brussels region or in Wallonia. Among the professionals, three of them have experience of collective emergencies as first responders. It is interesting that, among the patient representatives, 2 of them were also active as first responders when their condition still allowed it.

This section will present the preliminary results: as of 27.06.24, 12 additional interviews are planned while 11 other participants volunteered to share their experiences (date of the interview is still under discussion). To date, only 2 participants decided to cancel their participation before the interview. Finally, we are currently planning a group discussion with occupational therapists working in an expertise centre providing assistive devices for persons with disabilities.

Method

The detailed methodology of engaging users and conducting interviews will be presented in Deliverable 6.1. The data were collected through semi-structured interviews, supported by an interview guide and analysed based on the transcripts of the interviews.

Interview guide for patient representatives

Questions	Probes
INTRODUCTION	
To begin, I would like you to introduce yourself and explain why you have chosen to take part in this discussion.	What interested you when you first heard about this research? How did you hear about this study? How do the themes of this project concern you?
To what extent have you been personally confronted with an emergency situation?	What happened? If not, in your entourage?
EMERGENCY PREPAREDNESS This section aims at eliciting the degree of emergency preparedness of the participants. Each question corresponds to a preparation stage, leading to possibilities for actions. This is a part that can help for entering into the topic from a more general perspective.	
Does your association help its members about what they should plan for an emergency situation?	Why/why not?
To which extent your association tried to learn or find out more about how to prepare for emergencies?	Where did you find it? Which information?
To which extent your association advise for preparing an emergency kit? Have you collected resources that would be useful to you? Have you thought about how to leave your home in an emergency?	What's in the kit? Why did you do it?
To which extent have you taken actions to develop a plan for the members, their family or their household?	What's the content?
CBRNE	
What does CBRNe mean to you?	Have you ever heard of CBRNe? What do you think these letters stand for? Can you give examples of incidents that you think are CBRNe incidents?
Researcher defines CBRNe for the participants. *CBRN is the abbreviation commonly used to describe the use of Chemical, Biological, Radiological and Nuclear materials or weapons. The malicious use of such materials could cause significant harm or disruption. (from CBRNe glossary of the European Commission)*	
Now that we've explained what CBRNe incidents are, would you like to add anything/complete your answers?	

What does «decontamination » mean to you?	What words come to mind? What do we decontaminate? People, surfaces, objects?
The researcher defines decontamination. *The removal or reduction of hazardous materials from the undesirable place (contamination) to lower the risk of further harm and/or cross contamination.* *Dry decontamination: the use of techniques without water or liquids to decontaminate people or property.* *Wet decontamination: the application of water (or other liquids) to decontaminate people, property or infrastructures.* *Mass decontamination: the physical process of rapidly removing contaminants from a large number of people in the shortest possible time lapse, in potentially life-threatening situations to lower the risk of further harm and/or cross contamination.* *(from CBRNe glossary of the European Commission)*	
Now that we've explained what decontamination involves, would you like to add anything / complete your answers?	
In your opinion, if the professionals have to decontaminate you, what will they ask you to do?	How do you think this will work? Does it have to be dressed? Do I need to take medication?
The researcher explains the procedures of decontamination AND/OR present videos *The person needs to take a shower and brush himself/herself very carefully, every inch of the body, to remove any possible contaminant. Special attention - to the hair, hair absorbs a lot, so washing the hair (and beards for men!) is essential. If the person is wounded, injured or handicapped - cannot take the shower him/herself, then the firemen - first responders- do it for the person. The person is brought inside the decontamination tent on a stretcher, the clothes is cut off, removed and placed in the plastic bag and the person is put in the shower and treated with water and brushes.* *https://www.facebook.com/watch/?v=422692475036473* *https://www.youtube.com/watch?v=-50bBNTRcrk&t=629s*	
What do you expect from professionals **before** decontamination?	What is the information? What are the attitudes? What should they say? What should they do? What should they never say? What should they never do?
What do you expect from professionals **during** decontamination?	What is the information? What are the attitudes? What should they say? What should they do? What should they never say? What should they never do?

What do you expect from professionals **after** decontamination?	What is the information? What are the attitudes? What should they say? What should they do? What should they never say? What should they never do?
TRANSITION *As we explained earlier, decontamination is essentially based on "wet" techniques. This means that it will not be possible to decontaminate certain objects and aids to daily living without delay.*	
MANAGEMENT OF ASSSTIVE DEVICES AND HANDICAP	
In your opinion, what should be planned **BEFORE** decontamination / an incident to ensure that decontamination goes smoothly for these people? [Repeat according to the different assistive devices]	What should you have ready in case a CBRNe incident occurs?
Who should have this responsibility? Why is this important?	Who should organise the preparation?
In your opinion, what should be planned DURING decontamination to ensure that decontamination goes smoothly for these people? [Repeat according to the different assistive devices]	What resources are needed during the incident?
Who should have this responsibility? Why is this important?	Who should organise the response during the incident?
In your opinion, what should be planned AFTER decontamination / an incident to ensure that decontamination goes smoothly for these people? [Repeat according to the different assistive devices]	What resources are needed after the incident?
Who should have this responsibility? Why is this important?	Who should organise the post-incident response?
CLOSING	
What would you recommend for professionals who deal with people with disabilities during emergencies?	
We've come to the end of this interview. Would you like to add anything or complete any of your answers?	

3.1. Physical requirements

Participants firstly emphasised that handicap is a personal situation: each person has an individualised experience of the handicap, with heterogeneous needs and resources. Moreover, they also insisted that the persons with the more complex needs are likely to experience several handicaps (e.g. those with extreme mobility problems can also have respiratory problems, cognitive problems or sensorial limitations). They also stressed the need for considering invisible handicaps, that are not directly visible by first responders: this was, e.g., mentioned for persons living with Ehler-Danlos syndrome or those with Multiple Sclerosis. Several participants even stressed that those patients with cognitive problems or mental health problems are even more complex to manage as their reactions are difficult to predict and anticipate, leading to an individualised response for each person. From the interviews, it appears to be particularly the case for children or adults with autistic problems as their reactions could be violent or confronting for first responders. It was also mentioned by the professionals that – in general – first responders have few experiences with persons living with disabilities and that it could lead to inappropriate reactions (infantilisation, speaking too loud, impatience, etc.). Consequently, several participants feared that these persons are at risk of being excluded from proper care during an emergency. Some even feared that the first responders end up using force, violence or contention to force them to undergo decontamination. A participant therefore suggested that giving an anxiolytic could help those who are too stressed.

When it comes to physical requirements during the CBRN incident response and decontamination process, participants suggested to distinguish assistive devices whose removal is not harmful or life-threatening (e.g. audio prothesis, wheelchair) from devices that cannot be removed or should be replaced within minutes (e.g. respiratory assistance). Devices whose removal is life-threatening should be replaced in a minute of time while, for some devices, participants estimated that they can wait if support is offered providing a mechanic wheelchair, organising the possibility of staying in a health care facility instead of going back home without assistive devices, helping for quickly receiving a substitute. Some participants stressed that priority should be saving the life and preserving life. If a device is removed, other participants insisted that the priority should be helping patients regaining the autonomy as quickly as possible.

Some also distinguished devices that are tailor-made for the persons from devices that are more generic (without specific programming of the devices for the need of the persons). In the second case, it was perceived easier to provide a replacement.

They suggest keeping the devices as long as possible with the persons: when removed, the device should be clearly identified before being decontaminated. As these technologies are user-tailored, i.e. adjusted to the needs and physical features of every particular person, participants favour the option of decontaminating the individual device of the person as

quickly (and safely) as possible. Some suggested having a “material decontamination chain” in parallel to the “human decontamination chain”.

For those with mobility problems, **attention should be paid to the assisting a person with a disability**. As the victims may suffer from a neuromuscular disease, they won’t be able to help (e.g. for some, even lifting the head is not possible). If the time lapse allows it, it can be useful to have patient lift in the “dirty zone” for helping to the transfer. Patients can remain lying: it is maybe not relevant to have a wheelchair for each person. However, some patients cumulating a respiratory problem with a neuromuscular problem must be half-sitting. It should then be possible to have stretcher with lift-up backrest. Some persons with disabilities have also a certain degree of autonomy, meaning that being put on a stretcher may be not adapted. It was suggested to use “**shower plastic wheelchair**” for the decontamination, so that the person can preserve its autonomy and spare the professional resources.

While waiting for the decontamination or if the victims must travel to the decontamination tent, attention should be paid that not all persons that appear to be valid are able to walk the distance or to wait standing. Chairs for the waiting zone, wheelchairs for the small noria are then needed. After the decontamination, ensuring that persons can – comfortably- lie down, especially those with muscular problems, was pointed as important.

Moreover, some participants stressed that not all devices can be seen directly such as urinary catheters, stomas or parenteral probes. Participants were wondering how this can be managed by FR, as – in their view - this kind of material is not part of the standard equipment of an ambulance. Also, a participant recalled that some victims could have incontinence problems (it will be particularly the case if the incident takes place close to a nursing home or a home for the elderly or an institution for persons with polyhandicaps). After the decontamination shower, when dressed, it will be necessary to put on protections.

Additional devices were mentioned as important to consider as it is perceived by the participants difficult to replace and not suitable for an intensive washing: compression garments, orthopaedic insoles, adapted shoes, compression splints and cuddly toys.

Thorough the interviews, a particular category of devices also emerged: **the tablets and smartphones** that some persons will sensorial and/or cognitive problems use to communicate. For example, some persons with severe hearing loss have specific applications on their phone to communicate, same for persons with autistic disorders. Without these devices, there won’t be any form of communication possible: for some participants, it is not possible to envision removing these devices for more than the time of the decontamination. It was also pointed that diabetics use their cell phone (or similar device) to control their insulin pump and they need to monitor their glycemia.

Table 1 summarises the key ideas extracted from the questionnaires regarding physical requirements.

Table 1. Emergency Considerations for Vulnerable Groups: Physical Needs

Vulnerable groups: Physical requirements	
Individualised experiences	Participants highlighted that disabilities are unique to each person, requiring tailored approaches.
Cumulative handicaps and complex needs	Complex needs often involve multiple disabilities (e.g., mobility, respiratory, cognitive); patients with cognitive or mental health problems are challenging to manage due to unpredictable reactions.
Invisible disabilities	Invisible disabilities (e.g., Ehler-Danlos syndrome, Multiple Sclerosis) are not directly visible to first responders and need consideration during emergency responses.
First Responder Challenges	First responders may lack experience with disabilities, risking inappropriate reactions or exclusion from care; the fear from being exclude from care is real
Decontamination of Assistive Devices	Decontamination processes should start with tracking and tracing the device, differentiating between devices that can wait and those that require immediate
	Critical assistive devices : Assistive devices differ in their removal needs; some are non-critical, while others must be replaced immediately (e.g. respiratory assistance).
	Invisible devices and stomas : risk assesment should be conducted for medical or feeding probes, catheters,
	Tailor-made devices : They should be distinguished from generic devices, which are easier to replace.
Assiting a person with a severe disability	In case of mobility or respiratory needs: considering using a stretcher with a lift-up backrest to allow them to be half-seated or provide a chair in the shower. Comfortable lying positions should be ensured post-decontamination, particularly for those with neuro-muscular problems.

3.2. Psychological requirements

Whatever the nature of the impairment or of the disability, all participants insisted on the need for a **clear, continuous and calm communication**. As expressed by a participant, if there is a permanent communication, it will be easier to remove the assisting devices as the victims are reassured. Some participants also stressed that they understand that the situation requires rapid actions and that it is not a moment when one can start an in-depth dialogue. Consequently, these participants suggested to communicate more regularly in “normal” situations to help persons to prepare themselves.

The choice of the words used is important during the emergency situations such as saying disabled persons or just “disabled”.

Verbal communication is important, but also **additional communication strategies** as pictograms for the deaf and hearing-impaired persons are needed, and these recommendations were confirmed also by the findings of H2020 PROACTIVE project[47]. As the masks worn by the first responders can prevent the visual contact, some also suggested to have transparent masks, allowing for lip-reading. Several participants also suggested having interpreters in sign language during and after the decontamination process although they also acknowledged that not all persons master this language. Colour codes, pictograms, videos were also mentioned during the interviews as helpful supporting materials.

Ensuring a permanent presence, never letting the persons alone was also mentioned as key during the interviews. This can be a FR or another person. Especially for persons having cognitive problems, a physical presence can be important. Also, an interviewee, based on his experience of evacuating nursing homes, explained that for those with cognitive problems, they may not realise what is happening. Some participants wondered if the **families could stay together** during the decontamination.

Alongside the presence, several participants also pointed the physical environment: when there are too many sensorial stimulations, particularly the noise and the light, it could be contributing to the anxiety and stress. Among other examples, persons with hearing loss have troubles to distinguish the sounds and too many of it can overwhelm them, leading to a rupture of communication. A participant suggested to reduce the light of the headlamp. Participants suggested then to **pay attention to the physical environment of the waiting area before the decontamination and after the decontamination**: reduced light, reduced noise, possibility of being “isolated”, social distancing rules. For persons with behavioural problems, the specialised educators suggested to have “something” to occupy them to help them to wait.

The director of the elderly home also suggested to involve as soon as possible the **usual professionals** in the management of the situation. For example, if the residents of the elderly home must be decontaminated, once the process is over, the nurses of the elderly home can take over. Similarly, for persons with disability living in an institution, being as quickly as possible surrounded by familiar faces, without masks or PPE can help to reduce the anxiety and the stress. A participant suggested that usual professionals can remain “dirty” longer to help with the decontamination of the patients, meaning that they might not be decontaminated directly as “valid” persons in the first priority, but having to wait until the last patient needing assistance for the decontamination is cleaned. Therefore, as pointed by the participant, not all professionals can be ready to accept such a non-priority role and should never be forced to do it. Another interviewee suggested that the professionals used to

[47] https://proactive-h2020.eu/wp-content/uploads/2021/03/PROACTIVE_20210226_D3.4_V5_DHPol_Common-approaches-civil-society.pdf

accompany the persons should be decontaminated, equipped as the FR and be present during the decontamination process.

Some participants also raised the question of consent: during emergencies, they fear that they will be likely to be asked to comply with orders although this can be perceived as disrespectful, rude or abusive (e.g. having to be naked in front of male FR). These participants suggested then to have a possibility for debriefing the incident, to voice their discomfort. But, other participants also pointed out that for those with cognitive and behavioural problems, even touching them could be a source of distress and anxiety. Again, working with a referent person (from the family or the professional entourage) was perceived as a solution to facilitate the process.

Building on the experiences during COVID, a participant discussed the triage. Victims need to assure that **if there is a triage, it is not because of their handicap** but because of clinical criteria like other victims, e.g. based on a T1/T2/T3 triage groups classification, the vital prognosis, the consciousness. This participant explained that, during COVID, a young girl with autistic problems was refused to intensive care because she was perceived as a disabled person. He also had several testimonies of persons severely disabled for whom the health care professionals wrongly projected that they have a poor quality of life and should not be resuscitated although the persons themselves have a strong craving for life. In that sense, he advised that more exchanges between FR and persons with severe disabilities may help them to better understand what it does mean “quality of life” when the person lives with numerous limitations. **Involving patient associations in training and education of FR** was mentioned by several participants as an asset for better knowing and understanding life with disabilities.

One should not neglect that **some persons living with disability may already consider themselves with less chances of survival from the beginning**. It was mentioned by some persons with mobility problems. If an incident happens, they will need to be evacuated, they cannot do it by themselves and some reported that they are aware that they may be dead before the FR reach them or that they won’t be considered as priority.

Finally, an important part of the psychological dimension concerns **the relation that the persons living with an assistive device has with this device**. Although some devices can be removed without endangering the life of the person, the removal of the devices can trigger a whole range of reactions (anxiety, panic attack, verbal or physical violence, withdrawal, refusal, opposition…). It implies, from the responders, a careful appraisal of the removal of the device, even a simple pair of glasses or an audio prothesis, and, again, working whenever possible with a referent person to help reassuring the patients.

Table 2 summarises the key ideas extracted from the questionnaires regarding psychological requirements.

Table 2. Emergency Considerations for Vulnerable Groups: Psychological Needs

Vulnerable groups: Psychological requirements	
Communication with a person with hearing or visual disabilities	Clear, continuous communication is essential during emergencies to reassure and guide people with disabilities; Specialised communication strategies (e.g., pictograms, sign language, transparent mak for lip-reading, video) should be used to aid those with sensory impairments.
Environmental Considerations	Reducing sensory stimulation (e.g., noise, light), ensuring a permanent presence, and provide distrations to help them wait in waiting areas can help reduce stress and anxiety for people with disabilities waiting for decontamination.
Involvement of Usual Professionals	Involving familiar caregivers or family members from the start can reduce anxiety and improve cooperation during decontamination, particularly for those with cognitive or behavioural problems.
Consent and Sensitivity	Emergency protocols should consider consent and respect (using the term "disabled person" is respectful whereas "disabled" alone is not; Forced actions (e.g., undressing) can be distressing.
Triage and Fair Treatment	Ensuring fair treatment during triage is crucial; decisions should be based on clinical criteria, not disability status.
Perceived Survival Chances	Some people with disabilities may feel they have reduced chances of survival; responders should be aware of this mindset and be trained accordingly, ideally with the involvement of disabled people's associations.
Emotional Attachment to Devices	The psychological attachment to assistive devices means removing them can cause anxiety or distress, requiring careful handling.
Post-Decontamination Debriefing	Stress and discomfort can be significantly reduced if a debriefing session is organized after the decontamination. During this time, additional details about the fate of personal assistive devices can be provided.

4. Emerging method for decontaminating sensitive electronic devices

The eNOTICE-2 project aims to assess electronic-friendly decontamination methods by reviewing the state-of-the-art literature and gathering direct feedback from Research and Technology Organizations (RTOs) as well as small and large companies that are stakeholders in the project. A lecture on emerging decontamination technologies and the best candidates for decontaminating sensitive electronic devices was presented during the eNOTICE-2 Simulation Exercise (SimEx) at FDDO, Dortmund, in April 2024. A review summarizing the findings will be published during the project. The following Table 3 summarizes the content of this lecture.

Table 3. Emerging electronic-friendly decontamination methods: main features.

Decontamination Method	Working mechanism	Effectiveness against biological agents	Pros	Cons	Impact on materials
		(Bacteria, enveloped and non-enveloped RNA or DNA viruses, endospores of *bacillus subtillis* and *thuringiensis*)			
Cold plama	Highly ionized gas produces Reactive Species (ROS) that alter pathogen's genetic and protein material	Highly effective against viruses and bacteria but less effective against spores, particularly Bacillus subtilis.	- Non-chemical, environmentally friendly	- Can modify surface properties of polymers and rubbers	- Polymers (PP, PETG, Polyethylene, etc.) may experience surface modifications
			- Compatible with electronics and metals	- Requires specialised equipment	- Metals (Aluminum, Tungsten) generally compatible
		NB: The effectiveness of cold plasma against Bacillus endospores depends on several factors, including the type of cold plasma used (atmospheric or low-pressure), the exposure time, plasma power, and	- Operates at low temperatures	- Limited penetration in complex geometries	- electronics generally stable but avoid prolonged exposure; certain materials might be more reactive or sensitive to the plasma-generated species than others
				- Potential material degradation with prolonged exposure	
UV-C	Direct Photochemical Damage: UV-C Light induces thymine Dimers and inhibits microbial replication	Highly effective against viruses (especially enveloped) but less effective against spores.	- Safe for metals and most electronics with short exposure	- Heat Generation: some UV-C lamps can produce heat as a byproduct, which may be harmful to heat-sensitive electronic components.	- Polymers (PP, PETG, Polycarbonate) may yellow or become brittle
				- Limited penetration for shadowed areas	- Metals (Tungsten, Aluminum) are generally unaffected
				- Surface damage: Can degrade polymers and rubbers with prolonged exposure, causing discoloration, brittleness, and other forms of surface damage to sensitive electronic devices, potentially compromising their structural integrity.	- Not suitable for light sensitive electronic components '- Electronics plastic or rubber casings may degrade over time, which may affect the integrity and functionality of electronic components that are made from or contain these materials
Vaporised Hydrogen Peroxide (vHP, Dry HP vapour)	Oxidative Damage (ROS) to Microorganisms' Genetic Material and Proteins.	Highly effective against most pathogens, including spores (though moderately effective against Bacillus subtilis spores).	- Highly effective against various pathogens	- Requires specialized equipment	- Generally compatible with a wide range of materials, including plastics and metals if condensation on the surface is prevented
			- Can reach difficult areas	- Needs careful handling to avoid overexposure	- May not be suitable for electronics due to its corrosive nature and moisture content; not all matarials used in electronic devices are compatible; Suitable for well-sealed and designed to be moisture-resistant or have protective coatings and if temporary or controlled exposure

Table 3. Emerging electronic-friendly decontamination methods: main features (continued).

Decontamination Method	Working mechanism	Effectiveness against biological agents	Pros	Cons	Impact on materials
		(Bacteria, enveloped and non-enveloped RNA or DNA viruses, endospores of *bacillus subtillis* and *thuringiensis*)			
(Bacteria, enveloped and non-enveloped RNA or+A16 DNA viruses, endospores of *bacillus subtillis* and *thuringiensis+A14:F21*)	Oxidative damage to microorganisms' cell walls and genetic material.	Highly effective against most pathogens, with lower effectiveness against non-enveloped RNA viruses and Bacillus subtilis spores.	- Penetrates hard-to-reach areas	- Corrosive to some materials (e.g., rubbers, certain metals)	- May damage elastomers, some polymers, and sensitive metals (e.g., silver)
			- Effective against a broad spectrum of pathogens	- Toxic to humans, requiring strict safety measures	- Risk of oxidation for electronic components; suitable only for well-sealed, moisture-resistant devices with protective coatings, and if exposure is temporary or controlled
Autoclave (steam sterilisation)	Heat and pressure induce denaturation of microorganims' proteins	Highly effective against all tested pathogen, including spores	- Extremely effective at eliminating all microorganisms	- Not compatible with heat-sensitive materials (e.g., electronics, certain plastics)	- Highly effective on heat-resistant metals and materials
			- Suitable for heat-resistant materials		- Can melt or deform heat-sensitive plastics and composites
Gamma irradiation	Radiation Induces DNA Breaks	Highly effective against all tested pathogen, including spores	- Deep penetration	- Requires access to specialized facilities	- May degrade certain plastics and rubbers
			- Effective against a wide range of microorganisms	- Potential material degradation, especially in plastics and rubbers	- Metals and electronics generally resistant but need controlled doses
Electron beams	Electron Beam Induces DNA damage and cellular disruption	Highly effective against viruses, bacteria, and spores, including Bacillus subtilis and Bacillus thuringiensis	- Rapid and effective sterilisation	- Limited penetration depth	- Some materials (e.g., certain polymers) may become brittle or degrade with exposure
			- No residual chemicals	- High equipement cost: this method requires specialised equipment and safety measures (shielding required to protect the operators)	- Metals generally unaffected; suitable for heat-sensitive materials
		NB: Electron beam effectiveness is generally high for surface sterilisation but may require adjustments in energy levels for deeper penetration or thicker materials.	- Can be precisely controlled for dose and duration	- This method can generate heat: Sensitive devices could be at risk if exposed to excessive heat during the process.F22	- Certain electronics or radiation-sensitive materials should be evaluated for compatibility; risk of damage to certain electronic components if not adequately shielded

5. Summary and next steps

Effective decontamination is crucial for maintaining safety and readiness in CBRN environments. By following established principles and utilizing both passive and active methods, civilian and military institutions can mitigate these threats. Decontaminating sensitive assistive devices in various environments in emergency, military and industrial response is essential and requires reliable solutions.

This deliverable outlines the existing methodologies for decontaminating supportive devices, focussing on both general procedures and special considerations for people with disabilities. Key issues were identified, highlighting the need for first responders to be familiar with the challenges and equipped with appropriate tools. By following the cleaning guidelines and understanding the materials and types of different supporting devices, users might be able to recuperate their devices and continue to use them after the decontamination process.

Moreover, the deliverable also explains the general decontamination procedure according to the latest standards from different institutions, covering preparation, equipment, PPE, training, operation sequences and the structure of emergency personnel. The FwDV 500 standard ensures for Dortmund operations are conducted professionally to manage hazardous situations and ensure the safety of people, the environment and property.

The knowledge gained from the exercise provided by FDDO by using the above mentions FwDV 500 standard gives valuable insights for improving the decontamination standards processes. Specific recommendations learned from the exercise include:

1. Cleaning guidelines of assistive devices:
    - Implement the guidelines and procedures for cleaning the supporting devices.
    - Test, compare and validate the procedures for efficiency, safety for humans, animals and environment, time, cost
2. Communication with people with disabilities:
    - Provide different communications strategies during the decontamination procedure.
    - Have a small briefing session with the vulnerable groups before the procedure.
3. Education and training of first responders:
    - Regular training programmes to keep first responders up to date with the latest decontamination techniques and procedures.

By implementing these recommendations learned from the exercise, first responders can be better prepared for emergencies, increase the safety and efficiency of decontamination processes and ensure the long-term usability of supporting devices. This will help to strengthen the resilience of communities to CBRN threats and ensure the protection of people, the environment and property.

The results of the exercise can be used as a basis for further research in order to further improve the standard of decontamination in CBRN situations. The aim is to identify gaps and in particular, to find improvements in procedures, equipment and communication with the affected population.