Guidance on the human health impact of industrially contaminated sites

COST Action IS1408
Industrially Contaminated Sites and Health Network - ICSHNet

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ABSTRACT

Industrially contaminated sites represent a major environmental health issue, as they embrace exposure to many environmental hazardous pollutants from multiple sources affecting air, water, soil and food chain. COST Action on Industrially Contaminated Sites and Health Network (ICSHNet) since 2015 has been greatly contributing to consolidate the awareness and policy profile of contaminates sites towards the implementation of the World Health Organization European Environment and Health Process commitments and transition to the Sustainable Development Goals framework. Aiming to share and improve understanding of these experiences, available evidence and policy needs, the ICSHNet COST Action produced this guidance document. This guidance document aims to provide practical guidance to the environment and health sector on how to understand and report on the human health impacts of industrially contaminated sites. This document also synthesises the significant efforts of researchers and practitioners from different fields and provides a common framework for research and response. The main audience for this document are professionals working in public health and environment agencies and institutions. Other audiences include policy makers, business and civil society organisations. This document is structured in four parts: about the human health impacts of industrially contaminated sites; what do we know; best practice methods and approaches; and tools for responding to human health concerns on industrially contaminated sites.

Keywords

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This document was also developed through expert feedback in the Consultation Meeting on “Contaminated sites and health: developing guidance and tools Bonn, 15-16 January 2019.

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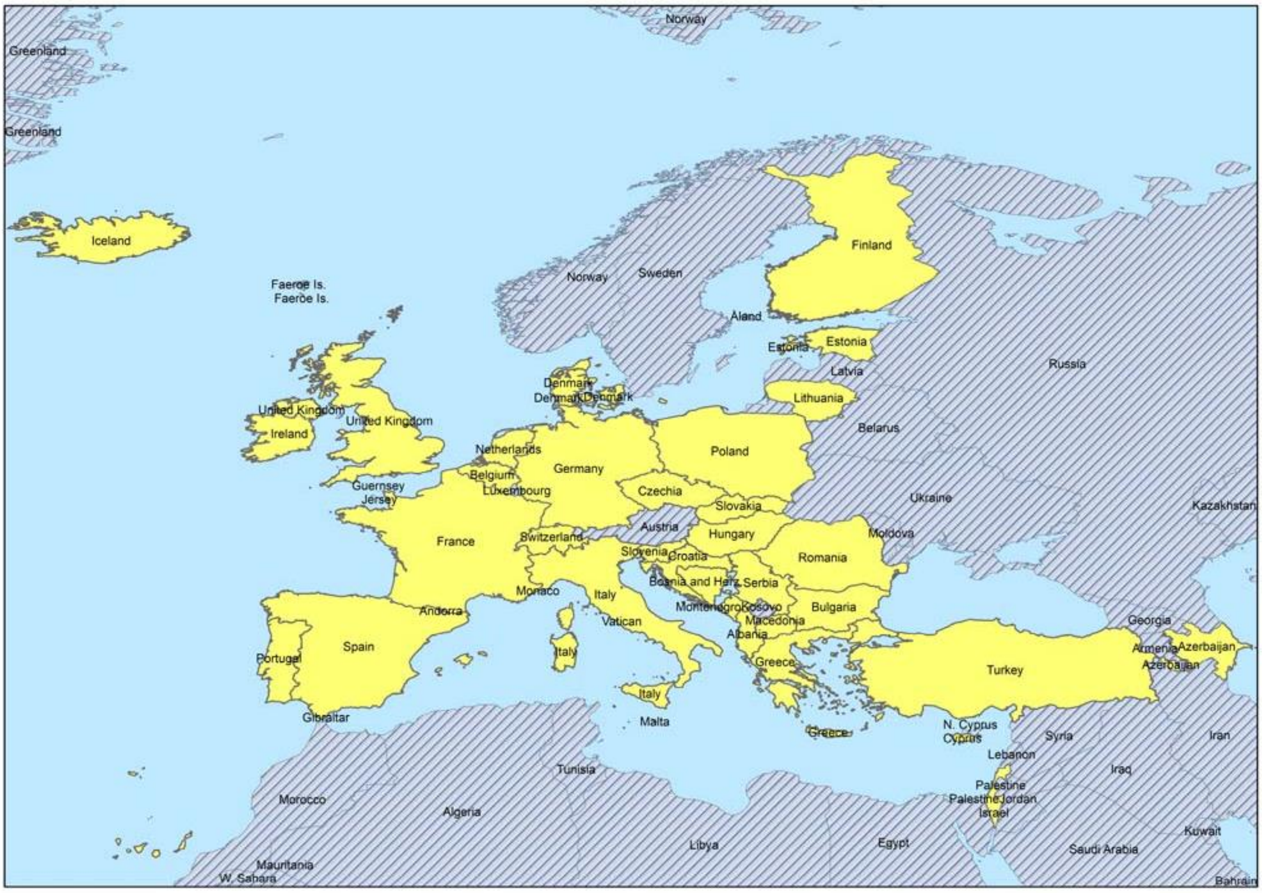

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EXECUTIVE SUMMARY

The question of human health in industrially contaminated sites (ICS) is multi-faceted at the level of problem framing, study design, methodology, analysis, interpretation and communication of results, and derivation of implications for policy and remediation. These dimensions are often separately addressed in real contexts, and this is one of the reasons why a comprehensive approach to the problem is still lacking.

Industrial development has led and leads to many societal benefits. However, the legacy of current or closed industrial sites has also resulted in environmental contamination that impact on human health through different exposure pathways and multiple effects. These health effects are often unequally distributed to lower socioeconomic groups who live near contaminated industrial sites.

Previous European definitions of ICS have focused on soil contamination. A broader definition requires consideration of soil, air, water, food chain, as well as generation of waste and occupational exposures.

ICS are usually bad hotspot areas that call for a multidisciplinary approach to integrate multiple environmental exposures and multiple pathways to human health. A proactive approach to measuring and acting on the health impacts of industrially contaminated sites is therefore urgently required. This implies involving intersectoral strategies to deal with environmental, social, occupational, industrial, and health issues.

Complex mixtures of chemicals of toxicological concern are often found to characterise environmental media in ICS. Remedial action to address environmental contamination from ICS should thus not be delayed on the grounds of scientific uncertainty including having insufficient quality of epidemiological studies, exposure, population and health data, or inadequate sample sizes.

Communication of the available knowledge on the health impact of ICS must be both evidence-based and also be a two-way process between government and other stakeholders. The actors of communication are experts, stakeholders (local community, non-government organisation, government), the media, policy- and decision-makers other to be defined. The risk communication process must be interactive, given the highly critical environmental, social, occupational and political contexts.

In 2015, the European Cooperation in Science and Technology (COST) Action on Industrially Contaminated Sites and Health Network (ICSHNet) was launched in collaboration with the WHO European Centre for Environment Health, with the aim to clarify needs and priorities, support collection of available information, methods and data, promote shared initiatives and develop guidance and resources on risk assessment, management and communication across Europe.

Since its start the Action has been producing several contributions to improve the scientific knowledge, capacity building and awareness about the main challenges posed by industrial contamination.

The first Action deliverable was the publication of the Proceedings of the first plenary conference held in Rome, in October 2015, describing the environmental health dimension of ICS, the Action's framework, objectives, and goals; main challenges for science and policy posed by ICSs. Report reported on main methodological issues related to ICS, including exposure evaluation, epidemiological studies, health impact assessment. 17 European case studies from participating countries, described \environmental health assessments, human biomonitoring surveys, risk management and remediation activities related to ICSs. https://www.iss.it/documents/20126/45616/16_27_web.pdf/e3c40ddd-80db-9b64-0ee7-39f1cb1f4abc?t=1581099206825

In February 2017 the first international training school on environmental health in industrially contaminated sites was held in Thessaloniki, Greece, 7-10 February 2017. This 5-day training workshop was aimed to strengthen in-country capacity to respond to EH challenges posed by ICSs by creating a European "cohort" of about 50 participants from 25 countries; 30 scientific posters presented showing real-life issues in participating countries related to health and environmental pollution arising from ICSs.

The Action organised an international satellite workshop during the Sixth Ministerial Conference on Environment and Health (Ostrava, Czech Republic 13-15 June 2017) involving NGOs and several other stakeholders. Also thanks to the activities carried out by ICSHNet, contaminated sites and waste have been included for the first time as a priority area in the Declaration of the Conference, with a specific "*preventing and eliminating the adverse environmental and health effects, costs and inequalities related to waste management and contaminated sites, by advancing towards the elimination of uncontrolled and illegal waste disposal and trafficking, and sound management of waste and contaminated sites in the context of transition to a circular economy*".

Three papers on EH in CS were published by Public Health Panorama, the journal of the WHO Regional Office for Europe, concerning i) communication plans in contaminated areas as prevention tools for informed policy (https://apps.who.int/iris/handle/10665/325311), ii) hazardous waste: a challenge for public health (https://apps.who.int/iris/handle/10665/325310), and iii) searching for best and new emerging practices for involving youth in environmental health risk communication and risk governance (https://apps.who.int/iris/handle/10665/325316). This journal represents a platform to scientists and public health practitioners for the publication of lessons learned from the field, and to facilitate the use of evidence for public health action.

During the Fourth Plenary Conference of the COST Action (Bonn, Germany, 21- 22 February 2018) the Action members produced a Consensus Statement on Industrially Contaminated Sites and Health aimed at supporting the development of national portfolios for action on environmental health in ICS, to contribute to the Ministerial Conference Declaration. This document was also translated in Russian (https://apps.who.int/iris/handle/10665/346108).

The Action carried out a Survey on ICS across Europe to assess the availability of data, research and assessment tools in about 90 Industrially Contaminated Sites identified in 27 participating countries, providing important insight about current needs and priorities, quality of environmental, population and health data, assessment and reporting of human health risks and impacts (https://pubmed.ncbi.nlm.nih.gov/31650779/).

In 2018 the COST Action published a special issue reviewing the available scientific knowledge on industrial contamination and human health and identifying the main sound methods and tools to help facing the environmental health challenges posed by industrial contamination http://www.epiprev.it/materiali/suppl/2018/COST/Suppl_COST_WEB.pdf

FOREWORD

The quality of our environment plays a vital role in people's health. Poor environmental conditions lead to bad health, particularly for specific populations such as children, pregnant women, elders, and people living in lower socioeconomic conditions.

There are many societal benefits of human industrial activity including overall lifting of economic performance and social conditions. However, a legacy of industrial activity is environmental contamination that in turn leads to poor health conditions. Moreover, vulnerable groups tend to have less opportunities to avoid poor living conditions and protect themselves.

Industrial activities can cause multiple chemical contamination to air, water and soil and also involving occupational exposures. The different contamination types, and often single exposures, and their effects, are usually assessed and acted upon in isolation. However, a comprehensive and suitable approach requires accounting for how these exposures interact, how people are exposed, and the overall health burden due to all relevant different health effects that these exposures can lead to.

Measuring and acting on the human health impacts of industrially contaminated sites contributes to many of the Sustainable Development Goals. This includes the goals addressing health (SDG 3), Clean water and sanitation (SDG 6), affordable and clean energy (SDG 7), inequalities (SDG 10) , sustainable cities (SDG 11) and sustainable production and consumption (SDG12). Taking a proactive approach to the environmental and human health impacts industrially contaminated sites is a key entry point for intersectoral public health action and to ensure that the necessary and urgent transition from a linear economy to a regenerative, sustainable and equitable circular economy and sustainable communities enhances human health too.

This document is structured in four parts:

- about industrially contaminated sites and health
- what do we currently know about the human health impacts of industrially contaminated sites?
- best practice methods and approaches to understanding the human health impacts of industrially contaminated sites
- tools for responding to the human health impacts of industrially contaminated sites and future direction.

This guidance document is structured in this way to provide an oversight of key issues and to provide clear and practical guidance to a range of environment, health and civil society organisations to be able to more effectively respond to the complex problem of the health impacts of industrially contaminated sites. This document has also been prepared to provide best practice guidance on different issues. These best practice notes are spread throughout the document.

Measuring and responding to the human health impacts of industrially contaminated sites is a key pathway for promoting safe environment, good health, reducing inequalities and supporting sustainable cities and communities, and affordable energy and responsible production.

RATIONALE

Industrial development has created societal wealth and has improved standards of living in all European countries, with consequent gains in health and well-being for large sections of the population. However, the long-term legacy of industrial development also includes adverse environmental outcomes that can lead to negative health effects.
The consequences of past and present industrial contamination on the environment and human health are being increasingly understood and dealt with, but more evidence is needed to respond to this challenge more systematically.

Challenges in environmental health in ICS
Environmental factors are a major determinant of health in the European region and beyond. For example, it is widely recognised that air pollution is harmful to human health, with large impacts especially on vulnerable populations such as children, older people or people with existing health conditions. Similarly, contamination of water, soil, food plays a role in shaping people's health, and so do the quality of the different environments and settings where people spend their time. ICSs involve many of these factors. People who live in the vicinity of an ICS, or who work in one, can be exposed to many contaminants, through different pathways. In addition, the impact on socioeconomic disadvantaged populations, who often tend to live close to ICSs, can be disproportionately large. This complexity brings about several challenges when trying to estimate human health effects or impact of environmental hazards in ICSs, in terms of identification of the relevant sources of contamination, key pollutants, and exposure scenarios.

Particularly challenging is also the identification and use of the most suitable methodologies to estimate the health burden due to industrial contaminants in the exposed population, including the differential impact in vulnerable groups.

However, significant progress has been made in the domain and the available evidence, methods and resources for addressing the issue has substantially grown. While the overall picture remains fuzzy, and for example the extent of the health impact of ICSs in Europe is unknown, better approaches and tools are nowadays available for carrying out local assessments.

Purpose and audience of this document
The purpose of this document is to provide practical advice and guidance on how to deal with questions on ICSs and human health, by: framing the issue realistically in the broad context of the available relevant knowledge and evidence, investigating effects and assessing health impacts, interpreting results of analyses and conveying them into the policy debate, by engaging in a dialogue with relevant stakeholders. This document builds on the efforts of researchers and practitioners from different fields and provides a common framework for research and response around the human health impacts of industrially contaminated sites.

This document was mainly developed for professionals operating in public health and environment agencies and related research institutes, who need to respond on questions on ICSs and health. By extension, the intended audience incudes policy makers, civil society organisations and business.

Wider context
This document responds to a demand reflecting a level of policy profile and priority that has been growing in recent years around the theme of industrially contaminated sites and their implications for human health. Waste and contaminated sites and health were included as a priority area in the Declaration of the Sixth Ministerial Conference on Environment and Health, held in Ostrava, Czechia in 2017. The Ostrava Declaration includes a commitment towards "preventing and eliminating the adverse environmental and health effects, costs, and inequalities related to waste management and contaminated sites, by advancing towards the elimination of uncontrolled and illegal waste disposal and trafficking, and sound management of waste and contaminated sites in the context of transition to a circular economy."

This commitment nicely reflects the emphasis that current orientations in environment and health give to the broad notion of sustainability, with its reference to circular economy, and to inequalities. Understanding the wider political and economic context is important when considering the implications of any assessments for public health and protective policies.

PART 1: ABOUT INDUSTRIALLY CONTAMINED SITES AND HEALTH

WHAT ARE INDUSTRIALLY CONTAMINATED SITES?

There are no established and fully recognised definition of ICS. The work promoted by WHO and recently undertaken by extended expert networks in Europe adopted the following operational definition:
"*Areas hosting or having hosted industrial human activities which have produced or might produce, directly or indirectly (waste disposals), chemical contamination of soil, surface or ground-water, air, food-chain, resulting or being able to result in human health impacts*".

This health-centric definition may not coincide with others, based on environmental damage; for example, the inventory of contaminated sites held by the EEA is based on soil contamination; for the sake of the definition above, however, a contact with people resulting in some form of exposure is necessary.

Many studies and assessments have been published on the health impacts of contamination from large manufacturing, chemical, petrochemical, metallurgic etc industries, mines and extracting activities, as well as power plants; waste processing and disposal facilities, of municipal and hazardous waste, represent a large share of the published literature. Currently active sites and legacy sites, including deposits of chemicals, discontinued landfills, inactive industrial facilities, have been considered by retrospective assessments, i.e., assessments aiming at estimating the health impact of past and current exposures.

Several aspects contribute to make these sites a relevant public health issue, as they entail substantial emissions of many different pollutants into the air, soil, water and the foodchain. Residents and/or workers can be exposed in many ways, including via direct contact, ingestion or inhalation of noxious agents, often in mixtures, and via indirect mechanisms, such as adversely affecting local ecosystems and landscape or access to green spaces and other amenities. Odours, annoyance, visual impact, erosion of property value and general unattractiveness of these sites also play a role.

Characterizing the overall impacts of industrialized areas is a challenging task, due to several factors often related each other which include:

- heterogeneous hazards and chemical mixtures affecting several environmental matrices (soil, air, water, and food chain);
- multiple agents from multiple sources;
- close contiguity of industrial settings to urban areas, often densely populated and therefore with expected high impacts;
- multiple aetiology of most potentially related diseases;
- difficulty in gathering quantitative exposure estimates.

The question of human health in ICSs poses challenges at multiple levels: problem framing, study design, methodology, analysis, interpretation of results, and derivation of implications for policy and remediation.

Another distinctive feature, shared by many ICS, is that they often involve marked health inequalities. These sites, being in general non-attractive residential areas, tend to be inhabited by people of lower socioeconomic level and deprivation gradients are often seen around contaminated sites.

Given the concurrence of multiple contaminants, the social disadvantage, and additional burden imposed at the individual level by unhealthy lifestyles, contaminated sites can sometimes be seen as “hotspots” of generally bad environment and health.
In addition, society at large obviously benefits from the output of industrial activities, thus introducing an additional dimension of environmental (in)justice. For these reasons, the issue of human health in industrially contaminated areas is best addressed with a strong sustainability perspective, taking into account, on the one side, the evidence on health effects and impacts, but considering the broader context of environmental and ecosystem health, as well as the social environment – including the occupational opportunities that arise from industrial activities. All these things require an intersectoral approach and has to be seen as part of a social negotiation, where the legitimate needs and aspirations of vulnerable groups, residents, workers, investors, and business are taken into account in a non-discriminatory process.

The issue of a European response to the health problems caused by contaminated sites was initially raised in the frame of two technical meetings organized by the European Centre for Environment and Health of the World Health Organization (WHO), whose proceedings were subsequently published. This implied bringing together for the first time researchers and public health professionals operating in this field across Europe, reviewing existing scientific evidence and methodological options, exploring priorities and identifying topics and goals for collaborative works. One major output of the above-mentioned meetings, taking into account the inherent heterogeneity underlying this complex environmental health matter, was reaching a consensus about a first operational definition of contaminated sites.

Building on the experiences described above, a consequent relevant change in capacity building within environmental health issues in ICSs is the establishment of the first WHO Collaborating Centre for Environmental Health in Contaminated Sites (WHO-CC ITA97) in 2013. This WHO CC has been operating in strict collaboration with WHO on:

- expanding and consolidating networks and mechanisms for the collection and dissemination of information on environment and health in contaminated sites, through providing support in organisation of WHO conferences, workshops, training, dissemination activities, and other events;
- contributing to WHO efforts in identifying priorities on how to assess environmental health risks and to support primary prevention interventions to protect and promote public health in contaminated areas and environmental hotspots.

Among the activities coordinated by the WHO CC, the most important was the launch, in 2015, of a specific European Cooperation in Science and Technology (COST) Action on Industrially Contaminated Sites and Health Network (ICSHNet).
The ICSHNet COST Action is aimed at:

- clarifying knowledge gaps and research priorities;
- guiding collection and organisation of relevant data and information;
- stimulating development of harmonised methodology;
- promoting collaborative research initiatives;
- developing guidance on methods and tools for exposure evaluation, health risk, and impact assessment.

The Action currently involves WHO, European Union, and European Community bodies and public environmental health institution of 33 Countries. Overall, about 150 researchers and experts from about 50 public health institutions, universities, and environmental agencies are involved in the activities carried out by the COST Action.

One of the early goals of the Action was to adopt a common definition of industrially contaminated sites, building on the previous one proposed by WHO, among the Action participants. The adopted definition is the following:

Due to the multiplicity of ICSs and heterogeneity of the exposures scenarios and of the environmental, social, and occupational settings, an overall picture of the health impacts remains uncertain. The COST Action was launched to promote collaborative activities between researchers and risk managers to identify common strategies at European level to deal more

systematically with these issues. Therefore, the Action aims to consolidate the European network of experts and relevant
institutions, and to develop a common framework for research and response.
The networking activities carried out by the ICSHNet Action so far, in close collaboration with WHO, contributed to the inclusion, for the first time, of contaminated sites as an environmental health priority area in the Declaration of the Sixth Ministerial Conference on Environment and Health (held in Ostrava, Czech Republic, on 15th June 2017).

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Environmental contamination
By their very nature, industrial sites have the potential to lead to environmental contamination. A common type of environmental contamination from industrial sites is soil contamination. However, other types of contamination such as water, air, food chain and occupational contamination often occur. Industrial facilities can also produce and emit hazardous chemicals and wastes.

How many contaminated sites are there?
The most widely used definition of a contaminated site in Europe focuses on soil contamination. On that basis, the 39 countries served by the European Environment Agency contain around 2.5 million potentially contaminated sites.

Whatever the definition and criteria for inclusion, Europe has thousands of contaminated sites. They are the result of earlier industrialization and poor environmental management practices. Past and current activities can cause local and diffuse accumulation of environmental stressors to an extent that might threaten human health and the environment, by altering air quality, hampering soil functions, and polluting groundwater and surface water.

The contamination will impact on areas outside of the industrial site. For example, the impacts of environmental contamination may be experienced in people living close to the industrial site. When sites are near urban areas, many people will be affected. In some cases, the local social and political context has become a hot environmental justice topic.

A comprehensive definition of contaminated sites
Based on a public health perspective, the WHO definition for a contaminated site is “areas hosting or having hosted human activities which have produced or might produce environmental contamination of soil, surface or groundwater, air, and food chain, resulting or being able to result in human health impacts”.

THE 2017 OSTRAVA DECLARATION AND THE LINK TO CONTAMINATED SITES

The Ministerial Conferences of the European Environment and Health Process provide a unique intersectoral policy platform bringing together relevant sectors and partners to shape policies and actions on environment and health, support the implementation of effective evidence-based policies and advance actions on environment, health and well-being in the WHO European Region.

The Sixth Ministerial Conference was convened in Ostrava, Czech Republic, on 13-15 June 2017 to to provide a roadmap on how to continue and strengthen efforts to address the leading environmental determinants of human health.

The Ministerial Conference adopted by acclamation the Ostrava Declaration in which Member States commit themselves to drawing up a tailored national portfolio for action in seven priority areas and endorse the new institutional arrangements for the European Environment and Health Process.

One of these seven priority areas focuses for the first time on "*preventing and eliminating the adverse environmental and health effects, costs and inequalities related to waste management and contaminated sites, by advancing towards the elimination of uncontrolled and illegal waste disposal and trafficking, and sound management of waste and contaminated sites in the context of transition to a circular economy*". This is because:

- The large number of contaminated sites in the European region partly represents the pollution legacy of industrial development that still needs to be addressed, and its health and environmental impacts that need to reduced or eliminated.

- Waste disposal, management and trafficking and contaminated sites can cause important health effects and costs for current and future generations, environmental injustice and social inequalities.

There are a range of actions outlined in the Ostrava Declaration relating specifically to contaminated sites including but not limited to:

- Compiling an inventory of contamined sites and their likely emissions and human exposures, promote monitoring, and develop a response action plan.
- Identifying priority contaminated sites for remediation/phasing out based on human health impacts
- Adopt regulatory mechanisms implementing the polluter-pays principle and extended producer responsibility.
- Enhance capacities at national and subnational levels to assess impacts and manage risks to health from waste, contaminated sites and improperly recycled materials.
- Support and develop partnerships to promote the exchange of experience, the strengthening of capacities and the uptake of the best available technologies.

The Ostrava Declaration is therefore a fundamental document for focusing environment and health sector commitment to identifying and addressing the human health impacts of industrially contaminated sites, especially at the political level.

INEQUALITIES IN INDUSTRIALLY CONTAMINATED SITES

Taking action to reduce inequalities is an explicit part of the Ostrava Declaration, and it is also one of the key goals of the 2030 United Nations Agenda for Sustainable Development.

Environmental justice
Communities living in or close to contaminated sites tend to be characterized by a high prevalence of ethnic minorities and by an unfavorable socioeconomic status. This raises the issue of environmental justice.

There are two dimensions of environmental justice:

- **Distributive Justice** regards the fairness in the distribution of environmental risks and benefits among individuals or population groups
- **Procedural Justice** refers to the mechanisms and processes through which Distributive Justice is created and sustained.

Evidence on inequalities from contaminated sites
Since the 1990s, international evidence on inequalities in exposure and related health risks from contaminated sites has been growing. Data published from the European region provides further evidence that socially and economically deprived populations are disproportionately burdened by the health impacts of contaminated sites. Despite these data, awareness of environmental justice in how the European region is responding to contaminated sites is limited.[1]

Ethnic minorities and/or disadvantaged population sub-groups living close to contaminated areas are often not involved in decisions concerning around land-use.

Assessing inequalities from contaminated sites
Socioeconomic or socioeconomic attributes of populations living near or in contaminated sites can be assessed by:

- single variables (usually from national census or from data of local bureau of statistics)
- combining variables in indices of multiple deprivation.

Studies on environmental health inequalities should be implemented considering four main aspects:

- bring together different methods and experts to ensure that a causal approach to environmental health inequalities is considered
- ensure that the research design includes assessment of health inequalities from contaminated site impacts
- having a comprehensive approach to all available information including that ensuring that ad hoc local and national epidemiological monitoring data on contaminated sites and or health and social inequalities are considered
- having risk communication plans tailored to the issue of environmental justice in the impacts of the contaminated site.

Challenges in assessing inequalities from contaminated sites
Assessment of inequalities involves understanding the different pollutant sources and exposure pathways for people living in or near contaminated sites. There are a number of challenges in the assessment process including correctly identifying:

- the different space and time aspects of the assessment including the relevant geographic areas, affected populations, and the differential exposures
- the most meaningful administrative (geographical) unit to use as the basis of the assessment as well as identifying which local or regional government authorities that should be involved to reduce the impacts of the contaminated site, including the environmental justice impacts
- patterns at the local and national levels to make valid assumptions about the impacts of contaminated sites, including whether some areas have more or less inequalities as a result of contaminated sites.

BEST PRACTICE NOTE 1: Equity oriented mitigation actions in industrially contaminated sites

- Defining priorities for remediation activities at the country level, having identified areas and contaminated sites with the highest levels of inequity.
- Promoting environmental and epidemiological local monitoring programs to identify inequalities in exposure and disease patterns.
- Reinforcing secondary prevention interventions that promote access of disadvantaged groups to health services.
- Promoting initiatives to improve awareness of the health effects of contamination among communities and disadvantaged subgroups.

ICSHNet COST ACTION

COST (European Cooperation in Science and Technology) is a pan-European intergovernmental framework for the creation of research networks, called COST Actions.
COST Actions allow researchers, engineers and scholars to jointly develop their own ideas and take new initiatives across all fields of science and technology, while promoting multi- and interdisciplinary approaches. COST aims at fostering a better integration of less research intensive countries to the knowledge hubs of the European Research Area.

The COST Association, an International not-for-profit Association under Belgian Law, integrates all management, governing and administrative functions necessary for the operation of the framework. The COST Association has currently 36 Member Countries.

Industrially Contaminated Sites and Health Network (ICSHNet)
A COST Action on Industrially Contaminated Sites and Health Network (ICSHNet) was launched in 2015 to establish and consolidate a European network of researcher and experts from relevant institutions involved in assessing the impacts of industrial contamination.

Mission and outcomes
COST Action IS1408 is centred on developing a common European framework on industrially contaminated sites and health. It aims at clarifying needs and priorities, and collecting and evaluating available data and experiences, which are very heterogeneous across Europe.

Objectives
Expand and consolidate collaborations for the collection of data and dissemination of information on environment and health in contaminated sites across Europe. Identify needs and priorities on strategies to address environmental health impact and to promote interventions and public health in contaminated areas. Map expertise and resources for responding to questions of different nature on contaminated sites and health. Formulate priority research in the domain.

Main types of activities
The main activities of the ICSHNet are:

- scientific meetings
- short term scientific missions
- training and capacity building
- publications and dissemination activities

PART 2. WHAT DO WE CURRENTLY KNOW ABOUT THE HUMAN HEALTH IMPACTS OF INDUSTRIALLY CONTAMINED SITES?

WHAT DOES CURRENT EVIDENCE SAY ABOUT THE HEALTH OUTCOMES ASSOCIATED WITH INDUSTRIALLY CONTAMINTED SITES?

There are different ways that health outcomes can be measured from birth outcomes through to diagnosis of a specific disease (morbidity), hospital episodes (a measure of health service use), occurrence of a new cancer case (cancer incidence), and death (mortality) (**Summary Information Table 1**). Population-based data can be used to obtain information about a particular geographic area.

Summary Information Table 1. Common health outcomes of interest for industrially contaminated sites

Health outcome of interest	Main source of health data
Mortality	Routinely-collected vital statistics, cancer registries
Morbidity	Specific morbidity registries
Hospitalizations	Routinely-collected hospitalization records
Cancer incidence (childhood)	Population-based cancer registries and national birth registries
Cancer incidence (adults)	Population-based cancer registries and national vital statistics
Congenital anomalies and birth outcomes	Routinely collected vital statistics, congenital anomalies registries

In a recent review of 655 epidemiological studies looking at the health impacts of contaminated sites on local resident populations, the most frequently studied outcome was cancer (33.7%), followed by respiratory diseases (11.4%), and reproductive health (11.4%).[2] Almost half of the studies were either descriptive or cross-sectional with few (18%) of those studies having an analytical design, such as a case-control or cohort study design.

Recent evidence on the health impacts of industrially contaminated sites
A group of researchers looking at the health impacts of industrially contaminated sites has recently published new health outcome findings. Two sets of findings are particularly novel.

Health impacts associated with landfills in Europe
Shaddick and colleagues (2018) aimed to apply a recently developed method for estimating the health impacts of pollution from contaminated sites.[3] The researchers used large European datasets to apply this new method to waste landfills

Using available evidence on the health effects of living near a landfill, standard burden of disease and health impact assessment methods were applied. Specific geographic landfill data were combined with population and disease frequency data. Uncertainty was accounted for using simulation methods. The countries included in the analysis were covered by the European Environment Agency's European Pollutant and Transfer Registry.

The health outcomes of interest in the study were low birth weight, congenital anomalies, respiratory disease, and annoyance from odour. These outcomes were analysed separately. An estimate of disability-adjusted life years was calculated using all outcome data combined.

A total of 1,544 landfill sites were included in the analysis. 29.3 million people (6% of the total population) live within 4 km from one or more of these sites. The number of yearly attributable cases associated with low birth weight, congenital anomalies, respiratory diseases, and annoyance from odour were estimated.

Shaddick and colleagues reported that the largest health impact from waste landfills in terms of the number of attributable cases was respiratory disease and low birth weight (**Summary Information Table 2**). However, the highest number of disability-adjusted life years was for annoyance from odour (**Summary Information Table 3**).

Summary Information Table 2. Recent data on attributable cases associated with landfills in Europe

	Number of yearly attributable cases
Low birth weight	1,239
Congenital anomalies	70
Respiratory disease	1,582
Annoyance from odour	624

Summary Information Table 3. Recent data on disability-adjusted life years associated with landfills in Europe

	Associated disability-adjusted life years
Low birth weight	10,192
Congenital anomalies	958
Respiratory disease	2,688
Annoyance from odour	47,505
All outcomes combined	61,325

These researchers conclude that there are sizable health impacts from waste landfills. The recently developed method used to estimate these impacts has been shown to work for waste landfills and can equally be used for other types of contaminated sites.

Cancer incidence in children living near industrially contaminated sites in Italy
Despite incidence increasingly worldwide, little is still understood about the role that environmental factors play in childhood cancer. Industrially contaminated sites are important potential source of environmental exposures of childhood cancers.

Iavarone and colleagues (2018) aimed to describe cancer risk in children and young adults living in contaminated sites in Italy that have been prioritized as being nationally important.[4] The number of observed and expected cancer cases was calculated to create a relative rate of cancer in the population for 28 national priority contaminated sites (**Summary Information Table 4**).

A total of 1,050 cases of malignant tumours (MTs) were recorded among 3,161,786 person-years in people aged 0-29 years in 28 NPCSs (SIR: 1.03; 90%CI 0.98-1.09), with an age-standardised incidence rate of 317 per million. Excess cancer risks were observed for particular age groups and tumour types.

Summary Information Table 4. Recent data on cancer incidence in children living near ICS in Italy

Age group	Tumour type	Standardised incidence ratio and 90% confidence limits
<1 year	Central nervous system	3.2 (90%CI 1.4-6.3)
0-14 years	Soft tissue sarcoma	1.6 (90%CI 1.1-2.3)
	Acute myeloid leukaemia	1.7 (90%CI 1.1-2.4)
20-24 years	Non-Hodgkin lymphoma	1.5 (90%CI 1.1-2.1)
20-29 years	Germ cell tumours of male gonads	1.3 (90%CI 1.1-1.5)

The findings of the researchers supports the hypothesis that living in an NPCS increases the risk of some cancer types in children and young adults. This study will lead to future researchers to further investigate common sources of contamination, particularly pollutants known to be carcinogenic.

SURVEY OF COST ACTION PARTICIPANTS ON DATA AVAILABILITY AND DATA NEEDS ABOUT INDUSTRIALLY CONTAMINTED SITES

BEST PRACTICE NOTE 2. Key recommendations following the COST action questionnaire

- Improving collection and access to specific environmental, health and demographic data is crucial to characterize the multiple impacts on health from industrially contaminated sites.
- Promoting a strong interdisciplinary approach, with greater collaboration and sharing of data and expertise between environmental and public health experts.
- Stronger efforts for integrating risk communication strategies as essential elements of any approach for characterizing the impacts on health of ICSs are also needed. These strategies should be implemented at all stages of the process and involve all potential affected stakeholders, putting emphasis on a better understanding of the results and its uncertainties.

One of the objectives of the ICSHNet COST Action is to assess availability of data, research tools, methodologies, and information on communication strategies in ICS in all participating countries, by means of an *ad hoc* Action Questionnaire (AQ).

Since the evaluation was not feasible for all possible ICSs among 33 countries, a short list of ICSs at country level was defined This list was not aimed at identifying national priority lists, nor a list for priority settings. Rather, the list of ICS includes examples where to evaluate the capacity across countries to deal with ICS-related environmental health issues.

***A priori* identification criteria:**

ICSs were identified starting from the operational definition adopted by the Action:

“Areas hosting or having hosted industrial human activities which have produced or might produce directly or indirectly (waste disposals) chemical contamination of soil, surface or ground-water, air, food-chain, and resulting or being able to result in human health impacts”

ICS to be selected had to fulfil as many of the following criteria as possible:

- Policy relevance. Sites for which concern was raised by citizens, politicians, environment and health experts, scientists, media and other interested parties.
- Available evidence. Sites for which local environmental contamination by industrial activities has been documented as dangerous or potentially dangerous for human health.
- Extent of exposure. Sites where there is either direct or potential exposure to contaminants in the local neighbourhood regardless of the size of the local community.

A preliminary list of 99 ICSs from 30 countries was available.

Number of survey responses
We received responses from 82% of participating countries (n= 27) within the COST ACTION, with information gathered from 81 ICS reported by a total of 46 individuals.

It is important to note that data from the AQ was provided on a voluntary basis, probably with some time and resources constraints.

While this is a small proportion of the real number of ICSs in all participating countries within the COST, important insight can be gained about the information and tools available as well as the research gaps across Europe to assess the impact on health of the pollution caused by the industrial activity.

Types of industrial activities
The main types of industrial activities reported by survey respondents were:

- waste disposal
- chemical industry
- metallurgic plant
- mining industry
- electric power plant.

The other types of industrial activity listed by respondents included oil refinery, steel plan, petrochemical plan, pharmaceutical industry and oil extraction. A large proportion of sites (33/81) were reported to have more than 2 industrial activities working in the area.

All of the pharmaceutical industry and steel plant industrial sites and the majority of the electric power plant, metallurgic plan, and oil refinery sites are still in operation in the moment of reporting.

Different contamination types
From the reported data, the most common types of environmental contamination were:

- surface and ground water
- soil contamination
- ambient air.

However, contamination of sediments, biota and locally produced food was also reported.

An important output in this field was the large percentage of "don't know" reported in many cases (from 60% regarding data for contamination of biota to 20% in the case of surface and ground water). This could be due to the real absence of data, or due to the fact that the reporting person didn't know how to obtain that information. A better collaboration between environmental and public health experts is needed as well as a better integration and accessibility to environmental data.

Heavy metals and chlorinated hydrocarbons were pointed out as having the greatest impact on environmental pollution (air, biota and food, sediment, soil and water). Other relevant reported contaminants were arsenic and its derivate, especially in water and air (28% and 22%, respectively), and BTEX (benzene, toluene, ethylbenzene and xylene).

Only for the two main pollutants, environmental monitoring was conducted on a regular basis, up to a maximum of 25% of the total reported ICS. For the rest of pollutants, environmental media were monitored under *ad hoc* campaigns, at the best.

Population data
Around two thirds of respondents reported that locally resident population data was available with around 40% of respondents suggesting that this demographic data is updated yearly.

The majority (76%) of respondents stated that information about the gender and age of the locally resident population was published whereas data on ethnicity and socioeconomic position was reported as being less available (57% and 45% respectively). Where data on socioeconomic position was available, the most common indicators were educational level, income, occupation, and household characteristics.

Exposure assessment data
Just under half of respondents said that the exposure of people living in or near the industrially contaminated sites of interested have been characterized. However, about the same proportion did not know or stated that no exposure assessment had been carried out. Where an exposure assessment had been carried out, the three main population groups of interest were the general population, children, and workers.

The main categories of contaminants monitored in the conducted exposure assessments were heavy metals and those encountered in ambient air (particulate matter, sulphur and nitrogen oxide mainly), but also chlorinated hydrocarbons and BTEX.

The three methodological approaches generally used for characterising the exposure were:

- measures of contaminants in environmental media
- whether a population lived in the industrially contaminated site
- distance from the industrially contaminated site.

More precise approaches for exposure assessment such as the use of dispersion modelling, biomonitoring or personal exposure measurements were also applied.

From the data provided by respondents, the most common types of industrial sites that have had an exposure assessment conducted were:

- petrochemical plants (8 out of 9 sites have had an exposure assessment)
- pharmaceutical industry (5 out of 6 sites have had an exposure assessment)

Importantly, there was a large number of exposure assessments reported for chemical industry sites (20 out 33 sites reported) and waste disposal (22 out of 37 sites reported).

When analysed by contamination type, there was a high number of exposure assessments for:

- foodstuff contamination (17 out of 19 sites)
- biota contamination (13 out of 17 sites)
- ambient air (28 out of 30 sites).

Of the exposure assessments reported (39), almost all (90%) of them included demographic data about the local population and most (80%) included some form of health data.

Morbidity and mortality data
A number of questions were asked about access to morbidity and mortality data. Morbidity data includes access to hospital discharge data as well as information about specific diseases in a population.

Again, looking at health data availability, it is quite surprising that only one third (30%) of the participants were sure about the availability of mortality data, mainly at the municipality level, although some data at individual level was also reported.

A vast majority of respondents reported that the mortality data for all ICS, when available, was at least stratified by age (96%) and gender (92%), between 71% and a 54% reported also availability of those data by place of residence, place of birth and place of death, and for about one third was informed also of a breakdown by socioeconomic position (33%) and individual address (38%).

Similar patterns can be seen for access to hospital discharge data with:

- over a third (43%) of respondents not having access to hospital discharge for people living close to industrially contaminated sites
- where data was available, it was mostly presented at the municipal level (41%) or the individual level (35%)
- gender and age was the most common hospital discharge data breakdown (94%) following by place of residence (77%) and place of birth (71%)
- information about socioeconomic position, place of death, and individual address was less common (42%-53%).

Half of survey respondents were uncertain whether there are data from specific disease registries relating to local resident populations around industrially contaminated sites. Around a third of respondents were aware of cancer registry data (36%). One in five respondents were aware of databases on congenital anomalies.

BEST PRACTICE NOTE 3: Morbidity and Mortality Data

Accurate measurement of health outcomes, including breakdown of outcomes for different sub-population groups, is an important methodological consideration for responding to industrially contaminated sites.

The survey data highlights that:

- At least a third of survey respondents were not aware of mortality (death) or morbidity (hospital discharge) data available to assess the health status of people residing close to industrially contaminated sites
- Where death or hospital discharge data was available, the data could be broken down by gender and age with information on socioeconomic position considered to be not frequently available.

These survey findings suggest that additional data collection and reporting efforts are required to meet the methodological requirement to analyse health outcome data for all population groups combined and by socioeconomic position. If the data are already available, then greater sharing and promotion of this data with environment and health researchers interested in industrially contaminated sites is required.

Approaches for characterising the impact on health of industrially contaminated sites
Survey respondents were asked separately about three types of strategies for characterising the impact on health of ICS (see **Summary Information Table 5**):

- Human Health risk assessments
- Health impact assessments
- Epidemiological studies.

Human Health risk assessments
The most extensively methodological approach used for characterising the potential impact on health of ICS, was HHRA, applied in one third of the sites included in this survey (26 out of 81) This prevalence of HHRA over other approaches match that was reported in the review by Xiong et al. (2018).[5] However, an important percentage of participants were not sure about possible HHRA conducted in the sites assigned to them, showing the difficulties in accessibility to the information in this field. It is important to highlight that in many ICS worldwide, HHRA are operated by environmental departments (national or regional level) particularly for categorising the soils contamination level of, but those reports are not easily accessible as they are published in restricted data bases, at the best.

The main contaminants monitored in the reported HHRA were:

- Metals (81% of total HHRA reported)
- Polycyclic aromatic hydrocarbons (59%)
- Persistent organic pollutants (46%).

The next group of common contaminants were arsenic, benzene, toluene, ethylbenzene and xylenes (BTEX), and particulate matter (PM).

The exposure indicator most broadly used in the identified HHRA was *ad hoc* environmental monitoring (73%), followed by modelling (50%) and human biomonitoring (23%). Those approaches were probably applied complementarily rather than alternatively or exclusively.

Following the specification of this methodological approach, the reported health outcomes were either cancer incidence or other non- carcinogenic endpoints (morbidity and mortality).

The HHRA conducted in this survey focused principally on general population followed by children and workers.

Epidemiological studies
The methodological approach most commonly used after HHRA in the ICS from the COST Action survey was epidemiological studies, in 21 over 81 sites, with a higher predominance of cross-sectional/descriptive designs, followed by ecological studies, case-control and geographical studies. A similar trend was observed in a recent review.[2]

The reported outcome more generally addressed in these epidemiological studies was morbidity following by mortality and cancer incidence. Congenital anomalies and other types of health outcomes were less frequently reported by survey respondents as epidemiological study outcomes.

Respondents stated that the general population, regardless of gender or age group, was more frequently population group reported in the epidemiological studies.

The most common type of exposure indicator in epidemiological studies reported by respondents were:

- the population resides in an industrially contaminated site
- measurement of contamination levels in the environment
- the distance that a population lives from an industrially contaminated site.

In the AQ, a section that gathered information on the type of main pollutants included in epidemiological studies was not included.

Health impact assessment
Finally, health impact assessment was applied in 10 ICS over 81 sites from our list, mostly focusing on heavy metals, particulate matter and BTEX, measured in air. This finding is well correlated to the most extensive scientific evidence available for epidemiological dose-response factor that allows calculating the increase number of specific health outcomes within a population (attributable cases or attributable fraction for specific causes of morbidity or mortality or other indicators), according to changes in the environmental exposure to those pollutants in air.[6-9]

Similarly to the other two approaches already described, the most frequently reported population of interest was the general population followed by children.

Communication strategies and approaches
Finally, survey respondents were asked about communication campaigns on risk issues relating to industrially contaminated sites.

The main findings from the survey were that:

- Almost half (47%) of respondents were either not aware or did not know whether:
  - a risk communication campaign was ever undertaken on the industrial contaminated site of interest
  - stakeholders were involved in the development of the communications strategy
- Where there was a communications campaign, about two thirds of campaigns focused on either environmental pollution only or environment pollution combined with health risk data. There were very few campaigns focusing solely on health risk data.
- The main ways of communicating were brochures, websites and research reports
- The main stakeholders involved in the community strategy in order were the public sector, voluntary organisations, populations living close to industrially contaminated sites, the general public and the private sector.
- The media were less likely to pick up and distribute results that related to health risks
- At least 40% of survey respondents thought that there is poor to no understanding of the reporting of uncertainty in health risk estimates for industrially contaminated sites. This did not differ substantially by the type of stakeholder.

BEST PRACTICE NOTE 4: Risk Communication

These survey findings suggest that strong efforts are required in:

- Ensuring that risk communication strategies are developed as part of health assessments of industrially contaminated sites
- The risk communication strategies ensure that health risks, and uncertainty around risk estimates, are more clearly communicated.

Summary Information Table 5. Main characteristics of the studies conducted in industrially contaminated sites as reported by participants to the COST Action survey

	Human health risk assessment (N=26)	Epidemiological studies (N=21)	Health impact assessment (N=10)
Main contaminants assessed	Metals (81%) POPs (46%) PAH (59%)	Not reported	Metals (50%) PM (50%) BTEX & As (40%)
Exposure indicator	Environmental monitoring (73%) Modelling (50%) HBM (23%)	Residence (71%) Environmental monitoring (52%) Distance (43%) HBM (38%)	Environmental monitoring (70%) Modelling (60%) HBM (50%)
Health outcome	Cancer (39%) Others (31%) Morbidity (23%) Mortality (19%)	Morbidity (71%) Mortality (62%) Cancer (57%) Congenital abnormalities (24%)	AC/AF (50%) YPLL (30%) DALYs (20%)
Population of interest	General population (73%) Children (42%) Workers (23%) None (4%)	General population (86%) Children (52%) Workers (24%) None (5%)	General population (80%) Children (50%) Workers (10%) Others (10%)

Acronyms: POPs: HHRA: human health risk assessment; Epi studies: epidemiological studies; HIA: helath impact assessment; persistent organic pollutants; PAH: polyromantic hydrocarbons; HBM: human biomonitoring; Cancer inc.: cancer incidence; GRAl population: general population; PM: particulate matter (mainly PM10, and PM2,5); AC/AF: attributable cases/attributable fraction; YPLL: Years of potential life lost: DALYS: Disability adjusted life years

Policy priorities for addressing the human health impacts of industrially contaminated sites include:

- development of comprehensive lists of industrially contaminated sites within relevant jurisdictions
- identification from the comprehensive list the type of industrial activity, whether the industrial activity is current or past, the type of contaminants and the size of the local population
- identification of what health assessments have already been undertaken and what the knowledge gaps are
- identification of what remediation has already taken place and what other remediation needs to take place
- allocation of resources for both research that assesses the health impacts of industrially contaminated sites as well as resources for remediation to remove health hazards
- ensuring that a comprehensive and multidisciplinary approach is taken when assessing and acting on the health impacts of industrially contaminated sites
- developing action plans for urgent and non-urgent responses to mitigate the health impacts of industrially contaminated sites
- increase and improve the placement of multiple environmental exposures and multiple health outcomes, including unequal distribution of health impacts, in all conversations about industrially contaminated sites
- promoting public awareness of the human health impacts of industrially contaminated sites
- be actively involved in the urgent transition from single exposure assessment methods for contaminated sites to a comprehensive and multidisciplinary approach that brings together the environment and health sectors.

PART 3: BEST PRACTICE METHODS AND APPROACHES TO UNDERSTANDING THE HUMAN HEALTH IMPACTS OF INDUSTRIALLY CONTAMINATED SITES

HOW ARE HUMAN HEALTH IMPACTS OF INDUSTRIALLY CONTAMINATED SITES ASSESSED?

The time between exposure to environmental pollutants and the onset of health-related symptoms can be highly variable, depending on the mechanism of action of the chemical agent, and therefore on its role in the development of human diseases.
As ICS are usually characterised by the presence of mixtures of hazardous chemicals, assessing the overall human health impact of ICS involves addressing multiple exposure-outcome associations, accounting for the appropriate time windows of relevant exposures. Health impacts assessments may for instance concern hospitalisation from acute respiratory diseases in children due to short-term changes in exposure levels to air pollutants, as well as the incidence of long latency diseases, like many tumours, which take decades to develop in association to exposure to carcinogenic contaminants.

Main assessment approaches
Different approaches are available to assess the health impacts of ICS, but few have been applied in real-case scenarios. The suitability to use one or other approach depends upon the availability of environmental and health data, cost-benefit aspects and the type of issue that needs to be addressed (Xiong et al., 2018; Martin-Olmedo et at., 2018 and 2019; Shaddick et al., 2018; Shavitz, 2018).

Risk assessment based on toxicological data can be very rapid and low cost, and provides direct information on the expected impact when public health interventions are urgent, and no suitable dose-response functions are available from epidemiological studies. Complementing the results obtained from different approaches, like for instance public health surveillance might also provide an efficient response in specific settings where exposure data are not easily available. A new emerging area is the exposone-based health impact assessment that allows for the interplay of genetic, epigenetic, environmental, dietary, and sociodemographic factors (Sarigiannis et al., 2018). A first major common issue incarrying out health impact assessments in ICS is the selection and use of the most appropriate indicator of exposure (Evidence Box 1).

Risk assessment
The risk assessment approach uses data on contamination and people's exposure as entry point and aims at identifying an appropriate hazard exposure indicator; the latter is then used to estimate, based on existing knowledge, the magnitude of the predicted human health risks and impacts in the population; this may include health effects in particular population groups, such as by age or gender, or socioeconomic groups.

This approach can produce different types of results: 1) semi quantitative where the output is an estimated hazard quotient and index; 2) quantitative where the output is an estimated lifetime event (e.g.,cancer) probability; 3) health impact where the estimate is attributable risk or number of events; and 4) burden of disease, where the output is an estimate of years of life lost and morbidity occurrence.

The strengths of the risk assessment approach include that it can be fairly rapidly undertaken (as long as contamination data are available) and the disease aetiology from exposure to specific pollutants is relatively well understood.

There are however several limitations of this approach including different terminology used across studies and few studies looking at how multiple exposures impact on human health.

Evidence Box 1: Exposure assessment

To provide recommendations on improved exposure assessment methods for industrially contaminated sites, Hoek and colleagues (2018) examined 54 studies from a systematic review of hazardous waste sites; a systematic review of 41 studies on incinerators and 52 additional studies on industrially contaminated sites and health identified for their review.[10]

Almost all of the 54 hazardous waste studies used proximity indicators of exposure rather than individual metrics of residential location or detailed measures of the distance from the contaminated site. Almost all studies did not have a direct measure of land use with proxy measures used instead.

Environmental multi-media modelling methods were not used in any of the studies assessed in this review.

Hoek and colleagues make a number of recommendations for refining exposure assessment methods to accurately measure the health impacts of industrially contaminated sites. These include better integration of land use data, other local contamination sources, individual behaviours and individual characteristics.

Improved exposure assessment methods also included human biomonitoring (HBM). Colles and colleagues (2019) identify four key-phases of HBM: the preparatory phase; study design including sampling schemes; selection of the target population and biomarkers; study outcome and how results are communicated and finally the impact of the results at scientific, societal and political levels.

Health assessment through epidemiological studies

This approach is to quantify the health effects attributable to exposure to environmental pollution based on dose-response relationships based on association between exposures (residential, occupational) and the risk of health effects in ICS affected populations. This approach is commonly based on data from analytical epidemiological studies. The health outcomes can include data such as mortality, incidence of cancer in children or adults, hospitalisation, occurrence of specific disease types, or birth defects.

BEST PRACTICE NOTE 5: Main categories of epidemiological studies

Epidemiological studies that can be conducted in industrially contaminated sites can be group in three main categories, based on their aim:

- to describe the health profile of populations living in industrially contaminated sites
- to assess the associations between environmental exposures and health outcomes, in order to verify specific etiological hypotheses
- to perform epidemiological surveillance

There are several reasons why epidemiological studies would benefit the knowledge on human health impacts of industrially contaminated sites. The reasons include:

- ability to directly examine the relationship between exposure from the industrial site and the health outcomes in the affected population
- responding to community concerns around the potential health impacts of living near a contaminated site
- providing an opportunity to learn more about the health impacts of different exposures that occur in contaminated sites.

However, epidemiological studies can be costly and can raise unrealistic expectations to the community about the type of data that may be produced. These data usually require access to individual and or aggregate (grouped) data. If socio-demographic data are not available for a particular area then the study findings might be biased. Analytical epidemiologic studies are therefore expected for emerging environmental hazards or when findings of the new studies are able to implement public health actions without postponing remediation of ICS.

BEST PRACTICE NOTE 6: Key considerations in performing informative epidemiological studies

There are many benefits of epidemiological studies. However, there are a number of important methodological factors that need to be considered when conducting and interpreting the results of epidemiological studies looking at industrially contaminated sites. Individual-based epidemiological study (cohort and case-control stufdies) instead of ecological level studies should be performed to accurately assess causal associations.

Healthy cities There may be more than one industrially contaminated site in a single urban area. This poses many challenges for ensuring the health of a city. As urban redevelopment plans are implemented, it is important to carefully understand the nature of any industrially contaminated site, its likely health impacts, who the health effects impact most, and what can be done to ensure that harm from the contaminated site to local communities is minimised.

Transboundary contamination. One of the challenges for dealing with industrially contaminated sites in Europe is the possibility of transboundary pollution, including where the contamination source is from one country but impacting on the human health of a neighbouring country. Conducting a health assessment may require political, technical and stakeholder cooperation from the neighbouring country.

Small population samples. Careful consideration should be given to how data on small populations living in or near an industrially contaminated site is interpreted and communicated. Smaller population sample sizes are likely to lead to scientific uncertainty. However, this uncertainty should not limit the importance of the health effects identified at a particular contaminated site. The use of a meta-analytic approach can be helpful in evaluations of the health impact of specific sources of exposure that might be present in several sites.

Environmental and occupational exposure. Assessments of communities living near industrially contaminated sites require attention about the role of occupational and environmental exposures. Workers may be exposed to higher levels of contamination in shorter time periods whereas local communities may be exposed to lower environmental exposures.

Confounding factors. The association between environmental exposures and human health can be confounded by a range of lifestyle and socioeconomic factors. These factors should be measured where possible. If they cannot be measured, then this should be communicated in the results.

Assessment of environmental exposures. Best practice epidemiological studies and health risk assessments should rely upon direct measurement of the environmental exposure. In many cases however, these direct measurements may not be available and assessment is required based on indirect measurement. The strengths and limitations of the exposure measurement should be outlined in the results of the study.
Personal exposure assessment should be assessed as much as possible (better distance of residential address to a site than living in a community with an ICS, and even better the assessment based on human biomonitoring when feasible).

Evidence Box 2: Health risk assessment

Xiong and colleagues (2018) presented an up-to-date understanding of health risks in industrially contaminated sitespublished between 1989 and 2017.[5]

The authors identified and analyzed 92 relevant studies relating to industrially contaminate sites. In the majority of those studies (65%) health risks were presented as cancer risk probabilities, with a quarter presenting the findings as a hazard quotient or hazard index.

Xiong and colleagues conclude that there is a limited amount of studies that have quantified the health impact at industrially contaminated sites. Most of the studies have used semi-quantitative risk characterization approaches and the adopted methods are mostly of toxicological origin, while epidemiological analysis is almost lacking. The authors recommend that improvements in quantitative risk assessment are needed to ensure the inclusion of health impact and environmental burden of disease assessments at industrially contaminated sites.

Public health surveillance

Public health surveillance is the ongoing and systematic collection, analyses and reporting of data about the health of a population. This surveillance can be carried out at the local level, for example at a community level, as well as nationally. Public health surveillance is a key tool in understanding the health profile of a community. Public health surveillance data can also be analysed to understand global patterns and differences in health outcomes.

This approach has, as starting point, the health data for a population affected by one or more contaminated sites. Examples include the Italian SENTIERI studies (see the following case study) AND environmental public health tracking (EPHT).

Part of an overall public health surveillance system, EPHT focuses on the regular collection, reporting and action relating to data about environmental hazards in the community, the extent of exposures to those hazards, and health outcomes associated with exposure to environmental hazards

Evidence Box 3: Environmental public health tracking (EPHT)

There are a number of strengths of the EPHT approach including the use of existing public health surveillance systems. EPHT may also be more widely used in countries where quantitative risk assessment and epidemiological capacity and capability are limited. The EPHT approach is less reliable in that there is often poor exposure data. Further, it is unlikely that public health surveillance systems track single exposure data and do not analyze report on combined exposure data more relevant to understanding the health impacts of industrially contaminated sites.

Martin-Olmedo and colleagues (2018) aimed to identify existing arrangements for continuous collection and analysis of environmental and health data to guide the development of an optimal EPHT approach which would support the characterization of the impact on health of industrially contaminated sites.[11] They conducted a structured PubMed literature search. An additional eight articles from European countries were included in the review.

The authors identified 17 examples of surveillance studies. These studies covered a wide range of industrial activities including both local and cross-jurisdiction studies. There were only two cases where ongoing monitoring systems for gathering environmental data were in place.

From the identified articles, four main exposure assessment methods were identified: 1) qualitative definition for the presence/absence of a source 2) distance to a source, 3) dispersion modelling, and 4) biomonitoring.

Contaminated sites are a common issue across Europe. There are a large number of similarities across countries such as concern for populations living near contaminated sites, the legacy of past industrial activity, and the scale of public health prevention activities. However, the ways in which a country takes action on the issue of contaminated sites can be very different. Three examples of national approaches are reported below.

SURVEILLANCE CASE STUDY FROM ITALY

Italy: developing a national epidemiology surveillance system (SENTIERI)

Studies looking at the health impacts of environmental exposures often investigate situations where people are exposed to relatively low levels of environmental contamination. However, there are also cases where people are exposed to much higher levels of environmental contamination such as people living in or near industrially contaminated sites. This case study shows how a national epidemiological surveillance program has been set up specifically looking at the health impacts of contaminated sites in Italy

A national epidemiological surveillance approach

A permanent epidemiological surveillance program focusing on Italian populations living in nationally prioritised contaminated sites has been set up. This program is called SENTIERI.[12] Some of the driving factors for the establishment of program were that:

- people living near industrially contaminated sites can be exposed to single or multiple types of contamination in levels that are elevated or extremely high. This is different to other population groups where the exposure to those contaminants is much lower.
- people living near contaminated sites also often have a unique social and demographic profile, particularly with an unfavourable socioeconomic status.

A first step in setting up the program was to develop the criteria to define a national priority contaminated site with the definition including the extent of the contamination, the likely size of the health risks and any public concern around the site. The next step was to define the populations at risk as the people living in the municipalities defined as contaminated.

The first systematic approach to the epidemiologic study of contaminated sites in Italy was coordinated by the WHO European Centre on Environment and Health that operated in Rome for about 20 years before moving to Bonn, Germany.

Based on this background, a permanent epidemiological surveillance program focused on Italian populations resident in National Priority Contaminated Sites (NPCSs), the SENTIERI Project was started at Istituto Superiore di Sanità (ISS). SENTIERI is an acronym that stands for National Epidemiological Study of Territories and Settlements Exposed to Pollution Risk.

A key focus was to measure the association between suspected or known environmental exposures and disease with health outcomes being measured by cancer incidence, hospitalization and mortality.

Methodological challenges

There have been several methodological challenges that have been overcome in the SENTIERI program.

- **Confounding**. One of the challenges in environmental and health research is that the results may be confounded by social and economic factors. This can be addressed by having including a measure of socioeconomic position in the research data. In the SENTIERI project, a socioeconomic deprivation index was created and systematically applied to all health outcome analyses.
- **Exposure data**. In some cases, information about exposure was taken from public administration records or from information specific to a specific contaminated site. Where exposure data was missing, international literature was reviewed to understand what exposure information could be applied.

- **Health outcome selection**. It is easy for researchers to look for statistically significant patterns in data without understanding whether these data make sense from a causal perspective. To help address this problem, SENTIERI researchers selected diseases with known causal associations with environmental exposures relevant to contaminated sites.
- **Strength of causal associations**. It has been important in SENTIERI to report on the causal association for each disease-exposure combination. The causal association was classified as Sufficient (S), Limited (L), and Inadequate (I). The evidence for these classifications was determined from a hierarchy of evidence.

Findings from SENTIERI
Detailed description of SENTIERI methodology and findings are available in a monographic issue of *Journal of Environmental and Public Health.[12]* A summary of the findings of the first three reports of SENTIERI project is provided by Pasetto et al. 2016.[13]

Other reports have also been published including:

- a report specifically dealing with mesothelioma incidence in Italian national priority contaminated sites. This report showed a major health impact of asbestos both in sites where the occurrence of asbestos was the reason for the recognition of those areas as National Priorities, and in other sites recognized as National Priorities for different reasons.
- a report of 45 national priority contaminated sites including 319 Italian Municipalities (out of over 8.000 total Municipalities), with an overall population of 5.900.000 inhabitants at the 2011 census. An overall excess of 5.267 and 6725 deaths in men and women respectively has been observed. The total cancer death excess has been of 3.375 men and 1910 women.

Limitations of the SENTIERI approach
While there are a great number of strengths, there are also some limitations to the SENTIERI project including:

- **characterization of pollutants**. There is not yet a uniform procedure for characterizing the environmental quality of each site with the detection and enumeration of its index pollutants. This is because of the information held in different databases is not yet adequately linked.
- **the impact of smaller population sizes**. Statistical power may be a problem in different contexts because of limited population size of many contaminated sites and low frequency of many health outcomes; the use of a meta-analytic approach can be helpful in evaluations the health impact of specific sources of exposure that might be present in several sites.

Key lessons learnt
A key lesson is the development and fostering of a networking system involving all local health authorities and regional environmental protection agencies operating in the study areas.

The possibility to integrate the geographic approach of SENTIERI Project with a set of *ad hoc* analytic epidemiological investigations such as residential cohort studies, case-control studies, children health surveys, biomonitoring surveys, and with socio-epidemiological studies, might greatly contribute to the identification of health priorities for environmental remediation activities.

SENTIERI in Italian means “paths”, thus indicating a progressive itinerary towards better understanding the health impact of contaminated sites.

BEST PRACTICE NOTE 7: Lessons from a national surveillance program

Consistent criteria need to be developed to define national priority contaminated sites as well as the definition of local populations affected.

It is important to include research methods that can account for socioeconomic confounding factors and that report on the strength of association between environmental exposure and health impacts.

Stakeholder engagement plays a major role in how risk is perceived and communicated in assessments of contaminated sites.

Two-way communication between local populations, public health authorities, the scientific community and the media will help in ensuring transparency of information.[14]

There is a hierarchy of evidence that is important to consider when interpreting results of contaminated site assessments.

CASE STUDY FROM SERBIA

Republic of Serbia: developing a roadmap

The sound management of contaminated sites is an important priority for the Republic of Serbia. This sound management including building capacity across different sectors to prevent poor public health outcomes associated with contaminated sites. A roadmap of how to manage contaminated sites was developed to provide a framework for this cross-sector action.

A gap analysis was carried out before the development of the roadmap. The gap analysis identified four main areas: knowledge; monitoring and reporting; leadership and cooperation; and institutional arrangements.

The goals of the roadmap developed in 2018 were to:

- improve the relationships across different agencies at both the national and local level to ensure the effective management of contaminated sites
- establish a monitoring system for monitoring the social and health impacts of contaminated sites, including for local populations.

The Institute of Public Health was the main implementing agency. Other agencies included the Ministry of Health, Ministry of Environment Protection, Serbian Environment Protection Agency, and the Mining and Metallurgy Institute Bor.

The main strengths of the roadmap are that it:

- provides a good starting point for sound management of contaminated sites,
- uses a collaborative approach across sectors
- describes the capacity building activities needed in each sector
- ensures that vulnerable populations are a central focal point
- highlights the need for increased public awareness about the risks of contaminated sites
- shines a light on the need to increase the use of epidemiological approaches in contaminated sites.

The limitations of the roadmap include that:

- only two ministries were involved in the multisectoral development of the roadmap

- capacity building activities need to be harmonized with broader capacity building activities in each sector
- occupational exposure and to contaminated sites and risk communication were not specifically addressed
- the problem of linking environmental data to health outcomes was not resolved.

BEST PRACTICE NOTE 8: Lessons from an environmental health risk assessment process

The findings from environmental health risk assessment can used in the decision-making process around what to do about a particular contaminated site as well as responding to community concerns around the impact on their health and wellbeing.

Having a collaborative regional environment and health network is fundamental. In Flanders, there are three different levels of networks: scientific experts; environment and health government departments; and local knowledge sharing between key environment and health actors.

Participation of local communities in the assessment process is important. The assessment generates outcome data that can be used by the local community as well as for policy action.

HEALTH RISK ASSESSMENT CASE STUDY FROM FLANDERS

An environmental health risk assessment approach

In Flanders, a procedure on how to conduct an environmental health risk assessment has been developed with this procedure able to be used for industrially contaminated sites. The goal of this procedure is to assess the human health risks from exposure to environmental pollutants in a structured and systematic manner. The conclusion of the environmental health risk assessment can be used for both decision-making as well as communicating with the affected local community by providing them knowledge about the human health impacts of environmental exposure.

The procedure outlines an efficient four-step process for each the environmental exposures and the health impacts. Each step is an incremental increase in the complexity or sophistication of assessment. For example for environmental exposure, the first step is a semi-quantitative estimation followed by the second step of a conservative point estimate using quantitative methods followed by the third step of a refined quantitative point estimated and the final and fourth step of probabilistic estimation.

Once the tiers of each exposure and health effects assessment is completed, then a combined risk assessment is undertaken. If the exposure is below the effect threshold and/or the risk is acceptable, then no further action is required. However, if the risk is estimated to be above an acceptable exposure threshold, then actions are put in place to lower exposure or a more robust assessment of the environmental exposure and effect is undertaken.

BEST PRACTICE NOTE 9: Developing a road map

The development of a roadmap can help to provide a common understanding across different government stakeholders about how to best manage contaminated sites at the regional and local level.

A roadmap should form part of the broader national policy on contaminated sites and should include as many different agencies as possible.

Activities that help to ensure sound management of contaminated sites should be developed in a harmonized way with other national, regional or local priorities.

MAIN TYPES OF DATA NEED TO ASSESS THE HEALTH IMPACTS OF INDUSTRIALLY CONTAMINATED SITES

A range of different data types are needed to measure and report on the human health impacts of industrially contaminated sites. These data types include environmental exposure data, human health data, demographic data as well as toxicological and epidemiological data. A summary of these different data types and data categories is listed below.

The following table can help determine what data might be available for an assessment of the human health impacts from an industrially contaminated site.

Practical Guidance Table 1: Types of data needed

Type of data	Who might hold the data	What are the specific data categories	Is the information likely to be available
Environmental exposure data	• National, regional or local environmental agencies and departments • Research institutes	• Cross-sectional and **direct measurement** (supplemented with multi-media modelling) of air, surface and ground water, soil and sediments, biota and foodstuff locally produced	☐ Yes ☐ No
		• Longitudinal and **direct measurement** of air, surface and ground water, soil and sediments, biota and foodstuff locally produced	☐ Yes ☐ No
		• Cross-sectional **and indirect measurement** of air, surface and ground water, soil and sediments, biota and foodstuff locally produced	☐ Yes ☐ No
		• Longitudinal and **indirect measurement** of air, surface and ground water, soil and sediments, biota and foodstuff locally produced	☐ Yes ☐ No
Health data	• National, regional or local public health agencies • Research institutes	• Mortality data over time • Morbidity data over time • Cancer incidence or mortality data over time • Congenital abnormality data over time • Other disease specific data over time	☐ Yes ☐ No
Demographic data	• National, regional or local statistics agencies • National, regional or local public health agencies • Research institutes	• Cross-sectional data on number of people in the population by age, gender and socioeconomic position	☐ Yes ☐ No
		• Longitudinal data on number of people in the population by age, gender and socioeconomic position	☐ Yes ☐ No
		• Cross-section data on the number of people living in or near the contaminated	☐ Yes ☐ No

		site by age, gender and socioeconomic position	
		• Longitudinal data on the number of people living in or near the contaminated site by age, gender and socioeconomic position	☐ Yes ☐ No
Toxicological and epidemiological evidence	• National, regional or local environmental agencies and departments • National, regional or local public health agencies	• Direct and locally relevant evidence on the main pollutants identified as potential contaminants • Limit or reference values (available from systematic reviews or integrated assessments).	☐ Yes ☐ No ☐ Yes ☐ No
		• Direct and relevant evidence from the same region or country on the main pollutants identified as potential contaminants	☐ Yes ☐ No
		• Evidence from a similar country or region on the main pollutants identified as potential contaminants	☐ Yes ☐ No
		• Less relevant evidence from other countries on the main pollutants identified as potential contaminants	☐ Yes ☐ No

WHAT ARE THE RESEARCH GAPS IN THE AREA OF HUMAN HEALTH IMPACTS OF INDUSTRIALLY CONTAMINATED SITES?

One of the key strengths of measuring the human health impacts of industrially contaminated sites is the existing knowledge on methods approaches to individual exposure and health outcome assessment fields. However, it is clear that a much more coordinated and comprehensive approach is required that brings together environment and health science to fully understand the complex human health impacts of industrially contaminated sites.

Public health surveillance methods
Public health surveillance methods are capable of detecting the negative health outcomes associated with industrially contaminated sites.

The major limitation, however, is that current public health surveillances are not routinely integrating hazard information systems, health exposure data, and health outcome metrics. Standardised methods for data collection to have high-quality information across space and time are important.

As highlighted by Martin-Olmedo and colleagues, an example of where this integrated data approach has been implemented is the SENTIERI project.[11] SENTIERI is an Italian epidemiological surveillance system designed to monitor the health status of populations living in national priority contaminated sites.

The main methodological strength of SENTIERI is that it integrates different quantitative health outcome measures including mortality, hospital episodes, congenital anomalies and cancer incidence. The health endpoints are articulated based on the known health outcomes for specific industrial activities. The main limitation of SENTIERI is that the exposure data is often qualitative, rather than empirical exposure data, based on the type of industrial site.

A public health surveillance system for industrially contaminated sites needs to promote partnership, bringing together scientific information, technology, and health communication to make data accessible, usable, and understandable by a variety of users.

Exposure assessment methods
A key observation from a review of exposure assessment methods for industrially contaminated sites that modelling tends to focus on single exposures rather than multi-media modelling methods commonly used in regulatory risk assessment.

Implementation of the following issues would help improve the conduct of exposure assessments for industrially contaminated sites:

- Improvements in distance-based metrics from industrially contaminated site
- Increased use of land use data
- Validation of exposure data to reduce misclassification of exposure data
- Reductions in exposure measurement error
- More extensive use of multi-media exposure assessment models
- Use of dispersion modeling for inhalation as an exposure pathway, rather than distance as a proxy measure
- Improvements in how to assess the food ingestion exposure pathway with monitoring as currently most practicable solution□
- Additional work on how to model the indoor air inhalation exposure pathway
- Broadening the data used to correlate the space dispersion of contaminants from industrial site
- Consideration of human bio monitoring and personal exposure monitoring
- Increased use of internal dosimetry models
- Applications of various –omics models including the concept of the exposome
- Undertaking an ethical analysis of decisions around the siting of contaminated sites and the impacts on surrounding communities.

Epidemiological research

Public health surveillance and or health risk assessment is often an efficient way to respond to public health concern about an industrially contaminated site. However, new epidemiological studies are beneficial when there is little existing knowledge about a pollutant and when there is sufficient measurement of the exposures and outcome of interest.

Along with the public health surveillance and health risk assessment, there a number of factors in epidemiological research that need to be strengthened for measuring the health impacts of industrially contaminated sites: [15]

- accurate data on exposure at the individual level including interview data or biospecimens
- the use of individual-level routinely collected data, such as through the birth and death registry data
- collection of accurate confounding data such as smoking status and socioeconomic level
- ensuring there is a large enough population to meet sample size requirements. Where there is a small population, a risk assessment approach to estimate the effects may be more appropriate.
- health outcomes that have a short time period between exposure and disease are likely to be more useful for measuring and responding to industrially contaminated sites. Longer-term follow-up should not be discounted. For example, the time between asbestos exposure and malignant mesothelioma can be up to forty or fifty years.

There are also important methodological aspects whose improvements can be also useful to epidemiological research relating to specific types of contaminated sites. For example, Shaddick and colleagues (2018) have suggested a number of methodological developments for measuring the health impacts of waste landfills including the use of: [3]

- a simple ranking system to differ between sites that result in more or less environmental pressure
- more realistic buffers based on the fact the point sources may cover extended areas wider than originally conceived
- more complex risk surfaces to reflect actual scenarios
- a wider set of data, such as the socioeconomic position of the resident population
- a more realistic approach to dealing with uncertainty including how uncertainty is considered when calculating burden of disease measures such as disability adjusted life years.

BEST PRACTICE NOTE 10: Selecting the best type of human health assessment

Public health surveillance may be an appropriate and immediate response in resource constrained settings. Where possible, the public health surveillance system should be adapted for the purpose of industrially contaminated sites to allow for an integrated approach that combines:

- hazard information systems
- health exposure data
- health outcome metrics.

A risk assessment approach will provide stakeholders with an estimate of the potential health impacts of an industrially contaminated site by combining known information about a particular environmental exposure with toxicological and or epidemiological data. A local human biomonitoring campaign can also build trust of local stakeholders in surveillance of exposure at group and individual level.

The risk assessment, where possible, should incorporate assessment of the different exposure types and pathways as well as provide more granular analysis of land use and pollutant dispersion models.

It may be beneficial and efficient to combine both an integrated public health surveillance approach with a risk assessment approach.

A new epidemiological study that provides an actual health outcome measurement of an industrially contaminated site should be considered where:

- there is not enough data on the human health effects of a particular pollutant
- there is an appropriate level of technical and financial resources
- there is the ability to collect robust environmental exposure and health outcome data as well as data on any confounding factor.

RESEARCH GAPS AND NEEDS

Summary of research gaps

- There have been substantial advancements made in ensuring a more comprehensive approach to assessing the health impacts of industrially contaminated sites. These advancements have been possible through the COST Action investment and the time and expertise of environment and health researchers and policy makers. However, significant gaps remain.

- There is a wide range of industrial sites. An understanding of the multiple contaminants likely to occur at each industrial site type would provide greater consistency. Several factors that need to be considered are whether there is a contaminant type that would be greatest or least impact, the known time between environment and health outcomes from exposure to the contaminant and the interaction between different contaminant types.

- A process of mapping each of the multiple contaminants to the multiple exposure pathways is vital. A single contaminant may impact on three different exposure pathways (inhalation, ingestion, dermal absorption).

- Greater understanding of the relevant health outcomes for the multiple contaminants and exposure pathways is also vital. The decision on which outcome to select for analysis is also dependent on data availability. For instance, while mortality or cancer incidence may be the most valid health outcome the data may not be available for the latency period between exposure and outcome may be too long. A more immediate health outcome, such as the number or rate of hospitalisations, may be more useful.

- The unequal distribution of health impacts associated with industrially contaminated sites requires urgent attention for understanding which data and methods would most reliable estimate these health inequalities.

- Improved and more consistent reporting of health assessments of industrial contaminated sites would allow for greater transparency to stakeholders as well as the ability to compare findings across different jurisdictions.

EFFECTIVE STAKEHOLDER ENGAGEMENT

During the assessment of an industrially contaminated site, stakeholders may include landowners and residents living near the site, site owners and companies, officers from public health, environmental or other government regulatory authorities, non-government organizations, workers' unions and associations, and the media.

Stakeholder involvement is crucial because they have a moral entitlement to know what risks confront them, but also because they are crucial agents for risk response.

Understanding stakeholder engagement

Stakeholder engagement refers to deliberate action taken by the practitioner to involve any combination of stakeholders (with an interest in site conditions or activities occurring on the site) in the risk management process.

The overall aim is to improve the quality of the decisions made for a particular project, while also improving the decision-making process itself.

There are different forms and levels of stakeholder engagement:

- **Information**: "We want to tell you what has happened and what we are going to do next".
- **Consultation**: "We would like to obtain your view on…".
- **Involvement**: "Let's try and understand each other's perspective".
- **Collaboration**: "How should we decide on priorities / the way forward?".
- **Empowerment**: "Which task can you take over?".

Principles of engagement

Stakeholder engagement principles should be adopted to guide and inform the planning, implementation and evaluation of engagement and public participation activities. Meeting the objectives of each of the principles will ensure stakeholders find value participating in the engagement activity. Five key principles are summarized below:

- Purposeful
- Inclusive
- Timely
- Transparent
- Respectful.

Process for engagement

The process is a dynamic and ongoing cycle, which supports a comprehensive approach to engagement and will, over time, build an evidence-based platform for continuous improvement. A five-step process is structured to support thorough planning, preparation, action and evaluation of every engagement activity:

- Think
- Plan
- Prepare
- Engage
- Evaluate.

Integrating stakeholder engagement

The following key questions should be considered when developing the stakeholder engagement section of the implementation plan.

- Planning
  - How will stakeholder engagement help achieve the outcomes and objectives of the initiative?
  - Does the plan allow for results of stakeholder engagement to be incorporated into key decisions?
- Governance
  - Have clear roles, responsibilities and accountabilities for engagement been identified?

  - Will stakeholders play a part in the governance framework?
- Risk
  - What risks are posed to the program by stakeholder engagement?
  - What risks from the program may affect the degree and quality of stakeholder engagement?
- Monitoring, review and evaluation
  - Is review of stakeholder engagement included in monitoring, review and evaluation?
  - How will the implementation plan be adjusted based on feedback from stakeholders?
- Resource management
  - Have the resources for stakeholder engagement been factored into the implementation plan?
  - Does the team have the skills and expertise to engage stakeholders effectively, or will you need external expertise?
- Management strategy
  - Are the timeframes to conduct the proposed stakeholder engagement approach realistic?
  - Can you incorporate feedback from stakeholders into the selected project management tools?

Hurdles to effective stakeholder engagement
A number of common barriers can inhibit stakeholder engagement and must be identified before taking any engagement activity:

- Unclear purpose and objectives.
- Failure to accommodate differing capacity of stakeholders.
- Insufficient skills in the implementation team.
- Insufficient resources.
- Unfocused dialogue.
- Non-inclusive engagement approaches.
- Engagement fatigue.
- Failure to provide meaningful feedback.
- Failure to review and evaluate.

Strategies for successes
There is no single success factor that delivers effective stakeholder engagement. However, there are some common strategies that will help make stakeholder engagement fruitful and worthwhile:

- Map the stakeholders and get the relevant stakeholders to the table.
- Agree on the rules of engagement.
- Plan the engagement and manage expectations.
- Use a mixed or fit-for-purpose approach.
- Use consistent and appropriate messages.
- Act with transparency and accountability.
- Learn from others.
- Use the information you collect.
- Be focused and flexible.
- Maintain the right to disagree.

BEST PRACTICE NOTE 11: Stakeholder engagement

Different stakeholder engagement approaches may need to be used throughout the project.

Stakeholder engagement is a long, multi-dimensional and challenging process with an uncertain outcome.

Stakeholder engagement is now a standard component of any health impact assessment, remediation or management of an industrially contaminated site.

The next step of stakeholder engagement activities is now to shift from traditional methods of "deliver and inform" to "involve and collaborate".

ENSURING A YOUTH PERSPECTIVE IS INCLUDED

Why does industrially contaminated sites matter for young people?
Young people play an important, positive role in responding to present and future environmental contamination patterns, as well as providing societal support for health arrangements.[16]

Although commitments were made by all Member States of the World Health Organization (WHO) European Region in the Parma Declaration on Environment and Health in 2010,[17] only about a quarter have reported meaningful youth engagement.[16]

In June 2017, fifty-three Member States of the WHO European Region assembled at the Sixth Ministerial Conference on Environment and Health in Ostrava, Czech Republic. The main outcome of the Conference was the adoption of the Ostrava Declaration [18] led by the adoption of Ostrava Youth Declaration.[19]

Young people need special consideration, given their high sensitivity to environmental agents. Thus, policy-makers are faced with the ongoing challenge of making good decisions while remaining responsive to the young people affected by their decisions.

Challenges associated with industrially contaminated sites in the environmental health policy arena are often technically complex and value-laden, with multiple affected groups and stakeholders operating in an atmosphere of mistrust.

Another relevant issue is intergenerational justice because unsustainable waste management practices leave a toxic legacy that will adversely affect future generations.

Benefits of ensuring active youth participation

- Young people can engage in research without any prior research skills training (including designing their own experiments, analysing data and reflecting on results) by applying their own scientific and political knowledge, which is meaningful within their own societal context.[20]
- The overarching objective should be to support youth-initiated, youth-directed and youth-controlled practices so that young people can become autonomous learners and think critically about their actions and decisions regarding scientific practice and policy. Most of these skills, values and attitudes (e.g. critical thinking, individual responsibility, ability to work as part of a team) are recognized as being important for citizens to acquire so that they can participate effectively not only in scientific research but also in their daily life activities.[21]

What can policy makers do about it?

- Expand meaningful youth participation in national and international decision-making and policy development processes related to the environment and health in all WHO European Member States.
- Promote formal and non-formal education programmes on environmental health issues at every level of educational facility for raising awareness among children and young people in the WHO European Region.
- Policy officers and decision-makers should not judge what young people have to say about research using the same scientific and policy standards and the same criteria used to determine the credibility and trustworthiness of professional researchers; relationships and interactions should be transparent and aimed at building trust.

BEST PRACTICE NOTE 12: Youth participation
Prior and during the Sixth Ministerial Conference on Environment and Health (2017) young people strongly proved that they are more cohesive than ever not just in going through the challenges, but in defying it with real action, in making a difference by presenting and adopting the Ostrava Youth Declaration which represents a direct input of more than 70 international youth delegates from across the European Region. Young people are committed to act on environment and health by eliminating threats to human health in transition to circular economy and reducing waste and pollution in Europe.

TRAINING AND CAPACITY BUILDING

Capacity building in environment and health has been recognized as a critical need among Member States of the WHO European Region. Many countries are faced with the challenge of addressing the growing burden of disease arising from environmental exposures, oftentimes unprepared.

A first example of training package on Capacity Building in Environment and Health (CBEH) addressing also the issue of the health impact of contaminated sites, was developed by WHO, with the aim to build significant capacity in addressing environment and health matters among officials and practitioners from government agencies and research institutes in health, environment and other sectors related to environment and health.
The learning objectives of the training package were:
• provide the potential trainer examples on how a training in EH could be structured and how specific topics of the in-depth modules could be addressed in a given country;
• present an example of how joint trainings with EH experts can improve understanding between sectors and enhance intersectoral work; and
• generate ideas on how EH issues can be addressed within one's current area of work.

Within this training package, the specific module on "Methods for risk assessment related to contaminated sites" was adopted in an international training workshop on environment and health (19–23 March 2012 Riga, Latvia) and introduced concepts and guidance on how to deal with EH in contaminated sites (CS) using simple and most frequently available vital statistics. Participants were provided with methodological tools to examine environmental health aspects of living in CS and learned to assess appropriate responses to emerging problems associated with contaminated sites.
In particular, this module was divided into three slots, each one including an introductory lesson, a practical guided work group session and a plenary discussion. The first slot introduces important issues related to CS and presents an a priori evaluation of the epidemiological evidence of the causal association between specific diseases and environmental exposures in CS. The second slot addresses methodological aspects related to describing population health status in CS with an opportunity for participants to work through an example of calculation of crude rates, standardized rates, and standardized mortality/morbidity ratios, by age and socioeconomic status.
The third slot, building on the case-study results and information available from previous slots, proposes a guided approach on how to: i. decide on the need for further studies; ii. identify aspects that allow for attribution of environmental causes to a given health profile; And iii. recognize public health implications in terms of preventive interventions to be implemented.

More recently, as part of the activities of the ICSHNet COST Action a training school was successfully held in Thessaloniki in February 2017 with the aim to strengthen in-country capacity to face the environmental health challenges posed by Industrially Contaminated Sites (ICSs) https://www.icshnet.eu/category/training-schools/.
46 early career investigators from 25 countries participated in the 4-day workshop led by 21 lecturers, introducing concepts and methods used in epidemiology, exposure assessment and health impact assessment. Students participated presenting posters showing real-life issues in their respective countries related to health and environmental pollution arising from ICSs.

The training school "Environmental health in industrially contaminated sites" was one of the milestones of this Action, created to strengthen the in-country capacity to respond to the environmental health challenges posed by industrially contaminated sites (ICSs), through the training of early career investigators (ECI).
In fact youn generations of researchers are essential for spreading knowledge methods through different scientific communities in the future about emerging environmental health issues.
The aim of this training course was to strengthen in-country capacity to respond to the environmental health challenges posed by Industrially Contaminated sites (ICSs) by creating and assisting a European "cohort" of investigators dealing with Industrial contamination and

population health issues. The course aimed to provide these researchers with a scientific basis on knowledge of methods along with risk and uncertainty of the research, also matched to practical skills for evaluating the health effects and impact of industrially contaminated sites

Course content
The course included:

- Plenary sessions and discussions
- Lectures of principles and methodologies for exposure, health, and impacts assessment
- Lectures of case studies, placing the principles and concepts into context
- Practicals: hands-on data analyses, reviews of case studies, discussion sessions
- Use of mixed media: computer-based, presentations, round-table discussions
- Discussion on posters presenting cases of ICSs in participant countries.

Course structure
The structure of the course was built around 4 training modules, each lasting one day with a different focus:

Day 1. Plenary Day. Course: Plenary lectures
Shared with the Action management and participating scientists. It comprised invited keynote lectures introducing topics relevant to the Action more generally and the aims of the training school specifically, a complex multi-stakeholder case study of a local controversial contamination scenario, and introductory session for the students to be introduced to faculty and each other.

Day 2. Course: Epidemiology
The aim of the day was to introduce environmental epidemiological principles, recognizing that the student body included some with prior experience of epidemiology and was able to learn more deeply about the methods for studying ICS in detail and others who were new to epidemiology and needed more to understand the principles, so they can critically examine published work. Epidemiology can potentially identify whether or not there is a health risk, quantify the magnitude of the risk and monitor whether that risk falls following clean-up. Good design and good exposure assessment underpin reliable results. Topics covered included choice of study designs, approaches to analysing data, how to synthesise evidence from multiple studies, and a detailed illustration of such studies in the presentation of the example of SENTIERI epidemiology studies carried out in Italy.

Day 3. Course: Exposure assessment
The aim of the day was to give the students an introduction to environmental exposure assessment relevant to industrially contaminated sites including a description of methods and tools for all possible pathways (air, soil, water, food). A broad range of issues were covered including: the difference between measuring and modelling, exposure misclassification, temporal and spatial exposure scales, the use of GIS in exposure science, strengths and limitations of human biomonitoring studies to evaluate environmental exposure solutions. The students were also given a hands-on software experience, using the open-source software INTEGRA, to perform an exposure assessment (EA) in a case study setting. Afterwards there was time to share experiences and come up with solutions solving some of the problems faced by the students.

Day 4. Course: Health Impact Assessment (HIA)
The aim of day was to describe the rationale, objectives, methods and tools for assessments of the health impacts of environmental risk factors and determinants relevant for industrially contaminated sites. The day built on and logically followed the previous two days, where epidemiological and exposure assessment tools were covered: risks and exposure data both contribute to deriving health impacts, which can be expressed through various metrics, and these were taught in the course through theory and examples. Strong emphasis was also put on the available practical resources and tools for impact assessment, with a session on tools based on the R freeware software package. The different sessions presented and promoted discussions on relevant applications, case studies, examples, needs, while paying attention to feasibility, inequalities and environmental justice, interpretation and communication of results.

RISK COMMUNICATION

Mutual understanding between environmental and health disciplines is a key prerequisite for their better integration and, ultimately, for the improvement of studies. In this sense, training activities, specially designed to promote intersectoral collaboration between environmental and public health experts, are identified as a first key aspect to be addressed in the future.

The second aspect is to promote the development of a risk communication strategy between researchers, and policy-makers and relevant stakeholders, so that research design and findings can take local concerns into account and can effectively support the decision-making process. The COST Action encouraged its partners to share existing guidelines for environmental risk governance. As children are a vulnerable group of special interest, a bibliographic search in 3 databases was organised to trace best practices of children's active participation in environmental health issues.[20] The paper abstracts were screened using the 'ladder of participation'. A recommendation is not to impose the adult's definition of the issues to children but to remain open for their own framing of living conditions, concerns and ambitions. In this way, communication aspects are much more than choosing a communication channel.

BEST PRACTICE NOTE 13: Recommendations for risk communication action, reported in the communication strategy of cases (in the Action's survey, n=33)

1. Regulation and management (governance); e.g. optimizing and tightening the legislation on open fires, development of waste-water treatment plants
2. Exposure reduction recommendation (households); e.g. children not to eat eggs, washing hands after gardening
3. Technological recommendations (industry); e.g. implement new cleaner technologies, water-service companies had installed activated carbon filters in the water-treatment plants
4. Monitoring and surveillance (science); e.g. epidemiological surveillance of population living in the ICS, regular blood tests for anaemia in children

The third aspect is the need to develop a framework for risk governance, in which affected groups, experts and involved parties co-produce suggestions for local environmental policy and health promotion. Best Practice Box 12 displays the types of action that where referred to in 29 cases of the Action's survey, classified in 4 categories.

Furthermore with regard to risk governance, SDG-Indicator 16.7 is an appeal to ensure responsive, inclusive, participatory and representative decision-making at all levels. Even more promising is to go for engaging and more integrated and sustainable (re)development projects, in which affected groups are jointly involved in positive future thinking, instead of mere sectoral remediation projects.

Last but not least, one should keep in mind that the science-policy, social, political and institutional contexts vary across Europe. Discussion on national cases during the ISCHNET-meetings revealed that there can be high trust in competent authorities and risk management or not. That local social cohesion can support residents to cope with severe threats and to find trust in social institutions rather than the state. In the Casale Monferrato case for instance, volunteers, artists, celebrities, technicians, journalists, the local authorities, scientists, workers, associations all closely cooperated. In other cases, collaboration in risk management can precisely become a key

BEST PRACTICE NOTE 14: Use of media
From the Action's questionnaire, we learned that besides websites, brochures and the accessibility of the research reports also more particular media are relevant: mass media (e.g. TV spots, press conferences), community initiatives (e.g. public hearings, workshops) and individual initiatives (e.g. house to house communication, visits with GP).

INDUSTRIALLY CONTAMINATED SITES AND THE LINK TO SUSTAINABLE DEVELOPMENT GOALS AND THE CIRCULAR ECONOMY

The 2030 United Nations Agenda for Sustainable Development provide a way to ensure a sustainable future for everyone. The 17 Sustainable Development Goals address challenges faced by all countries. The circular economy offers an avenue to sustainable growth, good health and decent jobs, while at the same time protecting the environment and natural resources.

UN Sustainable Development Goals

Measuring and acting on the human health impacts of industrially contaminated sites contributes to many of the Sustainable Development Goals. This includes the goals addressing health (SDG 3), Clean water and sanitation (SDG 6), affordable and clean energy (SDG 7), inequalities (SDG 10), sustainable cities (SDG 11) and sustainable production and consumption (SDG12).

Ensuring healthy lives and promoting the well-being at all ages is essential to sustainable development.

Link to industrially contaminated sites

In many countries, life expectancy is increasing and at the same time morbidity and mortality among children is decreasing. Reducing the exposure to environmental factors harmful to human health is an important contribution to these patterns.
Reducing the human health impacts from industrially contaminated sites will contribute achieving good health and wellbeing in communities, particularly for specific population groups such as children, the elderly and lower socioeconomic groups.

Clean, accessible water for all is an essential part of the world we want to live in and there is sufficient fresh water on the planet to achieve this. However, due to bad economics or poor infrastructure, millions of people including children die every year from diseases associated with inadequate water supply, sanitation and hygiene.

Link to industrially contaminated sites

Contamination of surface and ground water is one of the key exposure pathways of human health impacts from industrially contaminated sites. More importantly, surface and ground water is one of several types of exposure from contaminated sites. A comprehensive assessment of the health impacts of industrially contaminated sites would not only consider contamination of surface and ground water but also how this source of exposure interacts with air and soil contamination.

Energy is central to nearly every major challenge and opportunity the world faces today. Be it for jobs, security, climate change, food production or increasing incomes, access to energy for all is essential. Working towards this goal is especially important as it interlinks with other Sustainable Development Goals. Focusing on universal access to energy, increased energy efficiency and the increased use of renewable energy through new economic and job opportunities is crucial to creating more sustainable and inclusive communities and resilience to environmental issues like climate change.

Link to industrially contaminated sites

Industrial sites are large users of energy and there are potential co-benefits for specific industrial sites. For example, a transition to cleaner processing of waste is likely to identify opportunities for increased energy efficiency. Reduce energy use will decrease the running cost for the industrial site and reduce greenhouse gas emissions.

10 REDUCED INEQUALITIES

There is growing consensus that economic growth is not sufficient to reduce poverty if it is not inclusive and if it does not involve the three dimensions of sustainable development – economic, social and environmental. Fortunately, income inequality has been reduced both between and within countries. At the current time, the per capita income of 60 out of 94 countries with data has risen more rapidly than the national average.

Link to industrially contaminated sites
Industrially contaminated sites are often located near residential areas. These areas are most often populated by people with lower socioeconomic position and, in turn, people with poorer health outcomes than the more socially advantaged socioeconomic groups. Exposure to industrially contaminated sites among people with lower socioeconomic position are likely to exacerbate existing poor health outcomes.

11 SUSTAINABLE CITIES AND COMMUNITIES

Rapid urbanization challenges, such as the safe removal and management of solid waste within cities, can be overcome in ways that allow them to continue to thrive and grow, while improving resource use and reducing pollution and poverty. One such example is an increase in municipal waste collection. There needs to be a future in which cities provide opportunities for all, with access to basic services, energy, housing, transportation and more.

Link to industrially contaminated sites
One approach to population growth is continue to increase the number of infrastructure facilities, such as landfills. Increasing the number of potential industrially contaminated sites, such as landfills, will lead to higher environmental exposures and, in turn, negative human health impacts. A more sustainable approach to infrastructure development would have environment and health co-benefits.

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Sustainable consumption and production is about promoting resource and energy efficiency, sustainable infrastructure, and providing access to basic services, green and decent jobs and a better quality of life for all. Its implementation helps to achieve overall development plans, reduce future economic, environmental and social costs, strengthen economic competitiveness and reduce poverty.

Link to industrially contaminated sites
A transition to a circular economy is not only a way to increase health benefits but also a way to contribute to the achievement of the Sustainable Development Goals. Benefits can be direct, such as sector-specific cost saving, as well as indirect from environmental and social outcomes.
Waste-related activities make up a large proportion of activities that occur at industrially contaminated sites. Waste activities are a good example of where the links between the concepts of the circular economy and the SDGs can be applied.

There are substantial health impacts of past and present waste disposal activities with populations between exposed to a variety of noxious agents. For example, there is strong evidence for excess cancer risk, congenital abnormalities and respiratory disease associated with informal, uncontrolled or poorly managed waste practices. This human health exposure is preventable through waste production prevention and clean processing cycles. These actions not only reduce the risk of human health impacts but also contribute to sustainability.

The two main policy recommendations that contribute to both the circular economy and achievement of SDG 12 are:

- Eradicate uncontrolled and illegal waste disposal and trafficking in affected countries. This can be achieved through conducting national assessments of poor waste management practice, increase the public awareness about safe waste management, and ensuring the prosecution of people responsible for illegal waste dumping, particularly hazardous waste.
- Prevent and eliminate potential adverse health impacts from waste and contaminated sites. Strategies for this recommendation including remediation or phasing out of waste facilities that create health hazards, safe management of landfill sites, engagement of the health sector, and building of capacity of assessing the health impacts of waste.

Circular economy

The circular economy is a way to achieving progress towards sustainable development and can be focused on measuring through the sustainable development goals. The European Union Action clearly articulates the relationship between the global commitments under the Sustainable Development Goals and the circular economy. In particular, SDG 12 on ensuring sustainable consumption and production patterns. There is also a link to other Sustainable Development Goals, including good health and wellbeing (SDG).

There are two main ideas that underpin the circular economy concept. The first idea focuses on the use of resources in society. A linear economy there is a one-way direction from resource extraction, production, distribution, consumption and waste. In a circular economy, resources are produced, distributed, consumed, reused, repair or recycle with a closed loop back to production. The second idea in the circular economy is a broader focus, including efforts to change models of consumption.

There has been limited coverage of how the circular economy relates to both positive and negative health impacts. Positive health impacts of a circular economy occur through:

- reducing the use of primary resources, maintaining the highest value of materials and products, and increasing energy efficiency and the use of renewable energy
- changes that increase sustainable procurement models. These models will lessen environmental and human health impact and, if incorporated in large scale procurements, can have significant social, economic and health co-benefits.

Negative health impacts can also be triggered through a circular economy model through:

- the relocation or export of potentially harmful waste products, such as e-waste, to communities where there are informal or unregulated waste activities
- the reuse, repair and recycle process where there is exposure to harmful products or chemicals.

A number of priority actions have been identified that help maximise health benefits and minimise health risks. These actions include:

- ongoing development of regulations that aim to reduce human health risks
- data that helps the safe removal of harmful substances in recycled materials
- greater understanding and quantitative analyses of harmful environmental exposures on human health, including how health impacts are distributed in the population
- taking action on informal waste sites.

There are well established methods and approaches for quantifying and valuing health impacts. These methods and approaches can be readily applied to measuring the health impacts of the circular economy. For instance, the burden of disease attributable to different environmental risk factors have been estimated using robust data from risk assessment, exposure measurement and epidemiology data as well as from expert opinion.

Economic values can also be estimated to help quantify the health impact of the circular economy. These economic analyses can include:

- resource costs such as direct medical and non-medical costs
- opportunity costs
- quality of life and utility costs.

There are different policy options for how the circular economy can be implemented including [22]:

Summary Information Table 6. Policy options available to support a circular economy approach to industrially contaminated sites

Type of policy option	Example relating to industrially contaminated sites
Regulatory frameworks	Product standards and regulations
Economic instruments	Tax shift from labour to resources, e.g. landfill tax
Education information and awareness	Public communication and information strategies
Research and innovation policy	Research and development programmes, e.g. the European Cooperation in Science and Technology programme (COST)
Public procurement	Public investment in circular economy facilities, e.g. recycling collection and processing infrastructure

PART 4: TOOLS FOR PLANNING A RESPONSE TO THE HUMAN HEALTH IMPACTS OF INDUSTRIALLY CONTAMINATED SITES AND FUTURE DIRECTIONS

STAGES OF ACTION FOR ORGANISING A RESPONSE

Industrially contaminated sites are a ubiquitous presence in Europe. Hundreds of thousands of them are registered, and countless more exist throughout the continent. Many of them entail limited contamination, but some involve extensive contamination affecting soil, water, air and the food chain in their surroundings, hereby carrying a potential, or in some cases established, health threat. The environmental impacts are also of concern.

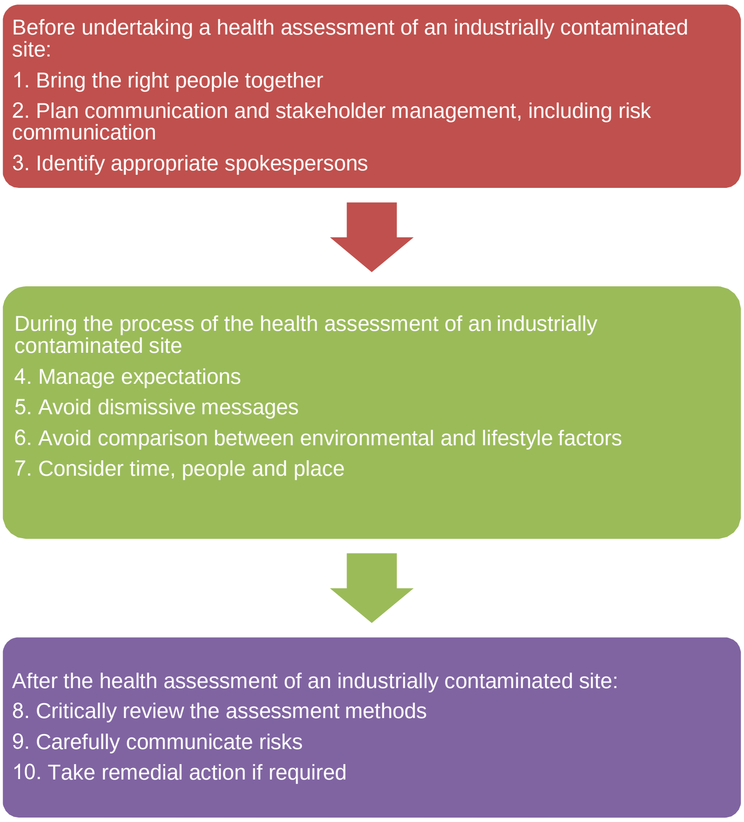
Health and environment agencies and authority may want to take a proactive approach to the issue, by promoting activities for the prevention of possible, suspected or established adverse health impacts. However, they often face situations where they are asked to respond to concerns and alarm, in a reactive fashion.

Two different major situations can be identified based on the level of social alarm and concern in a contaminated area: urgent and non-urgent response.

URGENT RESPONSE

Top 10 key actions
Here are 10 key things to think about to take a proactive, rather than reactive, approach to addressing urgent concerns around industrially contaminated sites.

Best Practice Figure 1. Stages of an urgent industrially contaminated site response



1. Bring the relevant people together
Gather the relevant multidisciplinary expertise. A proactive response would involve bringing together epidemiologists, toxicologists, exposure scientists, statisticians, technologists, and communication experts. Even limited support from these subjects will make a big difference. International expert networks can often provide support, and so can agencies such as WHO.

2. Plan communication and stakeholder engagement
Ensure you formulate an immediate response in form of a statement, referring to the need to clarify the facts through expert evaluation, but also to the obligation to respond to the concerns through concrete action on ground.

It might be useful to identify a complete list of stakeholders and determine whether they have a high, medium or low level of both interest and influence. This will help determine how to inform, involve or consult with a wide range of stakeholders.

3. Identify appropriate spokespersons preferably with technical competences. Follow up with regular updates, reassuring those affected that they are not alone.

4. Manage expectations
Keep in mind that two lines of work are equally important: one on proper communication and one on expert assessment of the situation. The two must proceed in parallel.

5. Avoid dismissive messages
Avoid conveying dismissive messages such as “nothing can be done until we have the evidence”. Absence of evidence is not evidence of absence. Similarly, do not discount lay reports of health effects, however weak they may be.

6. Avoid comparison between environmental and lifestyle factors
Do not draw comparisons between an environmental risk, even a suspected one, and other established risk factors, such as tobacco smoking or other lifestyle related ones.

7. Consider time, people and place
Pay attention to patterns and consistent excesses over time, space, across genders, age groups. Living (or working) near a contaminated site usually entails multiple exposures; it is also often accompanied by socio-economic disadvantage, which tends to involve additional pressures on health. The effect of the combination may be larger than the sum of the single risks.

8. Critically review the assessment methods
Regarding the expert assessment: If health effects or impacts are reported, examine the data carefully, paying attention to numerators (quality of data on the health events, reporting mechanisms, age and/or gender distribution, time period) and denominators (where they considered at all? If so, are they correct for the reported cases?)

Also, evaluate to what extent reported excess or clusters of cases are the result of post-hoc observations, such as selection of areas or subgroups maximising observed disease frequency.

9. Carefully communicate risks
Risk communication actions need to
reduce or eliminate communication obstacles between researchers and policy-makers, so that research findings effectively support the decision-making process.

10. Take immediate remedial action if required
If a remediation action, such as removal of the source of contamination or exposure, is available, it should be given priority over research and more detailed assessments. Do not

rule out precautionary interventions, based on uncertain evidence, but justified by serious risks' possible existence.

CHECKLIST FOR TAKING A PROACTIVE APPROACH TO AN URGENT HUMAN HEALTH RESPONSE TO AN INDUSTRIALLY CONTAMINATED SITE

Practical Guidance Table 2: Checklist for urgent response to an industrially contaminated site

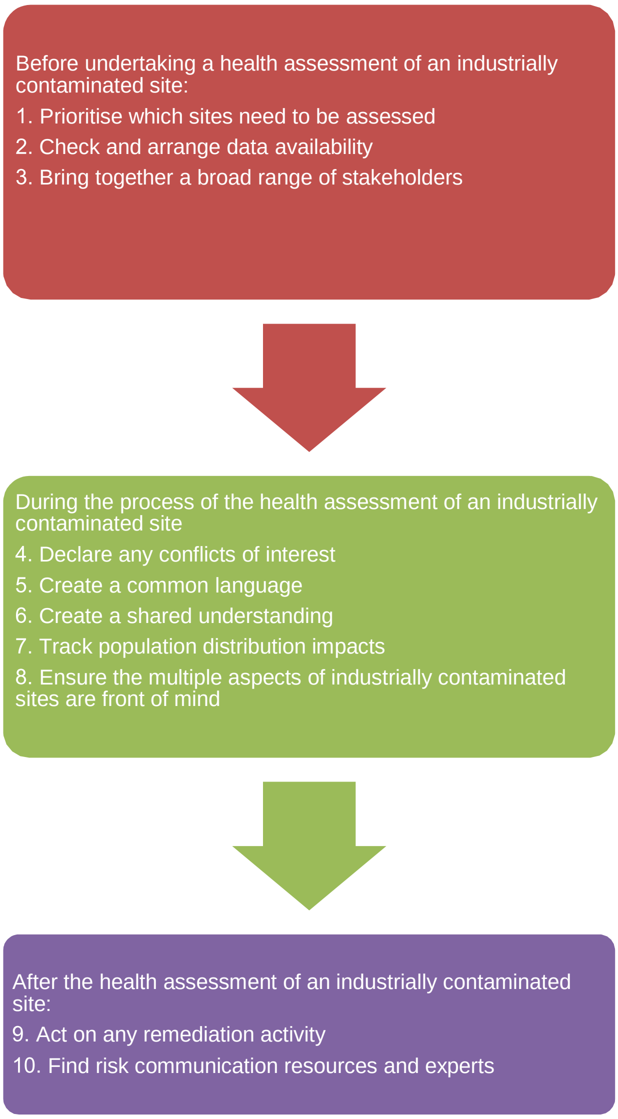
Stage of response	Key step	Completion of step	Comment
Before undertaking a health assessment of an industrially contaminated site	1. Did you bring the right people together at the start? For example, epidemiologists, toxicologists, exposure scientists, statisticians, technologists, and communication experts.	☐ Yes ☐ No	
	2. Did you develop a communication and stakeholder management plan?	☐ Yes ☐ No	
	3. Did you identify appropriate spokespersons?	☐ Yes ☐ No	
During a health assessment of an industrially contaminated site	4. Did you continue to manage expectations of both the communication and technical aspects?	☐ Yes ☐ No	
	5. Have you avoided messages that dismiss the potential impact of the contaminated site?	☐	
	6. Did you develop key communication messages to avoid comparison between environmental and lifestyle factors?	☐ Yes ☐ No	
	7. Did you consider factors associated with time, people and place in your assessment?	☐ Yes ☐ No	
After undertaking a health assessment of an industrially contaminated site	8. Did you carefully review the methods? For example, check how the numerator and denominator were calculated and example clusters of cases.	☐ Yes ☐ No	
	9. Did you carefully communicate the risks	☐	
	10. Did you take remedial action if needed?	☐ Yes ☐ No	

INITIATING AND STRENGTHENING ACTIVITY: WHAT CAN HEALTH AND ENVIRONMENT AGENCIES DO?

Non-urgent responses to industrially contaminated sites provide opportunities for the health and environment stakeholders to build capacity for the transition to a more comprehensive and multidisciplinary approach to the human health impacts of industrially contaminated sites.

Top 10 key actions
Here are 10 key things to think about when health or environment stakeholders are keen to initiate and strengthen activities that lead to human health assessments of industrially contaminated sites.

Best Practice Figure 2. Stages of a non-urgent industrially contaminated site response



1. Prioritise which sites need to be assessed
There is a large number of potential industrially contaminated sites that may need a health assessment. Identifying which sites in a particular are of highest priority for assessment and action is crucial.

2. Check and arrange data availability
A range of environment and health data will be required for the study. Understanding what data are available, who can access the data and to what sociodemographic level is key.

These data then need to be made accessible for the purpose of undertaking the assessment of the industrially contaminated site.

3. Bring together a broad range of stakeholders
The transition to a comprehensive assessment approach to industrially contaminated sites is dependent on having a broad set of stakeholders be part of the assessment process. This involves government, academia, and civil society and other interest groups.

4. Declare any conflicts of interest
Public confidence in the finding of a health assessment of an industrially contaminated site is vital. An essential part of this public confidence is identifying and managing any potential or actual conflicts of interest for anyone involved in the assessment process. For example, if someone is a technical advisor to the industry being assessed then this damage public confidence in the assessment unless the conflict of interest is well managed.

5. Create a common language
Bringing together different stakeholders will introduce different terms and concepts that will be less familiar to other people in the same room. Creating a glossary will ensure a shared understanding of key project assessment terms.

6. Create a shared understanding
A challenge will be ensuring that stakeholders transition from thinking about single exposures to multiple contaminant types, multiple pathways, and multiple health outcomes.

7. Track population distribution impacts
People who lived or work in or near an industrially contaminated site often having a socioeconomic position lower than other parts of the community. Exposure to contaminated industrial activity can exacerbate existing poor health outcomes for local residents and workers. Measuring and reporting health inequalities is a core task in the assessment process.

8. Ensure the multiple aspects of industrially contaminated sites are front of mind
Eliminating the public health risk from industrially contaminated sites requires health and environment agencies to have the multiple aspects of assessment always at the centre of discussion. This includes the multiple contaminant types, multiple exposure pathways and multiple health outcomes.

9. Act on any remediation activity
There is strong evidence about the negative health impacts of industrial activity contaminants. Inconclusive or not yet published data from a local assessment of an industrial site should not lead to a postponement of remedial action.

10. Find risk communication resources and experts
Effective risk communication requires time, money and people. Ensuring that this part of the assessment process is adequately resourced will avoid counterproductive communication efforts.

CHECKLIST OF CONSIDERATIONS IN MEASURING AND RESPONDING TO THE HUMAN HEALTH IMPACTS OF INDUSTRIALLY CONTAMINATED SITES

There are a number of practical factors that can help organisations decide on which contaminated sites should be prioritised for a health impact assessment and how the assessment will be carried out.

Practical Guidance Table 3: Checklist for prioritising industrially contaminated sites

Known industrially contaminated sites	
Why is this important?	**What factors are important?**
Understanding how many contaminated sites are in a particular geographic area, and where they are located, is important for prioritising resources. Working out whether the industrial activities are currently happening or have happened in the past will benefit your health impact assessment. It is also useful to group the sites into the different industrial process types including whether they were single or multiple use types. This will help in collating what type of data from other countries might be known about the health impacts of these industrial activities.	**List of sites** ☐ Is there a list of all active contaminated sites available? ☐ Is there a list of all closed contaminated sites available? ☐ Are these lists available? **Type of production or processing plants** ☐ chemicals? ☐ petrochemicals? ☐ manufacturing? ☐ waste disposal and or waste treatment? ☐ cement? ☐ power generation? ☐ mining and minerals? ☐ other?

Time status of the contaminated site	
Why is this important?	**What factors are important?**
Human health effects of environmental exposures may be able to detected relatively quickly where as some health impacts may take decades to be identified. Understanding the operating time of the industrial site can help researchers identify which health outcomes to focus on.	☐ Active with no end date to current activity in site ☐ Active with a proposed end date to activity ☐ Closed within the last 5 years ☐ Closed more than 5 years ago

Neighbouring residential areas	
Why is this important?	**What factors are important?**
Understanding how many and the location of contaminated sites in a particular geographic area is important for prioritising resources. It is also useful to group the sites into the different industrial process types including whether they were single use types or	**Proximity of residents and workers to the contaminated site** ☐ Within a 2km radius of the site ☐ Within a 2-5km radius of the site ☐ Within a 2-5km radius of the site **Known socioeconomic status of resident and working population** ☐ High, medium or low income group ☐ High, medium or low education level

Who has raised the concerns?	
Why is this important?	**What factors are important?**
Sometimes a health study of a contaminated site can be initiated because of concern from a particular stakeholder, such as the local community. It is important to know who is primarily concerned about the health impacts of a contaminated site. This will help inform which stakeholders need to be informed, involved or consulted.	**Key stakeholder who raised concerns** ☐ Local community? ☐ Non-government organisation? ☐ Government? ☐ Health researchers? ☐ Environmental researchers? ☐ Other?

Who will lead the study?	
Why is this important?	**What factors are important?**
Once it has been decided that a health study of the effects of a contaminated site is needed, it is important to work out who will lead the study. Because there are many different potential health impacts, a number of different stakeholders may need to be involved.	**Key stakeholder who will lead the study** ☐ Local community? ☐ Non-government organisation? ☐ Government? ☐ Health researchers? ☐ Environmental researchers? ☐ Other?

Who will be responsible for the communication about the assessment?	
Why is this important?	**What factors are important?**

There are two parallel processes that need to occur at the same time. The first is the scientific aspects of the exposure assessment. The researchers should agree on the need to consult local concerns with involved parties and how to communicate on design and results of the study. The second, and equally as important, is the communication about the assessment with key stakeholders and how the local community and other parties could assist in the further interpretation of the results. All this urges for a minimal coordination of a communication strategy, lead actors and agreed communication rules.	**Key stakeholder who lead the communication about the exposure assessment** ☐ Local community? ☐ Non-government organisation? ☐ Government? ☐ Health researchers? ☐ Environmental researchers? ☐ Other

What type of method will be used?	
Why is this important?	**What factors are important?**
There are different methodological approaches that can be used to measure and act on the health impacts of a contaminated site. These range from reviewing existing data through to undertaking new epidemiological studies. The financial and technical resources required will change depending on the preferred approach.	**Type of data analysis** ☐ Review of known data from other countries ☐ Public health surveillance ☐ Health risk assessment (and/or human biomonitoring) ☐ (New) epidemiological study

What type of exposures are likely?	
Why is this important?	**What factors are important?**
More traditionally, soil contamination has been the primary type of exposure from contaminated sites. However, there are other types of exposures such as air and water as well as interaction of how soil, air and water can be combined.	**Potential exposure types** ☐ Soil ☐ Air ☐ Water ☐ Occupation

What are the exposure pathway types?	
Why is this important?	**What factors are important?**
Along with multiple exposure types, there are different exposure pathways.	**Are people likely to be exposed through:** ☐ Inhalation? ☐ Ingestion? ☐ Contact?

What are the main health outcomes of interest?	
Why is this important?	**What factors are important?**
Understanding which health outcomes of interest to the community and researchers will help determine the scope of the assessment.	**Potential health outcome indicators:** ☐ Mortality? ☐ Morbidity? ☐ Hospitalizations? ☐ Cancer incidence in children? ☐ Cancer incidence in adults? ☐ Congenital anomalies and birth outcomes?

What are the main health outcomes of interest?	
Why is this important?	**What factors are important?**
Data on each type of health outcomes are held in different datasets. These datasets could cover regional or national outcomes. For example, birth and death registry are more likely to be national data while cancer registries could either be regional or national.	**Are people likely to be exposed through:** ☐ Vital statistics (death registries) ☐ Morbidity registries ☐ Routinely-collected hospital records ☐ Cancer registries ☐ National birth registries ☐ Congenital anomaly registries

Risk communication	
Why is this important?	**What factors are important?**
Without carefully planning for and implementing a risk communication plan, the best assessment can be counterproductive.	☐ Is there a current risk communication expert or resource that would be available for this project? ☐ Is there a list of risk communication experts that may be able to be accessed for this assessment? ☐ Are social scientists involved in the research project on the social and community aspects; is a social / stakeholder mapping available for the area of concern? ☐ Does the local community have experience with participatory initiatives?

COMMUNICATION IN INDUSTRIALLY CONTAMINATED SITES - LINES OF ACTION FROM THE ITALIAN SENTIERI PROJECT

In the last decade, international and national organizations in the WHO European Region have proposed theoretical approaches and practices for adopting effective communication strategies in contaminated areas that were endorsed as a part of the activities carried out by the Project Communication group in the Italian SENTIERI Project.[14]

This approach is based on a bi-directional communication strategy, which involves public health authorities and affected communities and has been tested in communication activities undertaken in contaminated areas in Italy and elsewhere in Europe.

RECOMMENDATIONS
These recommendations concern the international, national and local frameworks, as follows:

INTERNATIONAL. Consolidate interactions among WHO and/or national organizations in the WHO European Region in order to collect and make available information on practices for communicating environmental risk and health impact in contaminated sites.

NATIONAL. Plan national initiatives to foster the adoption of communication plans in areas affected by major environmental contamination by sharing a communication plan prototype.

LOCAL. Promote the adoption of the communication plan prototype and its implementation, taking into account the specificity of the local context.

KEY ASPECTS FOR BUILDING A COMMUNICATION PLAN

Elaboration of a communication plan should consider the following aspects:

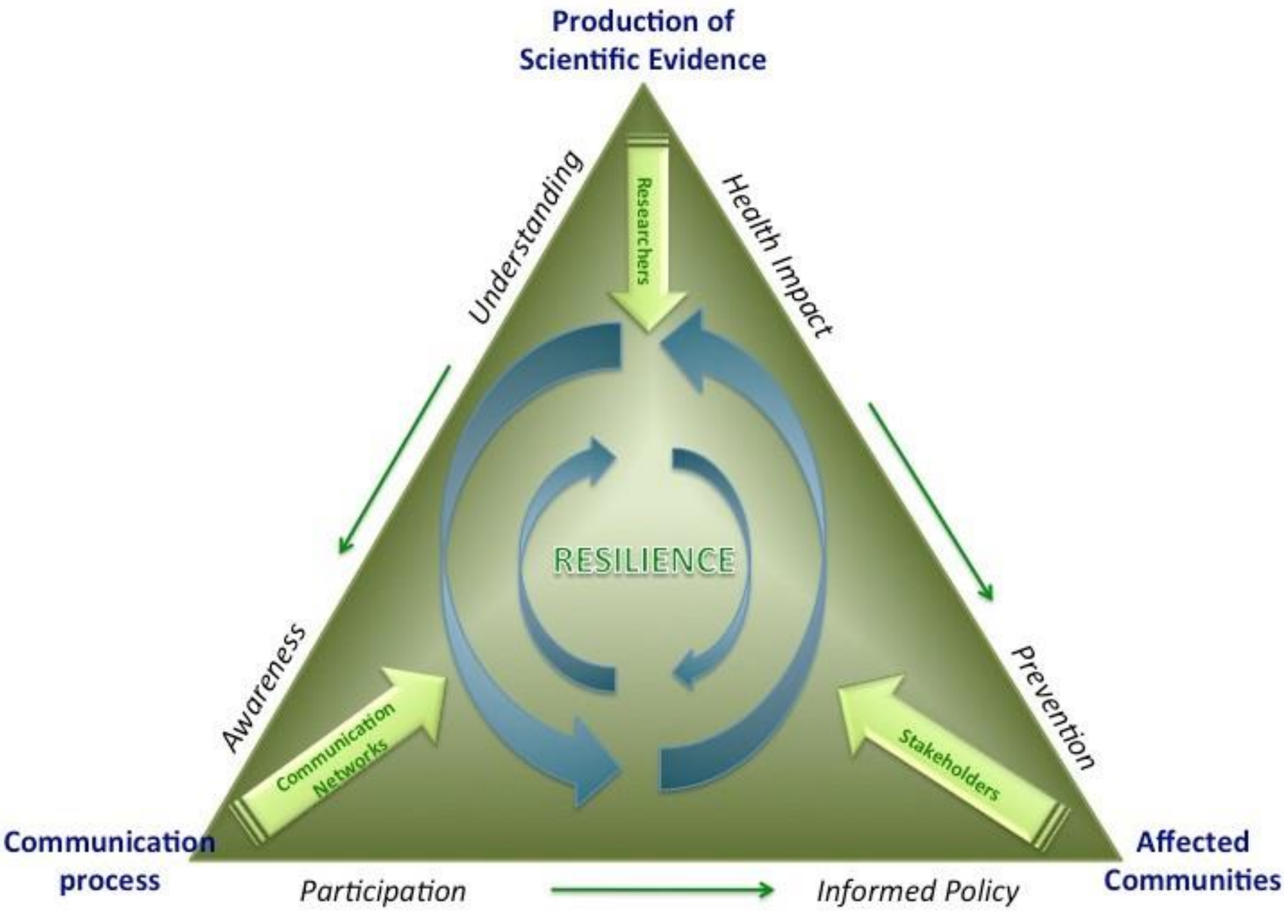
- Severity of the possible health impact related to environmental contamination;
- Attention to vulnerable groups living in the polluted site;
- Identification of stakeholder categories and target audiences;
- Feasibility of the communication plan.

LINES OF ACTION FOR COMMUNICATION

SENTIERI project has also proposed Lines of Action in for communication in contaminated sites of national interest for remediation in Italy with the goal to be shared and adopted by multi-disciplinary teams in local contexts involving health, environment and social sciences experts.

The proposed Lines of Action are summarized below.

- **CONSTRUCTON** of a communication process requires the existence of effective procedures adopted by national and local authorities capable of harmonizing different stakeholders' viewpoints and socio-economic interests in order to facilitate informed decision-making.
- **ACCESSIBILITY** to epidemiological data has to be ensured making them comprehensible to different stakeholders for creating trust towards the involved researchers and the health and environmental institutions. Trust means perceived competence, objectivity and coherence.
- **COMPLEXITY** of scientific contents has to be taken into account in selecting the information and in communicating scientific evidence and uncertainty in lay language to the people living in contaminated sites.
- **TRANSPARENCY** is an unavoidable requisite of any communication process in order to recognize the authoritative role of scientific institutions involved in the study of contaminated sites and in epidemiological surveillance.
- **INTERSECTORIAL RELATIONSHIPS** among national and local institutional actors as well as among scientists and local environmental and health prevention operators in charge of undertaking the interventions have to be strengthened. An effective communication process constitutes the framework to build an affective network.
- **LOCAL MEDIA** have the essential function of mediators of scientific information since they contribute to information dissemination and to increase environmental health literacy. The relationships between involved scientists and local media have to be long-lasting and should not solely rely on occasional meetings.
- **LOCAL EDUCATIONAL SYSTEMS** in contaminated areas should include environmental health issues in annual educational programs and envisage students' engagement in related activities.
- **ASSESSMENT** of communication activities has the goal of verifying the appropriateness and effectiveness of communication in each contaminated area.



BEST PRACTICE NOTE 15: Role of communication process to strengthen resilience (Marsili et al, 2019) [23]

Effective communication in contaminated areas can contribute to increase the resilience of the affected communities and to decrease its social vulnerability through the improvement of social capacity building. Sharing responsibilities for strengthening social capacity building requires the commitment of relevant stakeholders in the communication process.

CONCLUSION AND WAY FORWARD

There are multiple aspects that need to be considered when responding to human health impacts of industrially contaminated sites. These aspects including how the problem is framed, the design of the study and how the data are analysed and reported, and the policy and remediation implications. Assessing and acting on the human health impacts of industrially contaminated sites needs a multidisciplinary approach to integrate multiple environmental exposures and multiple pathways to human health. Without this multidisciplinary approach, an inaccurate or incomplete picture of the health impacts may be analysed and communicated leading to ongoing public health risks in the community. This multidisciplinary approach requires a coordinated approach across the environment and health sectors and between government and non-government organisations.

Conclusions

This section gives the key conclusions from this guidance document. The next section presents some key issues that will need progress for further developing the assessment and action on health impacts of industrially contaminated sites.

General conclusions

- A comprehensive approach to the question of human health impacts of industrially contaminated sites is still lacking.

- An assessment of single environmental exposures and single health outcomes is insufficient to meet the multidisciplinary approach required to access and act on the health impacts of industrially contaminated sites.

- A comprehensive approach to assessing the health impacts of industrially contaminated sites requires consideration of multiple contaminant types (and the combined effect of those contaminants), multiple exposure pathways and multiple health outcomes as well as how those health outcomes are distributed in the population.

- The health effects from industrially contaminated sites are often unequally distributed to lower socioeconomic groups who live near contaminated industrial sites. Exposure to harmful contaminants from industrial sites will exacerbate poor health and social outcomes that are already likely to be experienced by lower socioeconomic groups.

- A proactive approach to measuring and acting on the health impacts of industrially contaminated sites is therefore urgently required. This requires involving intersectoral attitude to deal with environmental, social, occupational, industrial, and health issues.

- Remedial action to address environmental contamination from industrially contaminated sites should not be delayed on the grounds of scientific uncertainty including having insufficient quality of exposure, population and health data, or inadequate sample sizes.

- Communicating the available knowledge on the health impact of ICS implies the need to develop a framework for efficient translation of scientific evidence to stakeholders and policy- and decision-makers in highly critical social, occupational and political contexts.

Research

- There have been substantial advancements made in ensuring a more comprehensive approach to assessing the health impacts of industrially contaminated sites. These advancements have been possible through the COST Action investment and the time and expertise of environment and health researchers and policy makers. However, significant gaps remain.

- There is a wide range of industrial sites. An understanding of the multiple contaminants likely to occur at each industrial site type would provide greater consistency. Several factors that need to be considered are whether there is a contaminant type that would be greatest or least impact, the known time between environment and health outcomes from exposure to the contaminant and the interaction between different contaminant types.

- A process of mapping each of the multiple contaminants to the multiple exposure pathways is vital. A single contaminant may impact on three different exposure pathways. When another contaminant is present, the impact on the exposure pathway may be

- Greater understanding of the relevant health outcomes for the multiple contaminants and exposure pathways is also vital. The decision on which outcome to select for analysis is also dependent on data availability. For instance, while mortality or cancer incidence may be the most valid health outcome the data may not be available for the latency period between exposure and outcome may be too long. A more immediate health outcome, such as the number or rate of hospitalisations, may be more useful.

- The unequal distribution of health impacts associated with industrially contaminated sites requires urgent attention for understanding which data and methods would most reliable estimate these health inequalities.

- Improved and more consistent reporting of health assessments of industrial contaminated sites would allow for greater transparency to stakeholders as well as the ability to compare findings across different jurisdictions.

Policy

Policy priorities for addressing the human health impacts of industrially contaminated sites include:

- development of comprehensive lists of industrially contaminated sites within relevant jurisdictions

- identification from the comprehensive list the type of industrial activity, whether the industrial activity is current or past, the type of contaminants and the size of the local population

- identification of what health assessments have already been undertaken and what the knowledge gaps are

- identification of what remediation has already taken place and what other remediation needs to take place

- allocation of resources for both research that assesses the health impacts of industrially contaminated sites as well as resources for remediation to remove health hazards

- ensuring that a comprehensive and multidisciplinary approach is taken when assessing and acting on the health impacts of industrially contaminated sites

- developing action plans for urgent and non-urgent responses to mitigate the health impacts of industrially contaminated sites

- increase and improve the placement of multiple environmental exposures and multiple health outcomes, including unequal distribution of health impacts, in all conversations about industrially contaminated sites

- promoting public awareness of the human health impacts of industrially contaminated sites

- be actively involved in the urgent transition from single exposure assessment methods for contaminated sites to a comprehensive and multidisciplinary approach that brings together the environment and health sectors.

Business/Civil society organizations

- Businesses play an essential role in understanding and promoting the financial, social and environment outcomes of industrial sites, often referred to as triple bottom-line outcomes. Triple bottom-line reporting needs to incorporate positive outcomes, such as local employment opportunities, with the longer-term environment and health legacy that results from unintentional or intentional contamination activities at an industrial site.

- There is a clear role for civil society organizations (CSOs) in ensuring transparent, accurate and timely assessment and action relating to the human health impacts of industrially contaminated sites.

- CSOs will often be trusted advocates for local communities who have been negatively affected by the environmental and health damage from industrial activity. As such, CSOs also have a key role in being part of, reviewing and communicating the findings of human health impact assessments of industrially contaminated sites.

Environment and health ministries, agencies and research institutes

- A comprehensive and multidisciplinary approach to assessing and acting on the health impacts of industrially contaminated sites will increasingly replace assessments based on single exposure and outcome measurements.

- Although largely absent to date, a broad and multidisciplinary approach is required to sufficiently address the complex nature of the health impacts of industrially contaminated sites. This approach should include and not be limited to expertise in environmental exposure assessment, risk assessment, toxicology, epidemiology, health inequalities and risk communication.

- The transition to a comprehensive approach to assessing and acting on the health impacts of industrially contaminated sites will contribute to the achievement of multiple Sustainable Development Goals including SDGs 3, 6, 7, 10, 11 and 12. A comprehensive approach is also consistent with the circular economy model.

- WHO, the COST Action and the broader health and environment sector should promote the transition to a comprehensive and multidisciplinary approach to assessing and acting on the health impacts of industrially contaminated sites. This transition will be achieved by actively supporting countries in identifying and responding to their capacity and capability needs and developing resources at the national, regional and local levels.

- Joint action is required to not only assess the health impacts but also remove the harmful environmental exposures from industrial sites to help promote the health of the environment and the health of local populations.

- A comprehensive approach will lead to findings about the multiple environmental exposures and health outcomes. These findings need to be well communicated, including clearly addressing how scientific uncertainty should be interpreted particularly where smaller number of affected populations are reported.

- Collaboration across WHO Member State and participating COST Action countries is vital to drive the comprehensive and multidisciplinary approach needed**.**

- Significant gaps in data availability, research methods and consistency of findings remain, particularly about how to measure and report multiple effects and outcomes and the unequal socioeconomic distribution of health outcomes in a population. Substantially more effort is required by environment and health researchers to further develop and implement a comprehensive and multidisciplinary approach to assessing and acting on the health impacts of industrially contaminated sites.

Bringing it all together - key aspects of this guidance document

This guidance has highlighted the different considerations that need to be thought of when assessing and acting on human health impacts of industrially contaminated sites.

With the large number of industrially contaminated sites in Europe, it is important to understand how many industrially contaminated sites there are in a geographic region and whether these sites are still in operation. The list of sites should be prioritised.

Once the site type is known, for example a waste disposal site or chemical industry plant, then a list of the different types of contaminants can be created and the pathways from contamination to human exposure can be mapped out. Bringing a wide range of stakeholders together is essential, including a clearly laid out stakeholder engagement and risk communication plan.

The urgency of response needs to be determined. This will help inform the type of assessment method to be used. A stocktake of available data sources on both the environmental exposure and human health impacts should be undertaken along with the development of an analysis plan that integrates multiple environment exposures and multiple health outcomes, including an assessment of the distribution of the health impacts by sociodemographic factors.

Presentation of findings, including a clear understanding of the uncertainty of estimates, should be created. These findings should be carefully communicated to stakeholders including the affected local communities as well as government and non-government actors.

Uncertainty around findings should not limit remediation of industrially contaminated sites with both health, environmental and social co-benefits of remediation activity.

It is likely that this process of assessing and acting on the human health impacts of industrially contaminated sites will need to be repeated many times over given the large number of sites reported in the European region.

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APPENDIX 1: ICSHNet Consensus Statement on Industrially Contaminated Sites and Health (in English and Russian)

ICSHNet COST ACTION IS1408

Fourth Plenary Conference COST Action IS1408
Industrially Contaminated Sites and Health Network (ICSHNet)
WHO European Centre for Environment and Health (ECEH), United Nations Campus, Bonn, Germany, 21- 22 February 2018

Consensus Statement on Industrially Contaminated Sites and Health

Preamble

Waste and contaminated sites have been included as a priority in the Declaration of the Sixth Ministerial Conference on Environment and Health (Ostrava, Czech Republic 15 June 2017). The Ostrava Declaration includes a commitment towards

…"*preventing and eliminating the adverse environmental and health effects, costs and inequalities related to waste management and contaminated sites, by advancing towards the elimination of uncontrolled and illegal waste disposal and trafficking, and sound management of waste and contaminated sites in the context of transition to a circular economy*".

Interested Member States of the WHO Regional Office for Europe will address the topic in the coming years and consider it when developing their "Portfolios for Action".

The COST Action IS1408 on Industrially Contaminated Sites and Health Network (ICSHNet) brings together 33 of the 53 Member States and aims at establishing and consolidating a European Network of experts and relevant institutions, and developing a common framework for research to respond to the health implications of industrially contaminates sites. On occasion of the 4th Plenary Conference of the Action, its Members prepared a consensus statement intended to stimulate further progress on the issue, as follows.

Statement

Members of the COST Action IS1408 on Industrially Contaminated Sites and Health Network:

- Underline the importance and relevance of industrially contaminated sites for public health: notwithstanding important knowledge gaps, available evidence indicates that human and ecosystem health are adversely affected by contamination due to past and current industrial activities including waste disposal.
- Invite relevant environmental health (EH) agencies, EH scientists and the EH community at large to further engage in work contributing to the Ostrava agenda efforts, drawing on established methodologies and successful case studies, and promote stronger technical and scientific exchanges on good practices between countries.
- Propose that further work is undertaken, and offer support to its implementation, to pursue the following goals:
    - Identify priority sites for remediation in each country, by means of transparent and shared procedures, taking into account human health as a state of complete physical, mental, and social well-being, but also including environmental and occupational, and economic perspectives;
    - Promote collaborative initiatives, and develop guidance and resources through dedicated research, especially addressing the multi-dimensional nature of the issue, i.e. considering the multiple pathways of exposure (soil, water, air, food etc.), integrating relevant disciplines and methods (epidemiology, eco-toxicology, exposure assessment including biomonitoring, markers of early effects, etc.);
    - Promote the development of regulatory frameworks and policies to protect soil (thereby complementing existing legislation on air and water), also in line with the objective of the Seventh European Union Environment Action Programme and with the UN resolution 'Managing Soil pollution to achieve Sustainable Development' adopted by the 2017 United Nations Environment Assembly [UNEP/EA.3/L.14];
    - Undertake a comprehensive assessment of the overall impact on health of contaminated sites in Europe;
    - Consider environmental justice a priority, as the uneven distribution of adverse health effects and impacts frequently affect disadvantaged and vulnerable people (like children) in a disproportionate way, often combined with unequal access to information and evidence, driven by unequal distribution of resources and capacity;
    - Stimulate development of harmonised approaches based on the best available and suitable strategies for research and response, which should be rigorous, open to stakeholders and mindful of local/country needs, priorities, preferences and values; International collaboration will ensure the identification of the most appropriate options for improving comparability between assessments and countries;
    - Ensure that building further evidence and refining it does not result in delaying remedial action where this is appropriate;
    - Undertake appropriate assessment to document public health benefits following remediation;
    - Increase public awareness of the importance of sustainable developments goals (SDGs) and circular economy;
    - Strengthen in-country capacity to face the environmental health challenges posed by contaminated sites, through ad hoc training activities, addressing in particular young generations of researchers. public health professionals, and decision makers;
    - Improve targeted communication initiatives addressing local populations, media and other stakeholders like children and youth; provide guidance on how to transfer scientific evidence into the policy making process.
- Offer a platform for collaboration between interested Member States of the European region and the expert members of the COST Action and the provision of technical assistance.

The COST Action Conference agrees on the opportunity that this document be taken to the meeting of the EH Task Force of the European Environment and Health Process (EEHP), scheduled for 20-21 March 2018 in Bonn.

Четвертая пленарная конференция COST Action IS1408

Сеть по вопросам территорий, загрязненных промышленными выбросами, и охраны здоровья (ICSHNet)

Европейский центр ВОЗ по окружающей среде и охране здоровья (ЕЦОСЗ), Здание ООН, Бонн, Германия, 21–22 февраля 2018 г.

Консенсусное заявление в отношении территорий, загрязненных промышленными выбросами, и охраны здоровья

Преамбула

Решение проблемы отходов и загрязненных территорий вошло в число приоритетов для Декларации Шестой министерской конференции по окружающей среде и охране здоровья (Острава, Чешская Республика, 15 июня 2017 г.). Одно из обязательств Остравской декларации предусматривает:

> …"*предотвращение и устранение негативных последствий для экологии и здоровья людей, а также затрат и неравенств, связанных с процессом удаления отходов и наличием загрязненных территорий, путем планомерной ликвидации неконтролируемого и незаконного удаления отходов и торговли ими, а также путем разумной утилизации отходов и решения проблемы загрязненных территорий в контексте перехода к экономике замкнутого цикла*".

Заинтересованные государства-члены в Европейском регионе ВОЗ в ближайшие годы будут принимать меры для решения вышеуказанной проблемы, а также учтут ее при подготовке собственных комплектов мероприятий.

Инициатива Европейской программы сотрудничества в области науки и технологий (COST) IS1408 относительно Сети по вопросам территорий, загрязненных промышленными выбросами, и охраны здоровья (ICSHNet) объединяет 33 из 53 государств-членов в Регионе. Ее задача – создать и консолидировать европейскую сеть экспертов и специализированных учреждений и сформировать единую рамочную основу для научных исследований по теме влияния территорий, загрязненных промышленными выбросами, на здоровье людей. По случаю Четвертой пленарной конференции Инициативы ее члены подготовили консенсусное заявление (см. ниже), которое должно будет стимулировать дальнейший прогресс в данной сфере.

Заявление

Члены Инициативы Европейской программы сотрудничества в области науки и технологий (COST) IS1408 относительно Сети по вопросам территорий, загрязненных промышленными выбросами:

- Подчеркивают значение и актуальность проблемы территорий, загрязненных промышленными выбросами, для общественного здравоохранения: несмотря на наличие серьезных пробелов в знаниях, имеющиеся фактические данные указывают на то, что загрязнение вследствие промышленной деятельности (включая удаление отходов), как ведущейся в настоящее время, так и осуществлявшейся в прошлом, негативно сказывается на здоровье людей и экосистем.
- Предлагают организациям, ученым и в целом всем заинтересованным сторонам в сфере окружающей среды и здоровья принять участие в дальнейшей работе по реализации Остравской повестки дня, с использованием существующих методик и примеров передовой практики, и способствовать интенсивному обмену техническим и научным опытом между странами.
- Рекомендуют принять меры и предлагают поддержку для реализации этих мер в целях выполнения следующих целей:
  - Для каждой страны составить списки приоритетных территорий для восстановления посредством открытых процедур с участием широкого круга сторон, с пониманием здоровья как полного физического, психического и социального благополучия, но также и с учетом интересов окружающей среды, занятости населения и экономики;
  - Всячески продвигать совместные инициативы и создавать, на основании тематических исследований, рекомендации и методические ресурсы, посвященные многогранной природе данной проблемы, т.е. с учетом многочисленных путей воздействия (через почву, воду, воздух, пищевые продукты и т.д.) и с интеграцией всех актуальных дисциплин и методов (в т.ч. эпидемиологии, экотоксикологии, оценки воздействия с помощью биомониторинга и маркеров раннего проявления эффектов, и т.д.);
  - Способствовать созданию регуляторных механизмов и мер политики для защиты почвы (тем самым дополняя существующее законодательство в отношении воздуха и воды), что также соответствует задачам Седьмой программы действий Европейского союза по охране окружающей среды и резолюции ООН "Борьба с загрязнением почвы в целях обеспечения устойчивого развития", принятой на Ассамблее ООН по окружающей среде в 2017 г. [UNEP/EA.3/L.14];
  - Предпринять комплексную оценку общего воздействия загрязненных территорий на здоровье населения Европы;
  - Рассматривать экологическую справедливость в качестве одной из приоритетных целей, ввиду неравномерного распределения негативных последствий для здоровья, при котором неблагополучные и уязвимые категории населения (например, дети) оказываются затронутыми в непропорционально большой степени, и которое часто усугубляется неравным доступом к информации и фактическим данным, что обусловлено неравномерным же распределением ресурсов и возможностей;
  - Стимулировать выработку гармонизированных подходов на основании наилучших и наиболее уместных из имеющихся стратегий в отношении научных исследований и ответных действий, которые должны быть достаточно скрупулезными и открытыми для заинтересованных сторон, а также будут учитывать потребности, приоритеты, предпочтения и ценности стран и местных сообществ. Международное сотрудничество позволит определить наиболее подходящие варианты для повышения сопоставимости результатов оценок и полученных от стран данных;
  - Обеспечить, чтобы дальнейшие процессы сбора и обработки фактических данных не приводили к задержкам в принятии необходимых мер по восстановлению;
  - Проводить оценки, которые позволят документально зафиксировать положительный эффект для здоровья населения в результате принятых мер по восстановлению;
  - Повышать осведомленность общественности о роли Целей устойчивого развития (ЦУР) и экономики замкнутого цикла;
  - Наращивать потенциал стран для преодоления угроз для окружающей среды, обусловленных загрязненными территориями, проводя специализированные учебные мероприятия, ориентированные в первую очередь на молодых исследователей, работников здравоохранения и руководителей, принимающих решения;
  - Совершенствовать целевую коммуникацию, адресованную местным жителям, СМИ и другим целевым группам, например – детям и молодежи; предоставлять рекомендации по выработке политики на основании данных научных исследований.
- Обеспечить платформу для сотрудничества между заинтересованными государствами-членами в Европейском регионе и экспертами, участвующими в инициативе COST, и для предоставления технической помощи.

Конференция инициативы COST одобряет возможность для вынесения настоящего документа на рассмотрение на совещании Целевой группы по окружающей среде и здоровью Европейского процесса "Окружающая среда и здоровье" (ЕПОСЗ), которое пройдет 20–21 марта 2018 г. в Бонне.

APPENDIX 2: DECALOGUES

RESPONDING TO AN EMERGING CONCERN ON ONE OR MORE ICSs: WHAT CAN HEALTH AND ENVIRONMENT AUTHORITIES DO WHEN FACED WITH ALARM AND URGENT REQUEST OF ACTION OVER A CONTAMINATED SITE?

1. Gather the relevant multidisciplinary expertise, including epidemiologists, toxicologists, exposure scientists, statisticians, technologists, communication experts. Even limited support from these subjects will make a big difference. The international expert networks can often provide support, and so can agencies such as WHO.
2. Manage expectations. Keep in mind that two lines of work are equally important: one on proper communication and one on expert assessment of the situation. The two must proceed in parallel.
3. Regarding communication: ensure you formulate an immediate response in form of a statement, referring to the need to clarify the facts through expert evaluation, but also to the obligation to respond to the concerns through concrete action on ground.
4. Identify appropriate spokespersons, preferably with technical competences. Follow up with regular updates, reassuring those affected that they are not alone.
5. Avoid conveying dismissive messages such as “nothing can be done until we have the evidence”. Absence of evidence is not evidence of absence. Similarly, do not discount lay reports of health effects, however weak they may be.
6. Do not draw comparisons between an environmental risk, even a suspected one, and other established risk factors, such as tobacco smoking or other lifestyle related ones.
7. Regarding the expert assessment: If health effects or impacts are reported, examine the data carefully, paying attention to numerators (quality of data on the health events, reporting mechanisms, age/gender distribution, time period) and denominators (where they considered at all? If so, are they correct for the reported cases?)
8. Evaluate to what extent reported excess or clusters of cases are the result of post-hoc observations, such as selection of areas or subgroups maximising observed disease frequency.
9. Pay attention to patterns and consistent excesses over tie, space, across genders, age groups. Living (or working) near a contaminated site usually entails multiple exposures; it is also often accompanied by socio-economic disadvantage, which tends to involve additional pressures on health. The effect of the combination may be larger than the sum of the single risks.
10. If a remediation action, such as removal of the source of contamination or exposure, is available, it should be given priority over research and more detailed assessments. Do not rule out precautionary interventions, based on uncertain evidence, but justified by serious risks’ possible existence.

A PROACTIVE APPROACH TO ICSs AND HEALTH: OUT OF THE EMERGENCY, WHAT CAN HEALTH AND ENVIRONMENT AUTHORITIES DO TO INITIATE OR STRENGTHEN INITIATIVES ON CONTAMINATED SITES AND HEALTH?

1. Establish a list of the ICSs that are of highest concerns for their environmental and health impacts; identify a shortlist for undertaking health assessments.
2. Make arrangements so that available data that is relevant for these assessments is accessible and can be gathered and compiled consistently. Often a lot of data on health outcomes, on environmental contamination, on sociodemographic characteristics, on occupational exposures exist, but are hard to identify and access.
3. Facilitate the creation of appropriate collaborations between relevant authorities, agencies and other actors such as academia, civil society, interest group, stakeholders etc.
4. Apropos stakeholders, ensure that all those involved are requested to disclose their interests, especially when they may be in conflict with public health goals; then carefully analyse those disclosures.
5. Promote the use of a “common language” around ICSs and health. Because multiple professional cultures and different interests will be encouraged to entertain a dialogue, some clarity will be needed about the basic terms of reference.
6. In particular: ensure there is a common, shared understanding of how ICSs can affect health, i.e., through multiple environmental media (air, water, soil, food, occupation) and pathways (inhalation, ingestion, contact) and that health impacts will reflect the combination of multiple stressors, involving mixtures of exposures.
7. Mind inequalities and environmental justice: ICSs entail localised exposures, and more often than not the most affected people are also subject to additional health pressures, for example through lifestyle, because of a social disadvantage.
8. Recognise the high complexity of assessing the health impacts of ICSs. It is exceedingly difficult to estimate the overall health consequences of the multiple health stressors involved. In some assessments, only individual pollutants are considered; in others, aggregate variables, such as residential proximity, are used as proxies. In most cases, assessments are surrounded by substantial uncertainty, which should be assessed, described and acknowledged.
9. Ensure that remedial action is not postponed on the ground of scientific uncertainty. Uncertainty can be a strong reason for collecting more data and conducting more research, but will not be eliminated, hence cannot be a reason for inaction.
10. Allocate resources for adequate risk communication. The best assessment can be wasted or even counterproductive if it is not planned, developed and presented taking into account the opinions, values and interests of the relevant stakeholders. This requires much time, money and manpower.