Compendium of WHO and other UN guidance on health and environment

World Health Organization

UNDP

UN environment

unicef for every child

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Contents

Preface

Environmental pollution and other environmental risks cause almost a quarter of the worldwide disease burden. To eliminate or at least substantially reduce this disease burden and to address the challenges in health, environment and climate change being faced, bold preventive action at national, regional, local and sector-specific level is needed. Policy-makers and other actors are increasingly prepared to take action on health and the environment, often as a result of requests by citizens and organizations, and need to be supported by adequate resources.

The World Health Organization (WHO) and various other United Nations (UN) organizations offer guidance on effective actions on health and the environment distributed over hundreds of different reports. This compendium consists of a systematic compilation of WHO and other UN guidance that addresses all major areas of health and the environment into one resource. Unlike regular reports, this compendium presents a database or repository extracting the relevant guidance for policy-makers and other key target audiences on health and the environment and refers to the original reports if more detail is needed.

This compendium supports the strategic objectives and their implementation at country-level of the WHO Global Strategy on Health, Environment and Climate Change to scale up action on health determinants in all policies and in all sectors for health protection and improvement. It further supports the implementation of the 2030 Agenda for Sustainable Development to address environmental risks through a shift towards primary preventive actions and the promotion of healthy choices.

In publishing this compendium, WHO seeks to assist policy-makers and other actors in countries to take actions to improve the health of people and the environment and reduce health inequities and provide assistance with implementation of norms and solutions. It does this by summarizing in one resource the most crucial policy recommendations to improve health and reduce the disease burden coming from environmental risks; it further provides guidance on the ways in which policy-makers and other actors can raise awareness of the risks being faced and the healthy practices people can take to reduce them.

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Abbreviations

CFU	colony-forming unit
CO	carbon monoxide
COP	Conference of the Parties
COPD	chronic obstructive pulmonary disease
COVID-19	coronavirus disease 2019
CPC	Central Product Classification
e-waste	electronic waste
EMF	electromagnetic fields
FAO	Food and Agriculture Organization of the United Nations
FCTC	Framework Convention on Tobacco Control
GDWQ	guidelines for drinking-water quality
GHG	greenhouse gas
HEAT	Health and Economic Assessment Tool
HHP	highly hazardous pesticide
HIA	Health Impact Assessment
HiAP	Health in All Policies
IAEA	International Atomic Energy Agency
ICD	The International Classification of Diseases and Related Health Problems
ICHI	International Classification of Health Interventions
ICSCs	International Chemical Safety Cards
ILO	International Labour Organization
INCHEM	International Programme on Chemical Safety
IOMC	Inter-Organization Programme for the Sound Management of Chemicals
IPC	infection prevention and control
ISIC	International Standard Industrial Classification of All Economic Activities
IVM	integrated vector management
MOOC	massive open online course
NBSAP	National Biodiversity Strategies and Action Plan
NCA	national competent authority
NCD	noncommunicable disease
NO_2	nitrogen dioxide
O_3	ozone
PM	particulate matter
$PM_{2.5}$	particles with an aerodynamic diameter equal to or less than 2.5 µm
PM_{10}	particles with an aerodynamic diameter equal to or less than 10 µm
PPE	personal protective equipment
SAICM	Strategic Approach to International Chemicals Management
SDG	Sustainable Development Goal
SI	sanitary inspection
SIDS	Small Island Developing States
SO_2	sulfur dioxide
SOP	standard operating procedure
STEPS	STEPwise Approach to NCD Risk Factor Surveillance
UN	United Nations
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
UNIDO	United Nations Industrial Development Organization
UNITAR	United Nations Institute for Training and Research
UV	ultraviolet
WASH	water, sanitation and hygiene
WHO	World Health Organization
WSP	water safety plan

Executive summary

The World Health Organization (WHO) and other United Nations (UN) organizations have published extensive guidance on a range of essential health topics over the years, specifically addressing disease, environmental pollutants, children's health, among many other topics. To date, however, there has been no systematic compilation of this guidance for policy-makers and decision-makers, which makes it difficult to get an overview of options available, and to determine where linkages exist between sectors and levels of government.

This compendium seeks to address these gaps by providing a systematic compilation of published guidance from WHO and other UN organizations on all major areas of health and the environment. This guidance also includes information about ways to raise awareness and advocate among the public and policy-makers, in addition to information about interventions to build and enhance capacity among various stakeholders. Guidance referring to priority settings for action – such as cities and other urban settlements, housing, workplaces and health care facilities – is also listed, as is guidance on cross-cutting topics, such as children's environmental health and Health in All Policies, which aims to enhance collaboration across sectors to systematically consider health in policy-making.

For greater practical relevance, each section of guidance is classified according to principally involved sectors, level of implementation and instruments for implementation.

The compilation of guidance for each area of health and the environment or priority setting for action is accompanied, as available, by information on main sources, exposure assessment and existing guideline values. Important tools and further resources are presented alongside, such as tools for assessment or implementing interventions.

This compilation of published guidance on health and the environment highlights that a large number of actions across major topics of health and the environment are available to improve health and reduce environmental risks. Compilation into one volume also shows how this guidance often involves various sectors and is applicable to various levels – local, regional and national. Where such interlinkages exist, this has been indicated in the text.

This compendium is intended to serve as a repository and easy-to-use resource for decision-makers and policy-makers working in the health and environmental sectors at various levels. It will be updated as additional guidance becomes available.

1. Background

As much as 24% of deaths are estimated to be attributable to environmental risks to health which are largely preventable *(1)*. Acting on environmental conditions can be a key contribution to reduce many communicable and noncommunicable diseases (NCDs), and injuries. To cite a few statistics, as much as 29% of deaths from ischaemic heart disease, 28% of stroke, 21% of cancers, 55% of respiratory infections, 61% of diarrhoeal diseases, 53% of chronic obstructive pulmonary disease (COPD), 40% of road traffic injuries and 76% of unintentional poisonings could be prevented through environmental improvements globally *(1)*. Preventive action through creating healthier environments should therefore be an important component of most disease control strategies.

Clean air, both indoors and outdoors, stable climate, adequate water, sanitation and hygiene (WASH), safe use of chemicals, protection from radiation, sound waste management, healthy and safe workplaces, health-supportive cities and built environments, sustainable diets, and preserved biodiversity and ecosystems are essential for ensuring good health. The coronavirus disease 2019 (COVID-19) pandemic has served as another reminder of the intrinsic linkage between human health and nature.

This compendium presents key guidance to those wishing to create healthier environments to address these statistics, minimize preventable deaths and disability and improve health now and in the future. It summarizes and aims to facilitate access to guidance from the World Health Organization (WHO) and other United Nations (UN) agencies, funds and programmes for creating healthier environments for healthier populations.

Environment in this compendium refers to the following environmental factors *(2)*:

- air, water and soil pollution with chemical and biological agents including air pollution from second-hand tobacco smoke;
- ultraviolet (UV) and ionizing radiation;
- electromagnetic fields (EMFs);
- occupational risks;
- the built environment, including housing, workplaces, the provision of water for washing hands, land-use patterns and roads;
- climate and ecosystem change;
- behaviour related to environmental factors, for example, hand-washing hygiene and physical activity fostered through improved urban design.

For this compendium, the following factors are not considered environmental:

- alcohol and tobacco consumption;
- diet (unless linked to climate change, environmental degradation or contamination through chemical and biological agents);
- unemployment;
- person-to-person disease transmission that cannot reasonably be prevented through environmental interventions.

1.1 Target audience

This compendium aims to provide practitioners with a rapid overview of WHO and other UN-recommended actions and tools to address various health risks. Practitioners targeted in particular include key decision-makers at national, regional and municipal levels, government officials, higher-level policy-makers, key actors such as municipal staff, staff in relevant ministries (including those working with industry), community health workers, WHO and UN partner agencies', funds' and programmes' country representatives and country staff, and nongovernmental organizations planning or performing country work.

1.2 Methods used for the development of the compendium

This compendium was developed by systematically compiling existing published guidance on health and the environment from WHO and other UN organizations. Relevant WHO technical units were systematically consulted on structure, content and resources. The units' inputs and subsequent reviews were incorporated. Relevant other UN organizations, responsible for content directly related to health and the environment, were also consulted for their inputs and review.

Guidance was included when referring to health protection and promotion by modifying the environment, safeguarding natural environments and climate, reducing pollution, introducing personal protective measures and promoting healthy behaviours linked to environmental exposures. Approaches included cover: i) primary prevention to act on determinants of health, ii) cross-sectoral action to ensure Health in All Policies (HiAP) effectively reach all environmental determinants of health, iii) strengthening of the health sector to build mechanisms for governance and political and social support, and iv) effective communication on risks and solutions to guide choices and investments, as put forward in the *WHO global strategy on health, environment and climate change (3)*.

Collated guidance was grouped under the categories "policies and actions" and "awareness raising and capacity building". Guidance was further attributed classifiers in order to provide useful information on the type of strategy or intervention to the implementer and the planner, as well as to serve as a search tool. These classifiers were informed by existing UN intervention guidance, including *Disease control priorities, improving health and reducing poverty* from the World Bank, *Healthy environments for healthy children: key messages for action* from WHO and the United Nations Environment Programme (UNEP) and *Programme guidance for early life prevention of non-communicable diseases* from the United Nations Children's Fund (UNICEF) *(4-6)*. Classifiers for each type of guidance include: i) the sectors principally involved in planning/implementation; ii) the level of implementation; and iii) the type of instrument (see section 1.3 How to use this compendium).

Another version of this compendium also contains classification of all interventions according to the International Classification of Health Interventions (ICHI) in view of reporting and analysing health interventions for statistical purposes *(7)*.[1] The codes were developed according to the ICHI classification system, and also use the International Classification of Diseases and Related Health Problems (ICD; 11th revision) *(8)* and International Standard Industrial Classification of All Economic Activities (ISIC) *(9)* where relevant, which provide additional specificity to define interventions.

The list of guidance is not comprehensive and will be updated as additional information becomes available.

[1] An additional version of the Compendium with ICHI codes will be made available as a separate document.

1.3 How to use this compendium

There are many opportunities where interventions can be leveraged to create healthier environments. This compendium provides an overview of guidance by environmental area, and points to more detailed WHO and other UN guidance for the next implementation steps. It serves to outline actions to create healthier environments and to guide and support the user in view of engaging in strategic discussions with other sectors and partners where necessary, to effect these changes.

While the main part of each section covers guidance, each section also provides information on assessment of the current situation (local data, exposure modelling, databases) and pollution sources; targets to achieve (guideline values) and selected tools are also provided where relevant.

Not all the guidance in this compendium will apply and work equally well in every context. Therefore the local circumstances and priorities should be considered before implementing any interventions, strategies or actions. Local circumstances may include: i) distribution of exposures to the risk factor; ii) effectiveness of source or exposure reduction by the strategy or solution; iii) health impact of the measure; and iv) cost–effectiveness of the measure.

Guidance in this compendium can be searched by the following classifiers.

- **Sector principally involved in planning/implementation:**[2] health, environment, agriculture, transport, industry, food, water/sanitation, waste, energy, housing, construction, land use planning, education, labour, finance, social welfare and family, sports and leisure, civil defence or multiple sectors.
- **Level of implementation:** national level, community, schools/child-care settings, health care, workplace. The additional classifier "universal health coverage" was attributed to guidance where the health sector directly contributes to achieving universal health coverage (often through prevention efforts by health workers in the community).
- **Instruments:** governance; regulation; taxes and subsidies; infrastructure, technology and built environment; other management and control; assessment and surveillance; information, education and communication; or other action.

Although not systematically mentioned throughout each section of this compendium, most areas will require adequate monitoring and evaluation, capacity building and resource mobilization, which will therefore not be repeated in every section. In addition, all policies and plans should consider gender and equity components when being established or implemented.

Messages for promoting health in the general population have been developed based on the guidance contained in this compendium and can be used by the audience to more broadly promote health (see Annex).

This compendium will be available in both print and online versions. References in the former will be located at the end of the document, while references in the latter will be included after each relevant chapter.

[2] This will usually focus on the main sector(s) responsible for planning/implementation. Early engagement of diverse sectors however needs to take place in most guidance to ensure active participation in the process, which will support implementation in the short–medium and long-term.

How to use the Compendium of WHO and other UN guidance on health and environment

Target audience

Practitioners and key decision-makers at national, regional and municipal levels

Environment

The environment in this compendium refers to the following environmental factors:

Air pollution

WASH

Solid waste

Chemicals

Radiation

Climate change

Nature and health

Safe environments and mobility

Safe and healthy food

Categories

Guidance was grouped under two categories:

Policies and actions

Awareness raising and capacity building

Classifiers

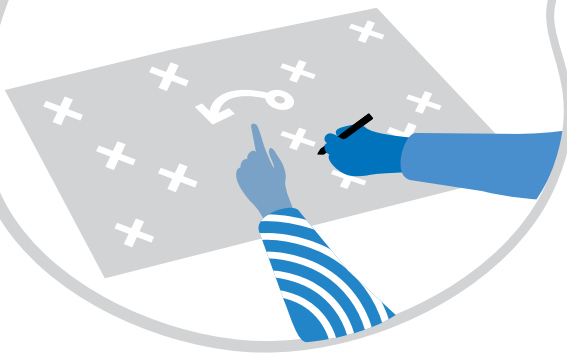
Guidance can be searched by the following classifiers:

Sector principally involved in planning/ implementation

- Health
- Environment
- Agriculture
- Transport
- Industry
- Food
- Water/sanitation
- Waste
- Energy
- Housing
- Construction
- Land use planning
- Education
- Labour
- Finance
- Social welfare and family
- Sports and leisure
- Civil defence
- Multiple sectors

Level of implementation

- National level,
- community, schools/childcare,
- healthcare, workplace,
- “universal health coverage”



Instruments

- Governance,
- regulation,
- taxes and subsidies,
- infrastructure,
- technology and built environment,
- other management and control,
- assessment and surveillance,
- information,
- education and communication,
- other action.

1.4 Links between diseases and environmental determinants of health

To target specific diseases, the environmental determinants or risk factors of greatest relevance can be identified through the risk–disease links identified in Table 1.1. In this way, suitable preventive action can be selected and integrated into disease control programmes.

Table 1.1. Indicative linkages between environmental risk factor and current disease or injury[a]

Disease or injury	Environmental risk factor													
	WASH	Indoor fuel combustion	Second-hand tobacco smoke	Ambient air pollution	Noise	Chemicals[b]	Other housing risks	Recreational environment	Water resources management	Land use and built environment	Other community risks	Radiation	Occupation	Climate change[c]
Infectious and parasitic diseases														
Respiratory infections		●	●	●			●							
Diarrhoeal diseases	●							●						●
Intestinal nematode infections	●												●	○
Malaria									●		●		●	●
Trachoma	●													○
Schistosomiasis	●							●					●	○
Chagas disease							●							○
Lymphatic filariasis	●								●				●	○
Onchocerciasis									●				●	○
Leishmaniasis							●						●	○
Dengue							●						●	●
Japanese encephalitis									●				●	○
HIV/AIDS													●	
STDs													●	
Hepatitis B and C													●	
Tuberculosis		●					●						●	
Other infectious diseases	●						●		●				●	
Neonatal and nutritional diseases														
Neonatal conditions	●	●	●	●		●							●	○
Protein–energy malnutrition[d]	●										●			●

Disease or injury	Environmental risk factor													
	WASH	Indoor fuel combustion	Second-hand tobacco smoke	Ambient air pollution	Noise	Chemicals[b]	Other housing risks	Recreational environment	Water resources management	Land use and built environment	Other community risks	Radiation	Occupation	Climate change[c]
Noncommunicable diseases														
Cancers		●	●	●		●					●	●	●	
Neuropsychiatric disorders					●	●	●						●	●
Cataracts		●										●	●	
Hearing loss					●	●							●	
Cardiovascular diseases		●	●	●	●	●				●			●	●
COPD		●	●	●									●	
Diabetes		●	●	●										
Asthma		●	●	●		●	●						●	○
Other respiratory diseases													●	○
Chronic kidney diseases						●							●	○
Skin diseases	●					●							●	
Musculoskeletal diseases	●												●	
Congenital anomalies			●	●		●						●	●	
Injuries														
Road traffic accidents										●			●	
Falls							●	●		●	●		●	
Drownings								●			●		●	●
Burns							●						●	○
Poisonings						●	●						●	
Other unintentional injuries							●	●		●	●	●	●	●
Violence						●	●			●			●	○
Self-harm						●	●			●			●	○

COPD, chronic obstructive pulmonary disease; **STDs**, sexually transmitted diseases.

[a] Coloured dots represent attributable fractions; an attributable fraction is the proportional reduction in death or disease that would occur if exposure to a risk were removed or reduced to a minimum exposure distribution currently achieved in certain population groups. The ranges of the attributable fractions are:

○ influence likely but not yet quantifiable; ● < 5%; ● 5–25%; ● > 25%. The environmental attributable fractions are indicative values, based on comparative risk assessment or expert opinion. They are discussed in further detail in *(2)*.

[b] Limited to industrial and agricultural chemicals and chemicals involved in acute poisonings.

[c] Global climate change will increasingly influence our lives. This table covers current risks to health. While hollow circles have been added to this table to highlight likely future impacts of climate change on health, most future health impacts are not currently quantifiable.

[d] Malnutrition and consequences.

Source: Adapted from *(2)*.

1.5 Links with social determinants of health

Many diseases and adverse health conditions such as malnutrition are strongly related to social determinants of health, which are the conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems shaping the conditions of daily life. Some social determinants of health are closely linked with environmental factors such as housing and certain basic amenities and are therefore considered in this compendium. Other crucial social determinants of health are income or socioeconomic position, education, employment status, job security and social support and inclusion. These are important causes of disease and disability but are not within the scope of this compendium *(10)*.

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2. Air pollution

2.1 Introduction

The combined effects from ambient (outdoor) air pollution and indoor air pollution cause approximately 7 million premature deaths every year, largely as a result of increased mortality from stroke, IHD, COPD, lung cancer and acute respiratory infections *(1)*. Air pollution can occur in both the outdoor and indoor environments. Cook-stoves in homes, motor vehicles, industrial facilities and forest fires are common sources of air pollution. Air pollutants with the strongest evidence for adverse health outcomes include particulate matter (PM; both $PM_{2.5}$ (i.e. particles with an aerodynamic diameter equal to or less than 2.5 µm) and PM_{10} (i.e. particles with an aerodynamic diameter equal to or less than 10 µm), ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2) and carbon monoxide (CO). Air pollution is however composed of many more pollutants *(1)*.

2.2 Ambient air pollution

This section contains the guidance to improve air quality in a location or country, information on the context and additional tools. While in-depth local assessments are generally needed to identify the most appropriate and efficient solutions, some lines of action are fundamental to achieve cleaner air, such as clean energy generation and transport, sustainable consumption and sound agricultural and waste management practices.

As part of local air pollution originates from sources far from the local context, some of the required action will go beyond the scope of the local practitioner, and will require action at another level, such as through international activities not addressed here *(2)*.

Many of the measures suggested also reduce those harmful emissions that lead to air pollution and climate change, and thereby create multiple benefits. Synergies between measures to reduce air pollution and those mitigating climate change should be actively sought when prioritizing action.

Overview

Air pollution originates from numerous sources of emission, both natural and anthropogenic, with the latter becoming globally dominant since the beginning of industrialization. The process of combustion is the greatest contributor to air pollution, in particular, combustion of fossil fuels and biomass to generate energy. Outdoor combustion sources include ground, air, and water transport; industry and power generation; and biomass burning, which includes controlled and uncontrolled forest and savannah fires and agricultural waste burning as well as waste burning in urban areas. Other sources and processes contributing to outdoor pollution are re-suspension of surface dust and construction activities. Long-range atmospheric transport of pollutants from distant sources contributes to local pollution, particularly urban air pollution *(3)*.

Over 90% of people live in places where the air is unhealthy to breathe, resulting in 4.2 million deaths globally each year (2016 data). Of all deaths from ambient air pollution, 38% were due to IHD, 20% were due to stroke and 43% were due to COPD *(4, 5)*.

Air pollution has an especially devastating impact on children's health and has been linked to respiratory infections, adverse birth outcomes, adverse impacts on brain development and lung function, obesity, asthma, otitis media, cancers and increased mortality *(6, 7)*. Air pollution also disproportionally affects older people.

How polluted is the ambient air in my country?

When people are exposed to air pollution levels above the WHO guideline levels, they are at increased risk of health impacts, in particular cardiovascular and respiratory diseases and lung cancer.
The current air quality (in PM) can be informed through the following.

a. In-situ measurements: Annual mean $PM_{2.5}$ is the indicator of ambient air pollution that best predicts health impacts, and can be measured locally. Assessment of additional indicators is also useful.[3]

   In-situ measurements are generally provided by national or subnational institutions. In addition, a global database, the WHO Global Ambient Air Quality Database *(8)* compiles $PM_{2.5}$ measurements for more than 4000 cities or localities in the world. In the absence of a monitoring system, modelled satellite data or use of low-cost sensors may be considered.

b. Interactive air pollution map *(9)*: This global interactive map shows modelled $PM_{2.5}$ annual concentration for every location, based on more than 27 000 in-situ measurements.

At national level, UN Sustainable Development Goal (SDG) indicators also monitor progress related to ambient air quality.

– SDG indicator 3.9.1: Mortality rate attributed to household and ambient air pollution *(10)*.
– SDG indicator 11.6.2: Annual mean levels of fine particulate matter (e.g. $PM_{2.5}$ and PM_{10}) in cities (population weighted) *(10)*.

What are the main sources contributing to ambient air pollution?

Source apportionment studies assist in identifying the main sources contributing to air pollution, in view of identifying efficient strategies to reduce the pollution in the area of interest (e.g. country, district, city). Some of the air pollution sources may be obvious, or can be assessed through other means (such as estimation of emissions). While local sources contribute to air pollution, sources located further away (even hundreds of kilometres, or transboundary) are important contributors as well.

A database on source apportionment studies for airborne PM is available, and a global review provides an overview *(11, 12)*.

What is the air quality we want to achieve?

WHO air quality guidelines *(13)* are available for a number of pollutants and cover concentrations of pollutants in the air for different averaging times (Table 2.1).

Table 2.1. Air quality guidelines for selected air pollutants

Pollutant	Averaging time (mean)	Air quality guideline (µg/m³)
$PM_{2.5}$	Annual	10
$PM_{2.5}$	24-hour	25
PM_{10}	Annual	20
PM_{10}	24-hour	50
Ozone	8-hour	100
Nitrogen dioxide	Annual	40
Nitrogen dioxide	1-hour	200
Sulfur dioxide	24-hour	20
Sulfur dioxide	10-minute	500

Source: Adapted from *(13)*.

Additional information is available.

– *Air quality guidelines – global update 2005. Particulate matter, ozone, nitrogen dioxide and sulfur dioxide (13).*
– *Air quality guidelines for Europe (14).*

[3] Specific information is available from national, subnational and intergovernmental institutions.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Transport systems: policies and actions			
Note: More guidance that promotes walking and cycling is listed in section 9.2 Environments for safe and sustainable transport, active mobility and physical activity.			
1. Develop or improve transport systems which prioritize efficiency, pollution reduction, inclusiveness taking into account vulnerable users, use of non-motorized transportation and alternatives to private motorized transport including walking and cycling through rapid urban transit transport[4], walking and cycling networks, rail, metro and bus as well as urban and regional development policies, integrated transport and spatial planning, and travel demand management *(15-18)*.	Transport; Land use planning	Community national	Infrastructure, technology and built environment; taxes and subsidies
2. Shift to cleaner lower-emission vehicles and fuels, including fuels with reduced sulfur content, for public transport, transport of goods and services and private vehicle users *(15, 16, 19, 20)*. This may involve disincentives for the use of private vehicles.	Transport; Environment	National	Taxes and subsidies; regulation; infrastructure, technology and built environment
3. Implement stricter vehicle emissions and efficiency standards *(16, 19)*.	Transport;	National	Regulation
4. Enforce mandatory inspection and maintenance for vehicles *(19, 20)*.	Transport;	National	Regulation
5. Regulate the trade of used vehicles using for example age limits for imported vehicles and fiscal instruments such as age-based taxation, progressive excise tax based on CO_2 emissions or engine size, and exemptions for specific vehicles, such as hybrid electric and electric vehicles *(21)*.	Transport;	National	Regulation
Industry: policies and actions			
6. Adopt improved industrial emission standards, clean technologies that reduce industrial smokestack emissions and post-emission controls *(16, 19, 22)*.	Industry; Environment	National	Regulation, infrastructure, technology and built environment
7. Enforce energy efficiency standards for industries *(19)*.	Industry; Environment	National	Regulation
8. Improve efficiency and emission standards for brick kilns and coke ovens *(16, 19)*.	Industry; Environment	National	Regulation
9. Reduce industrial solvent emissions through leak detection, repairs and solvent recovery *(19)*.	Industry	National community	Infrastructure, technology and built environment

[4] Transport, often on rapid transit (rail or bus), with high passenger capacities and frequency of service, and usually separated from other traffic.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
10. Introduce low-solvent paints *(19)*.	Industry	National	Infrastructure, technology and built environment
11. Improve existing oil and gas production by increasing recovery and use of gas released during fossil fuel production, stopping routine flaring and improving leakage control *(16, 19)*.	Industry	National community	Infrastructure, technology and built environment
12. Improve efficiency of existing coal mining by encouraging pre-mining recovery of coal mine gas *(19)*.	Industry	National community	Infrastructure, technology and built environment
Power generation: policies and actions			
13. Transition away from fossil fuel combustion (oil, coal) for large-scale energy production, and diesel generators for small-scale production *(16)*.	Energy; Environment	National	Taxes and subsidies; regulation; infrastructure, technology and built environment
14. Increase the use of low-emission fuels and renewable combustion-free power sources (like solar or wind); use incentives to achieve this *(16, 19)*.	Energy; Environment	National	Taxes and subsidies; infrastructure, technology and built environment; regulation
15. Increase reliance on the co-generation of heat and power, and distributed energy generation (e.g. mini-grids and rooftop solar power generation) *(16)*.	Energy	National community	Taxes and subsidies; infrastructure, technology and built environment; regulation
Waste and wastewater management: policies and actions			
Further actions, interventions and solutions on waste management can be found in chapter Solid waste.			
16. Support waste reduction, waste separation, recycling and reuse or waste reprocessing *(16)*.	Environment; Industry; Waste	National community	Taxes and subsidies; infrastructure, technology and built environment; regulation
17. Stop open waste burning *(16, 19)*.	Environment; Industry; Waste	National community	Regulation

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
18. Improve methods of biological waste management such as anaerobic waste digestion to produce biogas, and low-cost alternatives to the open incineration of solid waste. Where incineration is unavoidable, use of combustion technologies with strict emission controls are critical *(16)*.	Environment; Industry; Waste	National community	Regulation; infrastructure, technology and built environment
19. Practise landfill gas recovery *(16, 19, 23)*.	Environment; Industry; Waste	National community	Infrastructure, technology and built environment
20. Introduce two-stage wastewater treatment with biogas recovery *(19)*.	Environment; Water/sanitation	National community	Infrastructure, technology and built environment
Agriculture and forestry: policies and actions			
21. Reduce or ban the burning of agricultural fields and waste *(16, 19)*.	Agriculture; Environment	National community	Regulation
22. Alternate wet/dry rice irrigation *(16, 19)*.	Agriculture	National community	Infrastructure, technology and built environment
23. Improve the management of agricultural waste and livestock manure, including the capture of methane gas emitted from waste processing and waste sites *(16, 19)*.	Agriculture; Waste; Environment	National community	infrastructure, technology and built environment
24. Improve the use of nitrogen fertilizers through efficient application; for urea use urease inhibitors and/or substitute with, for example, ammonium nitrate *(19)*.	Agriculture	National community	Infrastructure, technology and built environment
25. Adopt improved forest, land and water management and fire prevention strategies to prevent forest and peatland fires *(19)*.	Agriculture; Forestry; Water	National community	Other management and control
Housing: policies and actions			
26. Improve energy efficiency of homes and commercial buildings through insulation and passive design principles such as natural ventilation and lighting *(16)*.	Housing; Construction	National community	Infrastructure, technology and built environment

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
27. Optimize ventilation methods, siting of access roads and exercise areas in order to minimize population exposure *(24)*.	Housing; Construction; Land use planning	National community	Infrastructure, technology and built environment
Land use: policies and action			
28. Design land use and reallocation policies that reduce travel demand, shift transport modes towards non-motorized mobility options, ensure adequate access to public open space and favour more densely (compact and diverse) urban design and energy-efficient housing *(15)*.	Land use planning	National community	Infrastructure, technology and built environment
29. Consider planning or redesigning sites with reduced air pollution exposure for facilities with vulnerable populations (nurseries, schools, care facilities) *(24)*.	Land use planning; Health; Education	National community	Infrastructure, technology and built environment
30. Reduce dusts from construction and roads, for example by increasing green areas, their quality and management *(19, 25, 26)*.	Land use planning; Construction; Transport	National community	Infrastructure, technology and built environment
Other: policies and actions			
31. Consider mass sport events in locations and/or times when reduced air pollution is expected *(24)*.	Health; Other sectors	National community Universal health coverage	Other management and control
32. Consider provision of end of trip facilities for cycling in urban centres and at all public amenities; and design access to prioritize walking and cycling *(27)*.	Building; Construction	National community	Infrastructure, technology and built environment
33. Consider measures for reducing exposure for vulnerable occupations *(24)*.	Health; Other sectors	National community Universal health coverage	Other management and control

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Awareness raising and capacity building			
34. Raise awareness about health effects of air pollution and personal measures to reduce air pollution. Examples include: • promote walking, cycling and other forms of active mobility *(27)*; • promote healthy diets low in red and processed meat and rich in plant-based foods *(16)*.	Health; Environment	National community Universal health coverage	Information, education and communication
35. Raise awareness about vulnerable populations including children, periods with high air pollution/high ozone levels and recommended behaviour *(5) (7, 24)*. Examples include: • schedule outdoor activities for the morning or evening when ozone is usually lower, and select less physically intense activities *(28)*; • adapt timing and intensity of physical activity to the level of air pollution *(24)*.	Health; Environment	National community Universal health coverage	Information, education and communication

Selected tools
UNEP 2020: *Frequently asked questions on air pollution (29)*
EEA 2019: *EMEP/EEA air pollutant emission inventory guidebook 2019 (30)* This report provides technical guidance to prepare national emission inventories.
UNICEF 2017: *Danger in the air: how air pollution may be affecting the brain development of young children around the world (7)*
UNICEF 2016: *Clear the air for children. The impact of air pollution on children (31)*
UNEP 2016: *Actions on air quality (32)*
WHO Regional Office for Europe 2006: *Air quality guidelines – global update 2005. Particulate matter, ozone, nitrogen dioxide and sulfur dioxide (13)*
WHO/CCAC/UNEP 2018: The BreatheLife Campaign *(33)* The campaign combines public health and climate change expertise with guidance on implementing solutions to air pollution in support of global development goals.
WHO Regional Office for Europe 2020: AirQ+ software tool for health risk assessment of air pollution *(34)*
WHO Regional Office for Europe 2019: WHO Health and Economic Assessment Tool (HEAT) for walking and cycling *(35)*
UNECE 1979: 1979 Convention on Long-range Transboundary Air Pollution, including its protocols, programmes and activities *(36)*. The protocols of the Convention identify specific measures to be taken by the parties that ratified the Convention to cut their emissions. EMEP 2020: Tools under the co-operative programme for monitoring and evaluation of the long-range transmission of air pollutants in Europe *(37)*. The United Nations Economic Commission for Europe (UNECE) also has materials on capacity building activities *(38)* and programmes *(39)*.

2.3 Indoor air pollution: household air pollution, second-hand tobacco smoke, dampness and mould

This section covers guidance to improve the quality of air within and around household environments from various pollutants and polluting sources. The most important source of pollution worldwide, in particular in low- and middle-income countries,[5] comes from inefficient fuel combustion for cooking, heating and lighting, generating PM and other noxious gases. Other harmful pollutants include second-hand tobacco smoke, as well as radon and compounds released into the air from microbial growth (moulds). This section also includes information on the context and relevant tools for assessment and implementation.

Measures to reduce indoor air pollution from combustion sources overlap with those to reduce harmful emissions that contribute to ambient air pollution and climate change – thereby create multiple benefits. Synergies between measures to reduce air pollution and those mitigating climate change should be actively sought when prioritizing action.

Most households using unclean fuels and technologies are poor. General measures to reduce poverty often will enable people to switch to cleaner fuels and technologies and thereby reduce their exposure to air pollutants.

For guidance on radon, see section 6.4 Radon.

Overview

Almost half of the world's population live in households polluted with smoke from cooking with unclean fuels and technologies. Exposure is particularly high among women and young children, who spend the most time near the domestic hearth *(40)*. The fine PM (e.g. $PM_{2.5}$ and PM_{10}) component of this pollution mix leads to an estimated 3.8 million deaths per year (2016 data) *(5)*. Of those 3.8 million deaths, 27% were due to IHD, 18% were due to stroke and 54% were due to COPD. Household air pollution is responsible for 45% of all pneumonia deaths in children aged under 5 years and contributes to 28% of all pneumonia deaths in adults *(4, 40)*.

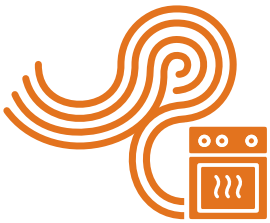
In addition, small PM and other pollutants in indoor smoke lead to airway inflammation, which impedes normal immune function and the oxygen-carrying capacity of the blood *(40)*.

Exposure to second-hand tobacco smoke and radon cause 1.3 million and 84 000 deaths per year (2019 data) respectively *(41)*.

Note: Active smoking causes 7.7 million deaths per year but is not considered an environmental risk and therefore not directly considered in this compendium.

[5] Country income groupings of low, lower-middle, upper-middle and high are determined by the World Bank and based on gross national income (GNI) per capita; see: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups and https://blogs.worldbank.org/opendata/new-country-classifications-income-level-2019-2020. These groupings are updated annually.

2.3.1 Particulate matter, carbon monoxide and other pollutants from incomplete combustion processes



What is the proportion of households impacted by indoor combustion in my country?

When people are exposed to household air pollution levels above the WHO air quality guidelines, they are at increased risk of health impacts, in particular cardiovascular and respiratory diseases and lung cancer, cataract and adverse pregnancy outcomes.

The proportion of households using polluting or unclean fuels and technologies can be informed through the following.

a. Household surveys: Household surveys are used to assess the proportion of households mainly using clean fuels and technologies used for cooking, heating and lighting. Harmonized household energy survey questions are available to assist in this assessment *(42)*.

b. Global database on clean fuel and technology use *(4)*: Energy use at household level is monitored by an SDG indicator *(10)*: 7.1.2 – Proportion of population with primary reliance on clean fuels and technology.

   WHO data on this indicator are available in this global database with estimates of the proportion of the population cooking with clean fuels and technologies by country, based on recent household surveys; this database is used for SDG reporting *(43)*.

c. Global household energy database *(44)*: WHO maintains an exhaustive database that compiles all nationally representative survey data on fuels and technologies used for cooking, heating and lighting.

Conducting field measurements of household air pollution is not required (although encouraged); use of the resources above to ascertain the extent of polluting fuel use for cooking should be sufficient to motivate action to expand clean household energy in the home. However, if there is interest in monitoring the level of household air pollution, this can be assessed through the following.

a. **In-situ measurements**
   Guidance on how to collect household and personal $PM_{2.5}$[6] and carbon monoxide measurements is provided by WHO *(45)*.

b. **Global database of household air pollution measurements** *(46)*
   This database contains household air pollution measurements (household and/or personal measurements) collected in hundreds of studies.

What is the contribution of residential biomass burning to ambient air pollution?

The contribution of domestic fuel burning to ambient air pollution can be estimated through source apportionment studies.

A database on source apportionment studies for airborne PM is available, and a global review provides an overview *(11, 12)*.

[6] That is, particles with an aerodynamic diameter equal or less than 2.5 micrometre.

What is the indoor air quality we want to achieve?

WHO air quality guidelines are available for a number of pollutants and cover concentrations of pollutants in the air. Worldwide, the most important indoor air health hazard originates from PM due to combustion. Health-based guideline values include the following maximum values and interim targets (Table 2.2). Interim targets are proposed as incremental steps in the reduction of air pollution and are intended for use in areas where pollution is high *(13)*.

Table 2.2. Air quality guidelines and interim targets for selected (indoor) air pollutants

Pollutant	Averaging time (mean)	Interim target (µg/m³)			Air quality guideline (µg/m³)
		1	2	3	
$PM_{2.5}$	Annual	35	25	15	10
$PM_{2.5}$	24-hour	75	50	37.5	25
PM_{10}	Annual	70	50	30	20
PM_{10}	24-hour	150	100	75	50
Carbon monoxide	24-hour	–	–	–	7[a]

[a] mg/m³
Source: Adapted from *(13)* for PM; *(47)* for carbon monoxide.

Additional information, including on other pollutants, is available.
- *WHO guidelines for indoor air quality: household fuel combustion (48).*
- *Air quality guidelines – global update 2005: particulate matter, ozone, nitrogen dioxide and sulfur dioxide (13).*
- *WHO guidelines for indoor air quality: selected pollutants (47).*

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
General: policies and actions			
1. Develop or update policies and strategies to meet the following device and fuel emission rate targets for household fuel combustion *(48)*: $PM_{2.5}$ (unvented): 0.23 mg/min $PM_{2.5}$ (vented): 0.80 mg/min Carbon monoxide (unvented): 0.16 g/min Carbon monoxide (vented): 0.59 g/min Where intermediate steps are necessary, transition fuels and technologies that offer substantial health benefits should be prioritized.	Environment Health	National	Regulation
2. Establish effective mechanisms for policy coordination at government level, to address the challenge of taking action by multiple sectors to address household energy *(48)*.	Environment Health Other sectors	National	Governance

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
3. Conduct systematic monitoring and evaluation of policies that promote progress towards cleaner fuels and technologies for household energy *(48)*.	Environment Health Other sectors	National	Assessment and surveillance
Use of clean fuels and technologies: policies and actions			
4. Support implementation of clean cooking solutions: a combination of fuel and technology for cooking that is considered clean for health. A cooking device burning biomass is classified as clean if it meets the emission rate targets in the WHO *Guidelines for indoor air quality: household fuel combustion*, according to the international laboratory testing protocol and tested by a third party *(19, 48, 49)*.	Health Environment Energy Industry	National; community Universal health coverage	Taxes and subsidies; infrastructure, technology and built environment; regulation
5. Support implementation of clean space heating solutions – a combination of fuel and technology that is considered clean for health. A heating device burning biomass is classified as clean if it meets the emission rate targets in the WHO *Guidelines for indoor air quality: household fuel combustion*, according to the international laboratory testing protocol and tested by a third party *(19, 48, 49)*.	Health Industry Environment	National; community Universal health coverage	Taxes and subsidies; regulation
6. Support implementation of clean lighting solutions – a combination of fuel and technology that is considered clean for health *(19, 48, 49)*.	Health Environment	National; community Universal health coverage	Taxes and subsidies; regulation
7. Restrict using unprocessed[7] coal as a household fuel *(48)*.	Health Environment	National; community Universal health coverage	Regulation
8. Discourage use of kerosene as a household fuel until data show its safety *(48)*.	Health Environment	National; community Universal health coverage	Regulation; information, education and communication
9. Improve energy efficiency of household appliances, buildings, lighting, heating and cooling *(19)*.	Housing Industry Energy	National; community	Infrastructure, technology and built environment
10. Encourage solar and wind-based electricity; support installation of rooftop solar panels *(19, 49)*.	Housing Industry Energy	National; community	Infrastructure, technology and built environment

[7] Which has not been treated by chemical, physical or thermal means to reduce contaminants.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
11. Subsidize or exempt tax on cleaner fuels and improved technologies for household cooking, heating and lighting *(49)*.	Finance Environment Other sectors	National; community	Taxes and subsidies
12. Foster consumer credit/lease arrangements for cook-stove purchases *(49)*.	Finance Industry	National; community	Taxes and subsidies
13. Make available microfinance schemes to help entrepreneurs and small businesses set up kiosks to sell or service cleaner technologies, such as solar light charging points *(49)*.	Finance Industry	National; community	Taxes and subsidies
14. Develop/adopt standards for laboratory testing of cook-stoves, including PM and carbon monoxide emissions and safety (which are in line with the WHO *Guidelines for indoor air quality: household fuel combustion (48)*), such as *Household air pollution: interventions & tools (49)* or ISO 19867-1:2018 *(50)*.	Health Industry Environment	National	Regulation
15. Implement third-party emission rate testing before promoting a technology or fuel, optimally including measuring of actual air pollution levels during everyday use in homes *(48)*.	Health Environment	National	Regulation
Housing: policies and actions			
16. Reduce the need for extra heating or cooling by designing homes that utilize passive heating and cooling principles *(49)*.	Housing Construction	National; community	Infrastructure, technology and built environment
17. Incorporate adequate ventilation sources into homes to vent smoke from cooking, heating and lighting activities *(49)*.	Housing Construction	National; community	Infrastructure, technology and built environment
Awareness raising and capacity building			
18. Encourage health-protective behaviour appropriate to the local setting, such as cooking outdoors, improving ventilation, spending less time close to the smoky cooking and heating hearths, drying fuel wood before use and using lids on pots to shorten cooking time *(28)*.	Health	National; community Universal health coverage	Information, education and communication
19. Promote replacing traditional household solid fuel cook-stoves with lower-emission cook-stoves *(16, 33, 48)*.	Health Environment	National; community Universal health coverage	Information, education and communication

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
20. Conduct awareness raising activities to promote behaviour change for use of cleaner technologies and fuel use *(48, 51)*.	Health Environment	National; community Universal health coverage	Information, education and communication
21. Implement labelling scheme for cooking devices and fuels with information for consumers on whether device emissions are safe for health *(48)*.	Health Environment	National	Information, education and communication

Selected tools
WHO/CCAC/UNEP 2018: The BreatheLife Campaign *(33)* The campaign combines public health and climate change expertise with guidance on implementing solutions to air pollution in support of global development goals.
WHO 2018: WHO Clean Household Energy Solutions Toolkit (CHEST) *(52)* A step-by-step guide and tools to support the implementation of the WHO *Guidelines for indoor air quality: household fuel combustion (48)*. The module Guidance on Standards and Testing provides practical guidance for setting national standards for and testing of cook-stoves and clean cooking solutions.
WHO 2020: Situational Assessment and Stakeholder Mapping with the Household Energy Assessment Rapid Tool (HEART) *(53)*
WHO 2020: Household Multiple Emission Sources (HOMES) model *(54)* This model helps planners and policy-makers estimate the pollution concentration (PM, CO) that will result from the use of different cook-stoves or devices in different settings.
WHO 2020: Performance Target (PT) model *(55)* This model calculates the emission performance of cook-stoves or other household energy devices (e.g. space heaters or lights). The primary application of the PT model is to derive context-specific targets (or tiers) for PM and carbon monoxide emissions, such as tier of performance for cook-stoves when locally collected data are available.
Clean Cooking Alliance 2020: *Clean cooking catalogue (56)* This catalogue contains a list of cooking fuels and technologies with emissions data from laboratory testing.
WHO 2008: *Evaluating household energy and health interventions: a catalogue of methods (45)* This catalogue includes information on evaluating laboratory performance, cook-stove adoption and use, household and personal concentrations of various pollutants, including exposure levels, health and safety, economic impacts and more.

2.3.2 Second-hand tobacco smoke

This section particularly relates to the exposure to second-hand tobacco smoke, often referred to as passive smoking. Specific guidance on active smoking and related interventions can be found here *(57)*.

Overview

Exposure to tobacco smoke in the environment is proven to cause cardiovascular, respiratory and other diseases, killing more than 1.3 million people each year (2019 data) *(41, 58)*.

Active smoking causes 7.7 million deaths per year (2019 data) but is not considered an environmental risk and therefore not directly considered in this compendium *(59)*.

The toxic mix in tobacco smoke contains thousands of known chemicals, including at least 250 known carcinogenic or toxic agents *(60)*, similar to those from other incomplete combustion processes and additional ones that are specific to tobacco smoke. This smoke is also often measured in particulate matter. Children and infants are particularly susceptible to second-hand smoke, and are at increased risk for respiratory disease, middle ear disease and sudden infant death syndrome *(61)*.

Moreover, tobacco production adversely impacts human health by creating waste and inflicting damage on the environment across its entire life cycle, including via agricultural practices of cultivating and curing tobacco, tobacco product manufacturing, transportation and distribution, as well as post-consumption waste, such as cigarette butts and toxic third-hand smoke materials – chemical residue of tobacco smoke on surfaces *(62)*.

What is the proportion of people impacted by second-hand tobacco smoke in my country?	Current exposure to second-hand tobacco smoke can be informed through the following. – National and regional household surveys. – WHO STEPwise Approach to NCD Risk Factor Surveillance (STEPS) *(63)*. The STEPS approach is a simple, standardized method for collecting, analysing and disseminating data on NCDs and risk factors. – Global Burden of Disease estimates attributable to second-hand tobacco smoke *(59)*.
What levels of exposure to second-hand tobacco smoke do we want to achieve?	There is no safe level of exposure to tobacco smoke. Only 100% smoke-free indoor environments are the single proven way to protect health *(61)*. Note: “Indoor” areas include any space covered by a roof or enclosed by one or more walls or sides, regardless of the type of material used for the roof, wall or sides, and regardless of whether the structure is permanent or temporary *(64)*.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Policies and actions			
1. Comprehensively implement the WHO Framework Convention on Tobacco Control (WHO FCTC) *(65)*.	Health Industry	National	Regulation
2. Ban smoking in all public indoor areas, including public transport, workplaces, health institutions, educational and government facilities, universities, retail shops and shopping malls, hospitality and catering facilities, such as restaurants, pubs, bars, hotels, community and sports centres, manufacturing and processing plants, and all public areas in multiple unit dwellings, including lobbies, elevators and stairwells *(64, 66-68)*.	Health Industry Transport Education	National	Regulation
3. Refrain from approaches other than 100% smoke free indoor environments, including ventilation, air filtration, and the use of designated smoking areas, as ineffective *(64)*.	Health Building Industry Transport Education	National	Regulation
4. Consider making outdoor or quasi-outdoor areas and public places smoke-free, for example playgrounds, parks, beaches, outdoor stadiums, patios *(60)*. This will also reduce tobacco product waste from smoked cigarettes which contains over 7 000 toxic chemicals, including known human carcinogens, which leach into and accumulate in the environment *(62)*.	Health Industry Transport Education	National	Regulation
5. Monitor compliance and impose legal responsibilities both on business establishments and individual smokers, specifying fines and/or administrative sanctions for violation *(64)*.	Health Industry Transport Education	National	Assessment and surveillance; regulation
6. Require managers/owners of public establishments to implement the smoking ban *(64, 69)*. Key actions might include: • posting clear signs at entrances that smoking is not permitted; • removing ashtrays from premises; • supervising observance of the rules; • discouraging individuals from smoking by asking them not to smoke. In case of non-compliance: • discontinuing service; • asking the person to leave the premises; • contacting a law enforcement agency.	Health Industry Transport Education	National	Regulation; other management and control; assessment and surveillance

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
7. Implement inspections of compliance to non-smoking policies in all business premises and workplaces *(69)*.	Health Industry Transport Education	National	Assessment and surveillance
Awareness raising and capacity building			
8. Raise awareness about the risks of second-hand tobacco smoke exposure and the environmental implications of the tobacco farming and manufacturing process and tobacco waste through informational campaigns (including during mass events) and community engagement sessions *(62, 64, 70, 71)*.	Health Environment	National; community Universal health coverage	Information, education and communication
9. Inform, consult and involve the public by clearly explaining the purpose of any smoking ban legislation to ensure support and smooth implementation *(64)*.	Health	National; community Universal health coverage	Information, education and communication
10. Implement educational strategies to reduce second-hand smoke exposure in homes *(72)*.	Health Education	National; community Universal health coverage	Information, education and communication
11. Engage the community in monitoring compliance and reporting violations, for example by establishing a toll-free telephone complaint hotline or similar system *(64)*.	Health	National; community	Assessment and surveillance; information, education and communication

Selected tools
WHO 2018: Cigarette smoking: an assessment of tobacco's global environmental footprint across its entire supply chain, and policy strategies to reduce it *(73)*
WHO/UNDP 2017: *The WHO Framework Convention on Tobacco Control. An accelerator for sustainable development (74)*
WHO/International Union Against Tuberculosis and Lung Disease 2011: *Protect people from tobacco smoke: smoke-free environments. Building capacity for tobacco control: training package* (69) This package is aimed at those responsible for promoting, developing and implementing and enforcing comprehensive legislation to protect the public and workers from exposure to second-hand tobacco smoke.
WHO 2010: *A guide to tobacco-free mega-events (71)*
WHO 2009: *Guidelines for implementation of Article 8 of the WHO Framework Convention on Tobacco Control. Guidelines on protection from exposure to tobacco smoke (64)*

Selected tools
WHO 2020: WHO Framework Convention on Tobacco Control (FCTC) Implementation Database, Article 8 updates *(75)*
WHO 2013: Best practices in implementation of Article 8 of the WHO FCTC. Case studies: Seychelles and South Africa *(76, 77)*
WHO 2014: *Literature review on the health effects of smoke-free policies in light of the WHO FCTC (78)*
WHO 2007: *Policy recommendations on protection from exposure to second-hand tobacco smoke (60)*
WHO 2007: World No Tobacco Day 2007 materials, such as *Smoke-free inside (72)*, which is a brochure to promote smoke-free environments.
WHO 2020: STEPwise Approach to NCD Risk Factor Surveillance (STEPS) *(63)*. STEPS is a simple, standardized method for collecting, analysing and disseminating data on NCDs and risk factors.

2.3.3 Dampness and mould

This section summarizes measures to control mould growth indoors. The most important means for avoiding adverse health effects is the prevention (or minimization) of persistent dampness and microbial growth on interior surfaces and in building structures.

Overview

Indoor moisture can lead to microbial pollution caused by hundreds of species of bacteria and fungi, in particular filamentous fungi (mould), growing indoors. The most important effects are increased prevalence of respiratory symptoms, allergies and asthma as well as perturbation of the immunological system.

What is the indoor air quality we want to achieve?

Persistent dampness and microbial growth on interior surfaces and in building structures should be avoided or minimized, as they may lead to adverse health effects *(79)*.

Additional information, including on other pollutants, is available: *WHO guidelines for indoor air quality: dampness and mould (79)*.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Policies and actions: prevention of dampness and mould			
1. Develop comprehensive national regulations, strategies and campaigns about healthy buildings that include dampness and mould prevention *(80)*.	Housing Construction Health	National	Regulation
2. Equip local authorities with a clear mandate and sufficient resources to work on the prevention of dampness and mould *(80)*.	Housing Construction	National	Governance
3. Implement preventive measures against dampness and mould in building design and construction such as adequate insulation, ventilation and heating *(80)*. Building design and construction needs to consider climate, culture, location and intended use.	Housing Construction	National; community	Other management and control; infrastructure, technology and built environment
4. Implement regular professional building inspection and maintenance *(80)*.	Housing Construction	National; community	Assessment and surveillance; other management and control
Policies and actions: existing dampness and mould			
5. Provide targeted and easy-to-access information by health, housing and consumer protection agencies, which tend to be the first agencies contacted for support *(80)*.	Housing Construction Health	National; community	Information, education and communication
6. Ensure prompt and adequate remediation including both moisture control and mould abatement *(80)*.	Housing Construction	National; community	Other management and control
7. Remove or mechanically clean all mould and contaminated materials *(80)*.	Housing Construction	National; community	Other management and control
8. Identify the root causes of damp, moisture or mould occurrence *(80)*. Selected key actions include: • identify and address indoor and outdoor sources of dampness; • improve thermal insulation; • control or adapt ventilation; • increase indoor temperatures as necessary.	Housing Construction	National; community	Assessment and surveillance; other management and control
9. Avoid the use of biocides and/or chemical compounds for the prevention of mould and, to the extent possible, minimize their use in mould remediation *(80)*.	Housing Construction	National; community	Other management and control

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Awareness raising and capacity building			
10. Develop and disseminate information to the public with a focus on vulnerable population groups – such as people with asthma, allergies or respiratory disorders; those immunocompromised; and children, older people and people living in substandard housing *(80)*. This should entail information on the health effects of indoor dampness and mould, advice on preventing dampness and excessive moisture (e.g. through information on adequate residential behaviour, ventilation and building maintenance) and on suitable steps to take if mould growth does occur.	Health Housing Construction	National; community Universal health coverage	Information, education and communication
11. Implement appropriate training and education curricula within the housing and construction sectors to address the relevance of building quality and its links to health *(80)*.	Housing Construction Health	National	Information, education and communication
12. Raise awareness among building users about key indicators and signs that indicate problems with moisture or mould *(80)*.	Housing Construction Health	National; community Universal health coverage	Information, education and communication
13. Raise awareness among building owners about their responsibility for providing healthy workplaces or living environments that are free of excessive moisture and mould *(80)*.	Health Housing Construction	National; community Universal health coverage	Information, education and communication
14. Raise awareness among the health sector about key indicators and typical health outcomes associated with indoor environments *(80)*.	Health	National; community Universal health coverage	Information, education and communication
15. Develop housing manuals that summarize the operative tasks and challenges of the building, its construction style and its equipment as a guidance and information tool for building users *(80)*.	Housing Construction	National; community	Information, education and communication

Selected tools
WHO Regional Office for Europe 2010: *Technical and policy recommendations to reduce health risks due to dampness and mould (80)*
WHO Regional Office for Europe/Health and Environment Alliance 2009: *Damp and mould: health risks, prevention and remedial actions. Information brochure (81)*
WHO Regional Office for Europe 2007: *Guidelines for indoor air quality: dampness and mould (79)*

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3. WASH

3.1 Introduction

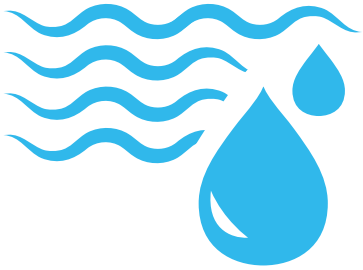
Safe WASH are crucial to human health and well-being. Safe WASH are not only a prerequisite to health, but contribute to livelihoods, school attendance and dignity and help to create resilient communities living in healthy environments *(1)*.

Inadequate or unsafe WASH may cause disease through a range of interrelated transmission pathways, which include among others:

- ingestion of water that is contaminated with faeces or chemicals
- inadequate personal hygiene which may be linked to lack of water
- contact with pathogen-containing water
- proximity to water bodies where disease vectors proliferate *(2)*.

An estimated 829 000 diarrhoeal disease deaths were estimated to be caused by unsafe WASH in 2016. Other diseases caused by inadequate WASH include among others acute respiratory infections, malnutrition, malaria, soil-transmitted helminth infections, schistosomiasis and trachoma *(3)*. In addition, environmental enteropathy, a chronic subclinical inflammatory condition of the gut, which is related to faecal contamination of the environment, might be a key mediating pathway for adverse effects on child nutritional and developmental status from inadequate WASH *(4, 5)*.

3.2 Water



3.2.1 Drinking-water

This section focuses on water that is used for drinking, though safe water is essential also for other domestic purposes and food production *(6)*. Safe water used for recreational purposes is treated in section 3.2.2 Recreational water.

Overview

As of 2020, 26% of the worldwide population lack safely managed drinking-water services. Approximately 144 million people still collect drinking-water directly from surface water. Contaminated drinking-water is estimated to cause 485 000 diarrhoeal deaths each year, in addition to malnutrition and many other diseases *(3, 7, 8)*.

Note: A safely managed drinking-water service is defined as being accessible on premises, available when needed and free from contamination.

What is the situation in terms of drinking-water supply and drinking-water quality in my country?

Most countries monitor access to safe water and progress in improving it. This is usually performed through surveys of households, schools and health care facilities, as well as through routine water quality surveillance.

At national and global levels, SDG monitoring includes indicators related to drinking-water *(9)*:

- SDG indicator 3.9.2: Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene (exposure to unsafe Water, Sanitation and Hygiene (WASH) services).
- SDG indicator 6.1.1: Proportion of population using safely managed drinking-water services.

WHO and UNICEF, through the Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP), serve as custodian agencies for the global monitoring of these WASH indicators in the framework of measuring progress towards the SDGs *(1)*.

What is the level of drinking-water quality and safety we want to achieve?

WHO produces guidelines for drinking-water quality (GDWQ) that form the basis for national drinking-water regulations and standards *(10)*. The GDWQ cover a broad range of chemicals, pathogenic bacteria, viruses and parasites, radioactive substances and aspects of taste, odour and appearance that can affect drinking-water quality. The GDWQ provide health-based targets for over 200 parameters.

WHO guidance on water quality parameters and safe limits is presented within a broader framework for safe drinking-water, which addresses the following.

- **Health-based targets:** These include parameters with associated limits (such as those included in drinking-water quality regulations and standards). Health-based targets that include chemical guideline values in the GDWQ can be used to establish country-specific targets. Guideline values generally represent a concentration of a parameter in drinking-water that does not represent a significant risk to health over a lifetime of consumption.
- **Water safety plans (WSPs):** These are part of a comprehensive risk assessment and risk management approach that encompass all steps of water supply from catchment to consumer.
- **Independent surveillance:** This refers to the continuous and vigilant public health assessment and review of drinking-water supplies to confirm effective risk management and safety.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Policies and actions			
1. Develop or update drinking-water quality regulations and standards *(10, 11)*. National (or subnational) drinking-water regulations and standards should be based on the GDWQ, incorporating the three components of the framework for safe drinking-water. Regulations should be customized to consider local needs, priorities and capacities, as well as the economic and health benefits resulting from improved drinking-water supplies. Suggested practical steps for developing/revising drinking-water quality regulations and standards are: • identify the lead institution • define roles to support the process • define objectives and scope of the regulations and standards • review existing regulations and standards • gather baseline data for analysis • prepare the separate sections of the regulations and standards • ensure peer review. These steps are further detailed in *Developing drinking-water quality regulations and standards (11)*, with a particular focus on taking a risk-based approach to establishing parameters, limits and monitoring requirements.	Water/sanitation	National	Regulation

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
2. Protect drinking-water supplies using WSPs *(12)*. Proactive management of risks to drinking-water supplies through WSPs should be promoted at national (or subnational) level, with related support (e.g. capacity building) provided to drinking-water suppliers. A WSP involves the following steps. ***(a)*** Assemble the team. ***(b)*** Describe the water supply system. ***(c)*** Identify hazards and hazardous events and assess the risk. ***(d)*** Determine and validate control measures and reassess the risk. ***(e)*** Develop, implement and maintain an upgrade/improvement plan. ***(f)*** Define monitoring of control measures. ***(g)*** Verify the effectiveness of the WSP. ***(h)*** Prepare management procedures. ***(i)*** Develop supporting programmes. ***(j)*** Plan and carry out periodic review of the WSP. ***(k)*** Revise the WSP following an incident. These WSP steps are further detailed in the *Water safety plan manual: step-by-step risk management for drinking-water suppliers (13)* with an alternative six-task approach for small water supply systems *(14)* (see also the "Special considerations for small water supply systems" section below.) Guidance on the systematic consideration of women and disadvantaged groups through the WSP process in order to ensure equitable benefit is also available *(15)*. Additional practical guidance on WSPs is available in the various resources outlined in *Water safety planning: a roadmap to supporting resources (10)*. Guidance on applying the WSP approach to identify and manage the impacts of climate variability and change on drinking-water systems is presented in Chapter 7. Climate change.	Water/sanitation	National	Other management and control
3. Confirm water safety through independent surveillance *(10)*. Surveillance provides independent verification that drinking-water supplies are safe and water suppliers are proactively managing risks. Surveillance includes: • direct testing to confirm compliance with drinking-water quality standards; • WSP auditing or sanitary inspection to confirm effective risk management; • review of supplier monitoring records to confirm that compliance monitoring practices and results are in accordance with requirements in drinking-water quality standards. Guidance on surveillance is provided in Chapter 5 of the GDWQ and volume 3 of the GDWQ: surveillance and control of community supplies *(10, 16)*. Guidance on establishing WSP audit schemes and carrying out audits is provided in *A practical guide to auditing water safety plans (17)*. An associated training package on WSP auditing is available *(18)*.	Water/sanitation	National; community	Assessment and surveillance

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
4. For the management of chemicals in drinking-water, including cyanotoxins, the key components of the GDWQ framework for safe drinking-water should be applied. This includes selecting which priority parameters to include in drinking-water quality regulations (and associated limits), taking management actions to reduce concentrations of these contaminants as part of WSPs, and monitoring as part of surveillance. Refer to the GDWQ *(10)* and *Developing drinking-water quality regulations and standards (11)*. The WSP approach can be adapted to manage pharmaceuticals and microplastics by preventing their entry, or the entry of their precursors, in the water cycle. This could include improved recycling programmes and minimizing inappropriate disposal. These contaminants have the potential to reach drinking-water, although the concentrations generally found in drinking-water or its sources are unlikely to pose a risk to human health. Therefore, routine monitoring of these contaminants is not necessary and concerns over these emerging contaminants should not divert resources from known dangers, including removing of microbial pathogens *(19)*.	Water/sanitation	National	Other management and control
5. For the management of radioactivity in drinking-water in non-emergency situations the key components of the GDWQ framework for safe drinking-water should be applied, as described above. Radionuclides in drinking-water generally present a very low health risk compared to microbial pathogens and chemicals. Radiation exposure through drinking-water in normal situations mostly results from naturally occurring rather than human-made radionuclides. In contrast, following radiation emergencies involving radioactive release, human-made radionuclides may represent the major source of exposure. These factors should be considered for establishing criteria included in drinking-water quality regulations, management actions and surveillance activities (see section 6.5 Radioactivity in food and drinking-water and 6.6 Radiological emergencies) *(10, 20-22)*.	Water/sanitation	National	Other management and control
6. Include safe drinking-water, sanitation and hygiene in relevant health policies, strategies and programmes *(23)*.	Water/sanitation Health	National; community Universal health coverage	Regulation

Note: For additional publications related to drinking-water safety, see *Supporting publications to the guidelines for drinking-water quality (18)*.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Special considerations for small water supply systems			
7. Consider the special needs, challenges and opportunities for small water supply systems when applying the framework for safe drinking-water *(10)*. Small water supply systems tend to share a common set of characteristics that set them apart from other systems. For instance, there are often great numbers of systems covering a large geographic spread (including remote locations); limited technical and financial support; reliance on undertrained and/or unpaid staff; and limited surveillance oversight and support. Developing drinking-water quality regulations and standards *(11)* offers considerations for small systems and other settings with limited resources, and water safety planning for small community water supplies *(14)* presents a simplified six-task WSP approach for the small systems context (which is an abridged version of the 11-module approach outlined in point 2 above). See volume 3 of the GDWQ: surveillance and control of community supplies *(16)* and the associated sanitary inspection forms for further guidance *(24)*.	Water/sanitation	National; community	Regulation
8. Consider water safety improvements within the context of broader WASH efforts. As those responsible for managing or overseeing small systems may also be responsible for hygiene and sanitation, it is important to consider WASH improvements holistically.	Water/sanitation	National; community	Regulation; infrastructure, technology and built environment
9. Provide sufficient and safe drinking-water in communities, schools, health care facilities, workplaces and public places *(23, 25-27)*.	Water/sanitation	Community; schools/child-care settings; health care; workplace	Infrastructure, technology and built environment
10. Support and provide point-of-use/household drinking-water treatment and safe storage as an interim solution for safer drinking-water while longer-term infrastructure improvements are being planned and implemented *(23)*. Further guidance and detail can be found in the following documents *(28, 29)*.	Water/sanitation	Community	Infrastructure, technology and built environment
Awareness-raising and capacity building			
11. Promote the use of safe drinking-water in communities, schools, health care facilities, workplaces and public places *(23, 25-27)*.	Health Education	Community; schools/child-care settings; health care; workplace Universal health coverage	Information, education and communication

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
12. Promote point-of-use/household drinking-water treatment and safe storage as an interim solution for safer drinking-water until longer-term infrastructure improvements can be implemented *(23)*.	Health Education	Community; schools/child-care settings; health care; workplace Universal health coverage	Information, education and communication

Selected tools
WHO 2020: WHO sanitary inspection (SI) forms support water safety planning and/or surveillance by presenting a simple set of questions designed to assess key sanitary risks to drinking-water supplies. SI packages – which include an updated SI form, technology fact sheet and management advice sheet – have been developed for various water supply system technologies *(24)*. SI forms for additional technologies are included in volume 3 of the GDWQ: surveillance and control of community supplies *(16)*.
WHO 2017: *Water safety planning: a roadmap to supporting resources (10)* This overview includes publications by WHO and partners and provides guidance on various aspects of water safety planning, such as development, implementation, training, advocacy and auditing.
WHO/Neglected Tropical Disease NGO Network 2020: *WASH and health working together: a 'how to' guide for NTD programmes (30)* This is a toolkit to address WASH and neglected tropical diseases.
UNICEF 2017: *Thirsting for a future: water and children in a changing climate (31)*

3.2.2 Recreational water

Overview

Recreational use of fresh and coastal waters as well as waters in swimming pools and similar environments can deliver important benefits to health and well-being such as physical activity, relaxation, cultural and religious use. Yet, recreational water use can pose risks to health through exposure to microbial and chemical pollution as well as physical risk such as Drowning and injury.

What is the status of recreational water quality in my country?

Most high-income countries and some middle-income countries monitor safety of recreational water sites with the purpose of identifying and addressing pollution sources and providing water users with timely information on whether it is safe to enter.

At national and global levels, SDG monitoring includes indicators related to, but not directly assessing, water quality of water bodies used for recreation *(9)*.

- SDG indicator 6.3.1: Proportion of domestic and industrial wastewater flow safely treated.
- SDG indicator 6.3.2: Proportion of bodies of water with good ambient water quality.

WHO and UN-HABITAT serve as custodian agencies monitoring that wastewater is safely treated globally and UNEP is the custodian agency for monitoring ambient water quality globally *(32)*.

What is the level of recreational water safety we want to achieve?

WHO produces guidelines for recreational water in two volumes: *Guidelines on recreational water quality. Volume 1: coastal and fresh waters* and *Guidelines for safe recreational water environments. Volume 2: swimming pools and similar environments (33, 34)*. These guidelines focus on water quality-related health hazards for the general population engaging in all type of recreational water use involving contact with water and beach sand.

WHO guidance on recreational water quality parameters and safe limits is presented within a broader recreational water safety framework including three core recommendations for coastal and fresh water (as listed in Tables 3.1–3.3).

Table 3.1. Guideline values for microbial quality of coastal and fresh recreational waters

Microbial water quality assessment categories[a]	Intestinal enterococci (95th percentile value per 100 ml water sample)
A	≤ 40
B	41–200
C	201–500
D	> 500

Categories A–D: Based on risk evaluation, e.g. estimated risk of gastrointestinal illness per exposure: A: <1%, B: 1–5%, C: 5–10%, D: >10%.
[a] See *(33)* for further information on combining categories with sanitary surveys for beach classification.
Source: Adapted from *(33)*.

Table 3.2. Indicators and guideline values for harmful algal blooms in freshwater

	Cyanobacterial biomass indicator values	Cyanotoxin guideline values, recreation (cyanotoxin type)
Vigilance level	1–4 mm^3/L biovolume or 1–12 µg/L chlorophyll *a* (with dominance of cyanobacteria)	–
Alert level 1	4–8 mm^3/L biovolume or 12–24 µg/L chlorophyll *a* (with dominance of cyanobacteria)	24 µg/L[a] (microcystin) 6 µg/L[a] (cylindrospermopsin)
Alert level 2	Scum or transparency < 0.5–1 m	60 µg/L (anatoxin-a) 30 µg/L (saxitoxin)

[a] Provisional value.
Source: Adapted from *(33)*.

Table 3.3. Guidelines and operational monitoring limits for other hazards

Hazard category	Guideline values or operational monitoring limit
Beach sand	Provisional guideline value of 60 CFU/g of intestinal enterococci.
Chemicals	Chemical concentration 20 times higher than the guideline value in the WHO *Guidelines for drinking-water quality* as a screening approach.
Other microbial hazards	No dose–response relationship established for these organisms to support guideline values. Monitor environmental conditions favouring proliferation of organisms[a].
Nuisance aspects	No guideline value. Operational monitoring via visual inspection and data collection on priority aesthetic aspects of concern.

CFU: colony forming units.

[a] Examples of bacteria: *Aeromonas* spp., *Leptospira* spp., *Pseudomonas aeruginosa, Staphylococcus aureus*, noncholera *vibrio cholerae*; examples of free-living amoebae: *Acanthamoeba* spp., *Naegleria fowleri*; examples of Helminth: *Schistosoma mansoni, S. intercalatum, S. guineensis, S. mekongi, S. japonicum, S. haematobium, Trichobilharzia* spp.)
Source: Adapted from *(33)*.

Swimming pools and related water environments

Volume 2 of the WHO guidelines on safe recreational water environments *(34)* provide guideline values for chlorine- and bromine-based disinfectants, chlorine dioxide, ozone (in air), pH and operational guidelines for microbial testing. The WHO guidelines are intended to form the basis for national and international regulations and standards.

Guidance to create safe environments to prevent drownings is provided in section 9.3.1 Drownings.

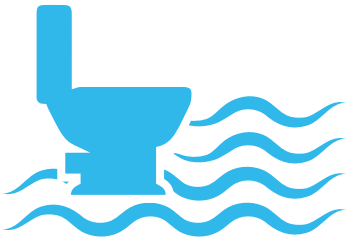
Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Coastal and fresh water environments: policies and actions			
1. Set national health-based targets for recreational water bodies *(33)*. • Express targets as microbial water quality standards for sources of faecal contamination based on WHO guideline values (see Table 3.1). • Develop additional water quality standards for cyanotoxins or biovolume indicators from harmful algal blooms based on WHO guideline values (see Table 3.2). • Consider additional standards based on provisional guideline values for beach sand and chemicals, operational monitoring limits for other microbial hazards and aesthetic and nuisance aspects, if justified by national or local risk assessment and resource availability for monitoring and control measures (see Table 3.3).	Health Environment	National	Regulation
2. Develop and implement recreational WSPs for priority bathing sites *(33)*. Steps for developing an RWSP include the following. a. Identify the lead entity and assemble a team to develop the recreational WSP. This includes identifying the lead entity and key stakeholders and forming a coordination committee that includes relevant stakeholders with clear roles and responsibilities. b. Undertake a system assessment for each existing priority recreational water site (or group of sites within the same catchment) and before developing new sites. • Describe the recreational water environment – by combining a sanitary survey of adjacent land and water drainage with an initial microbial quality assessment to assign a beach classification. • Identify hazards and hazardous events, considering seasonality and predicted local climate change scenarios. • Assess and prioritize the risks. • Identify existing control measures, assess risks and prioritize risks that are insufficiently controlled. • Establish plans, with sustainable funding, for managing currently effective control measures. • Establish improvement plans, with sustainable funding, for incrementally implementing control measures where priority risks are insufficiently controlled. c. Conduct and maintain system monitoring. • Establish and implement an operational monitoring regime for priority control measures in the catchment to give rapid warning when operational limits are exceeded. • Establish and implement corrective actions for exceedances of operational limits. • Conduct ongoing verification monitoring of water quality. • Establish procedures to verify effectiveness of the recreational WSP.	Health Infrastructure Environment	Community	Infrastructure, technology and built environment; information, education and communication; other management and control

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
d. Establish coordinated management and communication strategies to support effective pollution control and public communications. • Document management procedures for normal and incident conditions, including incident response plans. • Where feasible, develop predictive models to support timely communication to water users. • Develop supporting programmes – for example, training, research and development, standard operating procedures (SOPs), quality control activities, procedures for visual inspections, sample collection and equipment calibration. • Establish communication protocols between responsible organizations and agencies. • Establish mechanisms for communication with users and managers of the site. e. Review and update recreational WSPs. This includes meeting periodically and after incidents to review performance of plans, including operational monitoring and water quality results, an updated sanitary survey and beach classification, the occurrence of incidents, communication and complaints; if necessary, update the risk assessment. More information is provided in the *Guidelines on recreational water quality. Volume 1: coastal and fresh waters (33)*.			
3. Conduct ongoing surveillance and risk communication of recreational water-related illness *(33)*. • Collect, analyse and interpret health-related data on suspected or confirmed illness in humans and/or animals, and systematically document outbreaks associated with recreational waters. • Provide the public with timely information about the status of health risks, and provide water users with advisory warnings before, during and after a public health incident, in conjunction with recreational WSPs.	Health	National; community	Assessment and surveillance
Swimming pools, spas and similar water environments: policies and actions			
4. Develop a pool safety plan for swimming pools and similar environments *(34)*. Points to consider include: • adequate water treatment including filtration and disinfection, pool hydraulics, addition of fresh water, cleaning and ventilation. • Provision and encouragement of the use of showers and toilets • Monitoring of turbidity, residual disinfectant and pH. Note: The WHO guidelines for safe recreational water environments (volume 2) provide operational guidelines for microbial testing *(34)*.	Health Environment	National; community	Assessment and surveillance
5. Ensure adequate clarity of pool water to minimize injury hazard (e.g. through filtration and pool design) *(34)*.	Health Infrastructure Recreation	Community; national	Infrastructure, technology and built environment; other management and control

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
6. Provide rescue services and access to emergency response/ services. Pre-set maximum water temperatures to < 40°C *(34)*. Examples for rescue services and emergency response include: first aid availability, accessible emergency shut-off for pool water outlet pumps, telephones with emergency numbers, properly trained and equipped lifeguards, emergency accessibility.	Health Recreation Infrastructure	Community; national Universal health coverage	Infrastructure, technology and built environment; other management and control

Selected tools
WHO 2021: *Guidelines on recreational water quality. Volume 1: coastal and fresh waters (33)* WHO 2006: *Guidelines for safe recreational water environments. Volume 2: swimming pools and similar environments (33, 34)*
Bartram J, Rees G, editors (2000): *Monitoring bathing waters: a practical guide to the design and implementation of assessments and monitoring programmes (35)*

3.3 Sanitation



Overview

Nearly half the world's population lacked safely managed sanitation services in 2020. Such deficiencies cause 432 000 diarrhoeal disease deaths globally each year (2016), and also lead to soil-transmitted helminth infections, malnutrition and numerous other diseases *(3, 7, 8)*. Poor sanitation contributes to the spread of antimicrobial resistance and negatively affects broader well-being *(36)*.

Benefits of improving sanitation extend well beyond reducing the risk of diarrhoea and other diseases and include among others increased dignity and safety, particularly among women and girls, and increased school attendance.

Evidence suggests that simply improving sanitation facilities might not lead to the desired health impacts but needs to be accompanied with the safe disposal of children's and animal faeces, and the cessation of open defecation *(37)*.

Who has inadequate sanitation in my country?	Most countries are monitoring progress on access to safe sanitation. This is usually performed through surveys of households, and also schools and health care facilities. At national level, SDG indicators also monitor progress related to sanitation *(9)*: – SDG indicator 3.9.2: Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene (exposure to unsafe Water, Sanitation and Hygiene for All (WASH)). – SDG indicator 6.2.1: Proportion of population using safely managed sanitation services, including a handwashing facility with soap and water. – SDG indicator 6.3.1: Proportion of domestic and industrial wastewater flow safely treated. Chapters 3 and 4 of the WHO *Guidelines on sanitation and health* provide definitions of safely managed sanitation for all steps of the chain (toilet, containment, conveyance, treatment, disposal/end use) and good practice advice on translating definitions into national targets, policies, regulations and monitoring systems.
What do we want to achieve in terms of sanitation services to protect people's health?	Safe sanitation systems should be designed and used to separate human excreta from human contact at all steps of the sanitation service chain from toilet capture and containment, through emptying, transport, treatment (in-situ or offsite) and final disposal or end use. The WHO *Guidelines on sanitation and health (38)* provide guidance to maximize the health impact of sanitation interventions including preventing infections and maintaining mental and social well-being through four main recommendations: i) ensuring universal access to and use of toilets that safely contain excreta among entire communities, institutions, workplaces and public places; ii) ensuring universal access to safe systems along the entire sanitation service chain based on context-specific solutions and local health risk assessment to protect the health of individuals, communities and workers; iii) integrating sanitation into regular local government-led planning and service provision; and iv) ensuring the health sector fulfil core functions to ensure sanitation interventions effectively protect public health.

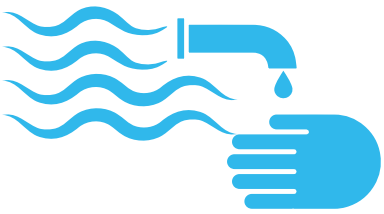
Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Policies and actions			
1. Develop or update government-led multisectoral sanitation policies, planning processes and coordination *(38)*.	Water/sanitation Health	National	Regulation
2. Sustain health sector engagement in sanitation through dedicated staffing and resourcing, and through action on sanitation in health services *(38)*.	Health	National; community	Information, education and communication
3. Develop or update national guidelines, standards and regulations, to ensure sanitation systems and services protect public health *(38)*, to include the following elements: • safe management at each step of the sanitation chain, for example through minimum requirements for toilets and pit latrines or septic tanks, SOPs for safe emptying and transport of faecal waste, and health based standards for faecal sludge and wastewater treatment and disposal or use in agriculture and aquaculture *(39)*; • risk management and management along the entire sanitation chain – see *Sanitation safety planning (40)*; • occupational health and safety for sanitation workers *(36)*.	Water/sanitation Health	National	Regulation
4. Include sanitation in health policies where sanitation is needed for primary prevention, to enable coordination and integration into health programmes *(38)*. For example, by including sanitation promotion in training curricula of health professionals, in job descriptions and local budgets.	Health Water/sanitation	National; community Universal health coverage	Regulation
5. Conduct national risk assessment using health surveillance data to target sanitation services to settings with high disease burden, and to support outbreak prevention efforts. This process involves standardized data gathering and a stakeholder meeting, possibly as part of a joint sector review *(38)*.	Health Water/sanitation	National	Assessment and surveillance
6. Implement local risk assessment and management to prioritize improvements and manage system performance. Sanitation safety planning involves an assessment of the sanitation system, identification of hazardous events and assessment of control measures, development of an incremental improvement plan, and monitoring and evaluation. The WHO manual *Sanitation safety planning* provides specific training and support *(40)*.	Water/sanitation	National; community	Assessment and surveillance; other management and control
7. Address demand and supply of sanitation facilities and services concurrently by enabling marketing of sanitation services and developing sanitation services and business models *(38)*. Approaches to generate demand may include social marketing or incentives such as subsidies, etc.	Environment Industry Water/sanitation	Community; national	Taxes and subsidies

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
8. Design, implement and monitor locally appropriate and safe systems along the entire sanitation chain *(38)*. Examples include the following. • Toilets should be made of durable material that can be easily cleaned, provide safety and privacy, with facilities for anal cleansing, hand washing and menstrual hygiene management. • Ensure safe containment of faecal waste through adequate design, operation and maintenance. • Use motorized emptying and transport over manual emptying and transport wherever possible, implement SOPs and health and safety measures for workers. • Ensure adequate treatment of faecal waste before end use/ disposal. • Ensure multi-barrier approach is used along the entire service chain. For more information, Annex 1 of *WHO guidelines on sanitation and health* contains sanitation system fact sheets which describe applicability of different sanitation systems to a given context, with consideration on design, operation and maintenance and mechanisms for protecting public health *(38)*.	Water/sanitation Health Environment	National; community	Infrastructure, technology and built environment
Awareness raising and capacity building			
9. Perform context-specific behaviour change programming based on understanding sanitation behaviours and their determinants *(38)*.	Health Water/sanitation	Community; national Universal health coverage	Information, education and communication
10. Promote access to safe toilets in schools *(26)*, health care facilities *(27)*, workplaces and public places.	Health Water/sanitation Environment	Community: schools/child-care settings; health care; workplace Universal health coverage	Information, education and communication
11. Promote shared and public toilet facilities that safely contain excreta as an incremental step when individual household facilities are not feasible *(38)*.	Health Water/sanitation Environment	Community Universal health coverage	Information, education and communication
12. Provide training and technical support to community health workers/environmental health officers for inspection of sanitary facilities and supporting households in improving their sanitation facilities *(38)*. See SI forms and sanitation system fact sheets *(41, 42)*.	Water/sanitation Environment Health	Community; national Universal health coverage	Information, education and communication
13. Raise awareness about climate adaptation options for sanitation systems, such as selecting sites less prone to floods, taking measures during/after extreme weather events, constructing simplified sewer networks to withstand flooding and flotation, etc. *(38) (43)*. Also see "Sanitation safety: Adaptation and increased resilience" section in Chapter 7. Climate change.	Water/sanitation Environment Health	Community; national Universal health coverage	Information, education and communication

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
14. Involve children at home and in school in promotion of safe sanitation *(44)*.	Education Water/sanitation Environment Health	Community; schools/child-care settings Universal health coverage	Information, education and communication
15. Involve and support all community members in the design, construction and use of sanitation facilities *(44)*.	Water/sanitation Environment Health	Community Universal health coverage	Information, education and communication
16. Promote avoiding open defecation and adopting safe sanitation facilities *(38)*.	Health Environment	Community; national Universal health coverage	Information, education and communication
17. Promote safe disposal of child faeces, that is, into latrines *(38)*.	Health Environment	Community; national Universal health coverage	Information, education and communication
18. Promote washing hands with soap at critical times, such as after defecation, after child cleaning and before preparing food *(38)*.	Health Environment	Community; national Universal health coverage	Information, education and communication
19. Promote maintaining functional and clean toilets *(38)*.	Health Environment	Community; national Universal health coverage	Information, education and communication
20. Promote safe management of domestic animals and their excreta *(38)*.	Health Environment	Community: national Universal health coverage	Information, education and communication

Selected tools
WHO 2018: Sanitation system fact sheets: Annex 1 of the *Guidelines for sanitation and health (38)*
WHO 2006: *Guidelines for the safe use of wastewater, excreta and greywater*; volumes 1–4 *(45)*
WHO 2020: Sanitary inspection forms for sanitary systems, sanitation system fact sheets *(41, 42)*
WHO/Neglected Tropical Disease NGO Network 2020: *WASH and health working together: a 'how to' guide for NTD programmes (30)* This is a toolkit to address WASH and neglected tropical diseases.

3.4 Personal hygiene



Because of its proven health benefits, hand washing with soap and water *(46)* is usually the top priority for both health promotion and hygiene monitoring.

This section focuses on individual hygiene behaviours in different settings and covers mainly hand hygiene but also other aspects of personal hygiene such as face washing. It does not address hygiene in health care facilities, which is included in the section on health care facilities (section 11.4 Health care facilities).

Overview

Hygiene is multi-faceted and comprises many behaviours, including hand- and face washing, menstrual hygiene and food hygiene. Hand washing with soap at crucial events such as after visiting the toilet, defecating or before preparing food was estimated to be a poorly practised behaviour globally *(47)*.

Approximately 2.3 billion people lacked functioning hand-washing facilities with water and soap in 2020 *(7)*. Inadequate hygiene behaviours are an important risk factor for infectious diseases like diarrhoea, soil-transmitted helminth infections, respiratory diseases and contribute to malnutrition and other diseases; they were estimated to have caused 165 000 deaths from diarrhoea alone in 2016 *(3, 8)*.

Who has inadequate access to basic hygiene facilities in my country?

Direct assessment of hand-washing practices is usually considered too resource-intensive, especially at national level. Personal hygiene practices can be estimated by the proportion of people with access to hand-washing facilities with soap and water on premises (basic hand-washing facilities). Access to basic hand-washing facilities is usually assessed in large and nationally representative household surveys. Survey data on access to hand-washing facilities are also available for individual countries for schools and health care facilities *(1)*.

Progress related to hygiene and improved hand washing with soap is also assessed within the SDGs *(9)*. SDG 6 includes a target of adequate and equitable sanitation and hygiene for all. SDG indicators specifically mentioning hygiene or hand washing with soap include the following.

- SDG indicator 3.9.2: Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene (exposure to unsafe Water, Sanitation and Hygiene for All (WASH)).
- SDG indicator 4.A.1: Proportion of schools with access to: [. . .] (e) basic drinking-water; (f) single-sex basic sanitation facilities; and (g) basic handwashing facilities (as per the WASH indicator definitions).
- SDG indicator 6.2.1: Proportion of population using safely managed sanitation services, including a hand-washing facility with soap and water.

What do we want to achieve in terms of personal hygiene?

Everyone should have access to basic hygiene facilities at home, at school, at the workplace and in public buildings *(38)*. Hand washing should be practised with soap and water and at crucial events such as after visiting the toilet, defecating or before preparing food *(38, 48)*.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Policies and actions			
1. Support the installation of hand-washing facilities, especially in homes and public places such as schools and health care facilities (see also section 11.4 Health care facilities), bus and train stations and private commercial buildings *(38, 49)*. Hand-washing facilities with soap and water should be available close to (usually within 5 m) of sanitation facilities *(26, 38)*.	Health	National; community Universal health coverage	Infrastructure, technology and built environment
2. Enforce hand-washing facilities in public places such as food establishments and markets, and include them in routine inspection and monitoring schemes *(38)*.	Health Industry	National; community	Regulation; assessment and surveillance
3. Make soap and water available to households, institutions and in public places *(26, 38)*.	Health	Community; national	Infrastructure, technology and built environment
4. Support the inclusion of culturally- and context-appropriate facilities for hand washing, anal cleansing and menstrual hygiene management into toilet design *(38)*.	Health Construction	Community; national	Infrastructure, technology and built environment
Awareness raising and capacity building			
5. Promote regular hand hygiene outside of private homes such as when entering public buildings or public transport *(49)*.	Health Education	Community; national Universal health coverage	Information, education and communication
6. Promote hand washing with soap after defecation and any potential contact with faeces (e.g. child faeces) *(38)*.	Health Education	Community; national Universal health coverage	Information, education and communication
7. Promote hand washing with soap before handling food and during food preparation *(48)*.	Health Food	Community; national Universal health coverage	Information, education and communication
8. Promote face washing for the prevention of certain infectious diseases such as trachoma *(50)*.	Health	Community; national Universal health coverage	Information, education and communication
9. Promote safe hygiene behaviours such as hand washing with soap in communities, institutions such as schools and in public places *(26, 38)*.	Health	Community; schools/child-care settings Universal health coverage	Information, education and communication

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
10. Promote the installation and availability of hand-washing facilities with soap and water *(38)*.	Health	Community; national Universal health coverage	Information, education and communication

Selected tools
WHO 2020: Awareness-raising and educational material on how to hand-wash, how to hand-rub and when and how to perform hand hygiene in health care settings *(51)*
WHO 2009: Water, sanitation and hygiene standards for schools in low-cost settings *(26)* This includes an assessment checklist for WASH in schools.
WHO 2006: Five keys to safer food manual *(48)* The manual provides key messages, resources and training materials related to food hygiene.

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4. Solid waste

Solid waste management starts from generation to collection, transport, treatment and disposal of waste. Challenges of solid waste management encompass for example poor waste collection and improper disposal such as in uncontrolled dumpsites with no measures to protect soil or groundwater.

This section includes municipal and electronic waste (e-waste); health care and medical waste is included in section 11.4 Health care facilities. Interventions on health care waste can be found in section 11.4 Health care facilities.

Overview

Solid waste refers to any type of garbage, trash, refuse or discarded material. It can be categorized according to where the waste is generated, for example as municipal solid waste, health care waste and e-waste. Over 2 billion tons of municipal solid waste are produced annually *(1, 2)*.

Improper disposal can lead to adverse health outcomes, for example through water, soil and air contamination. Hazardous waste or unsafe waste treatment such as open burning can directly harm waste workers or other people involved in waste burning and neighbouring communities. Vulnerable groups such as children are at increased risk of adverse health outcomes. Poor waste collection leads to environmental and marine pollution and can block water drains. Resulting flooding and other standing waters in waste items favour cholera and vector-borne diseases such as malaria and dengue *(1)*.

About 54 million tons of e-waste, such as TVs, computers and phones, are created annually (2019 data) with an expected increase to 75 million tons by 2030. In 2019 only 17% of e-waste was documented as being properly collected and recycled *(3)*. Exposure to improperly managed e-waste and its components can cause multiple adverse health and developmental impacts especially in young children *(4)*.

What is the situation regarding solid waste in my country?

Municipal solid waste
SDG indicator 11.6.1 monitors progress related to safe waste management: Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities.

E-waste
The Global E-Waste Statistics Partnership monitors development related to e-waste and assists countries in producing their own e-waste statistics *(5)*.

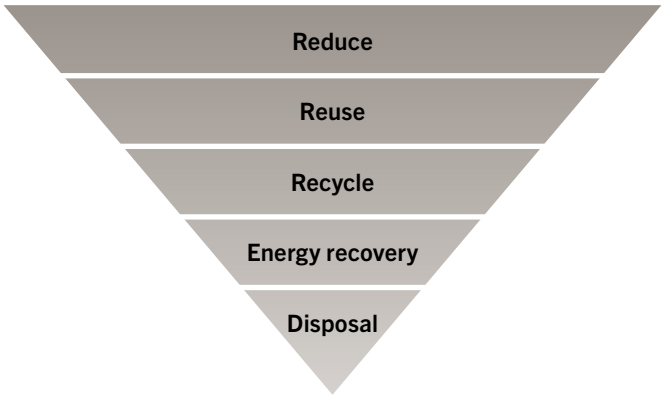
What do we want to achieve?

A safe management system for solid waste
A solid waste management system includes different components: waste generation, collection, transport, treatment and disposal. Solid waste management is a key budgetary expenditure for many local governments, is important for economic and social development and protects the health of especially the most vulnerable populations. Regulating and formalizing informal structures play a crucial role in providing safe waste management systems including for hazardous waste.

Reduced waste generation
Reduction of the amount of solid waste generated following the three-tiered approach (the 3 R's) to managing solid waste:
1. reduce
2. reuse
3. recycle.

The 3 R's are part of the waste management hierarchy (Fig. 4.1), which ranks waste management options or interventions starting from the most favoured (reduce) to the least favoured (disposal) *(1)*.

Fig. 4.1. Waste management hierarchy



Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Policies and actions			
1. Implement a solid waste management system prioritizing actions along the waste management hierarchy (Fig. 4.1) *(1, 4)*.	Environment Waste	National; community	Other management and control; Regulation
2. Develop or update policies and actions across relevant sectors that reduce harmful exposure to all types of solid waste, particularly for children *(6)*.	Environment Industry Waste Health	National	Regulation
3. Implement international agreements such as the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal *(7)*, the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade *(8)*, the Stockholm Convention on Persistent Organic Pollutants *(9)* and the Minamata Convention on Mercury *(10)*.	Environment Health	National	Regulation
4. Eradicate child labour within all waste management *(4)*. This is especially relevant for the management of hazardous waste, including management of e-waste.	Labour Environment	National; community	Regulation
5. Promote screening and (bio)monitoring of harmful waste exposure in target populations accompanied with environmental monitoring (e.g. of water, soil, air) *(4)*.	Environment Health	National; community; health care Universal health coverage	Assessment and surveillance
6. Restrict and discourage open dumping of waste *(1)*. Waste that cannot be reused, recycled or recovered should be treated in an appropriate waste treatment facility or be disposed in regulated sanitary landfills that have measures to avoid environmental contamination.	Environment	National; community	Regulation
7. Clean up and remediate contaminated sites or hot spots *(4)*.	Environment	National; community	Other management and control
8. Phase out single-use plastics progressively *(11)*. Examples include bans and taxes on plastic bags and Styrofoam products.	Environment	National; community	Regulation; taxes and subsidies

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
E-waste: policies and actions			
Note: Guidance particularly concerning e-waste is also relevant for prevention of hazardous exposure to e-waste, which is also discussed in section 5.2 Chemical safety			
9. Phase out the use of specific toxic chemicals from electrical and electronic equipment *(4, 12)*.	Industry Environment Health	National	Regulation
10. Identify and address illegal transboundary movement of electrical and electronic equipment and e-waste *(12)*.	Industry Environment Health	National	Regulation
11. Identify e-waste streams and formalize and regulate waste management and recycling to ensure safe treatment of e-waste *(4, 12)*. This may require the development of local and/or regional recycling facilities.	Environment Waste Health	National	Assessment and surveillance; regulation; infrastructure, technology and built environment
12. Implement regulations to prevent discharge of toxic chemicals *(12)*.	Environment Industry Health	National	Regulation
13. Implement standards, actions and programmes in e-waste toxicant exposures: • reduce and reuse waste policies • "take back" programmes • design maximized for durability, reparability and reusability *(4, 12)*.	Environment	National; community	Regulation; other management and control
Capacity building and awareness raising			
14. Ensure sufficient health sector capacity for engaging in harmful waste exposure reduction *(6)*.	Health	Health care Universal health coverage	Information, education and communication
15. Train workers in formal and informal waste-settings on good practices in waste management *(4)*.	Waste Environment	Workplace	Information, education and communication

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
16. Raise awareness and communicate on behaviour change among consumers and health impacts from harmful waste exposure, especially in children *(6)*.	Health Environment	Community; national Universal health coverage	Information, education and communication
17. Implement a campaign to mobilize people to use alternatives to plastic bags *(11)*.	Environment	Community; national	Information, education and communication

Selected tools
World Bank 2020: Solid Waste Management (MOOC) *(1)* This is a massive open online course (MOOC) on solid waste management.
World Bank 2020: Solid Waste Management Knowledge Silo Breaker (KSB) *(13)* This is a community of practice aiming to achieve knowledge sharing of solid waste challenges and innovations between community members of all affiliations.
UNEP 2018: Single-use plastics: A roadmap for sustainability *(11)*
UNEP 2015: *Global waste management outlook (14)*
UNEP/Institute for Global Environmental Studies 2020: *Waste management during the COVID-19 pandemic: from response to recovery (15)* Factsheets on topics such as waste management, green jobs, resource efficiency among others, are also available from UNEP *(16)*.
WHO 2008: The paediatric environmental history: a tool for health-care providers *(17)* A series of basic, concise questions that enables health professionals to identify children's potential exposure to environmental factors and special vulnerabilities.
E-waste
United Nations University/UNITAR/ International Telecommunication Union/International Solid Waste Association 2020: *Global e-waste monitor (3)* This report provides comprehensive insight to address the global e-waste challenge.
WHO 2019: Electrical/electronic waste and children's health. In: Training modules and instructions for health care providers. Children's health and the environment *(4)*
EIT Climate-KIC Online course "The E-Waste Challenge MOOC" *(18)*

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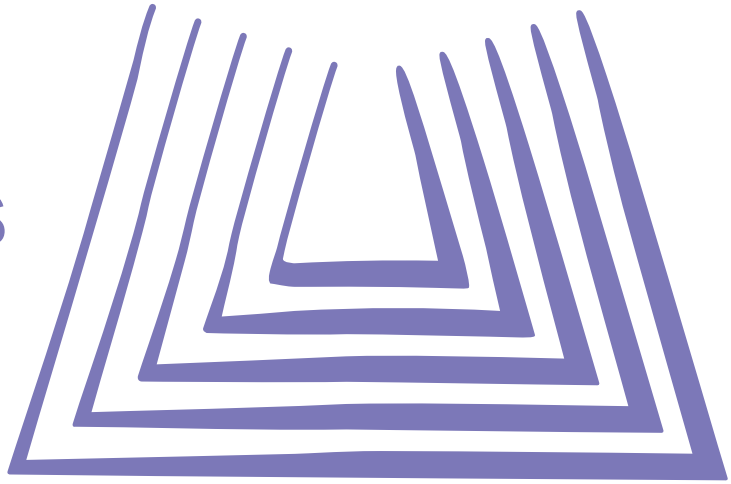
5. Chemicals



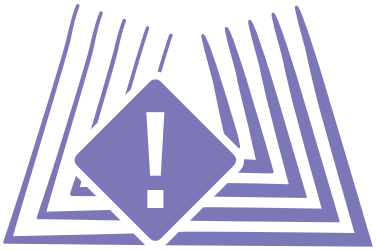
5.1 Introduction

More than 160 million chemicals are known to humans *(1)*. About 40 000 to 60 000 of them can be found in commerce; 6000 of these account for more than 99% of the total volume of chemicals in commerce globally *(2)*. In 2017, the chemical industry was the second largest manufacturing industry in the world and the trend is going upwards – chemicals sales are projected to almost double from 2017 to 2030 *(3)*.

Chemicals, whether of natural origin or produced by human activities, are part of our environment. Manufactured chemicals include industrial and agricultural products such as pesticides, petroleum products and processed metals. Some chemicals are manufactured for specific uses, while others are unwanted by-products, including wastes, or products of combustion such as toxic gases and particles from industrial emissions and burning of fuel.

All people come in contact with chemicals as part of normal life – through the food and drinking-water they consume, the products they use or are surrounded by at home or the workplace, through the contact with the environment (e.g. through breathing air, touching the soil, and swimming in recreational waters) or as a result of a chemical incident. Many of the chemicals people use and are exposed to are harmless or even beneficial; others pose a threat and are hazardous to people's health and the environment. Levels of exposure and resulting health impacts are determined by social as well as biological factors. Men, women and children are exposed to different kinds and levels of chemicals and are exposed with different frequency. In addition, men, women and children vary in their physiological susceptibility to health effects from exposure to hazardous chemicals *(4)*.

5.2 Chemical safety



In May 2017, the Seventieth World Health Assembly approved the *Chemicals road map* to enhance health sector engagement in the Strategic Approach to International Chemicals Management (SAICM) *(5)*. The road map identifies concrete actions where the health sector in countries has a lead or important supporting role to play in the sound management of chemicals, recognizing the need for multisectoral cooperation. An important role of the health sector is to make a contribution to reducing health risks from exposures to chemicals by promoting health protection strategies, regulating chemicals, increasing public education, and sharing information and best practices. In doing so, the role of the health sector is to increase knowledge and evidence about the toxicological properties of chemicals and related human health risks and impacts. Another role of the health sector is to promote the inclusion of health considerations in all chemicals policies including those developed by other sectors.

At the national level, countries usually have in place laws to ensure the safe handling of chemicals and to protect the environment, consumers and workers from contamination by and exposure to hazardous chemicals. In addition, laws are in place to prevent, prepare and respond to chemical incidents, including accidents at hazardous installations (e.g. chemical plants) and during transport. Regulations specify classification, labelling, packaging and transport of hazardous materials, including hazardous chemicals *(6)*. National laws also define chemical emission and quality standards, for example permitted concentration of chemicals in air, water, food and consumer products. Specific laws regulate the management of groups of chemicals, for example the management of pesticides.

Overview

In 2016, a small number of chemicals for which data are available were estimated to cause 1.6 million deaths from a variety of health outcomes including poisonings, heart diseases, chronic respiratory diseases and cancers *(7)*. Chemical pollution also negatively impacts a range of facets of the ecosystem, which can harm human health.

Some hazardous chemicals are of particular health concern because of their widespread presence in the environment, their toxicity and capacity to magnify and accumulate in environmental and human media, and the fact that many humans easily come in contact with them thereby harming the health of large populations. Chemicals or groups of chemicals of major public health concern include air pollution, arsenic, asbestos, benzene, cadmium, dioxin and dioxin-like substances, inadequate or excess fluoride, lead, mercury and highly hazardous pesticides (HHPs) *(8)*.

Who is impacted by unsafe levels of chemicals in my country?	**Exposure of the general population** Some countries routinely conduct population surveys to study the status and trend of chemical exposures (e.g. through the environment, food, and consumer products) and the related health risks of (sub-) populations. Often chemical exposure is determined by human bio-monitoring, that is, concentrations of chemicals are measured in human fluids (e.g. blood, urine) or tissues (e.g. hair, fingernail) *(9, 10)*. **Exposure through air, water and food** Mandatory environmental and food monitoring programmes routinely measure chemicals in certain contexts, for example ambient and indoor air, surface and groundwater, and various food items, as well as in occupational environments. Often these programmes focus on monitoring specific chemicals indicating a broader exposure pattern and, therefore, the range of substances being monitored may be limited (see Chapter 2 Air pollution and sections 3.2.1 Drinking-water, 10.1 Food safety and the environment, and 11.3 Workplaces). Environmental monitoring data provide an estimate of the health risks when compared to the WHO air quality guidelines 2005 update and WHO GDWQ *(11, 12)*. Food monitoring data of pesticide residues, food additives and contaminates can be compared with the guidance values (e.g. Acceptable Daily Intakes prepared by the Joint FAO/WHO Expert Committee on Food Additives and the Joint FAO/WHO Meeting on Pesticide Residues *(13-15)*. **Exposure through soil** In soils, chemicals are generally only assessed when contamination is suspected, for example in the case of an abandoned waste site where there is a pollution risk to groundwater. Activities and industries that have shown to pollute soil include used lead acid battery recycling, mining and ore processing, tanneries, dumpsites, industrial estates, smelting, artisanal small-scale gold mining, product manufacturing, chemical manufacturing and the dye industry.
What levels of chemicals in the air, water, products, etc. do we want to achieve?	*Chemicals in air:* WHO air quality guidelines are available for a number of pollutants and are presented in concentrations of pollutants in the air: particulate matter, ozone, nitrogen dioxide and sulfur dioxide in ambient air, and additional chemicals in indoor air *(12, 16)* (see Chapter 2 Air pollution). *Chemicals in drinking-water:* WHO drinking-water quality guidelines propose guideline values for a wide variety of chemicals *(11)*. *Chemicals in soil:* Some countries have set standards for contaminants in soils in residential areas and for farming and crop production. *Chemicals in food:* WHO and the Food and Agriculture Organization of the United Nations (FAO) implement the Codex Alimentarius, which is a collection of standards, guidelines and codes of practice on foods and their contents, including chemical contaminants and food additives *(15, 17, 18)*. Additional guidance and guideline values (e.g. occupational exposure limits) can be found in Environmental Health Criteria Documents, Concise International Chemical Assessment or International Chemical Safety Cards (ICSCs) – all are available in the International Programme on Chemical Safety (INCHEM) database *(9)* and in the Inter-Organization Programme for the Sound Management of Chemicals (IOMC) Internet-based Toolbox for Decision Making in Chemicals Management (IOMC Toolbox) *(19)*.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Policies and actions			
1. Implement the WHO *Chemicals road map* to enhance health sector engagement in the SAICM towards the 2020 goal and beyond, approved by the World Health Assembly in 2017 *(5)*. • Manage health risks from exposures to chemicals: Develop health protection strategies, regulate chemicals, educate the public about health risks, share information and best practices, develop high-quality health care settings. • Improve knowledge and evidence about the health effects and impacts of chemicals: improve risk assessment methodologies, increase bio-monitoring and surveillance, estimate disease burden from chemicals, share information and collaborate with partners. • Strengthen national capacities to address health threats from chemicals, including in response to chemical incidents and emergencies: Strengthen national policies and regulatory frameworks, implement the International Health Regulations (2005) and provide training and education. • Strengthen leadership and coordination: Promote the inclusion of health considerations in all policies related to chemicals, engage the health sector in chemicals management activities at the national, regional and international levels, and engagement of the health sector with other sectors.	Health	National; healthcare; workplace	Governance; regulation; assessment and surveillance; information, education and communication
Note: Some of the below recommendations (2–9, 11 and 12) are actions included in the WHO *Chemicals road map*.			
2. Implement the International Health Regulations (2005) to establish/strengthen core capacities for chemical incident and emergency preparedness, detection and response chemical events, including poison centre and laboratory capacities *(20)*.	Health Environment Labour Other sectors	National	Regulation
3. Implement the chemicals and waste-related multilateral environmental agreements, particularly health protective aspects, e.g.: • Minamata Convention on Mercury *(21)* • Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal *(22)* • Rotterdam Convention on Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade *(23)* • Stockholm Convention on Persistent Organic Pollutants (POPs) *(24)* • Montreal Protocol on Substances that Deplete the Ozone Layer *(25)*.	Health, Environment Agriculture Other sectors	National	Regulation
4. Nominate a health ministry contact point for the WHO Global Chemicals and Health Network *(5)*.	Health	National	Governance
5. Support the inclusion of health priorities in all policies relevant to chemicals *(5)*.	Health Other sectors	National	Governance

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
6. Facilitate participation of all relevant sectors and stakeholders in chemicals management and strengthen the engagement of the health sector with other sectors, recognizing the shared leadership of the health and environmental sectors *(5)*.	Health Environment Agriculture Labour Other sectors	National	Governance
7. Establish health-based guidelines for chemicals in water, air, soil, food, products, and occupational exposure, drawing on WHO norms, standards and guidelines, as appropriate, and participating in their development *(5)*.	Health Other sectors	National	Regulation
8. Support regulations to prevent discharge of toxic chemicals and advocate appropriate recovery and recycling technology, as well as safe storage and disposal *(5)*.	Health Other sectors	National	Regulation
9. Support implementation of the Globally Harmonized System of Classification and Labelling of Chemicals, coordinating internationally, where appropriate *(5, 6)*.	Health Other sectors	National	Regulation
10. Prevent the construction of homes, schools and playgrounds near polluted areas and hazardous installations *(26, 27)*.	Health Land use planning Construction Housing	National; community	Regulation
Awareness raising and capacity building			
11. Conduct public awareness campaigns for priority health concerns related to chemicals throughout their life cycle (e.g. HHPs, lead, mercury, etc.) *(5)*.	Health	National; community Universal health coverage	Information, education and communication
12. Promote communication of relevant information, including training, on chemicals used in products and processes, to enable informed decision-making by all actors throughout a product's life cycle, and to promote safer alternatives *(5)*.	Health Labour Other sectors	National; community; workplace	Information, education and communication
13. Educate and raise awareness about the health effects of chemicals and about actions to prevent exposure to toxic chemicals *(28, 29)*.	Health	National; community; workplace Universal health coverage	Information, education and communication

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
14. Promote safe storage of chemicals at home *(26, 27)*: • Keep all chemicals and medicines out of the reach of children, either locked or stored in places they cannot access. This applies to cleaning products in kitchen and bathroom, paraffin or kerosene, medicines, fuels and caustic products in the garage or pesticides in the shed. • Chemicals should never be stored in drinking bottles.	Health	National; community Universal health coverage	Information, education and communication
15. Promote the use of child-resistant packages for pharmaceuticals and for chemical products *(26)*.	Health	National; community Universal health coverage	Information, education and communication
16. Ensure clear labelling for cleaners, fuels, solvents, pesticides and other chemicals used at home and in schools *(27)*.	Health	National; community Universal health coverage	Information, education and communication
17. Inform parents, teachers and child-minders about the potential chemical hazards in the places where children spend their time *(26)*.	Health	National; community Universal health coverage	Information, education and communication
18. Raise awareness among families and communities about poison control centres *(26)*. (See also the *World directory of poison centres (30)*).	Health	National; community Universal health coverage	Information, education and communication

Specific actions on priority chemicals of concern – These include the ten chemicals of major public health concern as listed by INCHEM *(8)*. There are various other chemicals, including persistent organic pollutants, which are not included here but are highly hazardous and negatively affect health and the environment, especially when improperly managed.

Arsenic – Reduction of arsenic exposure through drinking-water *(31)*			
19. Screen drinking-water and identify where delivered water is above the WHO provisional guideline value of 10 µg-arsenic per litre or national permissible limit. Combine screening activities with awareness-raising campaigns.	Health Environment Water	National; community	Assessment and surveillance
20. Use alternative groundwater sources, microbiologically safe surface water (e.g. rainwater harvesting) or arsenic removal technologies.	Health Environment Water	National; community	Infrastructure, technology and built environment

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Asbestos – Elimination of asbestos-related diseases *(32)*			
21. Stop the use of all types of asbestos as the most efficient way to eliminate asbestos-related disease.	Health Construction Housing	National; community	Regulation
22. Replace asbestos with safer substitutes and develop economic and technological mechanisms to stimulate its replacement.	Construction Housing	National; community	Infrastructure, technology and built environment; regulation
23. Take measures to prevent exposure to asbestos in place and during asbestos removal (abatement).	Construction Housing	National; community	Infrastructure, technology and built environment; regulation
24. Improve early diagnosis, treatment, social and medical rehabilitation of asbestos-related diseases and establish registries of people with past and/or current exposures to asbestos.	Health	Health care; community Universal health coverage	Assessment and surveillance; other management and control
Benzene – Interventions to reduce worker and population exposure *(33)*			
25. Support the use of alternative solvents in industrial processes.	Industry	Workplace	Regulation
26. Develop or update policies and legislation to remove benzene from consumer products and to discourage domestic use of benzene-containing products.	Industry Health	National	Regulation
27. Promote building codes requiring detached garages.	Construction Housing	National	Regulation
Cadmium – Interventions to reduce work and population exposure *(34)*			
28. Reduce cadmium emissions from mining and smelting, waste incineration, application of sewage sludge to the land, and use of phosphate fertilizers and cadmium-containing manure, among others.	Industry Agriculture Other sectors	Workplace; national; community	Infrastructure, technology and built environment
29. Support safe and effective measures to increase recycling of cadmium.	Industry Other sectors	Workplace; national; community	Infrastructure, technology and built environment
30. Restrict non-recyclable uses of cadmium.	Industry Other sectors	National	Regulation

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
31. Support the elimination of use of cadmium in products such as toys, jewellery and plastics.	Industry Health Other sectors	National	Other management and control
Dioxins and dioxin-like substances – Actions to reduce emissions of these substances (required by the Stockholm Convention) *(35)*			
32. Identify and safely dispose of material containing or likely to generate dioxin and dioxin-like substances such as electrical equipment.	Environment Other sectors	Workplace; national; community	Regulation; infrastructure, technology and built environment
33. Ensure appropriate combustion practices to prevent emissions of dioxins and dioxin-like substances.	Environment Waste Industry Other sectors	Workplace; national; community	Regulation; infrastructure, technology and built environment
34. Implement FAO/WHO strategies to reduce contamination in food and feed, and monitoring of food items and human milk *(36)*.	Food Agriculture	National	Regulation; assessment and surveillance
Inadequate or excess fluoride *(37)*			
35. Ensure sufficient fluoride intake where this is lacking, so as to minimize tooth decay.	Health Water	National	Regulation
36. Provide drinking-water with a moderate (i.e. safe) fluoride level in areas where groundwater contains high fluoride levels. Guideline values for fluoride in drinking-water and air are available *(37)*.	Water Health	National; community	Regulation
37. Provide guidance on the need to control population exposures to fluoride and establish the important balance between caries prevention and protection against adverse effects.	Health	National	Regulation
Lead – Risk mitigation recommendations *(38, 39)*			
38. Develop and enforce health, environmental and safety standards for manufacturing and recycling of lead-acid batteries, e-waste and other substances that contain lead *(40)*.	Health Industry Labour Environment Other sectors	National; community	Regulation

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
39. Enforce environmental and air-quality regulations for smelting operations.	Health Industry Labour Environment Other sectors	National; community	Regulation
40. Manage drinking-water safety so that quality standards have strict parameters on lead *(11)*.	Health Industry Labour Environment Other sectors	National; community	Regulation
41. Ensure that health care practitioners have training on, and resources for, the diagnosis and management of lead poisoning.	Health	National	Information, education and communication
42. Ensure the availability of laboratory capacity for blood lead testing.	Health	National; community	Regulation
43. Phase out the use of lead additives in fuels and lead in paint where this has not yet been done; adopt legally binding limits on lead in paint.	Industry Transport Environment Health	National	Regulation
44. Eliminate the use of leaded solder in food and drink cans and water pipes; lead in homes, schools, school materials and children's toys; lead glazing for pottery intended for cooking, eating or drinking; spices; and lead in traditional medicine and cosmetics.	Industry Other sectors	National; community	Regulation
45. Identify contaminated sites and exposure routes and take necessary action to prevent human exposure to lead from these areas. Identify sources of lead exposure in children such as lead in contaminated soil, paint, toys, water distribution pipes, etc. *(27)*.	Environment Health Other sectors	National; community	Assessment and surveillance
46. Monitor blood lead concentrations in populations at risk by sensitive analytical methods *(41)*.	Health	National; community Universal health coverage	Assessment and surveillance

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
47. Enhance the collection of data on lead in foodstuffs and make this information publicly available so that appropriate action can be taken.	Food	National; community	Assessment and surveillance
48. Educate the public regarding the dangers of misusing lead-containing products, which covers risks from lead exposure and the ways to protect themselves, their families and their communities. This may include public education campaigns to parents and caregivers, schools including classroom teachers and students, youth associations, community leaders and health care workers, workers and owners of lead-related industries (e.g. lead-acid battery recyclers and smelters, ceramic potters, spice adulterators). Existing media and communication resources and mediums may be used to reach audiences that may not be aware of the risks of lead exposure to children and pregnant women.	Health Education	National; community Universal health coverage	Information, education and communication
49. Promote preventive and educational measures to protect young children from lead in their environment.	Health Education	National; community Universal health coverage	Information, education and communication
Mercury – Interventions to prevent health risks from mercury exposure *(42, 43)*			
50. Implement the Minamata Convention on Mercury.	Environment Health	National	Regulation
HHPs – Measures to reduce exposures to HHPs and their health impacts *(38)*			
51. Establish national regulation of the registration, labelling, marketing, purchase and use of pesticides, including HHPs *(44-46)*.	Agriculture	National	Regulation
52. Implement the FAO guidance on the appropriate handling and use of pesticides *(47)*.	Agriculture	National	Regulation
53. Eliminate the use of persistent HHPs and inappropriate wastes, especially HHPs subject to the Stockholm and Rotterdam Conventions *(23, 24)*.	Agriculture	National	Regulation
54. Raise awareness and understanding among pesticide users about the importance and ways of protecting health and the environment from the possible adverse effects of pesticides and the existence of less hazardous alternatives.	Health Agriculture Environment	National; community Universal health coverage	Information, education and communication
55. Educate and inform health professionals on recognition and treatment of pesticide related poisoning *(38)*.	Health	Health care	Information, education and communication

Note: Actions for risk reduction from the use of chemicals in health care settings are listed in section 11.4 Health care facilities. Additional information and more comprehensive guidance on health sector engagement is available in the *Chemicals road map (5)*.

Selected tools

WHO 2017: *Chemicals road map and workbook (5)*

The road map identifies concrete actions where the health sector has a lead or important role to play in the sound management of chemicals.

The associated workbook helps to prioritize and plan actions outlined in the chemicals road map.

WHO 2020: *Ten chemicals of major public health concern (8)* includes information for decision-makers, including tools for action, norms and guidelines, fact sheets, etc. Further resources on the ten chemicals are below.

Air pollution
See Chapter 2 Air pollution

Arsenic
WHO/UNICEF 2018: *Arsenic primer: guidance on the investigation & mitigation of arsenic contamination (48)*

Asbestos
WHO 2014: *Chrysotile asbestos (49)*

Benzene
WHO 2019: *Exposure to benzene: a major public health concern (33)*

Cadmium
WHO 2019: *Exposure to cadmium: a major public health concern (34)*

Dioxin and dioxin-like substances
UNEP/Stockholm Convention 2013: *Toolkit for identification and quantification of releases of dioxins, furans and other unintentional POPs (50)*

Fluoride
WHO 2013: *Oral health surveys: basic methods – 5th ed. (51)*

Lead
WHO 2020: Global elimination of lead in paint: why and how countries should take action. Policy brief *(52)* and technical brief *(53)*

WHO 2020: *Brief guide to analytical methods for measuring lead in paint, 2nd edition (54)*

WHO 2020: *Brief guide to analytical methods for measuring lead in blood, 2nd edition (55)*

WHO 2020: Guidance on organizing an advocacy or awareness-raising campaign on lead paint *(56)*

UNEP 2018: *Model law and guidance for regulating lead paint (57)*

Mercury
WHO 2021: Minamata Convention on Mercury: annotated bibliography of WHO information *(43)*

WHO 2021: Exposure to mercury: a major public health concern, second edition *(58)*

WHO 2019: Addressing health when developing national action plans on artisanal and small-scale gold mining under the Minamata Convention on Mercury *(59)*

WHO 2019: Strategic planning for implementation of the health-related articles of the Minamata Convention on Mercury *(60)*

WHO 2018: Health sector involvement in the Minamata Convention on Mercury *(61)*

WHO 2015: Developing national strategies for phasing out mercury-containing thermometers and sphygmomanometers in health care, including in the context of the Minamata Convention on Mercury: key considerations and step-by-step guidance *(62)*

WHO 2011: A step-by-step guide for phasing our mercury thermometers and sphygmomanometers *(63)*.

Selected tools

Highly hazardous pesticides HHPs
WHO 2020: *The WHO recommended classification of pesticides by hazard and guidelines to classification (64)*

FAO/WHO 2019: *Detoxifying agriculture and health from highly hazardous pesticides – a call for action (60)*
FAO 2019: Pesticide Registration Toolkit *(45)*
The FAO Pesticide Registration Toolkit provides technical advice on various processes and methods in pesticide registration, such as data requirements, assessment methods for parts of the registration dossier, decision-making steps, etc.

Other tools and resources can be found in the IOMC Toolbox.

IOMC 2020: *IOMC Toolbox for decision making in chemicals management (19)*
The IOMC Toolbox is a web-based platform that provides access to information and tools on the sound management of chemicals developed by participating organizations of the Inter-Agency Programme for the Sound Management Chemicals (IOMC), that is, FAO, the International Labour Organization (ILO), the United Nations Development Programme (UNDP), UNEP, the United Nations Industrial Development Organization (UNIDO), United Nations Institute for Training and Research (UNITAR), WHO, the World Bank and the Organisation for Economic Co-operation and Development (see also https://www.who.int/iomc/en/).

UNEP 2019: *Global chemicals outlook II – from legacies to innovative solutions (3)*

SAICM 2021: *Chemicals Without Concern (66)*

UNEP 2019: Factsheet titled *Suggested steps for establishing a lead paint law (67)*

UNEP 2015: *UNEP guidance: on the development of legal and institutional infrastructures and measures for recovering costs of national administration for sound management of chemicals (68)*

UNEP 2019: *UNEP guidance – enforcement of chemicals control legislation (69)*

WHO 2020: *INCHEM database (13)*.
This database contains detailed information on the physico-chemical properties and toxicology of numerous chemicals.

WHO 2020: *Guidelines for establishing a poison centre (65)*

WHO 2015: *Health in All Policies: training manual (70)*
This training resource guides the systematic consideration of health implications in all public policies to improve population health and health equity.

FAO 2000: *Assessing soil contamination. A reference manual (71)*

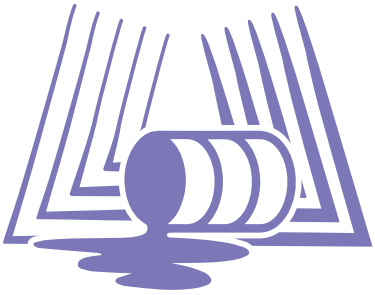
ILO/WHO 2020: *International Chemical Safety Cards (72)*
ICSCs provide essential health and safety information on chemicals to promote their safe use. They are used at the “shop floor” level by workers, and by those responsible for health and safety in factories, agriculture, construction and other workplaces, and often form part of education and training activities. They can also be used by agencies responding to chemical incidents. ICSCs for more than 1700 chemicals are available in many languages.

ILO 2020: ILO instruments on the sound management of chemicals at work *(73)*

UNICEF/Pure Earth (2020): The toxic truth: children’s exposure to lead pollution is hindering a generation of potential *(74)*

UNICEF 2018: Understanding the impact of pesticides on children: a discussion paper *(75)*

5.3 Chemical incidents



This section focuses on incidents of chemical and radiological nature. The section *Selected tools* contains information relating to natural disasters and environmental health services during emergencies.

Overview

Chemical events arising from technological incidents, natural disasters, conflict and terrorism, polluted environments, and contaminated foods and products are common and occur worldwide. Between 2000 and 2020, there were over 1000 technological incidents involving chemicals worldwide, affecting over 1.85 million people *(76)*.

Some chemical incidents can have international consequences, for example when a chemically-contaminated product is distributed to multiple countries or when a chemical release contaminates an environmental medium such as air or water and subsequently traverses national borders *(77)*. It then falls under the IHR (2005) *(20)*. Under IHR (2005), Member States must have in place the necessary capacities to detect, evaluate and respond to public health events caused by any hazard, including chemicals. WHO, in turn, should provide assistance on request to Member States for investigating and controlling such events.

How do we assess a chemical (or radiological) incident?

Many chemical incidents are overt and are quickly recognized, such as a fire or large leak from a chemical plant. Some chemical releases may, however, only become apparent with the presentation or reporting of a number of cases with similar signs and symptoms, with common histories and linked in time and space. The timely identification of the cause of clusters or suspected outbreaks associated with exposure to chemicals may require a detailed investigation involving clinical, toxicological, epidemiological, environmental and laboratory analytical approaches.

Provided they are adequately resourced, poison centres can play a key role in identifying chemical incidents, and in supporting assessment and response. They are centres of expertise on clinical toxicology and have access to databases on products and substances. Most poison centres perform toxicovigilance, that is, they are engaged in the active process of identifying and assessing the toxic risks from exposure in a community or population to consumer products, pesticides, pharmaceuticals, environmental and industrial chemicals, controlled substances and natural toxins. Toxicovigilance involves the monitoring of data from poison centres to identify trends in poisoning exposures and the emergence of new risks associated with toxic substances *(65, 78)*.

What do we want to achieve?

Comprehensive management of chemical incidents requires prevention and preparedness, early detection and effective response and recovery.

Prevention focuses on general measures that can be taken to diminish the likelihood of a chemical incident and to limit its severity.

Emergency planning and preparedness details broad goals that can be accomplished to ensure adequate public health preparedness of all involved parties to respond to a chemical incident.

Detection and alert describes various channels that can be used to detect a chemical incident and to alter the response of stakeholders involved in a chemical event emergency.

Response deals with the public health tasks that should be carried out during an emergency.

Recovery details the methods used to evaluate the causes and responses to chemical incidents and to follow up the victims in order to learn from the experience of incidents and near incidents, and to restore and remediate the affected environment *(79, 80)*.

Acute chemical exposure guidelines are available from countries, including Acute Exposure Guideline Levels and the Immediately Dangerous To Life or Health values.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Policies and actions			
1. Implement international agreements into national laws. Selected international agreements include: • IHR (2005) – a legally binding agreement providing a framework to better prevent, prepare for and respond to public health events and emergencies of potential international concern, including chemical events *(20)*. • The ILO Prevention of Major Industrial Accidents Convention (C174) *(81)*.	Environment Health Other sectors	National	Regulation
2. Develop or update national policies and plans for prevention, preparedness, response, detection and recovery for chemical incidents, including for chemical incidents arising from natural hazard events (e.g. earthquakes, floods and cyclones) *(80)*.	Health Environment Other sectors	National	Regulation
Core capacities required under the International Health Regulations (2005) *(20, 77)*			
3. Establish designated focal points for IHR (2005) in all authorities that have an important role in the management of chemical events, for coordination and communication; establish a multisectoral national chemical emergency coordinating body; ensure adequate capacity for health-sector preparedness for prompt and adequate response to chemical events.	Health Environment	National	Governance

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
4. Implement a tested surveillance system for the detection, verification and risk assessment of chemical events of (potential) international health concern as part of a multi-hazard surveillance strategy and accompanied by a surveillance plan. Important sources of chemical incident notification and alert include: • poison centres; • hospital emergency departments; • primary health care facilities; • toxicology laboratories; • non-health sector sources such as agencies for consumer protection and food safety, environmental agencies, chemical plant operators, first responders and the public.	Environment Health	National	Assessment and surveillance
5. Implement tested emergency response plans taking into account possible event scenarios, addressing priority chemicals, hazardous sites and vulnerable populations. (Detailed information for the development of an emergency response plan is provided in the *Manual for the public health management of chemical incidents (80)*).	Environment Health	National	Other management and control
6. Ensure access to expertise, that is, maintaining an updated list and roster of experts and specialized centres, including poison centres, for: • risk assessment • exposure modelling • chemical fate and transport assessment • biological and environmental monitoring • (clinical) toxicology • diagnosis and treatment • health surveillance.	Environment Health	National	Information, education and communication
7. Ensure access to specialized drugs and equipment to be used by experts and/or specialized centres and to be placed strategically to ensure national coverage, including: • antidotes • PPE • decontamination equipment • equipment for biological and environmental monitoring.	Health Environment	National	Infrastructure, technology and built environment
8. Ensure access to toxicological and environmental laboratories, that is, laboratories are prepared to accept and analyse human and environmental samples at the time of a chemical emergency and arrangements are in place to ship the samples.	Health Environment	National	Information, education and communication; other management and control
9. Conduct chemical event scenario analysis including the modelling of adverse impacts for guiding the building of surveillance and response plans and to develop related capacities.	Environment Health	National	Other management and control

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Additional recommendations for prevention, preparedness, detection, response and recovery of chemical incidents			
Prevention			
10. Avoid locating chemical facilities in hazard-prone or densely populated areas.	Land use planning	National	Regulation
11. Enforce a minimum set of safety standards and building regulations for all chemical facilities.	Environment	National	Regulation
12. Restrict and control chemical transportation and storage, including the requirement of licensing of hazardous sites and transport routes.	Environment	National	Regulation
13. Implement labour health and safety regulations including minimum levels of training, chemical protection and medical surveillance.	Labour	National	Regulation
14. Control waste disposal sites.	Environment	National	Regulation
15. Implement inspections of hazardous sites and transportation.	Environment	National	Regulation
16. Implement early-warning systems for weather-related natural events.	Health Environment	National	Regulation
17. Raise awareness about potential exposures, vulnerabilities to and health impacts from chemicals.	Health	National; community Universal health coverage	Information, education and communication
Preparedness			
18. Establish databases on hazardous sites, contents of transportation, chemical information, health care resources and emergency contact information.	Environment Health	National	Assessment and surveillance
19. Implement an incident management system, that is, a standardized approach to the command, control and coordination of emergency response.	Environment Health	National	Other management and control
Response			
20. Stop the release of the chemical, prevent the spread of contamination and limit exposure.	Industry Environment Health Other sectors	National; community Universal health coverage	Other management and control

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
21. Provide an initial risk assessment and advise and alert health care services.	Health Environment	National; community Universal health coverage	Assessment and surveillance
22. Disseminate information and advice to responders, the public and the media.	Health Environment	National; community Universal health coverage	Information, education and communication
23. Register all individuals exposed during the incident. Collect appropriate human and environmental samples (this may include blood, urine, soil and water samples).	Health Environment	National; community Universal health coverage	Assessment and surveillance
24. Conduct investigations during the incident.	Health Environment	National; community Universal health coverage	Assessment and surveillance
Recovery			
25. Provide victim support such as medical care and a single point of contact for information and advice.	Health	Health care; national; community Universal health coverage	Information, education and communication; other management and control
26. Register exposed persons for follow-up and surveillance.	Health	Health care Universal health coverage	Assessment and surveillance
27. Conduct risk and health outcome assessments and environmental assessments.	Health Environment	Health care; national; community Universal health coverage	Assessment and surveillance
28. Implement rehabilitation actions including remediation and restoration of the environment, actions to prevent a further occurrence through causative factor analysis and emergency response evaluation, and to improve the affected community's health.	Health Environment	Community; national Universal health coverage	Other management and control
29. Contribute to the information of the international community.	Health Environment	National	Information, education and communication

Selected tools
Chemical incidents
WHO 2018: *Chemical releases caused by natural hazard events and disasters. Information for public health authorities (82)* contains a guide to important resources and tools for chemical incidents and emergencies in general (Annex D).
WHO 2015: *International Health Regulations (2005) and chemical events (77)*
Natural incidents
WHO 2018: *Chemical releases caused by natural hazard events and disasters. Information for public health authorities (82)*
WHO Regional Office for Europe 2017: *Flooding: managing health risks in the WHO European Region (83)*
General
WHO 2019: *Health Emergency and Disaster Risk Management Framework (79)*
WHO 2002: *Environmental health in emergencies and disasters: a practical guide (84)*

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6. Radiation

6.1 UV radiation – natural and artificial

Overview

Human exposure to solar UV radiation may result in acute and chronic health effects of the skin (such as skin cancers) the eye (such as cataracts) and the immune system. All skin types can be affected *(1, 2)*. Natural UV radiation levels depend on sun elevation, latitude and altitude, cloud cover and ground reflection. More than 60 000 skin melanoma-related deaths were estimated to be caused by solar UV radiation in the year 2000 *(3)*.

Exposures can occur through UV radiation from the sun, but also from sunbeds and other artificial tanning devices. While all populations are potentially at risk, specific subpopulations such as children, outdoor workers and fair skinned people are at particular risk of skin cancer.

What exposure levels to UV radiation do we want to achieve?

Only small amounts of UV radiation are beneficial for people and essential in the production of vitamin D. The UV index can assist to make healthy choices about the level of sun protection needed *(4)*.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Solar UV radiation exposure from the sun: policies and actions			
1. Develop or update national sun protection policies and action plans to help prevent skin cancer and eye disease from solar radiation exposure.	Health	National	Regulation
2. Support the production, labelling and distribution of affordable UV protection products that use national or international protection labels/standards such as sunscreens (sun protection factor), clothing (UV protection factor), and sunglasses to ensure clear and safe guidelines for manufacturers and consumers *(1)*.	Health	National	Regulation
3. Establish and enforce exposure limits and protective measures for outdoor workers, such as education programmes, tailored working hours, PPE, health surveillance *(5)*.	Health Industry Agriculture Construction	National; workplace	Regulation
4. Establish national registries/statistics on UV radiation-induced skin and eye diseases *(1)*.	Health	National	Assessment and surveillance
5. Support the provision of shaded areas in schools and in public places such as playgrounds, parks and swimming pools *(1)*.	Health	National; community; schools/child-care settings; Universal health coverage	Infrastructure, technology and built environment
Artificial UV radiation: policies and actions			
6. Establish and enforce exposure limits and protective measures for indoor workers (e.g. welders) such as engineering controls and administrative controls, such as training, access limitation, hazard warning and signs and PPE *(5)*.	Health Industry	National; workplace	Regulation;
7. Ban the use, marketing and promotion of artificial tanning services (sunbeds for cosmetic purposes) *(6)*.	Health	National	Regulation
8. Ban the hire and sale of sunbeds and other artificial tanning devices for domestic use *(6)*.	Health	National	Regulation
Note: in case no bans (actions 7 and 8) are being implemented, a combination of the following (actions 9 to 10) can be opted for.			
9. Restrict the use of sunbeds and other artificial tanning devices *(6)*: • prohibit unsupervised access; • set an age limit on the use of sunbeds and other artificial tanning devices.	Health	National	Regulation
10. Manage the use of sunbeds and other artificial tanning devices *(6)*: • require surveillance and licensing of artificial tanning services; • set tanning lamp limits and exposure times; • require eye protection; • train operators.	Health	National	Regulation

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
11. Impose taxes on sunbed sessions *(6)*.	Health Finance	National	Regulation; taxes and subsidies
12. Require informing users of sunbeds and other artificial tanning devices about health risks and display of warning signs *(6)*.	Health	National	Regulation
Awareness raising and capacity building			
13. Develop a risk communication strategy to sustainably raise awareness and educate the public about the health risks of skin cancer and eye diseases from UV radiation exposure.	Health	National; community Universal health coverage	Information, education and communication
14. Use the UV Index through the media as part of public awareness programmes *(1)*.	Health	National; community Universal health coverage	Information, education and communication
15. Implement repeated education programmes to raise awareness about the health risks from prolonged UV exposure and protection measures to take, including *(1)* the following. • Supply health care professionals, teachers and caregivers of children with educational material for distribution to the public. • Organize workshops for medical doctors and other health professionals. • Establish education programmes for teachers. • Establish education programmes for outdoor workers.	Health	National; community; health care; schools/child-care settings; workplace Universal health coverage	Information, education and communication
16. Inform the public about the risks of sunbeds and other artificial tanning devices *(6)*.	Health	National; community Universal health coverage	Information, education and communication

Selected tools

WHO 2021: *The Global Health Observatory data repository – legislation of artificial tanning sunbeds (7)*
WHO 2017: *Artificial tanning devices: public health interventions to manage sunbeds (6)*
WHO 2020: *Ultraviolet (UV) radiation (8)*

6.2 Electromagnetic fields

Overview

EMF covered in this section include those generated by consumer products (electric appliances, mobile phones), fixed installations (power lines, base stations, TV antennas, medical devices (e.g. those using magnetic resonance imaging) and other technologies which can be found in the environment, at the workplace and in health care facilities.

What EMF exposure levels do we want to achieve?

Exposure standards for EMF generally refer to maximum levels of exposure to the body. Such standards have been developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP)[8], and the Institute of Electrical and Electronics Engineers (IEEE/ICES),[9] as well as many national authorities. WHO provides a framework which can be used to develop national standards *(9)*.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Policies and actions			
1. Establish exposure standards that limit EMF exposures to the public and workers as part of national legislation *(9)*.	Health	National	Regulation
Awareness raising and capacity building			
2. Inform the public about potential health risks from EMF (mobile phones, antennas and emerging technologies). Updates should be made as evidence from ongoing studies becomes available *(10)*. Engage in dialogue and consider the issues, perceptions and concerns of all interested parties, while relying on the available evidence.	Health	National; community Universal health coverage	Information, education and communication

Selected tools

WHO Global Health Observatory – Database of national regulations for electromagnetic fields *(11)*

[8] http://www.icnirp.org

[9] https://www.ices-emfsafety.org/

6.3 Radiation exposures in health care

Overview

Every year, millions of patients globally benefit from medical uses of radiation. Because of the risks associated with radiation exposure, enhancing access to radiation technologies should be linked to building capacity to their safe and appropriate utilization. A balanced approach is required to maximize the benefits while minimizing risks for patients, health care workers and members of the public.

Policies and interventions are needed to ensure that radiation safety standards *(12)* are applied and that guidance and tools are available for health facilities utilizing radiation for diagnostic and/or therapeutic purposes *(13, 14)*. Radiation protection should be integrated into policies and actions to improve quality of care, thus providing a framework for intersectoral cooperation involving all relevant stakeholders.

What radiation exposure levels do we want to achieve in medical settings?

Justification and optimization are the two fundamental principles of radiation protection in medicine. Medical exposures must result in a sufficient benefit to the patient, based on a benefit–risk analysis that provides the basis for the justification of radiological medical procedures. To ensure optimization of protection and safety, the design and construction of equipment and installations as well as the protocols and working procedures applied should result in the minimum patient dose required to achieve the clinical purpose and the probability of errors/incidents should be minimized. While dose limits are not applied to medical exposures, annual radiation dose limits are applied to health workers and members of the public. Further information on radiation safety in health care settings can be found on the WHO web site: https://www.who.int/activities/enhancing-radiation-safety-in-health-care. Description of guidance, examples of policies and practices, as well as of awareness raising and capacity building interventions are provided in section 11.4 Health care facilities under “Radiation”.

6.4 Radon

Overview

Radon is a radioactive gas that emanates from uranium in rocks and soils and tends to concentrate in enclosed spaces such as buildings and underground mines. It can also be present in water and in some building materials. Radon causes increased risk of lung cancer. A combination of smoking and indoor radon gas further increases the cancer risk. Exposure to radon causes 84 000 deaths per year (2019 data) *(15)*.

How polluted are indoor environments with radon?	The air concentration of radon can be informed through the following. – In-situ measurements: devices for measuring radon levels in homes are available and measurements should comply with prevailing (national) protocols *(16)*. – Radon maps: several countries/regions have created radon maps and databases *(16)*.
What are the indoor radon levels we want to achieve?	To limit the risk to individuals, a national reference level of 100 Bq/m^3 is recommended. Wherever this is not possible, the chosen level should not exceed 300 Bq/m^3 *(16, 17)*. Additional information is available. – *WHO handbook on indoor radon: a public health perspective (16).* – *WHO guidelines for indoor air quality: selected pollutants (18).*

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Policies and actions			
1. Develop or update a national radon action plan covering both radon prevention (new buildings) and mitigation (existing buildings) to control public and occupational radon exposure in order to achieve an overall risk reduction *(16)*.	Housing Construction Health Workplace	National	Regulation
2. Establish national reference levels for air concentration in homes/ buildings with high public occupancy, and workplaces *(16, 17)*.	Housing Construction Workplace Health	National	Regulation

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
3. Establish national regulations, building codes and/or guidelines for radon prevention and mitigation *(16)*.	Housing Construction Workplace Health	National	Regulation
4. Test radon levels and monitor to determine the effectiveness of any radon prevention or mitigation effort, especially in the context of energy efficiency programmes *(16, 19, 20)*.	Housing Construction	National; community	Assessment and surveillance
5. Incorporate radon as a risk factor in national cancer control, tobacco control, energy conservation and indoor air quality strategies and health promotion programmes *(16)*.	Housing Health	Community; national Universal health coverage	Governance
6. Subsidize or provide tax incentives to householders carrying out radon mitigation renovations *(16)*.	Finance Housing	National, community	Taxes and subsidies
7. Impose radon measurements and remediation as part of property transactions, where relevant *(16)*.	Finance Housing	National, community	Regulation
Awareness raising and capacity building			
8. Educate radon professionals, who are key for controlling radon exposure. Radon control choices depend on concentration, sources and levels of transport of radon through housing materials. Examples of control options include active and passive ventilation and soil depressurization *(16)*.	Housing Construction	National; community	Information, education and communication
9. Develop a risk communication strategy to raise awareness and educate the public about the health risks of lung cancer from radon exposure *(16, 17)*.	Health Housing Construction	Community; national Universal health coverage	Information, education and communication
10. Raise awareness among policy-makers and health practitioners that radon is an important public health issue that requires action *(16)*.	Health	National; community Universal health coverage	Information, education and communication

Selected tools
WHO 2020: Global Health Observatory – database of national regulations on radon exposure *(21)*
WHO 2018: *Management of radioactivity in drinking-water (22)*
WHO 2009: *Handbook on indoor radon: a public health perspective (16)*

6.5 Radioactivity in food and drinking-water

Overview

Food and drinking-water can contain radioactive substances (radionuclides) that could present a risk to human health. The radiation exposure resulting from ingestion of radionuclides makes a contribution to the overall population radiation dose from the many different natural and human-made radiation sources of radiation found in our everyday lives. Foods and drinking-water can have a considerable range in variation of radionuclide concentrations, reflecting the radionuclide content of water, rocks, soil and fertilizers from where they originated and the prevalent circumstances (e.g. normal situations vs radiation emergencies).

What are the radiation exposure levels we want to achieve in food and drinking-water?

In normal circumstances, natural radionuclides are the major source of exposure through ingestion, and the radiation risks are usually small compared with the risks from microorganisms and chemicals that may be present in food and drinking-water. Following radiation emergencies, human-made radionuclides released into the environment may be transferred to food and water and represent a significant source of exposure. These factors should be considered for establishing criteria for food and water safety regulation, management and surveillance. In normal situations, the International Basic Safety Standards require that the national relevant regulatory authorities establish specific reference levels for radiation exposure due to radionuclides in food and drinking-water, each of which shall typically be expressed as, or based on, an annual effective dose to the representative person generally that does not exceed a value of about 1 mSv *(12)*. Specific standards for response to nuclear and radiological emergencies include criteria for management of radioactivity in food and drinking-water *(23)*. Further guidance on radioactivity in food and drinking-water has been developed by WHO and other international organizations *(22, 24-26)*; for further information specifically related to drinking-water, see section 3.2.1 Drinking-water.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Policies and actions			
1. Manage radioactivity in food and drinking-water (3.2.1 Drinking-water) *(26)*. **Radioactivity in food** Ensure consistency with international radiation safety standards for the provision of food in the market, which includes the following. • Consider the international standards developed by the FAO/ WHO Codex Alimentarius Commission when adopting criteria in terms of levels of individual radiation dose, levels of activity concentration of specific radionuclides or both. • Seek to improve radiation safety in food trade and consumption engaging relevant stakeholders including regulators, suppliers and consumers. • Foster cooperation between relevant authorities in the field of public health, food and agriculture, radiation protection and trade to ensure consistency in policies, and regulations about radioactivity in food.	Water/sanitation Agro-food Health	National	Regulation, other action

6.6 Radiological emergencies

IHR (2005) have established provisions and requirements for countries to be prepared for radiological and nuclear emergencies, and be able to detect, assess and respond to a crisis *(27)*. WHO, in turn, should provide technical assistance on request to Member States for assessment and management of risks, as well as for a long-term recovery process.

For radioactivity in drinking-water, please refer to section 6.5 Radioactivity in food and drinking-water and section 3.2.1 Drinking-water.

Overview

Radiation emergencies (including radiological and nuclear emergencies) may result from technological incidents, natural disasters, transport accidents, acts of terrorism, polluted environments, and may involve over-exposure from external sources or internally from contaminated air, drinking-water, foods and products. Large-scale nuclear accidents such as those that occurred in Chernobyl or Fukushima are rare but may affect millions and have global consequences.

Detection, monitoring, and assessing risk of radiation emergencies	In most countries, the responsibility for monitoring radioactivity and detecting radiation emergencies rests with specialized competent authorities (e.g. radiation protection or nuclear safety agencies) and environmental protection agencies. In case of an industrial accident, the operator of the facility will notify the competent authorities, which in turn will notify the International Atomic Energy Agency (IAEA) under the international convention for early notification in case of a nuclear accident or radiological emergency *(28)*. For other accidents not involving licensed activities – such as human over-exposure from a lost radioactive source or due to a malevolent act – health specialists may be the first to identify a cluster of radiation injuries. In this case, the notification channel will involve the national IHR focal point and WHO, which will promptly inform the IAEA, according to Article 6 of the IHR (2005) *(27)*. The timely identification of the cause of clusters or suspected outbreaks associated with exposure to radiation may require a detailed investigation involving clinical, epidemiological, environmental and laboratory analytical approaches from multiple sectors/agencies. Risk assessment in case of radiological and nuclear emergencies also involves a multidisciplinary approach. Identification and assessment of exposure and determining the radiation dose for affected individuals/populations will be crucial for risk assessment.
What do we want to achieve?	Comprehensive management of radiation emergencies requires prevention and preparedness, early detection and effective response and recovery *(23)*. **Prevention** focuses on general measures that can be taken to diminish the likelihood of a radiation emergency and to limit its severity. **Emergency planning and preparedness** involve putting in place relevant legislation, financing for a whole system of emergency preparedness and response based on the protection strategy, putting in place operating procedures and well-coordinated emergency response plans. In addition, adequate public health preparedness involves designated health facilities to be equipped and well-resourced and emergency response staff to be trained regularly. **Response** deals with the various aspects of radiation emergencies *(25)*, including public health aspects of emergency sheltering and evacuation, distribution of potassium iodide pills if needed *(29)*, ensuring adequate risk communication and management of the psychosocial impact of radiation emergencies. **Recovery** follows the transition period and includes evaluation of the lessons learned of the past radiation emergencies, long-term follow up of the affected persons, ensuring access to social, health care and welfare services, and restoring the affected communities and environment and return to normality.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Policies and actions *(23, 25, 27)*			
1. Develop or update national policies and plans for prevention, preparedness, monitoring, response and recovery after radiation emergencies.	National competent authority (NCA) with the mandate pertaining to nuclear safety and/or radiation protection Environment Emergencies Health Law enforcement Civil defence	National	Regulation
2. Implement international agreements into national laws. Selected international agreements include the following. • IHR (2005) – a legally binding agreement providing a framework to better prevent, prepare for and respond to public health events and emergencies of potential international concern *(27)*. • Convention on Early Notification of a Nuclear Accident *(28)*. • Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency *(28)*.	Environment	National	Regulation
Core capacities required under the International Health Regulations (2005) *(27, 30)*			
3. Establish designated focal points for IHR (2005) in all authorities that have an important role in the management of chemical events, for coordination and communication. • Establish a multisectoral national radiation emergency coordinating body. • Ensure adequate capacity for health-sector preparedness for prompt and adequate response to radiation emergencies.	Health NCA Environment	National	Governance
4. Implement a radiation monitoring system for the detection, verification and exposure assessment of environmental radiation, as part of a multi-hazard surveillance strategy and accompanied by specific criteria for activating emergency response. Important sources of radiological and nuclear emergency notification and alert include: • non-health sector sources of ionizing radiation, such as industry, agriculture, academia and nuclear installations operators; • first responders and the public; • hospital emergency departments; • primary health care facilities.	Environment NCA Health Civil defence Emergency and disaster management sector	National	Assessment and surveillance

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
5. Develop national emergency response plans that consider the country's risk profile and address possible event scenarios and the needs of vulnerable populations.	NCA Environment Health	National	Other action
6. Ensure access to expertise, that is, maintain an updated list and roster of experts and specialized centres for: • environmental monitoring • exposure modelling • radiation dose and risk assessment • bio-dosimetry *(31)* • diagnosis and treatment of radiation injuries *(32)* • radiation emergency stockpile agents *(33)* • health surveillance • mental health and psychosocial support.	Environment Health NCA	National	Information, education and communication; other action

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7. Climate change

Overview

Climate change impacts health directly due to extreme weather events. Extreme heat, rising sea levels, floods, extreme precipitation, droughts, and storms are increasingly frequent and lead to tens of thousands of deaths every year, mainly in low- and middle-income countries *(1)*. Indirect effects of climate change result for example from food and water insecurity, increasing transmission of vector- and water-borne diseases, the disruption of the health care system and water and sanitation supplies, increased health inequality, and displacement/migration of communities.

Main contributors to global climate change are fossil fuel combustion and industrial processes but also agriculture, deforestation and other land-use changes, transportation and building energy use *(2)*. In addition, the health sector is a significant contributor to global carbon dioxide emissions (2014 data) *(3)*.

All people are exposed to the hazardous effects of climate change but some groups are particularly vulnerable such as people living in small island nations and other coastal regions, megacities, and mountainous and polar regions. Other vulnerable groups include children, older people and those with underlying health conditions, especially those living in low-income countries *(4)*.

Actions in the area of climate change and health entail the following.

(a) Mitigate climate change, by reducing or preventing emissions of greenhouse gases; many of these actions have co-benefits, for example they also reduce air pollution or save energy. Such co-benefits are already listed in the respective sections of the compendium – Chapter 2 Air pollution and section Housing – the most important ones are listed in this section as well.

(b) Adapt and increase resilience to climate change by increasing the ability to cope with the effects of climate change, and respond in order to maintain essential functions; this is the main focus of this section.

How vulnerable is population health to climate change, and what adaptation is needed?

Perform a vulnerability and adaptation assessment to assess the most vulnerable populations, identify weaknesses in the systems that should protect them, and identify interventions to respond *(5)*.

The steps in conducting such an assessment include *(5)* the following.

- Frame and scope the assessment.
- Analyse the risks of climate-sensitive health outcomes and the impact of climate conditions.
- Analyse the capacity of health and other sectors to manage the risks of those health outcomes.
- Estimate future health risks and impacts under climate change.
- Identify and prioritize policies and programmes to address future health impacts.
- Identify resources for implementation, and estimate costs of action and inaction.

Detailed guidance on how to conduct vulnerability and adaptation assessments is available *(5)*.

Climate change and health in Small Island Developing States (SIDS): SIDS are uniquely vulnerable to climate change due to frequent exposure to extreme weather and climate events, sea level rise, while also being constrained by limited resources. WHO has therefore developed a special initiative on climate change and health in SIDS *(6)*. Though most of the guidance listed below will apply to SIDS even more urgent action to adapt to climate change will be needed in these countries, as they are they among the first countries being adversely affected.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Mitigation			
1. Mitigate climate change by reducing GHG emissions and other climate-changing pollutants like black carbon for example through better energy-use choices, agricultural practices, transport, food, city densification and industrial technology use and practices *(1, 4)*.	Agriculture Transport Industry Energy Other sectors	National; community	Taxes and subsidies; infrastructure, technology and built environment
2. Reduce deforestation and implement afforestation and sustainable forest management *(1)*.	Forestry Environment Land use planning	National; community	Other management and control; regulations
3. Implement sustainable infrastructure development and spatial planning to avoid locking societies into GHG-intensive emission pathways that may be difficult or very costly to change *(1)*.	Land use planning	National; community	Infrastructure, technology and built environment
4. Establish and enforce air quality standards, in line with the WHO air quality guidelines 2005 update *(7)*.	Environment Health	National	Regulation
5. Adopt very low energy building codes for new buildings and retrofit established buildings *(1)*.	Housing Construction	National; community	Regulation; infrastructure, technology and built environment
6. Improve the efficiency of material use, re-use of materials and products and recycling, and reduce product demand overall *(1)* (Fig. 4.1).	Industry Waste	National; community	Infrastructure, technology and built environment; other management and control
7. Ensure and promote enabling environments for behaviour change related to choices of energy use, transport, living, food, waste generation and general consumption *(1)*.	Agriculture Transport Industry Energy Other sectors	National; community Universal health coverage	Information, education and communication; other management and control

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
8. Ensure political commitment and effective leadership to build climate resilience. This includes policy prioritization and planning to address climate risks, establishment of institutional mechanisms, capacities and roles and responsibilities to address climate change impacts, and health protection from climate change in legal and regulatory systems. Partnerships and cross-sectoral cooperation are necessary for efficient regulatory, policy and strategic implementation *(8)*. Concrete examples of outputs may include the following. **Governance** • Climate change and health focal points are designated within the health ministry with specific programme of action and budget allocated. • Climate change and health focal points or units work in collaboration with relevant climate-sensitive health programmes (e.g. vector-borne diseases, nutrition, infectious diseases, disaster risk reduction) to build resilience of programmes. **Policy** • National strategy on health and climate change and/or health component in national adaptation plans is developed. **Cross-sectoral collaboration** • Agreements (e.g. Memoranda of Understanding) are established between the health ministry and main stakeholders at the national level (e.g. meteorological services, ministries of environment, food and agriculture, energy, transport, planning, water, sanitation, infrastructure/ public works), which include specific roles and responsibilities in relation to protecting health from climate change. • Health representation is ensured in main climate change processes at national, regional and global levels (e.g. the United Nations Framework Convention on Climate Change (UNFCCC) meetings and Conference of the Parties (COP), national adaptation plan, national communications to the UNFCCC). • Main policies and strategies from health-determining sectors reflect climate change and health considerations both in relation to adaptation (e.g. climate-resilient WSPs) and mitigation (e.g. health co-benefits in transport systems including walking and cycling). • Health Impact Assessments (HIAs) are conducted for new mitigation and adaptation policies and programmes in all health-determining sectors.	Health Environment Other sectors	National	Governance

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
9. Strengthen the technical and professional capacity of health personnel, organizational capacity of health systems, and institutional capacity to work with others *(8)*. Concrete examples of outputs may include the following. **Human resource skill building, training and education** • Training courses on climate change and health topics targeting health personnel are conducted. • Curricula on climate change and health are developed and imparted at secondary and/or tertiary levels. **Organizational capacity development** • Contingency plans for the deployment of sufficient health personnel in case of acute shocks, such as extreme weather events and outbreaks are developed at the relevant level (i.e. national, subnational, local). • Realistic and innovative capacity-building plans (e.g. from capacity or vulnerability and adaptation assessments) are developed to address identified human resources and institutional capacity gaps. • Contingencies, adaptation costs and potential losses and damages from climate change are incorporated by management staff into investment plans. **Communications and awareness raising** • Internal and external communication plans (including the development of knowledge products) are developed and implemented to raise awareness of health and climate change, and response options targeting key audiences, such as health professionals and decision-makers, communities, the media and other sectors. • Health professionals, the media and community leaders are trained in risk communication, including communication of uncertainty. • Stakeholder forum on protecting health from climate change is established as a way to engage health-determining sectors and the community.	Health	National; health care Universal health coverage	Governance; information, education and communication

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
10. Implement integrated risk monitoring and early warning systems to inform preparedness, surveillance and response in a timely manner. Key risks to monitor include extreme weather events, temperatures, UV radiation, seasonal allergen loads and occurrences, and water availability and quality *(8)*. Concrete examples of outputs may include the following. **Integrated disease surveillance and early warnings** • Early detection tools (e.g. rapid diagnostics, syndromic surveillance) are used to identify changing incidence and early action triggered. • Geographic and seasonal distribution of health risks and outcomes (i.e. risk mapping) are tracked. • Early warning systems for relevant extreme weather events and climate-sensitive diseases (e.g. heat-stress, zoonotic diseases, undernutrition) are established. **Monitoring** • Indicators on climate change impacts, vulnerability, response capacity and emergency preparedness capacity, as well as climate and environmental variables are included in relevant monitoring systems at national level and reported over time. • Periodic reviews for improvements or deterioration of capacities are identified in vulnerability and adaptation assessments. • Impacts of main environmental determinants of health are monitored by the health sector. **Communication** • Communication strategy on climate risks to health is developed and implemented, outlining the scope of information for diverse audiences (e.g. media, public, health personnel and other sectors) and events, including who should communicate, and the means of communication. • Community engagement and feedback mechanisms are established to empower affected populations to respond to warnings, and to guide future development of monitoring and warning systems.	Health Environment	National; community Universal health coverage	Assessment and surveillance; information, education and communication

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
11. Provide climate resilient and sustainable health infrastructure, technologies and services. These may include water and sanitation services, energy supply and waste management technologies. Consider the influence of climatic conditions on medical products, and the use of new information technologies *(8)*. Concrete examples of outputs may include the following. **Adaptation of current infrastructures, technologies and processes** • Specifications for siting and construction of health facilities, and energy, water, sanitation and health care waste management infrastructure and services are revised in line with current and projected climate risks. • Training and recommendations for prescription of pharmaceuticals during extreme heat conditions are revised. **Sustainability of health operations** • Impact of health sector on the environment is assessed, and appropriate mechanisms to monitor carbon emissions and environmental impacts developed. • Sustainability in selection of products, technologies and procurement of services including energy, water, transport and waste management is assessed and prioritized by health facilities.	Health Water/sanitation Energy Waste Other sectors	National; community Universal health coverage	Infrastructure, technology and built environment; assessment and surveillance
12. Jointly manage environmental determinants of health which are linked to climate change with other sectors, such as energy and transport for air quality, water resources for water availability and quality, municipal services for waste management, etc. *(8)*. Concrete examples of outputs may include the following. **Monitoring** • Integrated monitoring systems allowing collection and analysis of data on environmental hazards, socioeconomic factors and health outcomes are established. • Evidence-based quality standards for climate-sensitive environmental conditions are defined. **Regulation** • Regulations on key environmental determinants of health (air quality, water quality, food quality, housing safety, waste management) are revised and enforced to reflect broader ranges of expected climatic conditions. • Building regulations and waste management infrastructure, environmentally sustainable and resistant to likely local extreme events, are promoted. **Coordinated management** • Health impact assessments (HIAs) for policy and programmes in sectors such as transport, agriculture and energy, are implemented. • Joint multisectoral risk management approaches to health risks related to disasters, water, waste, food and air pollution (e.g. food safety, diarrhoeal disease control, integrated vector management, risk communication) are undertaken.	Health Transport Energy Environment Water/sanitation	National; community	Governance; regulations; assessment and surveillance

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
13. Integrate climate-related health information into health programming. Programmes addressing communicable diseases (particularly vector-borne diseases), NCDs, nutrition and food safety or geriatrics would benefit from consideration of climate risks and vulnerability and becoming increasingly climate resilient *(8)*. Concrete examples of outputs may include the following. **Health programming** • Medium- and long-term plans for disease control programmes are revised to consider capacities that may be stressed or exceeded by climate change. • Investment plans are defined to address identified capacity gaps. **Delivery of interventions** • Risk maps and analysis of seasonal trends in diseases are used to target resources and preventive measures for those most at risk. • Contingency plans for health care provision in extreme weather events, or delivery of interventions to control outbreaks of infectious diseases in new locations, are developed and tested.	Health	National; health care Universal health coverage	Other management and control
14. Establish climate-informed preparedness plans, emergency systems and community-based disaster and emergency management plans for outbreaks and emergencies triggered by climate variability *(8)*. Concrete examples of outputs may include the following. **Inform policies and protocols** • Climate-sensitive health risks are included under national disaster reduction strategy and plans, and wider development processes. • Risk assessments for current and projected future exposure to extreme weather events are routinely used to inform health sector strategic development plans, as part of risk management. • Health sector contingency plans for extreme weather events are developed, including risk reduction, preparedness and response, in line with the WHO emergency response framework. • Emergency response plans for individual health facilities are defined and implemented in case of need. **Community empowerment** • Stakeholder mechanisms are established to support participation, dialogue and information exchange among stakeholders, and particularly to empower civil society and community groups as primary actors in emergency preparedness and response. • Capacity development programmes are implemented to identify and support the role of local communities to identify risks, prevent exposure to hazards and take action to save lives in extreme weather events.	Health	National; health care Universal health coverage	Other management and control; assessment and surveillance

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Heat-health response: adaptation and increased resilience			
15. Designate an agency with the authority to coordinate response activities and disseminate information about heat-related health impacts *(9)*.	Health Environment	National	Governance
16. Plan places that are more resilient to climate change and natural disasters: create well-designed and accessible green and blue spaces which also act as buffer zones and functional landscapes *(10)*.	Land use planning	Community; national	Infrastructure, technology or built environment
17. Inform the public of anticipated heatwaves and how long they are forecasted to last *(9)*.	Health Environment	National; community Universal health coverage	Information, education and communication
18. Communicate clear messages of the dangers of heatwaves, emphasizing that health protection is the first priority. Where possible, postpone outdoor or sporting activities during the heat of the day, including at schools. Work with utilities to prevent suspensions of water and electricity service *(9)*. Examples of messages may include: • stay out of the sun between 11:00 and 15:00 • drink more (non-alcoholic) fluids.	Health Environment	National; community; health care; schools/child-care settings; workplace Universal health coverage	Information, Education and communication; other management and control
19. Inform caregivers and those responsible for particularly vulnerable populations of the risks and appropriate responses to heatwaves. Additional emergency medical personnel may be assigned to address any increase in demand for services. Cooling centres can be opened to provide relief and transportation thereto can be provided for the most vulnerable *(9)*.	Health	National; community Universal health coverage	Information, education and communication; other management and control
20. Provide access to additional sources of information, such as media broadcasts, toll-free numbers, websites and hotlines to report concerns about individuals who may be at risk of the effects of heatwaves *(9)*.	Health	National; community Universal health coverage	Information, education and communication
21. Prevent heat stress in outdoor workers; most can be prevented by *(9)*: • engineering controls, such as general ventilation, evaporative cooling and spot cooling; • changing work practices, such as providing plenty of drinking-water; • scheduling heavy work during the cooler parts of the day or reducing the physical demands during the hottest part of the day; • alternate work and rest periods, with rest periods in a cool area; • wearing appropriate clothing; • educating employees about the hazards of heat stress.	Health Labour	Workplace Universal health coverage	Other management and control

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Drinking-water safety: adaptation and increased resilience			
Water safety may be affected by i) more intense precipitation and flooding; ii) increased drought; iii) increased temperature; and iv) sea level rise. This can lead to increased levels of waterborne pathogens and other harmful contaminants, increased vector breeding sites, floods, and water and food scarcity.			
22. Develop a water safety plan (WSP) to systematically manage all risks within a water supply system, from catchment to consumer, which may impact public health, including climate-related risks. Note: This section describes only how climate considerations can be integrated into the WSP approach. For general information on WSPs, see section 3.2.1 Drinking-water. The key actions of water safety planning for climate resilience include the following. • Augment the WSP team with relevant climate-related expertise. • Integrate relevant climate information into the water supply system description. • Identify climate-related hazards and assess the risks. • Develop an incremental improvement plan to increase climate resilience. • Develop management procedures and supporting programmes that strengthen the climate resilience of the system *(11)*.	Water/sanitation	National; community	Other management and control
Sanitation safety: adaptation and increased resilience			
Similar to water safety, sanitation safety may be affected by i) more intense precipitation; ii) more variable or declining rainfall or run-off; iii) more frequent or more intense storms or cyclones; iv) sea level rise; and v) more variable and increasing temperatures. This can lead to damaged infrastructure, flooding of latrines and other sanitation systems causing faecal environmental contamination and bypassing of treatment processes, spillage and contamination, higher pollution concentration in wastewater, increased deposits and blockages due to water scarcity *(12, 13)*.			
23. Perform an assessment of climate risks and vulnerability or use information from existing assessments to inform climate resilience of sanitation systems *(12)*.	Water/sanitation	National; community	Assessment and surveillance
24. Integrate climate considerations into sanitation safety plans *(14)* by targeting the greatest health risks and planning for incremental improvements. Main steps to address include *(12)*: • engaging climate-related experts when preparing the sanitary safety plan, to define scope and priorities; • describing the sanitation system; • identifying hazards and assessing risks; • developing and implementing an incremental improvement plan; • monitoring control measures and verify performance; • developing supporting programmes and review plan.	Water/sanitation	National; community	Other management and control
25. Increase climate resilience of sanitation systems. Detailed guidance is provided in *(13)*.	Water/sanitation	National; community	Other management and control

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Undernutrition: adaptation and increased resilience			
In case a vulnerability and adaptation assessment *(5)* has pointed to undernutrition as a thematic priority, a number of steps and actions can be taken to assess, anticipate and adapt to improve child nutrition. This section lists possible examples of concrete actions that can be taken to adapt to climate change according to local risks and circumstances, beyond health system strengthening on nutrition *(15)*.			
Leadership and governance			
26. Promote cross-sectoral communication to align adaptation actions in agriculture or infrastructure (such as increasing WASH coverage) with adaptation within the health sector *(15)*.	Agriculture Health Other sectors	National	Governance
27. Promote national commitment to shift towards healthy, sustainable diets *(15)*.	Food Health Environment	National	Information, education and communication
Awareness raising and capacity development in the health and nutrition workforce			
28. Raise awareness on nutrition and climate change among decision-makers and policy-makers *(15)*.	Food Health Environment	National; community	Information, education and communication
Integrated risk monitoring and early warning			
29. Train health personnel in the use of climate information and early warning systems *(15)*.	Health	Health care Universal health coverage	Information, education and communication
30. Integrate risk monitoring across relevant environmental determinants of health (such as WASH) and relevant diseases and food hazards, and improve the use of nutrition early warning/early response systems *(15)*.	Food Health Environment	National; community Universal health coverage	Assessment and surveillance; information, education and communication
Climate-resilient and sustainable technologies (in addition to those cited in 3.2.1 Drinking-water, 3.3 Sanitation, 11.1 Cities and other urban settlements, 11.2 Housing, 11.4 Health care facilities)			
31. Promote better crop diversity and biodiversity for improved nutrition, with an emphasis on vegetables and fruits, for example through agricultural extension services *(15)*.	Food Agriculture	National; community	Other management and control
32. Exploit synergies of horticulture, aquaculture and small livestock rearing to reduce waste and expenses on agricultural inputs; and increase food production diversity *(15)*.	Food Agriculture	National; community	Infrastructure, technology and built environment

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Management of the environmental determinants of health (in addition to those cited in the respective sections above)			
33. Improve household food production and livelihoods (i.e. diversification of household food production for self-consumption to improve the nutritional quality of the family diet) *(15)*.	Agriculture Health	Community Universal health coverage	Information, education and communication
34. Enhance the access and affordability of sustainable and healthy foods *(15)*.	Food Agriculture	National; community	Taxes and subsidies; other management and control
35. Promote sustainable land use management and integrated agroforestry systems to reduce deforestation, restore degraded soils, promote biodiversity within the agricultural system; and promote sustainable exploitation of nutrient-rich non-wood forest products, particularly in areas with traditional agroforestry knowledge *(15)*.	Land use planning Agriculture	National; community	Other management and control
36. Create a restored, diversified natural resource base and ensure that populations have the capacities and means for sustainable management of their natural resources *(15)*.	Environment	Community; national	Other management and control
Climate-informed health and nutrition programmes			
37. Use school-based approaches (school feeding programmes, school gardens, nutrition education) to include considerations of climate variability and long-term change into existing nutrition initiatives *(15)*.	Education Health	Schools/child-care settings Universal health coverage	Other management and control; information, education and communication
38. Provide education on healthy diets and sustainable food systems.	Education Food Health	National; community Universal health coverage	Information, education and communication

Selected tools
WHO 2015: *Operational framework for building climate resilient health systems (8)*
WHO 2020: *WHO guidance for climate-resilient and environmentally sustainable health care* facilities *(16)* provides a set of suggested interventions in four key areas for providing safe and high-quality care in the context of climate change: i) the health workforce; ii) water, sanitation, hygiene and health care waste management; iii) sustainable energy services; and iv) infrastructure, technologies and products.
UNICEF (2015): *Unless we act now: the impact of climate change on children (2)*
WHO 2015: *Heatwaves and health: guidance on warning-system development (9)* This guidance also includes country examples.
WHO 2017: *Climate-resilient water safety plans: managing health risks associated with climate variability and change (11)* This guidance also contains numerous support tools.
WHO 2019: *Technical series on adapting to climate sensitive health impacts: undernutrition (15)*

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8. Nature and health

8.1 Protection of nature, biodiversity and ecosystems for health

Many interventions that protect nature, biodiversity and ecosystems such as interventions for mitigating climate change are not included here but in many of the other topics included in this compendium. Examples include raising awareness about pollution abatement of recreational water bodies (section 3.2.2 Recreational water), interventions for a sustainable healthy diet (section 10.2 Healthy diets and the environment) and interventions for safe and sustainable mobility (section 9.2 Environments for safe and sustainable transport, active mobility and physical activity).

Overview

Human health and well-being depend on the natural environment, which is the source of clean air, water, healthy soils and food. The natural environment comprises ecosystems, which when healthy and thriving, also confer protection against climate change and disaster risk. Ecosystems include for example forests, marine and freshwater ecosystems, grasslands and mountains and comprise a range of different species that interact with each other and the surrounding environment. The stability and health of ecosystems, however, depend on biodiversity.

Biodiversity has many more strong links to health; examples include the prevention of infectious disease outbreaks and pandemics, nutritional diversity and food security, and the provision of medicines. Ecosystems and biodiversity are directly threatened by human activities such as land use change, overexploitation of resources, climate change, pollution and invasive alien species. Reducing pressure on the natural environment, from deforestation to intensive and polluting agricultural practices, to unsafe management and consumption of wildlife, will protect the environment that humans rely on, for their health and ultimately their economy *(1-3)*.

What is the situation regarding the protection of nature and biodiversity in my country?	The indicators of SDG 14 "Conserve and sustainably use the oceans, seas and marine resources for sustainable development" and SDG 15 "Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss" are directly relevant for assessing national efforts towards greater protection of nature, ecosystems and biodiversity *(4)*. The majority of SDGs are directly or indirectly related to biodiversity. Indicators for country assessment of the 20 Aichi Biodiversity Targets (listed below) have also been proposed *(5, 6)*.
What do we want to achieve?	The tenth meeting of the COP held in 2010 in Nagoya, Aichi Prefecture, Japan, adopted a revised and updated Strategic Plan for Biodiversity, including the Aichi Biodiversity Targets, for the 2011–2020 period *(7)*. The 20 Aichi Biodiversity Targets *(6)* aim for: 1. increased awareness of the values of biodiversity 2. integration of biodiversity values into decision-making 3. elimination of incentives that are harmful to biodiversity 4. sustainable production and consumption 5. reduced loss of natural habitat 6. sustainable management of marine resources 7. sustainable agriculture, aquaculture and forestry 8. reduced pollution to levels that are not detrimental to ecosystem function and biodiversity 9. prevention and control of invasive alien species 10. reduced anthropogenic pressures on vulnerable ecosystems 11. increased and improved protected areas 12. prevention of species extinction 13. maintaining and safeguarding genetic diversity 14. safeguarding ecosystems that provide essential services 15. restoring ecosystems and enhancing their resilience 16. implementation of the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization 17. adoption of National Biodiversity Strategies and Action Plans (NBSAPs) 18. respect for traditional knowledge, innovations and practices of indigenous and local communities 19. improved knowledge of biodiversity values, functions and trends, which is shared and applied 20. increased financial resources for effectively implementing the Strategic Plan for Biodiversity 2011–2020.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
General: policies and actions			
1. Implement and update NBSAPs in line with the 20 Aichi Biodiversity Targets *(2)*.	Environment Other sectors	National	Governance
2. Incorporate biodiversity values, ecosystem protection and the "value of nature" into national and regional policies, strategies and programmes, including in public health policies and in national accounting and reporting systems *(2)*.	Health Other sectors	National	Governance
3. Eliminate or reform incentives, including subsidies that are harmful to biodiversity, including those that promote monoculture production systems *(7, 8)*.	Industry Other sectors	National	Taxes and subsidies
4. Implement integrated public health and biodiversity-related interventions for the management of both short- and long-term health risks resulting from biodiversity loss and unsustainable practices *(2)*. Selected examples include *(9)*: • integrating biodiverse green spaces in urban development; • improving availability of and accessibility to diverse diets; • tightening control and rationalizing use of antimicrobial agents, pesticides and other biocides; • ecosystem-based adaptation, ecosystem-based mitigation and ecosystem-based approaches to disaster risk reduction; • maximizing the health benefits of exposure to biodiverse environments; • implementing policies and programmes in line with the One Health approach (human, animal, plant, ecosystem health) *(10)*.	Health Environment	National; community Universal health coverage	Regulation; other management and control
5. Implement integrated environment and health surveillance to support timely and evidence-based decisions for the effective identification and management of short and long-term risks to human health posed by ecosystem degradation and biodiversity loss *(2)*.	Health Environment	National; community Universal health coverage	Assessment and surveillance
6. Ensure sufficient financial resources to effectively protect nature and preserve biodiversity and ecosystems *(6)*.	Finance Environment Health	National	Governance
7. Implement preventive and precautionary strategies and policies and safe minimum standards for sustainably managing ecosystems and for valuing ecosystem services for health *(2)*. Examples include considerations of the purposeful introduction of invasive alien species, avoidance of high-density monocultures, human activity/settlement adjacent to biodiverse ecosystems, integrated disease surveillance in wildlife, livestock and human populations, ecosystem-based approaches for climate change mitigation and adaptation and disaster risk reduction.	Environment Health	National	Regulation; other management and control

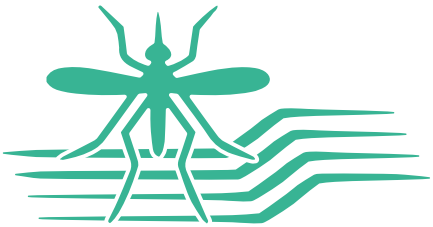
Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
8. Strengthen international and regional partnerships, joint work programmes and intersectoral collaboration on biodiversity–health linkages *(2)*.	Environment Health	National	Governance
9. Adopt integrated approaches to health, such as One Health, Ecohealth and Planetary Health, which promote cross-disciplinary and/or cross-sectoral collaborations for health and biodiversity *(2)*.	Health	National	Governance; other management and control
Ecosystems: policies and actions			
10. Avoid ecosystem loss and degradation and promote ecosystem integrity and resilience and protection of species *(2)*.	Environment	National; community	Other management and control
11. Reduce the adverse impact on biodiversity and ecosystems from land-use change, loss of natural habitats, overexploitation of nature such as of marine ecosystems, environmental chemical pollution, invasive alien species and climate change *(2)*.	Land use planning Environment Industry Other sectors	National; community	Other management and control
12. Protect and conserve genetic resources *(2)*.	Agriculture Environment	National; community	Regulation; other management and control
Medicine and disease: policies and actions			
13. Recognize contribution of genetic resources and traditional knowledge to medicine *(2)*.	Health	Health care Universal health coverage	Information, education and communication
14. Ensure benefit-sharing arising out of the utilization of genetic resources *(2, 11)*. Benefits derived from the use of genetic resources may include the sharing of the results of research and development carried out on genetic resources, the transfer of technologies which make use of those resources, and participation in biotechnological research activities. Benefits may also be monetary when products based on genetic resources are commercialized.	Industry Agriculture	National	Regulation
15. Limit unnecessary use of antibiotics and other pharmaceuticals *(2)*.	Health	Health care; national Universal health coverage	Regulation

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
16. Limit or control human–wildlife contact to reduce the risk of infectious diseases, including zoonotic and vector-borne diseases *(2)*.	Agriculture Forestry Environment Health	Workplace; national; community	Regulation
Awareness raising and capacity building			
17. Strengthen core national capacities that enable health systems to prepare for and effectively respond to public health threats resulting from ecosystem degradation *(2)*.	Health Environment	National	Governance
18. Raise awareness about the health benefits of biodiversity and ecosystem protection *(2)*. Examples include the positive impacts of biodiversity on: a. food security and nutrition b. water supply and other essential ecosystem services c. pharmaceuticals and traditional medicines d. mental health and physical and cultural well-being.	Health Environment	National; community Universal health coverage	Information, education and communication
19. Develop education programmes and training on the importance of health–biodiversity linkages at various levels and the sustainable management of ecosystems for professionals in the health and biodiversity sectors as well as for the public *(2)*.	Health Environment	Health care; national; community Universal health coverage	Information, education and communication
20. Promote lifestyles that contribute to positive health and biodiversity outcomes *(2)*. Interventions that promote sustainable healthy diets (section 10.2 Healthy diets and the environment) and safe and sustainable mobility (9.2 Environments for safe and sustainable transport, active mobility and physical activity) are presented elsewhere in the compendium.	Health Environment	National; community Universal health coverage	Information, education and communication

Selected tools
WHO/Secretariat of the Convention on Biological Diversity/UNEP 2015: *Connecting global priorities: biodiversity and human health: a state of knowledge review (2)* This review synthesizes the available information on the most important interlinkages between biodiversity, ecosystem stability, nutritional diversity and health.
Convention on Biological Diversity 2013: *Quick guides for the Aichi Biodiversity targets (6)* provides resources, tools and indicators for each target.
Hesselink et al. 2007: The Communication, Education and Public Awareness (CEPA) programme of the Convention on Biological Diversity provides a toolkit for national focal points and coordinators of NBSAPs *(12)*.

Selected tools
The Economics of Ecosystems and Biodiversity (TEEB) provides guidance to policy-makers for mainstreaming the values of biodiversity and ecosystem services into decision-making at all levels *(13)*.
UNEP 2012: *Global environment outlook 5 (14)*
UNEP 2019 *Global environment outlook 6 (15)*
Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) 2019: *Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (3)*
WHO 2020: *Guidance on mainstreaming biodiversity for nutrition and health (8)*

8.2 Vector control



Overview

Vector-borne diseases are human illnesses caused by parasites, viruses and bacteria that are transmitted by vectors. In most, but not all, cases the vector is a female mosquito in search of a blood meal. Vector-borne diseases account for more than 17% of all infectious diseases and cause more than 700 000 deaths annually *(16)*. They comprise a range of diseases such as malaria, dengue, Chagas disease, human African trypanosomiasis and leishmaniasis.

Diversity, composition and abundance of vector populations are closely linked to local climate and ecosystems. Changes to environmental factors and systems such as through climate change but also management and use of land, clearing of forests, mining and other extraction industries, large-scale construction and development projects, urban and peri-urban development, water resources and solid waste management may influence vector abundance and distribution *(17)*.

The table below lists some major vectors and the diseases they transmit *(16)*.

Vector	Disease(s)
Mosquitoes	Malaria, dengue, lymphatic filariasis, Japanese encephalitis, Mayaro virus disease, yellow fever, Chikungunya, West Nile fever, Zika virus disease and Rift Valley fever, Oropouche virus disease (mosquitoes and midges)
Sandflies	Leishmaniasis
Tsetse flies	Human African trypanosomiasis
Blackflies	Onchocerciasis
Triatomine bugs	Chagas disease
Ticks	Tick-borne encephalitis
Aquatic snails	Schistosomiasis

Vector-borne diseases are mainly prevented through vector control. Vector control includes both chemical insecticide-based methods and non-chemical methods (see the following section on integrated vector management).

WHO response to vector control: integrated vector management

The WHO *Global vector control response 2017–2030 (17)* provides strategic guidance to countries and development partners for urgent strengthening of vector control as a fundamental approach to preventing disease and responding to outbreaks. It requires a re-alignment of vector control programmes, supported by increased technical capacity, improved infrastructure, strengthened monitoring and surveillance systems, and greater community mobilization.

The global vector control response builds on the basic concept of integrated vector management (IVM) with renewed focus on improved human capacity at national and subnational levels and for strengthened infrastructure and systems.

IVM, a rational decision-making process to optimize the use of resources for vector control, was presented in 2004 in a WHO global strategic framework, and subsequently in other supporting documents *(18, 19)*. IVM is a management approach that improves the efficacy, cost–effectiveness, ecological soundness and sustainability of vector control interventions with available tools and resources. One of the key elements of an integrated approach to disease vector control is the integration or combination of different, often chemical and non-chemical vector control methods against multiple vector-borne diseases.

Chemical vector control methods include use of insecticide-treated nets, indoor residual spraying, outdoor spraying and other methods such as adding chemicals to water bodies and use of insect repellents. Concerns with insecticide resistance and environmental toxicity have increased the need for alternatives and, where feasible, more environmentally-sound approaches *(20)*.

Non-chemical methods include biological and other methods and environmental management. Biological methods include the utilization of natural enemies of the vector and biological toxoids. Housing improvements can also facilitate vector control, although in many cases these also deploy an insecticide, for example on insect screens *(20)*.

Environmental management seeks to change the environment in order to prevent or minimize vector propagation and human contact with the vector-pathogen by destroying, altering, removing or recycling non-essential containers that provide larval habitats. It comprises the planning, organization, carrying out and monitoring of activities for the modification and/or manipulation of environmental factors or their interaction with humans for preventing or minimizing vector propagation and reducing human-vector-pathogen contact *(21)*.

Three types of environmental management exist.

1. Environmental modification – long lasting physical transformations to reduce vector larval habitat.
2. Environmental manipulation – temporary changes to vector habitats.
3. Changes to human habitation or behaviours – actions to reduce human-vector contact. It includes for example reduction of vector breeding habitats, use of PPE and housing alterations *(20, 22)*.

How prevalent are vector-borne diseases in my country?

National reporting systems may capture statistics on different vector-borne diseases. As part of SDG Target 3.3 – by 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases – SDG 3 indicators also monitor the occurrence of vector-borne diseases at national level:

- SDG indicator 3.3.3: Malaria incidence per 1,000 population
- SDG indicator 3.3.5: Number of people requiring interventions against neglected tropical diseases.

In addition, the WHO Global Health Estimates provide a comprehensive and comparable assessment of death and disability due to diseases and injuries for all WHO Member States and all WHO regions of the world *(23)*.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
General: policies and actions			
The Seventieth World Health Assembly resolution WHA70.16 and WHO report *Global vector control response 2017–2030 (17)* promote effective, locally adapted and sustainable vector control by: • strengthening of inter- and intra-sectoral collaboration • engaging and mobilizing communities • enhancing vector surveillance, and monitoring and evaluation of interventions • scaling up and integrating tools and approaches.			
1. Develop or update national and regional vector control policies and action plans in line with the WHO global vector control response strategy *(17)*. Priority activities include the following. • Conduct/update national vector control needs assessment and develop resource mobilization plan (including for outbreak response). • Appraise and enhance national entomology and cross-sectoral workforce to meet identified requirements for vector control. • Train relevant staff from ministries of health and/or their supporting institutions in public health entomology. • Establish national and regional institutional networks to support training/education in public health entomology and technical support. • Establish/review progress of national agenda for basic and applied research on entomology and vector control. • Establish national inter-ministerial task force for multisectoral engagement in vector control. • Develop national plan for effective community engagement and mobilization in vector control. • Strengthen national vector surveillance systems and integrate them with health information systems to guide vector control. • Align national targets for protection of at-risk population with appropriate vector control across vector-borne diseases.	Health Environment Education Housing Waste Water/sanitation Research Other sectors	National	Regulation
2. Strengthen inter- and intra-sectoral action and collaboration on vector control *(17)*. • Re-align programmes so that staff are equipped to address multiple vectors and diseases and integrate efforts for greater efficiency and effectiveness. • Broaden collaborations within and beyond the health sector.	Health Environment Education Housing Waste Water/sanitation Other sectors	National	Governance
3. Enhance vector surveillance, and monitoring and evaluation of interventions *(17)*. • Strengthen and integrate national surveillance systems for vectors, interventions and diseases. • Coordinate surveillance and action between neighbouring countries.	Health Education	National; community Universal health coverage	Assessment and surveillance

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
4. Scale up and integrate tools and approaches for vector control *(17)*. • Ensure vector control methods are selected and combined appropriate to the local setting. • Integrate innovations as recommended by WHO.	Health Research	National; community Universal health coverage	Other management and control
5. Combine different vector control methods and interventions and integrate vector control efforts for different vectors and diseases in an appropriate and evidence-based way *(20), (17)*. Vector control strategies need to be adapted to and appropriate for the local context. Aspects of effectiveness, human and environmental safety, risk for development of resistance, affordability, community participation and policy and logistic support need to be considered when choosing vector control methods.	Health	National; community Universal health coverage	Other management and control
6. Support improved water resource, wastewater and solid waste management for improved control of many disease vectors *(24), (17)*.	Health Water/sanitation Education Waste Environment	National; community Universal health coverage	Infrastructure, technology and built environment
Awareness raising and capacity building			
7. Educate the community, community health workers and community leaders and raise awareness about the linkages between vector occurrence and disease prevalence, transmission mechanisms and ways of avoiding exposure *(20), (17)*. Strengthening capacity in the community should consider special training requirements of, for example, community health workers and agricultural extension workers.	Health Other sectors	National; community Universal health coverage	Information, education and communication
8. Engage and mobilize the community in vector control efforts for achieving greater coverage and sustainability and thereby effectiveness of vector control *(17)*. Enable communities to lead and sustain vector control activities, such as eliminating vector habitats from their environment and improving housing.	Health	Community Universal health coverage	Information, education and communication

Note: The examples below summarize recommendations on malaria and dengue, which are two major vector-borne diseases.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Malaria			
The two core interventions for malaria vector control recommended by WHO are insecticide-treated nets and indoor residual spraying. One of these core interventions should be chosen and supplied to the entire population at risk for malaria. In specific settings, and under special circumstances, these core interventions can be supplemented by larviciding (conditional recommendation) or other forms of larval source management (no recommendation). As yet there is no evidence for the public health value for deployment of personal protection measures such as repellents and clothing (conditional recommendation against deployment of topical repellents and insecticide-treated clothing as interventions with public health value), however topical repellents and insecticide-treated clothing may provide personal protection against malaria. Due to limited evidence no recommendation is given on the non-chemical methods for malaria vector control listed below. They should only be applied supplementary to (one of) the core interventions. Space spraying against malaria should be strongly discouraged given the limited evidence of the intervention's effectiveness and the potential for wastage of resources *(23)*.			
9. Support larval source management as supplementary interventions for mosquito reduction. Larval source management as a supplementary intervention for malaria vector control includes environmental management such as habitat modification and manipulation, larviciding and biological controls. In general and where feasible, environmental management (habitat modification and manipulation) should be the primary strategy to reduce the availability of larval habitats. However, no systematic reviews have so far been conducted to inform the development of WHO guidance in this area *(23)*. This may include the management of wetlands and drains and management of irrigation *(20)*.	Health	National; community Universal health coverage	Other management and control
10. Support housing improvements as potential additional measures to reduce the transmission of malaria and other vector-borne diseases *(23)*. Available evidence indicates that poor-quality housing and neglected peri-domestic environments are risk factors for the transmission of malaria and other vector-borne diseases. However, specific evidence-based recommendations on housing and vector-borne diseases are still needed. The evidence base for housing improvement as an approach for malaria prevention and control is currently under review.	Housing Construction Health	National; community Universal health coverage	Infrastructure, technology and built environment

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Dengue			
Dengue mosquito control will reduce dengue, particularly when targeting *Aedes aegypti* in urban habitats, though a sustainable tool to do so is lacking. Novel delivery methods have been developed to control *Aedes* vector populations using residual killing agents, including targeted indoor residual spraying, which shows promise for reducing dengue. Adulticiding for dengue prevention is most effective when it is conducted as part of an IVM plan that includes source reduction and larviciding. Successful dengue prevention programmes include a combination of tools and strategies that are applied with enhanced intersectoral and interdisciplinary cooperation and strong community engagement.			
11. Implement environmental management (source reduction) measures as the main pillar of dengue vector control *(25)*. Environmental management measures for dengue vector control include the following. • Environmental modification such as installation of reliable piped water on premises. • Environmental manipulation such as frequent emptying, cleaning or mosquito-proof covering of water containers, removal or filling of non-essential water containers, improved solid waste management, and screening of construction sites, open drains, and water bodies with stagnant water. • Changes to human habitation and behaviour such as installing mosquito screens on windows, doors and other entry points. • Perifocal treatment of larval habitats and peripheral mosquito resting surfaces or targeted residual spraying in homes and other settings such as schools and workplaces as part of an integrated dengue vector management programme.	Health Other sectors	National; community Universal health coverage	Other management and control

Selected tools
WHO 2019: *Guidelines for malaria vector control (23)*
WHO 2017: *Global vector control response 2017–2030 (17)*
WHO 2017: *Framework for a national vector control needs assessment (26)*
WHO 2016: *A toolkit for integrated vector management in sub-Saharan Africa (19)*
WHO 2016: *Technical handbook for dengue surveillance, dengue outbreak prediction/detection and outbreak response (27)*
WHO 2013: *Larval source management (28)* This report is an operational manual on larval source management.
WHO 2012: *Handbook for integrated vector management (20)*
WHO 2012: *Core structure for training curricula on integrated vector management (29)* provides guidance on training on IVM.
WHO 2011: *Operational guide for assessing the productivity of* Aedes aegypti *breeding sites (30)*

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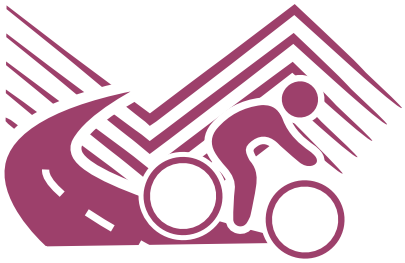
9. Safe environments and mobility

9.1 Introduction

Sustainable transport and mobility systems in this section refer to systems that are multi-modal which support walking, cycling, other forms of active transport and mobility (e.g. such as skating, wheelchairs), as well as public transport in addition to private vehicles.

Interventions towards sustainable transport and mobility systems are aimed at reducing road traffic fatalities and injuries while at the same time improving people's health and well-being, protecting the environment and address climate change. They often have broad impacts, and would therefore be relevant for other sections of this compendium as well.

9.2 Environments for safe and sustainable transport, active mobility and physical activity



Overview

Systems of mobility that include public transport and infrastructure for cycling and walking can contribute to increasing levels of physical activity. The positive health effects of regular physical activity include improved muscular and cardiorespiratory fitness, improved bone and functional health, reduced risk for NCDs such as cardiovascular diseases, cancer and diabetes, and falls and fractures and weight control *(1)*. Regular physical activity also improves mental and cognitive health and is recommended for people of all ages and abilities. Encouraging and enabling regular physical activity requires adequate provision of, and equitable access to supportive environments that encourage participation in walking, cycling, sports, active recreation and play by people of all abilities *(2, 3)*.

Transport can also affect health and health equity by enabling and facilitating access to education, decent jobs, health care, leisure and clean water. Road infrastructure and urban design can have an impact on social interaction within neighbourhoods while also discouraging motorized transport and slowing the impact of climate change *(4)*.

Road traffic accidents kill 1.3 million people per year (2019 data); pedestrians, cyclists and motorcyclists in low- and middle-income countries are disproportionally affected *(5, 6)*. More cycling and walking tends to lead to fewer road traffic accidents as motorists become sensitized to the presence of non-motorized traffic and to sharing the road *(7)*. Increased road safety and the provision of public and green spaces can enable and motivate people to walk and cycle more, especially for short trips. Less motorized traffic also reduces air pollution, noise and carbon emissions.

As the majority of the world population is living in urban areas, cities have a particular responsibility and opportunity for improving urban design and transport systems to retain and support increasing levels of walking and cycling. Affordable and accessible transport systems and sustainable community infrastructure development are however equally relevant for peri-urban and rural areas *(4)*.

How do we assess safe environments for, and levels of, physical activity in my country?

For country assessment of population levels of physical activity in adults, the WHO STEPS approach includes the Global Physical Activity Questionnaire. This collects data on physical activity undertaken across three domains in the past week: for transport (which is defined as walking and cycling; at work (paid and unpaid/around the home) and for recreation, leisure or sport. The Global Physical Activity Questionnaire provides measures of the prevalence of walking and cycling and time spent walking and cycling in the past week.

Countries may have their own similar health surveillance system with questions on physical activity, however these do not always separate out a measure of walking and cycling from total physical activity or may not include walking and cycling for transport. For example, some countries assess "sports participation" only.

For children there are school-based instruments that collect data on physical activity, and these can also include questions on travel to/from school by walking and cycling. The global school-based student health survey and the health behaviour in school-aged children survey are two widely used instruments and protocols.

Personal transportation surveys, usually conducted by ministries of transport or similar agencies, can also collect data on walking and cycling trips. These questions and data reporting vary between countries and there is no global standardized reporting available yet. Nonetheless, usually data are presented as the proportion of trips by mode that can be tracked over time and assessed by setting (urban, rural) and by categories of trip length.

Urban design for safe walking and cycling can be assessed using the road safety assessments and criteria set for roads achieving at least a 3 star rating (of a 5-star maximum) *(8)* for each road user (i.e. for pedestrians, cyclists and users of public transit). New roads and urban infrastructure can be assessed during the development plan approval process. Both approaches are recommended as part of the Decade of Action on Road Safety 2011–2020, the Global Action Plan on Physical Activity 2018–2030 and the WHO ACTIVE technical guidance toolkit to increase physical activity *(2, 3)*.

At the global level, countries can monitor their progress towards key SDGs to which active mobility and physical activity contribute *(9)*. These include the following.

SDG 3: Ensure healthy lives and promote well-being for all at all ages.
- Indicator 3.4.1: Mortality rate attributed to cardiovascular disease, cancer, diabetes or chronic respiratory disease.
- Indicator 3.6.1: Death rate due to road traffic injuries.

SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable.
- Indicator 11.2.1: Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities.
- Indicator 11.7.1: Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities.

Other SDGs that are directly or indirectly transport-related include SDG 2 "End hunger, achieve food security and improved nutrition and promote sustainable agriculture", SDG 7 "Ensure access to affordable, reliable, sustainable and modern energy for all", SDG 9 "Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation", SDG 12 "Ensure sustainable consumption and production patterns" and SDG 13 "Take urgent action to combat climate change and its impacts". In addition, SDG indicator 3.9.1 monitors air pollution.

What do we want to achieve?

Shift more passenger and freight travel to more environmentally friendly modes (e.g. walking, cycling and clean public and freight transport) together with improvements in the energy efficiency of all motorized transport modes (private and public) through low carbon fuel and vehicle technologies *(10)*.

Reduce passenger trips and freight movement by motorized transport modes through urban and regional development policies, integrated transport and spatial planning and travel demand management *(11, 12)*.

Investments in strengthening transport and mobility systems that take into consideration underlying social and environmental determinants of health can also help to ensure equitable access to mobility and reduce disparities. For instance, improved mobility for women, children, older people and the poor also enhances health equity *(10), (11, 12), (7)*.

People of all ages and abilities need to have equitable access to safe and appropriate places and spaces in their cities and communities in which they can engage in regular physical activity. In addition, people need to know and understand the multiple benefits of regular physical activity which can be achieved through regular community-wide campaigns and education *(2)*.

WHO recommends that all children and adolescents achieve at least 60 minutes of moderate to vigorous-intensity physical activity daily. Adults should do at least 150 minutes of moderate-intensity physical activity or do at least 75 minutes of vigorous-intensity physical activity throughout the week. More detailed recommendations on physical activity are provided in the *Global recommendations on physical activity for health (13)*.

Road traffic crashes and road injuries and fatalities can be reduced for example through developing, implementing and enforcing a safe systems approach which places the focus on the design of the system rather than on road user behaviour. Special attention needs to be paid to how systems that are poorly designed put road users such as walkers and cyclists in positions of vulnerability and the ways in which they can be amended *(14)*.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Governance: policies and actions			
1. Strengthen and support implementation of the HiAP approach at the national and subnational level *(2, 15, 16)* (See also section 12.2 Health in All Policies).	Health Other sectors such as education, land use planning, finance, transport for all governance actions	National	Governance
2. Build partnerships between the health sector and other relevant sectors such as transport and urban planning *(2, 16)*.	Health Transport Other sectors	National	Governance

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
3. Support the effective engagement and direct participation of communities in planning and policy development *(2, 16)*.	Health Other sectors	Community; national Universal health coverage	Governance
4. Conduct health, economic and environmental assessments of future and existing policies and interventions *(2, 16, 17)*.	Health Environment Finance Other sectors	National; community Universal health coverage	Assessment and surveillance
Road safety: policies and actions			
5. Develop or update national strategies, policies and actions to improve road safety, especially safety of pedestrians and cyclists and other vulnerable groups such as children and older people *(2) (14)*.	Transport Health Other sectors such as education, land use planning, finance, environment	National	Regulation
6. Establish a lead agency on road safety *(14)*.	Transport Health	National	Governance
7. Monitor road traffic deaths, injuries and crashes, risks such as alcohol or drug intake of drivers and protective factors such as average speed, helmet- and seat-belt-wearing rates and use of child restraint systems *(14)*.	Transport Health	National; community Universal health coverage	Assessment and surveillance
8. Implement interventions for improving road safety with particular focus on pedestrians and cyclists *(2, 7, 18)*. Selected key interventions include the following. • Provide sidewalks and dedicated cycle lanes to separate pedestrians and cyclists from motor traffic. • Provide crossing enhancements for pedestrians and cyclists. • Improve walking and cycling infrastructure around educational facilities, public open and green spaces, sports and leisure facilities and public transport hubs. • Implement and enforce traffic speed limits and other traffic calming interventions such as road-narrowing measures. • Implement regulations to redistribute the impact of motorized vehicles such as car-free zones, identify hazardous road locations and take corrective measures accordingly. These engineering interventions need to be accompanied by education and enforcement of for example traffic laws and vehicle safety standards.	Transport Health	National; community Universal health coverage	Infrastructure, technology and built environment; other management and control

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Infrastructure development, transport and mobility: policies and actions			
9. Develop or update policies that promote walking, cycling and non-motorized transport policies and actions and set time-bound targets *(2, 3, 12)*.	Transport Land use planning	National; community	Governance
10. Prioritize active and sustainable mobility as preferred mode of travel in relevant transport, spatial and urban planning policies *(2, 12)*.	Transport Land use planning	National; community	Governance
11. Ensure integrated transport and urban planning policies that deliver highly connected, mixed-use and compact neighbourhoods that promote and prioritize active mobility *(2, 4, 10)*. This includes street design and urban development regulations that promote neighbourhoods that offer pedestrian and bicycle access to shops, retail and services, green areas and educational facilities.	Transport Land use planning Other sectors such as health environment finance labour education	National; community	Governance
12. Ensure provision of walking and cycling infrastructure on all streets designed for use by pedestrians and cyclists according to best practice street design standards and guidelines *(2)*. Walking and cycling infrastructure should comply with the following core principles *(7)*. • It should be **safe** and perceived as such under all weather conditions, day and night. • It should be **accessible**, forming an uninterrupted network that is linked with public transport services. • It should be **convenient**, to allow direct and well-signalled access to homes, shops and workplaces as well as schools, recreation and leisure locations. • It should be **comfortable**, to cater to all users, including children and older people. • It should be **attractive**, in terms of cleanliness, noise and quality of infrastructure offering pleasant surroundings and well-functioning bicycle parking facilities.	Transport Land use planning	National; community	Infrastructure, technology and built environment
13. Redistribute space from private motorized transport to support active and more sustainable modes of transport *(2)*.	Transport Land use planning	National; community	Infrastructure, technology and built environment
14. Restrict car parking options for private vehicles to provide more public open and green spaces *(2, 4)*.	Transport Land use planning	National; community	Infrastructure, technology and built environment
15. Implement proactive urban planning policies, building design and crime prevention strategies to increase access to and use of green infrastructure and safe public spaces, and to increase active and sustainable mobility *(4, 12, 19)*.	Transport Land use planning Housing Construction	National; community	Infrastructure, technology and built environment

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
16. Ensure access to good-quality public and green open spaces for people of all ages and abilities including safe play areas and sports and recreational spaces for children and young people *(2, 19)*.	Land use planning	National; community	Infrastructure, technology and built environment
17. Support people to be physically active through appropriate building design and standards, particularly for all public buildings and education and day-care facilities *(2)*. Selected proposed actions include: • ensuring prioritized building access by pedestrians, cyclists and public transport; • providing clean, accessible and safe stairways; • providing access to public open space; • limiting car parking options; • ensuring adequate provision of end-of-trip facilities, such as secure bicycle parking, locker facilities and showers and change rooms.	Building Construction	National; community	Infrastructure, technology and built environment
18. Promote walking and cycling through free and accessible public events that foster use of active mobility and green spaces such as by regular closure of road networks to motorized vehicles and walk/cycle to school/work programmes *(2, 3)*.	Health Environment Land use planning	Community Universal health coverage	Other management and control
19. Conduct economic assessments of walking and cycling infrastructure and all developments using HEAT *(17)*.	Health Environment Finance Other sectors	National; community Universal health coverage	Assessment and surveillance
Awareness raising and capacity building			
20. Conduct public campaigns to increase safe behaviours of road users, such as increased use of seat-belts and helmet wearing, and to reduce risky behaviours such as speeding, drink-driving and the use of mobile devices *(2, 7, 18)*.	Health Transport	Community; national Universal health coverage	Information, education and communication
21. Raise awareness for the health benefits and the social, economic and environmental co-benefits of increased walking, cycling and other forms of active mobility *(2, 17)*.	Health Environment	Community; national Universal health coverage	Information, education and communication
22. Train professionals from different sectors such as health, education, transport and urban planning on the health, social, economic and environmental co-benefits of physical activity, and particularly of more walking, cycling and other forms of active mobility *(2)*.	Health Environment	Community; National Universal health coverage	Information, education and communication
23. Conduct community surveys on perceptions of road safety and walking and cycling to raise awareness of potential obstacles and promote community discussion to determine solutions *(3)*.	Health Environment	Community; national Universal health coverage	Information, education and communication

Selected tools
WHO 2021: Walking and cycling – a toolkit of policy recommendations *(3)*
WHO Regional Office for Europe 2020: *Moving around during the COVID-19 outbreak (20)*
WHO 2020: Urban health initiative: guidance and tools *(16)*
UN-Habitat 2020: Integrating health in urban and territorial planning: sourcebook for urban leaders, health and planning professionals *(12)*
WHO 2020: *WHO manifesto for a healthy recovery from COVID-19 (21)*
WHO Regional Office for Europe 2019: *Health Economic Assessment Tool (HEAT) for walking and cycling (17)* The use of HEAT is recommended to support economic assessment of investment in walking and cycling networks and new infrastructure.
WHO 2018: *Global action plan on physical activity 2018–2030: more active people for a healthier world (2)* This plan recommends national policy actions and roles for various stakeholders in its Appendix 2.
WHO 2018: *ACTIVE: a technical package for increasing physical activity (22)*
WHO/Finland Ministry of Social Affairs and Health 2014: *Health in all policies: Helsinki statement. Framework for country action (15)* This document serves as a "starter's kit" for applying HiAP in decision-making and implementation at national and subnational levels. It can be easily adapted for use in different country contexts and at regional and global levels.
WHO 2013: *Pedestrian safety: a road safety manual for decision-makers and practitioners (18)*
Dora et al. 2011: *Urban transport and health. Sustainable transport: a sourcebook for policy makers in developing countries (4)*
WHO 2011: *Health in the green economy. Health co-benefits of climate change mitigation – transport sector (10)*

9.3 Safe environments to prevent drownings, falls and burns

9.3.1 Drownings

Overview

Drowning is a leading cause of unintentional injury and deaths worldwide and about 90% of unintentional drowning deaths occur in low- and middle-income countries *(6, 23)*. In 2019, an estimated 236 000 people died from drowning, making drowning a major public health problem worldwide *(6)*. Children are at increased risk of drowning and 35% of drowning deaths occurred in children aged under 15 years.

How prevalent are drownings in my country?

National reporting systems may capture statistics on drownings and other injuries.

Injury surveillance guidelines are available to assess data on injuries *(24)*.

In addition, the WHO Global Health Estimates provide a comprehensive and comparable assessment of death and disability due to diseases and injuries for all WHO Member States and all WHO regions of the world *(25)*.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Policies and actions			
1. Develop or update water safety policies. Among these are safe boating, shipping and ferry regulations, which may include *(26, 27)*: • establishing systems that ensure vessel safety, availability of flotation devices in boats, avoidance of overcrowding, and appropriate travel routes and rules; • laws on alcohol and drug use while boating or swimming; • occupational safety measures, such as the wearing of personal flotation devices and guard-rails, for example on commercial fishing vessels. Other water safety policies may include signage and barriers for high-risk locations, risk assessments for recreational water settings (see section 3.2.2 Recreational water) and water safety lessons for schools.	Transport Other sectors such as health education migration land use planning construction	National	Regulation

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
2. Develop or update national water safety plans (WSPs) to build resilience and manage flood risks and other hazards *(26, 27)*.	Water/sanitation Environment	National	Regulation
3. Provide safe places away from water for preschool children, including (the journey to) schools, child-care settings and recreation and leisure settings *(27)*.	Education	Schools/child-care settings	Infrastructure, technology and built environment
4. Support safe water systems, such as drainage systems and flood control *(26)*.	Water/sanitation Environment	National; community	Infrastructure, technology and built environment
5. Install barriers or fencing that control access to water, such as lids or mesh covers for open wells, playpens, doorway barriers and pool fencing in the form of four-sided, child-resistant fences and self-closing gates with safety latches *(27)*.	Housing Construction	National; community	Infrastructure, technology and built environment
6. Create and maintain safe water zones for recreation *(26)*.	Land use planning	National; community	Infrastructure, technology and built environment
7. Establish supervised child-care programmes *(26)*.	Education	Schools/child-care settings	Other management and control
Awareness-raising and capacity building			
8. Raise awareness of drowning to highlight the particular risks of children, as well as to signpost dangerous areas and pre-position rescue equipment *(26)*.	Health Environment	Community; national Universal health coverage	Information, education and communication
9. Implement individual and community education programmes on drowning risks and safety regulations *(26)*.	Health Education	Community; national Universal health coverage	Information, education and communication
10. Implement training on basic swimming and water safety skills for school-age children *(27)*.	Education	Community; national	Information, education and communication
11. Train the public in safe rescue and resuscitation *(26)*.	Education Health	Community; national Universal health coverage	Information, education and communication
12. Raise awareness about the importance of emptying or covering standing water and containers such as wells, tanks, cisterns and baths *(26)*.	Health	Community; national Universal health coverage	Information, education and communication

Selected tools
WHO 2017: *Preventing drowning: an implementation guide (27)* includes a situational assessment tool.
WHO/CDC 2001: *Injury surveillance guidelines (24)* Guidelines to assess data on injuries that will help to develop effective prevention strategies in countries.

9.3.2 Falls

Overview

Falls are the second leading cause of accidental or unintentional injury or deaths worldwide. Each year an estimated 684 000 individuals die from falls globally, the majority of which occur in low- and middle-income countries *(6)* (2019 data). Environmental risk factors for falls include aspects of the built environment such as poor building design, slippery floors and stairs and insufficient lighting *(28)*.

How prevalent are falls in my country?

National reporting systems may capture statistics on falls and other injuries.

Injury surveillance guidelines are available to assess data on injuries *(24)*.

In addition, the WHO Global Health Estimates provide a comprehensive and comparable assessment of death and disability due to diseases and injuries for all WHO Member States and all WHO regions of the world *(25)*.

While all people who fall are at risk of injury, the age, sex and health of the individual can affect the type and severity of injury. Children and adults older than 65 years of age are among the high-risk groups, while the latter have the highest risk of death or serious injury arising from a fall, with the risk increasing with age *(28)*.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Policies and actions			
1. Develop or update housing standards and building regulations *(29)*.	Housing Construction Health	National	Regulation

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
2. Develop or update playground standards, such as for the depth of appropriate surface material, height of equipment and periodic maintenance *(30)*.	Construction Health Education	National	Regulation
3. Promote policies requiring protective equipment such as helmets during certain sports and leisure activities *(30)*.	Health Education Sports and leisure	National	Regulation
4. Assess and improve safety, if needed, of sports and recreational equipment *(29)*.	Industry Health	National	Assessment and surveillance; infrastructure, technology and built environment
5. Support the installation of window guards, bars and child-proof locks for windows in high-rise blocks, stair guards or gates, grab rails, lockable access to balconies and hazard removal *(29, 30)*.	Housing Construction	National; community	Infrastructure, technology and built environment
6. Consider implementing home visits, assessment of home furniture and environmental modification for people with children or those at an older age/with known risk factors or a history of falling, including stair gates and guard rails *(28-30)*.	Health	National; community Universal health coverage	Assessment and surveillance; infrastructure, technology and built environment
7. Promote physical activity to prevent falls *(2)*. More guidance to promote physical activity especially though increased levels of walking and cycling is listed in section 9.2 Environments for safe and sustainable transport, active mobility and physical activity.	Health	National; Community Universal health coverage	
Awareness raising and capacity building			
8. Raise awareness about risks of falls, high-risk groups (children and older people) and available interventions (such as installation of window guards and grab rails, balcony risk and protection, promotion of physical activity, and hazard removal) *(28, 29)*.	Health Housing Construction	Community; national Universal health coverage	Information, education and communication
9. Give parents information about child fall risks and support them to reduce these risks around the home *(30)*.	Health	Community; national Universal health coverage	Information, education and communication

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
10. Provide parenting programmes for low-income and other marginalized families *(30)*.	Health Education Social welfare and family	Community; national	Information, education and communication
11. Provide school-based teaching of martial arts-based fall techniques and exercises *(30)*.	Education	Community; national	Information, education and communication
12. Make available gait, balance and functional training and Tai Chi classes, the latter particularly to older people *(30)*.	Health Sports and leisure	Community; national Universal health coverage	Information, education and communication

Selected tools
WHO 2012: TEACH-VIP 2 users' manual: the second iteration of Training, Educating and Advancing Collaboration in Health on Violence and Injury Prevention *(31)* This is a comprehensive injury prevention and control curriculum that has been developed through the efforts of WHO and a network of global injury prevention experts.
WHO/CDC 2001: *Injury surveillance guidelines (24)* Guidelines to assess data on injuries that will help to develop effective prevention strategies in countries.
WHO 2018: *Global action plan on physical activity 2018–2030: more active people for a healthier world (2)*

9.3.3 Burns

Overview

An estimated 114 000 deaths every year are caused by burns *(6)* (2019 data), the vast majority of which occur in low- and middle-income countries. Non-fatal burn injuries are a leading cause of morbidity, including prolonged hospitalization, disfigurement and disability, often with resulting stigma and rejection *(32)*.

Burns are preventable and occur mainly in the home and workplace. Women and children are particularly vulnerable to burns, with burns being the fifth most common cause of non-fatal childhood injuries *(32)*. Furthermore, burn victims are often among the poorest and most vulnerable population groups, especially in low- and middle-income countries *(33)*.

How prevalent are burns in my country?

National reporting systems may capture statistics on burns and other injuries.

Injury surveillance guidelines are available to assess data on injuries *(24)*.

In addition, the WHO Global Health Estimates provide a comprehensive and comparable assessment of death and disability due to diseases and injuries for all WHO Member States and all WHO regions of the world *(25)*.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Policies and actions			
1. Develop or update policies on burn prevention, to cover for example the following points *(33)*. • The placement of smoke alarms in all buildings. • Setting and enforcing regulations requiring fire-activated sprinklers in residential and non-residential buildings. • A set temperature of hot water for the prevention of scald burns. • The safety of cook-stoves in the domestic environment. • Child resistant lighters and flame-retardant fabrics.	Health Housing Other sectors	National	Regulation
2. Develop or update safety regulations to housing design and materials, including fire and electrical codes; develop or update industrial safety regulations (e.g. for products used in homes and other buildings such as schools, child-care settings and recreational facilities) *(29, 32, 33)*.	Housing Industry Health Other sectors	National	Regulation
3. Increase safety of construction materials, heating and lighting equipment at homes and public buildings such as schools, child-care settings and recreational facilities, and household materials such as upholstered furniture and mattresses *(29)*.	Housing Industry	National; community	Infrastructure, technology and built environment

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Awareness raising and capacity building			
4. Raise awareness on risks of burning and preventive interventions, especially for parents, and provide fire safety education programmes and training of communities in first aid *(33)*.	Health Education	Community; national Universal health coverage	Information, education and communication
5. Discourage storage of flammable substances at home, schools and child-care settings, and promote the use of safe lamps and cook-stoves *(29)*.	Environment Health	Community; national Universal health coverage	Information, education and communication
6. Promote safer cooking practices in the domestic environment by enclosing fires and using safer cook-stoves. This may include installing cook-stove guards, and by separating cooking from living areas *(29, 33)*.	Health Housing	Community; national Universal health coverage	Information, education and communication

Selected tools
WHO 2012: TEACH-VIP 2 users' manual: the second iteration of Training, Educating and Advancing Collaboration in Health on Violence and Injury Prevention *(31)* This is a comprehensive injury prevention and control curriculum that has been developed through the efforts of WHO and a network of global injury prevention experts.
WHO/CDC 2001: *Injury surveillance guidelines (24)* Guidelines to assess data on injuries that will help to develop effective prevention strategies in countries.
WHO 2020: Global Burn Registry *(34)* This Registry is based upon a standardized data collection form developed by WHO and a global network of experts. Its aim is an improved, standardized and global data collection system of burns.

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10. Safe and healthy food

10.1 Food safety and the environment

A safe food supply contributes to food and nutrition security and supports national economies, trade and tourism, stimulating sustainable development *(1)*. This includes proper food preparation, which can prevent a large share of foodborne diseases. Different governmental departments and agencies, encompassing public health, agriculture, education and trade, need to collaborate and communicate with each other and engage with civil society, including consumer groups, to ensure a safe food supply.

This section only covers aspects of food safety related to the environment, such as household and community hygiene practices and the use of wastewater, excreta and greywater in agriculture.

Overview

Access to sufficient amounts of safe and nutritious food is key to sustaining life and promoting good health. Safe food is not contaminated with potentially harmful bacteria, parasites, viruses, toxins, chemicals and/or radionuclides. However, food can become contaminated at any point of production and distribution. A large proportion of foodborne disease incidents are caused by foods improperly or unhygienically prepared or mishandled at home, in food service establishments or markets.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Food safety in households and the community: awareness raising and capacity building			
1. Promote safe food handling behaviours among all consumers and food handlers *(2)*. Key messages include the following. **Keep clean** • Wash hands before handling food and often during food preparation. • Wash hands after going to the toilet. • Wash and sanitize all surfaces and equipment used for food preparation. • Protect kitchen areas and food from insects, pests and other animals. **Separate raw and cooked** • Separate raw meat, poultry and seafood from other foods. • Use separate equipment and utensils, such as knives and cutting-boards, for handling raw foods. • Store food in containers to avoid contact between raw and prepared foods. **Cook thoroughly** • Cook food thoroughly, especially meat, poultry, eggs and seafood. • Bring foods like soups and stews to boiling to make sure that they have reached 70°C. For meat and poultry, make sure that juices are clear, not pink. Ideally, use a thermometer to ensure proper temperature. • Reheat cooked food thoroughly. **Keep food at safe temperatures** • Do not leave cooked food at room temperature for more than 2 hours. • Refrigerate promptly all cooked and perishable food (preferably below 5°C). • Keep cooked food piping hot (more than 60°C) prior to serving. • Do not store food too long even in the refrigerator. • Do not thaw frozen food at room temperature. **Use safe water and raw materials** • Use safe water or treat it to make it safe. • Select fresh and wholesome foods. • Choose foods processed for safety, such as pasteurized milk. • Wash fruits and vegetables, especially if eaten raw. • Do not use food beyond its expiry date.	Health Agro-food	Community; workplace Universal health coverage	Information, education and communication

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
2. Promote growing safer fruits and vegetables *(3)*. Key messages include the following. **Practise good personal hygiene** • Wash and dry hands with a clean, dry towel after toilet use, diapering a child and contact with animals. • Change clothes and bathe regularly. • Cover cuts, lesions and wounds. • Use a toilet or latrine to urinate or defecate. **Protect fields from animal faecal contamination** • Keep animals from roaming in a growing field. • House livestock downhill from growing fields in a fenced area. • Remove trash from in and around growing fields. **Use treated faecal waste** • Use faecal waste (manure and human excreta) that is properly treated. • Apply treated faecal waste to fields prior to planting. • Maximize the time between the application of treated faecal waste and harvest. **Evaluate and manage risks from irrigation water** • Identify all water sources relevant to the growing field. • Be aware of the risk of microbial contamination of water. • Protect water from faecal contamination. • Apply control measures when using contaminated water or water of unknown quality. **Keep harvest and storage equipment clean and dry** • Wash harvest and storage equipment with clean water and dry before use. • Keep containers off the ground before, during and after harvesting. • Remove visible dirt and debris from fruits and vegetables in the field. • Cool fruits and vegetables quickly after harvest or when intended for storage. • Limit access of animals, children and other non-workers to the harvest and storage areas.	Health Agro-food	Community; workplace Universal health coverage	Information, education and communication

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
3. Promote safer aquaculture products *(3)*. Key messages include the following. **Practise good personal hygiene** • Use a toilet or latrine to urinate or defecate. • Wash and dry hands with a clean, dry towel after toilet use, diapering a child and contact with animals. • Cover cuts, lesions and wounds when working around fishponds. • Wash hands and change clothes after working around the fishponds and harvesting fish. • Locate fishponds away from latrines, livestock and poultry. • Choose a pond site where the chance of contamination with heavy metals or other harmful chemicals is low. • Remove weeds, rubbish chemical containers and old equipment from pond site. • Keep livestock and poultry in an area that prevents access to the fishpond. **Manage water quality** • Select a water source that has a very low chance of contamination with heavy metals, other chemicals and harmful microorganisms. • Prevent people and animals, including ducks, geese and pets, from flying over, wading or swimming in fishponds. • Keep rubbish, food and faecal waste removed from the home away from the fishpond. • Do not pen animals over the fishpond. **Keep fish healthy** • Stock ponds to the proper density with healthy fish seed stock from a certified hatchery or reliable supplier. • Maintain stock at the proper density in the growing pond. • Remove and dispose of sick and dead fish daily. • Avoid using unapproved chemicals to maintain fish health. **Use clean harvest equipment and containers** • Wash harvest containers and equipment with clean water. • Harvest fish early in the day and transport live or cool quickly. • Use clean water to wash harvested fish. • Keep harvested fish in clean containers on non-porous material.	Health Agro-food	Community; workplace Universal health coverage	Information, education and communication
4. Promote healthy and safe food markets *(4)*. Many of the key messages listed in the three sections above apply here. Additional points include the following. **Healthy and safe food markets** • Ensure the provision of safe and nutritious food. • Seek to improve food safety from production to consumption. • Foster partnerships between suppliers, government and consumers. More detailed information on food hygiene can be found in the WHO/FAO Codex Alimentarius basic texts on food hygiene *(5)*.	Health Agro-food	Community; workplace Universal health coverage	Information, education and communication; other management and control

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Use of wastewater, excreta and greywater in agriculture/aquaculture: policies and actions			
5. Develop or update national standards and regulation for the safe use of wastewater, excreta and greywater in agriculture and aquaculture in line with the WHO guidelines *(4)*. This includes the setting of health-based targets that define a level of health protection relevant to each hazard. For setting and achieving the health-based targets the following steps are important. • Routinely assess health risks associated with the use of wastewater, excreta and greywater in agriculture or aquaculture, for example through microbial and chemical laboratory analysis, epidemiological studies and quantitative microbial (and chemical) risk assessment. • Identify health protection measures (covered below). • Monitor and assess the system (covered below). Note: The WHO guidelines generally apply to the use of domestic wastewater. Industrial wastewater usually poses greater risks, which may require different precautions and measures *(4)*.	Water/sanitation Agro-food Health	National	Regulation; assessment and surveillance
6. Implement risk management strategies/health protection measures/control strategies for achieving the health-based targets related to the use of wastewater, excreta and greywater in agriculture or aquaculture *(4)*. Often a combination of measures will be needed. Examples of key measures and messages include the following. **For the protection of consumers** • Treat wastewater and excreta used in agriculture/aquaculture. • Use lower quality effluents to irrigate non-vegetable crops or those that are not eaten uncooked (crop restriction). • Apply wastewater application techniques that minimize contamination (e.g. drip irrigation). • Allow pathogen die-off after the last wastewater application. **For the protection of workers and their families** • Treat wastewater and excreta used in agriculture/aquaculture. • Use PPE during handling. • Provide access to safe drinking-water and sanitation facilities. • Implement disease vector and intermediate host control. • Reduce vector contact. **For the protection of local communities** • Treat wastewater and excreta used in agriculture/aquaculture. • Restrict access to irrigated fields, hydraulic structures and aquacultural facilities. • Provide access to safe recreational water, especially for adolescents. • Provide access to safe drinking-water and sanitation facilities. • Implement disease vector and intermediate host control. • Reduce vector contact.	Water/sanitation Agro-food Health	National; community; workplace Universal health coverage	Other management and control; regulation; infrastructure, technology and built environment

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
7. Consistently monitor and assess health risks of wastewater, excreta and greywater use in agriculture and aquaculture *(4)*. The most effective means of consistently ensuring safety in wastewater, excreta or greywater use in agriculture or aquaculture is through the use of a comprehensive risk assessment and risk management approach that encompasses all steps in the process, from the generation and use of wastewater, excreta or greywater to product consumption. System assessment aims to establish a comprehensive understanding of the system, the range and magnitude of hazards, the magnitude of risk levels and the ability of existing processes and infrastructure to manage actual or potential risks.	Water/sanitation Agro-food Health	National; community; workplace Universal health coverage	Assessment and surveillance
8. Seek community and stakeholder participation early on and in all phases of wastewater, excreta or greywater use in agriculture or aquaculture *(4)*.	Water/sanitation Agro-food	National; community; workplace	Governance
9. Implement management strategies for reducing negative environmental impacts of wastewater, excreta and greywater use (e.g. contamination of surface waters, groundwater and increase in soil salinity). Strategies are dependent on the polluting agent and are further detailed in *Guidelines for the safe use of wastewater, excreta and greywater in agriculture and aquaculture (4)*.	Water/sanitation Agro-food Environment	National; community; workplace	Other management and control
Use of wastewater, excreta and greywater in agriculture/aquaculture: awareness raising and capacity building			
10. Communicate and educate communities and other stakeholders about potential health risks and health protection measures related to the use of wastewater, excreta or greywater in agriculture and aquaculture *(4)*.	Health Water/sanitation Agro-food	Community; workplace Universal health coverage	Information, education and communication

Selected tools
WHO 2006: *The Five keys to safer food manual (2)* This guidance provides key messages, resources and training materials about safer food practices.
FAO/IFAD/UNICEF/WFP/WHO 2020: *The state of food security and nutrition in the world 2020. Transforming food systems for affordable healthy diets (6)*

10.2 Healthy diets and the environment

Overview

Access, intake and uptake to sufficient amounts of safe and nutritious food is key to sustaining life and promoting good health *(1)*. A healthy diet protects against malnutrition as well as NCDs such as diabetes, IHD, stroke and cancer *(7)*.

With regard to health, much of the food that is consumed contains too little whole plant foods (fruits and vegetables) and too much added sugars and salt, saturated fats and trans-fatty acids. Shifting to more healthy diets would reduce a great disease burden mainly from NCDs *(6, 8)*.

With regard to the environment, current patterns of food production and consumption use much of the world's resources on land and water and contribute significantly to climate and ecosystem change through for example deforestation, loss of biodiversity and GHG emissions *(9)*. This is aggravated by the fact that about one third of food produced for human consumption is wasted *(10)*.

Which diets are sustainable and healthy?

Sustainable healthy diets are diets that promote individuals' health and well-being and have low environmental impact. They are based on a great variety of plant-based, and unprocessed or minimally processed foods. These foods must be made available, accessible, affordable, safe and desirable to the whole population including the most vulnerable *(11)*. They need to be accessible, affordable, safe and culturally acceptable.

SDG 2 "End hunger, achieve food security and improved nutrition and promote sustainable agriculture" includes the following selected targets *(12)*.

- Target 2.1: By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round.
- Target 2.2: By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons.
- Target 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.
- Target 2.5: By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Policies and actions			
1. Develop or update national food-based dietary guidelines through the full integration of environmental sustainability elements in each of the guideline's recommendations, according to national contexts *(11)*.	Health Agro-food Environment	National	Regulation
2. Integrate sustainable healthy diets in existing food systems *(11)*. Possible actions include the following. • Support the production, processing, distribution, labelling, marketing and consumption of foods that contribute to sustainable healthy diets (such as plant-based foods and unprocessed foods). • Align food policies across sectors, such as health, agriculture, education, environment, water and trade. • Collect information on current diets across different population groups. • Identify availability of different foods, mismatches in food supply and demand, and required changes in the existing food system. • Improve access to local healthy food choices *(13)*. • Implement restrictions on unhealthy food in and around open public spaces, schools and sports facilities *(13)*. • Pay special attention to the poor and their access to healthy and sustainable food. • Develop national food-based dietary guidelines that define context-specific sustainable healthy diets. • Minimize the use of antibiotics and hormones in food production. • Minimize the use of plastics and derivatives in food packaging.	Health Agro-food Environment	National	Regulation; taxes and subsidies
3. Improve storage, preservation, transport and distribution technologies and infrastructure to reduce seasonal food insecurity, food and nutrient loss and waste *(9)*.	Agro-food	National; community	Infrastructure, technology and built environment
4. Support the diversification of crops including underutilized traditional crops, applying sustainable food production and natural resource management practices *(14, 15)*.	Agro-food Environment	National; community	Taxes and subsidies; other management and control
5. Support agrobiodiversity and the use of integrated pest management to reduce the need for chemical pesticides and herbicides *(15)*.	Agro-food Environment	National; community	Infrastructure, technology and built environment
6. Support healthy soils/healthy soil management *(15)*. This can be achieved through the following examples. • Use cover crops, legumes, composting and agroforestry. • Curb land clearing. • Prevent further land degradation and loss of soil fertility (e.g. through reduced monocultures and increased crop rotation).	Agro-food Environment	National; community	Infrastructure, technology and built environment

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
7. Support and enhance sustainable local food production and processing, especially by small-holder and family farmers *(15)*.	Agro-food Environment	National; community	Infrastructure, technology and built environment; taxes and subsidies
8. Preserve fish habitats and support sustainable fisheries *(15)*. • Maintain/restore catchment vegetation to reduce runoff erosion. • Reduce water pollution from for example industry and urban areas. • Restrict destructive fishing methods.	Agro-food Environment	National; community	Infrastructure, technology and built environment; taxes and subsidies
Awareness raising and capacity building			
9. Educate consumers about healthy and sustainable food *(11)*.	Agro-food Health Environment	National; community Universal health coverage	Information, education and communication
10. Promote sustainable healthy diets that are high in whole grains, pulses, a variety of fruits and vegetables, and nuts and seeds; low in energy-intensive animal-sourced and discretionary foods (such as sugary beverages); and with a carbohydrate threshold *(11, 16)*.	Health Food	National; community Universal health coverage	Information, education and communication
11. Promote healthy dietary changes towards less emission-intensive food products *(9, 16)*. Key messages may include the following. • Reduce the consumption of meat, other animal-sourced foods and processed foods, while increasing the consumption of unprocessed and plant-based foods such as whole grains, legumes, fruits, vegetables, nuts and seeds. • Buy and consume locally produced food.	Health Environment Food	National; community Universal health coverage	Information, education and communication
12. Raise awareness about the benefits of local food production related to community development, climate change and health and provide appropriate training on local food production *(15)*.	Health Environment Food	National; community Universal health coverage	Information, education and communication

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11. Priority settings for action

11.1 Cities and other urban settlements

Cities and other urban settlements can bring many opportunities for better health, a cleaner environment and climate action. Strong urban policies must match those goals since health is essential for fostering good urban livelihoods, building a productive workforce, creating resilient and vibrant communities, enabling physical mobility, promoting social interaction and protecting vulnerable populations.

This section addresses the main principles and areas for actions to better integrate health in the built environment and spatial planning decisions in cities. The agenda for mutual and cross-cutting support between the built environment, planning and health is very long. It encompasses multiple levels (e.g. local, regional), numerous stakeholders and many sectors (e.g. transport, housing, land-use).

Cities and other urban settlements should also make use of the opportunity presented by having a single authority under a city mayor who is empowered to take cross-sectoral decisions, for example on urban planning, transportation systems, purchasing, supply of energy, water and sanitation and waste management. Strategic urban planning will be the key to creating supportive and enabling environments for health, making sure that health and equity considerations are integrated throughout the planning process, investment period, and policy decisions made at the local level.

Overview

Urbanization is one of the leading global trends of the 21st century that has a significant impact on health. Over 55% of the world's population live in urban areas, a proportion that is expected to increase to 68% by 2050 *(1)*. As most future urban growth will take place in developing cities, this provides policy-makers with a unique opportunity to guide urbanization and other major urban development trends in a way that protects and promotes health.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Policies and actions			
1. Create economically and socially viable local communities with accessible local amenities. This includes citywide access to safer walking, biking, nature, public spaces with public transport supporting mobility, recreation, access to services and social interactions, which reduces the use of energy and resources *(2-4)*.	Land use planning	Community; national	Infrastructure, technology or built environment
2. Create variety in spatial planning, such as in land parcel size, forms of land tenure and size of housing to facilitate more socially inclusive (public) places and (green) spaces *(2, 4)*.	Land use planning	Community; national	Infrastructure, technology or built environment
3. Plan places that are more resilient to climate change and natural disasters: create well-designed and accessible green and blue spaces which also act as buffer zones and functional landscapes *(2)*.	Land use planning	Community; national	Infrastructure, technology or built environment
4. Design human settlements which are less demanding on resources: protect and restore urban ecosystems, use nature-based solutions, innovative solutions and good practices of production, consumption, waste reduction and disposal to promote health, protect the environment and improve resilience to climate change *(2, 4)*.	Land use planning Industry Environment Other sectors	Community; national	Infrastructure, technology or built environment; other management and control
5. Implement interventions in polluting sectors, such as in transport and industries, and promote cleaner indoor air through access to cleaner fuels and technologies for cooking, heating and lighting *(3)*; see also Chapter 2 Air pollution.	Transport Industry Energy Other sectors	Community; national	Other management and control
6. Provide well-managed WASH facilities, adequate waste disposal and housing and access to healthy food (see relevant sections in this compendium) *(4)*.	Water/sanitation Waste Housing Food	Community; national	Infrastructure, technology or built environment
7. Strengthen institutions for integrated urban and territorial planning: increase capacity for integration and participation, and inform and integrate decision-making processes for urban policies with other relevant sectorial policies and interventions, including through the HiAP framework *(2, 4, 5)*.	Land use planning Health	Community; national	Governance
8. Perform health and economic impact assessments for urban policies, including health equity assessments, linking to social and environmental impact assessments; involve communities in the assessment of impacts of local interest *(2, 4)*.	Land use planning Health	Community; national Universal health coverage	Assessment and surveillance

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
9. Allocate resources across sectors to account for the expected health impacts of sector-based policies. Use fiscal and financial mechanisms to influence the urban determinants of health, through investments in health-enhancing policies as well as taxation of unhealthy products and practices *(2, 4)*.	Finance Health Environment	Community; national	Taxes and subsidies
10. Monitor and track risks to health and well-being of different population groups; monitor the adoption of policies and investments that address these health risks; and assess cities' health performance using timely data and targeted indicators *(2, 4)*.	Health Environment	Community; national Universal health coverage	Assessment and surveillance
11. Develop the necessary capacity, skills, SOPs, training procedures and job functions for the public health system to integrate health into urban development and deliver on the New Urban Agenda *(2, 4)*.	Health Land use planning	National; community Universal health coverage	Information, education and communication
12. Develop a common vision for social cohesion and health equity by adopting a person-centred "right to health" framework that includes the right to access, use and sustainably transform urban environments *(2, 4, 6)*.	Health Land use planning	National; community Universal health coverage	Other management and control

Selected tools

UN-Habitat/WHO 2020: *Integrating health in urban and territorial planning: a sourcebook for urban leaders, health and planning professionals (2)*
One of the main challenges today is to ensure that urban and regional leaders have the knowledge and guidance to integrate health and well-being into their planning processes. This guidance document Integrates health in urban and territorial planning, a sourcebook designed as a tool to assist national governments, local authorities, planning professionals, health professionals and civil society organizations on how to improve planning frameworks and practice through the incorporation of health considerations, at all levels of governance and across the spatial-planning continuum. The sourcebook explains why health needs to be a part of urban and territorial planning and how to make it happen, offering a comprehensive variety of resources, including frameworks, entry points, guidance and tools, as well as specific case studies illustrating recommended approaches to bring together planning and public health.

WHO 2020: Urban Health Initiative model process *(7)*
The Urban Health Initiative model process and its step-wise approach can help urban leaders to create demand for action for healthier and more climate-friendly cities by making the best use of local data, knowledge, competencies and processes to include health in the development equation. The model process comprises six levels of urban transformation: i) mapping the current situation, policies and decision-making processes; ii) adapting and applying health and economic tools in the local context; iii) developing and testing scenarios; iv) building capacity to engage effectively; v) communication and outreach to sustain and mobilize support; and vi) monitoring results and refining policy.

UN-Habitat: Global Land Tool Network *(8)*
The Global Land Tool Network is an alliance of international partners committed to increasing access to land and tenure security for all, with a particular focus on the poor and women. It uses a rights-based approach. The network's partners include international civil society organizations, research and training institutions, bilateral and multilateral organizations and international professional bodies. The network provides a suite of land rights-based tools covering a range of subject areas.

Selected tools
WHO Regional Office for Europe 2017: *Urban green spaces: a brief for action (9)* This briefing presents the key findings of a review of research evidence and practical case studies on urban green space interventions and provides implications for practice. It covers urban green spaces and their benefits, and planning and design involving the community and stakeholders, while promoting monitoring and evaluation. It also describes potential risks and challenges to be considered and avoided with a set of key messages and further reading.
FAO 2020: *City region food systems programme (10)* A suite of online guidance, tools and information that offers concrete policy and programme opportunities through which rural and urban areas and communities in a given city-region can be directly linked. Directly addresses the wider determinants of health and sustainability through a territorial approach. The programme supports assessment and improvement of city-region food systems to help achieve better economic, social and environmental conditions in both urban and nearby rural areas.
WHO 2015: *Measuring the age-friendliness of cities: a guide to using core indicators (11)* The tool is based on the perspectives and inputs of older people, caregivers and service providers collected from 33 cities across all six WHO regions: African, Americas, Eastern Mediterranean, European, South-East Asia and Western Pacific. The publication focuses on eight key domains of urban life that encompass determinants of health and well-being: outdoor spaces and buildings; transportation; housing; respect and social inclusion; civic participation and employment; social participation; community and health services; and communication and information.
UNICEF 2018: *Shaping urbanization for children. A handbook on child-responsive urban planning (12)* This handbook on child-responsive urban planning provides details for creating thriving and equitable cities where children live in healthy, safe, inclusive, green and prosperous communities. By focusing on children, this publication provides guidance on the central role that urban planning should play in achieving the SDGs. It is applicable for global perspectives and local contexts for all cities. It provides a highly accessible presentation of concepts, evidence and technical strategies to bring children to the foreground of urban planning.
UN-Habitat 2001: *Tools to support participatory urban decision making (13)* This toolkit is a contribution to the Global Campaign on Urban Governance, an initiative led by UN-Habitat in collaboration with a whole range of partners whose development goal is to contribute to the eradication of poverty through improved urban governance. This toolkit will contribute to the wider dialogue, advocacy and capacity-building efforts towards improved urban governance.

11.2 Housing

Improved housing conditions can save lives, prevent disease, increase quality of life, reduce poverty and help mitigate climate change. Housing is becoming increasingly important to health in light of urban growth, ageing populations and climate change.

This section addresses the main principles and areas for action to improve housing conditions and provide healthy and sustainable housing for all. Multiple co-benefits for health, the environment and social equality arise from addressing the key health risks associated with housing. For example, installing adequate thermal insulation and energy efficient heating can improve indoor temperatures that support health, while also lowering expenditure on energy and reducing carbon emissions.

Successful implementation of housing improvements requires the government to work together across the local, regional and national level as well as across different sectors including health, housing and energy. As many interventions need to be realized by homeowners and through the support of the private sector, civil society engagement and collaboration with implementing actors – such as housing managers, architects, urban planners, social housing services, consumer protecting agencies, and the building industry – is crucial.

Overview

According to UN-Habitat estimates, about 3 billion people – or 40% of the world's population – will need access to adequate housing by 2030 *(14)*. This creates a need for 96 000 new, affordable and accessible housing units every day. Access to safe and healthy housing is a human right and one mechanism through which social and economic inequalities translate into health inequality.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
1. Develop or update strategies to prevent and reduce household crowding *(15)*.	Housing Construction Land use planning	National; community	Regulation
2. Ensure sufficient indoor housing temperatures to protect residents from the harmful health effects of cold. For countries with temperate or colder climates, 18°C has been proposed as a safe and well-balanced indoor temperature to protect the health of general populations during cold seasons *(15)*.	Housing Health Energy	National; community	Regulation
3. In climate zones with a cold season, install efficient and safe thermal insulation in new housing and retrofit it into existing housing *(15)*.	Housing Construction Energy	National; community	Infrastructure, technology and built environment

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
4. In populations exposed to high ambient temperatures, develop or update strategies to protect populations from excess indoor heat *(15)*.	Housing Health Energy	National; community	Regulation
5. Equip housing with safety devices (such as smoke and carbon monoxide alarms, stair gates and window guards) and take measures to reduce hazards that lead to unintentional injuries *(15)*.	Housing Health Construction	National; community	Infrastructure, technology and built environment
6. Make an adequate proportion of the housing stock accessible to people with functional impairments, based on the current and projected national prevalence of populations with functional impairments and considering trends of ageing *(15)*.	Housing Construction Health	National; community	Regulation; governance
7. Fit ceilings, reduce cracks, screen windows, eaves and doors, and reduce aquatic habitats and breeding sources around houses to hinder vectors from entering the house and reduce vector-borne diseases like malaria, dengue or Chagas disease *(16)*.	Housing Health Construction	National; community Universal health coverage	Infrastructure, technology and built environment
8. Access to healthy housing and tenure security *(17)*: • Promote secure tenure and the availability of housing options, including the neutral treatment of tenure options (such as ownership or renting), in order to encourage the development of adequate supplies of affordable housing. • Promote transparent and fair rental markets with a balance of rights and duties between landlords and tenants through adequate legislation and conflict resolution mechanisms in order to facilitate residential and labour mobility. • Contribute to well-functioning, efficient, equitable and transparent housing markets and land markets, which respond to different types of housing demand as well as favouring credit access for socially and economically vulnerable population groups, including through alternative forms of funding, such as housing microfinance.	Housing Finance Land use planning	National; community	Regulation; governance
9. Introduce loans and subsidies to support homeowners in implementing housing improvement interventions *(15)*.	Housing Finance	National; community	Taxes and subsidies
10. Develop or update legislative and regulatory codes to control the design and construction of new dwellings to ensure that the necessary and appropriate precautions and sustainability measures are incorporated to protect against the identified potential threats to health and safety *(18)*.	Housing Construction Health	National; community	Regulation

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
11. Develop or update national and local policies and programmes with defined, prioritized target areas where the most serious conditions in the existing housing stock are likely to be present *(18)*.	Housing Construction Health	National; community	Regulation
12. Raise awareness and educate all those involved in the design, construction, management, maintenance and repair/rehabilitation of housing and building-related equipment about the links between housing conditions and health *(18)*.	Housing Construction Health	National; community Universal health coverage	Information, education and communication
13. Conduct public awareness campaigns to enable householders to make informed decisions such as bout adequate room temperatures, by informing them of dangers (such as carbon monoxide and the threats to others from second-hand tobacco smoke) and of important precautions (such as effective ventilation). Householders should also be made aware of any subsidies that may be available, such as financial assistance towards energy efficiency improvements *(18)*.	Housing Health Energy	National; community Universal health coverage	Information, education and communication
14. Increase involvement of the health sector in the development and implementation of policies and programmes directed at dealing with inadequate housing. Systems should be put in place that enable health professionals to refer patients for housing advice where they present with health conditions and injuries that could be related to housing conditions *(18)*.	Health	National; community Universal health coverage	Information, education and communication
15. Use integrated slum upgrading strategies to improve the health and well-being of householders in slums, providing them with access to basic services and infrastructure and including them in decision-making processes *(19)*.	Housing Construction Land use planning Health	National; community Universal health coverage	Infrastructure, technology and built environment
16. Ensure that housing strategies include land use and transport planning for walking, cycling and rapid transit/public transport, as well as access to green areas to enhance health and climate benefits and reduce risks (e.g. urban heat island effect) *(18)*.	Housing Construction Land use planning Health Transport	National; community Universal health coverage	Infrastructure, technology and built environment; governance
17. Integrate planning and construction of houses into urban development strategies *(4)*.	Housing Construction Land use planning	National; community	Governance

Selected tools
WHO 2020: *Repository and review of policies, regulations and legislation to promote healthy housing (20)* The repository provides an overview of policies, regulations and legislation from all six WHO regions to improve housing-related health risks such as crowding, indoor air quality, indoor temperature and building materials. The related review analyses implementation barriers and facilitators of example policies and describes case studies of multisectoral implementation projects.
SHERPA for sustainable housing projects *(21)* SHERPA is a self-evaluation tool for project managers, communities and other stakeholders involved in the planning, design, construction and assessment of housing projects.
WHO 2018: *WHO housing and health guidelines (15)* The WHO housing and health guidelines provide evidence-based and practical recommendations on how to reduce health risks from poor housing conditions. The guidelines summarize all WHO guidance relevant to housing and provide practical implementation considerations such as a list of existing crowding measures or case studies on home modification programmes simultaneously addressing several housing risks.
UN-Habitat 2018: *Alternative solutions to forced evictions and slum demolitions (22)* Using four real-life cases, this publication prescribes short-term, medium-term and long-term guidance that has prevented forced evictions and mitigated the risks of evictions that have taken place.
UN-Habitat 2017: *The human rights-based approach to housing and slum upgrading (23)* This handbook is a guide for practitioners upgrading housing and slums in using the human rights-based approach in their interventions by applying methods such as causality analysis, role pattern analysis and capacity gap analysis.
UN-Habitat 2014: *Accessibility of housing. A handbook of inclusive affordable housing for persons with disabilities and older persons (24)* This handbook aims to bridge the existing gap between the needs and rights of persons with disabilities and older persons through slum upgrading, reconstruction, and large-scale affordable and social housing programmes. Through the provision of concepts, major policy approaches, practical information and technical tools, the handbook intends to build capacity to increase accessibility (such as through design and implementation) in identified contexts. Likewise, it brings to light the implications and the global importance of developing accessibility of sustainable human settlements.
UN-Habitat 2013: *Housing and slum upgrading: gender issue guide (25)* This guide's objectives are to: i) increase understanding of gender concerns and needs in housing and slum upgrading; ii) develop capacity to address gender issues in this area; iii) encourage the integration of a gender perspective into policies, projects, and programmes for sustainable urban development; and iv) support the institutionalization of the culture of gender mainstreaming and gender equality, the implementation of gender-sensitive projects and programmes, and the monitoring of gender-mainstreaming progress.
UN-Habitat 2010: *A practical guide for conducting housing profiles – revised version (26)* A practical guide to conducting comprehensive national housing profiles with a direct objective of understanding the housing sector, while offering evidence-based data to inform policy reform. The housing profile process also aims to be highly participatory and engage multi-stakeholder groups that influence and are influenced by the housing sector.
UN-Habitat 2001: *Tools to support participatory urban decision making (13)* This toolkit is a contribution to the Global Campaign on Urban Governance, an initiative led by UN-Habitat in collaboration with a whole range of partners whose development goal is to contribute to the eradication of poverty through improved urban governance. This toolkit will contribute to the wider dialogue, advocacy and capacity-building efforts towards improved urban governance.

11.3 Workplaces

Overview

More than 1.2 million deaths annually (2015 data) are estimated to be caused by occupational risks *(27)*. Large gaps persist with regard to the health status of workers and their exposure to occupational risks. In addition, only a small minority of the global workforce has access to occupational health services. Nevertheless, effective interventions to prevent occupational hazards and to protect and promote health at the workplace are available *(28)*.

Assessment of national occupational health and safety

Workers' health is determined not only by workplace hazards but also by social and individual factors and access to health services *(28)*.

The following SDG indicators are important for national assessment and monitoring of occupational health and safety.

- Indicator 8.8.1: Fatal and non-fatal occupational injuries per 100,000 workers, by sex and migrant status.
- Indicator 8.8.2: Level of national compliance with labour rights (freedom of association and collective bargaining) based on ILO textual sources and national legislation, by sex and migrant status.
- Indicator 1.3.1: Proportion of population covered by social protection floors/systems, by sex, distinguishing children, unemployed persons, older persons, persons with disabilities, pregnant women, newborns, work-injury victims and the poor and the vulnerable.

In addition, there are SDG targets for monitoring the proportion of informal employment, average hourly earnings, unemployment rates, proportion of youth not in education, employment or training and proportion and number of children aged 5–17 years engaged in hazardous child labour.

Workplaces with a high risk for work-related disease and injury include mining, construction, agriculture and manufacturing. Other occupational groups, such as office- or health care workers, are at risk of specific health conditions such as stress and musculoskeletal diseases or overexertion and infections *(27)*.

Special attention needs to be paid to the approximately 2 billion people (61% of the world's employed population) working in the informal economy. The informal economy involves vulnerable groups such as children, pregnant women, older persons and migrant workers. Informal work has usually harmful effects on workers' rights, social protection and working conditions, thus placing informal workers at greater risk of work-related deaths and disease *(29)*.

What is the level of occupational health and safety we want to achieve?

SDG 8 focuses on sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all *(30)*. Relevant targets include the following.

- Target 8.3: Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services.
- Target 8.5: By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value.
- Target 8.6: By 2020, substantially reduce the proportion of youth not in employment, education or training.
- Target 8.7: Take immediate and effective measures to eradicate forced labour, end modern slavery and human trafficking and secure the prohibition and elimination of the worst forms of child labour, including recruitment and use of child soldiers, and by 2025 end child labour in all its forms.
- Target 8.8: Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment.

The WHO Global Plan of Action on Workers' Health 2008–2017 *(28)* underlines the importance of:

- all workers being able to enjoy the highest attainable standard of physical and mental health;
- favourable working conditions for all workers;
- the workplace not threatening health and well-being;
- primary prevention of occupational health hazards;
- all components of health systems to be involved in an integrated response to the specific health needs of working populations.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Policies and actions			
1. Develop or update national policies and action plans on occupational safety and health *(28, 31, 32)*.	Labour Health Other sectors	National	Regulation
2. Support implementation of essential occupational health interventions for primary prevention of occupational and work-related diseases and injuries *(28)*. Such measures might include: • integrated chemical management; • elimination of second-hand tobacco smoke; • improved occupational safety; • health impact assessment of new technologies, work processes and products at the design stage; • regular assessment of workplace risks and the effectiveness of their control.	Labour Health	Workplace Universal health coverage	Other management and control; assessment and surveillance

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
3. Enforce a basic set of occupational health standards to ensure that all workplaces comply with minimum requirements for health and safety protection *(28)*. This includes enacting regulations, workplace health inspections and collaboration between regulatory agencies.	Labour Health	National	Regulation; assessment and surveillance
4. Increase the capacity of the health sector; develop human resources for workers' health *(28)*. This may be achieved through the following actions: • extend postgraduate training in relevant disciplines; • build capacity for basic occupational health services; • incorporate workers' health in the training of primary health care practitioners and other health professionals; • create incentives for attracting and retaining human resources for workers' health; • encourage the establishment of networks of services and professional associations.	Labour Health	Health care; workplace Universal health coverage	Information, education and communication
5. Promote inclusion of workers' health in other sectors' policies *(28)*.	Health	National	Governance
At the workplace			
6. Ensure that workplaces, machinery, equipment and processes are safe and without risks to health *(31)*.	Health Other sectors	Workplace Universal health coverage	Other management and control
7. Provide appropriate measures of protection, such as protective clothing, when handling chemical, physical and biological substances and agents that pose risks to health *(31)*.	Health Other sectors	Workplace Universal health coverage	Infrastructure, technology and built environment
8. Provide measures to deal with emergencies and accidents in the workplace, including adequate first-aid arrangements, such as cardiopulmonary resuscitation (CPR) *(31)*.	Health	Workplace Universal health coverage	Other management and control
9. Strengthen primary prevention of occupational hazards, diseases and injuries through increased resources, training of workers and employers, introduction of healthy work practices, work organization and a health-promoting culture at the workplace *(28)*.	Health	Workplace Universal health coverage	Information, education and communication; other management and control

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
10. Implement appropriate occupational health services for all workers, including informal, migrant and contractual workers, in consultation with representative employer and worker organizations and groups *(33)*. Functions of occupational health services include the following. • Assess occupational risks or hazards. • Monitor worker's health in relation to work. • Monitor factors in the working environment that may affect health such as sanitary installations, canteens and housing. • Advise on healthy work planning/organization including workplace design and work equipment. • Participate in programme development for improving work practices and equipment according to health and safety. • Advise on occupational health, safety and hygiene, on ergonomics and protective equipment. • Contribute to measures of vocational rehabilitation. • Collaborate in providing information, training and education about occupational health/hygiene and ergonomics. • Organize and provide first aid and emergency treatment. • Participate in analysis of occupational accidents and occupational diseases.	Health	Workplace Universal health coverage	Assessment and surveillance; information, education and communication; other management and control
11. Inform all workers about health hazards involved in their work and provide information, instruction and training on occupational safety and health *(33)*.	Health	Workplace Universal health coverage	Information, education and communication
12. Promote health and prevent NCDs at the workplace *(28)*. Action points include the following. • Promote a healthy diet. • Introduce balanced working time arrangements. • Support tobacco cessation and ban smoking at the workplace. • Promote physical activity and active workplace arrangements to prevent sedentary work. • Prevent work-related NCDs – occupational cancer and chronic respiratory diseases (asthma, COPD and pneumoconiosis). • Promote mental health at work.	Health	Workplace Universal health coverage	Information, education and communication; regulation
13. Implement early detection, surveillance and reporting systems for major occupational risks, occupational accidents and diseases *(28)*.	Health	Workplace Universal health coverage	Assessment and surveillance
14. Implement strategies to ensure reintegration of sick and injured workers *(28)*.	Health	Workplace Universal health coverage	Other management and control; regulation
15. Build workplace resilience to public health threats and emergencies, such as chemical and radiological incidents, extreme weather events (heatwaves, floods), periods of severe air pollution and outbreaks of infectious diseases in all economic sectors *(34)*.	Health Other sectors	Workplace Universal health coverage	Other management and control

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Health care facilities			
16. Establish occupational health policies and programmes in all health care facilities *(35, 36)*. The WHO-ILO Global Framework for National Occupational Health Programmes for Health Workers includes the following building blocks. • Identify a responsible person with authority for occupational health at both the national and workplace levels. • Develop a written policy on safety, health and working conditions for health workforce protection at the national and workplace levels. • Ensure access to occupational health services by strengthening the existing, or establishing a new, occupational health programme, and allocate sufficient resources/budget to the programme, occupational health professional services and the procurement of necessary PPE and supplies. • Create joint labour-management health and safety committees, with appropriate worker and management representation. • Provide ongoing (or periodic) education and training that is appropriate to all parties, including occupational health practitioners, senior executives, front-line managers, health and safety committees, front-line workers and their representatives, and the general public. • Identify hazards and hazardous working conditions in order to prevent and control them, and manage risks by applying the occupational health hierarchy of controls, which prioritizes elimination or control at the source. • Provide pre-service and ongoing immunization against hepatitis B and other vaccine-preventable diseases in the workplace at no cost to the employee (this includes all three doses of the hepatitis B vaccine for all workers at risk of blood exposure, including cleaners and waste handlers). • Promote exposure and incident reporting, eliminating barriers to reporting and providing a blame-free environment. • Promote and ensure health worker access to diagnosis, treatment, care and support for HIV/AIDS, tuberculosis and viral hepatitis B and C. • Utilize appropriate information systems to assist in the collection, tracking, analysing, reporting and acting upon data to promote health and safety of the health care workplace and health workforce. • Ensure that health workers are entitled to compensation for work-related disability in accordance with national laws.	Health	Workplace; health care Universal health coverage	Regulation
17. Provide adequate infection prevention and control (IPC) and PPE, such as masks, gloves, goggles, gowns, hand sanitizer, soap and water, cleaning supplies, in sufficient quantities to health care staff and other workers at risk, such as cleaners, that are in contact with potential infectious patients or materials *(35-37)*. Note: Adequate IPC and PPE depend on the procedure performed and on the suspected disease (see section 11.4 Health care facilities for more information).	Health	Workplace; health care Universal health coverage	Infrastructure, technology and built environment

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
18. Promote hand hygiene and respiratory hygiene as essential preventive measures *(37)*.	Health	Workplace; health care Universal health coverage	Information, education and communication
19. Ensure single-use of syringes and injection devices if possible by procuring syringes with a sharps injury protection feature (SIP devices) and with a re-use prevention feature (RUP devices). Provide puncture-resistant sharps' containers for safe sharps disposal *(37, 38)*.	Health	Workplace; Health care Universal health coverage	Infrastructure, technology and built environment
20. Provide information, instruction and training on occupational safety and health including training on IPC, on the correct use of PPE, and on safe patient handling for prevention of back injuries *(37)*.	Health	Workplace; health care Universal health coverage	Information, education and communication

Selected tools
WHO 2020: Awareness-raising and educational material on how to hand-wash, how to hand-rub and when and how to perform hand hygiene in health care settings *(39)*
WHO 2020: Immunization of health care workers – summary of WHO Position Papers *(40)*
WHO 2020: How to put on and take off personal protective equipment *(41)*
WHO 2020: *Coronavirus disease (COVID-19) outbreak: rights, roles and responsibilities of health workers, including key considerations for occupational safety and health (40)*
WHO 2020: *Infection prevention and control during health care when novel coronavirus (nCoV) infection is suspected (41)*
WHO 2019: *WHO guidelines on tuberculosis infection prevention and control – 2019 update (42)*
WHO 2019: *Minimum requirements for infection prevention and control (IPC) programmes (43)*
WHO 2019: *How to implement seasonal influenza vaccination of health workers. An introduction manual for national immunization programme managers and policy makers (42)*
WHO 2018: *Occupational safety and health in public health emergencies: a manual for protecting health workers and responders (44)*
WHO 2017: *Prevention of HIV transmission in health care settings (45)*
WHO 2016: *Guidelines on core components of infection prevention and control programmes at the national and acute health care facility level (37)*
WHO 2014: *Guidelines on infection prevention and control of epidemic- and pandemic-prone acute respiratory infections in health care (46)*
ILO/WHO 2014: HealthWISE – Work Improvement in Health Services *(47)*
WHO/ILO/UNAIDS 2010: Joint WHO/ILO policy guidelines on improving health worker access to prevention, treatment and care services for HIV and TB *(48)*
Pan American Health Organization 2009: *Aide memoire 2009: hepatitis B immunization of health workers (49)*

Selected tools
WHO 2003: *Aide-memoire for a strategy to protect health workers from bloodborne viruses (50),* which includes a checklist
ILO/International Council of Nurses/WHO/Populations Services International 2002: *Framework guidelines for addressing workplace violence in the health sector (51)*
ILO 2018: *Safety and health in opencast mines. Second (revised) edition (52)*
ILO 2013: *Safety and health in the use of machinery (53)*
ILO 2009: *Safety and health in underground coalmines (54)*
ILO 2005: *Code of practice on safety and health in the iron and steel industry (55)*
ILO 2003: *Safety and health in the non-ferrous metals industries (56)*
ILO 2001: *Ambient factors in the workplace (57)* Factors include radiation, EMF, heat and cold, noise and vibration.
ILO 2001: *Safety in the use of synthetic vitreous fibre insulation wools (glass wool, rock wool, slag wool) (58)*
ILO 2004: *Safety and health in shipbreaking: guidelines for Asian countries and Turkey (59)*

11.4 Health care facilities

There are a considerable number of co-benefits to health of environmentally responsible practices such as climate change mitigation measures; examples may include use of natural ventilation, capture and use of rainwater, improved recapture and reuse of anaesthetic gases, and well-designed telehealth schemes. Environmentally responsible practices can also increase health equity and access to health care such as the siting of health care facilities along major public transport routes and the development of low-energy or no-energy medical devices *(60)*.

Recommendations listed in the guidance tables in many other sections are relevant for health care and health care facilities, and are not usually repeated here. They can be found in the guidance tables under the rubric "health" and "health care" of the columns showing the sector involved and level of implementation, respectively.

Overview

Access to reliable and sustainable energy is a prerequisite for high-quality health care. Safely managed water, sanitation, access to basic hygiene facilities and adequate waste management are needed to maintain hygienic environments and prevent health care-acquired infections. Occupational health services need to protect health care workers in order to ensure health care delivery. Furthermore, the health sector can adopt a wide range of environmentally responsible practices when offering its health care and prevention services, and help protect and promote health through those practices *(60)*.

Yet as many as 1 in 4 health care facilities lack access to even basic levels of water, exposing 1.8 billion people to greater risk of infections. In addition, 1 in 3 health care facilities lack hand hygiene at points of care, 1 in 3 do not segregate waste safely and 1 in 10 have no sanitation services (based on a 2020 global update from WHO/UNICEF which includes data for 165 countries) *(61)*.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
WASH and wastewater management			
1. Ensure safety of water for drinking, cooking, personal hygiene, medical activities, cleaning and laundry for the purpose intended *(62)*. Concrete examples may include the following. • A WSP is implemented, possibly as part of a wider WASH safety plan (see WASH FIT in tools/resources section). • Drinking-water meets WHO GDWQ or national standards *(63)* (see section 3.2.1 Drinking-water for further information). • Non-potable water is used only for cleaning, laundry and sanitation and is appropriately labelled.	Water/sanitation Health	Health care Universal health coverage	Regulation; other management and control

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
2. Ensure availability of sufficient water at all times for drinking, food preparation, personal hygiene, medical activities, cleaning and laundry *(62)*. Note: Sufficient water relates to minimum water quantities required in the health care setting. Set figures are available for planning and designing water supply systems. Actual figures of water quantities required depend on a number of factors, such as size of facility, services offered and number of patients accessing services, climate, level of care and local water use practices.	Water/sanitation Health	Health care Universal health coverage	Infrastructure, technology and built environment
3. Provide sufficient water-collection points and water-use facilities in the health care setting to allow convenient access to, and use of, water for medical activities, drinking, personal hygiene, food preparation, laundry and cleaning *(62)*. Concrete examples may include the following. • A drinking-water station with safe[10] drinking-water available and accessible for staff, patients and carers at all times and in main waiting areas and/or entrances to each ward and in all rooms where patients stay overnight or receive specialized care. • Functioning hand hygiene stations (water and soap or alcohol-based hand rub) are available at all points of care and service areas. • Hand-washing facilities (water and soap) within 5 metres of all toilets or latrines and at least one shower or bathing area per 40 in-patients or per ward (whichever is lower) and are functioning and accessible.	Water/sanitation Health	Health care Universal health coverage	Infrastructure, technology and built environment
4. Provide adequate, accessible and appropriate toilets for patients, staff and caregivers *(62)*. Concrete examples may include the following. • A sufficient number of functional toilets are available, separated by sex and by staff/patient status. • Toilets are easily accessible, safe to use and are appropriate for local technical, financial, cultural and social conditions. • Toilets have a functioning hand-washing facility with soap and water within 5 metres. • Toilets are cleaned at least once daily and are adequately maintained and repaired if any problems arise. • At least one functional toilet provides the means to manage menstrual hygiene needs and can be accessed by those with limited mobility. • Excreta and wastewater is safely managed and treated according to WHO guidelines *(64)*.	Water/sanitation Health	Health care Universal health coverage	Infrastructure, technology and built environment; regulation

[10] Drinking-water has appropriate chlorine residual (0.2mg/L or 0.5mg/L in emergencies) or 0 E. *coli*/100 ml.

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
5. Promote correct use of water, sanitation and waste facilities *(62)*. Concrete examples may include the following. • Staff, are trained and educated about IPC practices, environmental cleaning and waste management necessary for limiting disease transmission, and compliance and monitoring activities are undertaken regularly *(65)*. • Dedicated, trained cleaning staff are available and appropriate and well-maintained materials for cleaning (i.e. detergent, mops, buckets, etc.) are available. • Hand hygiene promotion materials are displayed in all wards/ treatment areas and clearly visible. • Facilities and resources enable staff, patients and caregivers to practise behaviours that control disease transmission in an easy and timely way.	Health	Health care Universal health coverage	Information, education and communication
6. Ensure rapid and safe wastewater disposal *(62, 66)*. Concrete examples may include the following. • Wastewater is conveyed safely away from the facility to treatment with minimal leaks/overflows. • Wastewater drainage is built and managed to avoid contamination of the health care setting or the broader environment. • A stormwater (i.e. rainwater) and greywater drainage system is in place that diverts water away from the facility into a safe drainage or leach field and does not carry contamination from the health care setting to the outside surrounding environment. • Hazardous chemical waste and pharmaceuticals are not discharged into wastewater.	Water/sanitation	Health care	Infrastructure, technology and built environment
7. Implement an IPC programme *(37)*. The basic set of IPC guidelines should include as a minimum: • standard precautions; • hand hygiene; • use of PPE; • sterilization and medical devices decontamination; • safe handling of linen and laundry; • health care waste management; • patient placement; • respiratory hygiene and cough etiquette; • environmental cleaning; • principles of asepsis; • prevention of injuries from sharp instruments and post-exposure prophylaxis; • transmission-based precautions; • aseptic technique and device management for clinical procedures, according to the scope of care. Since the scope of practices may be very different in health care facilities according to the type of care offered, the guidelines should prioritize the most frequent and/or risky practices and settings.	Health	Health care Universal health coverage	Other management and control

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
8. Educate/train health care facility staff on crucial moments to perform hand hygiene and appropriate techniques for hand washing and hand rubbing *(39)*. Five moments when to perform hand washing in health care include: • before touching a patient • before clean/aseptic procedure • after body fluid exposure risk (and after glove removal) • after touching a patient • after touching a patient's surroundings. More detailed guidance is available in the *WHO guidelines on hand hygiene in health care (67)*.	Health	Health care Universal health coverage	Information, education and communication
Waste management			
See also Chapter 5. Chemicals for waste containing mercury.			
9. Consider as much as possible options for waste minimization, environmentally preferable purchasing and green procurement, and safe reuse, recycling and recovery *(68)*. Concrete examples may include the following. • Ensure all staff practise appropriate waste segregation at all points of care using a three-bin system. • Raise awareness about and train medical staff in clinical and general practices to use or waste fewer materials, with techniques such as the "first in, first out" principle (what has been purchased first, should also be used first). • Choose approaches to ordering supplies that generate less waste, such as more frequent ordering of relatively small quantities, particularly for unstable products, and selecting products that produce less or less hazardous waste. • Use physical rather than chemical cleaning methods (e.g. steam disinfection). • Purchase hazardous chemicals centrally and monitor their use. • Procure equipment made from plastics that can be more easily recycled (e.g. polyethylene, polypropylene and polyethylene terephthalate instead of polyvinyl chloride or mixed materials such as paper covered in plastics). • Implement an environmental management system.	Waste	Health care	Other management and control; regulation

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
10. Ensure safe segregation, collection, transportation, storage, treatment and disposal of health care waste *(62, 66)*. Concrete examples may include the following. • Trained waste handlers are available and have sufficient PPE to carry out their duties safely. • Waste segregation should be nationally standardized, should rely on a uniform colour coding or labelling system and should at the least segregate general waste from sharps waste and (other) infectious waste. • General waste and infectious or hazardous waste should be collected, transported and stored separately. • Collection and internal transportation should happen at fixed times and fixed waste routes from the most to the least hygienically sensitive area. • Internal waste storage locations must be totally enclosed and well separated from other areas; the storage location for infectious and sharps waste must be clearly identifiable with floors and walls sealed or tiled. External waste storage should be fenced as a minimum. Only authorized staff should have access to the waste storage areas. Maximum storage times for infectious waste, which are temperature dependent, need to be considered. • In general, health-care waste should be treated using a technique which minimizes the formation and release of chemicals or hazardous emissions. Infectious and sharps waste should generally be treated by steam or other non-burn technologies where these options are locally available and sustainable. • Final disposal should happen in designated places outside the premises of the health care facility. A functional burial pit/ fenced waste dump or municipal pick-up should be available for disposal of non-infectious (non-hazardous/general) waste and waste disposal areas should be built to withstand climate-events and emergencies. • Pharmaceutical waste should be treated and disposed of safely by one of the following options: at a centrally managed safe treatment & disposal facility (i.e. off-site)/sent back to the manufacturer/co-incinerated by industries using high-temperature kilns.	Waste	Health care	Other management and control
Access to energy			
11. Prioritize electrification of all health care facilities to ensure basic health care services *(69)*. See also energy subsection (point 14) under Climate change/environmental degradation below.	Energy	Health care Universal health coverage	Infrastructure, technology and built environment

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Climate change/environmental degradation			
12. **Building:** build and renovate in an environmentally responsible and sustainable way *(70, 71)*. Concrete examples may include the following. • Siting: orientation relative to the sun path, accessibility by public transport, foot and bike, with access to water, and not in a flood-prone area. • Lighting, shading: use of natural sources (daylight and vegetation) and renewable energies such as solar energy. • Ventilation: use of natural ventilation, optimized window siting that enables cross ventilation. • Walls and roofs: insulation, double walls and roofs, reflective materials and colour, built to withstand extreme weather events.	Construction	Health care	Infrastructure, technology and built environment
13. **Food:** implement a sustainable food system *(70)*. Concrete examples may include the following. • Implement a sustainable food plan, which includes local/ regional food procurement. • Reduce the use of disposable products. • Implement measures to reduce food waste.	Food	Health care	Other management and control
14. **Energy:** develop or update clean energy policies to promote increased health-sector reliance on clean energy, promote energy efficiency and ensure that appropriate resources and responsibilities are allocated to the management (and maintenance) of health facility energy resources *(70, 71)*. Concrete examples may include the following. • Implement energy conservation plans. • Use clean energy sources for heating water and electricity. • Replace inefficient light bulbs such as incandescent bulbs with more efficient alternatives such as LED, if suitable for the application.	Energy	Health care	Regulation; taxes and subsidies; infrastructure, technology and built environment
15. **Water:** reduce the use of potable water *(70)*. Concrete examples may include the following. • Develop/update a water conservation plan. • Employ water conservation strategies such as a rainwater capture system for uses other than drinking. • Repair leaking faucets and pipes. • Use technologies to maximize water savings such as high-efficiency plumbing fixtures, low-flow or motion-activated faucets (where regular water quality monitoring exists) and dual-flush toilets. • Raise awareness among staff, patients and visitors about the need to conserve water. • Reduce water use for landscaping such as through drought-relevant species, drip irrigation or mulching.	Water/sanitation	Health care	Regulation; infrastructure, technology and built environment; Information, education and communication

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
Chemicals			
See also the points under the *Climate change/environmental degradation* and *Waste management* subsections above.			
16. Establish safe procedures for procuring, storing, dispensing and proper disposal of pharmaceuticals *(70)*.	Health	Health care	Regulation; other management and control
17. Phase out/replace items that contain mercury, complying with the Minamata Convention on Mercury *(66, 72)*.	Health	Health care	Regulation
18. Phase out or replace substances with high ozone depleting or global warming potential *(70)*. Concrete examples may include the following. • Buy equipment that uses minimally polluting refrigerants and has a reduced refrigerant charge. • Ensure regular maintenance of equipment containing refrigerant to avoid leakage or release into the atmosphere. • Phase out ozone-depleting substances in fire suppression systems.	Environment Health	Health care	Regulation
Radiation			
19. Implement procedures and guidelines to ensure that justification of radiologic imaging becomes an effective, transparent and accountable part of normal radiological practice *(73, 74)*.	Health	Health care Universal health coverage	Regulation
20. Enhance the implementation of the principle of optimization of radiation protection and safety *(73, 74)*. Concrete examples may include the following. • Develop and regularly update evidence-based imaging referral guidelines and make them available at the point of care as decision-support tools for enhance justification of radiological procedures *(75, 76)*. • Establish and use up-to-date diagnostic reference levels for adult and paediatric patients, and quality assurance programmes for radiological procedures. • Implement harmonized criteria and develop detailed guidance for the release of patients after radionuclide therapy. • Apply technological solutions, such as electronic health records, for harmonized monitoring of radiation exposure.	Health	Health care Universal health coverage	Regulation
21. Ensure that heath care staff are appropriately trained in radiation protection. Pay particular attention to the training of health professionals in situations of implementing new technology *(74)*.	Health	Health care Universal health coverage	Information, education and communication

Guidance	Sector principally involved in planning/ implementation	Level of implementation	Instruments
22. Prevent medical radiation incidents and accidents *(73, 74)*. Points to consider may include the following. • Integrate radiation protection contents into the curricula of medical and dental schools, and in the education and periodic training of health professionals involved in the use of radiation in health care. • Create reporting and learning systems for medical radiation incidents/accidents and near misses, perform root cause analysis and prospective risk assessment analysis to inform preventive actions and enhance safety culture *(75)*. • Implement independent safety surveillance and verification and perform periodic quality and safety assessments in health facilities using radiation for diagnostic or therapeutic purposes.	Health	Health care Universal health coverage	Assessment and surveillance; other management and control
23. Increase awareness about radiation benefits and risks among health care staff and patients. Train health care staff in radiation risk communication. Enable an active and informed decision-making process for patients *(73, 74, 76)*.	Health	Health care Universal health coverage	Information, education and communication

Selected tools
See Chapter 3 WASH, including the fact sheets under *selected tools* in 3.3 Sanitation).
WHO/UNICEF 2019: Monitoring WASH and related infection prevention and control in delivery rooms – draft module *(77)*
WHO/UNICEF 2018: Water and Sanitation for Health Facility Improvement Tool (WASH FIT) *(78)* WASH FIT is a risk-based management approach developed by WHO and UNICEF to assist health care facilities improve quality of care through improved WASH. It includes an assessment tool to enable a comprehensive assessment of WASH and IPC within a facility.
WHO/UNICEF 2018: *Core questions and indicators for monitoring WASH in health care facilities in the Sustainable Development Goals (79)*
WHO 2010: *Hand Hygiene Self-Assessment Framework (65)*
WHO 2008: *Essential environmental health standards in health care (62)* This report contains an assessment checklist which provides a set of questions for the listed recommendations on water quality and quantity, water facilities and access to water, excreta disposal, wastewater disposal and health care waste disposal.
WHO 2020: WHO IPC core components – implementation tools and resources *(80)*, which includes a facility-level assessment tool.
WHO/UNICEF 2020: Knowledge portal on WASH and waste in health care facilities *(81)* This includes over 400 tools, standards and training reports, mostly for the country level.
WHO/UNICEF 2020: *Global progress report on WASH in health care facilities: fundamentals first (61)* Publication provides the latest data on access and implementing World Health Assembly resolution WHA72.7 on WASH in health care facilities, country case studies and efforts to integrate WASH with health.
Health care waste management

Selected tools
WHO 2014 and 2017: Safe management of wastes from health-care activities, second edition and a summary of guidance *(66, 68)* Handbooks for public health managers and policy-makers, hospital managers, environmental health professionals, and all administrators with an interest in and responsibility for waste management.
WHO 2019: *Overview of technologies for the treatment of infectious and sharp waste from health care facilities (82)*
Climate change/environmental degradation
WHO 2020: *WHO guidance for climate-resilient and environmentally sustainable health care facilities (83)* This guidance provides a set of suggested interventions in four key areas for providing safe and quality care in the context of climate change: i) the health workforce; ii) water, sanitation, hygiene and health care waste management; iii) sustainable energy services; and iv) infrastructure, technologies and products.
Pan American Health Organization 2017: Smart Hospitals Toolkit *(70)* The Smart Hospitals Toolkit is a practical guide for hospital administrators, health disaster coordinators, health facility designers, engineers and maintenance staff to achieve Smart Health Facilities by conserving resources, cutting costs, increasing efficiency in operations and reducing carbon emissions.
UNDP 2020: *Solar for Health (84)* The Solar for Health initiative supports governments to increase access to high-quality health services through the installation of solar energy photovoltaic systems (PV), ensuring constant and cost-effective access to electricity, while also mitigating the impact of climate change and advancing multiple SDGs.
Health Care Without Harm/UNDP (2020): *Sustainable Health in Procurement Project (85)* UNDP's Sustainable Health in Procurement Project is a programme in collaboration with Health Care Without Harm that aims to reduce the harm to people and the environment caused by the manufacture, use and disposal of medical products and by the implementation of health programmes.

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12. Cross-cutting topics

12.1 Children's environmental health

Overview

Children are exposed to many different environments that have a profound influence on their growth and development. Environmental exposures, both adverse and health-promoting, do not work in isolation but interact with social and nutritional determinants of health to influence children's health and well-being. Adverse environmental exposures include among others polluted indoor and outdoor air, contaminated water, lack of adequate sanitation, household and community environmental hazards, toxic hazards, disease vectors, UV radiation and degraded ecosystems *(1, 2)*.

Children are especially vulnerable to environmental threats due to their developing organs and immune systems, smaller bodies and airways. Proportionate to their size, children ingest more food, drink more water and breathe more air than adults. In addition, certain modes of behaviour, such as putting hands and objects into the mouth and playing outdoors can increase children's exposure to environmental contaminants. Furthermore, children as young as five years old sometimes work in hazardous settings *(2, 3)*.

Health-damaging exposure to environmental risks often begins before birth. Lead in air, mercury in food and other chemicals can result in long-term, often irreversible, effects such as infertility, miscarriage and birth defects. Women's exposure to pesticides, solvents and persistent organic pollutants may potentially affect the health of the fetus. In addition, while the overall benefits of breastfeeding are recognized, high levels of contaminants in breast milk may affect the health of the newborn. Health impacts resulting from exposures at young ages may only emerge later in life *(2)*.

An estimated 1.6 million deaths in children aged under 5 years in 2016 were due to environmental risks, which means 28% of all deaths in children that year could have been prevented through a cleaner and safer environment. Especially in low-income countries, environmental health risks are important contributors to childhood death and disease *(4)*. More than 90% of children breathe toxic air every day *(5)*. Up to 800 million children (or around 1 in 3) have blood lead levels at or above 5 µg/dl *(6)*. Improving children's environmental health presents an essential contribution towards the achievement of the SDGs.

Selected tools
WHO 2020: WHO training package on children's environmental health for the health sector *(2)* This package contains introductory modules in children's environmental health as well as modules on many of the sections of this compendium including on sanitation, hygiene, e-waste, chemicals, mercury, second-hand tobacco smoke, air pollution and climate change.
WHO 2020: *The paediatric environmental health history: Recording children's exposure to environmental health threats: a "green page" in the medical record (7)* This page contains a series of basic, concise questions that enables health professionals to identify children's potential exposure to environmental factors and special vulnerabilities.
WHO 2017: *Inheriting a sustainable world? Atlas on children's health and the environment (1)* This WHO publication is a detailed review that presents continuing and emerging challenges to children's environmental health.
WHO 2010: *Children's environmental health units (8)* This document provides an overview of the services that a Children's Environmental Health Unit may provide to children, parents, the community, health professionals and governmental officials working towards preventing environmentally related diseases among children.

12.2 Health in All Policies

Overview

HiAP is a framework for action with the aim of collaborating across sectors to systematically consider health in policy-making. It is an approach to public policy that considers the health implications of decisions, seeks synergies and avoids harmful health impacts in order to improve population health and health equity *(9, 10)*.

Many risks to health are influenced or even determined by policies in sectors other than the health sector. Examples are transitions in energy and transport that have multiple health co-benefits for environmental protection. Other key sectors responsible for policies that offer win-win situations for health and the environment include WASH, agriculture and food items, land use planning, labour, housing, industry and the energy sector.

The health sector needs a policy mandate, space and competencies to work with other sectors to understand their constraints and interests, and to identify challenges and opportunities to include the health and co-benefit argument in relevant policies. In addition, the health sector needs to increase its efforts to engage with other sectors to promote health protection, ensure essential environmental services and healthy workplaces, and work towards making the health sector more environmentally sustainable *(10, 11)*. The WHO HiAP manual provides some information on needed skills and competencies *(12)*.

12.3 Health Impact Assessment

Overview

The Health Impact Assessment (HIA) uses a combination of procedures, methods and tools by which a policy, programme or project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population. The HIA involves working with a range of decision-makers and stakeholders to support the building of healthy public policy. It uses both quantitative and qualitative methods to describe the expected health impacts. It can be included in environmental impact assessments, strategic environmental assessments, social impact assessments or integrated impact assessments *(13, 14)*.

Policy decisions made outside of the health sector influence many determinants of health. The HIA evaluates the likely positive and negative health impacts from proposed policies, programmes or projects from different sectors and makes recommendations on how to improve health. It is typically a prospective assessment before implementation, although it may be carried out concurrently or retrospectively.

The HIA includes the following steps.

- Screening – determine whether an HIA is required by determining potential health implications of a policy, programme or project.
- Scoping – identify key health issues and public concerns to be covered in the assessment. Potential health determinants may include factors such as the social and physical environment (i.e. housing quality, crime rates and social networks), personal or family circumstances (i.e. diet, exercise, risk-taking behaviour and employment) and access to public services.
- Appraisal – estimate potential health gains or losses, including assessment of population groups affected, baseline health status and predictions about likely changes of health status through the programme, policy or intervention and from possible strategies to prevent negative health impacts.
- Reporting – draw conclusions and make recommendations.
- Monitoring – monitor the actual health impacts.

Selected tools
WHO 2019: *Healthy environments for healthier populations: Why do they matter, and what can we do? (10)*
UNEP 2016: *Healthy environment, healthy people. Thematic report. Ministerial policy review session (15)*
WHO 2020: *WHO global strategy on health, environment and climate change: the transformation needed to improve lives and wellbeing sustainably through healthy environments (11)*
UNEP 2018: *Implementation plan 'towards a pollution-free planet' (16)*
UNEP 2020: *Working with the environment to protect people. UNEP's COVID-19 response (17)* The landing page on which the report is located also contains factsheets on waste management, green jobs, resource efficiency among others.
UNEP 2020: *Preventing the next pandemic: zoonotic diseases and how to break the chain of transmissions (18)*
UNEP 2017: *Towards a pollution-free planet background report (19)*

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Annex: Messages on health and environment for the general public

This annex contains messages adapted from the guidance in this compendium for people having completed at least primary education. These messages are part of the WHO Actions & Rights project (https://www.actions-rights-health-consultation.org/). They will be used in an "environmental health" section of the project website. This project aims to make WHO's comprehensive health advice available to the general public. Health messages in this project aim to be understandable, accessible and actionable. Messages come in three levels: broad message (**level 1**); summary points expanding the initial message (**level 2**); and links to more information (**level 3**). Messages aim to be informative without sounding too prescriptive.

The audience of this compendium can use the messages below to promote health among the general public.

Level 1: Protecting nature, the environment and our climate

Level 2:

People need a healthy environment in which to live. The planet we live on is under pressure. Too many resources are being taken from the planet. This extraction and pollution lead to climate change and destroy nature. Some actions you can take to protect nature are below.

- Protecting nature and reducing pollution.
- Eating food grown locally, primarily vegetables, fruits, nuts and grains.
- Choosing to travel and commute by public transport, walking and cycling.
- Building houses that are good for your health. Such houses have insulation, ventilation and heating and provide protection against mosquitoes and other dangerous insects and animals.
- Using clean energy and safe and energy saving devices for cooking, lighting and heating. Clean energy comes for example from the sun or wind. It does not come from burning of fossil fuels.
- Avoiding using pesticides and herbicides.
- Avoiding single-use plastics. Examples for single-use plastics are plastic bags and food packaging.

Level 3:

- WHO webpage on climate change including fact sheets on climate change and health, and biodiversity and health: https://www.who.int/health-topics/climate-change#tab=tab_1
- The WHO Manifesto for a Healthy and Green Recovery from COVID-19 – six steps to take: https://www.who.int/multi-media/details/six-prescriptions-to-who-manifesto-for-healthy-recovery

Level 1: Breathing clean air

Level 2:

Most people breathe air that is harmful to their health. Air becomes polluted in many ways. Pollution can come from cars and other vehicles, fires, factories, and by burning waste. Cooking on open fires and unsafe cook-stoves creates smoke that makes people sick as well. Some actions you can take to reduce air pollution are below.

- Cycling, walking and using public transport rather than driving a car.
- Using cook-stoves that vent outside and that do not burn wood or coal.
- Building homes with insulation, ventilation and heating.
- Ensuring waste is safely disposed of.
- Avoiding burning waste.

Level 3:

- Infographics:
  - https://www.who.int/phe/infographics/infographics-airpollution-childhealth-2-1200px-EN.jpg
  - https://www.who.int/phe/infographics/infographics-airpollution-childhealth-3-1200px-EN_ATM.png

- Fact sheet:
  - Ambient (outdoor) air pollution: https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health
  - Household air pollution: https://www.who.int/news-room/fact-sheets/detail/household-air-pollution-and-health

Level 1: Accessing safe water and safe toilets

Level 2:

People who drink safe water and use safe toilets are less likely to fall ill with diarrhoea and other diseases. Safe water comes from a water tap, a borehole or other safe sources. Safe toilets are those that separate excreta from human contact. Some actions to access safe water and safe toilets are below.

- Drinking-water from a safe source.
- Making your water safer for drinking. This can be done by boiling, filtering, chlorination or solar disinfection.
- Using safe toilets and keeping them clean.
- Ensuring your children have access to safe drinking-water and toilets. Using a potty for small children and emptying it into a safe toilet.
- Preventing animal scat from being where people are or removing it immediately.

Level 3:

- Include WHO Factsheets on Drinking-water (https://www.who.int/news-room/fact-sheets/detail/drinking-water) and Sanitation (https://www.who.int/news-room/fact-sheets/detail/sanitation)

Level 1: Washing hands

Level 2:

Washing hands with soap is an easy way to stay healthy. Actions you can take are below.

- Washing hands with soap and water often. Washing is particularly important before eating, before preparing food, after going to the toilet, and after cleaning a child's bottom.
- Ensuring your children wash their hands with soap. For small children, helping them to wash their hands with soap and water often.

Level 3:

- Video: Will you wash your hands with Akili? https://www.youtube.com/watch?v=ogJUASq5Gv0

Level 1: Safe handling of chemicals

Level 2:

People get in contact with many different chemicals every day. Many chemicals are harmless or even good for you. Others are dangerous and can harm your health. There are ways to protect yourself and your family from contact with these chemicals. Some actions you can take are below.

- Storing chemicals and medicines safely. Safe storage means children cannot reach them or open them.
- Adding clear labels to packages of chemicals. Not storing chemicals in drinking bottles.
- Disposing of chemicals and medicines safely. Safe disposal means not on the ground, in rivers, or into sinks, drains or toilets.
- Avoiding using pesticides.
- Using special clothes, gloves and breathing protection when using pesticides.
- Knowing where to get help in case of an emergency. This includes knowing the telephone number of the nearest poison centre.

Level 3:

- WHO summary page on chemical safety (https://www.who.int/health-topics/chemical-safety#tab=tab_1), including fact sheets and further information of chemicals of major public health concern.

Level 1: Protecting yourself from harmful radiation

Level 2:

Different kinds of radiation can impact your health. Ultraviolet radiation is one type. It comes from the sun or sunbeds. Too much ultraviolet radiation harms your skin and causes cancer. Too little is also not good. The body needs some ultraviolet radiation to produce vitamin D. Vitamin D is important to health. Some actions you can take to reduce your exposure to ultraviolet radiation are below.

- Being aware of your time exposed to the sun. Young children and fair-skinned people need special protection.
- Staying out of the sun, particularly between 10:00 o'clock in the morning and 4:00 o'clock in the afternoon.
- Wearing long-sleeved clothing.
- Applying sunscreen to protect your skin.
- Using broad-brimmed hats and sunglasses to protect your eyes.
- Avoiding using sunbeds or other tanning devices.

Level 3:

- Sunbeds cause cancer – infographic: https://www.who.int/images/default-source/imported/radiation/sun-beds-radiation.jpg?sfvrsn=fa9dcf28_8
- WHO summary page on UV-radiation: https://www.who.int/health-topics/ultraviolet-radiation#tab=tab_1

Level 2:

Radon is a radioactive gas that comes out of the ground. It may be found in high concentrations in buildings, such as homes and workplaces. Concentrations of concern occur on lower floors, mainly ground floor and below. Radon is one of the leading causes of lung cancer. Actions you can take to reduce your exposure are below.

- Informing yourself whether you live in a region at risk of radon exposure.
- If you live in a region at risk of radon exposure, measuring the radon level in your home.
- Contacting local government to find out how to proceed.
- Taking action to reduce high radon levels.

Level 3:

- WHO summary page on radon: https://www.who.int/health-topics/radon#tab=tab_1
- WHO fact sheet on radon: https://www.who.int/news-room/fact-sheets/detail/radon-and-health

There are other kinds of radiation, such as X-rays, which are used in medical settings under controlled conditions. These are discussed under “Electromagnetic fields”, “Radiation exposures in health care”, “Radioactivity in food and drinking-water” and “Radiological emergencies".

Level 1: Protecting yourself from health risks at work

Level 2:

People may spend many hours each day at work. There are many types of workplaces. Examples include offices, factories, restaurants and farms. You can experience different risks at your workplace. These include exposure to sounds, ultraviolet and other radiation, chemicals and germs. Other risks relate to movement. This includes heavy lifting, awkward postures and prolonged sitting. Some actions you can take to protect yourself at work are below.

- Following the rules established by your employer on workplace safety. These will differ based on the type of work you do.
- Using special clothing or personal protective equipment according to the rules for workplace safety.
- Taking training on safe work practices, prevention of accidents and work-related stress.
- Keeping your workplace tidy, clean and comfortable.
- Reporting to your manager any situation at work you believe may be harmful for you and your co-workers.
- Getting to know where to find first aid and how to help your co-workers in case of emergency.
- Keeping a healthy balance between your work and your private life. This means not working consistently long hours, helping and respecting your co-workers, being positive, avoiding sitting for a long time and adopting healthy eating habits at work.

Level 3:

- WHO summary page on occupational health including different fact sheets on workers' health (https://www.who.int/health-topics/occupational-health

Level 1: Protecting yourself from injuries

Level 2:

Many people get injured or die from drowning, falls and burns and other accidents. Most of these deaths and injuries can be prevented. Children and older people are at special risk. Some actions you can take to protect yourself from injuries are below.

- Making your home safe for children and yourself. Examples are installing fire detectors, bars and childproof locks for windows and guards and gates for stairs.
- Securing open waters such as pools, wells and ponds so children cannot access them.
- Teaching all school-aged children how to swim.
- Teaching older people exercises to prevent falls and other accidents.
- Preventing fires in the home. You can do this in many ways: by quitting smoking, using safe cook-stoves and undamaged electrical appliances.
- Engaging in behaviours to prevent injuries. Examples are cycling with a helmet, using seatbelts in cars and drinking less alcohol.
- Learning first aid skills.

Level 3:

- WHO fact sheets on burns (https://www.who.int/news-room/fact-sheets/detail/burns), drowning (https://www.who.int/news-room/fact-sheets/detail/drowning), falls (https://www.who.int/news-room/fact-sheets/detail/falls) and road traffic injuries (https://www.who.int/news-room/fact-sheets/detail/road-traffic-injuries).

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