Toolkit
for safe listening
devices and systems

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Make Listening Safe

Contents

Foreword

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Globally, a billion teenagers and young adults are at risk of developing hearing loss due to the practice of listening to music at high volumes for prolonged time over their personal audio devices. Once hearing loss due to loud sounds sets in, it cannot be reversed. Such hearing loss, if unaddressed, can greatly impact one's ability to communicate, gain education or find and hold suitable employment. However, hearing loss that results from loud sounds can be prevented through raised awareness and appropriate prevented measures.

To address this issue the World Health Organization (WHO) and the International Telecommunications Union (ITU) have developed the **Toolkit for safe listening devices and systems**, which provides the necessary practical guidance for the implementation of the Global standard for safe listening devices (ITU-T H.870). The standard outlines key features to regulate the user's exposure to sound, limit volume and provide information on safe listening. The implementation of the safe listening features recommended here will be key to protect users from hearing loss caused by loud sounds and ensuring that people can continue enjoying the sounds they like listening to.

Governments can act by regulating for the standard and manufacturers can develop and market devices that implement the recommendations of the toolkit. Civil society can advocate for the implementation of the standard and raise awareness on safe listening.

ITU and WHO call upon Member States, industry partners and civil society to play their part in promoting safe listening and in addressing this emerging health challenge.

The use of this toolkit and implementation of the H.870 global standard will promote the responsible use of technology to enhance health and wellbeing among its users.

Ms Doreen Bogdan-Martin, ITU   Dr Etienne Krug, WHO

Acknowledgements

Executive summary

This toolkit provides practical guidance to support Member States, industry partners and civil society groups in the use and implementation of the WHO-ITU H.870 Global standard on safe listening devices and systems. The WHO-ITU Global standard is the result of a collaboration between the World Health Organization (WHO) and the International Telecommunication Union (ITU), and has been developed in response to the growing prevalence of hearing loss and the threat to hearing posed by unsafe listening. The WHO-ITU Global standard has been deve-lo-ped using an evidence-based and consultative process, with the participation of experts in the field of sound, audiology, acoustics, communication, and smartphone technology.

This toolkit outlines the need for hearing loss prevention and describes how WHO and ITU have shaped their response to this. It summarizes the WHO-ITU Global standard in a simplified way and provides a step-wise approach for implementation by three main partners in the field of hearing loss prevention:

• Governments
• Industry
• Civil society

A section tailored to each partner outlines the steps necessary for effective implementation of the WHO-ITU Global standard. A variety of tools are included to help with this: a situation assessment tool; an outline of planning workshops; and sample awareness-raising commu-ni-cations and slide presentations.

The aim of the toolkit is to make it easy for partners to adopt, implement and monitor the WHO-ITU Global standard. Its overall goal is to ensure that all users of personal audio systems are empowered with information on safe listening and have the option to make safe listening choices in order to protect their hearing.

Background
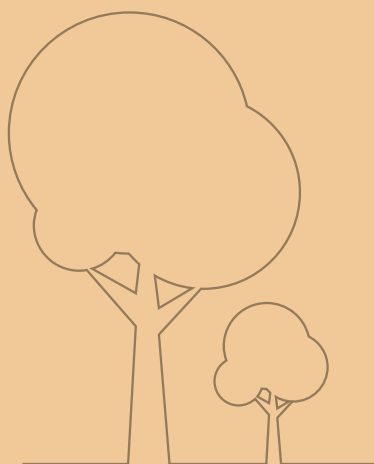
Background

WHO estimates that over a billion young people worldwide are at risk of hearing loss due to unsafe listening practices (1). Action is therefore urgently needed. In recent years, there has been a rapid growth in access to technology and an ever-increasing number of people are using such technology to communicate. In addition, there has been a significant increase in the number of people exposed to loud sounds through use of personal audio systems as well as in entertainment venues, which put them at high risk of damaging their hearing.

Overall, the number of people with hearing loss is growing at a rapid pace. It is estimated that there are currently around 466 million people with disabling hearing loss globally (2). Of this total, 432 million (93%) are adults and 34 million (7%) are children. Recent WHO projections suggest that unless action is taken, there will be 630 million people living with disabling hearing loss by 2030. This number is expected to grow to over 900 million by 2050 (2) along with a proportionate rise in the current annual cost of more than US$ 750 billion (in international dollars) globally if hearing loss is not addressed (1,3).

Several risk factors affect a person's hearing throughout life. While some of the risk factors associated with hearing loss are declining in parts of the world (e.g. rubella and meningitis), preventable factors such as noise (which are mainly a consequence of our modern way of life) are on the rise.

Noise as a risk factor for hearing

Ears are the organs that process sounds, enabling the brain to interpret what the individual is hearing. The ear is divided into three parts – outer ear, middle ear, and inner ear (see Figure 1). Usually sound is perceived by the sensory cells located in the inner ear, and when these cells are exposed frequently to loud sounds they can be permanently damaged, affecting individual's hearing.

Figure 1: Structure of the ear.
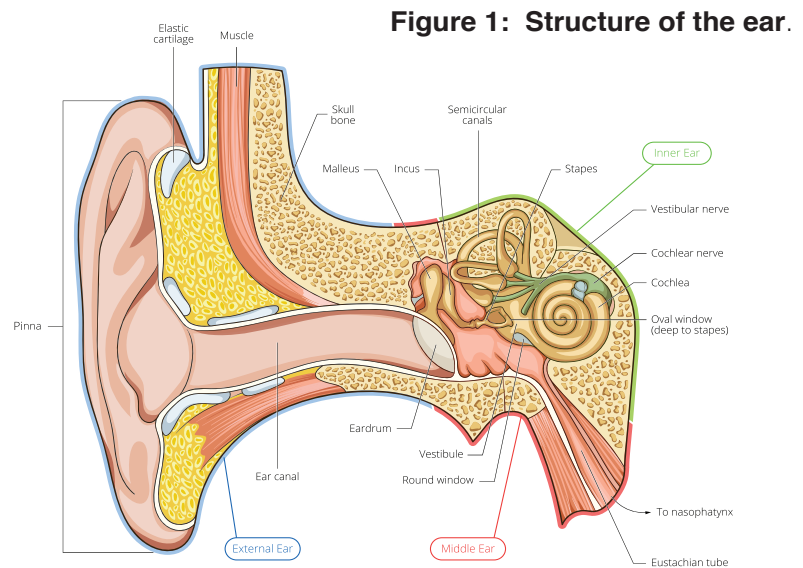
Noise-induced hearing loss can be caused by a variety of environments and behaviours. For example, 40% of those frequenting such discotheques, clubs, sporting events or music concerts are exposed to potentially damaging sound levels (4). There is evidence that those exposed over the past 20 years to loud sounds in social settings are three times more likely to suffer hearing loss than those unexposed.

The widespread uptake of personal audio devices such as smartphones and MP3 players has added to this risk. Smartphone use in developing countries has grown from 45% in 2013 to 54% in 2015 (7) and in in developed countries this figure stands at 87%.

It is estimated that 50% of those listening to music over their personal audio devices do so at levels that put their hearing at risk (4).

This toolkit focusses on hearing loss caused by unsafe listening using personal audio devices. Unsafe listening practices were identified as a major contributor to hearing loss by the Scientific Committee on Emerging and Newly Identified Health Risks in 2008. The committee indicated that 5–10% of listeners are likely to develop hearing loss due to their personal preferences of volume levels and duration of listening. (8) The availability of evidence varied across countries, but one study revealed that more than 40 million adults in the Americas between the ages of 20 and 69 are affected by noise-induced hearing loss due to non-occupational causes (5).

Impact of hearing loss

Noise-induced hearing loss in young children impairs language acquisition (6,7), learning disabilities, anxiety and attention seeking behaviours are also common in children exposed to loud sounds. (11) Chronic noise exposure in classrooms affects academic performance in areas such as reading ability, comprehension, short and long term memory, and motivation. On average, children who are exposed to noisy learning environments have lower assessment scores on standardized tests, which in the long term might affect their academic and profes-sional development (4, 8).

In adults, unaddressed hearing loss can mean loss of earnings and difficulty in finding and retaining jobs. In Europe, for example, people with unaddressed hearing loss are twice as likely to be unemployed compared to their normal hearing peers. When employed they often earn lower wages, for example in the USA, wages are found to be between 50% and 70% lower for adults with unaddressed hearing loss. It affects social relationships and can be a cause for stress in domestic relationships.

Noise exposure in young people also contributes to age-related hearing loss that can lead to significant communication difficulties, with the subsequent emotional and cognitive effect this might imply (9). Recent evidence suggests that outcomes such as depression, isolation, frustration, cognitive decline, and decreased personal safety are twice as common among seniors with hearing loss than those without hearing loss (10, 11, 12, 13).

While noise-induced hearing loss is irreversible, it can nonetheless be prevented. In the case of hearing loss caused by the unsafe use of personal audio devices, there are simple, effective practices such as keeping the volume within safe listening levels and limiting the time spent engaged in noisy activities that, if followed, can have a protective effect on people's hearing.

Taking preventive action is mostly in the realm of listeners themselves by adopting safe listening behaviours. However, government, health care providers, manufacturers and civil society can create an environment which enables safe listening.

WHO's Make Listening Safe initiative

In 2015, responding to this growing public health issue, WHO launched the Make Listening Safe initiative, with the overall vision of ensuring that people of all ages can enjoy listening with full protection of their hearing.

The aim of this global initiative is to reduce the risk of hearing loss due to unsafe exposure to sounds in recreational settings through:

- regulating exposure to loud sounds through personal audio systems;
- undertaking a public awareness campaign to change listening behaviours among the target population;
- developing a regulatory framework for safe listening in recreational settings.

To achieve the first objective, ITU and WHO collaborated in developing the WHO-ITU Global standard for safe listening devices and systems.

Rationale for a standard for safe listening devices

Experience from other fields of public health (for example reducing tobacco use or improving road safety) show that policies, regulations and their enforcement can eventually influence people's behaviours. This is the case for mandatory graphic warnings on cigarette packages, for example, and for fines for ignoring mandatory seatbelt-wearing laws, for example. In line with these experiences (14), it is believed that the design and implementation of specific legislation that regulates the amount of sound energy received through a personal audio system can help prevent hearing loss by ensuring a lower level of sound exposure in people using these devices.

Currently, there is one example of regulation that targets sound exposure through personal music players, which is the 2009 directive from the European Commission limiting the output level of personal music players and making it essential to provide a warning to listeners. Legal and regulatory interventions have proved to be an effective strategy for many sentinel public health achievements. An strong example is legislation worldwide on smoking bans that has been effective in reducing the incidence of passive and active smoking as well as the rate of acute coronary syndrome in populations concerned (15).

Legislation and its enforcement is shown to be a key intervention for road safety, which can lead to reduction in speeding and drunk driving (16, 17). On the basis of these examples it makes sense to put in place regulations or legislation that address exposure to loud sounds as a public health issue in order to bring about a sustained change in listening habits.

WHO-ITU H.870 Global standard on safe listening devices and systems

The WHO-ITU Global standard (18) builds on recommendations made by the European Commission (19) and provides evidence-based guidance for promoting safe listening among users of personal audio systems.

In principle, the WHO-ITU Global standard proposes ways in which the technology used for listening (personal audio systems) can become a part of the solution of the u nsafe listening challenge. The rapid emergence of sophisticated technology that can track behaviour and health status, and provide personalized feedback, can be implemented to promote safe listening practices, while continuing to provide an enjoyable experience to the listener.

Smartphone technology, in which smart mobile devices are connected to powerful computational resources, can thus provide a platform to deliver targeted, customized, safe listening interventions in a timely enough way for maximum effect.

Through the use of technology and the creation of targeted protective features, the WHO-ITU Global standard aims to create a safe environment around those who listen to music through personal devices. The protective features recommended by the WHO-ITU Global standard will, among other things, aim at limiting the intensity and duration of users' exposure to loud music. However, since users can decide to overrule technology (e.g. by deactivating the protective features), the WHO-ITU Global standard also includes recommendations for integrating into the protective features an educational component aimed at helping users to track, interpret and learn from their behaviours.

Based on behavioural change theory and models, for users it might be easier to adopt and sustain a safe listening behaviour if they receive information and cues on the types of behaviour that put them at risk, the potential consequences, and what to do about it.

Developing the WHO-ITU Global standard

The WHO-ITU Global standard is based on current evidence and is the result of collaboration over a period of 2 years with a wide-raging group of experts and stakeholders, including audiologists, academia, sound engineers, professional associations, manufacturers of devices and headsets, regulatory bodies working at global or European level, and members of thetarget age range (12–35 years). Convened alternately by WHO and ITU, this wide-ranging group has provided inputs and feedback to the text of the WHO-ITU Global standard. All background papers and evidence compiled is publicly available. Before entering into force, the WHO-ITU Global standard prepared by the group was posted online for additional comments and inputs from the 193 Member States of the International Telecommunication Union, as well as from its hundreds of sector members.

The WHO-ITU Global standard consists of two integral components: a technical specification and a communication/educational element. The two are closely linked and both must be implemented together in order to be effective.

1. Technical aspects addressed in the WHO-ITU Global standard:

Dosimetry: The WHO-ITU Global standard recommends that each device includes a system that tracks the user's exposure time and estimates sound level and percentage used of a reference exposure (sound allowance)

> **Dosimetry**
> The calculation and assessment of the amount of sound received by the ear, as compared to the reference exposure (or sound allowance)

This acoustic dosimetry must include all media playback through the device (whether stored on the device or streamed) during times when the user is using earphones or headphones. (Voice calls are excluded as they are separately specified by other standards)

It is also recommended that the device allows the user to select their reference exposure as one of two modes:

> **Mode 1:** (WHO) standard level for adults. This will apply 1.6 Pa2h[1] per 7 days as the reference exposure (i.e. 80 dBA SPL for 40 hours per week).
> **Mode 2:** (WHO) standard level for sensitive users (e.g. children). This will apply 0.51 Pa2h per 7 days as the reference exposure (i.e. 75 dBA SPL for 40 hours per week).

The mode choice is given when using the player for the first time (or when the device is reset to factory settings) Mode choice can be changed at any later time, e.g. via a device settings menu.

Volume limiting: This is a feature where by a volume-limiting message and option is automatically provided every time the user reaches 100% of their weekly allowance. The message should allow them the option to "continue listening" if they do not wish the device volume to reduce. When the message is not acknowledged, the default action will be to reduce the volume output to a pre-set level. If possible, users should be given the option to customize this level (the level at which they would like their device to limit the volume) according to their preference.

The feature may also be used by individual users in order to limit their own sound exposure, if they wish to do so, by fixing the maximum output on their device.

Parental control: It is recommended that the device should offer an option whereby maximum sound output can be fixed and locked in the settings, possibly through use of a password. This would allow parents (or other adults) to limit the maximum sound output of the child's device in a way that cannot be changed by the child.

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1 Pa2h: pascal squared hours is the unit used to measure sound energy.

2. Communication aspects addressed by the WHO-ITU Global standard:

The WHO-ITU Global standard intends to provide users with information and guidance to enable them to make safe listening choices by tracking, interpreting and learning from their own behaviours. Such a component includes:

– **Personal usage information** which is based on the tracking system mentioned in technical component. This will help the user to know:

- their own listening habits (use of daily and weekly sound allowance);
- how to use safe listening features of the specific devices.

– **Personalized recommendations** and cues for actions for safe listening, customized based on each user's listening profile.

– **General information on:**
- safe listening and ways to practice it;
- the risk associated with unsafe listening;
- the risk of hearing loss due to loud sounds from sources other than the personal audio system.

Objective of the toolkit

This toolkit aims to provide a practical guide on the implementation and follow-up of the WHO-ITU Global standard that should be used as the basis for regulations or legislation by all Member States, or adopted voluntary by manufacturers in order to protect users from noise-induced hearing loss. The WHO-ITU Global standard is designed to support countries, industries and civil society in approaching noise-induced hearing loss prevention in a strategic, evidence-based and user-friendly way.

This toolkit is organised in three sections. Each section is targeted to a group whose action is essential to ensure that the WHO-ITU Global standard is adopted and users protected. This includes:

- government, specifically the ministries and departments working in the field of health, technology, commerce, industry, consumer protection and any other department related to disability or accessibility issues;
- industry, specifically manufacturers of personal audio systems;
- civil society organizations working in the field of hearing or consumer rights.

Each section provides the rationale for the stakeholders to take action on safe listening; they list possibilities of how the WHO-ITU Global standard can be implemented or promoted by that particular group; and suggests tools for taking action.

The processes, steps and tools are provided for guidance and can be adapted, translated or modified by stakeholders to suit the needs of individual countries and manufacturers.

Implementation by
governments
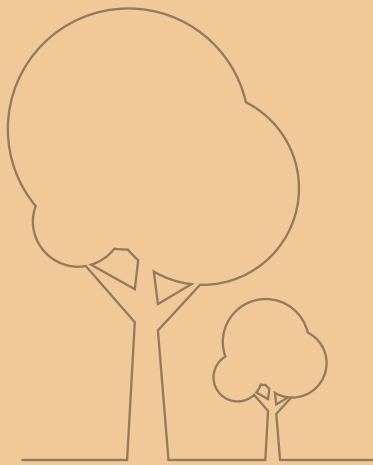
Implementation by governments

The section is intended as guidance for (among others):

- public officials responsible for drafting policies, advising ministries, setting the priority agenda in the field of health, for example in adolescent health; education; technology; information and communication technology; telecommunication; as well as regulatory or standardization bodies; consumer protection agencies; and managers of hearing programmes or adolescent health within ministries of health;
- officials responsible for school health or purchase of equipment within ministries of education;
- officials in charge of accessibility issues within government departments.

Rationale

Hearing loss is increasing in all regions worldwide, posing a public health challenge that carries a significant financial cost. WHO estimates that unaddressed hearing loss costs the world approximately US$ 750 billion each year (in international dollars).

Investment in hearing loss prevention can help governments save already-scarce resources. Ministries of education and of technology should advocate for and support hearing loss prevention, in part achieved through implementation of the WHO-ITU Global standard, to fulfil their mandates for protecting technology users in general and in particular children using technologies to learn. The increasing access to technology worldwide and its improper use is posing a huge challenge in this respect. To mitigate the associated risk, it is essential that people learn how to use technology properly so that its harmful impacts can be minimized. The WHO-ITU Global standard makes it possible to use technology interfaces as a platform for prevention of noise-induced hearing loss.

What actions can governments take?

Implementation of the WHO-ITU Global standard can be promoted through:

1. Legislation: The WHO-ITU Global standard should be integrated in regulations and legislation related to the manufacturing, importing and selling of personal audio devices.

2. Other policies:

a. Government regulation: The relevant government department (technology, health, consumer protection etc.) should define a mechanism to enforce such policies or regulations that ensure all personal audio devices and systems sold within its jurisdiction comply with the WHO-ITU Global standard and protect users from noise-induced hearing loss.

In 2003, ITU defined an international standard for video compression (Recommendation ITU-T H.264), which has been widely adopted by industry. France developed a regulation and Brazil issued a presidential decree mandating the use of ITU-T H.264 for over the air broadcast services, resulting in benefits for end users: not only quality of images broadcasted over TV in these countries was significant improved, but also lower cost for the necessary set top box receivers.

b. Procurement policies: Government departments that regularly procure technologies on a big scale (through tenders and public procurement) should ensure that all devices procured by them are aligned with the WHO-ITU Global standard.

Public procurement has been used as a tool to further public policies in many fields and has the potential to deliver on societal goals (20).

Where the department of technology has an advisory role and informs decisions made by other departments (concerning relevant devices), they should recommend the alignment of these procurement policies as per the features defined in the WHO-ITU Global standard.

3. Along with legislation and other policies to implement the WHO-ITU Global standard for safe listening devices, governments should launch a **public awareness campaign** to raise awareness on:

- the risks posed by loud sounds, especially those experienced in recreational settings;
- safe listening practices that can reduce the risk of hearing loss among listeners.

Engaging partners

All stakeholders in the field should be involved, including:

- different government departments such as technology, health, education, commerce and industry; environment, youth;
- civil society groups including associations of hard of hearing; NGOs, professional societies,
- youth organizations;
- manufacturers;
- consumer electronics associations;
- major retail groups;
- consumer protection organizations;
- others as may be relevant in the context of the country.

Proposed steps

A step-wise approach, as proposed below, is recommended to ensure the inclusion of the WHO-ITU Global standard in relevant policies and regulations.

Step 1: Assessment and policy development

a. Conduct a situation assessment: The initiating department should carry out a situation assessment in order to understand:
- the safe listening features in the devices currently sold in the country;
- current statistics on hearing loss in the country/region, especially hearing loss caused by loud sounds, if available;
- existing policies related to hearing loss prevention, noise control and safe listening; who the main stakeholders are, including government departments, civil society groups, youth organizations, manufacturers.

A format for conducting a situation assessment can be found in Appendix 1.

b. Organize a planning consultation: Following the situation assessment, the initiating department/ministry should organize a meeting to plan for the implementation of the WHO-ITU Global standard and get a buy-in from all relevant stakeholders. This meeting should include all key stakeholders identified in step 1. During this meeting, results of the situation assessment should be presented, the WHO-ITU Global standard outlined, and further steps for its implementation proposed.

An outline of stakeholders' consultation is provided in Appendix 2.

c. Develop the policy on safe listening devices: The initiating department should draft the legislation, policy or regulation and discuss it with the relevant ministerial/government departments. It should then be shared with stakeholders to get their feedback, which should be addressed prior to finalization and approval of the policy document.

d. Determine ways and means for raising awareness among the target group: Along with development of the policy for safe listening devices, the initiating department should outline a strategy for raising awareness on safe listening and informing users about the new safe listening features proposed in the regulations. This should be done in consultation with relevant health professionals and communication experts. The country can make use of the validated WHO awareness materials that can be adapted and translated for use in the country.

Step 2: Launch and communication

a. Organize a sensitization workshop: Once the policy or legislation is finalized, a sensitization workshop should be held by the initiating department in collaboration with other departments involved. The purpose of such a workshop is to inform manufacturers and key retail groups of the rationale and intent of the regulations and to gain their support in their implementation.
An outline of the workshop is provided as Appendix 4, for guidance.

b. Undertake media outreach: A press announcement should be made to launch the new regulations. This should be accompanied by a media campaign through all channels relevant in the context of the country and the target group, e.g. social media, print media, digital media etc. Governments can launch these regulations on the World Hearing Day in order to maximize the advocacy effort.

Step 3: Implementation and monitoring

a. Monitor policy implementation: Implementation of the policy, regulation or legislation should be monitored by the government through established mechanisms.

b. Undertake evaluation and revision: The policy, regulation or legislation and its implementation should be evaluated at regular pre-designated intervals (e.g. every 2 years). This evaluation should further be discussed with the stakeholders and revisions made, depending on the feedback received.

Additional actions

Wherever possible, the government should make efforts to do the following:

 a. Monitor epidemiology of hearing loss: The relevant department in the Ministry of Health should regularly assess hearing loss prevalence in the target population through a population-based prevalence study. Such a study should ideally be done at the start of the initiative and repeated every 5 years.

 b. Carry out research: Relevant departments should assess the occurrence of hearing loss among users of personal audio devices.

Planning:
situation assessment, discussions,policy development, awareness raising

Launching:
sensitization workshop, media outreach

Monitoring implementation:
monitoring, evaluation, feedback, revision

Supporting actions:
assessment of hearing loss and listening behaviour outcomes
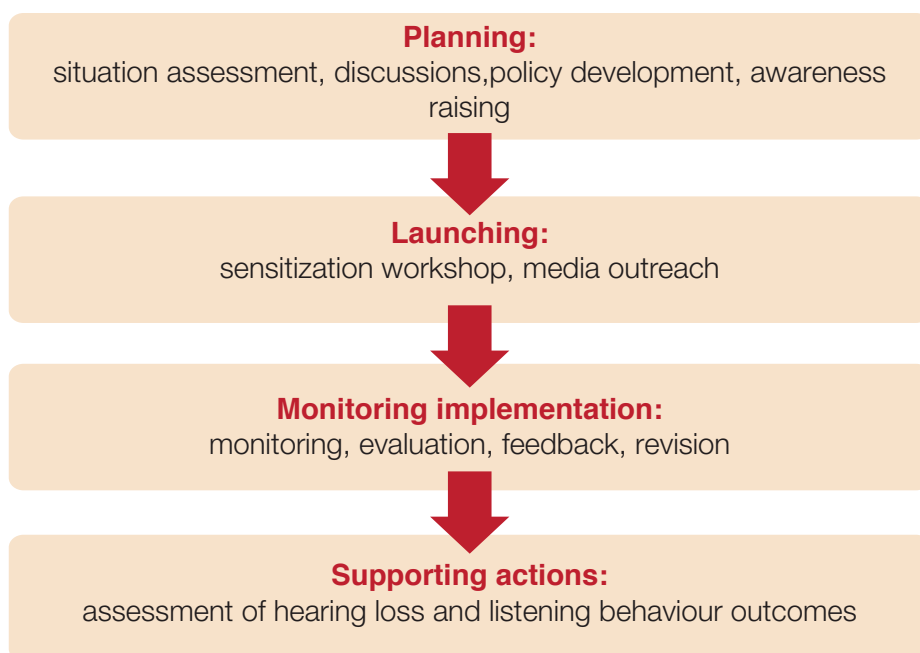
Tools

the following tools are available to guide governments in application of the WHO-ITU Global standard:

- Situation assessment/analysis tool (Appendix 1)
- Format for stakeholders consultation (Appendix 2)
- Introductory presentation with key messages (Appendix 3)
- Format for sensitization workshop (Appendix 4)
- Materials for raising awareness (Appendix 5)

Implementation by
industry partners

Implementation by industry partners

The section is intended as guidance for:

- Manufacturers of personal audio systems including:
  - Smartphones
  - MP3 players
  - Other devices with music playing capability
  - Headphones/earphones

Rationale

Investing in the hearing health of their customers makes good business sense for an industry that relies on considerably on its clients' ability to hear. At present, the increasing use of technology is part of the threat to good hearing. The easy access to such technology without any information or education on safe listening practices is putting at risk the hearing of millions of young people across the world. With the growing penetration of technology, this challenge is likely to grow too, unless concrete steps are taken.

At the same time, technology is being used successfully to raise awareness on various health issues and promote healthy lifestyles. This has led to an increasing number of health-related applications made available to users through certain devices. Following this approach, the appropriate use of technology can reduce the risk it poses to hearing.

Hence, as part of risk mitigation and in line with principles of responsible business, manufacturers of personal audio devices must share the responsibility of promoting safe listening practices, and to offset any potential harm from the use of their products.

This can be done by proper implementation of the WHO-ITU Global standard. Safe listening will reduce the risk posed to hearing and can potentially reduce the occurrence of hearing loss.

What actions can manufacturers take?

Manufacturers should take the following actions.

- Lead the field of safe listening by voluntary implementation of the WHO-ITU Global standard by ensuring that the personal audio devices manufactured by them comply with:
  - requirements of the WHO-ITU Global standard;
  - optional features within the WHO-ITU Global standard.

- Improve the accuracy of the 'dose/allowance' measurement by:
  – striving to improve the testing algorithm and minimize measurement errors;
  – ensuring that the algorithms are compatible with a large variety of commonly used headphones/earphones available in the market (including those manufactured by other companies).

- Experiment with and create a user interface that is both appealing and informative. The user interface should:
  – present information on safe listening in an engaging manner that appeals to the user;
  – provide information on the user's listening parameters and use of sound allowance in an easily understandable format;
  – provide access to reliable and validated sources of information on safe listening.

A complementary example is the case of digital subscriber line (DSL) technologies that enable broadband Internet access at homes. Amongst others, ITU-developed standard ITU-T G.993.1, which, while it was not mandated by governments, was selected by network operators in their procurement as the technology to enable data rates up 25 Mbit/s between their premises and a user's home. Beyond high speed Internet, this allowed network operators to simplify provisioning of the services and reduce costs. Equipment manufacturers could now bid for a larger number of contracts and offer units to end-users via retail channels. It benefitted users through reduced operation costs and allowing them to choose from a variety of equipment providers (knowing that interoperability was guaranteed).

Engaging partners

All stakeholders in the field should be involved, including:
- other manufacturers that have implemented the WHO-ITU Global standard;
- retailers that sell devices manufactured by the company;
- consumer groups, target group;
- government: when applying for any government contracts, the manufacturers can highlight the safe listening features available in their devices; others as may be relevant.

Proposed steps

Step 1: Planning

a. Carry out an internal assessment: Manufacturers should assess the current state of play relating to safe listening features in the devices they manufacture different parts of the world.

b. Download and understand the WHO-ITU Global standard: This can be found at *https://itu.int/rec/T-REC-H.870.* A summary outline is included in Appendix 6 of this document. Staff working on safety measures and acoustics in the company should read the full WHO-ITU Global standard and applicable references, and understand their implications.

c. Discuss implementation: Hold internal discussions regarding the method of including the proposed safe listening features in devices and devise a complete implementation plan.

Step 2: Development and testing of safe listening features

a. Develop and test a user interface: The WHO-ITU Global standard provides guidance on what sort of information should be conveyed through the device interface. Wherever possible, manufacturers should research this aspect and develop a user-friendly interface for safe listening features, in line with the WHO-ITU Global standard. Where manufacturers cannot or do not wish to undertake such research, they can follow the suggestions provided in Appendix 7

b. Develop and test messages and cues for action: Such messages and instructions have to be included within the user interface. It is important to test these, taking into consideration cultural, linguistic and regional contexts. Where a manufacturer is unable to or does not wish to engage in developing and testing an interface and messages, they could adopt the examples outlined within the tools (see Appendix 7 and Appendix 8)

c. Check that your device conforms to the WHO-ITU Global standard: Once the H.870 safe listening specifications are implemented in your company's products, they should be tested for compliance using a pre-established conformance assessment plan.

Step 3: Publicizing and promoting

a. Inform and train retailers: Once products that implement the WHO-ITU Global standard are available, retailers should be informed about these features and trained to promote them.

b. Popularize the safe listening features of your device: Wherever possible, advertisements and websites should highlight the safe listening features, which will help raise awareness on safe listening and highlight the company's responsible attitude towards its consumers.

Step 4: Reviewing and revision

a. Gather feedback from users: Manufacturers should regularly seek feedback from users regarding the relevance, user friendliness and clarity of safe listening features in their devices.

b. Undertake revisions and improvements: The user interface and messaging should be revised periodically based on user feedback.

c. Keep up to date with the latest version of the WHO-ITU Global standard: Manufacturers should revise the features as and when the WHO-ITU Global standard is revised.

Planning:
situation assessment, understanding the standards, internal discussions

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Development and testing:
user interface, messages, compliance testing

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Publicizing and promoting:
informing retailers, advertisements, websites

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Review and revision:
feedback, updates, revisions
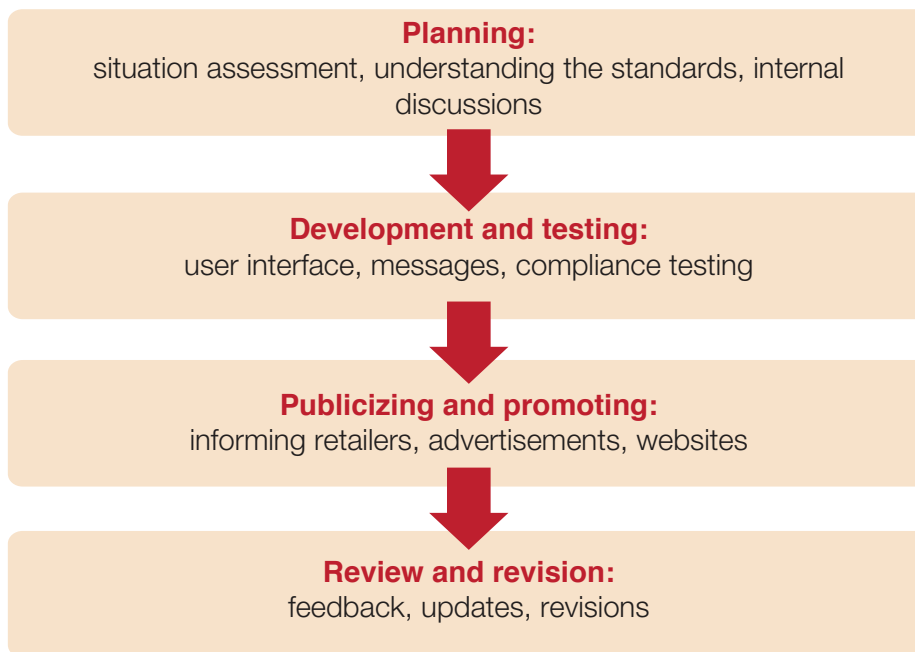
Tools

The following tools are available to guide manufacturers in application of the WHO-ITU Global standard:

- Summary of the WHO-ITU Global standard (Appendix 6)
- Example of information flow (Appendix 7)
- Key considerations when developing messages and generic examples (Appendix 8)
- List of information sources (Appendix 5)

Role of civil society
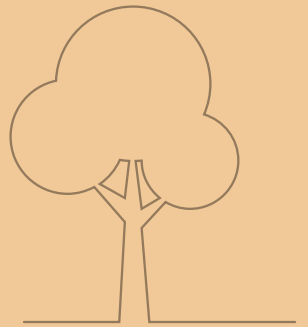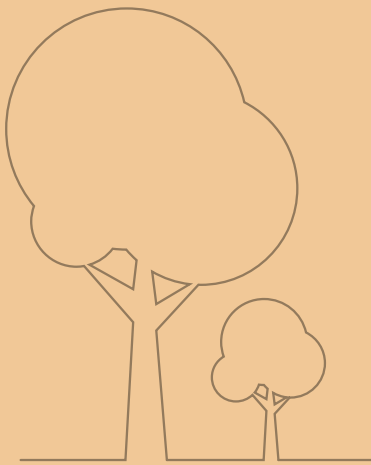
Role of civil society

The section is intended as guidance for professional associations and civil society organizations and groups working on:

- hearing loss prevention;
- noise control
- consumer rights.

Rationale

Exposure to loud sounds is a key contributor to preventable hearing loss. It is estimated that 50% of people using personal audio systems do so in a way that puts their hearing at risk. Implementation the WHO-ITU Global standard can promote safe listening behaviours and reduce the risk personal audio systems pose to hearing. Civil society partners should advocate with policy makers for their implementation as a means to prevent hearing loss.

What actions can civil society organizations take?

Civil society organizations should undertake the following actions:

- Advocacy work to persuade governments to develop regulations to implement the WHO-ITU Global standard.
- Awareness campaigns to sensitize people regarding hearing loss prevention and safe listening.
- Sensitization of manufacturers of devices to motivate them to voluntarily implement the WHO-ITU Global standard in the products they sell.

Engaging partners

All stakeholders in the field should be involved, including:

- Other organizations working in the field of hearing loss prevention, noise control and consumer protection.
- Departments of health, education and technology.
- Local schools.
- Media.
- Corporate social responsibility (CSR) departments of manufacturing organizations.
- Others that may be considered relevant.

Proposed steps

Step 1: Plan:

a. Identify and brainstorm with other stakeholders to plan actions.
b. Determine the target audience they will address e.g. policy makers, manufacturers, schools and universities, the community at large, others.
c. Identify the key messages to convey to these audiences and the impact they want to have (e.g. policy development by government; implementation of safe listening features by manufacturers; use of safe listening apps by young people etc.).
d. Establish what would be the most effective strategy to convey these messages e.g. through a meeting, media event, awareness sessions etc.

Step 2: Prepare

a. Review and adapt the WHO advocacy and awareness resources on safe listening to the local context and translate, if required.
b. Review other available materials on safe listening.
c. Finalize the resources and materials to be used.

Step 3: Advocate with the target group identified through available means.
This could include:

a. Media outreach;
b. Social media;
c. Websites;
d. Webcasts;
e. Workshops on safe listening in schools and universities;
f. Public events.

Step 4: Follow up with the target group and monitor outcomes and impact in terms of:

a. Policies established or actions initiated by governments;
b. Implementation of safe listening features by manufacturers;
c. Use of safe listening applications/features by users of personal audio devices;
d. Change in listening habits of users.

Planning:
identify stakeholders, brainstorming, determine target audience,
identify key messages, strategize

↓

Prepare:
review and adapt available advocacy materials

↓

Advocate:
with the target group

↓

Follow up and monitor outcomes

Tools

The following tools are available to guide civil society organizations in promoting the WHO-ITU Global standard:

- Awareness-raising materials for policy makers and the general population (Appendix 5)
- Social media materials (Appendix 5);
- Resources for school-based workshops on safe listening (Appendix 9).
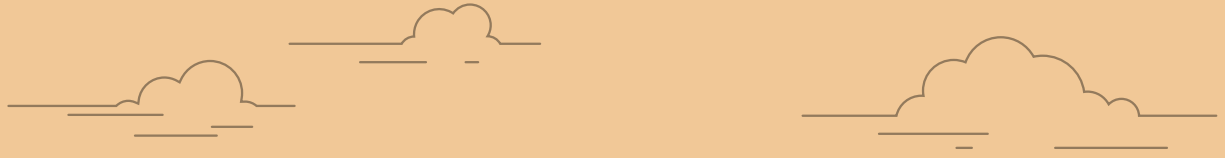
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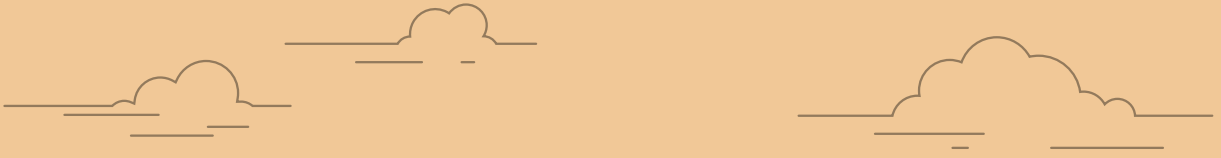
Appendices
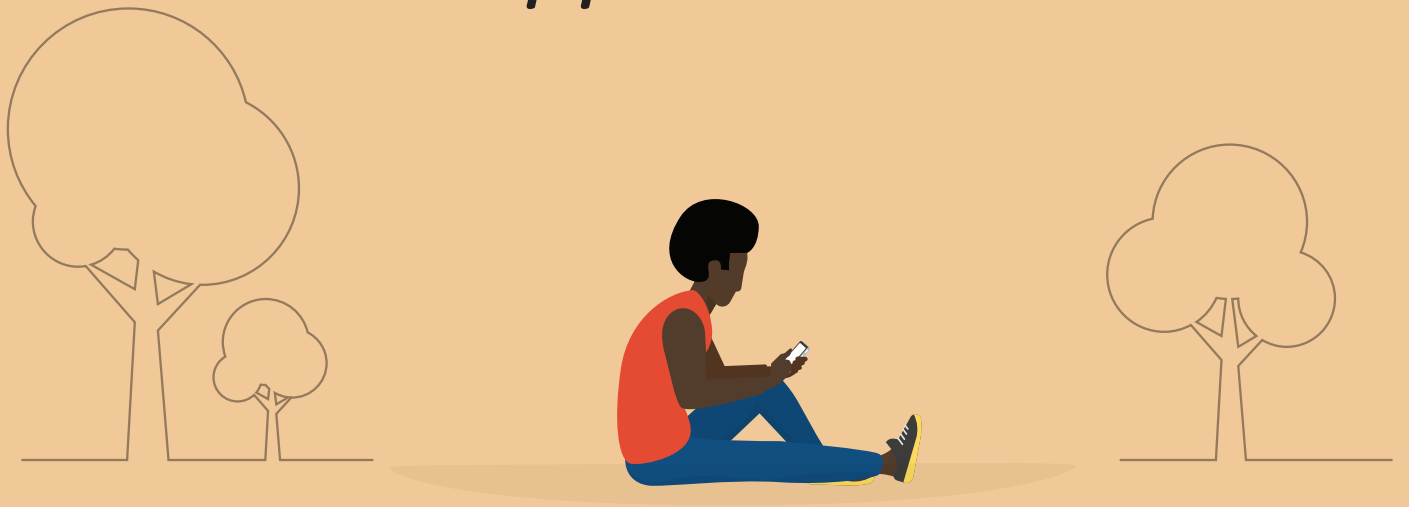
Appendix 1

Situation assessment tool

This situation assessment tool has been developed to help governmental departments and ministries gather relevant information to prevent unsafe listening, and to promote and regulate safe listening practices in their country under the WHO-ITU H.870 Global standard on safe listening devices and systems. Information to complete this assessment can be obtained from existing peerreviewed literature, World Health Organization (WHO) statistics, national statistics, and Ministry of Health documents. Technical assistance in conducting a situation assessment or using the results is available from WHO.

[Country name]

National data profile compiled by:	
National Data Coordinator Name of the person in charge of this Situation assessment	
Designation and qualification	
Institution	
Address	
Email	
Telephone numbers	

Respondent's details (this form can be duplicated for each person interviewed)	
Name	
Position/Title	
Institution	
Email	
Telephone numbers	
Fax	

Section A. General country information

Population profile	
Name of the area (state, region, province, district) (if relevant) for which this situation assesment is being undertaken	**Area**: 37 State: (optional) Region: (optional) Province: (optional) District: (optional)
Total number of mobile device users in the country/area	
Total number of mobile device users between the ages of 12 and 35 years	
Total number of smartphone users in the country/area	
Total number of smartphone users between the ages of 12 and 35 years	
Sex distribution of mobile device users (%)	Male: % Female:%
Rural-urban distribution of mobile device users (%)	Rural:% Urban:%
Literacy rate among mobile device users (as a % of total population)	%
Any other population-related factor that needs to be considered in mobile device services	

Mobile device usage

Languages used by mobile device users

Total number of personal audio devices sold in the country/area:
Number of smartphones sold:
Number of MP3 players:
Number of other related devices (personal audio players)

% of population/area reached by internet services:%

Number of companies that sell personal audio devices in the country/area

Name of mobile device brands sold in your country	[] Samsung [] Motorola [] Apple [] Alcatel [] Sony [] Nokia [] Huawei [] Google [] LG [] Other (please specify):
Names of leading retailers that sell mobile devices in the country/area	Names
Names of leading mobile phone service providers that operate in the country/area	Names

Hearing loss

Prevalence of disabling hearing loss:
Overall:%
Age group 12 to 35 years:%
Any other age group (as reported in literature): %

If information on disabling hearing loss is not available, indicate the definition used in estimation of prevalence:

What is the percentage of people with disabling hearing loss due to noise-induced hearing loss and other relevant causes?
Overall:%
Age group 12 to 35 years:%
Any other age group (as reported in literature):%

Section B. Leadership and governance

Lead agency profile	
Is there a government agency or department that takes responsibility for overseeing and/or coordinating hearing care activities/plans (i.e. a lead agency) in your country?	[] Yes (please name this agency) [] No (please skip to Section B) [] Don't know (please skip to Section B)
Where is this agency located within the government structure (please tick one)?	The agency is a single government ministry/department, or situated within one government ministry/department (please specify ministry and department, if relevant) [] Stand-alone entity [] Other (please specify) [] Don't know
For which of the following functions is the lead agency responsible? (please tick all that apply)	**Coordination** [] Coordination of intergovernmental working processes at central government level [] Coordination of hearing care decision-making across central government [] Coordination across different levels of government (e.g. central, regional, local) [] Coordination of national mass media initiatives **Legislation** [] Periodic review of legislation, rules and standards against best practice, and recommendations for improvement [] Development and/or revision of legislation **Monitoring and evaluation** [] Establishing and supporting data systems that are used to monitor safe listening devices [] Compilation and dissemination of national statistics **Other (please specify)**
Is funding allocated in the government's budget for the lead agency to carry out the functions listed above?	[] Yes [] No [] Don't know

Section C. Strategy and targets

National strategy profile	
Is there a national strategy for deafness and hearing loss prevention in your country?	[] Yes (please submit relevant source documents) [] No [] Don't know
If yes, does this strategy include prevention of recreational noise-induced hearing loss?	[] Yes (please submit relevant source documents) [] No [] Don't know
Is there a regulation regarding safe listening features in personal audio devices?	[] Yes (please submit relevant source documents) [] No [] Don't know
If answer to any of the above is yes, do any strategies that exist include volume regulations on personal audio devices such as mobile phones, mp3 players, tablets, etc?	[] Yes (please submit relevant source documents) [] No [] Don't know
Is there an awareness programme regarding noise control in environmental/recreational settings?	[] Yes (please provide details/source documents as annex) [] No [] Don't know
If yes, does the awareness programme include a focus on safe listening?	[] Yes (please submit relevant source documents) [] No [] Don't know
Are funds available to implement part or all of any strategies that exist?	[] Yes, fully funded [] Partially funded [] Not funded [] Don't know

If a national strategy exists, does it set measurable targets to increase the number of personal music players with safe listening features?	[] Yes
	[] No
	[] Don't know
	
	If yes, please provide the targets and their timeframes:
	    • Device targeted increase:
	
	    • Time period relating to device target (please specify start and end years that these targets relate to, e.g. (2002–2012) (2016-2020)

Does the national strategy include recommendations for any of the following:	
Reducing volume level	[] Yes [] No [] Don't know
Allowing users to keep track of their sound usage	[] Yes [] No [] Don't know
Showing messages to the user when reaching unsafe volume levels	[] Yes [] No [] Don't know
Showing messages about safe listening practices	[] Yes [] No [] Don't know
Encouraging the use of earplugs in loud environments such as bars, sporting events and concerts	[] Yes [] No [] Don't know

Section D. Stakeholder analysis

Please mention all potential and existing stakeholders in your country that are or could be involved in ear and hearing care services. Identify the lead or responsible position or person, where possible, and give contact details.

Stakeholder profile
Government departments
List in order of perceived priority for collaboration in developing and implementing a safe listening strategy

	Name of Department	Lead/contact person (name and designation)	Contact details	Level of influence (1–10)	Level of interest (1–10)
1.			Address: Telephone no: Email:		
2.			Address: Telephone no: Email:		
3.			Address: Telephone no: Email:		
4.			Address: Telephone no: Email:		
5.			Address: Telephone no: Email:		

	Name of Institute or association	Lead/contact person (name and designation)	Contact details	Level of influence (1–10)	Level of interest (1–10)
Professionals and academics **List in order of experience and interest in the development and implementation of the safe listening strategy**					
1.			Address: Telephone no: Email:		
2.			Address: Telephone no: Email:		
3.			Address: Telephone no: Email:		
4.			Address: Telephone no: Email:		
5.			Address: Telephone no: Email:		

Civil society groups, including disabled persons' organizations List in order of perceived priority for collaboration in developing and implementing the safe listening strategy					
	Name of Institute or association	Lead/contact person (name and designation)	Contact details	Level of influence (1–10)	Level of interest (1–10)
1.			Address: Telephone no: Email:		
2.			Address: Telephone no: Email:		
3.			Address: Telephone no: Email:		
4.			Address: Telephone no: Email:		
5.			Address: Telephone no: Email:		

UN agencies					
	Name of agency	Lead/contact person (name and designation)	Contact details	Level of influence (1–10)	Level of interest (1–10)
1.			Address: Telephone no: Email:		
2.			Address: Telephone no: Email:		
3.			Address: Telephone no: Email:		
4.			Address: Telephone no: Email:		
5.			Address: Telephone no: Email:		

	Name of Company	Lead/contact person (name and designation)	Contact details	Level of influence (1–10)	Level of interest (1–10)
1.			Address: Telephone no: Email:		
2.			Address: Telephone no: Email:		
3.			Address: Telephone no: Email:		
4.			Address: Telephone no: Email:		
5.			Address: Telephone no: Email:		

Any others (can include any other groups that are interested in hearing loss prevention, noise control, audiology, acoustics or consumer rights)					
		Lead/contact person (name and designation)	Contact details	Level of influence (1–10)	Level of interest (1–10)
1.			Address: Telephone no: Email:		
2.			Address: Telephone no: Email:		
3.			Address: Telephone no: Email:		
4.			Address: Telephone no: Email:		
5.			Address: Telephone no: Email:		

Appendix 2

Outline of stakeholders planning meeting for regulations on safe listening

The following stakeholder groups should be invited to the meeting:

- Relevant government departments: technology, health, education, commerce and industry, environment, youth
- Civil society groups including associations of hard of hearing; ngos, professional societies
- Youth organizations
- All manufacturers
- Consumer electronics associations
- Major retail groups
- Consumer protection organizations
- WHO and ITU representatives

Purpose:

- To inform stakeholders about the global standards and the country's intention to implement them
- To gain buy-in from relevant stakeholders in this respect
- To discuss the way forward regarding adoption of standards and their implementation
- To agree on timelines
- To discuss customization and adaptation of the awareness materials

The following outline is suggested:

- Introductions
- Need for safe listening
- Current status in the country regarding regulations on safe listening
- Global standards for safe listening
- Perspectives required to implement safe listening strategies and regulations:
  - Government (Technology, health, any other)
  - Users (one representative to present user view)
  - Industry (umbrella organization or a company with leadership in this field to speak on behalf of industry)
  - Hearing care profession (one member from a professional, hearing-related organization to speak)
  - Civil society view (one speaker from a relevant civil society group to speak)
- Possibilities regarding adoption and implementation of the Standard in the country (including timelines): discussion
- Need for raising awareness and available tools
- Determining the next steps for:
  - developing a regulation/legislation;
  - developing an awareness campaign and adapting awareness materials.

Appendix 3

Make listening safe initiative: Introductory presentation

WHO estimates that 1.1 billion young people worldwide could be at risk of hearing loss as a result of unsafe listening practices.

Hearing loss is on the rise!
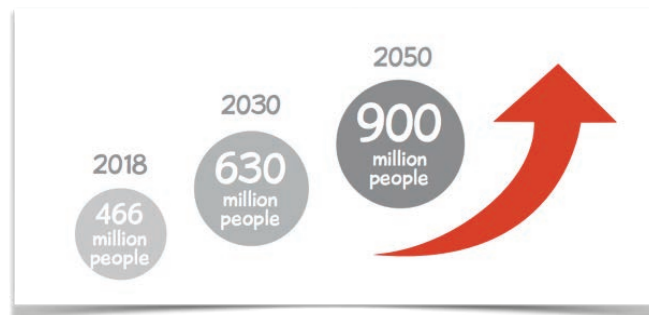
Overarching messages

- Rise and ageing of the global population
- 466 million people globally are currently living with disabling hearing loss
- 630 million people estimated to be living with disabling hearing loss by 2030
- Over 900 million estimated to be living with disabling hearing loss by 2050

Stevens G, Flaxman S, Brunskill E, Mascarenhas M, Mathers CD, Finucane M. Global and regional hearing impairment prevalence: an analysis of 42 studies in 29 countries. Eur J Public Health 2013; 23: 146-52 (http://dx.doi.org/10.1093/eurpub/ckr176, accessed 19 January 2019).

How do we hear?
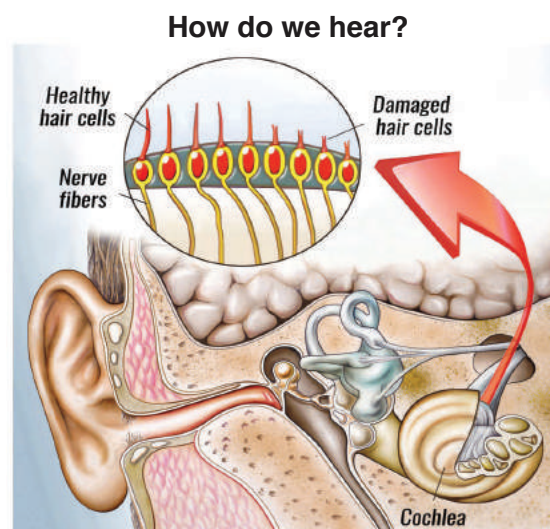
Recreational noise, unsafe listening practices and the impact of hearing loss

• Those exposed to loud sounds in social settings over the past 20 years are over three times more at risk of hearing loss compared to those unexposed.
• 50% of people listening to music over their personal audio devices do so at levels which put their hearing at risk.
• 5–10% of listeners are likely to develop hearing loss due to their personal volume preferences and duration of listening.
• Depression, isolation, frustration, cognitive decline and decreased personal safety are twice as common among seniors with hearing loss than those without hearing loss.

Noise-induced hearing loss is irreversible

Photos from top to bottom by Thibault Trillet, Kevin Grieve, Simon Matzinger, Adobe PhotoStock.

Make listening safe initiative

Prevention

This means creating an environment that enables the exercise of safe listening practices, including through:

- • Regulating exposure to loud sounds through personal audio systems.
- • Undertaking public awareness campaigns to change listening behaviours among people aged 12 to 35 years.
- • Developing a regulatory framework for safe listening in recreational settings.

WHO-ITU H.870 Global standards for safe listening devices and systems

Smartphone technology can provide a platform to deliver targeted, customized safe listening interventions while continuing to provide an enjoyable experience to the listener.

Technical aspects

Acoustic dosimetry

- • Tracking users' exposure time to sound
- • Estimating sound level
- • Estimating % used of a reference exposure, or sound allowance

- • **Mode 1:** (WHO) standard level for adults: 85 dBA SPL for 40 hours per week
- • **Mode 2:** (WHO) standard level for sensitive users (e.g. children): 80 dBA SPL for 40 hours per week

Volume limiting

- Volume limiting message
- "Continue listening" option
- Default action: to reduce the volume output to a predetermined level
- Customizing option

Parental control

- Maximum sound output can be fixed and locked in the device's settings

Communication aspects

Personal usage information

- Listening habits, including sound allowance
- How to use safe listening features

Personalized recommendations and cues

- Actions for safe listening
- Customized advice based on user's listening profile

General information

- Safe listening and ways to practice it
- Risk associated with unsafe listening
- Risk of hearing loss due to loud sounds from sources other than personal audio devices and systems

Make listening safe toolkit

Practical guide for implementation and follow-up of global safe listening standards in recreational settings to be adopted by all countries worldwide

- Designed to support countries, industries and civil society in approaching noise-induced hearing loss prevention in a strategic, evidence-based and user-friendly way.
- Targets three key stakeholders that can be instrumental in implementing the standards
- Government: ministries/departments working in the field of health or technology
- Industry: manufacturers of personal audio devices and systems
- Civil society organizations: field of hearing or consumer rights

The processes, steps and tools are provided for guidance and can be adapted, translated or modified by stakeholders to suit the needs of individual countries and manufacturers.

Appendix 4

Outline of sensitization workshop for regulations on safe listening

The following groups should be invited to participate in the workshop:

- Relevant government departments: technology, health, education, commerce and industry, environment, youth
- All manufacturers
- Consumer electronics associations
- Major retail groups

Purpose:

To sensitize manufacturers and retailers regarding regulations on safe listening devices and to to guide them regarding implementation, timelines and reporting.

The following outline is suggested:

- Introductions
- Rationale for safe listening standards
- Outline of national regulations on standards: essential and optional components
- Timelines for implementation
- Monitoring/reporting mechanism on implementation
- Manufacturers' issues and concerns
- Awareness materials that can be used for by manufacturers for distribution, social media and websites

Appendix 5

Advocacy materials

Goal

These awareness materials are designed to inform people about the risk of hearing loss due to unsafe listening; the concept of safe listening; and available tools to promote its practice.

Who are these materials for?

These evidence-based advocacy materials are intended to provide key stakeholders (government, industry and civil society organizations) with tools to raise awareness among policymakers and the public about safe listening.

Communication objectives

- Raise awareness and engage the public on the importance of safe listening practices.
- Create a conversation on the risk of hearing loss due to loud sounds from sources such as personal audio systems and mobile devices.
- Raise awareness about the risks of unsafe listening practices among teenagers and young adults.
- Build an understanding of the importance of multisectoral engagement and action for implementing the WHO-ITU H.870 Global standard for safe listening devices and systems.
- Promote examples of good multisectoral engagement leading to successful interventions that have addressed the issue of exposure to loud sounds in recreational settings.

Overarching messages

- Noise-induced hearing loss is irreversible!
- Prevention is one of the most effective strategies to reduce the occurrence of noise-induced hearing loss.
- Keeping the volume within safe levels and limiting the time spent engaged in noisy activities can reduce the risk of hearing loss.
- Smartphone technology can be used as a means to promote and practice safe listening.
- The design and implementation of specific legislation can lead to a lower level of sound exposure

Advocacy materials

WHO's resources to promote safe listening are available at:
www.who.int/deafness/make-listening-safe/advocacy-materials/en/

Share information and materials on social media

Our social media channels

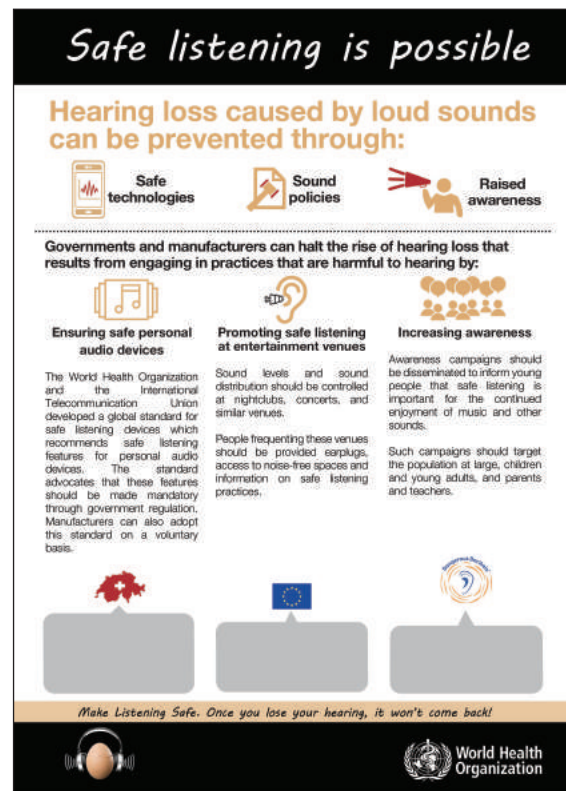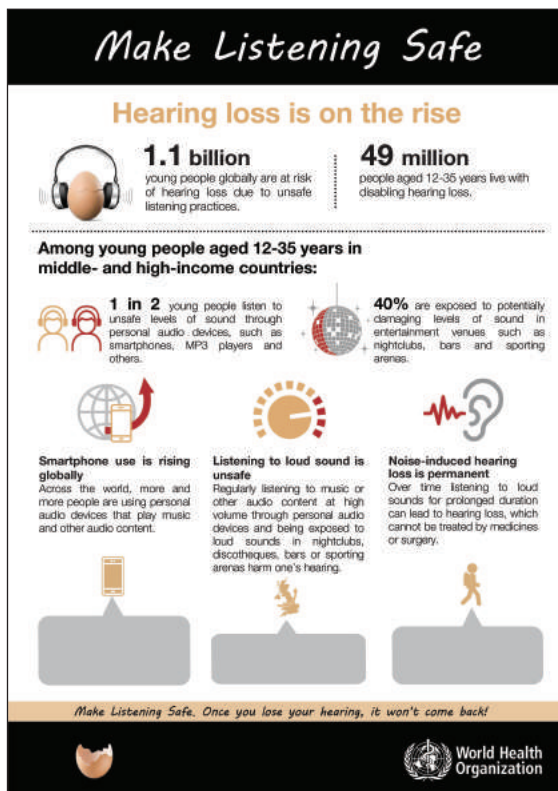- Follow us on Twitter, Facebook and Instagram **@WHO** and tag us in your posts

Twitter official hashtag

- #SafeListening

Twitter official hashtag

- #WHO
- #HearingCare
- #HearTheFuture
- #WorldHearingDay

Infographic

Poster

Brochure

Tips for safe listening

Press release

Related document
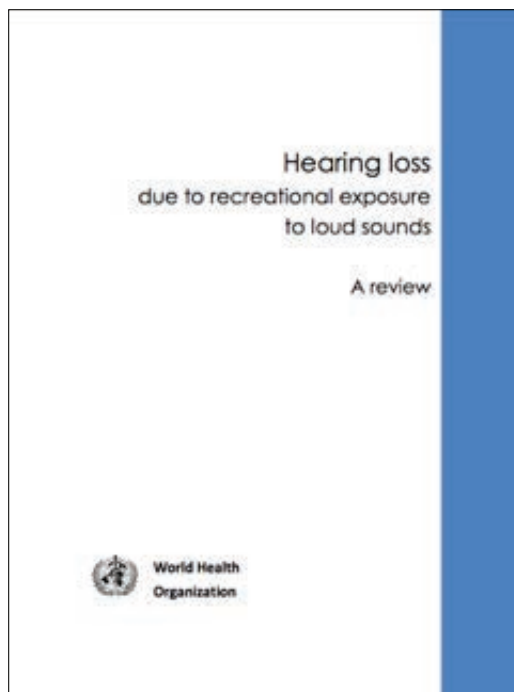
Videos

Facebook posts

Instagram posts

Tweets

FAQs

1. Introduction
2. How is loudness measured? What is dB?
3. What is safe listening?
4. How do loud sounds affect my ears?
5. How can I tell if my hearing has been affected?
6. Once I have lost my hearing can I get it back?
7. Is there a way to use a mobile phone to monitor my listening levels?
8. How can I monitor sound exposure or daily allowance for music that is not stored on my device?
9. What can I do to make my listening safe?
10. What can I do as a parent to ensure safe listening?
11. What can I do as a teacher to ensure safe listening?
12. What can I do as a physician to ensure safe listening?
13. What can I do as a manager of an entertainment venue to ensure safe listening?
14. What can I do as a manufacturer of personal audio devices to ensure safe listening?
15. What can governments do to ensure safe listening?

Relevant websites

- World Health Organization (WHO) http://www.who.int/deafness/make-listening-safe/en/
- Centers for Disease Control and Prevention (CDC)
  https://www.cdc.gov/hearingloss/default.html
- Action on Hearing Loss https://www.actiononhearingloss.org.uk/
- European Union of the Deaf https://www.eud.eu/
- Hear The World Foundation https://www.hear-the-world.com/en
- American Speech Language Hearing Association – Listen To Your Buds campaign
  https://www.asha.org/buds/
- Dangerous Decibels http://dangerousdecibels.org/

Media interest

If you are a journalist interested in covering issues related to the Make Listening Safe initiative please email us at whopbd@who.int

Appendix 6

Summary of WHO–ITU global standard H.870 for safe listening devices and systems

Safe listening refers to listening behaviour that does not put a person's hearing at risk. The risk of hearing loss depends on the level (loudness), duration (time period) and frequency of exposure to loud sounds. Such exposure may be through personal audio devices, in entertainment venues, or outside (for example in traffic), in the workplace, or at home.

The WHO–ITU H.870 standard describes requirements for personal and portable audio systems, especially those for playing music, with the aim of protecting people from developing hearing loss as a result of their use. It provides a glossary for common terms to help understanding, as well as background information on sound, hearing and hearing loss.

The Standard recommends criteria for avoiding unsafe listening: one for adults and the other for children, both based on the equal energy principle.

Importantly, the Standard provides guidelines on health communication for safe-listening so that appropriate warning messages can be delivered effectively when necessary. Examples of such messages can be found in the Standard's Appendix VII.

Finally, the Standard also provides information about implementation of dosimetry and related issues. The key aspects of the WHO–ITU H.870 standard for safe listening devices/systems are summarized below.

1. Scope of the standard

This document describes requirements for personal/portable audio systems, especially those used for playing music, in order to reduce the risk of hearing loss posed to the users of these devices.
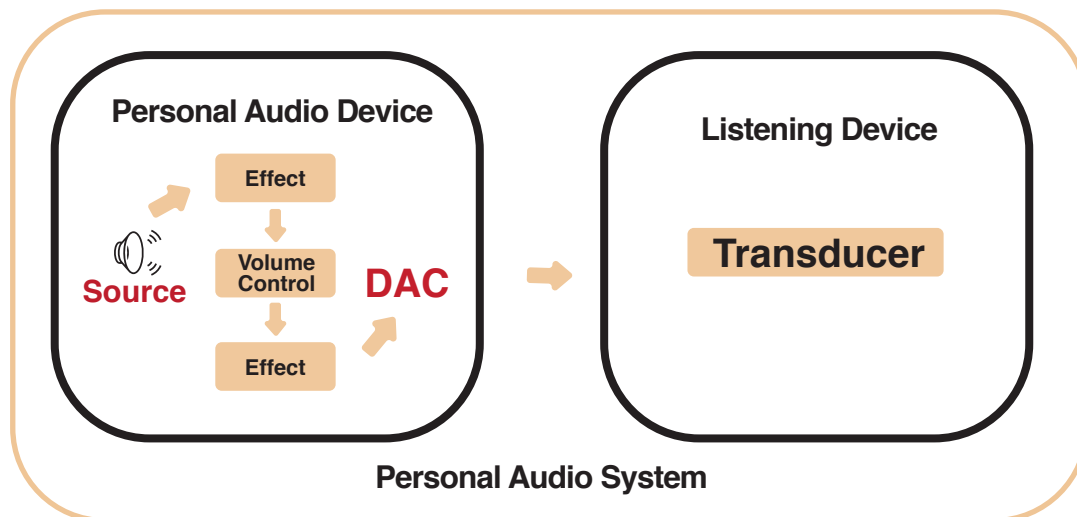
Figure 6.1: Architecture of a personal audio system

In such devices, "source" can be either stored or retrieved remotely, e.g., streaming from a local server or the Internet (see Figure 6.1)

A PAS is intended for use by an ordinary person and;

- is designed to allow the user to listen to audio or audiovisual content / material; and
- uses a listening device, such as headphones or earphones that can be worn in or on or around the ears; and
- has a player that can be body worn (of a size suitable to be carried in a clothing pocket) and is intended for the user to walk around with while in continuous use (for example, on a street, in a subway, at an airport, etc.)

Examples are portable CD players, MP3 audio players, mobile phones with MP3 type features, PDAs or similar equipment. For the purposes of this Standard, the following types of devices are excluded:

- Communication devices (walkie-talkies, etc.)
- Rehabilitative and medical devices (e.g. hearing aids, FM systems, and other assistive listening devices (ALD) approved as part of hearing aids and cochlear implants systems, etc.)
- Personal sound amplification devices
- Professional audio equipment and devices
- Portable game consoles

2. Equal energy principle

The recommendations of this Standard are based on the equal energy principle. This is the assumption that the total effect of sound on ear and hearing is proportional to the total amount of sound energy received by the ear, irrespective of the distribution of that energy in time.

According to this principle, equal amounts of sound energy is expected to cause equal amounts of sound induced permanent threshold shift regardless of the distribution of the energy across time.
In practical terms this implies that listening to lower volumes for long periods of time can have the same impact as listening to very loud volumes for a short duration e.g. listening to a 100 dB sound for 16 minutes will have the same impact as listening to an 80 dB sound for 40 hours.

Based on this principle, "dose" of sound energy is defined as the squared A-weighted sound pressure, p_A, integrated over the exposure time $T = t_2 - t_1$
Mathematically, this is expressed as:

$$dose = \int_{t1}^{t2} (p_A(t))^2 dt$$

Where p_A is the A-weighted and diffuse-field corrected sound pressure.

The unit of this value is Pascal squared hours, or Pa2 h.

3. Reference exposure/sound allowance, operational modes

It is recommended that each device includes a system that tracks the user's exposure time and loudness level, and estimates the percentage used of a reference exposure (also referred to as sound allowance)

This must take account of all media played through the device (i.e. whether it is stored on the device itself, or streamed) during times when the user is using ear/headphones. Voice calls may be excluded as they are separately specified by other standards.

It is also recommended that the device allow the user to select their reference exposure as one of two operational modes:

> **Mode 1:** (WHO) standard level for adults. This will apply 1.6 Pa2h per 7 days as the reference exposure (derived from 80dBA for 40 hours a week)
> **Mode 2:** (WHO) standard level for sensitive users (e.g. children). This will apply 0.51 Pa2h per 7 days as the reference exposure (derived from 75dB for 40 hours a week)

The user should be allowed to select either of the two modes when using the player for the first time (or when the device is reset to factory settings). It should be possible for the user to change the mode choice at a later time, e.g. via a device settings menu.

Sound allowance

Refers to a dose estimate of sound exposure over a certain rolling period of time (e.g., daily or weekly), commonly expressed as a percentage of the reference exposure. A 100% weekly sound allowance is equivalent to the weekly reference exposure, based on the mode selected.

Examples of weekly listening time duration based on sound allowance for the modes described earlier can be found in Table 1 and Table 2.

Table 1: Example of weekly listening time for Mode 1

dB(A) SPL	Weekly ($1.6\ Pa^2h$)
107	4.5 minutes
104	9.5 minutes
101	37.5 minutes
98	75 minutes
95	2.5 hours
92	5 hours
89	10 hours
86	20 hours
83	20 hours
80	40 hours

Table 2: Example of weekly listening time for Mode 2

dB(A) SPL	Weekly ($0.51\ Pa^2h$)
107	1.5 minutes
104	3 minutes
101	6 minutes
98	12 minutes
95	24 minutes
92	48 minutes
89	1 hours 36 minutes
86	3 hours 15 minutes
83	6 hours 24 minutes
80	12 hours 30 minutes
77	25 hours
75	40 hours

4. Measurement methods/acoustic dosimetry

Standard H.870 defines dose in the context of acoustic audiometry. Under mode 1, 1.6 Pa2h constitutes 100% weekly sound allowance, corresponding to 100% calculated sound dose (CSD) as defined in [EN 50332-3]. For mode 2, 0.51 Pa2h is the total weekly sound allowance or reference exposure.

Standard H.870 also refers to other related standards that describe a dose measurement system in a portable music player (PMP). [IEC 61252] describes acoustic dosimeters to be worn on the body including [EN 50332-1], [EN 50332-2] and [EN 50332-3].

Appendix II of H.870 gives an example of how a dosimeter can be implemented in a personal audio system when measuring the digital media signal and considering known or assumed properties of headphones. It is based on the equal energy principle in hearing loss risk assessment, where the squared A-weighted sound pressure, integrated over the exposure time, constitutes the dose.

The dosimeter functionality is tested by playing the programme simulation sound according to [EN 50332-1] and [IEC 60268-1] and measuring the time until the dose estimate reaches 100% CSD, using interpolation and tolerances as described in [EN 50332-3]. Such testing may be performed in the acoustic domain (when a certain headset is used) or in the electrical domain using a 32 Ω resistive load (when the headset characteristics are unknown). See measurement setup information in [ITU-T P.381].

Uncertainties: In estimating sound dose there are a number of sources for uncertainties and margin of error can be very high. It is therefore suggested to refrain from signalling "safe" and "green" to the user based on dose readings below a certain limit. The dose estimation is however relevant in accounting for the general trends:

- Higher signal level means higher risk
- Longer exposure means higher risk
- The spectral content of the music is accounted for

5. Health communication

A key aspect of the Standard is to provide user with a tool that will allow them to monitor their own personal sound exposure. Such a tool should give users the choice of safe listening, and empower them to make informed choices for listening through greater awareness.

This section of the Standard summary outlines its health communication aspects that should be applied for complete implementation of standards for safe listening devices. Specifically, it presents evidence-based recommendations on how to communicate the risks of unsafe listening and support users in adopting appropriate behaviour in this respect.

Purpose of including health communication as part of the standards for safe listening personal audio systems

The intent is to provide users with information and guidance to enable them to make safe listening choices. These include providing:

- Personal usage information, in order for the user to know:
  - their own listening habits (use of daily and weekly sound allowance);
  - how to use safe listening features of the specific devices.
- Personalized recommendations and cues for actions for safe listening, customized based on each user's listening profile.
- General information on:
  - safe listening and ways to practice it;
  - the risk associated with unsafe listening;
  - the risk of hearing loss due to loud sounds from sources other than the personal audio system.

This information and guidance must be shared by default with users via their mobile devices in order to reduce the risk of hearing loss.

Key recommendations for communication as part of safe listening devices

Information and messages on safe listening must be provided through:

- the device interface[3] (wherever an appropriate visual interface is available);
- instruction manuals;
- when possible, information about the safe listening features of the device should be included on or in the packaging.

Refers to the hardware components (such as screen) that allows a human being to interact with an electronic device.

6.1 Information delivered through device interface

Personal usage information

Information regarding various listening parameters defining the users' listening habits should be accessible to users in order to allow them to keep track of their exposure to sound through the device. For devices with a screen, this could be through an icon on the screen.

Through the icon, the user should be able to see their use of daily/weekly sound allowance in an easy to understand presentation, e.g. the person may be able to view how much of the weekly sound allowance has been used and to see how their listening behaviour has been over the past seven days. In devices without screen, the information should be made available through alternate means, such as audio cues.

The device (when capable) should display:

- the average sound level for the day and week;
- the time for which the user has listened in hours and minutes over the day and the week.

Figure 6.2 gives a non-normative example of information provided on a smartphone visual interface for safe listening
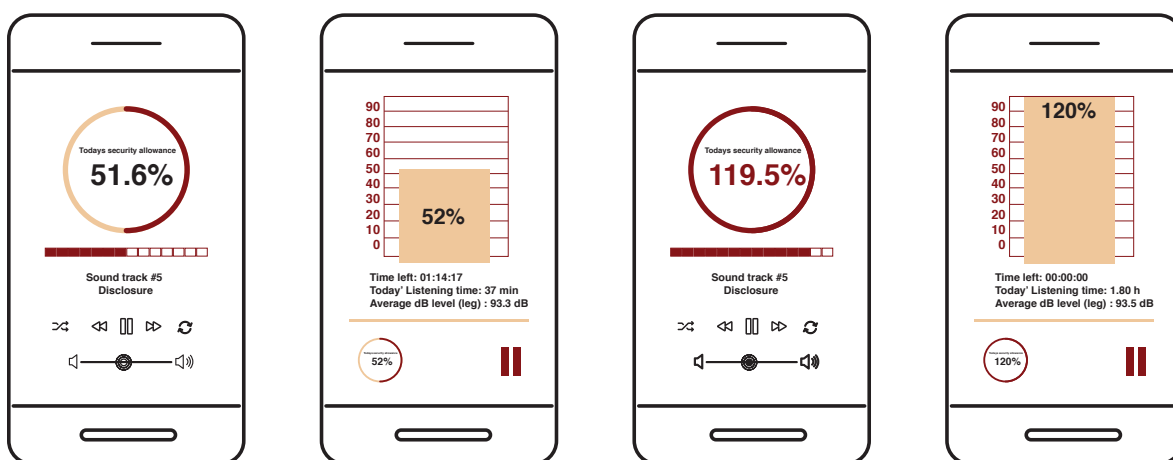
Figure 6.2: Examples of information provided on a smartphone visual interface for safe listening

Personalized recommendations and cues for actions and messages:

a.The device should give relevant warnings and cues for actions when the user exceeds 100% of the weekly allowance.
- The user will receive first a "warning" expressed through text and visuals informing that a threshold has been reached and that from this point on, further listening at the same volume will pose a hearing risk.
- The warning will be followed by a "cue for action" in which the user is offered the choice to either accept the risk of continued listening or protect their hearing. The "cue for action" should be linked to active options on the device, such as:
    – automatic safe volume option, by which the device automatically changes the volume to a safe volume level;
    – direct access to volume settings;
    – set up of default volume limits;
    – "remind me later" option;
    – "ignore and continue" option.
- If the user fails to take any action, the volume will automatically be reduced to below the standard level (80 or 75 dBA as selected).

b.The device should provide relevant messages when the sound allowance usage reaches certain pre-determined levels. Refer to Appendix 8 for the suggested levels at which warnings/cues can be given and sample content.

Such warnings depend on the device's capability and should be multimodal, e.g. a mix of visual, vibratory or audible warnings, in order to ensure that the user's attention can be directed towards these.Figure 6.3 gives non-normative examples of messaging displayed in a smart watch.

Figure 6.3: Example of messaging displayed in a smart watch

Daily messages: the device should provide a daily summary message based on the user's listening behaviour in recent days, encouraging safe listening habits and discouraging or warning against unsafe listening habits. Examples of such messages are provided in Appendix 8

General information: when the device has a screen, information on what is safe listening and its benefits – as well as the risks posed by unsafe listening – should be displayed on the screen. It is recommended that the availability of this information be indicated on the user interface (home screen) through a distinct and recognizable icon. Figure 6.4 gives a non-normative example of a safe listening icon displayed on a smartphone screen.
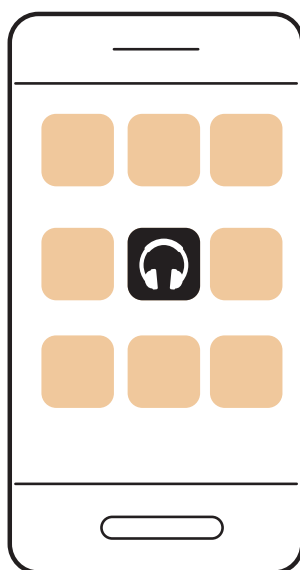
Figure 6.4: Safe listening icon displayed on a smartphone screen

There should be a tutorial informing users about safe listening; the risks of unsafe listening; and the device's safe listening features and how to use them. The screens should also include links to relevant webpages where the user can find more information. Figure 6.5 gives non-normative examples of screens linking to information on safe listening and external links.

Figure 6.5: Examples of screens linking to information on safe listening and external links

6.2 Information delivered by means other than the device itself

User manual

The user manual should clearly state that unsafe listening practices using the device pose the risk of permanent hearing loss. It should also give details of the volume-limiting functions and cues for action.

The user manual should also clearly outline how the allowance-assessment system works and refer to its uncertainty. It should indicate that information on the device does not take into account additional sources of sound exposures either from other audio devices or environmental sound exposure.

The manual could also provide information regarding hearing protections from loud environmental sounds in order to minimize the risk of hearing loss.

Packaging

Wherever possible, a clear, concise message or warning should included on the external packaging of the device. It is recommended that such a warning/message be:

- concise, simple and clear;
- accompanied by a relevant illustration;
- positioned on a plain background.

Website and advertising

Information on safe listening should be included on the manufacturer's website. Such information should be aligned to the specifications in Standard H.870. A link to WHO website and other relevant, reputable websites could be included.

Wherever possible, advertising of products could also provide relevant information. Such information can refer to both the potential harm to hearing through improper use of their device and the advantages of listening safely in order to maintain healthy hearing while enjoying a good listening experience.

7. Volume control

Volume limiting: as per Standard H.870, the device should provide the user with a suitable method for volume-limiting. This refers to a feature where a message will be given before or when the user reaches 100% of the weekly allowance, offering them the option to "continue listening", if they do not wish the device volume to reduce. When the message is not acknowledged, the default action will be to reduce the volume output to the predetermined level. If possible, users should be given the option to customize this level (the level at which they would like their device to limit the volume) according to their preference.

Parental control: it is recommended that the device should have the option whereby the maximum sound output can be fixed and locked in the settings, possibly through use of a password. The purpose of this feature is to allow parents (or other adults) to limit the maximum sound output of the child's device, in a way that cannot be changed by the child. The feature can also be used by individual users in order to limit their own sound exposure, by fixing the maximum output on their device.

Appendix 7

This section and the figure below contains suggested steps for explaining how the communication aspects of the standard can be implemented within devices

Packaging
- **A clear, concise message/warning should be included on the external packaging of the devices, wherever possible.**
- **Messages should appear on a plain background and be short, simple, and clear, with a relevant illustration.**
- **The manual should clearly state that unsafe listening via the device may pose the risk of permanent hearing loss.**
- **It should indicate that the device is equipped with safety features to help users protect their hearing.**

User manual
- This message should align with information provided through the device interface. It should contain similar text regarding the risks of hearing loss from unsafe listening and the recommendations for safe listening.
- It should also detail the safe listening features within the device.

Device interface
- **A visible icon on the device screen will direct users to the general information on safe listening. ·This icon will also lead the user to a display (in devices with screens) which provides information regarding individuals' listening parameters and (daily and weekly) usage statistics.**

1st use
- The first use of ear/headphones with the device should direct the user to a tutorial with information on safe listening, how to practice it, and their personal listening profile (same information as available through the icon).
- It will describe the standard levels for adults and children and allow the user to select a level.
- Users will be given the option to set up how often and at what levels of usage they wish to receive the notifications.

Personal Usage
- **The information on the daily/weekly sound allowance consumption is available to users at any time through the distinctive icon above mentioned.**
- **Calculation should include all sounds played through the music players or online, as long as ear/headphones are used.**
- **The displayed information should include: weekly allowance used and remaining; listening time (for the day/week), and indicate how the user's listening has been for the past 7 days, including current day, where possible.**

Notifications
- Warnings and cues for action shall be delivered every time the user reaches 100% of the allowance exposure levels and also as per settings customized by the user.
- These should be visual (where possible) and audible/vibratory to ensure that the user's attention be directed towards these.
- The notifications should include information on the level of audio usage and the corresponding recommendations for safe listening.

Daily alerts
- **The first time a user connects to an ear/headphones or starts playing music on a given day, the device could give a welcome message based on the usage on the previous days/week.**

Figure 7.1: Flow of information as part of standards for safe listening devices

Example of how the information on listening parameters can be conveyed to users

Through a clearly recognisable icon, users should be able to access a "dedicated space" (screen) on the device where information on the user's listening habits is stored, visualized and interpreted. In this space, the user should be able to access a graphic representation of his/her overall listening habits or patterns and learn if (and what type of) unsafe listening practices have occurred. The visualization of the user's listening habits will include:

- graphic display of the use of weekly sound allowance;
- graphic display of daily sound exposure through a colour-coded display;
- duration of listening, over each day and the past 7 days in hours and minutes.

1. Information on use of weekly allowance

Use of weekly allowance can be graphically conveyed as illustrated in Figure 7.2

60% 40%

Listening time (for last 7 days):
4 hours 20 minutes

Used   Remaining
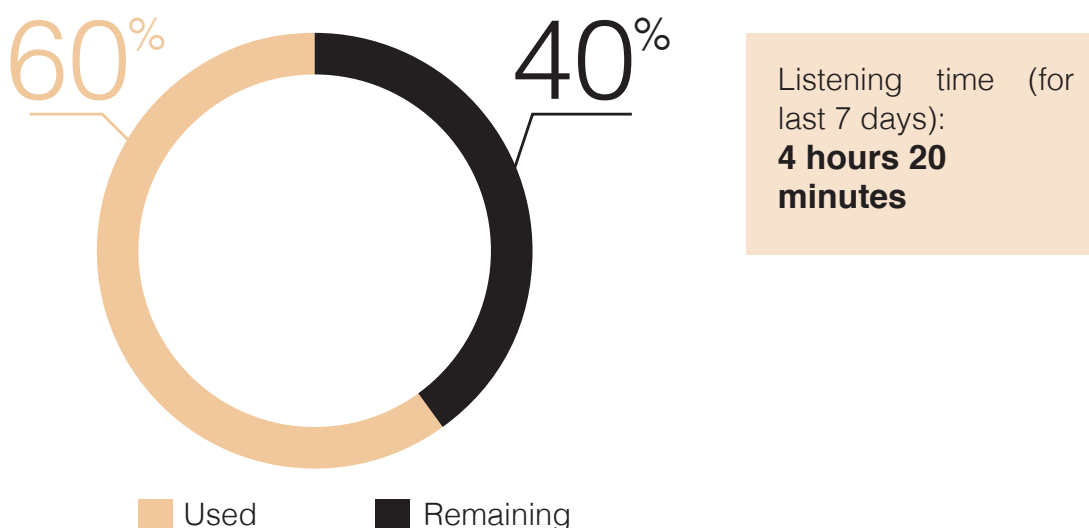
Figure 7.2 – Illustration of how to graphically convey the use of a weekly allowance

2. Information on how the user has used the allowance on any day

For the purpose of this display, the maximum daily allowance will be equal to weekly allowance divided by 7 (approximately 15% of the weekly allowance).

Usage for the last 7 days (including the present day) would be indicated by a range of colours depicting different levels of usage, e.g. red for over 100% use and green when use is below 50%.

For the purpose of this communication, each day would be considered as a separate unit and colour coding for the day would not take the previous days' exposure into account. Hence, the user would start with green icon each day, regardless of past days' usage.

3. Listening time

Information on the overall time the user spent listening to audio content through the device each day will also be displayed (as shown in Figure 7.3.)

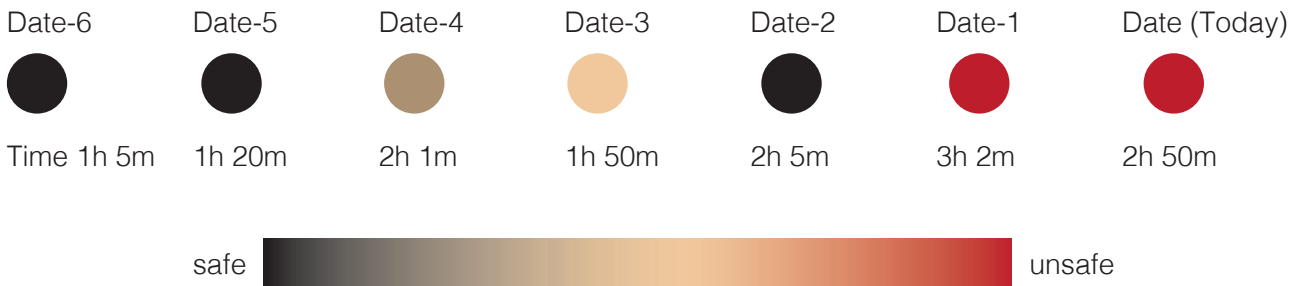| Date-6	Date-5	Date-4	Date-3	Date-2	Date-1	Date (Today)
⚫	⚫	🟤	🟡	⚫	🔴	🔴
Time 1h 5m	1h 20m	2h 1m	1h 50m	2h 5m	3h 2m	2h 50m

safe ▬▬▬▬▬▬▬▬▬▬ unsafe

Figure 7.3 – Information on the overall daily time the user spent listening to audio content

4. Warnings and cues for actions

Warnings accompanied by cues for action should be provided to the user regularly:

- When reaching 80% and 100% of the weekly allowance.
- Upon reaching 100% of weekly allowance, the device should automatically reduce the volume to the reference level unless the user choses to continue listening at high volume despite the risk communicated.
- Each message should be accompanied by a cue for action that will facilitate the listener to reduce the volume or stop listening.
- Every day, the user should be provided with a notification informing them of how their listening has been over the last day and suggesting action to be taken that day. This may be an encouraging or warning type of message.

Examples of such messages and cues for action are included in annex 8.

Appendix 8

Key considerations when developing messages and examples

Given below are some evidence-based considerations for manufacturers develop messages as part of the safe listening features for their devices. As far as possible, manufacturers should try to develop messages which are appropriate for the cultural and linguistic context of the country.

- The aim of such messages is to gain attention, build interest and encourage users to practice safe listening.
- They should share actionable information, provide viable alternative behaviours and facilitate safe listening practices.

Points to consider while developing such messages/cues are:

- They should clearly convey the benefits of safe listening and the risks of not doing so.
- There should be 3–4 variations of each message that can convey the information in a non- repetitive manner, designed to address a wide audience.
- Text should be simple, clear and jargon-free in order that they can be understood by the majority of users.
- Some messages should be positively and others negatively worded.
- Written information should be complemented by pictorial information for ease of understanding.
- Messages should be based on recommendations from a credible source.
- Wherever possible, messages should be pre-tested by the manufacturer before use.

The following are some examples of warnings and cues for action for the safe listening features.

Examples of warnings and cues based on weekly use

Information when user reaches:

a. 80% of weekly allowance: friendly warning message:
You have already spent 80% of your allowance. Turn down the volume to protect your hearing
Reduce volume/Stop listening/Ignore warning/Go to personal usage information.

OR

Hello! It looks like you have been playing a lot of loud music lately. Why don't you take a short break to protect your hearing?

Reduce volume/Stop listening/Ignore warning/Go to personal usage information.

b. 100% of weekly allowance: warning message (with an option to pause listening immediately):
You are now OVER 100% of your safe listening allowance. Unsafe listening poses a risk to your hearing.

> Reduce volume/Stop listening/Ignore warning/Go to personal usage information

> OR

> Hey! You have played too much loud music recently. Take a break and protect your hearing.

> Reduce volume/Stop listening/Ignore warning/Go to personal usage information

> Unless the user agrees to "ignore warning: or to "pause listening", the default will reduce the volume to below an average of 80 or 75 dB

Examples of messages based on daily use

Daily message (when opening the app or at player page) which should be based on the user's use of sound allowance over the last few days:

a. Mostly in green (where the user stays below 50% weekly usage most days, not exceeding the allowance on any day): encouraging messages

> Good job. This is the way to listen well

> Good job! Keep playing music safely for endless fun

> Well done. Keep listening safely and have endless fun

b. Mostly green or yellow/orange (where the user stays below 80% on most days, not exceeding the allowance on any day):

> Be careful and listen safely.

> Hey! It seems that sometimes you enjoy high volume! Be careful and protect your hearing for endless fun!

> You can listen safely for longer by lowering the volume

c. Mostly yellow/orange with occasional red (where the user is not exceeding the allowance on any day):

Be careful! Keep the volume down to listen safely for longer

Hey! It seems that sometimes you enjoy loud music! Be careful and protect your hearing for endless fun!

Hey! You should watch how you listen.

d. Mostly red (exceeding the allowance on most days):

You are putting your hearing at risk. Keep the volume low to listen safely Hey! You need to watch how you listen. Turn it down.

Hey! It seems that you enjoy really loud music! Don't put your hearing at risk and have endless fun.

Examples of messages with positive versus negative frame; and emotional versus rational appeal

Positive frame:

You exceeded your daily allowance for safe listening. Keeping the volume low lets you listen safely for longer without risk to hearing. Turn it down.

Negative frame:

You exceeded your daily allowance for safe listening. If you keep listening this way, you risk damaging you hearing forever. Turn it down

Rational appeal:

The evidence says that if you listen to music above the 80 dBA SPL, for 8 hours or its equivalent, you might damage your hearing forever. Turn down the volume.

Emotional appeal:

Once you lose your hearing, it will not come back. Listen safely. Turn down the volume.

Appendix 9

Resources for school-based workshops for safe listening

Cheers for Ears

Developed by the Ear Science Institute Australia, Cheers for Ears educates school students aged 10 to 12 years old about the dangers of hearing loss and its prevention. The programs use various multimedia materials and provide interactive sessions in schools. Aside from the programs, the team has created a number of activities including: Safe Hearing Suzie, Epic Ear Defence and Cheers for Ears Charlie, the mascot. These activities have been successful in encouraging safe listening among 21,300 children at 226 schools over last three years. There are three aims of the project: "to develop a health promotion program to educate primary school-aged children in the dangers of exposure to dangerous levels of noise and music," "to develop an application to monitor and track noise exposure from personal music players," and "to develop an Internet resource as a central information site for all matters related to NIHL and exposure to entertainment-related sounds." For more information on Cheers for Ears, go to
http://www.hearingservices.gov.au/wps/wcm/connect/8c6fc19a-4f10-4307-93f3-d350f50fbe5b/cheers-for-ears.pdf?MOD=AJPERES

Resources

- Safe Hearing Suzie is a mannequin head with a built-in sound level meter and hearing loss simulator. Suzie shows the decibel level of the sound as well as information on whether the sound is a safe listening volume or not. Therefore, Suzie teaches students about the truths and risks of NIHL.
- Epic Ear Defence is an online game that students can actively engage in learning the importance of protecting ears. During the game, players have to use defensive techniques to fight off the incoming loud sounds (enemy). "As more loud sounds escape the player and reach the eardrum, the game begins to subtly simulate hearing loss and tinnitus into the over sound track." This simulation is an engaging activity that people can enjoy while learning the importance of hearing.
- Cheers for Ears Charlie is the mascot, shown as a superhero demonstrating headphones as a way to reduce the risk of NIHL. This mascot appears in different settings such as Hearing Awareness Week, school assemblies, and children's festivals.
- Workshops are delivered to schools, and age-appropriate presentations are used. Classroom activities include poster competition, creating a television or radio advertisement and quiz.

Contact Information

- For more information, email Natalie Leishman natalie.leishman@earscience.org.au

Hear 4 Tomorrow

Hear 4 Tomorrow is a classroom-based program to educate primary school children about ear health. It was primarily designed for school teachers as a teaching tool with various curricula. The extensive curriculum is composed of four educational modules: understanding hearing loss, the hearing system and noise, how loud is too loud and protecting our hearing. Each module covers different aspects of hearing health, and students learn noise reduction behaviour. The aim of Hear 4 Tomorrow is "to provide teachers with a resource that enables them to teach hearing health in a way that complements their existing teaching programmes." For more information on Hear 4 Tomorrow, go to https://hear4tomorrow.nal.gov.au/index.html.

Resources

- For each module, there is a variety of resources that students experience.
    - Hearing Loss Simulation allows people to have a hands-on experience of hearing loss at different levels. It demonstrates how the audio might sound for a 35-year-old with NIHL or how the audio might sound like for people with NIHL and tinnitus altogether. By providing different cases of diagnosis, the hearing loss simulation helps them understand hearing loss and its challenges.
    - Students learn to measure the levels of different noises and the relationship between volume and duration of exposure through the flash cards.
    - Teaching notes are provided.

Contact Information

- Hear 4 Tomorrow was developed by the National Acoustic Laboratories, the research division of Australian Hearing. You can contact enquiries@nal.gov.au

Dangerous Decibels

Dangerous Decibels focusses on three ways to prevent noise-induced hearing loss. The programme gives classroom presentation to schools that teach the concepts of noise-induced hearing loss and preventive strategies. Through an interactive workshop, it highlights the importance of protecting the hearing health and suggests to "walk away," "turn it down," and "use earplugs." This school-based workshop has been tested for effectiveness and they haveshown that such presentation is very effective in modifying behavior, knowledge and attitudes among the primary school students.

The aim is to "reduce the incidence and prevalence of noise-induced hearing loss (NIHL) and tinnitus (ringing in the ear) by changing knowledge, attitudes, and behaviors of school-aged children." The programme has created Jolene, a mannequin equipped with a sound level meter, which attracts children and promotes safe listening.

Resources

- Jolene and the Jolene cookbook: Jolene was constructed using a used fashion mannequin and a sound level meter wired to a silicon ear. Jolene makes appearances at schools and universities, scientific meetings, health fairs, and many other public events. Jolene has also been used as a research tool to study the beliefs and listening practices regarding personal stereo systems. Jolene cookbook is the production by the National Hearing Conservation Association for people to make their own Jolene.
- Coloring Sheets is a set of three coloring sheets for the young kids. They make good take-homes.

For more resources, please go to http://dangerousdecibels.org/.

Noisy Planet

Noisy Planet is a public education campaign, developed by the National Institute on Deafness and Other Communication Disorders (NIDCD). Noisy Planet has numerous teaching toolkits for different groups of people (parents, health teacher, school nurses and health professionals). Their aim is to "increase awareness of the causes and prevention of noise-induced hearing loss." These educational resources include toolkits, advice and tips for safe listening. According to data from two surveys, the Noisy Planet is very effective in reaching target audiences. Additionally, Wise Ear campaign, also launched by the NIDCD, educates primary school students about preventing noise-induced hearing loss. For more information, go to https://www.noisyplanet.nidcd.nih.gov.

Resources

- The website provides noisy planet presentation, student activity videos and other resources
- There are training videos that show the activities in the presentation. Instructions provide in-depth descriptions of each activity, including the required equipment, number of student volunteers needed, and the estimated time for each activity.

Contact Information

- For general questions, contact NPInfo@nidcd.nih.gov

Listen to Your Buds

Developed by American Speech and Hearing Association (ASHA), Listen to Your Buds campaign provides various instructions on how to prevent hearing loss through teaching materials. The campaign is delivering an important health message that all parents and kids need to hear. It aims to "make effective communication a human right, accessible and achievable for all." The campaign educates the public about the risk of hearing loss in children from the unsafe use of personal audio technology, particularly earbuds or headphones. Furthermore, the Listen To Your Buds concert series visit schools, teaching kids about the importance of technology to protect their hearing health. For more information, go to https://www.asha.org/buds/.

Resources

- Interactive school-based workshops are held in primary schools. Elementary school students learn how to protect their hearing for a lifetime from renowned musicians.
  Video: https://www.youtube.com/watch?v=cfkPUnWBmiI
- Listen to Your Buds Bookmarks
- Listen to Your Buds Colouring Book
- Turn Down the Volume Song
- Radio Disney PSA (educative narrative to protect hearing)
- Self-Test for Hearing Loss

Contact Information

- There is no direct email address but contacting ASHA is possible by filling out information: https://www.asha.org/Forms/Contact-ASHA/

9 789241 515283