

TOPIC: WATER QUALITY – IMPORTANCE AND REGULATORY SETTINGS

SUB-TOPIC: PART C: WATER QUALITY GUIDELINES AND STANDARDS

Supporting Transcript

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Slide 1

Hello, my name is Sam Addison and welcome to this lesson on water quality standards.

Slide 2 – Topic/lesson

This lesson will start with an introduction and the objectives. Then we will have an introduction to standards and guidelines. Followed by looking at the standards and guidelines of the World Health Organisation and various countries. The lesson will finish with a learning exercise and information for further learning.

Slide 3 – Introduction

This lesson will be about the purpose of water quality standards, their importance and also will provide real examples. This lesson builds on the topics of previous mini lecture “Water quality definitions and importance” and “water types” in this series “Water Quality - Importance and Regulatory Settings”.

Slide 4 – objectives

The objectives of this lesson are to be able to identify why water quality standards are set, to be able to describe the requirements of standards and to be able to discuss some of the challenges of setting standards.

Slide 5 – section break

Slide 6 – Importance

As discussed in the previous lesson on water quality definitions and importance, we discussed why water quality is important. A key reason identified was that water quality can have a significant impact on human health, ecosystem health and socio-economic development. As a way to ensure that water quality is usable for its different purposes, guidelines and standards are developed and worked towards.

Slide 7 - Guidelines

The World Health Organization works to provide an international framework which provides guidelines for individual countries to convert and adapt the philosophy, guidance, and numeric values of the general guidelines into water quality standards.

The World Health Organisation is considered a Health Authority and a specialised agency of the United Nations dedicated to public health and international matters related to health. But importantly, the guidelines that it sets are not enforceable.

The guidelines are designed for use by countries as a basis for the development of standards which if properly implemented will ensure the safety of drinking water supplies. WHO guidelines are generic by nature, aimed at protecting public health on a worldwide basis, whilst national standards are defined by each country and are based on the specific conditions of the country itself.

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Within this lesson there will be a specific focus on drinking water quality guidelines and standards. However, the WHO sets guidelines for a range of water uses, as the uses differ in their water quality needs. The different guideline categories include drinking water, wastewater reuse and recreational water use.

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The difference between the WHO guidelines and a countries standards is that the standards have legal status and are part of law. Countries may set different types of standards however.

They may issue a maximum contamination level for inorganic chemicals when the toxicity or carcinogenicity requires specific maximum level values not to be exceeded. They are enforceable standards. Whilst a recommended standard is a suggested standard based on the goal to acquire a lower level of the contaminant concentration than the level previously accepted or practiced. Standards are adapted and changed depending on factors such as current environmental conditions, economic reasons and acceptable risk. Whilst water standards can be strictly enforced, nevertheless, they are designed to always be considered ready to be revised. This is particularly true in the field of carcinogens where negative or positive evidence is continuously surfacing as new research is completed.

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Due to the complexity of factors determining water quality, large variations are found between rivers or lakes on different continents or in different hydroclimatic zones. Similarly, the response to anthropogenic impacts is also highly variable. As a consequence, there is no universally applicable standard which can define the baseline chemical or biological quality of waters. At best, a general description of some types of rivers, lakes or aquifers can be given. Therefore, standards are set specifically to regions and countries.

Whilst setting standards there are 4 key requirements of standards when they are set. These are that the standards are 1. technologically viable, 2. the standard is economically viable, 3. it is easily measurable and 4. the standard will fulfil the requirement for which it is meant.

The idea behind these requirements is that there would be no point in setting a standard if there was no chance that the government who set it would be able to achieve it or even be able to tell if they have achieved it. Therefore, governments need to be able to set a standard where they will be able to afford the improvements to water quality to achieve the standard, be able to develop or have the technology to achieve it and they need to be able to monitor progress. Finally, the standard also needs to be set at a point in which the improvements of water quality would make a difference i.e., setting a standard too leniently may mean that significant health effects still occur at the standard set.

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If the guideline values set by the WHO were treated as absolute values, then not all countries are likely to achieve them, due to the reasons as discussed on the previous slide. Therefore, guideline values are treated as targets, which all countries should eventually aim towards and be able to achieve them, some on a short-, some on a medium- and others only on a long-term basis.

One of the key concepts is that countries are suggested not to take one large, concentrated effort to reach the targeted standard and sometimes instead smaller distributed efforts are taken. There are many advantages to the approach to reach the targeted standard. The advantages are based on areas such as educational advantages and economic advantages, as the country can develop and learn approaches and this will benefit further work in the future. For finance, by taking small steps it means that the impact of attempting to achieve the standard can be managed better. Furthermore, polluters are allowed to develop control measures with time, meaning that they too can learn and change steadily with the changing water quality requirements, meaning that the impact upon them is not as significant.

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Often countries face many issues when trying to implement the standards and it is important to understand these problems as they allow us to learn about how better to implement standards.

Firstly, countries may directly use guidelines as their national standard. As we have discussed guidelines were designed to provide a general indication of where a country should aim for the standards as variables within the country based on the specific conditions of the country itself differ. Economic, social and cultural aspects, prevailing diseases, environmental circumstances, acceptable risks and technological development are all particular to each country and are better taken into account by the country itself when converting the WHO guidelines into national or regional standards. By not developing their own standard it may lead to more difficulties in achieving the standard set as it is general for the world based on health impacts.

Additionally, often guideline values are treated as absolute values and not target values. The guidelines are designed to be worked towards, and so short, medium and long term goals can be set, where the country aims to sustainably work towards the standard. However, if the guideline is treated as an absolute value that needs to be achieved immediately, then this would likely ultimately lead to failure as the improvements would be very difficult to implement and keep on a sustained and sustainable duration.

Finally, without monitoring a country would not be able to see if the standards are being worked towards or achieved and so monitoring is needed, however, sometimes this may not be implemented.

Slide 13 – Section break

Slide 14

An important concept to be aware of is that standards that are set for drinking water aim to work towards the provision of water that is safe for consumers. However, how we view what is safe changes over time. As research and models develop, our understanding of water contamination and health improves and this higher understanding can be applied to standards. Ideally water quality standards are based on health-based targets, which in turn are based on a review of the current epidemiological and medical research and models. For that reason, drinking water quality criteria, from which standards are derived, are constantly being reviewed with standards equally likely to be tightened or relaxed depending on the most reliable information. However, equally, standards often depend on economic assessments as well as health risk assessments.

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The WHO when setting guidelines, sets guidelines for a range of parameters. These include, microbial, chemical, radiological and acceptability aspects. Each of these are categorised differently as they generally lead to different health impacts and so are considered separately. An example would be that microbial impacts would generally have a short-term health impact whilst the impact of chemical contamination would be on a longer term basis.

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Shown in this table are some of the essential priority chemicals and the guideline value that the WHO has set for them. The guideline is given in milligrams per litre, which is a unit of the concentration of a constituent in water. It represents 0.001 gram of a constituent in 1 litre of water which is approximately equal to one part per million, parts per million being the number of parts by weight of a substance per million parts of water.

As one can see, the level of contamination appears to be very small, however, the guidelines are set where concentration levels above the guidelines are a concern for health.

If we look at arsenic as an example, we can see that the guideline is 0.01mg/litre, this is based on at the level in which contamination has a reduced impact on human health. However, even if we drink water with arsenic that is lower the guideline value i.e. 0.009 mg/l this may still lead to health impacts. The reason for this is because, as discussed earlier they are set with other requirements in mind such as technological availability, the ability to measure and being economically viable. If the level was set at 0.001 mg/l, then we would very likely see no health impact, however the ability to reach this level would very difficult and not possible for many countries.

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As discussed, the WHO guidelines are designed to be adapted and the table shows this. In the table on this slide, we can see 4 chemicals and their WHO guideline value along with the number of countries that are setting guidelines for the chemicals and if they are above, level or below the guideline value set by the WHO.

As we can see of the countries that have set standards for the majority of the chemicals $\frac{3}{4}$, most countries have set a standard level with the WHO guideline and the number of countries that have set either above or below the chemicals, vary with the given chemical.

Most notably, arsenic shows that a high proportion of countries set a standard higher than the WHO guideline and this is as the arsenic guideline set by the WHO organisation over time has lowered. In (enter year) the guideline was 50 ppb rather than 10 ppb. For many countries they may deem that 10 ppb is unachievable and so aim to work towards a more achievable target of 50 which used to be the guideline value.

Another notable chemical is selenium. As can be seen, 93 of 96 countries set a standard which is lower than the guideline of 0.04. This can be accounted for, by the alteration of guidelines by the WHO. As shown on the previous slide from the 2011 guidelines, the value was 0.01, however in this updated WHO document it is 0.04. The increased guideline value will be a result of updated research and findings on selenium, which led to guideline alterations. However, the standards within countries will not have altered.

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Here are some example sets of standards from countries in South & Southeast Asia and their standard that they set in comparison to the WHO guideline. As one can see, the countries show different concentration levels for their standards.

For arsenic and selenium, we can see that the 4 countries all have the same standards with only one exception. However, for fluoride and nitrate there is more variation between the different countries. The variation will be based upon the different circumstances of the countries such as the economic considerations and the current water quality situation.

Slide 19 – Section break

Slide 20

In summary guidelines are set by the WHO based on microbial and chemical aspects aimed to protect human health. Guidelines can be dependent on use such as drinking or for irrigation. WHO provides an international framework which informs some country-specific legislation. Guidelines and standards are under constant review and as research develops, so should guidelines and standards.

Slide 21 – Section Break

Slide 22

For the learning exercise, look at the World Health Organization guidelines and look at all of the different guideline's parameters that exist. You will be able to see how many different chemicals and pathogens are important to water quality and that have been assessed and studied in regard to water quality.

Slide 23 – Section Break

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Here is a list of references that were used in this lesson and can be used for further reading.

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Thank you for watching this lesson.