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Revision

Making ORS safer

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Although the aim of the *Prospects* column in BIOLOGICAL SCIENCES REVIEW is to provide information about careers linked to biological sciences, the April 2013 issue includes some relevant discussion of the clinical trials that must be completed before a drug can be licensed for use. It progresses to consider some of the ethical issues that form an important part of How Science Works. This resource comprises two worksheets:

- Making ORS safer
- Trialling a malaria vaccine

They link to the *Prospects* column and explore both the protocols involved and the underlying ethical issues. Oral rehydration solutions and malaria occur on some specifications but not on all. Knowledge of these topics, however, is not necessary in order to attempt the worksheets.

The teacher notes that accompany the student worksheets have been set out in the same way in both instances:

- **Objectives:** these relate primarily to the different aspects of How Science Works that underpin the present A-level science specifications.
- **Overview:** as the title suggests, this gives a brief sketch of the underlying biology.
- **Further information:** should you wish to look at the original source material, the reference is here. In both cases this material may be downloaded at no charge.
- **Suggested marking guidelines:** these guidelines give an indication of what might be expected by way of answers. They are intended as a basis for discussion.

Making ORS safer

Objectives

This exercise is designed to emphasise the following aspects of How Science Works:

- Use appropriate methodology to answer scientific questions and solve scientific problems.
- Analyse and interpret data to provide evidence, recognising correlations and causal relationships.
- Communicate information and ideas in appropriate ways using appropriate terminology.
- Consider applications and implications of science and appreciate their associated benefits and risks.
- Consider ethical issues in the treatment of humans, other organisms and the environment.
- Appreciate the ways in which society uses science to inform decision-making.

It links to the following topic, found in many specifications:

- Disease may be caused by infectious pathogens.

Overview

Access to safe drinking water is very limited in many parts of the world. Oral rehydration solutions (ORS) prepared in hospitals in such countries are often contaminated by pathogenic bacteria. This risk is widely appreciated but it is felt that the benefits outweigh the disadvantages.

Doctors working in a hospital in west Africa during a cholera epidemic carried out an intervention study comparing the existing treatment for making ORS in the hospital with a new treatment.

The material in this study has been used as the basis for the questions on the accompanying worksheet.

Further information

The original paper from which the information in this question was taken may be seen under <http://rehydrate.org/resources/donoharm.htm>.

Worksheet: making ORS safer

One of the main problems associated with severe diarrhoea, such as occurs with cholera, is the risk of dehydration. One way of treating dehydration is to use an oral rehydration solution (ORS). In many countries, access to safe drinking water is very limited. Oral rehydration solutions prepared in hospitals in these countries are often contaminated with pathogenic bacteria.

Doctors working in a hospital in west Africa during a cholera epidemic carried out an intervention study. This means that they compared the existing treatment for making ORS in the hospital with a new treatment.

Existing treatment

- Each morning the staff washed out the buckets they used to make and store the ORS with soap and tap water.
- They made up the solution and added two drops of disinfectant per litre of solution.
- The buckets were placed in the wards and patients helped themselves to the ORS by dipping their cups into the buckets.

New treatment

- The staff used sealed containers with taps to make and store the ORS.
- Each morning they emptied the containers and washed them out with disinfectant .
- They then made up the new solution and added two drops of disinfectant per litre of solution.
- The containers were placed in the wards and patients helped themselves from the taps.

The doctors took samples of ORS from the existing treatment and from the new treatment at different times during the day. They counted the number of pathogenic bacteria in these samples. Some of their results are shown in Table 1.

Table 1 The effects of different ways of preparing ORS on the number of pathogenic bacteria in the solution.

Sample	Number of pathogenic bacteria per 100 cm ³	
	Existing treatment	New treatment
Tap water	1	9
Immediately after making ORS	1.8×10^2	6.6×10^1
8 hours after making ORS	4.0×10^6	6.4×10^1
24 hours after making ORS	4.1×10^8	7.0×10^3

1 (a) There were more pathogenic bacteria immediately after making ORS with the existing treatment than there were with the new treatment. Calculate how many times more. Show your working. (2 marks)

(b) Use the information about the treatments to suggest why there were more pathogenic bacteria immediately after making ORS with the existing treatment. (1 mark)

2 The number of pathogenic bacteria in the two tap water samples was different. Suggest an explanation for this difference. (2 marks)

3 The doctors who carried out this investigation suggested that the new treatment was more effective than the existing treatment. Do the data in the table support this suggestion? Explain your answer. (2 marks)

4 The doctors published their findings in a scientific journal. Suggest **two** reasons why it was important that they published their findings. (2 marks)

5 This investigation was carried out on human patients. These patients were informed about the investigation before the start. Do you think it was ethically acceptable to carry out this trial? Explain your answer. (1 mark)

Suggested marking guidelines

These guidelines give an indication of what might be expected by way of answers. They are intended as a basis for discussion.

1 (a) If answer is correct, 2.73/2.7, award 2 marks and ignore working;

If answer is incorrect award 1 mark if there is a clear indication that the answer has been derived by dividing 1.8×10^2 by 6.6×10^1 ; 2

This question is designed to test basic understanding of the use of standard form in expressing the data included in the table. It should also lead to candidates appreciating that there were more bacteria in the ORS with the existing technique, a point that weaker candidates may not appreciate.

(b) The containers were washed with disinfectant before making up the ORS; 1

2 **Either**

There will be variation in numbers of bacteria;

Over time/as this measurement was made at different times;

or

There could be errors in measurement;

These are very small numbers; 2

This question relates to the design of the investigation and the influence that this may have on the very small numbers of pathogenic bacteria found in tap water.

3 (Yes)

Fewer pathogenic bacteria with new treatment;

Number of pathogenic bacteria rose less steeply with new treatment; 2

No credit should be given for the word 'Yes'. This merely provides a focus for the answer.

4 By publishing the material is available to others;

So protocol and can be used in other investigations;

So provides scientists with the opportunity to replicate/further test work;

So technique can be used in other hospitals; max 2

Candidates need to be able to explore the broader aspects of How Science Works such as those tested in this and the next question.

5 Yes because...

Answer supported by a valid reason such as

- the new technique was designed to improve the existing one/
- the patients were informed and gave consent;

No because...

Answer supported by valid reason such as

- The doctors should not have delayed the start by collected information about the existing technique; 1

We should accept either yes or no answers with questions concerning ethics. They must, however be supported by valid reasoning.