

## Research Article

# Express Intervention in Health Education

**Maria Manuel Azevedo\*, Ana Teresa Silva, Cidália Pina-Vaz, Acácio Rodrigues**

Department of Microbiology, Faculty of Medicine, University of Porto, Porto, Portugal

**\*Corresponding author:** Maria Manuel Azevedo, Department of Microbiology, Faculty of Medicine, University of Porto, 4200-319 Porto, Portugal. Tel: +351936320962; Email: maria.manuel.azevedo2011@gmail.com

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## Abstract

Researchers from the Microbiology Division of the Department of Pathology from the Faculty of Medicine, Porto implemented a teaching activity (interactive lecture with discussion) using a PowerPoint presentation in order to explore some contents related with health education and microbiology contents. The overarching goals of this study were: a) to promote health literacy mainly in microbiology field and b) to put students in close contact with physicians and researchers. Students' knowledge was evaluated with a survey instrument. Responses were analyzed before and after the implementation of this teaching activity, in the same day. Our findings suggest significant increases in health literacy and microbiology contents after the implementation of this activity. This express intervention is valuable and helped to improve student knowledge in health literacy. This study also highlights the importance of motivate students concerning medical microbiology with particular focus on adequate antibiotic use in order to prevent bacterial resistance. It is noteworthy that all of the students participated very actively in this activity. It was also our feeling that they accomplished the lecture and the discussion with pleasure, demonstrating interest and motivation.

**Keywords:** Health Literacy; Microbiology and Antibiotic Knowledge; Middle-School Students

## Introduction

Lack of health literacy affects a high percentage of the worldwide population [1]. However, nowadays taking into account these concerns several activities promoted by Universities and Research Institutions contribute to students health literacy such as Scientists for a day [2], the Brain Awareness Week [3], the Junior University [4,5] and the European Night of the Researchers [6].

In light of this 26 Portuguese students from the 9th grade attended to an active learning experience carried out in the Microbiology Division Department of Pathology of the Faculty of Medicine, Porto. This activity is integrated in the Summer Course promoted by the Innovation and Technology Center N. Mahalingam Águeda, Portugal. This experience includes an interactive lecture followed by active discussion. According to Forsetlund and co-workers, there is a growing interest in active learning strategies due to the belief that active learning results in enhanced knowledge retention and skills application [7]. In this lecture some contents related with microbiology such as microbial diseases (malaria, tuberculosis, and diarrheal diseases), correct antibiotic use

and bacterial resistance were developed, since health literacy in this domain is scarce. Recent data reported information gaps relatively to tuberculosis and malaria [8]. Some health interventions emerged to produce a positive impact on malaria beliefs, attitudes and treatment [9]. In 2012, Zuñiga and collaborators described an insufficient health literacy regarding tuberculosis infection [10].

In what concerns antibiotic use, data from the literature revealed that antibiotics are among the most commonly prescribed medications, however they are very often misused [11,12], and the indiscriminate use of antibiotics has contributed to the progressive loss of bacterial susceptibility and spreading of bacterial resistant strains [13]. Factors relating incorrect antibiotic use include self-medication, sharing medication with other people, not taking a full course of treatment and keeping part of the course for another occasion [10].

In Portugal, studies performed in schools at different educational levels had also shown a lack of knowledge about antibiotics and their correct use [14]. Even when antibiotics are available by prescription, education on correct use of antibiotics is necessary for the success of the treatment and prevention of the spread of bacterial resistance [15]. Educational programs implemented were successful in reducing antibiotic use for viral illnesses.

In light of the above described the overarching goals of this study were: a) to promote health literacy mainly in the microbiology domain, and b) to put students in close contact with physicians and researchers.

## Methods

### Research question

In this study, the research question addressed intend to confirm the following hypothesis:

- The knowledge of the students who attended this activity increased from the activity time zero (T0) to time one (T1).

### Participants

This study was carried out in June 2017. A convenience sample of students was used. Information regarding possible confounders, namely socio-economic status and intellectual level was not collected. The socio-demographic variables measured in this study only include age and school grade (Table 1). The sample comprises 26 Portuguese students (9<sup>th</sup> grade) from Águeda who attended the activity carried in the Microbiology Division Department of Pathology of the Faculty of Medicine, Porto. This activity is integrated in the Summer Course promoted by the Innovation and Technology Center N. Mahalingan Águeda.

Ethical approval for the study was obtained from the Head of the Microbiology Division, Department of Pathology, Faculty of Medicine, Porto University. All the participants were invited to take part and informed about the study purposes and objectives. Students' participation was voluntary and anonymous and blind. No refusals were registered.

Test group	No. of students	Age
Group 1	26	14-16

Table 1: Characterization of the study group enrolled in the study.

### Description of the activity carried out at the Microbiology Department

Before the beginning of the lecture a 8 multiple-choice survey was given to the students for them to answer according to their current knowledge (see Appendix A). After, the researchers performed an interactive lecture (a computerized slide show of 30 min, Appendix B) followed by an active discussion. The interactive lecture was conducted by the Head of the Department, Professor Acácio Rodrigues, one of the authors of this manuscript.

Appendix A	
Questionnaire	
<b>Q1. The microorganism that causes malaria is:</b>	
(Select the correct option)	
a)	Parasite
b)	Fungi
c)	Vírus
d)	Prion
e)	Insect
<b>Q2. The malaria transmission between people occurs generally due to:</b>	
(Select the correct option)	
a)	Mosquito bite
b)	Fly bite
c)	Animal bite
d)	Kiss
e)	Blood Transfusion
<b>Q3. The microorganism that causes malaria when causes malaria in the human being is located usually:</b>	
(Select the correct option)	
a)	In the eye
b)	In the urine
c)	In the muscles
d)	In the skin
e)	In the blood
<b>Q4. The microorganism that causes tuberculosis is:</b>	
(Select the correct option)	
a)	Parasite
b)	Fungi
c)	Vírus
d)	Prion
e)	Bacteria
<b>Q5. One of the first antibiotics available for medical use was:</b>	
(Select the correct option)	
a)	Aspirin
b)	Insulin
c)	Penicillin
d)	Vancomycin
e)	Spectinomycin

<b>Q6. The antibiotics are indicated to treat:</b> <b>(Select the correct option)</b>
a) Cold
b) Flu
c) Pneumonia
d) Blindness
e) Hypertension
<b>Q7. The antibiotic resistance in humans may arise due to:</b> <b>(Select the correct option)</b>
a) Inappropriate use of antibiotics/Self medication
b) Appropriate use of antibiotics/ Animal production
c) Appropriate use of antibiotics/ Agriculture
d) None antibiotic utilization
e) None of the above reasons
<b>Q8. The correct and frequent washing the hands can lead directly to a reduction of:</b> <b>(Select the correct option)</b>
a) Headaches
b) Muscles ache
c) Diarrheal diseases
d) Diabetes
e) Hypertension

Professor Acácio Rodrigues explained the main characteristics of the different groups of microorganisms: bacteria, fungi, parasites, virus and protozoa. He gave particular emphasis to certain infectious diseases such as malaria, tuberculosis, meningitis, flu and cold in respect to the agent and ways to avoid and/or treat these diseases correctly. The problem of antibacterial drug resistance was duly clarified and the adequate use of antibiotics was addressed. It was also highlighted some simple behaviors that can reduce the occurrence of infectious diseases. The lecturer pointed out that the secret to fight against these diseases should be to focus on prevention. After the lecture the students were asked again to answer the same 8 multiple-choice survey.

## Data Collection

Students' knowledge was evaluated with a survey instrument to gather information regarding participants' views about several subjects namely: type of microorganism that causes malaria, their vector and the respective localization in the human body, organism that causes tuberculosis, first antibiotic discover, antibiotic mode of action and its adequate use, the problem of bacterial resistance and a simple gesture to save life such as the correct and frequent hands cleaning.

This survey consisted of 8 multiple-choice questions (see Appendix A). We measured the survey's face validity by recruiting

10 students from the same scholar level. Afterwards, the survey was revised based on the recommendations of these students, prior to administration to the study group. The surveys were completed within a time limit of 10 minutes. The time between the implementation of the activity and the post-test application was 1 h. The response rate was 100%.

Data were analyzed using the SPSS statistical software Version 22.0. (SPSS Inc. Chicago, IL, USA). Associations between variables were tested with Pearson's Chi-square ( $\chi^2$ ) with significance set at the  $p < 0.05$  level.

## Results and Discussion

### Malaria Contents (Questions 1, 2 and 3)

A high percentage of incorrect answers among the students evaluated in the pre-test concerning the microorganism responsible for malaria (Q1), malaria vector (Q2) and localization of the parasite in the human body (Q3) (Table 2 and Figure 1) was registered. However, after the intervention above described, we observed an increase in the number of correct answers for all these questions (Table 2 and Figure 1). In the pre-test, the majority of the students supposed that the microorganism that causes malaria is an insect, which demonstrates confusion with the vector. Nevertheless, some confusion remains in the post-test in Q1 and Q2. Recent data reported information gaps relatively to infectious diseases, such as malaria [8]. Although this disease was eradicated in Europe it still returns due to individuals that travel to foreign countries, in this perspective it is of great importance their study.

### Tuberculosis and antibiotic contents (Questions 4, 5, 6, 7)

A high percentage of incorrect answers among the students evaluated in the pre-test concerning the microorganism responsible for tuberculosis (Q4), the first antibiotic available for medical use (Q5), and the utilization of antibiotics (Q6) was showed. Concerning the antibiotic resistance (Q7) the performance of the students is a little better (Table 2 and Figure 1). In respect to all these questions was observed a significant improvement in all the questions in the post-test (Table 2 and Figure 1).

On the topic of tuberculosis (Q4), a notifiable disease in Portugal, only 58% of the students in the pre-test answered correctly, however significant increase was detected in the post-test (92% correct answers) (Table 2, Figure 1). Tuberculosis is one of the most damaging infectious diseases and has resurged during the last decade in many countries. New strains of *Mycobacterium tuberculosis* that are resistant to one or more antibacterial compounds are emerging [16]. Tuberculosis induces high mortality rates in the world, killing 2 to 3 million patients each year [17]. Regarding the first antibiotic available for medical use (Q5), in the pre-test the results were slight which demonstrates lack of knowledge concerning Science History Literacy; however, after this intervention

the results obtained were quite satisfactory. Data from literature corroborates these results [18]. Relatively to the utilization of antibiotics to treat some diseases (Q6) the gains obtained between the pre- and post-test were relevant. In the pre-test, a considerable number of students believed that antibiotics are effective against cold and flu. Data from literature mentioned that students demonstrated misconception on this topic; they believe that antibiotics can cure viral infections [14,19]. Furthermore, a study from 2001 showed that 60% of the Europeans do not know that antibiotics are ineffective against viruses [20]. A research performed in New Zealand with primary school teachers belonging to 39 schools showed gaps in the understanding of antibiotics [21]. According to this work, only about 60% of the teachers knew that antibiotics were beneficial only in the treatment of bacterial infections. Despite these results, actually was demonstrated the great effectiveness of implementation of some school interventions in this area [22-24]. On the topic of antibiotic resistance (Q7), the performance of the students in the post-test reached 100% which is extremely relevant since the students are the antibiotic users of tomorrow so is imperative to invest in their education. The misuse of antibiotics leads to considerable risks, such as bacterial resistance [15,25,26]. Antimicrobial resistance is a current problem, including the treatment of multidrug resistant bacterial infections and the prevention of the spread of resistant microorganisms. The World Health Organization estimates that about half of all medicines are inappropriately prescribed and about half of the patients fail to take their medicines properly.

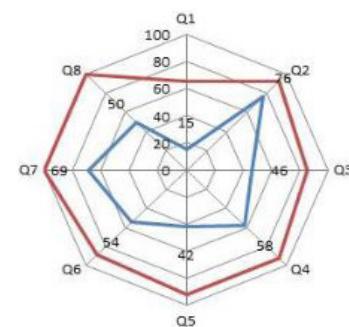
### Importance of correct and frequent washing of the hands (Question 8)

In the pre-test, a high percentage of incorrect answers among the students concerning the importance of frequent washing of the hands to avoid infectious diseases was observed (50%), which is according the literature (Azevedo, et al. 2017). However, in the post-test all the students answer correctly (Table 2 and Figure 1). It should be noted that in the lecture, Professor Acácio Rodrigues gave particular emphasis to this aspect, he call that "A simple gesture that can save lives". He exemplified all the steps to be taken to properly wash hands.

Questions	Number (n) and % of correct answers		
	T0	T1	p value
Q1.	(n=4)15	(n=17)65	<0.001
Q2.	(n=20)76	(n=24)92	0.125
Q3.	(n=12)46	(n=22)85	0.004
Q4.	(n=15)58	(n=24)92	0.004
Q5.	(n=11)42	(n=24)92	<0.001
Q6.	(n=14)54	(n=23)89	0.006
Q7.	(n=18)69	(n=26)100	0.002

Q8.	(n=13)50	(n=26)100	<0.001
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**Table 2:** Performance in the Pre- (T0) and Post-test (T1) (n=26).



**Figure 1:** Radar map showing the percentage of correct answers in the pre- (blue) and post-test (red).

### Conclusion

This study assessed health literacy in Portuguese school students and evaluated the impact of a teaching intervention on this knowledge. In this study, we detected a lack of knowledge concerning some diseases such as, tuberculosis, malaria and diarrheal diseases, type of microorganisms and diseases associated, correct use of antibiotics, as well as the importance of personal hygiene measures in order to avoid the development of infectious diseases. However, after this express intervention the results were improved significantly. Concerning the students, it is noteworthy that all of the students participated very actively. They accomplished the lecture and the discussion with pleasure, demonstrating interest and motivation.

In conclusion, the strategy used in this study seems promising, we believe it can be replicated in basic and secondary schools, complemented by experimental activities.

### Limitations

The sample used in this study is limited, only 26 students participated, additionally, the socio-demographic variables measured in this study were only age and school grade, and did not take gender distinction into account. This study must be replicated with a large sample of students for the same grade level in different regions of Portugal.

### Ethical Approval

Ethical approval for the study was obtained from the Head of the Microbiology Division, Department of Pathology, Faculty of Medicine, Porto. All the participants were invited to take part in the study and informed on the study purpose and objectives. Student participation was voluntary and anonymous. There were no refusals to the participation in the current study.

## Informed Consent

Informed consent was obtained from all individual participants included in the study.

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