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## SHORT COMMUNICATION

# Medicines, environment and clinical pharmacology

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## Abstract

Medical associations and other societies have announced their theses on protection of the climate and environmental aspects in medicine. The challenges with climate change and sustainability are complex, and no quick solutions are to be found. However, basic knowledge on these issues should be available to everyone, and environmental aspects of drugs are important to all healthcare professionals.

We present here a study with medical students who were introduced for the first time to environmental aspects of medicines. The results confirmed the suitability and feasibility of the approach to introduce this subject to students, and we propose that the same method can be used also when explaining the issue to medical professionals. We would like to encourage particularly clinical pharmacologists, pharmacologists and pharmacists to take a more apparent position in this field and to participate in the discussions where the strategies for the choice of medicines are considered.

## KEYWORDS

drugs, environment, healthcare professionals, sustainability

## 1 | INTRODUCTION

Environmental aspects connected to medicines are widely recognized.<sup>1,2</sup> Discussions about hazards associated with potential medical pollution, and possible actions needed to protect the environment and human health, mostly take place between specialists of environment and politicians. As a result, for example, the bio-monitoring of environmental exposure to chemicals has advanced markedly.<sup>3,4</sup> Today, many healthcare workers

have shown a growing interest towards the environmental aspects of drugs. For example, associations of anaesthesiologists have published guidelines for sustainability of operation theatres. While prescribing a medicinal product to a patient, a common environmental question from physicians today is what we know about the environmental impacts of the medicines and is it possible to claim one product to be superior to the others.

During the last years, pharmaceutical regulators have paid increasing attention to the environmental aspects of medicines and increased their requirements to pharmaceutical companies on providing data and reducing the environmental influence of their production and products.<sup>5</sup> At the same time, it has become evident that

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knowledge on these aspects among healthcare students and workers is scant and narrow. Consequently, regulators have encouraged universities to figure out how these environmental aspects could become a part of the medical curriculum and how to fill in the existing knowledge gap. In addition to improving education, we would like to encourage physicians, particularly clinical pharmacologists, to actively participate in environmental discussions from a clinical point of view and to contribute to increase the awareness of the environmental impact of medicines.

## 2 | METHODS

Being familiar with the Generation Green project in the Faculty of Pharmacy at the University of Helsinki that reformed the curricula to implement green pharmacy practice to higher education in pharmacy, we decided to implement basic knowledge of the environmental aspects of medicines also into the curriculum of clinical pharmacology at the University of Helsinki. The first experimental learning session was conducted in 2019 as small group discussions with sixth year medical students. After these sessions, the students participated in a survey to evaluate the teaching. The questions of the survey followed the same pattern as those addressed to the pharmacy students, as described previously by Sivén et al. (2019), and included a multiple choices question containing five statements and open-ended questions.<sup>6</sup>

Inductive content analysis was used to analyse the answers to open-ended questions. The answers were coded and rearranged into categories. This was done by two independent investigators, after which any differences in the analysis were discussed by them until a mutual opinion was reached. Results are presented as qualitative data with extracts of typical responses in each category.

In 2020, the contact teaching method was changed to a virtual interactive lecture because of the coronavirus pandemic. The same clinical teacher was responsible for the lecture during the two subsequent years. Lecture evaluations were conducted with surveys.

The content of the group discussions/lecture is described in more detail in Table 1.

## 3 | RESULTS

The survey of medical (m) students in 2019 ( $n = 121$ ) was compared to that of pharmacy (p) students (year 2015,  $n = 75$ ) (Figure 1). The survey answers were generally very positive for sustainability and the need for teaching in environmental aspects. For example, more than 80% of the students chose the statement “It is important to take sustainable development and environmental viewpoints

**TABLE 1** The contents of the environmental lecture for the medical students

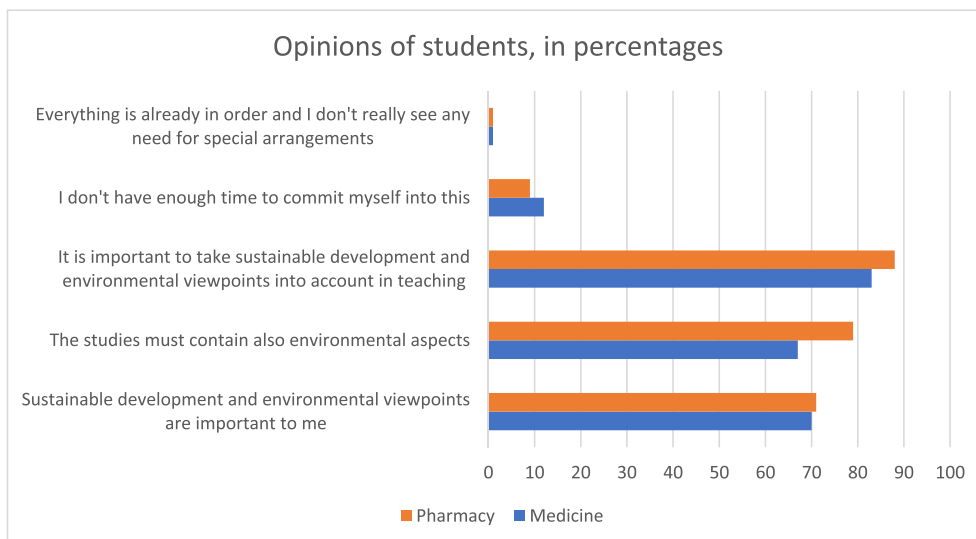
Goal	To make students recognize <sup>a</sup> that medications have an impact on the environment even when they are used properly and that doctors/prescribers can change the impact.
Structure	In the beginning of the lecture there is a short patient case. The same case will be presented at the end of the lecture, too. Students are able to receive information during the lecture and to reflect on their previous answers.
Patient case	A 20-year-old patient is visiting you because of a non-specified health issue and just when leaving, the patient asks your opinion about pain medications. When playing tennis/football/ice hockey/etc. the day before, the patient hit a lower extremity and the question is whether to apply diclofenac. Other options are ibuprofen gel, ice gel or just relaxation for a couple of days.
Content	The lecture includes the basic aspects of the environmental impact of pharmaceutical manufacturing and medicines overall, and the specific impact on the water environment, difficulties to measure these impacts and terms used in this connection. There is also an example involving diclofenac, including its demonstrated environmental hazards, the experience of how difficult it is to make decisions covering the whole EU and finally how Sweden decided to handle the environmental effects of diclofenac.
Conclusion	At the end of the teaching, the patient case is presented again, followed by a discussion. As there is no single, correct answer, different justifications are typically presented. For example, if the patient already has diclofenac gel at home, the typical argument is that it is better to use that than buy some new medication. Furthermore, the potential caveats of large-scale use of ibuprofen gel are raised for discussion. Therefore, the discussion with students is important here.

<sup>a</sup>Bloom's taxonomy Category Understand.<sup>7</sup>

into account in teaching.” There was a trend towards a slightly more positive attitude in pharmacy students, compared to medical students (Figure 1).

The open-ended questions of the survey yielded 30 written responses (25% of the students). Altogether, four main categories for students' elaboration on environmental viewpoints (One Health approach; Profession; Regulatory; Patient) were identified, as presented in Table 2. The majority of the responses approached the issue from the One Health principle, emphasizing that the health of people is closely related to our shared environment.

**FIGURE 1** Responses of medical ( $n = 121$ ) and pharmacy ( $n = 75$ ) students to the following question concerning their education: “In the following, you will find selected statements. Please, select the ones that you consider relevant in curriculum reform and future progress towards green pharmacy practices in education. (multiple choices are possible).” Results are shown in %



The general conclusion from the answers is that the students emphasized that it is an important responsibility of the medical professionals to consider and take measures to minimize environmental impacts of medicines in healthcare practise. Moreover, the patient's role was seen from two viewpoints. The patient was considered as an active player, being involved in decisions, and taking responsibility of their own medication. On the other hand, it was considered important that the patient should not be burdened with the issue.

In 2020, the teaching session given as a remote lecture was evaluated using a simple widely used scaling manner. The gradual score ranged from 1 to 5, where the greatest value was indicated by the highest score (5). Additionally, the students were given the opportunity to express anonymously their views on the subject by writing on a virtual platform. There were 66 students out of 120 who answered, and they raised the importance of the environmental aspects in their curriculum. The lecture was highly valued, receiving an average score of 4 in the scale 1–5. The acceptance of the subject and the need for the further information was clearly expressed in a written format by the students.

## 4 | DISCUSSION

Although environmental issues are connected closely to the pharmacy and medical practices, discussions about environmental questions concerning pharmaceuticals are scarce among healthcare professionals, especially among physicians. To the best of our knowledge, there are no previous surveys describing the attitudes of medical students on this subject. The purpose of this paper was to demonstrate that the environmental impact of medicinal products, or the information about their environmental risks

**TABLE 2** The identified main categories of students' thinking of the environmental sustainability of medicines

<b>One health approach</b>	<p>“If our environment is not healthy, the patient is not healthy either”</p> <p>“I trust on actions targeted on population...”</p>
<b>Profession</b>	<p>“I value if we in our own profession can have an impact on environmental issues.”</p> <p>“I appreciate that we [Medical students] are educated in these [environmental] issues.”</p> <p>“Important issue.”</p>
<b>Regulatory</b>	<p>“I think the resolution is regulatory framework for steering”</p> <p>“International guidelines”</p> <p>“...incentives that make harmful processes unprofitable.”</p>
<b>Patient</b>	<p>“Consumers' interest in environmental issues has increased and patients may ask on this on doctor's surgery.”</p> <p>“...The patient should not be burdened with environmental concerns.”</p>

Note: The survey yielded 30 written responses whereof qualitative results are presented. An extract of a typical response in category is given in quotes.

are not easily available to healthcare professionals and that no extraordinary learning method is needed for introducing basic information on this subject to medical students.

There are limitations in this lecture-based survey. For feasibility reasons, the number and type of questions was limited, and consequently, the analysis of the results was done in a very pragmatic way. The benefit of this approach, however, was that we received responses to the main question from all the students, who participated in the teaching. Accordingly, the results are likely to reflect the students' opinions accurately.

Our study showed that, just like pharmacy students, also medical students considered it important to present environmental viewpoints in teaching. Sustainability and the environmental impact of medicines should be integrated in any appropriate course, such as clinical pharmacology, microbiology or anaesthesiology.<sup>8,9</sup> Although the students emphasized the importance of the issue, they felt insecure about their competency mostly because of lack of knowledge. The availability of reliable data on environmental impact of medicines should be increased and easily found. Interestingly, the students also stressed the responsibilities of the regulators and industry to produce more transparent data. In pharmacy education, the environmental knowledge is comprehensively evident throughout the curriculum, and teaching methods support generic sustainability skills such as information seeking and critical thinking. Such an approach is aimed to support knowledge-based decision-making later in profession.

Medical students stressed that a patient with a diagnosed disease should be confident that the treatment and medication have been chosen correctly based on efficacy, quality and safety, as well as with economic and environmental aspects in mind. Patients should not be responsible for taking into account the environmental aspects or any other possible hazards of the treatment. Furthermore, the pharmacist also has an obligation to provide the necessary personal advice on the use of the medicine, including the environmental aspects, especially in the case of over-the-counter (OTC) products. Our study also suggests that development of an educational curriculum on environmental aspects of pharmaceuticals for healthcare professionals including physicians should be encouraged. Medical agencies and regulators are also currently evaluating how to address the environmental challenges and how to enhance the environmental knowledge of healthcare workers. Also, more information and multi-professional discussions are needed, so that environmental aspects of medicines are considered without putting the patient's treatment in danger or at risk.

In conclusion, our experience and the conducted student survey indicated that there is a need to figure out how environmental aspects could become a part of the medical training and how to fill in the existing knowledge gaps. Consequently, a short introduction to environmental aspects of medicines has been integrated into the medical curriculum as part of the clinical pharmacology course at the University of Helsinki, following the example of the Faculty of Pharmacy. Our study included only medical students. In the future, it would be interesting to study the attitudes of more experienced healthcare professionals, including both prescribers and pharmacists. The research could add valuable information also for interprofessional learning.

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## CONFLICT OF INTEREST

None declared.

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