

# Incorporating Medical Museum Specimens Into the Training of Environmental Health Students

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**ABSTRACT:** Xenobiotics, radiation, and other environmental health risk factors leave their mark on human organs. This can be demonstrated through the use of pathology museum specimens. Upon completing two semesters of postgraduate studies in environmental health, a tour of the Museum of Pathology is offered to postgraduate students at Athens Medical School who are being trained in environmental health. A structured questionnaire is employed to assess the specimens' impact on several aspects: improving students' observational skills, reinforcing the taught material, acquiring new relevant knowledge, and cultivate the social-cognitive ability of empathy. Additionally, students are asked to evaluate the necessity of preserving metadata associated mainly with the social context of the specimens. This research-educational initiative, a component of an ongoing larger project, underscores the significant educational and research value of museum specimens pertaining to environmental health. Furthermore, effectively utilizing such exhibits can enrich the museum experience for visitors and increase public awareness of environmental health issues.

**KEYWORDS:** Environmental health, environmental health education, medical museums, specimens, xenobiotics

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## Introduction

Educators' and learners' interaction with museums has been proved beneficial as regards the overall educational process and engagement with sciences.<sup>1–4</sup> There is also evidence that medical museum specimens may improve medical students' observation skills, increase their knowledge and cultivate their empathy,<sup>3,5</sup> that is, their ability to understand other people from their perspective and/or to experience their feelings and thoughts.<sup>6</sup> Furthermore, given the origin of pathology specimens from past years, researchers have a distinctive opportunity to examine them using modern techniques such as molecular, genetic, and/or radiological methods, with the results presenting educational, medical, historical and socio-economic interest.<sup>3,7–9</sup>

The negative impact of certain environmental health risk factors, such as xenobiotics and harmful radiation, does leave footprints on human organs, via various pathways such as endocrine disruptions and/or DNA damage.<sup>10,11</sup> These footprints can be found on relevant pathology specimens, available in medical museums. The Museum of Pathology at the Athens Medical School is situated within the premises of the Medical School in Athens, specifically in the 1st Laboratory of Pathology. It showcases an extensive collection of specimens

dating from the 1850s to the present day.<sup>12</sup> Many of these specimens carry an environmental health and/or occupational health footprint, as the cases of malignant melanomas, liver cirrhosis, and anthracosis of the lung. The aim of the current report is to present the most significant preliminary insights regarding the ongoing effort of incorporating such specimens into the educational activities and training of environmental health students.

## Methods

After completing 2 semesters of obligatory studies, environmental health postgraduate students are offered a tour of the Museum of Pathology. Following their visit, a structured questionnaire was employed to evaluate how specimens contribute to improving their observational skills, reinforcing the taught material, acquiring new knowledge, and fostering empathy. Empathy is particularly relevant due to the significant number of pathological specimens associated with severe pain or challenging psychological situations. Furthermore, students are requested to assess the necessity of preserving metadata related primarily to the social context of these specimens. The obtained results underwent statistical analysis using RStudio 4.1.3 and Python 3.11.4.



## Results

The questionnaire was answered by 62 students of the post-graduate program. The significant contribution of museums to the educational process was confirmed, as 97% of postgraduate students consider the contribution of the Museum of Pathology to be at least significant. Specific factors such as the lack of certain necessary knowledge for disease recognition and the morphological deformation of some exhibits—many of these issues are currently being addressed during the ongoing museum renovation, for example, through the replacement of old worn-out labels—often hinder students in recognizing diseases. Nonetheless, characteristic diseases related to environmental or professional risk factors, such as anthracosis of the lung, asbestos-related conditions, melanomas, liver cirrhosis, thalidomide-induced phocomelia and fetal anencephaly,<sup>13-18</sup> were recognized by the students.

Furthermore, 89% of respondents believe that interacting with exhibits is at least very important for acquiring knowledge, while 85% stated that museum visits positively impacted their awareness of diseases depicted in the exhibits. Additionally, 87% of students acknowledge the high scientific-research value of the exhibits, especially regarding potential analysis with new techniques (eg, molecular and genetic analyses) that were not available previously, as indicated by 79% of respondents. Concerning the museum's environmental footprint, students recognize its importance, without considering it less or more significant than other museums ( $P$ -value = .1642). It should also be noted that 90% of students mention that public exposure to exhibits related to environmentally-induced diseases can raise awareness of environmental health risk factors.

Moreover, 80% of the students found information in the exhibits with non-direct medical-biological interest that caught their attention, with 69% of the students considering the preservation of this information very important. For example, the specimen featuring a stomach being bitten by 2 snakes impressed 52% of the students.

Given the importance of the social determinants of environmental health, it is worth noting here that the previously mentioned specimen is closely related to the social context accompanying the German occupation in Greece (1941-1944). The milk—a scarce commodity for people forced to live in poverty during the occupation—that a rural resident had found and drunk in the countryside had attracted these 2 snakes—endemic vipers of Greece—which had entered the gastrointestinal tube and were found within the stomach at autopsy. This specimen belongs to a broad category of samples with interesting environmental health and socio-economic backgrounds, such as the one featuring multiple metastatic melanoma in the liver along with the relevant malignantly transformed pigmented nevus extracted from the back of a male patient (farmer). Initially, the patient had disregarded the significance of the growing nevus.

## Conclusion

Due to the limited annual intake of students and the ongoing nature of the whole project which focuses on museum renovation and the incorporation of new exhibits, conducting an exhaustive statistical analysis at this stage is not feasible. Nevertheless, this research-educational initiative reinforces the considerable educational and research value inherent in museum exhibits, whether directly or indirectly linked to environmental health. Additionally, the analysis of the collected data offers valuable insights to enhance the museum visitor experience and public awareness, with a distinct emphasis on environmental health.

The environmental origins of diseases depicted in medical and non-medical museum specimens highlight the intersection of biology, medicine, and history. This interdisciplinary perspective, which is often overlooked, enhances the overall scientific value of such specimens that carry the footprints of environmental exposures occurring throughout history. In the context of the wider project, relevant specimens are identified in museums around the world. With open invitations for collaboration, the project aims to gain enough publicity, provide an alternative educational approach, and raise public awareness on environmental health issues.

## Author Contributions

S.M.: conceptualization, first draft, S.L.: statistical analysis, A.K., M.M., A.C.L., E.P. & N.K.: review, editing & overall research project coordination.

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