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From Household Environmental Pollutants to Clinical Education: The Need to Incorporate Exposure History-Taking into Medical Education Curricula

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Abstract

Household exposures to radon, secondhand tobacco smoke, combustion-related pollutants, and selected indoor chemicals may contribute to cancer and other chronic diseases. However, environmental exposure history-taking remains insufficiently integrated into medical education. This letter highlights the need to teach medical students and residents how to identify household exposures, distinguish hazards from risks, and provide appropriate preventive counselling. Structured checklists, problem-based learning, clinical simulation, and objective assessments may support the integration of environmental exposure history-taking into routine clinical practice.

Key Words: Curriculum Development; Environmental Exposure; Indoor Air Pollution; Medical Education; Preventive Oncology.

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Dear Editor,

Evidence from environmental health and oncology indicates that the home is not necessarily free from health hazards, despite common assumptions to the contrary. Indoor pollutants—including radon, secondhand tobacco smoke, emissions from household fuel combustion, and selected indoor chemicals—may contribute to certain diseases, including cancer, particularly following prolonged or substantial exposure (1–6). Nevertheless, the ability to identify and assess environmental exposures in patients' everyday living environments remains insufficiently addressed in many medical education programs.

The purpose of this letter is to emphasize the need to revise medical education curricula and transform environmental exposure history-taking from a marginal topic into a fundamental, structured, and clinically applicable skill.

Evidence and Clinical Importance

Available epidemiological evidence indicates that certain household environmental pollutants are associated with malignancies. An integrated review of household environmental pollutants and cancer risk emphasizes that residential exposures may involve multiple pollutant categories and that the magnitude of risk varies according to the substance, exposure pathway, intensity, duration, and individual characteristics (6). The World Health Organization identifies residential radon as one of the most important risk factors for lung cancer after active tobacco smoking. Radon concentrations may increase in buildings with inadequate ventilation or in areas where geological and structural conditions facilitate its accumulation (1).

The WHO recommends a reference level of 100 Bq/m³ to minimize indoor radon hazards; where this level cannot be achieved, the selected reference level should not exceed 300 Bq/m³ (1). Public exposure to radon occurs primarily in enclosed environments, particularly homes. Concentrations may be higher in basements, rooms adjacent to the soil, and buildings with pathways for radon entry and inadequate ventilation (1). Therefore, questions about a patient's residence, building characteristics, and access to radon testing may form part of clinical assessment and preventive counselling in areas where exposure is likely.

Secondhand tobacco smoke has been classified by the International Agency for Research on Cancer (IARC) as a Group 1 carcinogen—that is, carcinogenic to humans (2). In addition, pollutants generated by the household combustion of fuels such as coal and biomass may pose important health risks. The type of fuel, combustion conditions, ventilation, and duration of exposure all contribute to the level of risk (3,4). The IARC has specifically evaluated indoor emissions from household coal combustion, while the WHO has provided health-based guidance on reducing risks associated with household fuel combustion (3,4).

For selected indoor chemicals, including benzene, formaldehyde, and polycyclic aromatic hydrocarbons, the level of risk depends on the specific substance, concentration, duration of exposure, indoor sources, ventilation, building characteristics, and individual susceptibility (5,6). Consequently, it is preferable to avoid treating all volatile organic compounds as having equivalent carcinogenic potential. Instead, clinicians should identify the specific substance or exposure source whenever possible and interpret the available evidence in context.

Among indoor pollutants, the evidence linking residential radon and secondhand tobacco smoke with lung cancer is relatively strong and consistent (1,2,6). For other exposures, including cooking-related emissions, household chemicals, pesticides, and certain drinking-water contaminants, the strength and magnitude of associations may vary according to the substance, exposure pathway, intensity, duration, and population studied (3–6).

Accordingly, consideration of the home environment during clinical assessment should not lead to the premature attribution of disease to a specific pollutant. Rather, it should form part of a systematic approach to identifying preventable exposures and modifiable risk factors. A recent integrated review similarly emphasizes the importance of interpreting household environmental exposures within a

broader environmental health and oncology framework rather than attributing individual cases of cancer to a single exposure without adequate assessment (6).

Distinguishing Hazard from Risk

One fundamental concept that should be addressed in medical education is the distinction between hazard and risk. A hazard is the inherent capacity of a substance or agent to cause harm, whereas risk refers to the probability that harm will occur under specific conditions, including the dose, intensity and duration of exposure, route of exposure, ventilation, individual characteristics, and coexisting risk factors (5, 6).

For example, the presence of a carcinogenic substance in the environment does not, by itself, mean that an individual will necessarily develop cancer. Risk assessment should consider the actual level of exposure and the patient's clinical context. The relationship between household pollutants and cancer is often influenced by multiple interacting factors, including smoking history, occupational exposures, socioeconomic conditions, building characteristics, genetic susceptibility, and coexisting diseases (6).

Failure to understand this distinction may result in two undesirable outcomes: exaggeration of risk, causing unnecessary anxiety among patients, or underestimation of genuine exposures and loss of opportunities for prevention.

Medical students and residents should therefore learn to interpret heterogeneous evidence, assess exposure intensity, identify factors that modify risk, and communicate environmental health information accurately, clearly, and proportionately. These competencies are particularly important when exposure measurements are unavailable or when the available evidence is based on population-level associations rather than individual-level causal assessment.

Environmental Exposure History

According to educational resources from the Agency for Toxic Substances and Disease Registry (ATSDR), an environmental exposure history should include a systematic review of the patient's residence, workplace, daily activities, potential exposure pathways, and the temporal relationship between exposure and symptoms (7). The goals of taking an exposure history include identifying hazards, recognizing disease at an early stage, and preventing or limiting disease progression (7).

Health effects associated with environmental exposures may present with nonspecific symptoms, such as chronic cough, dyspnoea, fatigue, headache, or weakness. Consequently, failure to obtain an adequate exposure history may make it difficult to identify a relevant contributing factor (7). However, the presence of nonspecific symptoms should not be interpreted as evidence that a particular household exposure caused the illness.

Conventional medical history-taking in many educational settings focuses mainly on previous illnesses, medication use, active tobacco smoking, and family history. Although these elements are essential, they are insufficient for a comprehensive assessment of environmental risk. Depending on the patient's clinical circumstances, an environmental exposure history should also address:

- The type of fuel used for cooking and heating.
- The ventilation status of the kitchen and other enclosed spaces.
- Exposure to tobacco smoke at home or in vehicles.
- The use and storage of solvents, paints, cleaning products, and other chemicals.
- The use of household pesticides or a history of indoor pest control.
- Dampness, moisture, or poorly ventilated basements.
- The type of building, residential location, and potential for radon exposure.
- The amount of time spent at home and whether symptoms improve after leaving the environment.
- Occupational exposures or the transfer of contaminants from the workplace to the home.

These questions are generally brief, inexpensive, and easy to integrate into the social history. Nevertheless, they may provide valuable information about potentially modifiable risk factors and

help determine whether further evaluation, exposure reduction, testing, or specialist referral is appropriate (1, 6, 7).

Recommendations for Curriculum Reform

The Institute of Medicine report *Environmental Medicine: Integrating a Missing Element into Medical Education* emphasized the need to integrate environmental medicine into clinical education and cautioned against limiting environmental health to a few theoretical topics in the basic sciences (8). Accordingly, the following measures should be considered.

- **Standardized exposure-history checklist**

  A small number of brief, targeted questions about the home environment, workplace, and lifestyle should be added to history-taking forms used during clerkships and clinical internships. The checklist should be adaptable to the patient's symptoms, age, occupation, residence, and geographic context rather than applied as a rigid instrument to every patient.

- **Problem-based learning and simulation**

  Clinical scenarios should be developed in which identifying household exposures forms part of the diagnostic and preventive process. For example, when assessing a patient with chronic cough, students should consider not only tobacco use but also the type of household fuel, ventilation, exposure to secondhand smoke, and possible residential radon exposure (1–4, 6).

- **Risk communication**

  Students should learn to explain environmental exposure findings clearly and proportionately, avoiding both unnecessary fear and false reassurance. They should be able to distinguish between the identification of a potential hazard and the demonstration of clinically meaningful individual risk. The multifactorial nature of household environmental exposures and cancer risk should be explicitly incorporated into this training (6).

- **Primary care and oncology integration**

  Training should include counselling on smoke-free homes, the use of cleaner household fuels, improved ventilation, reduction of unnecessary exposure to household chemicals, and radon testing or mitigation in areas where exposure is likely (1, 3–6). Primary care provides an appropriate setting for prevention and early identification of exposures, whereas oncology training can help learners understand the relationship between environmental risk factors, cancer prevention, and survivorship care.

- **Structured assessment**

  Environmental exposure history-taking could be incorporated into an Objective Structured Clinical Examination (OSCE) to ensure that it is taught and assessed as a practical clinical competency rather than as a purely theoretical topic. Assessment domains could include the ability to ask relevant questions, identify exposure pathways, distinguish hazard from risk, provide proportionate counselling, and recognize when additional testing or specialist referral is indicated.

Conclusion

Human health and disease are shaped by the environments in which people live, work, and rest. Evidence indicates that homes may contain persistent, potentially preventable pollutants that contribute to cancer risk, depending on the nature and extent of exposure. Environmental exposure history-taking should therefore be integrated into medical education as an essential component of preventive medicine and comprehensive patient care. Training future physicians to identify, interpret, and address household exposures may improve clinical assessment, patient communication, and prevention of chronic disease and cancer.

CONFLICT OF INTEREST: None.

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