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Tailoring a One Health course for an established non-One Health graduate program in Brazil

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We present a study of the tailoring of a One Health (OH) course for its integration into an established non-OH graduate program at a large public university in Brazil. The graduate program focuses on topics such as environmental resource management, impacts on ecosystems, precariousness of the work environment and relationships, workers' health, social determinants of health, and public policies. Tailoring the OH syllabus involved addressing broader OH concepts, condensing or adapting aspects of infectious diseases, covering non-infectious disease OH topics, and linking OH aspects to ongoing projects in the program. Despite the small class size, students brought diverse backgrounds, significantly enriching discussions. The course was offered in a longer (51 contact hours) and a shorter format (34 contact hours), both of which worked well within a lecture- and discussion-based structure. The extended format allowed more time for student activities and in-depth discussions. The multisectoral and transdisciplinary nature of lectures played a critical role in the course's success. This information may prove valuable for those designing OH courses for implementation in diverse settings, with the ultimate goal of disseminating OH concepts, fostering discussions, and facilitating the development and implementation of OH approaches in groups not typically exposed to this concept.

KEYWORDS

education, graduate program, graduate studies, syllabus content, syllabus adaptation, one health, planetary health, ecohealth

1 Introduction

One Health (OH) approaches recognize the interconnectedness and interdependence of human, animal, and environmental health, and aim at improving the health and well-being of living beings and the ecosystems in which they live (1–3). While infectious and zoonotic diseases represent a main focus of OH initiatives, the broader concepts of OH extend further, and cover a wide range of complex health issues at the interface of human, animal and environmental health, which may not necessarily involve infectious diseases. These include environmental threats, emergencies and disasters, chronic diseases, food safety and security, and economic impacts resulting from contaminated environments (1, 2, 4, 5). Indeed, it has been suggested that OH proposes so much that, in the end, it becomes about everything and nothing at the same time (6). We strongly disagree with this view, and firmly believe that OH has the potential to be tailored and applied to a broad range of fields and disciplines, making it relevant and meaningful in many contexts. Therefore, introducing the OH concept in diverse settings is critical, so that various audiences can adapt and use OH to address the specific challenges that they face.

In order to achieve this, teaching students about OH is as crucial (if not more so) as organizing large meetings on the subject with influential organizations that are involved in shaping OH frameworks. After all, students are the future generation that will be developing, implementing, and likely modifying OH approaches. In fact, integrating OH into the curriculum of academic programs (at various levels) has been identified as a critical strategy for promoting OH principles and enhancing human capacity building (7, 8). However, integrating OH into already established non-OH graduate programs can be challenging, as the OH content may not initially align to the program's main research lines and goals. To address this challenge, we provide as a case study our tailoring of a OH syllabus to the Graduate Program in Health, Environment and Work of the Federal University of Bahia (Universidade Federal da Bahia-UFBA) in Salvador, Brazil. The syllabus was developed from scratch by identifying relevant OH content from the literature and tailoring it to meet the specific needs and goals of the program while teaching critical OH elements. By doing so, the syllabus content became more naturally integrated into the program, rather than appearing as an isolated or unconnected topic.

2 Graduate program in Health, Environment and Work (PPGSAT)

PPGSAT is offered by the Department of Preventive and Social Medicine of the School of Medicine at UFBA. It proposes to investigate the relationships between health, environment, and work, and formulate strategies to mitigate environmental and workers' health problems. With an interdisciplinary approach based on the theoretical and political structure of Collective Health (9), and using conceptual and methodological tools, the program addresses topics such as environmental resource

management, impacts on ecosystems, precariousness of the work environment and relationships, workers' health, social determinants of health, global health, and public policies. It aims at developing alternatives and implementing actions to solve problems related to these fields in the short-, medium-, and long-term. A more thorough description and history of PPGSAT is available on the program's website at <https://sat.ufba.br/>.

3 One Health course description and syllabus tailoring/adaptations

The broad aim of the new UFBA PPGSAT One Health course was “to introduce students to the OH approach as a multisectoral, trans-disciplinary, and collaborative strategy to better address and deal with complex local, regional, and global health problems, recognizing the dimension of the interconnectedness of human, animal, and environmental health”. The syllabus was designed and structured to fit within the existing pillars of the graduate program.

The OH course was taught in two consecutive semesters of 2022, with both sessions held in person at the School of Medicine/UFBA in Pelourinho, Salvador – the first School of Medicine established in Brazil. In some cases, when the lecturers were from another country, their presentations were delivered online; however, the class still met in person to watch the presentations and engage in group discussions. In the first semester, the course comprised 51 contact hours, while in the second semester it was condensed to 34 contact hours. Classes met weekly for 17 weeks, with a variation in class duration between the two sessions (3 hours/class for the 51 contact-hour course, and 2 hours/class for the 34 contact-hour course).

Initially designed for 20-30 graduate students, with a few spots reserved for external students outside the PPGSAT program, the course structure included lectures and discussions. The distribution of time between lectures and discussions varied among classes, with an average allocation of 60% for lectures and 40% for discussions. Nevertheless, in several instances, the time allocated for discussions exceeded the scheduled class duration. In the 51 contact-hour course, certain classes featured student presentations of seminars and projects related to the course, as described in the ‘Evaluation methods’ section.

The main references used for class preparation and/or as pre-reading class material for students are listed in Table 1. Table 2 displays information about the course coordinators and lecturers.

We provide here a brief description of eleven of the classes' contents and some points of discussions raised during them.

3.1 Introduction to One Health - concept, history and importance

When asked, most students were not familiar with OH concepts or approaches. Following a discussion on the definitions of “health”, by briefly reviewing the concepts of medical, holistic, and wellness models, we introduced the broader concepts of OH along with the

TABLE 1 Main reading material used for class preparation or as a pre-class reading assignment for the students.

Class	Bibliography
1 - Introduction to One Health - concept, history and importance	(1–3, 10–18)
2 - Anthropocene/Introduction to zoonoses/Food production, food safety and food security	(2, 3, 13, 16, 19–25)
3 - Interface between human, animal and environmental health in Brazil – presentation of a member of the Department of Environmental Health Surveillance (DEHS) of Salvador	(26)
4 - Interface between human, animal and environmental health in Brazil – presentation by a member of the “Strategic Information Center for Health Surveillance of Salvador-SICHs” - Case study: Haff disease	(27)
5 - Human and environmental health – discussion around the theme “Female shellfish gatherers and artisanal fishermen and fishermen”	(28–32)
6 - Leishmaniasis: socioeconomic and cultural aspects and practical difficulties in implementing prevention and control strategies	(33–35)
7 - Interface between human, animal and environmental health in Brazil – presentation by a professional from the Agricultural Defense Agency of Bahia (ADAB)	(36, 37)
8 - The ecology of infection: zoonotic transmission at the anthropogenic interface/Leptospirosis in urban environments: eco-epidemiology and sanitation	(38)
9 - Workers’ health and infectious diseases	(39–44)
10 - Other relevant OH subjects: microbial resistance; vaccines; use of sentinel animals to monitor animal and environmental health problems	(45–53)
11 - Disasters in the context of OH – Case study: Cyclones Idai and Kenneth in Mozambique	(54–57)

terms “Planetary Health” and “Ecohealth”. We concluded that focusing on the development, implementation, and evaluation of approaches based on systemic or holistic perspectives is more important than narrowing down the OH definition.

3.2 Anthropocene/Introduction to zoonoses/Food production, food safety and food security

We introduced the concept of the “Anthropocene” and demonstrated its connection to OH approaches. We then discussed the Anthropocene’s interrelated concepts of geology, biosphere, resilience, and inequality. Climate change was inherently discussed in this class and continued to be brought up in subsequent classes. We then presented a brief history of the more restricted OH concept, associated with Veterinary Public Health and Zoonoses, and reviewed some major infectious disease outbreaks and pandemics, along with anthropogenic actions that can lead to them. Finally, we used the OH perspective to review several aspects of food production, and food safety and security, including sustainable agriculture.

TABLE 2 Information about One Health course coordinators and guest lecturers.

Name*	Institution(s)	Role in the OH course	Semester (Year 2022)
Tereza Magalhaes	1) Department of Entomology, Texas A&M University, College Station, USA 2) Department of Preventive and Social Medicine, School of Medicine, Universidade Federal da Bahia (UFBA), Salvador, Brazil	Couse Coordinator; Discussion facilitator on all classes; Lecturer on classes 1, 2, 9, 10	1, 2
Uriel Kitron	1) Department of Environmental Sciences, Emory University, Atlanta, USA	Couse Coordinator; Discussion facilitator on classes 1, 8, 11; Lecturer on class 2	1, 2
Lidice A. A. Paraguassu	1) Department of Environmental Health Surveillance (DEHS), Salvador’s Department of Health, Salvador, Brazil	Lecturer on class 3	1
Barbara N. Araujo	1) DEHS, Salvador’s Department of Health, Salvador, Brazil	Lecturer on class 3	2
Cristiane W. Cardoso	1) Strategic Information Center for Health Surveillance of Salvador (SICHs), Salvador’s Department of Health, Salvador, Brazil	Lecturer on class 4	1, 2
Monica Angelim G. Lima	1) Department of Preventive and Social Medicine, School of Medicine, UFBA	Lecturer on class 5	1, 2
Ana Angelica M. Trindade	1) Department of Preventive and Social Medicine, School of Medicine, UFBA	Lecturer on class 5	1, 2
Guilherme L. Werneck	1) Institute of Social Medicine, Universidade do Estado do Rio de Janeiro (UERJ) 2) Institute of Collective Health Studies, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil	Lecturer on class 6	1, 2
Maria Tereza Mascarenhas	1) Agricultural Defense Agency of Bahia (ADAB), Salvador, Brazil	Lecturer on class 7	1, 2
Federico Costa	1) Institute of Collective Health, UFBA 2) Instituto Gonçalo Moniz, Fundação Oswaldo Cruz, Salvador, Brazil	Lecturer on class 8	1

(Continued)

TABLE 2 Continued

Name*	Institution(s)	Role in the OH course	Semester (Year 2022)
	3) Yale University, New Haven, USA		
Thomas Gillespie	1) Department of Environmental Sciences, Emory University, Atlanta, USA	Lecturer on class 8	1
Vanio A. Mugabe	1) Universidade Licungo, Quelimane, Mozambique 2) Instituto Nacional de Saúde, Maputo, Mozambique	Lecturer on class 11	1, 2

*All guest lecturers provided consent to have their names listed in this table.

Following these two introductory sessions, we moved on to a series of presentations and discussions led by various experts.

3.3 Interface between human, animal and environmental health in Brazil – presentation of a member of the Department of Environmental Health Surveillance (DEHS) of Salvador

A member of DEHS explained the department's role in monitoring health risks associated with abiotic factors in water, air, and soil, as well as disaster risks and contingency planning. DEHS activities are designed based on health socioeconomic determinants and drivers, so that tailored community health plans can be implemented. The lecturer also highlighted that the DEHS team has participated in OH training sessions and that although OH concepts are well recognized by them, their institutionalization has not occurred. The multiplicity of governmental structures across different Brazilian states and cities was addressed to highlight the importance of considering these differences in the implementation of OH strategies. Further, the role of “community agents”, individuals who work for various government departments, as potential facilitators of OH strategy implementation within the communities in which they work was emphasized.

3.4 Interface between human, animal and environmental health in Brazil – presentation by a member of the “Strategic Information Center for Health Surveillance of Salvador-SICHs” - Case study: Haff disease

The SICHs representative discussed concepts in epidemiology and used Haff disease as a OH case study, as the department has been dealing with local cases of this health problem (27). The disease, a rare health outcome that causes myalgia and

rhabdomyolysis, has been linked to contaminated fish and seafood consumption (58).

This case study provided the class with an opportunity to expand their understanding of OH concepts through an exploration of a complex health issue involving human, animal and environmental health, one whose origins are still not completely understood.

3.5 Human and environmental health – discussion around the theme “Female shellfish gatherers and artisanal fisherwomen and fishermen”

The two guest lecturers in this class were faculty members of the PPGSAT. They first emphasized the importance of considering the political and social dimensions of health in OH approaches, highlighting the need for adaptation to diverse communities, especially those that are marginalized. They introduced the concepts of hegemonism (versus non-hegemonism), colonization and colonialism, and explained the importance of embracing these perspectives when thinking about OH. The presenters also talked with the class about projects in the PPGSAT program that align with an OH perspective, focusing on ongoing studies of the impact of oil spills on ecosystems and human communities – in particular female shellfish gatherers and artisanal fishing communities in Brazil.

3.6 Leishmaniasis: socioeconomic and cultural aspects and practical difficulties in implementing prevention and control strategies

The leishmaniasis were selected as an example of a complex group of zoonoses with expanding distribution worldwide, and with rapid adaptation to urbanization and other landscape changes. In addition to discussing the leishmaniasis disease complex and its association with poverty, the lecturer, an experienced infectious disease epidemiologist, talked about the advances and challenges of prevention and control methods for visceral leishmaniasis in Brazil. The class also discussed whether the different leishmaniasis can be considered occupational diseases under specific circumstances.

3.7 Interface between human, animal and environmental health in Brazil – presentation by a professional from the Agricultural Defense Agency of Bahia (ADAB)

In this session, a member of ADAB explained how the animal health surveillance and notification systems in Brazil operate, and exemplified situations when there is an overlap with human health departments. The class discussed rural rabies cases as an example of how a situation involving both departments is handled. Additionally, we discussed the fact that the “Zoonosis Department” is part of the

human health sector rather than the animal health sector, and the challenges this presents, highlighting the importance of intersectoral work even when the institutional framework does not fully support it.

3.8 The ecology of infection: zoonotic transmission at the anthropogenic interface/Leptospirosis in urban environments: eco-epidemiology and sanitation

This class was co-taught by two guest lecturers with extensive experience in OH-related projects. The first lecturer discussed model projects involving non-human primates and pathogenic bacteria aimed at studying spillover and spillback events between animals and humans. The second lecturer presented his decades-long collaborative works on leptospirosis, an urban zoonosis that occurs in Salvador, and how the team incorporated transdisciplinary and community-based approaches to research in order to deal with this disease in a complex urban environment.

This class was substituted by an in-person visit to the Salvador's Department of Sustainability and Resilience (Secretaria de Sustentabilidade e Resiliência-SECIS) the second time the OH course was taught.

3.9 Workers' health and infectious diseases

We discussed various infectious diseases affecting workers, with a particular emphasis on non-health professionals. An older version of a governmental document listing the recognized occupational infectious diseases in Brazil was compared to an updated document, which now includes a much more extensive list of these diseases. In addition, we explored the process behind the recognition of COVID-19 as an occupational disease in Salvador, taking advantage of a unique class expertise – one of the students participated in the development of the document that formed the basis for COVID-19 to be recognized as an occupational disease.

3.10 Other relevant OH subjects: microbial resistance; vaccines; use of sentinel animals to monitor animal and environmental health problems

While Anti-Microbial Resistance (AMR) has traditionally been one of the main focuses of OH approaches, in the tailored syllabus we only introduced this topic and discussed it in conjunction with other relevant OH subjects. We covered the types and spread of AMR, as well as how OH approaches can aid in managing the AMR global health crisis. The vaccine discussion included the history of smallpox and poliovirus vaccination, and whether immunization with the smallpox vaccine would help with the ongoing Monkeypox outbreaks worldwide (59). Socioeconomic aspects involved in the production, distribution, and access of vaccines, including those against the severe acute respiratory syndrome coronavirus 2 (SARS-

CoV-2), were broadly discussed. The topic of sentinel animals covered the intentional or unintentional use of various types of animals to monitor harmful substances, infectious agents, or environmental changes, as an early warning system.

3.11 Disasters in the context of OH – Case study: Cyclones Idai and Kenneth in Mozambique

In this class, the lecturer introduced sociodemographic and geographic features of Mozambique to contextualize the devastating effects of cyclones Idai and Kenneth, which hit the country in quick succession in March and April of 2019 (54). He then presented numerous health impacts caused by the cyclones and the actions taken to mitigate them. Emphasizing the role of community resilience in disaster preparedness, he highlighted the need to involve and empower communities in the planning and preparation process for effective disaster response. The class discussed how OH approaches can be useful to foster transdisciplinary collaborations and to elaborate a framework for the development of early warning systems, risk assessment and management, emergency response and even environmental restoration following disasters.

4 Evaluation methods

The students were evaluated based on attendance, participation in class discussions, and seminar presentations. In addition, in the 51 contact-hour course, they were asked to develop a group project aimed at applying an OH approach to address a complex health issue. Some of the themes chosen by the groups were “Adaptive management strategy – One Health for pervasive problem solving: the case of schistosomiasis” and “Oil spill on the coast of Bahia: an One Health issue”. Although not exhaustively elaborated, the projects provided an excellent opportunity for the students to practice OH thinking on their own.

5 Extra material that fostered important discussions

We watched and discussed two films in the OH course: “Pragas” (“Pests” in English) and “Mulheres das Águas” (“Women of the Waters” in English). Both films address topics that can foster deep OH-related discussions: the first shows the struggles of an environmental health agent in Recife, Brazil, when aiming to perform debatable activities to control urban pests in a degraded urban environment; the latter delves into the harsh reality of female shellfish gatherers living and working in a degraded mangrove ecosystem. Parallels were made to compare the two films, which are publicly available at <https://www.youtube.com/watch?v=XU5P2jW1oiE> and <https://www.youtube.com/watch?v=296bYFyW8Oc&t=2s>.

6 Students' educational backgrounds

Six and seven students of diverse backgrounds attended the course in the first and second semesters, respectively. The students were enrolled in either a Master's or PhD program at PPGSAT or an external program at UFBA or another higher education institution in Salvador. Over two semesters, the OH course was attended by graduate students with undergraduate degrees in a wide range of disciplines: Biology (3), Biomedicine (1), Civil Engineering (1), Interdisciplinary Health (1), Medicine (1), Nursing (2), Physiotherapy (1), Public Health Management (1), and Social Service (2).

7 Concluding remarks

Our challenge was to integrate an OH course into an established graduate program at a public university in Brazil. To do so, we tailored the OH syllabus to introduce students to basic OH concepts and elements, and to facilitate discussions on contemporary, complex health challenges through an OH lens. A very important aspect of course implementation were the discussions on the intersection of OH aspects within ongoing projects by PPGSAT students and faculty members.

Topics related to infectious diseases were either condensed or modified, because infectious diseases are not a central focus of the program. For instance, it was important to include a class on infectious diseases among non-health workers, because workers' health is a main pillar of the program. We only discussed AMR briefly, but this may be expanded upon, depending on the target audiences. In our case, discussions about local, non-infectious disease health problems, such as the oil spills and Haff disease, under an OH perspective were critical for the course's success.

Inviting guest lecturers from various sectors and with diverse expertise was an essential approach, as trans-disciplinarity and intersectionality are inherent to OH approaches. It was equally important for the class to observe and discuss the practical interaction and intersection of these sectors, including any gaps that exist.

Throughout the course, the pandemic caused by SARS-CoV-2 was continuously referred to (and experienced), and this clearly facilitated OH-related discussions that otherwise would have seemed less relevant to, or distant from, people's realities and/or fields of work.

Other relevant OH topics, such as the importance of demonstrating the added value of OH approaches, and combined vaccination strategies for both humans and animals, were also discussed. However, this article does not aim to give a complete overview of everything discussed in class. Instead, it focuses on the significant adaptations and discussions that were instrumental to integrate the OH subject into the program.

The number of students enrolled in both semesters was somewhat lower than expected; however, this is not surprising for a course that was newly developed by new instructors, and that addressed a novel subject. A class of up to 30 students could benefit

from the same lecture- and discussion-based course format, and although the format may need to be adapted for larger classes, discussions should remain an integral component of OH courses. In our case, the course attracted students from different backgrounds, significantly enriching the discussions. We strongly believe that implementing an OH course based on the broader OH concepts requires inviting students from diverse backgrounds to enroll.

Regarding the number of contact hours, both formats proved effective for lectures and discussions. Nevertheless, the 51 contact-hour version allowed for additional time for seminars, projects, and extended discussion periods. The number of contact hours and the activities developed by the students may be adjusted according to the coordinators and instructors' aims and needs.

In conclusion, the OH course should be tailored to effectively integrate into the program where it is being taught. This entails not only adapting the content but also adjusting its format as needed. Here, given the high-quality of the classes, the engaging discussions between students and lecturers, and the positive feedback received, the course has proven to be a valuable addition to the program.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material. Further inquiries can be directed to the corresponding author.

Author contributions

TM: Conceptualization, Funding acquisition, Methodology, Writing – original draft, Writing – review & editing, Validation. AB: Methodology, Writing – review & editing. JM: Methodology, Writing – review & editing. KS: Methodology, Writing – review & editing. Md: Methodology, Writing – review & editing. RG: Methodology, Writing – review & editing. RN: Methodology, Writing – review & editing. RC: Methodology, Writing – review & editing. GR: Funding acquisition, Validation, Writing – review & editing. UK: Conceptualization, Methodology, Validation, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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