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One Health in sub-Saharan African medical curricula: a cross-sectional, mixed-methods study

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Abstract

Introduction: *the One Health approach addresses human, animal, and ecosystem health. While important, there is little published information describing One Health training in medical education, particularly in sub-Saharan Africa. This study aimed to explore One Health topics and competencies integrated into sub-Saharan African medical curricula, how they are integrated, and the benefits and barriers to integration.* ***Methods:*** *in this cross-sectional, mixed methods study, purposive and snowball sampling were used to sample one Dean, administrator, or faculty member per identified medical education institution with self-reported knowledge about their institution's medical curriculum. Quantitative*

and qualitative data were collected using an online QualtricsXM survey and semi-structured interviews. Descriptive statistics and thematic analysis were used for data analysis. ***Results:*** *sixty-one participants from 27 sub-Saharan African countries completed the survey. Among these participants, 23 also completed a semi-structured interview. The most commonly reported One Health topics and competencies integrated into medical curricula were epidemiology (n=56, 93.3%) and ethics and values (n=40, 66.7%). Interviewees linked zoonotic/vector-borne diseases, collaboration, and research with One Health. The most commonly cited benefit of One Health was "holistic patient care" (n=14, 48.3%). "Not enough time" (n=23, 53.3%) and "lack of faculty knowledge" (n=16, 88.9%) were the most common barriers to integrating One Health.* ***Conclusion:*** *there are gaps in One Health integration into sub-Saharan African medical curricula. There are imminent needs to train medical teaching staff and future medical doctors to provide holistic, equity-focused care using One Health approaches.*

Introduction

The world is facing extraordinary global health issues. About 75% of emerging and re-emerging pathogens are zoonotic, resulting in millions of human deaths each year [1]. The burden of non-communicable diseases has increased [2], as well as Antimicrobial Resistance (AMR) [3], toxicoses [4], food insecurity [5], climate change [6], and biodiversity loss [7]. Experts in low- and middle-income countries (LMICs), particularly within sub-Saharan Africa (SSA), address these concerns interacting with (neo) colonialism, racism, and resource extraction [8,9].

To address these global health issues, the World Health Organization (WHO), the World Animal Health Organization (OIE), the Food and Agriculture Organization of the United Nations (FAO), and the United Nations (UN) Environmental Program (UNEP) promote the One Health (OH) approach [10]. One Health (OH) focuses on multisectoral, transdisciplinary actions addressing human-animal-environmental health intersections [11,12]. In 2008, a OH framework called "Contributing to One World, One Health: a strategic framework for reducing risks of infectious diseases at the animal-human-ecosystems interface" was initiated by the WHO, OIE, United Nations Children's Fund (UNICEF), United Nations Systems Influenza Coordination (UNSIC), and The World Bank [13]. This framework proposed a global response to the Highly Pathogenic Avian Influenza (HPAI) that originated in China and spread to Southeast Asia and Europe [13].

In addition to intergovernmental bodies embracing the OH approach, so have some universities [14]. One study describes joint African, European, and South American initiatives to integrate OH into graduate program curricula [15]. OH training has been developed by East African and American universities for early professionals and students from a variety of fields, including human medicine [14]. Tufts University in the U.S. designed an interdisciplinary OH course for undergraduate students from medical, dental, nutrition, and veterinary schools [16]. Students' confidence, understanding, and application skills toward OH increased [16]. Benefits of improving the OH educational landscape include promoting international collaboration, understanding of community needs, problem-solving strategies, and cultural awareness [14].

Collaboration between human medical practitioners, veterinarians, and environmental scientists is clearly indicated. For example, the antiviral agent Remdesivir, initially developed to treat feline infectious peritonitis caused by a feline coronavirus, was repurposed to treat COVID-19 in humans [17]. However, despite the importance of OH for human health professionals, studies show that veterinarians have embraced OH more than human-focused General Practitioners (GPs) [18]. One Australian study showed veterinarians were more concerned about zoonotic diseases and their diagnoses as compared to GPs, potentially related

to the lack of zoonosis training in human medical degree programs [18].

Specific OH topics and competencies for physicians have been identified. These include epidemiology, zoonotic/vector-borne diseases, risk analysis and biohazard identification, microbiology (including AMR), human-animal bonds and service animals, animal-related injuries, ecosystem health, food systems, the role of the environment in human health (including environmental pollution), ethics of balancing human, animal, and environmental health, comparative and evolutionary medicine, intersections between OH, health equity, and socioeconomic welfare [15,17,19,20]. OH competencies identified by the African One Health University Network (AFROHUN) for the African context are communication and informatics, management, gender culture, beliefs, values and ethics, leadership, collaboration and partnership, policy and advocacy, research and systems thinking [15].

Frameworks such as the Planetary Health Report Card focus on incorporating similar OH/Planetary Health concepts into medical school curricula [21]. Planetary health implies that for human civilization to attain the highest standard of living, the natural systems on which they depend should be sustained [21]. However, data from such tools in the sub-Saharan Africa (SSA) context had not yet been published in 2022 despite the strong connections between humans, animals, and the environment in the region [11]. Poverty, rapid urbanization, economic reliance on livestock, and the effects of climate change are OH-related concerns exacerbating poor health in SSA [11,22]. Given the importance of integrating OH into SSA medical curricula but the lack of research about the topic, this study aimed to explore OH topics and competencies integrated into SSA medical curricula, how they are integrated, and the benefits and barriers to integration.

Methods

Study design: this was a cross-sectional, mixed methods, descriptive study. Quantitative survey data focused on existing OH topic and competency recommendations for medical curricula (in SSA) [15]. Qualitative semi-structured interview data supported the identification of new OH-related insights through a qualitative description approach.

Setting and sample size: this study was conducted among medical education institutions from 40 SSA countries which were identified from the Centre for Capacity Research's "Master List of Health Education Institutions", a public domain dataset of the African Health Education Institutions (HEIs) [23]. Nine additional African HEIs with medical programs were identified through institutional websites, publications, researchers' contacts, and participant referrals. Institutions not located in SSA, those without medical programs, and those without active contact information were excluded. In total, 217 medical institutions from 40 countries were invited to participate. Initial contact and follow up with participants occurred between March and April 2022, and data collection and analysis were conducted between May and July 2022.

Participants inclusion/exclusion criteria:purposive and snowball sampling were used to recruit deans, administrators, and faculty members of SSA medical education institutions. Participants were excluded if they self-reported not having sufficient knowledge about the medical curricula and/or if they had not worked for their institution for at least one year. Participants consented to the study by checking a box and typing their signature in the survey. Those participating in the semi-structured interview verbally indicated their informed consent. After participants finished the survey, the researchers asked them if they wanted to participate in the semi-structured interview, and if so, appointments were scheduled. WhatsApp,

Zoom, or Microsoft Teams calls were used to conduct the interviews.

Data sources/measurements: the researchers collected data using QualtricsXM surveys and interview guides, each developed in English and translated into French and Portuguese. The French and Portuguese study tools were back translated for quality assurance. The components of all data collection tools were based on previous studies [11,12,19,24-26].

The survey asked participants about their demographics, OH topics and competencies, methods used in OH courses, the benefits and barriers of integrating OH, and recommendations for integrating OH into institutions' medical curricula. Questions were single answer, select all that apply, text entry, and ranking response formats. All participants were given 24 standardized questions. After the question, "From your perspective, to what extent is One Health integrated into your institution's medical curriculum?" the survey split into two sections: yes to having OH integration (yes-OH group) if they responded "to a large extent" or "to some extent," and no or undetermined OH integration (no-OH group) if they responded "not at all" or "I don't know". The yes-OH and no-OH groups then answered questions about how OH is or would be integrated. Participants' surveys were dropped if they did not answer the survey at least until the dividing question. This aimed to exclude large amounts of missing data.

The interview guide was developed by the researchers in consultation with OH experts from the One Health Commission, University of Global Health Equity (UGHE), and Gorilla Doctors and piloted prior to administration. Interview questions investigated participants' perspectives about OH, its importance, integration, and associated benefits and barriers. The interviews lasted approximately 45 minutes.

Quantitative variables and statistical methods: quantitative data were analyzed descriptively in SPSS (IBM, Version 28). Frequencies and percentages were reported for categorical data, mean and standard deviation for normally distributed continuous data, and median and interquartile range for non-normally distributed data.

Qualitative analysis: field notes were taken during the interviews as well as audio recordings, which were then transcribed. Interview transcripts were coded individually by the two primary researchers who then came together and standardized the codes. Interview data were analyzed through thematic analysis using Dedoose (SocioCultural Research Consultants, Version 9.045) and were integrated through triangulation [27]. The researchers estimated to have reached data saturation at approximately 20 interviews. After data collection, the major findings were sent to the participants for their comments.

Bias: to mitigate information and recall biases, the researchers selected the participants who had been working at their institutions for over a year and self-reported having sufficient knowledge about their medical curricula. To prompt participant recall, a OH description was included in the survey before asking questions about the integration of OH into their medical curricula.

Results

Socio-demographic characteristics of the study: among 217 participants, sixty-one participants (one per institution) from 27 countries answered the QualtricsXM survey fully (28.1% response rate). Among the surveys that were completed, 45 were English, 10 French, and 6 Portuguese responses. Participants were mostly male (n=50, 82.0%), 30-39 years old (n=20, 32.8%), holding a PhD (n=21, 34.4%), and Deans (n=25, 41.0%; Table 1). Participants were mostly from institutions in Ethiopia (n=16, 26.2%), followed by Nigeria and Kenya (n=4, 6.6% each). Other countries included Uganda, Zambia, Burundi, Democratic Republic of Congo, and Angola (n=3,

4.9% each); Rwanda, Cameroon, and Guinea-Bissau (n=2, 3.3% each); and South Sudan, Mali, Burkina Faso, Benin, Guinea, Liberia, Tanzania, Sierra Leone, Zimbabwe, South Africa, Botswana, and Malawi (n=1, 1.6% each).

The majority of institutions (N=61) were public (n=44, 72.1%) and located in the Eastern Africa region (n=24, 39.3%), followed by Western Africa (n=15, 24.6%), and Central and Southern Africa (n=11, 18.0% each). Most participants (N=61) reported that their institution was not part of the African One Health University Network (AFROHUN) (n=22, 36.1%), followed by "I don't know" (n=21, 34.4%), and "Yes'' (n=18, 29.6%).

Perspectives about OH topics and competencies included in institutions' medical curricula: the median number of OH topics and OH competencies included were 6 out of 12 (IQR=5) and 5 out of 9 (IQR=4), respectively. Participants ranked epidemiology (OH topic) and values and ethics (OH competency) as both the most included and important OH topic and competency, respectively (n=56, 93.3%; n=50, 82.0%).

Perspectives about how OH is (or could be) integrated: participants envisioned OH integration to mean having "some specific courses teach about OH" (n=29, 47.5%) and to "have all courses integrate OH" (n=28, 45.9%; Table 2). Forty-three participants reported OH is integrated "to some extent" or "to a large extent" in their institution's medical curriculum (Table 2). Eighteen participants indicated that OH was "not at all" integrated or that they "don't know." In both groups, epidemiology and environmental/ecosystem health were reported as the most common courses for (potentially) delivering OH content (n=6, 18.2%, n=7, 21.2%) respectively.

Participants indicating OH is already integrated, most reported using "in-class lectures" in OH-related courses (n=34, 79.1%). The most common response was "group study/assessments" among participants stating OH is integrated "not at all" or they did not know (n=10, 58.8%). The majority of participants in both groups stated OH was/would be taught in pre-clinical courses (n=36, 83.7%; n=14, 82.5%). Participants reported similarly for (potentially) teaching OH in clinical courses (n=30, 71.4%; n=16, 94.1%). Holistic patient care and health care delivery "for all" were the most reported (potential) benefits of integrating OH into medical education (n=14, 48.3%; n=8, 61.5%). Not enough time" and "lack of faculty knowledge" were the most reported barriers to further integrating OH into medical education (n=23, 53.5%; n=16, 88.9%).

Overall, most participants (N=61) "strongly agreed" (n=43, 70.5%) that OH should be incorporated into their institution's medical curricula, followed by those who "agreed" (n=15, 24.6%), "neither agree or disagree (n=2, 3.3%), and "prefer not to say" (n=1, 1.6%). Most participants (N=61) ranked the importance of OH content relative to other medical curriculum topics as "high" (n=41, 67.2%), followed by "moderate" (n=13, 21.3%), "low" (n=6, 9.8%), and "prefer not to say" (n=1, 1.6%).

Semi-structured interview results

Socio-demographic characteristics of the participants: among the 61 survey participants, 23 from 15 countries completed semi-structured, in-depth interviews (14 in English, 7 in French, and 2 in Portuguese). Most participants were from Ethiopia (n=5, 21.7%), followed by Uganda, Zambia, DRC, and Rwanda (n=2, 8.70% each).

Three major themes emerged. Participants described OH topics and competencies they perceived as (important to be) incorporated (Figure 1). They also described community/public health courses and fieldwork as methods of integrating OH into medical curricula. Participants reported multiple barriers towards integrating OH into medical curricula.

OH topics and competencies perceived to be important to integrate into SSA medical curricula: the participants stated that teaching OH would

enable students to address zoonotic/vector-borne diseases. Participants believed it would be unsustainable to treat patients who continue to be exposed to environmental risk factors, stressing the importance of understanding disease drivers. Interdisciplinary collaboration was seen to offer opportunities to address zoonotic/vector-borne diseases:

"In a country where we know [we have] a lot of epidemic cases; there is the Ebola epidemic, and there is COVID. They are transversal; that is to say, they concern several sectors. We worked with the veterinary doctor and we worked with agronomists… I think the experience was rich because… I am not a veterinarian, but with the exchanges with veterinary colleagues, we can understand the link between human health, animal health, and environmental health".

The participants described different partnerships between medicine and other departments. For example, the participants mentioned organizing workshops and seminars between the medicine department and agricultural sciences. Various topics covered from such collaboration include exploring malnutrition in clinical settings and how it can be tackled. They also stated that some institutions have research centers allowing students to learn about disease origins. Participants reported students could research indigenous plants for traditional medicine. The purpose of such research was to identify the healing properties of the plants and how this knowledge could be integrated into their medical practice:

"At the pharmacy level, we use a lot of plants in Africa to heal. Thus, the knowledge of these plants is very important for the medical students to do courses on them. Often they have outings in the forest to be able to identify plants and also collect plants to study them. We also realized that plants have clinical importance. When people from our country are sick, they take conventional drugs but they can also be treated with traditional medicine. Therefore, the knowledge of these plants is very important to be able to improve the management of cases."

Public/community health and fieldwork as methods of integrating OH into medical curricula

When responding about the integration of OH into their institutions' medical curricula, participants described community and public health courses, namely "community-based education," "community attachment," "community-based training program," "social and community medicine" "public health," "rural internship," and "management of health". Environmental health and epidemiology were viewed as topics within these courses or separate courses. Some participants discussed "ecosystems and biodiversity" courses in comparison to environmental health courses.

Fieldwork opportunities were highlighted as a form of instruction incorporating OH-related topics, including epidemiology, environmental and human health connections (e.g., sanitation), and food systems (e.g., malnutrition, agriculture). One participant discussed a "community-based training program" at their institution, in which students go "to the community" in successive stages and collect data (e.g., stool samples) based on their didactic course content, such as social determinants of health and parasitology. Another participant described students engaging in "a whole variety of assessments from housing to water, foods, and manufacturing, □ dairy and farming, [and] fertilizer and chemicals that are added to the crops."

Barriers to OH integration

The lack of trained human resources was a commonly identified barrier to integrating OH into medical curricula. Participants reported that OH is still a relatively new concept for them, to the extent that some had first heard about the approach during this study. Participants expressed the need for a better understanding of what OH is and its operationalization. For faculty members to

be trained, however, participants highlighted the need for their institutions' administrations to understand the urgency of OH, which, if recognized, could instigate educational policy reform:

"We don't have human resources trained in OH. So, we will have to be trained first, and it is only when we are trained that we can also pass the training to others. As I said, it is a new concept, it is in our interest first to understand it correctly and to pass the knowledge to others."

Some participants also stated that their curriculum was already too busy and that was unlikely for any new courses to be added. They did, however, suggest having OH extracurricular activities. Participants indicated that such activities would take the form of conferences, seminars, and fieldwork. Interdisciplinary teams organizing the activities could comprise students and staff with a background in human medicine, agronomy, environmental sciences, veterinary medicine, and public health.

However, some participants expressed their concerns that OH may make medical students less focused on human health, which is their core responsibility:

"I think OH (in the medical curriculum) could allow students to have a clear dedicated approach, but I'm wondering that by doing so, will it really be good for medical students or will it deviate them from their core responsibility of taking care of human health?"

Discussion

The majority of participants indicated that OH was integrated to some extent. Regarding OH topics, interview discussions centered around zoonotic/vector-borne diseases. Participants emphasized the need to better understand Ebola and COVID-19, diseases that originated from animals [28,29]. Participants' zoonotic disease focus is consistent with the literature, which shows OH integration into medical curricula is limited, and that OH interventions have been primarily focused on infectious diseases [30,31]. Survey results indicated that epidemiology and AMR were most frequently included in institutions' medical curricula. While epidemiology encompasses topics outside of infectious diseases, intersections between OH, epidemiology, and zoonotic/vector-borne diseases are commonly discussed [32,33]. This focus on infectious diseases and epidemiology may be in response to globally changing zoonotic disease patterns, resulting from environmental degradation and close human-animal contact [12].

The literature shows that epidemiological principles are relevant for policy development and implementation, including in SSA [34,35]. Studies report that OH-informed policies in SSA must address structural violence and health systems strengthening [34,36]. Efforts should consider all species at the level of patients, pathogens, and populations' natural and built environments [34]. Some countries in SSA have already incorporated OH into national systems, including Rwanda's national policies [37,38]. While physicians have been called upon to promote OH policies and practices, not all have engaged [34]. This general lack of engagement was also found in this study, as policy and advocacy were ranked as the least included and least important OH competency. Awareness about evidence-based, community-engaged, equity-focused policies, as well as physicians' roles in developing and implementing these policies, should be expanded.

Regarding OH competencies, participants most frequently reported the inclusion of values and ethics, also the competency they considered the most important. While this OH competency was defined by Amuguni *et al.*(2019) as "the demonstration of integrity, honesty, trust, fairness, adaptability, and respect in OH action in diverse contexts", participants may have interpreted the competency as closer to "medical ethics" [15]. Similarly, participants may have interpreted the OH topic of ethics and values of

balancing human and animal/environmental health, the third most-included topic, as medical ethics (N.B. definitions of OH topics and competencies were not given to participants). While medical ethics is considered a starting point to shift discussions from human-centered biomedical ethics to veterinary ethics, anthropocentric medical ethics by itself is not part of OH [39,40]. Ethics and principles in the OH context may be more closely associated with comparative medicine, a OH topic scarcely discussed in this study [39].

While the OH competency of values and ethics was highlighted in survey responses, participants focused on interdisciplinary research in the interviews. Many participants described the research conducted by their medical education programs as interdisciplinary; however, human health was the primary focus. For example, one participant described having students research communicable and non-communicable disease prevalence. However, anthropocentric disease surveillance and control are not examples of OH, they are examples of human-focused public health [41]. A OH-informed disease surveillance intervention would involve human, animal, and environmental health experts and significant community engagement [42].

Another notable finding was that participants ranked gender, culture, and beliefs as one of the least important OH competencies. Multiple literature sources highlight the importance of the social sciences in OH education [43,44]. OH experts report social science concepts, such as gender, culture, and beliefs, as vital for recognizing and contextually addressing how social factors intersect to impact human, animal, and environmental health [43]. Research has deepened the understanding of how gender and sex play an important role in the etiology, diagnosis, and treatment of patients [45]. Gender and sex, therefore, should be included in medical education and clinical practice to increase the competency of medical doctors.

Reported barriers to integrating OH included lack of faculty knowledge, not enough curricular space, and insufficient time, all of which the literature corroborates [11,16]. Thus, medical education institutions in SSA may consider joining consortiums, such as AFROHUN or the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM), to receive training and capacity building resources surrounding OH-related disease detection, prevention, and response [26,35]. OH-focused education initiatives have changed medical students' knowledge and perceptions about OH and medicine, and future training and networking opportunities could potentially affect those among medical teaching faculty [26,30,35].

Some participants also stated that medical students should understand and utilize community-based knowledge and beliefs (e.g., traditional medicine) to promote human and environmental health. The literature supports this integration of biological, psychological, social, environmental, and spiritual perspectives into clinical practices [46]. One participant in this study described the involvement of medical students in researching traditional plant medicine at their university, similar to opportunities explained in other studies [47]. Holistic, equity-focused OH educational practices, in which SSA-centered multidisciplinary knowledge, lived experiences, and cultures can be shared and valued, are recommended in the literature and should be promoted in SSA medical curricula [8,11,48].

Limitations: this study had a small sample size and a relatively large proportion of participants from one country. Participants were not required to answer all questions, which led to some missing data. Participants self-reported their knowledge about their institutions' medical curricula as well as how much OH was integrated. OH was a new term to many of the participants. Nevertheless, this study provides insights and recommendations to be further explored, particularly in the context of SSA.

Conclusion

More than half of survey participants in this study reported that OH topics and competencies were integrated into their institutions' medical education curricula to some extent. However, participants mainly highlighted the topic of zoonotic/vector-borne diseases. It is important for current and future physicians to learn that OH encompasses more than infectious diseases and epidemiology. For example, the health of humans, animals, and the environment are deeply tied to structural violence. Such concerns may be addressed through OH-informed policies and advocacy, a vital competency for physicians yet one not reportedly incorporated or important by participants in this study, who were reflecting upon the extent of OH in their institutions' medical curricula. Medical education institutions may partner bilaterally, within larger networks, and interdisciplinarity to share OH content and teaching approaches. By highlighting the imperativeness of OH and health equity, for not only humans but also between species and environments, physicians may provide holistic patient care and learn about new health-related threats through intersectoral, SSA-centered education, collaboration, and research.

What is known about this topic

- *More than 75% of emerging and re-emerging infectious diseases are zoonotic and this is a OH concern;*
- *Most of the One Health concerns are more pertinent in SSA;*
- *There have been calls from international health organizations to use the One Health approach in tackling emerging and re-emerging infectious diseases and unfortunately, there is a lack of research on OH integration into SSA medical curricula.*

What this study adds

- *The findings of this study indicated that there is generally room for improvement in how OH is integrated into medical curricula in SSA;*
- *The most common challenges of OH integration in medical curricula in SSA included limited time and lack of faculty knowledge.*

Competing interests

The authors declare no competing interests.

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Authors' contributions

Esther Ntiyaduhanye, Evelyn Grace Bigini, Maria Albin Qambayot, and Phaedra Henley contributed to the study design. Esther Ntiyaduhanye and Evelyn Bigini contributed to the implementation of the study, data acquisition, data analysis, and drafting of the manuscript. All authors edited the manuscript. The final version of the draft has been read and approved by all the authors involved.

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Tables and figure

Table 1: survey participant demographics

Table 2: perspectives about One Health integration into medical curricula

Table 3: benefits of integrating One Health into medical curricula

Figure 1: themes and sub-themes that emerged during interviews about One Health integration into medical curricula from sub-Saharan Africa

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Table 1: survey participant demographics

Age (years; N=61)	**n (%)**
20-29	4 (6.6%)
30-39	20 (32.8%)
40-49	15 (24.6%)
50-59	14 (23.0%)
60 or older	8 (13.1%)
Sex (N=61)	
Female	11 (18.0%)
Male	50 (82.0%)
Highest education (N=59)	
MD/MBBS	17 (28.8%)
Master' s in Medicine	15 (25.4%)
PhD	21 (35.6%)
Other	6 (10.2%)
Position at university (N=61)	
Dean	25 (41.0%)
Faculty member	20 (32.8%)
Administrators other than Dean	6 (9.8%)
Other	9 (14.8%)
Prefer not to say	1 (1.6%)

*The total number of responses varies per question because not all participants answered every question and/or the questions were only displayed to certain respondents (e.g., those indicating OH had already been included)

Table 2: perspectives about One Health integration into medical curricula	
Responses	**n (%)**
Have all courses integrate OH	28 (45.9%)
Have a sole course teach about OH	13 (21.3%)
Have some specific courses teach about OH	29 (47.5%)
Have it as an elective course	14 (23.0%)
Have it as an elective course	0 (0.0%)
I don' t know	
From your perspective, is One Health integrated into your institution' s medical curriculum? (N=61)	
To a large extent	4 (6.6%)
To some extent	39 (63.9%)
Not at all	14 (23.0%)
I don't know	4 (6.6%)

Table 3: benefits of integrating One Health into medical curricula	
What are the benefits of integrating One Health into your institution's medical curriculum? (N=29)	**n (%)**
Holistic patient care	14 (48.3%)
Understanding the interconnectedness of humans, animals, and the environment	6 (20.7%)
Students' capacity building related to disease dynamics	5 (17.2%)
Building OH competencies and skills	4 (13.8%)
From your perspective, is One Health integrated into your institution's medical curriculum? (N=61)	
Provide better health care services "for all"	8 (61.5%)
Preparedness for emerging zoonotic diseases	2 (15.4%)
Understanding the interconnectedness of humans, animals, and the environment	2 (15.4%)
Imparting the importance of OH	1 (7.7%)

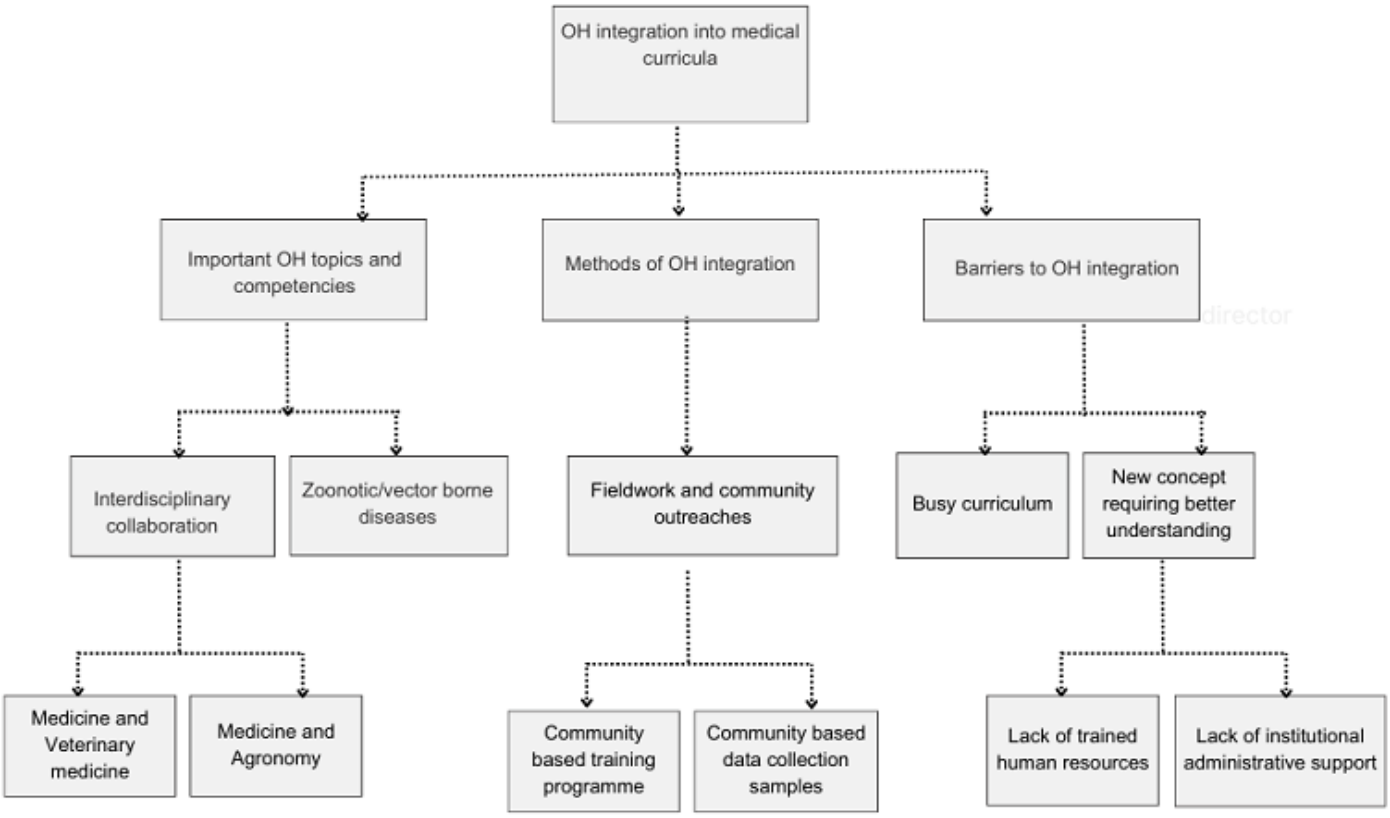

Figure 1: themes and sub-themes that emerged during interviews about OH integration into medical curricula from SSA