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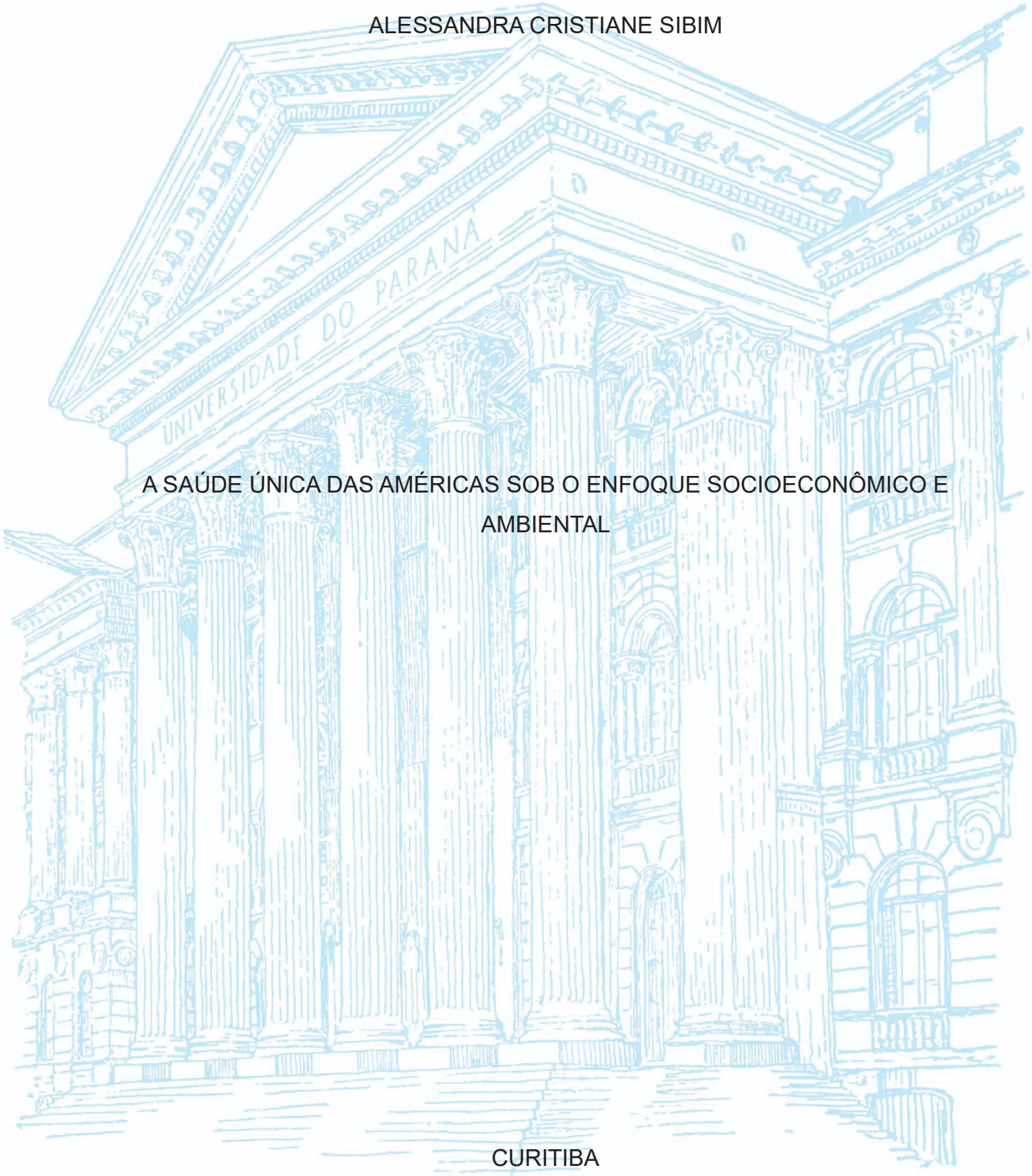
ALESSANDRA CRISTIANE SIBIM



A SAÚDE ÚNICA DAS AMÉRICAS SOB O ENFOQUE SOCIOECONÔMICO E AMBIENTAL

CURITIBA

2025

ALESSANDRA CRISTIANE SIBIM

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Tese apresentada ao Programa de Pós-Graduação em Ciências Veterinárias, Setor de Ciências Agrárias, Universidade Federal do Paraná, como requisito parcial à obtenção do título de Doutor em Ciências Veterinárias.

Orientador: Prof. Dr. Alexander Welker Biondo

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Os membros da Banca Examinadora designada pelo Colegiado do Programa de Pós-Graduação CIÊNCIAS VETERINÁRIAS da Universidade Federal do Paraná foram convocados para realizar a arguição da tese de Doutorado de **ALESSANDRA CRISTIANE SIBIM**, intitulada: **A SAÚDE ÚNICA DAS AMÉRICAS SOB O ENFOQUE SOCIOECONÔMICO E AMBIENTAL**, sob orientação do Prof. Dr. ALEXANDER WELKER BIONDO, que após terem inquirido a aluna e realizada a avaliação do trabalho, são de parecer pela sua APROVAÇÃO no rito de defesa.

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Dedico esta tese a toda minha família: meus filhos Pedro e Miguel e ao meu esposo Wagner, sem vocês nada faria sentido.

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"A saúde humana e a saúde dos animais são inseparáveis da saúde do nosso ambiente."

James E. Lovelock (cientista e autor da teoria Gaia)

RESUMO

A Saúde Única (One Health, Uma Só Saúde) é uma abordagem interdisciplinar que visa integrar saúde humana, animal, vegetal e ambiental, reconhecendo suas interdependências para enfrentar desafios globais como pandemias zoonóticas. A emergência da COVID-19, ressaltou a importância dessa abordagem para entender como fatores ambientais, sociais, políticos e econômicos contribuem para crises globais de saúde. Embora amplamente reconhecida, a implementação prática dessa abordagem enfrenta limitações devido à ausência de metodologias padronizadas e ferramentas adequadas de avaliação adaptadas a contextos específicos. Neste trabalho, estudamos a Saúde Única das Américas, qualificando e quantificando as saúdes humana, animal e ambiental desta macrorregião sob índices integrados. Por meio de levantamento bibliográfico e de entrevistas com representantes de diferentes países, significamos a região de acordo com parâmetros socioeconômicos, demográficos e ambientais. Nosso primeiro capítulo desenvolveu e avaliou um Índice de Saúde Única (OHI) para os países sul-americanos, assim como sua interação com indicadores socioeconômicos. Encontramos associação positiva entre OHI e Índice de Desenvolvimento Humano (IDH), mas não com o Produto Interno Bruto (PIB). Embora países com estabilidade política, maiores investimentos em saúde e políticas progressistas apresentem maior OHI, a saúde ambiental não se correlacionou diretamente com melhores indicadores de saúde humana e animal. A contribuição positiva da Floresta Amazônica para a saúde ambiental, contrastou com sistemas precários de saúde humana locais. A ausência de indicadores robustos para saúde animal foi identificada como uma limitação às estratégias de Saúde Única na região. Nosso segundo capítulo avaliou as iniciativas de Saúde Única das Américas por meio da percepção da saúde com enfoque veterinário de representantes de instituições governamentais das Américas. Nossos resultados, explorando a resposta de um questionário por representantes de 17 países, revelaram que aspectos relacionados à segurança alimentar dos países são mais bem avaliados que a execução de políticas públicas relacionadas à saúde. As rotinas institucionais relacionadas aos programas de zoonoses ainda são uma lacuna na região. O estudo mostrou que a integração internacional e o acesso às diretrizes globais na área de saúde com enfoque animal, foram mais bem avaliados do que a articulação interna, sugerindo que as políticas públicas da saúde dos países carecem de avanços. Portanto, é evidente a necessidade de métodos eficazes e indicadores eficazes para avaliar a interdependência entre saúde humana, animal e ambiental, especialmente em contextos vulneráveis, como a América do Sul. A integração de indicadores socioeconômicos e ambientais com a saúde é imperativa para implementação de políticas públicas que considerem as especificidades regionais e locais. Embora os países com maior estabilidade política e investimentos em saúde apresentem melhores resultados de Saúde Única, ainda existem desafios quanto à saúde animal e à coordenação interna dos países entre os diferentes setores envolvidos. Nossos resultados reforçam a necessidade de uma abordagem internacionalmente coordenada e integrada, para enfrentar as questões de saúde na região.

Palavras-chave: indicadores; índice; macrorregião; parametrização; saúdes.

ABSTRACT

One Health is an interdisciplinary approach that aims to integrate human, animal, plants and environmental health, recognizing their interdependencies to address global challenges such as zoonotic pandemics. The emergence of COVID-19 highlighted the importance of this approach in understanding how environmental, social, politic and economic factors contribute to global health crises. Although widely recognized, the practical implementation of this approach faces limitations due to the lack of standardized methodologies and appropriate assessment tools adapted to specific contexts. In this study, we investigated One Health in the Americas, qualifying and quantifying human, animal, and environmental health in this macro-region using integrated indices. Through a literature review and interviews with representatives from different countries, we characterized the region according to socioeconomic, demographic, and environmental parameters. Our first chapter developed and evaluated a One Health Index (OHI) for South American countries, as well as its interaction with socioeconomic indicators. We found a positive association between OHI and the Human Development Index (HDI), but not with Gross Domestic Product (GDP). Although countries with political stability, greater investments in health, and progressive policies have higher OHIs, environmental health did not correlate directly with better human and animal health indicators. The positive contribution of the Amazon Rainforest to environmental health contrasted with precarious local human health systems. The absence of robust indicators for animal health was identified as a limitation to One Health strategies in the region. Our second chapter assessed One Health initiatives in the Americas through the perception of veterinary health by representatives of government institutions in the Americas. Our results, exploring the response of a questionnaire by representatives from 17 countries, revealed that aspects related to food safety are better evaluated than the execution of public health policies. Institutional routines related to zoonosis programs are still a gap in the region. The study showed that international integration and access to global guidelines in the area of animal health were better evaluated than internal articulation, suggesting that countries' public health policies lack progress. Therefore, there is a clear need for robust methods and effective indicators to assess the interdependence between human, animal, and environmental health, especially in vulnerable contexts such as South America. The integration of socioeconomic and environmental indicators with health is imperative for the implementation of public policies that consider regional and local specificities. Although countries with greater political stability and investments in health have better One Health outcomes, challenges persist, especially regarding animal health and internal coordination among the different sectors involved. Our results reinforce the need for a coordinately and internationally integrated approach to address health issues in the region.

Keywords: index; indicators; macroregion; parametrization; healths.

SUMÁRIO

1 INTRODUÇÃO GERAL

Saúde Única (One Health, Uma Só Saúde) é uma abordagem integrada e unificadora que visa equilibrar e otimizar de forma sustentável a saúde de pessoas, animais, plantas e ecossistemas. Reconhece que a saúde dos seres humanos, animais domésticos e selvagens, plantas e o meio ambiente mais amplo (incluindo ecossistemas) estão intimamente ligados e interdependentes (Figura 1) (OHHLEP et al., 2022). Trabalha com uma abordagem científica e multidisciplinar para a saúde e o bem-estar contribuindo para a promoção da saúde planetária e demonstrando que tudo está intrinsecamente interconectado (AVMA, 2008). Ademais, o conceito de Saúde Única foi desenvolvido para incentivar parcerias colaborativas sustentáveis e promover a saúde ideal nestes diferentes contextos. Profissionais ao redor do mundo têm trabalhado para avaliar a interação e a interdependência interdisciplinar entre saúde e bem-estar em um ambiente em constante transformação (Pettan-Brewer et al., 2021). Durante o 59º CONSELHO DIRETOR da Organização Pan-Americana da Saúde (OPAS) e a 73ª SESSÃO DO COMITÊ REGIONAL DA OMS PARA AS AMÉRICAS, foi aprovada a política de *Uma Saúde: Uma abordagem abrangente para lidar com ameaças à saúde na interface homem-animal-ambiente* (OPAS, 2021). O objetivo desta política é promover a coordenação e colaboração entre as diferentes estruturas de governança dos programas de saúde humana, animal, vegetal e ambiental, para melhorar a prevenção e a preparação para os desafios de saúde atuais e futuros na interface entre seres humanos, animais e meio ambiente. A política inclui seis linhas de ação estratégica que podem fornecer orientações valiosas para as atividades das autoridades sanitárias nacionais e para a prestação de cooperação técnica pela OPAS. Ressalte-se que a primeira linha de ação estratégica desta política "Saúde Única" visa "*realizar uma análise e mapeamento das complexas interações entre atores e processos nos campos da saúde humana, animal, vegetal e ambiental em contextos nacionais específicos*".

A transmissão e a manutenção de agentes zoonóticos estão vinculadas com interações entre os próprios agentes etiológicos, seus hospedeiros e o ambiente, sendo que estas interações formam a tríade epidemiológica (Neves, 2005). A abordagem que relaciona a complexidade de doenças relevantes para a saúde humana e saúde animal em ambiente, associado ao vasto número de hospedeiros e seus potenciais agentes, integrado com os fatores ambientais, relacionando-os com a

sua emergência e reemergência já é concebida historicamente (Taylor; Latham; Woolhouse, 2001). No entanto, os registros literários do conceito e definição de Saúde Única são recentes. Daszak et al. (2000) é considerado o primeiro manuscrito que reúne perspectiva integrada das áreas de veterinária, ecologia, conservação e de medicina humana para explorar a emergência de zoonoses (Cunninghan, 2017). Mais recentemente, com o surgimento da pandemia de COVID-19, a Organização das Nações Unidas para Alimentação e Agricultura (FAO), a Organização Mundial de Saúde Animal (OIE), Programa das Nações Unidas para o Meio Ambiente (PNUMA) e a Organização Mundial de Saúde (OMS), acordaram iniciativas de suporte à estruturação de políticas com abordagem em Saúde Única no Fórum da Paz de 2020 (WHO, 2024). A prevenção de novas pandemias, principalmente as zoonóticas como a COVID-19, se faz pelo entendimento global da emergência de novas doenças e pela abordagem integrada proposta pelo conceito de Saúde Única, explorando fatores ambientais, sociais, econômicos, éticos e políticos (Lefrançois et al., 2022). Em 2022, a Aliança Quadripartite, formada pela Organização Mundial da Saúde (OMS) Organização Mundial de Saúde Animal (OMSA) Organização das Nações Unidas para Agricultura e Alimentação (FAO) Programa das Nações Unidas para o Meio Ambiente (PNUMA), juntamente ao painel de especialistas alto nível em Saúde Única (do inglês One Health High Level Expert Panel OHHLEP) publicou o Plano de Ação Conjunto para a Saúde Única (2022-2026), com a implementação da abordagem por meio de seis linhas de ação (FAO et al., 2022). Essas linhas visam fortalecer a abordagem One Health por meio do aprimoramento dos sistemas de saúde, da redução de riscos zoonóticos, do controle de doenças endêmicas, da segurança alimentar, do combate à resistência antimicrobiana e da integração do meio ambiente. Para tanto, é esperado uma série de objetivos, dentre eles o de fornecer diretrizes e ferramentas para implementar abordagens multissetoriais que promovam a saúde e previnam riscos na interface entre humanos, animais, plantas e ecossistemas.

Embora a abordagem de Saúde Única seja amplamente reconhecida (Mackenzie e Jeggo, 2019), ainda é necessária uma metodologia de avaliação apropriada para entender e definir metas e estratégias para a implementação desta abordagem, adaptada a contextos socioecológicos específicos (Zhang et al., 2022). Neste sentido, a tecnologia da informação e as análises estatísticas têm sido cada vez mais utilizadas pelos tomadores de decisão como uma ferramenta para medir o

progresso ambiental e as políticas voltadas para a sustentabilidade (Block et al., 2024), melhorar a compreensão do clima e vulnerabilidades ambientais (UNDP, 2021), analisar os riscos de desastres atuais e a longo prazo (World Risk Report, 2024), quantificar a vulnerabilidade entre diversas populações e lugares (Spielman et al., 2020), assim como propor medidas práticas da própria Saúde Única. Neste sentido, nosso grupo propôs e aplicou recentemente Índices de Saúde Única para medir de forma abrangente os indicadores de saúde humana, animal e ambiental na macrorregião de Curitiba, explorando aspectos holísticos dessa grande área metropolitana (de Moura et al., 2022) e até mesmo mais específicos, no contexto de acumuladores (de Moura et al., 2022b).

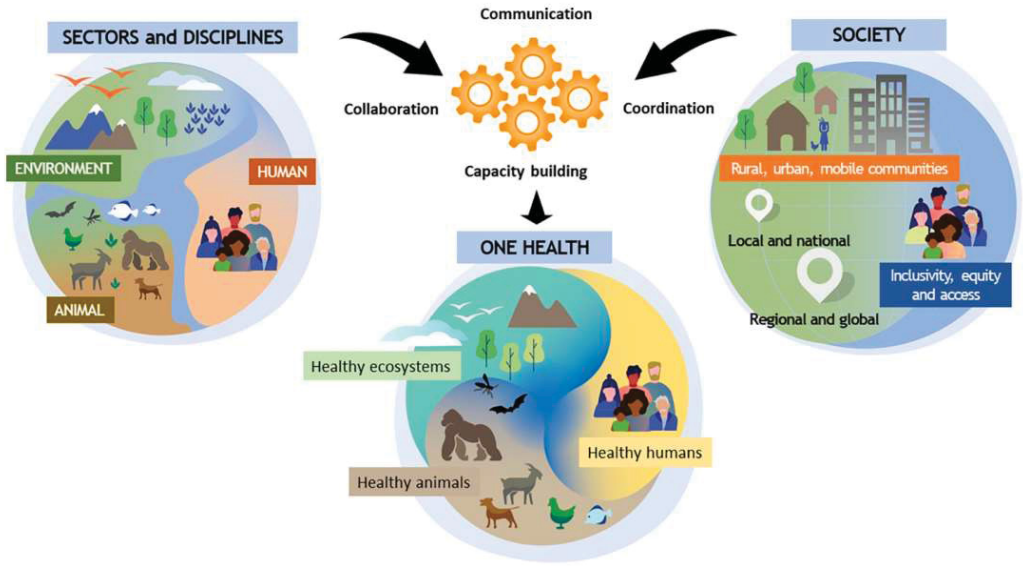

Figura 1. Saúde Única rumo a um futuro saudável e sustentável conforme desenvolvido pelo OHHLEP (doi: https://doi.org/10.1371/journal.ppat.1010537.g001).

1.1 OBJETIVOS

1.1.1 Objetivo geral

Estudar a Saúde Única das Américas. Por meio de levantamento bibliográfico dos indicadores de performance de cada país de interesse, e de entrevistas com profissionais da área de saúde nos diferentes países, nosso objetivo foi quantificar e qualificar as saúdes humana, animal e ambiental desta macrorregião sob índices

integrados e, posteriormente, ordenar e significar a região de acordo com parâmetros socioeconômicos, demográficos e ambientais.

1.1.2 Objetivos específicos

- Realizar levantamento bibliográfico dos principais índices que parametrizam países da América do Sul;
- Selecionar e agrupar indicadores de performance coerentes com as saúdes humana, animal e ambiental;
- Realizar levantamento de fatores de interesse no âmbito social, demográfico, econômico, político, infraestrutura e ambiental destes países;
- Aplicar um questionário para técnicos da área de saúde dos países das américas, abordando a percepção da saúde única nos respectivos países;
- Qualificar, quantificar e sintetizar as diferentes saúdes em Índices de Saúde Única – Uma Só Saúde.

2 CAPÍTULOS

2.1 CAPÍTULO 1 - ONE HEALTH INDEX APPLIED TO COUNTRIES OF SOUTH AMERICAN

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One Health Index applied to countries in South America

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Introduction: The One Health concept has proposed an integrated and unified approach aiming for health balance and enhancement by recognizing the interdependence of human, animal, and environmental health. The COVID-19 pandemic has pushed global One Health initiatives and policy improvement toward preventive measures for future pandemics, particularly of zoonotic origin. Such a scenario may be particularly relevant for South America, which is considered highly vulnerable due to its natural biodiversity superposed to socioeconomic and environmental issues, demanding effective methods and indicators for proper One Health strategies and goals that are aligned with macroregional contexts.

Methods: Accordingly, the present study aimed to assess the One Health Index (OHI) in South American countries, along with potential interactions with socioeconomic indicators. The results obtained using clustering analysis and permutational multivariate analysis of variance (PERMANOVA) have revealed a

One Health Index Applied to countries of South American

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Keywords: Health indicators, Socioeconomical factors, ecosystemic services, livestock, political stability.

ABSTRACT

The One Health concept has proposed an integrated and unified approach, aiming health balance and enhancement by recognizing the interdependence of human, animal, and environmental health. The COVID-19 pandemic has pushed global One Health initiatives and policy improvement toward preventive measures for future pandemics, particularly of zoonotic origin. Such scenario may be particularly relevant for South America, considered highly vulnerable due to natural biodiversity superposed to socioeconomical and environmental issues, demanding effective methods and indicators for proper One Health strategies and goals, aligned to macroregional contexts. Accordingly, the present study has aimed to assess the One Health Index (OHI) in South American countries, along with potential interactions with socioeconomical indicators. Results obtained by Clustering Analysis and Permutational Multivariate Analysis of Variance (PERMANOVA) have revealed a positive association between OHI and Human Development Index (HDI), but not with Gross Domestic Product (GDP). Although South American countries with political stability,

robust investment in health and progressist policies have shown a higher OHI, better environmental health was not associated to better human and animal health. In addition, although the Amazon biome (which overlaps 9/12 South American countries) had a positive impact to environmental health, such contribution contrasted to rudimentary local human health systems and may highlight the complexity of One Health within the South American context. Lack of stronger indicators for animal health was also considered an important weaking point for a true OHI assessment. Nonetheless, countries with more developed livestock have presented better animal health, which may not reflect an overall animal health indicator, as companion and wildlife animal health indicators were not available. Although lower (within-country) scale analysis such as states and metropolitan areas may better shape internal differences, the study herein has clearly shown One Health inequalities and challenges among South American countries. As important, forests and other natural areas of developing (particularly Amazon Forest) countries should receive incentives for sustainable economic growth, preventing the sacrifice of environmental health in benefit of human and livestock animal health.

INTRODUCTION

One Health has been defined as an integrated and unified approach, aiming for a sustainable assessment of human, animal, and environmental health, with a holistic strategy existing long before the term was coined (1). A recent One Health consensus report has considered humans, domestic and wildlife animals, plants and their ecosystemic environment as intimately connected and interdependent (2), with multidisciplinary and professional integration aiming to better recognize zoonotic emergences in a One Health perspective (3).

The recent COVID-19 pandemics has demanded a quadripartite agreement supporting such initiatives (4), with prevention of future epidemics addressed by global understanding of emergence of new diseases (5), and officially approved at the Pan-American Health Organization (PAHO) as a tool for dealing with health threats in the human-animal interface (6). The first action point of this policy resolution aimed to perform an analysis and map the complex interactions among actors and processes in the fields of human, animal, vegetal and environmental health in such specific national contexts.

South America has been considered as the Americas meridional portion, including 12 sovereign states and two dependent territories (7). Although comprising some of the most important natural reserves worldwide, such as the Amazon Rainforest and Andes, several cultural heritages, and large cultivable areas, the South America region remains mostly underdeveloped, and highly vulnerable to deforestation, poaching, and zoonotic diseases (8). Although nine South American countries share the Amazon forest, the world's largest tropical rainforest (9), which provides a significant carbon sink service and helps regulate global climate (10), several socioeconomic and environmental threats (11, 12) have demanded a trans-and multidisciplinary One Health approach to fight such complex challenges (13).

Although widely recognized, the One Health approach has required better and adapted strategies for specific socio-ecological contexts (14, 15). This includes the integration of information technology and statistical analysis to assess environmental and sustainable effectiveness (16), improved climate and environmental comprehension (17), evaluation of risk from current and future natural disasters (18), identification of vulnerable populations and areas (19), and the practical use of the One Health Index itself (20). Accordingly, the present study aimed to assess available indicators of human, animal, and environmental health from a statistical and comparative One Health Index (OHI) perspective of all 12 South American countries.

MATERIAL AND METHODS

Countries and socioeconomical factors

The present study included all 12 South American countries, namely Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guiana, Paraguay, Peru, Suriname, Uruguay, and Venezuela. The socioeconomic factors of these countries were obtained from official reports and sites and included the Human Development Index (HDI) (21) and the gross domestic product (GDP) per capita, based on the purchasing power parity (PPP) (22). The Human Development Index (HDI) has been described as a measure of a country's well-being and development, combining life expectancy, education, and standard of living, as the geometric mean of normalized indexes for each of these three dimensions (23). The gross domestic product (GDP) per capita, based on purchasing power parity (PPP), represents the average value of all goods and services produced by a country in a given year, adjusted for price differences, and expressed in international dollars, providing a more accurate measure of a country's comparative living standard (24).

Human, animal, and environmental health indicators

Updated indicators for human, animal, and environmental health of all 12 South American countries were selected from the available literature and official reports and sites to construct the One Health Index (Table 1; Supplementary Tables 1–4), based on the One Health Index previously established by our research group (20).

Table 1. Indicators for human, animal, and environmental health to construct the One Health Index of all 12 South American countries.

Health category	Performance indicators (PI)	Source	Reference
Human	1. GHS Index	Global Health Security Index	(44)
	2. Social Vulnerability	Multidimensional Vulnerability Index	(29)
	3. Vulnerability	World Risk Report	(45)
Animal	4. Zoonoses	Global Health Security Index	(44)
	5. Pesticides	Food and Agriculture Statistics	(46)
	6. WAHIS*	World Organisation for Animal Health	(40)

Environmental	7. Environmental vulnerability	Multidimensional Vulnerability Index	(29)
	8. Vulnerability to Climate Changes	Universal Vulnerability Index	(47)
	9. Environmental Performance	Environmental Performance Index	(16)

* Qualitative information parameters (absence and presence) of each country were divided into 1. Disease; 2. Serotype, subtype, genotype; 3. Animal category; 4. Outbreak identifier; and vaccinated.

Data analysis and One Health Index construction

The assessment of each country was based on nine indicators, which were equally distributed into three indicators per health category (Table 1). A performance (ranking) score was attributed to each country for each indicator, with the lowest graded as 1, the highest graded as 12, and the remaining ones graded accordingly (Table 2). The final grade for each country in each health category was the average of the three indicators. Thus, each sampling unit was the composite result of indicators, representing the three weighted grades, corresponding to each of the three health categories, as established and adapted (20). The One Health Index (OHI) of each country was calculated as the average of grades from the three correspondent health categories. It is important to mention that such applied methodology has resulted in composite indexes reflecting a relative panorama of One Health among South American countries, with a comparative rather than absolute OHI.

Table 2. Performance (ranking) grades attributed to each South American country, based on the nine performance indicators (PI), which comprise the human, animal, and human health categories, along with the grades for each category, expressed as total.

Countries	**Environmental health**				**Animal health**				**Human health**			
	PI.1	PI.2	PI.3	**Total**	PI.4	PI.5	PI.6	**Total**	PI.7	PI.8	PI.9	**Total**
Argentina	3	1	6	**3.3**	9	10	8	**9.0**	10	11	10	**10.3**
Bolivia	4	4	4	**4.0**	5	4	10	**6.3**	2	7	7	**5.3**
Brazil	6	8	8	**7.3**	11	12	4	**9.0**	8	5	4	**5.7**
Chile	2	2	12	**5.3**	4	9	7	**6.7**	12	12	11	**11.7**
Colombia	11	10	7	**9.3**	10	11	1	**7.3**	9	4	1	**4.7**
Ecuador	12	11	11	**11.3**	8	8	2	**6.0**	7	1	3	**3.7**
Guiana	1	7	2	**3.3**	1	2	3	**2.0**	3	6	8	**5.7**
Paraguay	5	5	5	**5.0**	6	6	9	**7.0**	5	2	9	**5.3**
Peru	9	3	3	**5.0**	7	7	11	**8.3**	11	9	2	**7.3**
Suriname	10	9	9	**9.3**	3	1	5	**3.0**	4	8	6	**6.0**
Uruguay	8	12	1	**7.0**	12	5	6	**7.7**	6	10	12	**9.3**
Venezuela	7	6	10	**7.7**	2	3	12	**5.7**	1	3	5	**3.0**

Ranking (score) according to socioeconomical factors

Countries were ordered according to their grades of each health category and analyzed using principal component analysis (PCA), which classified countries using cluster analysis, exploring 1.

One Health Index, 2. Human Development Index (HDI), and 3 gross domestic product (GDP) per capita, based on purchasing power parity. Statistical significance for country clusters in each factor was assessed using clustering analysis and permutational multivariate analysis of variance (PERMANOVA) (25), based on the three first coefficients of principal components, obtained from each PCA. A p-value less than 0.05 was considered significant. All statistical analyses were performed in the statistical environment R (26).

RESULTS

The results of One Health for each South American country were obtained, gathered, and presented (Figure 1; Supplementary Table 5). Overall, Uruguay (8.0), Chile (7.9), and Argentina (7.6) presented the highest grade of One Health. Guiana (3.7), Bolivia (5.2), and Venezuela (5.4) presented the lowest grade of One Health. The principal component analysis, presented in Figure 2, illustrates the significant differences among South American countries based on human, animal, and environmental health categories, as determined by the One Health grading (PERMANOVA; $F = 3.6305$; $p = 0.009$). Countries with higher One Health grades (Uruguay, Chile, and Argentina) were grouped to the left of the graphic.

The same pattern can be observed in significant differences among countries on health categories compared to the Human Development Index (HDI) (Figure 3). Chile (0.855), Argentina (0.842), and Uruguay (0.809) (countries grouped to the left of the graphic) also presented higher HDI (PERMANOVA; $F = 4.9113$; $p = 0.001$). However, no significant difference was observed for South American countries and gross domestic product (GDP) per capita based on purchasing power parity (PPP) (PERMANOVA; $F = 2.0781$; $p = 0.10$) (Figure 4). Guyana presented, at the same time, the highest GDP-PPP (U$ 60,650) and the lowest OHI (3.7).

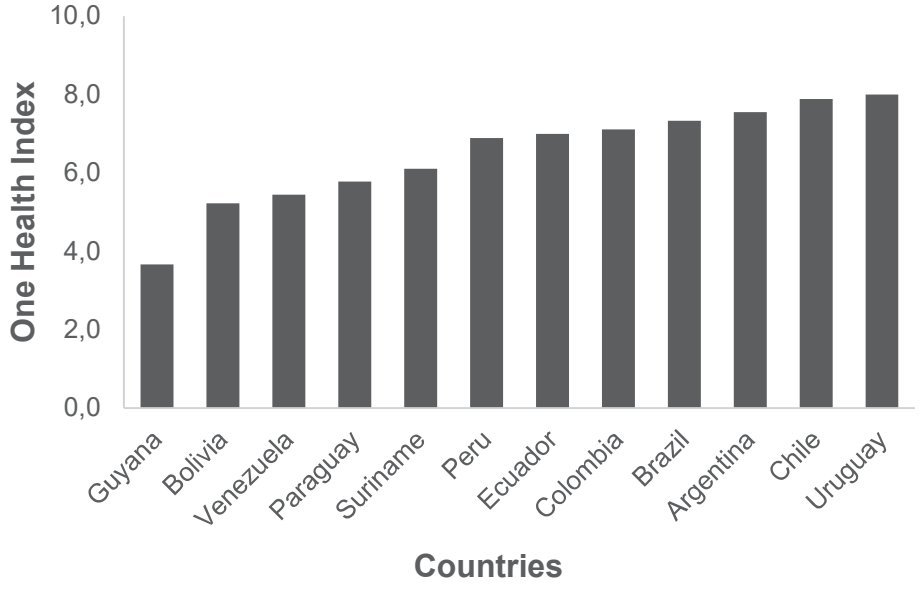

Figure 1. Graphic of One Health Index grading of South American countries.

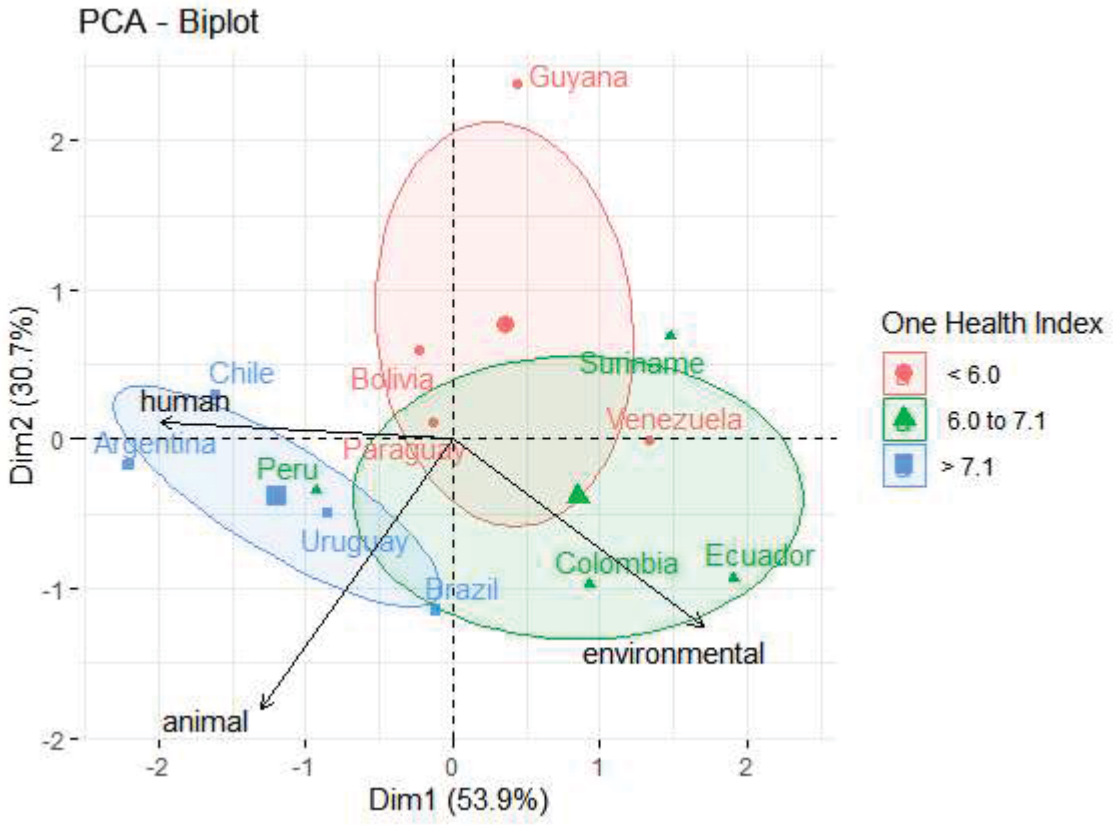

Figure 2. Graphic of Principal Components Analysis (PCA) showing the influence of (human, animal and environmental) health variables on all the South American countries. Colors and ellipsis circling the country groups represent the confidence ellipsis which delimited country clusters according to grading intervals of One Health.

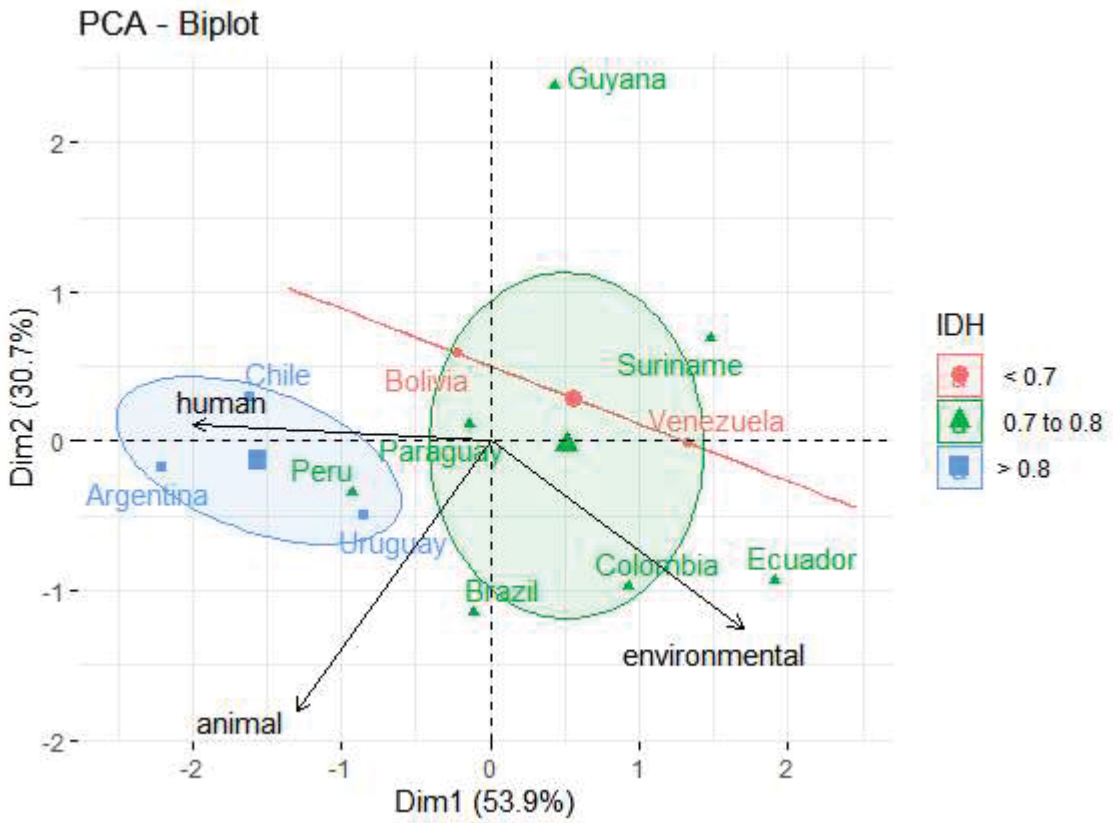

Figure 3. Graphic of Principal Component Analysis (PCA) showing the influence of (human, animal and environmental) health variables on all the South American countries. Colors and ellipsis circling the country groups represent the confidence ellipsis which delimited country clusters according to the higher Human Development Indexes (HDI).

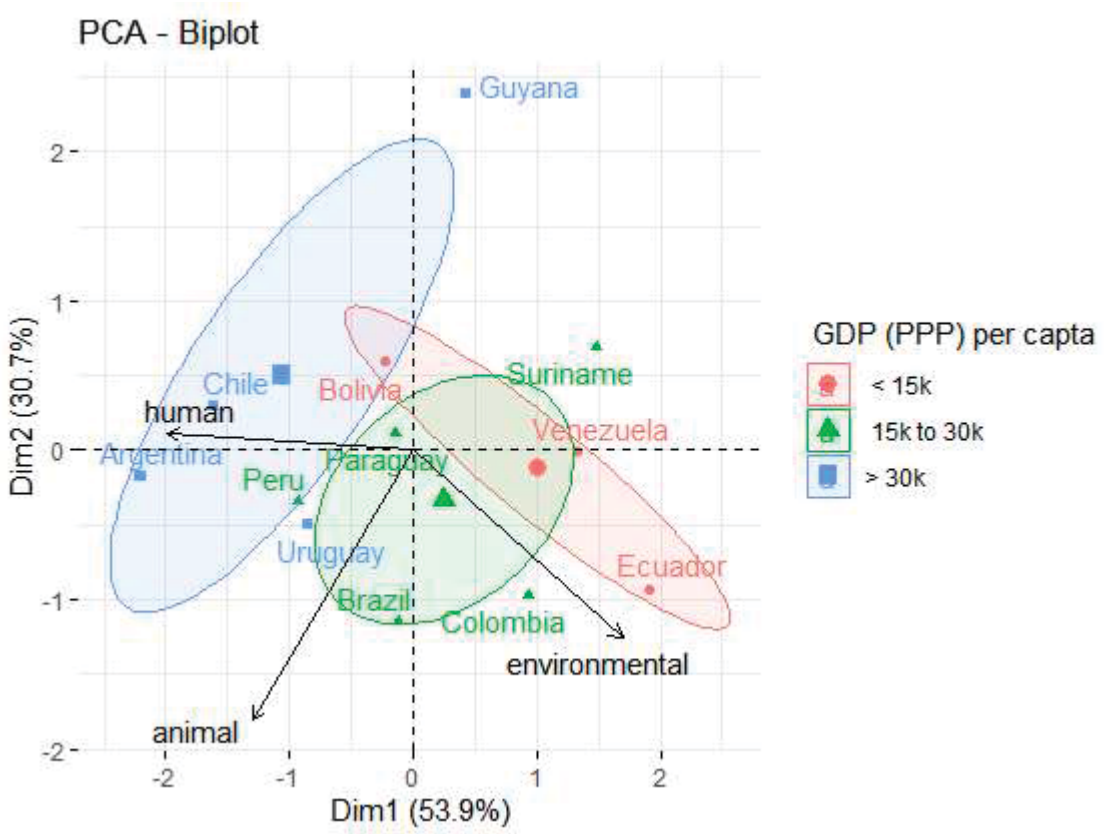

Figure 4. Graphic of Principal Component Analysis (PCA) showing the influence of (human, animal, environmental) health variables on the South American countries. Colors and ellipses circling the country groups represent the confidence ellipses which delimited country clusters according to the Gross Domestic Product (GDP) per capita, based on purchasing power parity (in U$).

DISCUSSION

The results indicated that South American countries with higher Human Development Indexes (HDIs) also had higher One Health Indexes (OHIs), which are composed of various education and health indicators. However, the results also showed no significant association between the One Health Index and gross domestic product (GDP) per capita. This suggests that the holistic nature of One Health is better explained by the HDI's social approach rather than by an economic index such as GDP, even when adjusted for purchasing power. Thus, despite the importance of explaining health in several contexts (27, 28), the economic factor was not the sole determinant of One Health.

The study herein showed that South American countries with higher environmental health also presented lower human and animal health. While Ecuador (1st), Colombia (2nd), Suriname (3rd), and Venezuela (4th) presented the highest scores in environmental health, their performance in animal health (Ecuador 9th and Suriname 11th) and human health (Colombia 10th, Ecuador 11th, and Venezuela 12th) was relatively lower. The environmental health indicators explored aspects such as climate change mitigation, air quality, biodiversity and ecosystemic services, fishing, and water resources (16), as well as vulnerability to natural disasters (29) and risk areas (30). These

South American countries have their territory overlapped by the Amazon forest (42% of Colombia, 48% of Ecuador, and 94% of Suriname), with most populations living in close contact with natural areas (31). Thus, the ecosystemic services provided by the rainforest may have a favorable impact on applied performance indicators of environmental health. The Amazon forest has been threatened by illegal human activities such as logging, mining, and fires. Notably, the southern and southeastern Brazilian regions of the Amazon have experienced increasing soil erosion and a 7% deforestation rate (411,857 km2) between 1960 and 2019, due to expanding agriculture and livestock activities (32). The annual Brazilian Amazon deforestation has surpassed 13,000 km2 from 2019 to 2021, which represents an increase of 56.6% when compared to 2016–2018 (33). Such an increase was reportedly associated with a government attempt to promote environmental sustainability through the agribusiness-based economy in the southern and southeastern Brazilian Amazon, which culminated in land grabbing, conflicts, and deforestation (33). In addition, modeling studies have indicated an increase of 4°C in temperature or deforestation exceeding 40% as two "tipping points" of irreversible changes for biodiversity and ecosystems of the Amazon forest (34). In such a scenario, recent studies have advocated for sustainable development in the Amazon, based on the non-use of natural resources, accompanied by an effort to improve ecosystem resilience (34, 35). Thus, considering the environmental health role for a better One Health, forests and other natural areas of developing countries (particularly the Amazon forest) should receive incentives for sustainable economic growth, preventing the sacrifice of environmental health for the benefit of human and livestock animal health. Although the data presented reflect the most recently available information, providing only a current temporal snapshot, the historical overall development situation in South America and its negative impact on the Amazon Rainforest as a side effect consequence over time should be considered a warning for a truly sustainable and healthy development of the region.

Despite having large natural areas, South American countries have deep health system limitations, with recent trajectories of health privatization and increased access inequalities to health services (36), political crises affecting the quality of services provided (37), and shortage of human resources (38). Thus, South American countries with political stability, higher investment in human health, and progressive political characteristics have been placed at a higher level of the One Health Index (OHI). The four countries with the highest scores in the OHI (Uruguay, Chile, Argentina, and Brazil) were among the five countries with the highest investments in human health per capita (39), presenting solid democratic political regimes throughout the last decades.

A limitation of this study is the difficulty in accessing animal health indicators, which were used along with several standard composite indexes of human and environmental health. Only one integrated animal health index was found at the global level, the Animal Protection Index (API), recently provided by the World Animal Protection (WAP), a non-profit organization. However, such an index was not used herein, as only 7 of 12 (58.3%) South American countries presented available API grades. Thus, only indirect performance indicators of animal health were explored,

such as zoonoses, pesticides (harmful to natural biota), and a selection of livestock indicators obtained from the World Animal Health Information Systems (WAHIS), a database maintained by the World Organisation of Animal Health (40). Thus, the animal health approach was based exclusively on livestock health (and not welfare), excluding analysis of both companion and wildlife animal health.

A previous One Health Index (OHI) study conducted at the city level Curitiba, the eighth biggest metropolitan area of Brazil, has also shown difficulties in obtaining animal health indicators (20, 41). In this study, qualitative (yes or no) indicators were used, assessing only companion animal health, including education and neutering/spaying programs, animal hoarder monitoring, enforcement against animal cruelty, microchipping, and adoption of abandoned pets. Such a lack of comprehensive and reliable data in the present study may have biased animal health as livestock health only. Thus, indicators may have rewarded agricultural performance, such as control of animal diseases and conscient use of pesticides. In such a scenario, South American countries with advanced livestock production, such as Brazil, Argentina, and Uruguay, were among the highest scorers for animal health in South America. Thus, further efforts and studies should focus on providing reliable animal health indexes for livestock, companion animals, and wildlife, which could then be used for comparisons at city, state, country, and continental levels.

As another limitation, the present study has assessed information at international official organizations, at country level, available in official languages of South American countries including English (Guiana), French (French Guiana), Portuguese (Brazil), and Spanish (all others), with exception of Dutch in Suriname and official native indigenous languages such as Guarani in Bolivia and Paraguay, Aymara in Bolivia and Peru, and Quechua in Bolivia, Ecuador and Peru. In addition, information obtained, particularly in large territorial countries, may not represent the within-country inequalities among states and provinces, or even among cities within the same state or province. In addition, as well-known, the largest South American metropolitan areas have been characterized by deep within-city inequalities, such as São Paulo, Buenos Aires, and Santiago cities (42). As the One Health Index applied at the country level may be impaired by inequalities and disparities at the state and city levels, further studies should compare and contrast One Health Index patterns across local, metropolitan, and regional regions within countries.

Despite the authors' recognition of the importance of temporal and spatial analyses, the data herein did not support a temporal analysis because the surveys only included the most recent available data, providing a current temporal snapshot. Although the data herein did not support spatial analysis, the discussion was focused on countries overlying the Amazon rainforest biome, which is important for current analysis and further research. The authors also acknowledge that the data herein may be insufficient to explore smaller spatial scales (such as large metropolitan areas), which would enhance the understanding of the One Health landscape in South America.

Finally, although in the highest available resolution and with bigger letters and captions, the figures presented in the present study have a standard outcome layout provided by the Tidyverse, Stats, and Factoextra statistical packages, which were used to build them.

Other One Health assessments have been recently reported, focusing on interdisciplinary setting effectiveness, with assessment tools of a calculated hexagon presented as OH-index (OHI) and OH-ratio (OHR) in spider diagrams, along with Theory of Change (TOC) as indicator for measurement of expected results, comparing One Health with conventional health initiatives (43). In addition, a Global One Health Index (GOHI) based on a three-layer framework has been proposed for the evaluation of One Health structure, process, and outcome (51). Although presenting important contributions to One Health assessment, both studies may lack the practical approach presented by the One Health Index (OHI) applied herein (20), which has combined several health indexes within human, animal, and environmental components, providing holistic and comparative strengths and weaknesses among municipalities.

The holistic One Health Index (OHI) approach herein has provided a better understanding of health as a whole in South American countries, contextualized by the Human Development Index (HDI) and contrasted by the gross domestic product (GDP) per capita. The higher grades of environmental health in some South American countries have not necessarily indicated better human and animal health. Progressive policies, consistent investments in human health, and political stability were important factors associated with higher One Health grades. The limitations and lack of reliable indicators, particularly for environmental and animal health, have highlighted the need for better indexes worldwide. Although within-country inequalities may have influenced the results of the present study, this is the first attempt to compare One Health in such a practical manner, and further studies should address local, metropolitan, and regional regions within countries in South America and other continents.

AUTHOR CONTRIBUTIONS

AS: Conceptualization, Formal analysis, Investigation, Methodology, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. WC: Conceptualization, Formal analysis, Investigation, Methodology, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. LK: Investigation, Methodology, Writing – review & editing. AB: Conceptualization, Methodology, Visualization, 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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SUPPLEMENTARY MATERIAL

Supplementary Table 1. Socioeconomic data of the countries, represented by the Human Development Index (HDI) (23) and the Gross Domestic Product per capita adjusted by purchasing power parity (in dollars) (53) of South American countries, as well as the considered classes.

Countries	HDI	Classes	GDP (PPP)	Classes
Argentina	0.842	High	31314	High
Bolivia	0.692	Low	14906	Low
Brazil	0.754	Average	19948	Average
Chile	0.855	High	31496	High
Colombia	0.752	Average	21056	Average
Ecuador	0.74	Average	15931	Low
Guyana	0.714	Average	60650	High
Paraguay	0.717	Average	20451	Average
Peru	0.762	Average	19587	Average
Suriname	0.73	Average	21016	Average
Uruguay	0.809	High	32744	High
Venezuela	0.691	Low	8030	Low

Supplementary Table 2. Raw values of the environmental health performance parameters of South American countries. EV_MVI = Environmental Vulnerability, Multidimensional Vulnerability Index (UN, 2023); PVCCI_UVI = Physical Vulnerability to Climate Change Index, Universal Vulnerability Index (54); EPI = Environmental Performance Index (55).

Countries	EV_MVI	PVCCI_UVI	EPI
Argentina	43.6	43.43	41.1
Bolivia	43.4	33.89	40.1
Brazil	34.2	31.58	43.6
Chile	53.4	40.53	46.7
Colombia	28.9	25.28	42.4
Ecuador	28.6	24.54	46.5
Guyana	58.9	32.38	38.5
Paraguay	39.7	33.45	40.9
Peru	31.8	37.48	39.8
Suriname	30.5	29.24	45.9
Uruguay	31.9	21.75	37.4
Venezuela	32.3	32.65	46.4

Supplementary Table 3. Raw values of the animal health performance parameters of South American countries. ZD_GHS = Zoonosis, Global Health Security Index (Bell and Nuzzo, 2021); PEST_FAO = Pesticides (kg*ha-1), Food and Agriculture Statistics; WAHIS = Parameters, World Organisation for Animal Health.

Countries	ZD_GHS	PEST_FAO	WAHIS				
			a	b	c	d	e
Argentina	46.5	488	1	0	1	1	1
Bolivia	26.2	359	1	1	0	0	0
Brazil	58.3	958	1	1	1	1	1
Chile	18.9	719	1	0	1	1	1
Colombia	48.8	1513	1	1	1	1	1
Ecuador	45.7	1403	1	1	0	0	1
Guyana	1.6	1013	1	0	0	0	1
Paraguay	31	468	1	1	0	1	0
Peru	43.6	187	1	1	0	0	1
Suriname	5.6	792	0	0	0	0	0
Uruguay	76.9	773	1	0	0	1	1
Venezuela	2.9	119	1	0	1	0	0

WAHIS parameters: a) Disease, b) Serotype/Subtype/Genotype, c) Animal Category, d) Outbreak_id, e) Vaccinated.

Supplementary Table 4. Raw values of the human health performance parameters of South American countries. SV_MVI = Social Vulnerability, Multidimensional Vulnerability Index; VUL_WRR = Vulnerability, World Risk Report (56); GHS = Global Health Security Index.

Countries	SV_MVI	VUL_WRR	GHS
Argentina	25.9	19.18	54.4
Bolivia	38.9	25.30	29.9
Brazil	41.8	28.47	51.2
Chile	10.7	15.37	56.2
Colombia	51.3	44.93	53.2
Ecuador	67.3	38.15	50.8
Guyana	40.8	25.14	30.8
Paraguay	63.2	20.23	40.3
Peru	36.3	39.22	54.9
Suriname	37	25.33	35
Uruguay	30.6	14.96	40.3
Venezuela	61.1	28.22	20.9

Supplementary Table 5. One Health Indices of South American countries.

Countries	OH index
Argentina	7.6
Bolivia	5.2
Brazil	7.3
Chile	7.9
Colombia	7.1
Ecuador	7.0
Guyana	3.7
Paraguay	5.8
Peru	6.9
Suriname	6.1
Uruguay	8.0
Venezuela	5.4

Supplementary Table 6. Projections on the Principal Component Analysis axes of South American countries, according to their scores in the three health dimensions (environmental, human, and animal).

Countries	X-axis	Y-axis	Z-axis
Argentina	-2.20369	-0.17605	-0.07484
Bolivia	-0.22698	0.590582	-0.85308
Brazil	-0.11447	-1.14518	-0.45529
Chile	-1.61709	0.292471	1.125731
Colombia	0.931876	-0.97359	-0.00425
Ecuador	1.909661	-0.92813	0.391575
Guyana	0.42978	2.383216	-0.19368
Paraguay	-0.14022	0.118389	-0.73905
Peru	-0.92605	-0.34781	-0.41207
Suriname	1.482084	0.691562	1.078681
Uruguay	-0.85278	-0.49716	0.695065
Venezuela	1.327879	-0.00831	-0.5588

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2.2 CAPÍTULO 2 - ONE HEALTH PRIORITIES: ADVANCING VETERINARY PUBLIC HEALTH THROUGH STRATEGIC INSIGHTS IN LATIN AMERICA AND THE CARIBBEAN

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One Health Priorities: Advancing Veterinary Public Health in Latin America and the Caribbean

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Abstract: One Health (OH) is an integrative approach to human, animal, and environmental health and can be used as a comprehensive indicator for comparative purposes. Although an OH index has been proposed for comparing cities, states, and countries, to date, no practical study has compared countries using this approach. Accordingly, this study aimed to assess OH initiatives using a survey with a veterinary public health focus. The questionnaire contained 104 quantitative questions and was sent to representatives of governmental institutions of 32 countries in the Americas. After exclusion criteria were considered, a total of 35 questionnaires from 17 countries were analyzed, with country names remaining undisclosed during the statistical analyses to protect potentially sensitive information. Principal component analysis (PCA) of health parameters in Latin America

One Health Priorities: Advancing Veterinary Public Health through Strategic Insights in Latin America and the Caribbean

Felipe Rocha [1], Alessandra Cristiane Sibim [2], Baldomero Molina-Flores [1], Wagner Antonio Chiba de Castro [3], Louise Bach Kmetiuk [4], Renato Vieira Alves [1], André Luis de Sousa dos Santos [1], Margarita Corrales Moreno [1], Álvaro A. Faccini-Martínez [5], Natalia Margarita Cediel [6], Alexander Welker Biondo [7], Ottorino Cosivi [1]
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Abstract

One Health (OH) is an integrative approach to human, animal, and environmental health and can be used as a comprehensive indicator for comparative purposes. Although an OH index has been proposed for comparing cities, states, and countries, to date, no practical study has compared countries using this approach. Accordingly, this study aimed to assess OH initiatives using a survey with a veterinary public health focus. The questionnaire contained 104 quantitative questions and was sent to representatives of governmental institutions of 32 countries in the Americas. After exclusion criteria were considered, a total of 35 questionnaires from 17 countries were analyzed, with country names remaining undisclosed during the statistical analyses to protect potentially sensitive information. Principal component analysis (PCA) of health parameters in Latin America and the Caribbean (LAC) as a function of country perception (self-vector) showed that food safety was ranked higher than public policies ($p = 0.009$), and that both ($p = 0.003$) were ranked higher than institutional routines related to zoonosis programs. National policies in accordance with international standards, regulations, recommendations, and guidelines was considered the standout topic for public policy, with higher-ranking topics including standard. Meanwhile, challenging topics included tools, preparedness, governance, and research. Food safety showed both strengths and challenges in the coordination of its activities with other sectors. Food safety communication was scored as a strength, while foodborne diseases prevention was ranked as a challenge. Institutional routines for zoonosis maintained both strong and challenging topics in the execution and implementation of attributions and daily routine. Thus, the survey showed that topics such as access to and compliance with international guidelines and intercountry integration were ranked higher than in-country articulation, particularly among food safety, zoonoses, and environmental institutions.

Keywords: sustainability; One Health index; veterinary public health; public policy; climate change

Introduction

Despite its longstanding application before the term was coined, and its extensive study in recent years [1], the practical implementation of the One Health (OH) approach in governmental processes remains a challenge, as does surveying its initiatives and indicators, including in Latin America and the Caribbean (LAC) [2]. Several perception questionnaires have recently been proposed and applied, varying according to survey subject and geographic region. Such studies include neglected vector-borne infections [3] and foodborne zoonoses, antimicrobial resistance, and emerging microbiological hazards [4] in European countries; a zoonosis survey in the Americas [5] and health responses to global challenges in Colombia and other LAC countries [6]; OH assessments in Sub-Saharan African countries [7], in French-speaking countries [8], and in the

French territory Guadeloupe [9]; and an OH index applied in a major metropolitan area of Brazil, city of Curitiba [10]. In addition, surveys on the OH approach have been proposed for zoonotic disease control at all levels [11], including OH initiatives in Asia [12], synergizing tools for OH operationalization [13], OH matrix surveillance [14], and the Global OH Index [15].

The Pan American Health Organization (PAHO) has been promoting a multisectoral approach to managing risks at the human–animal interface for several decades through its veterinary public health technical cooperation support. PAHO's Inter-American Ministerial Meeting on Health and Agriculture (RIMSA), first established in 1968, most recently met in 2016 to discuss "One Health and the Sustainable Development Goals" [16]. Furthermore, in September 2021, the 59th Directing Council officially approved PAHO's OH policy "One Health: A Comprehensive Approach for Addressing Health Threats at the Human-Animal-Environment Interface (Document CD59/9)", prioritizing endemic diseases of zoonotic and vector-borne origin, emerging and re-emerging infectious diseases of zoonotic origin, antimicrobial resistance, and food safety [17]. Resolution CD59.R4, endorsed the policy and called for Member States to implement OH and for the Pan American Sanitary Bureau to provide the related technical cooperation support [18].

PAHO's OH policy proposes the analysis and mapping of OH health interactions in specific national contexts, the establishment of OH governance, strengthening multidisciplinary and intersectoral aspects, emergency preparedness and response, digital technology and scientific tools, research, and capacity building. Following PAHO's OH policy, the six strategic lines of action for the implementation of OH into national policies were included in the question.

Within the Pan American Sanitary Bureau there is the Pan American Center for Foot-and-Mouth Disease and Veterinary Public Health (PANAFTOSA/VPH-PAHO/WHO), a specialized PAHO Center responsible for veterinary public health that is providing technical cooperation to both public health and official veterinary services of countries in LAC [19]. In July 2022, in Rio de Janeiro, Brazil, PANAFTOSA/VPH-PAHO/WHO coordinated a two-day meeting with 15 participants from the public health and official veterinary services sectors from 10 LAC countries (Argentina, Belize, Bolivia, Brazil, Chile, Colombia, Cuba, Honduras, Mexico, and Uruguay) to discuss OH. The meeting sought to identify OH best practices and gaps and address the need to gather information on OH policy implementation for veterinary public health in LAC countries.

There are several definitions of OH [17,20]; however, for the scope of this paper, OH is defined as an integrative approach to human, animal, and environmental health [1]. Therefore, OH can be used as a comprehensive indicator for comparative purposes [10]. Although an OH index has been proposed for comparing cities, states, and countries [10,15,21,22,23], no practical study has been conducted to compare countries using such an approach. Accordingly, the present study aimed to develop, apply, and analyze perception questionnaires as a basis for the assessment of OH strengths and challenges in LAC countries.

Materials and Methods

Survey Questionnaire

Thirteen recently published studies using questionnaires to assess OH were obtained from the available literature (Table 1). A comprehensive questionnaire focusing on veterinary public health was developed and reviewed as part of the activities discussed in the meeting coordinated by PANAFTOSA/VPH-PAHO/WHO. The questionnaire was sent to both the official veterinary service and the public health sectors of 32 LAC countries from December 2022 to March 2023. Responses from 42 institutions across 26 countries were gathered and used for statistical analysis (Supplementary Table S1). The questionnaire was available in three languages (Spanish, Portuguese, and English), having been discussed, reviewed, pre-tested, and unanimously approved by 15 institutions from 10 LAC countries on 12 and 13 July 2022 as part of the meeting organized by PANAFTOSA/VPH-PAHO/WHO. All institutions listed in the PAHO database related to human, animal, and environmental health–including national ministries of health, ministries of livestock and agriculture, and ministries of the environment–were contacted, and they received the online questionnaires through the PAHO channel. Professionals voluntarily answered the online questionnaire in their chosen language (Spanish, Portuguese, or English), and there was a common database for gathering and analyzing results.

Table 1. A review of 13 recently published studies with questionnaires for One Health assessment, obtained from the available international literature.

Applied Locations	Type of Survey	Reference
Pan-American countries	Prioritization of emerging and endemic zoonoses; countries' prioritization criteria and methodologies	[5]
European countries	Joint actions on foodborne zoonoses, antimicrobial resistance, and emerging microbiological hazards	[4]
37 European countries and neighboring areas	Collection of information on the existence of OH collaboration and implementation of OH initiatives	[3]
Colombia and some Latin American countries	Assessment of a fragmented health organization in relation to an integrated health response to global challenges	[6]
Guadeloupe, French territory	OH operationalization in past and current collaborative initiatives and analysis of the OH framework	[9]
Sub-Saharan African countries	OH Strengths, weaknesses, opportunities, and threats	[7]
French-speaking countries	OH applied to research, surveillance, and control of neglected tropical diseases	[8]
Major metropolitan area, Brazil	Comparative indicators of human, animal, and environmental health leading to an OH index	[10]
Asian countries	Experiences from previous studies as tools for capacity assessment and OH operationalization	[12]
Proposed	Examples and initiatives of national decision makers implementing OH	[13]
Proposed	Assessment of multisectoral collaboration by analysis of its organization, implementation, and functions	[14]
Proposed	Assessment steps towards a global OH index	[15]
Proposed	Use of OH in zoonotic disease programs at local, national, regional, and international levels	[11]

OH = One Health.

Data Analysis

Questionnaire Selection

Questionnaire outcome data based on the perceptions of OH by different delegates representing their respective countries were thoroughly examined. A total of 104 quantitative questions (rated on a 5-point Likert scale) were used, with open-ended questions excluded from the analysis. Questionnaires with missing answers were also excluded. When more than one answer was sent by a given country (i.e., more than one professional answered the questionnaire), the final score was defined as the average score.

Questionnaire Analysis

Questions regarding veterinary public health parameters were organized into three relevant thematic groups: (1) food safety–examining the perceived importance of OH in food safety in a given country; (2) public policies–exploring the perceived role of government in subsidizing OH in different areas, such as interaction, governance, internationalization, promptness, tools, and research; and (3) institutional routines related to zoonosis programs, searching for perceived role

of OH in the daily work of the relevant professionals. A list of the 104 questions used for the database construction, and their allocation into thematic groups, is provided in Table 2.

Table 2. Relevant thematic groups of the One Health questionnaire with a veterinary public health focus and their correspondent question allocations.

Thematic Group on Veterinary Public Health Parameters	Question Number in the Survey (See Supplementary Table S1)
Food Safety	34a_1, 34a_2, 34a_3, 34a_4, 34a_5, 34b_1, 34b_2, 34b_3, 35_1, 35_2, 35_3 e 35_4
Public Policy	39_1, 39_2, 39_3, 39_4, 39_5, 39_6, 40_1, 40_2, 40_3, 40_4, 40_5, 41_1, 41_2, 41_3, 41_4, 41_5, 42_1, 42_2, 42_3, 42_4, 42_5, 42_6, 42_7, 42_8, 42_9, 43_1, 43_2, 43_3, 43_4, 43_5, 44_1, 44_2, 44_3, 44_4, 44_5, 44_6, 44_7 e 44_8
Institutional Routines for Zoonosis	45_1, 45_2, 45_3, 45_4, 45_5, 45_6, 45_7, 45_8, 46_1, 46_2, 46_3, 46_4, 46_5, 46_6, 46_7, 46_8, 46_9, 46_10, 46_11, 46_12, 47_1, 47_2, 47_3, 47_4, 47_5, 47_6, 47_7, 47_8, 47_9, 47_10, 47_11, 48_1, 48_2, 48_3, 48_4, 48_5, 48_6, 48_7, 48_8, 48_9, 48_10, 48_11, 48_12, 48_13, 48_14, 48_15, 48_16, 48_17, 48_18, 48_19, 48_20, 48_21, 48_22 e 48_23

Differences between the health parameters of OH in LAC countries were assessed using permutation multivariate analysis of variance (PERMANOVA) [24] and by searching for paired comparisons [25]. A p-value of 0.05 or less was considered significant. Strengths (positive aspects) and challenges (negative aspects) were assessed using a principal component analysis (PCA) as a function of country perceptions (autovectors). All statistical analyses were performed using the statistical software package R, version 4.4.1 [26]. The five highest-scoring questions (strengths) and five lowest-scoring questions (challenges) per thematic group were chosen, totaling 30 questions.

Results

The survey questionnaire was answered by 54 professionals from 26 LAC countries: Anguilla, Argentina, Aruba, the Bahamas, Bermuda, Bolivia, Brazil, the British Virgin Islands, Chile, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala, Honduras, Jamaica, México, Nicaragua, Panamá, Paraguay, Perú, Suriname, the Turks and Caicos Islands, Uruguay, and Venezuela. Once the exclusion criteria were applied, a total of 35 questionnaires from 17 countries were analyzed (Figure 1). Sensitive data regarding professionals, institutions, and countries in the survey questionnaires were not disclosed in statistical analysis or data presentation. The survey respondents were professionals in charge of zoonosis and food safety programs at their countries.

In other words, they were decision makers at the national level who understood the situation in their countries. Despite the apparently small sample size, the value of the answers is considered of great significance.

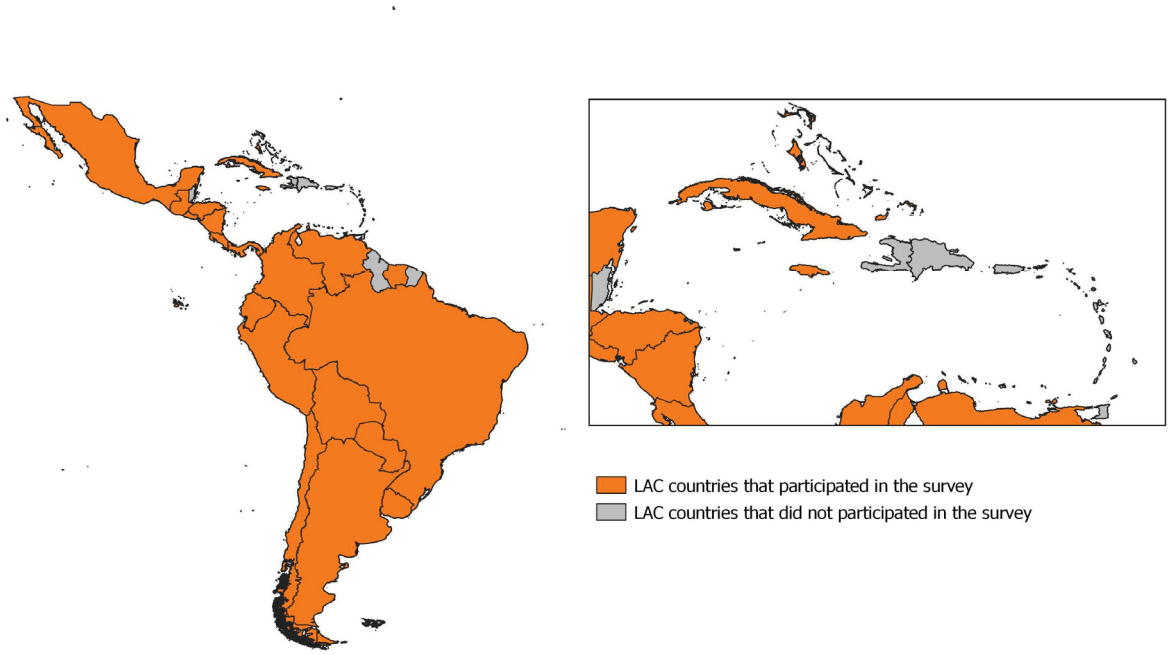

Figure 1. Countries participating in the One Health perception questionnaire.

PERMANOVA indicated significant differences between the OH thematic groups or parameters (Table 3). The PCA of health parameters in LAC as a function of countries' perceptions (self-vectors) showed that food safety and public policies were evaluated better than institutional routines for zoonosis (Figure 2).

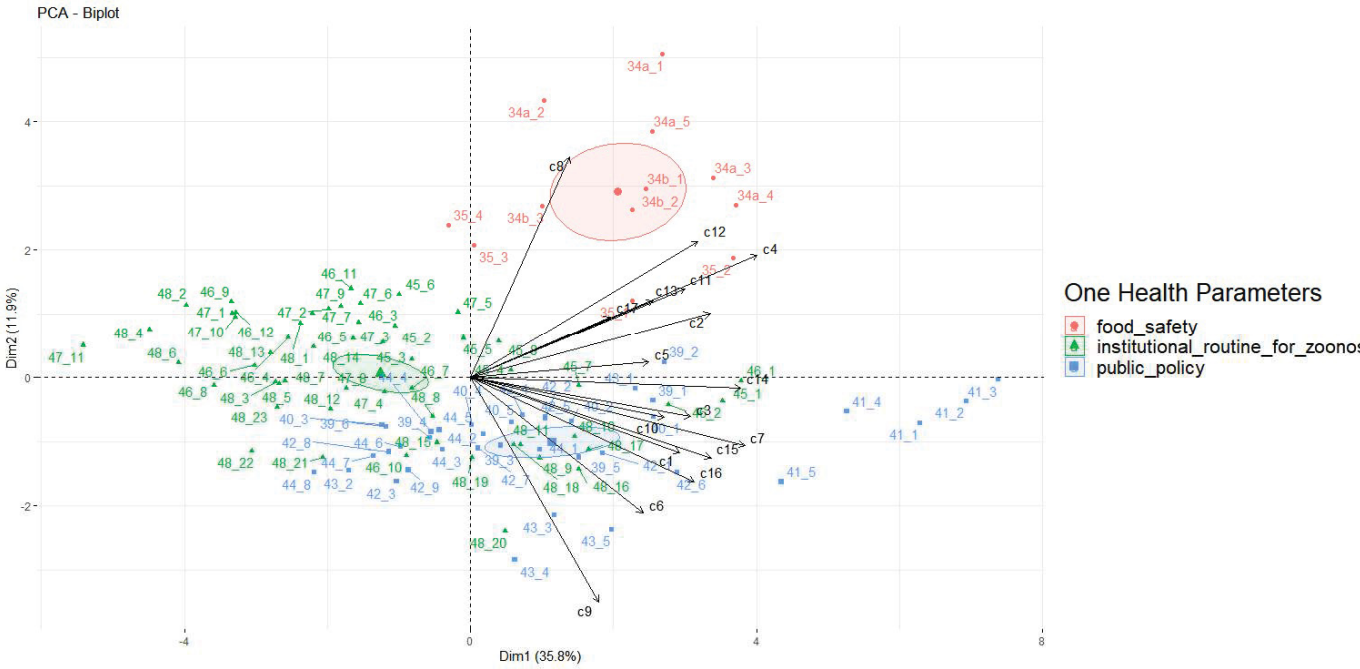

Figure 2. Graphic of principal component analysis showing the One Health perceptions of Latin American and Caribbean countries (17 self-vectors), with a focus on veterinary public health, based on the applied questionnaire (Supplementary Table S1). Colors indicate the veterinary public health parameters and ellipses indicate the confidence intervals (food safety in red, institutional routines for zoonosis in green, and public policy in blue).

Table 3. Results of the permutation multivariate analysis of variance that searched the paired comparisons among One Health parameters under the focus on veterinary public health.

Pairs of Parameters	Sums of Squares	F_Value	p_Value
Food safety vs. public policy	67.21559	4.676195	0.009 *
Food safety vs. institutional routines for zoonosis	142.5498	11.43743	0.003 *
Public policy vs. institutional routines for zoonosis	161.8979	12.2474	0.003 *

* Statistical significance of $p \leq 0.05$.

The questions with the highest and lowest scores for each thematic health parameter are presented in Table 4.

Table 4. List of questions, organized by health parameter, which presented the highest and lowest scores attributed by countries, indicating the strengths of and challenges for One Health in Latin America and the Caribbean.

Thematic Group on Veterinary Public Healthr	Questions	Topic	Scores (Highest)	Scores (Lowest)
Public Policy	41_3	WOAH and sanitary safety	4.31	
	41_2	Codex Alimentarius and food safety	4.23	
	41_1	IHR and public health	4.12	
	41_4	Global action plan and antimicrobial resistance	3.81	
	41_5	INFOSAN and food safety	3.72	
	43_2	Public health interventions and technology		2.35
	42_3	OH strategy and technical activity identification		2.32
	44_7	Encouragement of research and development		2.29
	40_3	OH integration between government and community		2.20
	44_8	Scientific journals' encouragement of OH articles		2.12
Food Safety	35_2	Surveillance of foodborne diseases	3.40	
	34a_4	Authority coordination on foodborne diseases	3.34	
	34a_3	Authority coordination on actions	3.34	
	34b_1	Better communication between countries	3.14	
	35_1	Control, monitoring, and reduction of contaminants	3.13	
	34a_1	Food control and zoonosis authorities		2.98
	34a_2	Food control and environmental authorities		2.84
	34b_3	Integrated surveillance between countries		2.77
	35_3	Management of agrochemicals and antimicrobials		2.62
	35_4	Disposal of agrochemicals and antimicrobials		2.50
Institutional Routines for Zoonosis	46_1	Geographic coverage	3.55	
	45_1	Common objective for surveillance systems	3.45	
	46_2	Hazards for the same disease groups	3.28	
	48_16	International collaboration and cooperation	3.21	
	48_17	Capacity to inform about epidemiological hazards	3.02	
	46_9	Feedback loops (correction measures)		1.86
	46_8	Monitoring and evaluation plan of OH system		1.86
	48_2	Sharing of statistical analysis techniques		1.81
	48_4	Common indicators used to analyze data		1.71
	47_11	Interoperability		1.51

WOAH = World Organisation for Animal Health; IHR = International Health Regulations; INFOSAN = International Food Safety Authorities Network; OH = One Health.

Discussion

The present study has shown statistically significant OH strengths and challenges in LAC countries based on high- and low-scored answers from an official survey, conducted among national governmental institutions, that addresses public policies, food safety, and institutional routines related to zoonosis programs.

Several LAC countries have established OH public policies that incorporate health, social, and economic determinants and have developed health systems that integrate multisectoral interventions [27]. Thus, the data herein should accurately mirror OH demands, as countries have previously shown high familiarity (92%) and collaboration (68%) baselines regarding OH, despite almost half of the participants (46%) referring to the establishment of such connections in the past five years [6]. This study also showed that food safety was ranked among the top three human, animal, and environmental health issues in LAC countries, along with antimicrobial resistance and zoonoses [6].

Such engagement has also been found on other continents, as two-thirds of respondents (63%) from 34 European countries declared that they were taking part in OH initiatives [3]. A survey in sub-Saharan Africa obtained 57 responses from different African countries with 145 OH initiatives [7], and in a survey of French-speaking countries, the vast majority of respondents (98%) acknowledged OH as relevant, and most respondents (64%) had already implemented OH initiatives [8]. The One Health European Joint Programme (OHEJP) has also identified food safety and policy changes as priority topics, indicating that communication and dissemination are key components for the successful achievement of OH actions [4]. Similarly, the Asian Development Bank suggested an interconnected OH approach to development problems, proposing solutions through transdisciplinary communication, coordination, and collaboration [12]. In another survey in Australia the participants agreed that OH was essential for effective infectious disease prevention and control [28].

Public Policy

National policies in accordance with international standards was considered the standalone strength for public policy, meaning that the standardization of, understanding of, and trust in international standards and corresponding organizations obtained the highest topic scores in the present survey. These international guidelines comprise the legal framework of the International Health Regulations (IHR); the standards, codes of practice, and other recommendations of the Codex Alimentarius; the international standards provided by the World Organisation for Animal Health (WOAH); the Global Action Plan on Antimicrobial Resistance; and the prevention of the international spread of contaminated food and foodborne diseases by the International Food Safety Authorities Network (INFOSAN) [29].

The interpretation of such results may indicate satisfactory delivery of standards and guidelines by international organizations, including availability, language, promptness, and training.

The COVID-19 pandemic showed the importance of international cooperation in responding to global health crises. International guidelines and public policies have also been shown to be important in preparing for addressing cross-border issues, as almost half of the guidelines and policies have been associated with zoonotic or food safety events [13].

Meanwhile, other topics related to tools, preparedness, research, and governance were identified as challenging issues that need to be addressed, obtaining the lowest scores in the survey. Including topics such as public health interventions and technology; strategy and technical activity; integration between governments and communities; and encouragement of OH research and development and scientific publication. Overall, organization structures and coordination and collaboration mechanisms are crucial for an effective OH approach and for monitoring strengths and weaknesses in a multisectoral surveillance system [14]. Other challenges are related to the formulation of the OH strategic roadmap and governance mechanisms, indicating the difficulty of internationalizing the implementation and application of the concept within national policies.

Thus, although the alignment between national and international policies was perceived as a strength, indicating favorable OH performance in LAC countries on the global scale, government–community integration should be addressed, as it remains a major challenge for institutional routines for zoonosis at the local level.

Food Safety

The highest and lowest scores for food safety in the present study indicated a positive cohesion between such topics. Topics related to the coordination with other sectors was simultaneously ranked as the strongest and the weakest characteristic for different food safety topics. Multisectoral coordination for preparedness and response to future emerging and re-emerging zoonotic diseases within a new OH framework has been demanded worldwide [30]. The strengths within topics related to the coordination between different technical areas include the surveillance of and authority coordination on foodborne diseases, along with contaminant issues and actions and communication between countries. Not surprisingly, stakeholders in governments, the food industry, and the research community should always work collectively to effectively address and communicate the safety of new food sources and production systems [31].

In contrast, the two lowest scoring topics in coordination were related to the management and disposal of pesticides and antimicrobials, which may serve as a warning about environmental contamination and pollution in LAC countries. Such harmful compounds may not be significantly removed in conventional wastewater processing and could be discharged into the environment, resulting in increased threats to human and animal health in anthropic and natural ecosystems [32].

The present study has also shown important positive advances in food safety understanding and concerns in LAC countries. Previously, disagreement on risk analysis in national food safety regulations has been found among professionals working in food safety in the

academic, government, and private sectors [33]. Assessing 23 countries of the LAC in 2014, only 70/279 (25%) stakeholders were able to correctly identify key principles of food safety, indicating a systematic lack of understanding of risk analysis [33]. In addition, water quality and its use for consumption and food preparation should be reviewed by local authorities and governments to achieve the targets of the Sustainable Development Goals, based on an assessment of documents on the official websites of countries in LAC, the Food and Agriculture Organization of the United Nations, and the World Food Programme [34].

The concern about food safety is not restricted to LAC countries; it is also reportedly one of the most pressing issues in Asia and the Pacific, particularly due to the negative impact of the COVID-19 pandemic on food security [12]. In such a scenario, achieving nutrition security in Asia required an integrated, cross-sectoral approach to producing healthy and nutritious food in sustainable food chains and improving food safety and livestock biosecurity [12]. In LAC countries the COVID-19 pandemic emphasized the demands on local food systems, family farming, and agroecology movements, particularly when the demands were increased by public policy pressures [35]. Although countries made great efforts to align their legislation with international standards during the pandemic, internal coordination between authorities and countries remains to be fully established, particularly in surveillance and responses to food safety events.

Food safety is not a recent concern. A 17-year-long survey of bacterial foodborne disease outbreaks in 20 Latin American countries found that meat, dairy products, water, and vegetables in the 1990s and eggs, vegetables, grains, and beans in the 2000s were the leading sources of bacterial diseases [36]. In this study, the changes in food sources of infection were associated with a series of changes over time, including zoonosis control, food consumption habits, outbreaks of public health interest, and pathogen data availability. This study has indicated the impact of surveillance systems and their data gaps in Latin America with respect to satisfactorily identifying foodborne pathogen sources [36].

Within the food safety parameter, prevention of illness received low scores for the following topics: interactions between food control authorities and zoonosis, interactions between food control authorities and environmental authorities, and national approaches to creating an integrated surveillance network among countries. The challenges of the national integration and collaboration of food safety with institutional routines related to zoonosis programs remain to be fully addressed at the global scale through the OH approach. Unfortunately, ministries of the environment and other national and international environmental organizations have not yet been enlisted as part of the taskforce against zoonotic diseases, as reported in European countries [3]. Thus, as ministries of health and ministries of agriculture have been working alone, the enrolment of environmental health professionals in teams for the control and monitoring of such diseases should be considered a challenge for the practical establishment of the Global One Health.

Institutional Routines for Zoonosis

As expected, topics related to the execution and implementation of attributions and daily routine resulted as both strong and weak topics for institutional routines related to zoonosis programs. Strengths included geographic coverage, a focus on surveillance systems, identifying the hazards of particular disease groups, international collaboration and cooperation, and the capacity to provide information about epidemiological hazards. In LAC countries, established commissions and interprogram working groups are tasked with addressing emergencies and fostering intergovernmental cooperation through efficient communication channels [37,38]. The sense of urgency created by the COVID-19 pandemic notably expedited interprogram collaboration among diverse governmental entities, with collaboration focusing on combating emerging and re-emerging zoonotic diseases [39].

Several challenges persist, including feedback-loop mechanisms for corrective measures, the establishment of robust monitoring and evaluation plans, the sharing of statistical techniques, adopting common indicators for data analysis, and ensuring interoperability. Notably, the institutional routines for zoonosis parameter yielded poorer results than food safety and public policy in the PCA (see Figure 1), underscoring the difficulty of implementing the parameter within national activities. Despite local OH initiatives addressing public health concerns, countries lack a cohesive approach to organizing and structuring national OH mechanisms at higher levels [40].

To bolster institutional routines for zoonosis, countries must facilitate extensive discussions aimed at developing robust communication channels and fostering information exchange through integrated information systems. These systems should not only focus on reporting disease occurrences but also document the actions and measures implemented to control diseases. Emphasis should be placed on identifying how each country contributes to its ongoing health initiatives.

Final Considerations

In the present study, topics such as access to and compliance with international guidelines and intercountry integration were ranked higher than in-country articulation, particularly for interactions among food safety experts, zoonoses, and environmental institutions and professionals. Although international guidance may indicate preparedness for global issues, national (technical working group) and subnational (information sharing and joint reporting) levels have been equally crucial for successful OH approaches to event-based surveillance [11].

This study revealed a lack of appropriated animal health parameters at the private and governmental institution, city, state, ministerial, and country levels, and animal health indicators were limited to qualitative actions for the health and welfare of companion animals rather than livestock or wildlife species.

Conclusions

The present study has shown statistically significant OH strengths and challenges within national governmental institutions pertaining to public policy, food safety, and institutional routines related to zoonosis programs in LAC countries. Access to, and compliance with, international guidelines and intercountry integration were ranked higher than in-country articulation, particularly among food safety, zoonoses, and environmental institutions. Based on our results, the concept of OH demonstrates notable strengths within the food safety sector in LAC, this being particularly evident in its alignment with international standards, which provide valuable guidance for the development of national policies. However, despite this alignment of international standards, and their positive influences, the practical application of OH in daily activities and its effective implementation remain significant challenges for the national authorities that participated in this survey.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/pathogens13080710/s1, Table S1: Raw data of responses from 42 institutions from 26 countries gathered and used for statistical analysis. Countries were replaced by numbers to avoid disclosing sensitive data from questionnaire surveys.

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Data Availability Statement: All data used in the present study are included in the Supplementary Materials, with no mention of sensitive data origins.

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3 CONSIDERAÇÕES FINAIS

Nossos resultados evidenciam a necessidade de estabelecer métodos eficazes para avaliar a interdependência entre saúde humana, animal e ambiental, especialmente em contextos específicos, como a América do Sul. A atual abordagem em Saúde Única pode ser particularmente relevante nos países da América do Sul, visto a sobreposição crescente da vulnerabilidade ambiental e socioeconômica desta macrorregião. A integração de indicadores socioeconômicos e ambientais com a saúde é imperativa para a implementação de políticas públicas eficazes que considerem as especificidades em diferentes escalas, sejam macrorregionais ou locais. Embora análises em escala mais baixa (dentro do país), como estados e áreas metropolitanas, possam moldar melhor as diferenças internas, o estudo mostrou claramente as desigualdades e os desafios da Saúde Única entre os países sul-americanos. Igualmente importante é que as florestas e outras áreas naturais, particularmente a Floresta Amazônica, deveriam receber incentivos para o crescimento econômico sustentável, baseado na não utilização dos recursos naturais acompanhado de um esforço de resiliência ecossistêmica, evitando assim o sacrifício da saúde ambiental e animal em benefício da saúde humana. Portanto, futuras pesquisas devem abordar as interações complexas entre as dinâmicas socioeconômicas, políticas e ambientais, especialmente no contexto da Amazônia e outras áreas naturais da macrorregião (i.e. Cordilheira dos Andes, Caribe, Terra do Fogo, deserto do Atacama). Ademais, é importante considerar desigualdades internas dentro dos países, uma vez que podem interferir na eficácia de políticas de saúde. Desta forma, sugerimos que futuros estudos também considerem escalas espaciais locais (i.e. estados, cidades, bairros) na contextualização da Saúde Única – Uma Só Saúde.

Embora os países com maior estabilidade política e investimentos em saúde apresentem melhores resultados de Saúde Única, a saúde animal ainda se apresenta como uma grande lacuna na integração das saúdes. Atualmente, a saúde animal carece de dados consistentes, principalmente sobre as condições de animais de estimação e da fauna selvagem. Em níveis locais, como em municípios, a ausência de dados padronizados sobre a saúde de animais de companhia e fauna selvagem limita ainda mais a capacidade de avaliação precisa da saúde animal (Moura et al., 2022b). Como os sistemas de saúde humana são, em geral, mais desenvolvidos do que os de saúde animal, e o monitoramento ambiental também é mais avançado (Sibim et al., 2024), a implementação de estratégias de Saúde Única em escalas locais pode promover substanciais melhorias na saúde animal. Desta forma, é necessário desenvolver índices que integrem melhor essas dimensões com os fatores sociais, econômicos e ambientais para uma avaliação mais fidedigna da saúde da região.

A coordenação interna dos países entre os diferentes setores envolvidos na saúde, por meio dos respectivos ministérios nacionais dedicados ao meio ambiente, saúde humana e animal, ainda é um desafio, principalmente no enfrentamento de emergências sanitárias como as zoonoses. Isso fica evidente na avaliação dos profissionais de saúde dos diferentes países das américas. Normativas internacionais e a integração das diretrizes globais, foram mais bem

avaliadas do que as articulações internas, limitadas por políticas públicas de saúde incipientes para vários países. Assim, existe a necessidade de colaboração internacional para promover melhorias nas saúdes, destacando o papel de instituições como a Organização Pan-Americana de Saúde, subsidiando as diretrizes macrorregionais. No âmbito local, é necessária maior articulação entre as diferentes escalas, (i.e. municipal, estadual e nacional), buscando maior integração dos profissionais das áreas de meio ambiente e zoonoses.

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APÊNDICE – QUESTIONÁRIO DE SAÚDE ÚNICA

Instruções:

1. O questionário possui 48 perguntas. Você pode concluir a pesquisa on-line, e ela pode salvar seu progresso, para continuar mais tarde. Depois de concluir a pesquisa online, clique em "enviar" no final do formulário.
2. A pesquisa tem como alvo a saúde pública veterinária, focada em iniciativas para zoonoses endêmicas e emergentes, e de doenças transmitidas por alimentos em seu país.
3. Por favor, lembre-se de considerar a grande variedade de zoonoses e doenças transmitidas por alimentos. Isso é fundamental para que suas respostas reflitam claramente as prioridades do seu país.
4. A pesquisa compreende 5 diferentes seções que podem exigir a entrada de mais de uma pessoa. No entanto, aconselhamos que uma pessoa coordene a conclusão e o envio do formulário.
5. O tempo estimado para a conclusão da pesquisa é de cerca de 2,0 horas.
6. Pedimos gentilmente que você devolva o formulário até 30 de setembro de 2022.
7. Nenhum país será identificado individualmente. Os resultados serão apresentados em formato agregado e os dados serão mantidos em sigilo.

O levantamento apresenta uma situação ideal e tem como objetivo identificar a posição regional em relação aos mais altos padrões de zoonoses e doenças transmitidas por alimentos, vigilância e controle. Isso é muito difícil de alcançar na prática. Como resultado, você pode não ser capaz de responder a algumas das perguntas. Isso é intencional. Agradecemos sua compreensão.

Se você tiver alguma dúvida ou dúvida sobre a pesquisa ou sua conclusão, entre em contato conosco nos seguintes endereços de e-mail: Marco Antonio Natal Vigilato (vigilato@paho.org) e Baldomero Molina Flores (molinab@paho.org).

Obrigado pelo seu tempo.

Unidade de Zoonoses PANAFTOSA/SPV-OPAS/OMS

Questão 1
País

_____

Questão 2
Organização/Afiliação (ex. Ministério da Saúde, Ministério da Agricultura, Universidade etc.)

_____

Questão 3
Departmento interno na Organização

_____

Questão 4
Nome completo da pessoa que coordena o preenchimento de todo este formulário

_____

Questão 5
Cargo na Organização

_____

Questão 6
E-mail da pessoa que coordena o preenchimento de todo este formulário

_____

Questão 7
Número telefônico (incluindo código local e do país) da pessoa que coordena o preenchimento de todo este formulário

_____

Questão 8
Qual sua área de formação?
o Ciências ambientais (1)
o Saúde humana (2)
o Ciência animal (3)
o Saúde pública (4)
o Outro (5) _____

Questão 9
Você já ouviu algo sobre iniciativas de Saúde Única?
o Sim (1)
o Não (2)

Questão 10
O que você entende por Saúde Única? Por favor, defina Saúde Única em uma sentença:

_____

Questão 11
Você está envolvido(a) em iniciativas de Saúde Única? (ex. desenvolvimento de plano de Saúde Única, ou inclusive vigilância, prevenção e controle de zoonoses e doenças vetoriais, contaminantes ambientais nos alimentos, raiva, etc.)
o Sim (4)
o Não (3)

Questão 12
Por favor, forneça uma breve descrição destas iniciativas:

_____

Questão 13
Sua instituição adotou/endossou oficialmente políticas de Saúde Única?
o Sim (3)
o Não (4)
o Eu não sei (6)

Questão 14
Por favor, descreve como:

_____

Questão 15
Por favor liste, se houver, programas/atividades as quais sua instituição adotou o enfoque Saúde Única:

o Minha instituição não adota o enfoque Saúde Única (1)
o Lista de atividades: (2) _____

Questão 16a
Existem conselhos/comitês/associações que lidam ativamente com questões/iniciativas de Saúde Única em seu país?
o Sim (1)
o Não (2)
o Eu não sei (3)

Questão 16b
Por favor, liste os conselhos/comitês/associações que lidam ativamente com questões/iniciativas de Saúde Única em seu país.
_____

Questão 17
Você saberia se há conexões administrativas FORMAIS e INSTITUCIONAIS entre saúde humana/veterinária e saúde pública em seu país (instituições governamentais ou serviços)?
▢ Sim (3)
▢ Não (5)

Questão 18
Em que nível?
▢ Local (1)
▢ Regional, provincial ou estadual (2)
▢ Nacional (3)
▢ Internacional (4)

Questão 19
E qual seria a natureza desta cooperação?
▢ Troca de informação e dados (1)
▢ Financiamento compartilhado (3)
▢ Vigilância conjunta (2)
▢ Investigação conjunta (9)
▢ Intervenção conjunta (4)
▢ Prontidão conjunta (5)
▢ Treinamento conjunto (6)
▢ Políticas de saúde (7)
▢ Outro (8) _____

Questão 20
Esta cooperação formal foi estabelecida em:
o Nos ultimos 5 anos (1)
o De 5 a 10 anos atrás (2)
o De 10 a 20 anos atrás (3)
o A mais de 20 anos atrás (4)

Questão 21
Baseado em seu conhecimento e opinião pessoal, existem iniciativas em Saúde Única sendo implementadas em seu país?

o Sim (1)
o Não (2)
o Eu não sei (3)

Questão 22
Por favor, selecione o campo de atividades na qual estas iniciativas são implementadas:
▢ Monitoramento e vigilância de doenças (1)
▢ Prevenção e controle de doenças (2)
▢ Conscientização de participantes dos programas (3)
▢ Programas de educação superior (4)
▢ Pesquisa (5)
▢ Outro (6) _____

Questão 23
Baseado em seu conhecimento, quais destas seguintes áreas profissionais estão diretamente empregadas/engajadas com iniciativas de Saúde Única em seu país?
▢ Veterinária (1)
▢ Médica (2)
▢ Medicina da família (4)
▢ Biologia/entomologia (5)
▢ Química (6)
▢ Especialistas ambientais/ecossistemas (Ecologia) (7)
▢ Especialistas em gênero/sociologia/antropologia (8)
▢ Economista/advogado (11)
▢ Eu não sei (9)
▢ Outro (10) _____

Questão 24
Se você trabalhou com Saúde Única em seu país, quais foram os fatores que restringiram a interdisciplinaridade/intersetorialidade?
o Eu nunca trabalhei com Saúde Única (1)
o Lista de fatores: (2) _____

Questão 25
Avalie o quanto bem implementado é o enfoque Saúde Única por profissionais empregados(as)/engajados(as) nos setores de veterinária, saúde pública e saúde ambiental em seu país (Onde 0 significa Ausente; 1 significa Pobre; e 5 significa Excelente)

	Eu não sei (1)	0 (2)	1 (3)	2 (4)	3 (5)	4 (6)	5 (7)
Quantifique a implementação de Saúde Única (1)	○	○	○	○	○	○	○

Questão 26
Existem iniciativas (formais) recentes para estabelecimento/fortalecimento de colaboração intersetorial destinado à advocacia global do enfoque Saúde Única?
o Sim (1)
o Não (2)
o Eu não sei (3)

Questão 26b
Por favor, descreva:
_____

Questão 27a
Quais são os três principais problemas das saúdes ambiental, animal e humana em seu país nos ultimos 5 anos?
o Primeiro (1) _____
o Segundo (2) _____
o Terceiro (3) _____

Questão 27b
Por favor, liste ao menos três instituições que coordenam/sejam responsáveis por atividades de Saúde Única em seu país.
o Eu não sei (1)
o Não há instituições coordenando atividades de Saúde Única (2)
o Lista de instituições: (3) _____

Questão 28
Em sua opinião, onde e quais são os gargalos nas temáticas de Saúde Única?
o Eu não sei (1)
o Gargalos: (2) _____

Questão 29a
Em sua opinião, qual o nível de consciência/percepção sobre Saúde Única entre cidadãos(ãs)/consumidores(as) de seu país? (Onde 1 significa Pobre; e 5 significa Excelente)

	Eu não sei (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)
Avalie prontidão/percepção (1)	○	○	○	○	○	○

Questão 29b
Quais iniciativas poderiam ser realizadas para desenvolver/melhorar esta percepção?
_____

Questão 30
Quanto relevante são as seguintes qualidades de Saúde Única no seu serviço? (Onde 0 significa Nada relevante; e 5 significa Altamente relevante)

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)
Detecção precoce e oportuna de ameaças, ou resposta rápida (1)	○	○	○	○	○	○
Melhores/mais efetivas medidas de controle contra enfermidades e/ou biossegurança (2)	○	○	○	○	○	○
Benefícios/aumento da eficiência econômica (3)	○	○	○	○	○	○
Melhoramento em saúde ou bem-estar humana e animal (4)	○	○	○	○	○	○
Melhor qualidade ou maior quantidade de informação e dados e melhor conhecimento e habilidades (5)	○	○	○	○	○	○
Benefícios para o ecosistema (6)	○	○	○	○	○	○
Benefícios pessoais ou sociais (7)	○	○	○	○	○	○
Composição de políticas em saúde (8)	○	○	○	○	○	○
Outra vantagem: (9)	○	○	○	○	○	○

Questão 31
Existe uma cooperação ativa entre Ministério da Saúde e o Serviço Veterinário Oficial, quando lidam com zoonoses?
o Sim (1)
o Não (2)
o Eu não sei (3)

Questão 32

Há uma legislação/norma regulatória sobre colaboração entre Saúde Pública e serviço veterinário (i.e. obrigação para garantir um fluxo recíproco de informação/dados)?

o Sim (1)
o Não (2)
o Eu não sei (3)

Questão 32b
Por favor, descreva:

_____

Questão 33
Selecione entre a lista de doenças zoonóticas quais são controladas e monitoradas por Ministério da Saúde e/ou Agricultura e/ou Meio Ambiente. Lista baseada em: Zoonoses and the Human Animal Ecosystems Interface (http://www.who.int/zoonoses/en/). Marque uma ou mais opções quando aplicável.

	Setor de Saúde Pública (1)	Setor de Agricultura (2)	Setor de Meio Ambiente (3)	Nenhuma destas opções (4)
Antrax (1)	☐	☐	☐	☐
Influenza aviária (2)	☐	☐	☐	☐
Brucelose (3)	☐	☐	☐	☐
Campilobacteriose (4)	☐	☐	☐	☐
Cisticercose (5)	☐	☐	☐	☐
Leptospirose (6)	☐	☐	☐	☐
Peste (7)	☐	☐	☐	☐
Febre Q (8)	☐	☐	☐	☐
Raiva (9)	☐	☐	☐	☐
Riquetsiose (14)	☐	☐	☐	☐
Salmonelose (10)	☐	☐	☐	☐
Toxoplasmose (11)	☐	☐	☐	☐
Triquinelose (12)	☐	☐	☐	☐
Outra (13)	☐	☐	☐	☐

Questão 34a

Em sua opinião, da perspectiva de prevenção de doenças transmitidas por alimentos, quão importantes são as seguintes atribuições de Saúde Única para segurança dos alimentos na região das Américas (em seu país)? (Onde 0 significa Ausente; 1 significa Pobre; e 5 significa Excelente)

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)
Autoridades competentes pelo controle de alimentos coordenam conjuntamente às autoridades competentes para o controle de zoonoses, no campo de segurança dos alimentos. (1)	○	○	○	○	○	○
Autoridades competentes pelo controle de alimentos coordenam conjuntamente às autoridades competentes pelo meio-ambiente, o campo de segurança dos alimentos. (2)	○	○	○	○	○	○
Autoridades competentes pelo controle de alimentos coordenam o controle, vigilância, e redução de contaminantes (físicos, biológicos, e químicos). (3)	○	○	○	○	○	○
Autoridades competentes pelo controle de alimentos coordenam a vigilância de doenças transmitidas por alimentos. (4)	○	○	○	○	○	○
Autoridades competentes pelo controle de alimentos coordenam o correto uso de agrotóxicos e antimicrobianos. (5)	○	○	○	○	○	○
Há mais questões relevantes para a coordenação de autoridades competentes? (6)	○	○	○	○	○	○

Questão 34b

Em sua opinião, da perspectiva de prevenção de doença transmitida por alimentos, quão importantes são as seguintes atribuições de Saúde Única para segurança dos alimentos em nossa região das Américas (em seu país)? (Onde 0 significa Ausente; 1 significa Pobre; e 5 significa Excelente)

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)
Enfoque geral do país em melhor comunicação e colaboração entre países. (1)	○	○	○	○	○	○
Enfoque geral do país em colaboração formal em redes de trabalho entre países. (2)	○	○	○	○	○	○
Enfoque geral do país em redes de trabalho para vigilância integrada entre países. (3)	○	○	○	○	○	○
Há mais alguma(s) questão(ões) relevante(s) para o enfoque geral do país para prevenção de doenças transmitidas por alimentos? (4)	○	○	○	○	○	○

Questão 35
Como você classificaria a coodenação entre autoridades competentes e outras entidades como o setor produtivo, o setor da pesquisa, o setor de capacitações, e outros, para assegurar segurança dos alimentos (onde 0 significa Ausente; 1 significa Pobre; e 5 significa Excelente):

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)
Controle, monitoramento e redução de contaminantes (físicos, biológicos, e químicos). (1)	○	○	○	○	○	○
Vigilância de doenças transmitida por alimentos (2)	○	○	○	○	○	○
Manejo correto de agrotóxicos e antimicrobianos (3)	○	○	○	○	○	○
Manejo de agrotóxicos e antimicrobianos e programas de descarte com agencias nacionais de segurança de segurança e saúde ambiental. (4)	○	○	○	○	○	○

Questão 36
Por favor, liste suas três principais zoonoses endêmicas, da mais para a menos importante, que refletem as atuais prioridades para sua instituição.

o Primeira prioridade: (1) _____
o Segunda prioridade: (2) _____
o Terceira prioridade: (3) _____

Questão 37
Por favor, liste suas três principais enfermidades transmitidas por alimentos, da mais para a menos importante, que refletem as atuais prioridades para sua instituição.

o Primeira prioridade: (1) _____
o Segunda prioridade: (2) _____
o Terceira prioridade: (3) _____

Questão 38
Nós estamos atualmente testemunhando a ocorrência transnacional de um número de condições zoonóticas no mundo, ex. Chikungunya, MERS CoV, Ebola, e COVID 19. Na sua opinião, da perspectiva de um programa de zoonoses, qual é o ponto mais crítico que as Américas devem

desenvolver para previnir a ocorrência e dissiminação de enfermidades como essas? (ex. melhor comunicação e colaboração entre países, uma rede formal entre países, vigilância integrada entre países, etc.).

_____

Questão 39
INTERAÇÕES: Classifique a condução das seguintes áreas em seu trabalho cotidiano: (Onde 0 significa Inexistente; 1 significa Pobre; e 5 significa Excelente)

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)
Riscos para a saúde relacionados à interface homem-animal-ambiente são gerenciados por entidades ou setores em conjunto. (1)	○	○	○	○	○	○
Soluções efetivas ocorrem através da colaboração entre os diferentes atores, setores e disciplinas envolvidas na área. (2)	○	○	○	○	○	○
Instituições governamentais e não governamentais trabalham na interface homem-animal-ambiente com comunicação e/ou coordenação. (3)	○	○	○	○	○	○
Análise e mapeamento dos atores asseguram a coordenação e a comunicação entre partes relevantes, compartilhando conhecimento e recursos, construindo sinergias e identificando lacunas. (4)	○	○	○	○	○	○
Saúde Única inclui parceiros além do setor da saúde, mas também da saúde e da produção animal, da agricultura e do meio ambiente, bem como os que trabalham em outras áreas, como os determinantes socias da saúde. (5)	○	○	○	○	○	○
Mapeamento da infraestrutura e dos recursos são presentes para assegurar o melhor uso das ferramentas, políticas, iniciativas e redes de especialistas. (6)	○	○	○	○	○	○

Questão 40

GOVERNANÇA: Classifique a condução das seguintes áreas em seu trabalho cotidiano: (Onde 0 significa Inexistente; 1 significa Pobre; e 5 significa Excelente)

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)
Autoridades nacionais reconhecem e abraçam os benefícios e as contribuições significativas à saúde pública que podem ser obtidas ao considerar as interações entre a saúde humana, animal, vegetal e ambiental. (1)	○	○	○	○	○	○
O país garante a institucionalização e implementação de Saúde Única por meio de mecanismos robustos de governança que promovem o trabalho multissetorial para alcançar resultados positivos de saúde por meio de ações colaborativas. (2)	○	○	○	○	○	○
Os mecanismos de governança da Saúde Única são liderados pelo governo, com participação de atores não governamentais e da comunidade, inclusive populações indígenas e grupos em situação de vulnerabilidade. (3)	○	○	○	○	○	○
Adoção de princípios de governança visando a aumentar a eficiência e a sustentabilidade das intervenções de saúde pública relevantes para a interface homem-animal-ambiente. (4)	○	○	○	○	○	○
Adoção de princípios de governança visando assegurar melhor planejamento e priorização das atividades. (5)	○	○	○	○	○	○

Questão 41

INTERNATIONALIZAÇÃO: Classifique a condução das seguintes áreas em seu trabalho cotidiano: (Onde 0 significa Inexistente; 1 significa Pobre; e 5 significa Excelente)

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)
O Regulamento Sanitário Internacional (RSI), proporciona o marco legal que define os direitos e as responsabilidades para manejar eventos e emergências de saúde pública com potencial de cruzar fronteiras. (1)	○	○	○	○	○	○
Codex Alimentarius proporciona códigos de prática, diretrizes e outras recomendações internacionalmente reconhecidas sobre alimentos, produção de alimentos e inocuidade dos alimentos (2)	○	○	○	○	○	○
A Organização Mundial de Saúde Animal (OMSA) international standards garante a segurança sanitária de ensures sanitary safety of international trade in terrestrial and aquatic animals and their product. (3)	○	○	○	○	○	○
A Tripartite monitora e avalia o Plano de Ação Global sobre Resistência Antimicrobiana gerando dados, objetivos e informação para tomada de decisões operacionais e estratégias. (4)	○	○	○	○	○	○
A Rede Internacional de Autoridades de Inocuidade dos Alimentos (INFOSAN) previne a disseminação internacional de alimentos contaminados e doenças transmitidas por alimentos e fortalecer os sistemas de inocuidade dos alimentos globalmente. (5)	○	○	○	○	○	○

Questão 42
PRONTIDÃO: Classifique a condução das seguintes áreas em seu trabalho cotidiano: (Onde 0 significa Inexistente; 1 significa Pobre; e 5 significa Excelente)

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)
O marco de Saúde Única inclui responsabilidade compartilhada entre os setores participantes pelos resultados de uma atividade técnica. (1)	○	○	○	○	○	○
Cada setor tem seus próprios recursos e responsabilidades e contribui para uma prestação de contas compartilhada. (2)	○	○	○	○	○	○
A formulação de um guia estratégico nacional de Saúde Única identifica as atividades técnicas a serem realizadas, que diferirão dependendo das ameaças prioritárias à saúde na interface homem-animal-ambiente. (3)	○	○	○	○	○	○
As atividades técnicas são sustentadas por uma sólida análise de riscos (4)	○	○	○	○	○	○
Essa análise examina a probabilidade e o impacto potencial de cada risco, os fatores que moldam os riscos e as opções para controlar os riscos. (5)	○	○	○	○	○	○
São prioritários os riscos que afetam os sistemas que a sociedade depende, como saúde, produção agropecuária e meio ambiente. (6)	○	○	○	○	○	○
A análise de riscos inclui os diferentes fatores da emergência de doenças, inclusive comportamento humano, fatores culturais e socioeconômicos, determinantes ambientais, práticas agrícolas, mudança do clima e condições ocupacionais. (7)	○	○	○	○	○	○
Entendimento e previsão de riscos, incluindo modelos preditivos, construção de opções de mitigação de riscos, e redução da implementação de respostas com uso intensivo de recursos. (8)	○	○	○	○	○	○
O engajamento das comunidades e da academia assegurando apoio à implementação de estratégias de gestão de riscos e redução de riscos bem-sucedida. (9)	○	○	○	○	○	○

Questão 43

FERRAMENTAS: Classifique a condução das seguintes áreas em seu trabalho cotidiano: (Onde 0 significa Inexistente; 1 significa Pobre; e 5 significa Excelente)

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)
Intervenções em saúde pública incluem acesso e uso de soluções digitais de saúde e ferramentas científicas. (1)	○	○	○	○	○	○
Intervenções em saúde pública incluem tecnologias emergentes como inteligência artificial, blockchain, wearables, big data, sistemas de informações geográficas, sequenciamento de última geração e plataformas de troca de informações. (2)	○	○	○	○	○	○
Quadros globais, regionais e nacionais para processos digitais de transformação são considerados fundamentais para o mundo globalizado. (3)	○	○	○	○	○	○
Novas tecnologias são essenciais para a implementação da Saúde Única, e demandam por plataformas baseadas na nuvem e soluções digitais, apoiando o acesso e o intercâmbio de dados entre diferentes setores de maneira segura, ética e interoperável. (4)	○	○	○	○	○	○
Tecnologias digitais contribuem para melhorar e fortalecer os sistemas de informação e para a desagregação e estratificação de dados. (5)	○	○	○	○	○	○

Questão 44

PESQUISA: Classifique a condução das seguintes áreas em seu trabalho cotidiano: (Onde 0 significa Inexistente; 1 significa Pobre; e 5 significa Excelente)

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)
Saúde Única é entendida e promovida como um enfoque transdisciplinar requerindo a geração e disseminação de novos conhecimentos. (1)	○	○	○	○	○	○
A academia, os órgãos de pesquisa e os institutos nacionais de saúde estão ativamente engajados na realização e apoio a pesquisas e fortalecimento da capacidade sobre ameaças à saúde na interface homem-animal-ambiente. (2)	○	○	○	○	○	○
Os centros acadêmicos são incentivados a incluir a Saúde Única em seus currículos. (3)	○	○	○	○	○	○
Pesquisa fortalece colaboração multisetorial e compartilhamento de conhecimento, quebrando barreiras entre diferentes setores e disciplinas. (4)	○	○	○	○	○	○
Equipes de pesquisa incluem diferentes expertises e disciplinas para facilitar um ponto de vista amplo e permitir que a interface homem-animal-ambiente seja pesquisada como um todo coerente. (5)	○	○	○	○	○	○
Pesquisa aplicada para identificar hotspots e entender os desafios que limitam o controle e a eliminação de zoonoses. (6)	○	○	○	○	○	○
Promoção da pesquisa e o desenvolvimento de vacinas, antimicrobianos, alternativas a antimicrobianos e diagnósticos para a saúde humana e animal. (7)	○	○	○	○	○	○
Os periódicos científicos revisados por pares são encorajados e habilitados a publicar resultados de pesquisas de alta qualidade, relevantes para o enfoque de Saúde Única. (8)	○	○	○	○	○	○

Questão 45

Classifique a condução das seguintes áreas em seu trabalho cotidiano: (Onde 0 significa Inexistente; 1 significa Pobre; e 5 significa Excelente)

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)
Objetivos comuns de sistemas de vigilância/colaboração (1)	○	○	○	○	○	○
Documentação oficial (apoiando/formalizando o enfoque Saúde Única) (2)	○	○	○	○	○	○
Lideranças clara e compartilhada/ Comitê diretivo (3)	○	○	○	○	○	○
Coordenação central (responsabilidades e composição definidas a nível central) (4)	○	○	○	○	○	○
Coordenação a nível intermediário (responsabilidades e composição definidas a nível intermediário) (5)	○	○	○	○	○	○
Coordenação a nível de campo (responsabilidades e composição definidas a nível de campo) (6)	○	○	○	○	○	○
Graus de esforço colaborativo entre setores (humano, animal, ambiental; onde for relevante) (7)	○	○	○	○	○	○
Graus de esforço colaborativos entre parceiros (ex. publico-privado, academia, público em geral, etc; onde for relevante) (8)	○	○	○	○	○	○

Questão 46

Classifique a condução das seguintes áreas em seu trabalho cotidiano: (Onde 0 significa Inexistente; 1 significa Pobre; e 5 significa Excelente)

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)
Cobertura geográfica (1)		○	○	○	○	○
Entre riscos da mesma categoria (ex.riscos de transmissão por vetores) (2)		○	○	○	○	○
Financiamento dedicado para coordenação/direcionamento (3)		○	○	○	○	○
Financiamento dedicado para atividades operacionais colaborativas (4)		○	○	○	○	○
Recursos humanos (profissionais e tempo) dedicados para atividades colaborativas (5)		○	○	○	○	○
Mutualização de recursos (ex. equipamentos) (6)		○	○	○	○	○
Capacitação em enfoque Saúde Única (recursos humanos) (7)		○	○	○	○	○
Planos de monitoramento e avaliação do sistema de Saúde Única (8)		○	○	○	○	○
Ciclo para autoalimentação (implementação de medidas corretivas) (9)		○	○	○	○	○
Adaptabilidade de mudanças internas e externas (ex. riscos emergentes) (10)		○	○	○	○	○
Memória intitucional (ex. Procedimentos operacionais padrão descritos (POP)) (11)		○	○	○	○	○
Avaliação da percepção de atores relacionada à funcionalidade da colaboração (12)		○	○	○	○	○

Questão 47
Classifique a condução das seguintes áreas em seu trabalho cotidiano: (Onde 0 significa Inexistente; 1 significa Pobre; e 5 significa Excelente)

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)
Indicadores de performance de Sistemas de Vigilância em Saúde Única (1)	○	○	○	○	○	○
Documentação oficial de suporte/formalização de coleção colaborativa de dados e compartilhamento de metodologias. (2)	○	○	○	○	○	○
Protocolos de vigilância desenhados colaborativamente. (3)	○	○	○	○	○	○
Coleção colaborativa de dados (4)	○	○	○	○	○	○
Harmonização de ténicas laboratoriais e prodecimentos entre setores ou compentes da vigilância (5)	○	○	○	○	○	○
Avaliação e validação de qualidade de dados (6)	○	○	○	○	○	○
Acordos para compartilhamento de dados (7)	○	○	○	○	○	○
Integridade de dados compartilhados (8)	○	○	○	○	○	○
Acessibilidade e armazenamento de dados (9)	○	○	○	○	○	○
Plano de gerenciamento de dados (mapeamento de dados disponíveis) (10)	○	○	○	○	○	○
Interoperalidade (e.g. formato interoperv (11)	○	○	○	○	○	○

Questão 48

Classifique a condução das seguintes áreas em seu trabalho cotidiano: (Onde 0 significa Inexistente; 1 significa Pobre; e 5 significa Excelente)

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)
Análise de dados integrados entre atores ou vigilância de componentes (1)	○	○	○	○	○	○
Compartilhamento de técnicas de análise estatística (ex. roteiros de vigilância sindrômica) (2)	○	○	○	○	○	○
Compartilhamento de expertise científica para interpretação de resultados (ex. para avaliar impacto de saúde pública) (3)	○	○	○	○	○	○
Indicadores comuns aplicados para análise de dados (4)	○	○	○	○	○	○
Comunicação interna (no escopo do sistema de Saúde Única) (5)	○	○	○	○	○	○
Política/plano de comunicação externo (ex. comunicação conjunta com parceiros relevantes) (6)	○	○	○	○	○	○
Disseminação para tomada de decisão (ex. seminário conjunto direcionados para oficiais dos ministérios) (7)	○	○	○	○	○	○
Reconhecimento das consequencias de compartilhar informação sobre suspeitas/eventos (8)	○	○	○	○	○	○
Atualização de informação sobre riscos epidemiológicos situacionais (9)	○	○	○	○	○	○
Detecção de emergências (se relevante para o sistema em avaliação) ou de um risco em ascenção (10)	○	○	○	○	○	○
Aumento da efetividade da vigilância (oportunamente, sensibilidade, precisão, robustês, etc.) (11)	○	○	○	○	○	○
Redução de custos com vigilância (financeiro, material, humano) (12)	○	○	○	○	○	○

Times de Saúde Única (ex. atores envolvidos em vigilância) (13)	○	○	○	○	○	○
Rede de trabalho em Saúde Única (ex. parceiros interessados pela vigilância) (14)	○	○	○	○	○	○
Aumento da confiança entre atores da vigilância (15)	○	○	○	○	○	○
Colaboração/cooperação internacional (16)	○	○	○	○	○	○
Capacidade de informar epidemiologia de riscos (17)	○	○	○	○	○	○
Aumento da percepção (18)	○	○	○	○	○	○
Oportunidades de pesquisa (além da vigilancia) (19)	○	○	○	○	○	○
Intervenções (20)	○	○	○	○	○	○
Mundanças políticas (21)	○	○	○	○	○	○
Mudanças de comportamento (22)	○	○	○	○	○	○
Advocacia (23)	○	○	○	○	○	○