

SWOT strategy for future global health security: insights from Indonesia, Cambodia, Vietnam, Dominican Republic, Ghana, and the Republic of Korea using the World Health Organization International Health Regulations monitoring tool

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ABSTRACT

Objectives: The study aimed to analyze the core capacities to implement World Health Organization International Health Regulations (IHR) in 6 countries: Indonesia, Cambodia, Vietnam, the Dominican Republic, Ghana, and the Republic of Korea.

Methods: Secondary data from relevant databases and reports, including the electronic State Party Self-Assessment Annual Reporting mechanism and global health security index, were used to assess health security in these countries. Descriptive statistics summarized the basic features of the scores, and a strengths, weaknesses, opportunities, and threats (SWOT) analysis was subsequently performed to identify factors affecting health security scores while highlighting key similarities and differences between countries.

Results: Early warning and event management emerged as the primary strength in most countries. Common opportunities included international commitments and immunization programs. In contrast, many countries shared weaknesses related to the policy, legal, and normative frameworks for IHR implementation, as well as challenges in human resources, chemical event management, and radiation emergency preparedness. Recurring threats involved issues such as biosafety, biosecurity, dual-use research and the culture of responsible science, infection control practices, coordination between public health and security authorities, laboratory supply chain vulnerabilities, and communication with healthcare workers during public health emergencies.

Conclusion: In order to counter future global health threats, countries should prioritize enhancing surveillance capacity (early warning and event management) as well as the immunization indicator (vaccination rates for human and animal diseases, including the national vaccine delivery system).

Keywords: Global health; Immunization; One Health; Surveillance

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Introduction

Health security and preparedness are crucial for nations to effectively prevent, detect, and respond to a wide range of global health threats—including infectious disease epidemics, disasters, and bioterrorism—in today's interconnected world [1,2]. In this context, the electronic State Party Self-Assessment Annual Reporting mechanism (e-SPAR) and the global health security (GHS) index provide comprehensive frameworks that enable systematic evaluation and comparison of countries' capabilities in these critical areas [3,4].

The International Health Regulation (IHR) 2005 is a legal instrument developed by the World Health Organization (WHO) to enhance the ability of signatory states to manage public health risks. States Parties are required to establish minimum capacities for surveillance and response to public health events, and the effectiveness of the IHR depends on full adherence and compliance by all signatories. Implementation is reported by the States Parties and reviewed by the Director-General of the World Health Assembly. Countries use the e-SPAR tool for annual self-assessment reporting, which covers 35 indicators across 15 IHR capacities, each evaluated using 1 to 3 specific indicators and further detailed by additional attributes. Following the World Health Assembly each year, the e-SPAR questionnaire is distributed to facilitate multisectoral self-assessment and comprehensive data collection [5].

The GHS index assesses health security capabilities in 195 nations. It enhances global preparedness for epidemics by providing objective data that holds governments accountable for pandemic readiness investments, supports evidence-based policymaking for resource allocation, and establishes benchmarks for biosecurity and pandemic preparedness. The 2021 GHS index evaluated countries across 6 categories, 37 indicators, and 171 questions using publicly available data. By contextualizing health security within broader factors such as political stability, the Joint External Evaluation, and health system robustness the index promotes transparency regarding national deficiencies in outbreak response [6].

In developing countries, health security is a multifaceted issue that encompasses food security, global health threats, and the need for robust health systems [7,8]. These interrelated factors significantly influence both health outcomes and overall security. Although Indonesia, Cambodia, Vietnam, the Dominican Republic, and Ghana differ in geographic, economic, and sociopolitical contexts, they face similar challenges in strengthening their health security systems. In contrast, the Republic of Korea is recognized for its robust surveillance system and overall preparedness [9]. This

HIGHLIGHTS

- World Health Organization International Health Regulations capacities were generally low, with particular concerns about preparedness for chemical disasters, food safety, and cross-border infectious disease transmission.
- The study emphasized that surveillance capacity—as an internal factor (early warning and event management)—and the immunization indicator—as an external factor (vaccination rates for human and animal diseases, including the national vaccine delivery system)—are priority strategies for strengthening future prevention and detection systems.
- To effectively respond to global health threats, countries must focus on improving 2 technical areas (early warning and event management, and national vaccine access and delivery) using a One Health approach.

study aimed to evaluate and compare the health security and preparedness of Indonesia, Vietnam, the Dominican Republic, Cambodia, Ghana, and the Republic of Korea using e-SPAR and GHS index scores, with the goal of identifying key strengths and weaknesses and offering targeted recommendations to strengthen national preparedness and promote international collaboration for future health threats.

Materials and Methods

This study employed a comparative case study approach that integrated quantitative and qualitative analyses. Secondary data from e-SPAR (internal evaluation) scores and the GHS index (external evaluation) were used to assess health security and preparedness in 6 selected countries. The 2023 e-SPAR database was obtained from the WHO website [5] and filtered to include reports from 5 low- and middle-income countries (LMICs)—3 Southeast Asian countries (Indonesia, Cambodia, and Vietnam), 1 Latin American country (the Dominican Republic), and 1 African country (Ghana). The selection criteria focused on countries with a strategic partnership with the Republic of Korea in terms of Official Development Assistance and on those represented by students in the Yonsei University School of Medicine's Global Health Security Research Group. The Republic of Korea was included to represent a developed country, having achieved the No. 1 ranking in Bloomberg's final tally for coronavirus disease 2019 (COVID-19) resilience.

Average scores for each country were summarized using descriptive statistics, with the lowest scores based on capacities and indicators identified. The GHS index scores for the 6 countries were obtained from the 2021 GHS index report [6]. Descriptive statistics were then used to compare each country's scores in various categories against the global average.

A strengths, weaknesses, opportunities, and threats (SWOT) analysis was conducted for each of the 5 LMICs (Indonesia, Cambodia, Vietnam, the Dominican Republic, and Ghana) to assess their current status in health security and preparedness. Strengths and weaknesses were sourced directly from the WHO e-SPAR database (2023). Opportunities were identified by selecting indicators with a minimum score of 75 (reflecting the range of the country with the highest overall health security index score) from the 2021 GHS index report, while threats were determined by identifying indicators with a score of 0 (mirroring the range of the country with the lowest score). Common features present in at least 3 countries were then highlighted through a collective SWOT analysis. Finally, the characteristics of the developing countries were compared with those of the Republic of Korea, and recommended strategies were proposed based on this analysis.

Results

The study examined 6 countries: 4 from Asia, 1 from Africa, and 1 from Latin America (Table 1). Politically, the sample included 1 constitutional monarchy (parliamentary cabinet system), 4 republics (presidential systems), and 1 socialist republic (communist party system). Four countries had a

gross domestic product per capita below 5,000 United States dollars (USD), 1 had approximately 10,000 USD, and 1 had around 30,000 USD. Four countries had populations under 50 million, 1 had about 100 million, and 1 had approximately 300 million. Technically, the 2024 global innovation index information and communications technology scores were 95 in the Republic of Korea, 76.7 in Indonesia, 70.6 in Vietnam, 59.3 in the Dominican Republic, 51.4 in Ghana, and 49.9 in Cambodia.

The overall average scores for the 15 IHR implementation capacities in 2023 were 99, 75, 68, 56, 54, and 52 for the Republic of Korea, Indonesia, Cambodia, Ghana, Vietnam, and the Dominican Republic, respectively (Figure 1). Compared with the global average of 64, the scores for Indonesia, Cambodia, and the Republic of Korea were above average, whereas the other 3 countries remained below this threshold.

According to the 2021 GHS index report, the Republic of Korea, Indonesia, Vietnam, the Dominican Republic, Ghana, and Cambodia ranked 9th, 45th, 65th, 103rd, 104th, and 126th, respectively. Figure 2 details the overall average scores and the 6 pillars of health security (prevent, detect, respond, health, norms, risks) for these countries. Indonesia's overall score was 50.4, with the lowest score in the prevention category. The overall scores for Cambodia, Vietnam, the Dominican Republic, and Ghana were 31.1, 42.9, 34.5, and 34.3, respectively, with particularly low scores noted in the health system category.

Each country was analyzed individually using the SWOT framework, with the e-SPAR and GHS index data used to identify internal factors (strengths and weaknesses) and external factors (opportunities and threats) as shown in Figure 3. Common features observed in at least 3 countries

Table 1. PEST analysis of 6 countries

Country	Cambodia	Indonesia	Vietnam	Ghana	Dominican Republic	Republic of Korea
Politics	Constitutional monarchy/ parliamentary cabinet system	Republic/ presidential system	Socialist Republic/ communist party	Republic/ presidential system	Republic/ presidential system	Republic/ presidential system
Economy (GDP per capita, USD/ economic growth)	2,744 USD/5.5% (2024 IMF)	4,920 USD/5.0% (2023 IMF)	4,649.1 USD/6.1% (2024 IMF)	2,270 USD/4.7% (2022/2021 IMF)	10,581 USD/4.9% (2022 IMF)	33,121 USD/2.5% (2023/2024 IMF)
Society (population/main religion/climate)	17,180,000/ Buddhism/ Tropical Monsoon	278,700,000/Islam/ Tropical Monsoon	100,770,000/ Buddhism/ Tropical and Subtropical Monsoon	32,400,000/ Christianity/ Tropical	10,630,000 (2022 IMF)/Roman Catholicism/ Tropical	51,680,000 (2024 IMF)/Christianity/ four-season mid-latitude temperate
Technology (2024 GII ICT scores)	49.9	76.7	70.6	51.4	59.3	95.0

PEST, politics, economy, society, technology; GDP, gross domestic product; USD, United States dollar; IMF, International Monetary Fund; GII, global innovation index; ICT, information and communications technology.

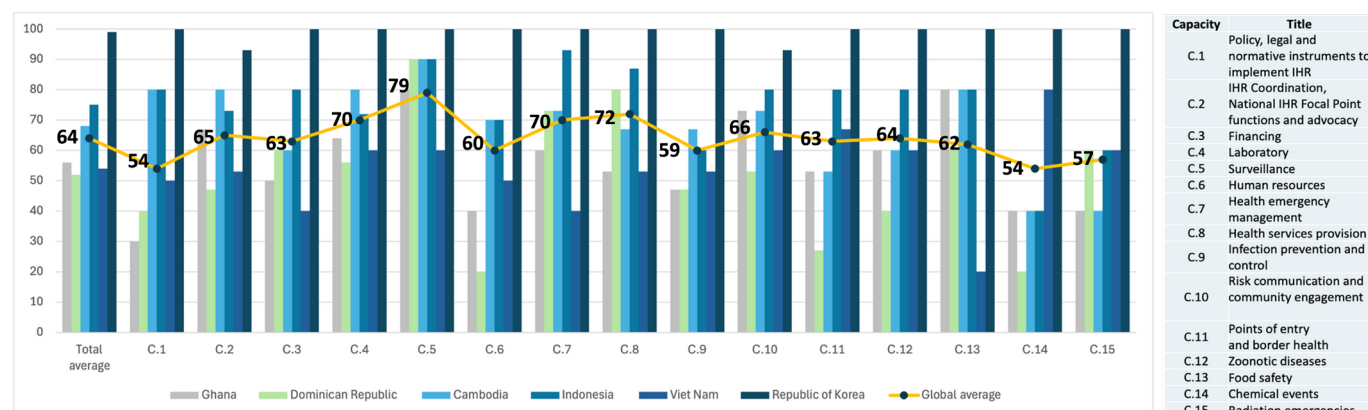


Figure 1. The International Health Regulations (IHR) electronic State Party Self-Assessment Annual Reporting mechanism scores for each capacity in 6 selected countries.

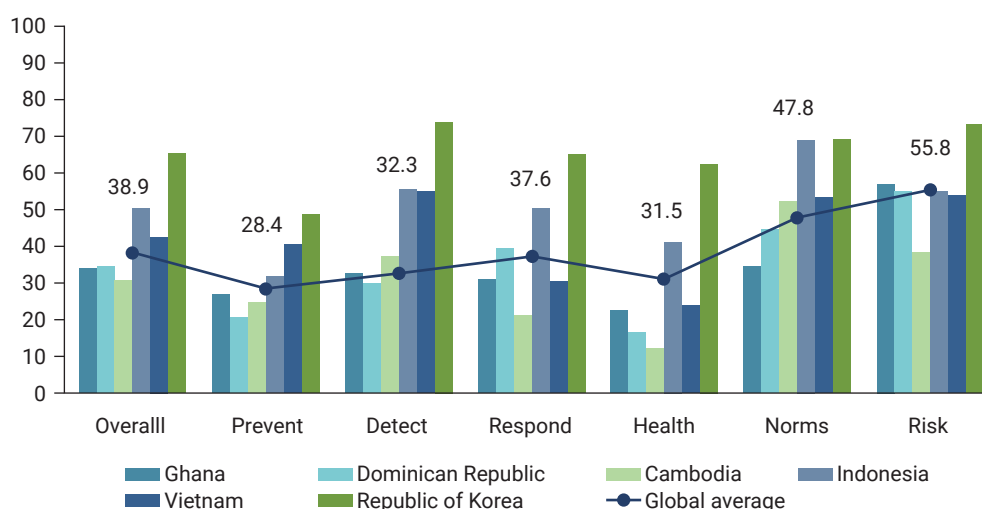


Figure 2. The global health security index scores of 6 selected countries.

were then highlighted in a collective SWOT analysis. Surveillance (early warning and event management) emerged as the primary strength across most countries. Common opportunities included international commitments and robust immunization programs. In contrast, many countries exhibited weaknesses related to policy, legal, and normative frameworks for IHR implementation, as well as challenges in human resources, chemical event management, and radiation emergency preparedness. Recurring threats involved biosafety, biosecurity, dual-use research and the culture of responsible science, infection control practices, coordination between public health and security authorities, vulnerabilities in laboratory supply chains, and communication issues with healthcare workers during public health emergencies (Figure 4).

Discussion

Figure 4 illustrates the main challenges and main strengths in every member state that submitted e-SPAR information to the WHO. The SWOT analysis of 6 countries found that common challenges in LMICs were policy, legal, and normative instruments to implement IHR, human resources, chemical events, and radiation emergencies, while common strengths were surveillance (early warning and event management). The GHS index (2021) was also analyzed for opportunities and threat analysis.

Based on the SWOT analysis, recommended strategies were developed to enhance GHS (Figure 5). Among these, strengthening surveillance (i.e., early warning systems and event management, which includes verification, investigation,

Indonesia		Cambodia		Vietnam	
Strengths - C7 Health emergency management - C5 Surveillance - C8 Health services provision - C1 Policy, legal and normative instruments to implement IHR	Weaknesses - C14 Chemical events - C9 IPC - C15 Radiation emergencies - C6 Human resources	Strengths - C5 Surveillance - C1 Policy, legal and normative instruments to implement IHR - C2 IHR coordination, national IHR focal point function and advocacy - C4 Laboratory	Weaknesses - C14 Chemical events - C15 Radiation emergencies - C11 PoEs and border health - C3 Financing	Strengths - C14 Chemical events - C11 PoEs and border health - C3 Financing - C5 Surveillance	Weaknesses - C13 Food safety - C3 Financing - C7 Health emergency management - C1 Policy, legal and normative instruments to implement IHR
Opportunities - AMR - Laboratory system, strength, and quality - Real-time surveillance and reporting - Linking public health and security authorities - IHR reporting compliance and disaster risk reduction - International commitments	Threats - Biosafety - Dual-use research and culture of responsible science - Infection control practices	Opportunities - Immunization - International commitments	Threats - Biosecurity - Biosafety - Dual-use research and culture of responsible science - Laboratory supply chain - Case-based investigation - Linking public health and security authorities - Trade and travel restrictions - Supply chain for health system and healthcare workers - Medical countermeasures and personnel development - Communication with healthcare workers during the public health emergencies - Infection control practices	Opportunities - Immunization - Laboratory system, strength, and quality - Epidemiology workforce - International commitments	Threats - Dual-use research and culture of responsible science - Laboratory supply chain - Linking public health and security authorities - Trade and travel restrictions - Communication with healthcare workers during the public health emergencies - Infection control practices

Dominican Republic		Ghana	
Strengths - C5 Surveillance - C8 Health services provision - C7 Health emergency management - C3 Financing	Weaknesses - C6 Human resources - C14 Chemical events - C11 PoEs and border health - C1 Policy, legal and normative instruments to implement IHR	Strengths - C5 Surveillance - C13 Food safety - C10 RCCE - C2 IHR Coordination, National IHR Focal Point functions and advocacy	Weaknesses - C1 Policy, legal and normative instruments to implement IHR - C6 Human resources - C14 Chemical events - C15 Radiation emergencies
Opportunities - Epidemiology workforce - Risk communication	Threats - Biosecurity - Dual-use research and culture of responsible science - Laboratory supply chain - Exercising response plans - Linking public health and security authorities - Supply chain for health system and healthcare workers - Medical countermeasures and personnel development - Communication with healthcare workers during the public health emergencies - Infection control practices - JEE and PVS	Opportunities - AMR - Immunization	Threats - Biosecurity - Biosafety - Dual-use research and culture of responsible science - Laboratory supply chain - Emergency preparedness and response planning - Linking public health and security authorities - Communication with healthcare workers during the public health emergencies - Infection control practices - Cross-border agreements on public and health emergency response

Figure 3. SWOT analysis of health security in 5 selected low- and middle-income countries using e-SPAR and GHS index. IHR, International Health Regulations; IPC, infection prevention and control; PoE, point of entry; JEE, Joint External Evaluation; PVS, Performance Veterinary Service; SWOT, strengths, weaknesses, opportunities, and threats; e-SPAR, electronic State Party Self-Assessment Annual Reporting mechanism; GHS, global health security.

Common features of the 5 LMICs		Republic of Korea	
Strengths - C5 Surveillance	Weaknesses - C1 Policy, legal and normative instruments to implement IHR - C6 Human resources - C14 Chemical events - C15 Radiation emergencies	Strengths - C1 Policy, legal and normative instruments to implement IHR - C3 Financing - C4 Laboratory - C5 Surveillance	Weaknesses
Opportunities - Immunization - International commitments	Threats - Biosafety - Biosecurity - Dual-use research and culture of responsible science - Infection control practices - Linking public health and security authorities - Laboratory supply chain - Communication with healthcare workers during the public health emergencies	Opportunities - AMR - Real-time surveillance and reporting - Surveillance data accessibility and transparency - Epidemiology workforce - Emergency preparedness and response planning - Linking public health and security authorities - Risk communication - Access to communications infrastructure - Health capacity in clinics, hospitals, and community care centers - Infection control practices - Capacity to test and approve new medical countermeasures - IHR reporting compliance and disaster risk reduction - International commitments - Financing - Socio-economic resilience - Infrastructure adequacy - Public health vulnerability	Threats - Dual-use research and culture of responsible science - Trade and travel restrictions

Figure 4. SWOT analysis of health security in low- and middle-income countries and Republic of Korea. LMIC, low- and middle-income country; IHR, International Health Regulations; AMR, antimicrobial resistance; SWOT, strengths, weaknesses, opportunities, and threats.

Internal External	Strengths	Weaknesses
	SO strategy	WO strategies
Opportunities	1. Surveillance through global cooperation - S: C5 Surveillance - O: International commitments	1. Policy and legal frameworks through international commitments - W: C1 Policy, legal and normative instruments to implement IHR - O: International commitments 2. Human resources with international support - W: C6 Human resources - O: International commitments
Threats	ST strategies Surveillance to support biosafety and biosecurity - S: C5 Surveillance - T: Biosafety; Biosecurity Supporting infection control practices through surveillance - S: C5 Surveillance - T: Infection control practices	WT strategies Human resources for infection control and communication - W: C6 Human resources - T: Infection control practices; Communication with healthcare workers during the public health emergencies Policies for biosecurity and biosafety - W: C1 Policy, legal and normative instruments to implement IHR - T: Biosecurity; Biosafety; Dual-use research and culture of responsible science Emergency preparedness to address chemical and radiation threats - W: C14 Chemical events; C15 Radiation emergencies - T: Biosecurity; Biosafety; Dual-use research and culture of responsible science Coordination between public health and security authorities through policies - W: C1 Policy, legal and normative instruments to implement IHR - T: Linking public health and security authorities

Figure 5. Recommended strategies based on SWOT analysis. SWOT, strengths, weaknesses, opportunities, and threats.

analysis and dissemination of information) through global collaboration emerged as the most promising strength-opportunity strategy for the 5 LMICs. This strategy is critical for managing transboundary diseases that affect human, animal, and environmental health. Integrating surveillance efforts across borders can lead to more efficient resource use, improved preparedness, and a robust response to emerging threats. Nevertheless, implementing such cooperative strategies poses challenges, including the uneven distribution of costs and benefits among participating countries. Global cooperative surveillance can optimize efficiency and resource allocation, with international partnerships enhancing the capacity to detect and respond to health events [10]. Moreover, global surveillance networks—such as the Global Public Health Intelligence Network and HealthMap—play crucial roles in informing both national and transnational practices [11]. Organizations like Connecting Organizations for Regional Disease Surveillance also highlight the importance of trust-based networks for sharing best practices and innovations in disease surveillance [12]. Enhanced surveillance supports biosafety, biosecurity, and infection control by providing early detection, situational awareness, and data-driven decision-making. Integrating advanced technologies and methodologies is essential to confront the growing challenges posed by emerging infectious diseases, bioterrorism, and the global movement of people and goods.

Surveillance was found to be a main strength in the Republic of Korea, as shown by a perfect score from e-SPAR capacity and a high score in the Detecting and Reporting category of the GHS index. This performance is particularly notable in real-time One Health surveillance, reporting indicators, and data accessibility and transparency. The Republic of Korea's health surveillance system, which is an advanced framework designed to monitor and manage public health threats effectively, integrates traditional surveillance methods with cutting-edge digital tools to enhance its capabilities in disease detection, monitoring, and response. For instance, its sentinel surveillance system for Hand, Foot, and Mouth Disease (HFMD), operational since 2009 in approximately 100 pediatric clinics nationwide, is crucial for tracking incidence trends and informing public health planning [13]. Additionally, the Korean National Healthcare-associated Infections Surveillance System has significantly reduced central line-associated bloodstream infection rates across intensive care units, demonstrating the system's effectiveness in infection control [14]. During the COVID-19 pandemic, the Epidemiological Investigation Support System leveraged big data from cellular base stations, credit card transactions, and QR codes to track infected individuals, enhancing the speed and accuracy of epidemiological investigations [15]. The National Health Insurance Claims-based Surveillance further complements conventional

methods by using claims data to monitor disease incidence, thereby providing a stable measure of disease trends with fewer limitations than traditional reporting systems [16]. The Republic of Korea's comprehensive surveillance system represents a best practice that developing countries could adopt to improve their One Health approach.

Some limitations of this study should be acknowledged. Although e-SPAR provides the most recent official data reported directly to WHO headquarters to describe internal factors, and the GHS index offers current external evaluations, both data sources may not fully capture the present situation. Moreover, due to the challenges of assessing all 195 countries, the SWOT analysis based on these 6 countries may not be generalizable worldwide. Future studies should also investigate the underlying causes of the identified weaknesses and threats.

Conclusion

The SWOT analysis, based on e-SPAR and GHS index scores for Indonesia, Cambodia, Vietnam, the Dominican Republic, and Ghana, indicates that countries should prioritize enhancing surveillance capacity (including early warning functions and event management encompassing verification, investigation, analysis, and information dissemination) as an internal success factor, and improving the immunization indicator (encompassing vaccination rates for human and animal diseases and the national vaccine delivery system) as an external success factor. Consequently, nations should concentrate on 2 technical areas: early warning and event management, and national vaccine access and delivery.

Global collaboration—through building trust-based networks with developed countries such as the Republic of Korea, which possesses a comprehensive government surveillance system and immunization ecosystem that includes the International Vaccine Institute—can facilitate the sharing of best practices.

Notes

Ethics Approval

The informed consent was waived because of the retrospective nature of this study.

Conflicts of Interest

Chashin Chu has been the managing editor of *Osong Public Health and Research Perspectives* since October 2011. The other authors have no conflicts of interest to declare.

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Availability of Data

The datasets generated and/or analyzed during the current study are available in the WHO repository, <https://extranet.who.int/e-spar/> and the GHS index repository, <https://ghsindex.org>.

Authors' Contributions

Conceptualization: MY, NF, OKA; Data curation: NF, TLNN, DIJB; Formal analysis: all authors; Investigation: all authors; Methodology: MY, NF, OKA; Project administration: NF, VP; Supervision: MY, CC; Validation: CC; Visualization: NF, MY; Writing—original draft: NF, MY; Writing—review & editing: all authors. All authors read and approved the final manuscript.

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