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Strengthening cross-regional networks: evaluation of Indonesia's national Early Warning Alert and Response System by field epidemiology training programmes from Indonesia and Japan, 2023

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The field epidemiology training programmes (FETPs) in Indonesia and Japan conducted a joint evaluation of surveillance by Indonesia's national Early Warning Alert and Response System (EWARS) in 2023. This effort was carried out under the supervision of the Indonesian Ministry of Health and in collaboration with the Japan International Cooperation Agency (JICA) EWARS Project. This collaborative activity underscored the importance of cooperation among FETPs to facilitate knowledge-sharing and network-strengthening. This report provides an overview of the joint project, highlighting key insights from the activity.

As of 2023, 98 FETPs have trained public health staff across more than 200 countries and territories.[1] These programmes are primarily designed to develop in-country human resources to strengthen public health systems. Recent evidence highlights the contributions of FETP trainees and alumni in enhancing the workforce's capacity for epidemiology and improving public health emergency infrastructure, particularly through their involvement in COVID-19 preparedness and response activities in different countries.[2] The COVID-19 pandemic further underscored the necessity of strengthening networks across countries and regions to ensure global health security.

While the content of the FETPs is tailored to the specific circumstances of each country, most are modelled on the Epidemic Intelligence Service, established in 1951 by the United States Centers for Disease Control and Prevention (CDC).[3] Additionally, the Training Programs in Epidemiology and Public Health Interventions Network (also known as TEPHINET), the

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Table 1. **Summary of the criteria for evaluating the Indonesian Early Warning Alert and Response System's surveillance for dengue fever and measles, 2023**

Criteria	Disease	
	Dengue fever	Measles
Case definition in Indonesia's Early Warning Alert and Response System	Sudden high fever (≥39 °C) lasting for 2 to 7 days without an obvious cause, accompanied by symptoms such as nausea, vomiting, headache, retro-orbital pain, joint pain and the presence of bleeding (e.g. positive tourniquet test)	Any case with minimal symptoms that include fever and a maculopapular rash
Public health importance	• Potential threat of massive outbreaks • High disease burden in Indonesia	• Highly contagious and potentially fatal • Vaccine-preventable disease targeted for elimination
Surveillance system objective	Monitor disease trends	Provide timely alerts to relevant sectors to carry out a rapid response
Purpose of evaluation	Identifying dengue cases primarily based on signs and symptoms can be challenging. The surveillance system was evaluated to gain a better understanding of the detection and reporting processes for dengue fever, including for both suspected and confirmed cases.	Every case initially suspected of being measles necessitates an epidemiological investigation along with laboratory confirmation. The surveillance system was evaluated to understand how effectively the alert mechanism enhances the quality of subsequent public health responses.
Evaluation question	To what extent do reports on dengue fever in the System capture trends in dengue fever?	To what extent does the alert in the System contribute to response activities aimed at controlling measles outbreaks?
Selected attributes	• Simplicity • Data quality • Representativeness • Positive predictive value	• Data quality • Timeliness • Acceptability

global network of FETPs, set standards for activities and deliverables within the curriculum, supporting the delivery of quality training.[4] Among the programme's components, the evaluation of surveillance activities or systems is one of the core epidemiological practices. The standard guidelines for this type of evaluation, developed by the CDC, have been adopted by various FETPs,[4–6] including FETP Indonesia and FETP Japan. Using this shared methodology, these two FETPs collaboratively evaluated Indonesia's EWARS.

EWARS, a web-based syndromic surveillance system established in Indonesia in 2009, aims to facilitate the early detection of public health events to enable a prompt response.[7,8] It monitors 24 types of diseases and syndromes through indicator-based surveillance, and issues weekly reports. The system operates across four hierarchical levels, from the national level down to the provincial, district and subdistrict levels, with Puskesmas (public health centres) serving as the primary reporting units at the subdistrict level. Aggregated data are transmitted weekly, primarily from reporting units to the national server via short message service (also known as SMS).[7,8] The EWARS database, administered by the Ministry of Health, includes aggregated weekly case counts sorted by disease type and reporting source for indicator-based surveillance.

Twelve alumni and facilitators from FETP Indonesia, representing six public universities that offer the Programme, participated in the collaborative project alongside four alumni from FETP Japan, who were dispatched by Japan's National Institute of Infectious Diseases. Necessary preparations were made in accordance with the CDC's guidelines for evaluating public health surveillance systems.[5] First, a concept note was created by the participants to clarify the background, purpose, assessment methods and target diseases for the evaluation. Dengue fever and measles were selected as the evaluation targets, and the criteria used in the assessment are outlined in **Table 1**. Second, standardized questionnaires for data collection were collaboratively developed for each disease in both English and Indonesian. These questionnaires included attribute-

based questions for qualitative analysis and indicators for quantitative analysis. Data were collected from face-to-face interviews with relevant surveillance officers and from EWARS and other surveillance databases. Informed consent was obtained from all respondents, and no personally identifiable information was collected.

Evaluation of the surveillance system was conducted from 6 November to 15 December 2023 in all three target provinces of the JICA EWARS Project (Banten, East Kalimantan and South Sulawesi), with each province assessed for 2 weeks. During the first week, the joint teams visited one provincial health office, two district health offices and four Puskesmas. They used the questionnaire to conduct interviews with surveillance officers, primarily in Indonesian, facilitated by the FETP Indonesia project members. A wrap-up session was held on the final day of the first week to share findings and challenges among all team members. During the second week, project members collaborated online to analyse quantitative and qualitative data and summarize the results. On the final day of the project, the findings, along with joint recommendations, were presented at an online seminar attended by more than 70 participants from national and local government agencies. Additionally, the joint evaluation activity was showcased at the 11th National Scientific Conference on Epidemiology in Indonesia in August 2024.

This collaboration, which used the standardized evaluation framework developed by the US CDC and shared by both FETPs, provided valuable insights, especially for the non-host FETP. FETP Japan alumni gained a better understanding of common reporting challenges related to notifiable syndromes in both Indonesia's EWARS and Japan's National Epidemiological Surveillance of Infectious Diseases (NESID) system. For instance, while laboratory confirmation for dengue fever is not required by Indonesia's EWARS (**Table 1**), some Puskesmas reported dengue cases that were positive only by rapid diagnostic test (RDT). This misunderstanding of the case definition may reflect the influence on staff members' reporting behaviour of the widespread availability of RDTs for dengue at the evaluated sites. A similar pattern has been observed in Japan's NESID for surveillance of infuenza-like illness, in which cases diagnosed with RDTs predominate, along with some clinically diagnosed cases.[9,10] As a result, mutual understanding through the joint evaluation fostered a robust relationship between FETPs in Indonesia and Japan, paving the way for future collaboration.

Implementing the joint evaluation revealed several challenges. First, bidirectional translation between English and Indonesian, particularly during the development of questionnaires and interviews, posed difficulties in terms of maintaining the accuracy of information. However, close communication among project members helped address this issue. Second, a knowledge gap emerged due to the different backgrounds of alumni from the two FETPs. However, involving individuals familiar with the surveillance systems of both countries facilitated smoother discussions and operations, thereby enhancing the joint evaluation. Specifically, JICA project members played a crucial role in overcoming this challenge. Third, the joint evaluation of the surveillance system required participants to possess a certain level of skills and knowledge, setting high expectations for FETP trainees and resulting in all participants being either alumni or facilitators. However, in the future, once a project's framework and methodology are clearly established, FETP trainees with relevant domestic experience could also participate in joint projects with technical support from senior FETP alumni. Additionally, participation in overseas projects has been reported to help trainees develop interpersonal skills in international settings, and these are often challenging to acquire through domestic training.[11] Lastly, securing FETP budgets for international networking is essential for promoting collaborative activities.

This report shares the experiences of a joint evaluation of the Indonesian EWARS, which utilizes an evaluation framework prevalent among FETPs worldwide. This model can be applied to FETPs in other countries to strengthen the global network through collaborative activities. Therefore, this experience could serve as a meaningful milestone and model, particularly given the growing need for enhanced global networking to improve global health security.

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Conflicts of interest

The authors have no conflicts of interest to declare.

Ethics statement

Formal ethical approval was waived because this project was conducted as part of surveillance activities under Indonesian Act No. 17 (2023) and Regulations of the Minister of Health No. 949 (2004) and No. 45 (2014). Standard procedures to protect personal information were implemented. Permission to implement and publish information about the project was obtained from the Indonesian Ministry of Health.

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Emergency medical team reclassification in WHO's Western Pacific Region: continuous learning and improvement of health emergency response capacities

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Emergency medical teams (EMTs) are groups of self-sufficient and equipped health professionals who deploy in a structured and coordinated manner in response to emergencies with health consequences. EMTs may be hosted by governments, nongovernmental organizations, private companies, academia, militaries, or through the International Red Cross and Red Crescent Movement.[1–3]

Since 2013, with the initial publication of the *Classification and minimum standards for foreign medical teams in sudden onset disasters* and the subsequent 2021 publication of the updated *Classification and minimum standards for emergency medical teams* (both known as the EMT Blue Book), the World Health Organization (WHO) has worked with Member States, organizations and partners to establish and apply common principles and core standards for medical teams around the world engaging in health emergency response.[1,2] The recently published *Emergency Medical Teams 2030 Strategy* set ambitious targets, including enhancing quality-assurance mechanisms for both national and international EMTs.[4]

EMTs pursue quality assurance through a structured mentoring and peer review process, culminating in verification and classification.[2] As of 31 May 2025, 55 EMTs from all six WHO regions had successfully achieved classification, including 17 EMTs from WHO's Western Pacific Region, with more than 15 EMTs from the Region pursuing classification.[3,5,6] EMT classification is valid for 5 years, after which a team must undergo reclassification.[2]

In 2022, the EMT Strategic Advisory Group (SAG) endorsed *The reclassification cycle for emergency medical teams*, a guidance document for reclassification of EMTs (unpublished), which was developed by a global EMT Reclassification Technical Working Group. Designed to be less intensive than the initial classification process, EMT reclassification involves a team confirming its continued interest in classification through submission of a "re-engagement" form and an "improvement dossier" detailing the EMT's deployment history and improvements made since initial classification. This process ensures the quality of health services during emergencies and actions taken to meet the standards and recommendations introduced in the 2021 EMT Blue Book.[2,5] A key element of the quality assurance is peer feedback provided by the verification team to the EMT during the initial classification visit, which is reviewed as part of reclassification. EMTs pursuing reclassification may request a mentor to be appointed from a WHO-classified EMT to guide them through the process. Allocated mentors may be a designated and trained EMT mentor or may be a senior member of a WHO-classified EMT with demonstrable experience with the classification/reclassification process.

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Following the submission of the improvement dossier, EMTs undergo an online desk review to present their continued compliance and improvements made following classification. The external verification team is composed of WHO headquarters and/or regional EMT focal points, as well as external peer reviewers from classified EMTs. Following the online desk review, a 1-day in-person site visit is conducted at a team's physical EMT base/camp to inspect the EMT's continued compliance with published minimum standards, lessons learned through their work in the 5 years following classification, and improvements made (**Table 1**). At the end of the reclassification visit, the panel may conclude that an EMT should be reclassified for an additional 5 years or recommend a re-evaluation 6 months later if deficiencies are identified. A site visit may also take place during an EMT deployment as part of an emergency response. In this scenario, the EMT must be deployed in the full capacity for which it was classified (such as an EMT Type 2 deployment for a Type 2 reclassification). This option does not alter the reclassification requirements but instead rearranges the steps, allowing the EMT to undergo quality assurance while deployed, followed by a desk review later.

ACTIONS

By the end of 2024, 10 of the 16 classified EMTs from the Region were due for reclassification. During the COVID-19 pandemic, the EMT SAG granted an extraordinary 2-year extension to mitigate the disruptions caused by the pandemic, ensuring that EMTs remained operational and recognized within the global classification framework.

Western Pacific Region EMTs due for reclassification by the end of 2024 included:

- Japan Disaster Relief (JDR) EMT following classification in 2016;
- five China International EMTs following classification in 2016 (1), 2017 (1), 2018 (1) and 2019 (2);
- Australian Medical Assistance Team (AUSMAT) following classification in 2016;
- New Zealand Medical Assistance Team (NZMAT) following classification in 2017;
- Aspen Medical following classification in 2018; and
- Fiji Emergency Medical Assistance Team (FEMAT) following classification in 2019.

As of 31 May 2025, four of these EMTs – AUSMAT, FEMAT, JDR and NZMAT – had completed the above process. An online desk review was held for the China International EMT (Shanghai) in July 2024, and the in-person visit for this reclassification is expected in 2025. The desk review for the China International EMT (Sichuan) is tentatively scheduled for the second half of 2025. The China International EMT (Macao) is currently preparing for reclassification in 2026. Other EMTs in the Region have initiated the reclassification process.

All four of the reclassified EMTs have deployed since their initial classifications.[5] The reclassification visits for AUSMAT and NZMAT included observers from regional EMTs. A hybrid approach was applied for FEMAT's reclassification visit, with the EMT secretariat from the WHO Regional Office for the Western Pacific participating online while WHO country office personnel and peer reviewers joined in person. This led to significant cost savings, reducing international travel for reclassifications.

Reclassification also allows for the field visit to take place during a real emergency deployment, local conditions permitting. This approach was tested in February 2023 during the Türkiye earthquake response, where JDR, along with EMTs from Italy and Spain, successfully underwent a reclassification field visit while their full EMT Type 2 was deployed. Following the field visit in February 2023, JDR completed the submission and online desk review of the EMT's improvement dossier in November 2023. Peer reviewers for the online desk review were from the Italian EMT Type 2 from Regione Piemonte and the global and Western Pacific regional EMT secretariats. This approach, considered a pilot, was subsequently approved by the EMT SAG in October 2023 for future reclassifications (unpublished).

OUTCOMES

Three EMTs in the Western Pacific Region were successfully reclassified in 2023: AUSMAT, JDR and NZMAT; FEMAT completed reclassification in March 2025.[5] All four teams completed the requirements for reclassification and demonstrated high levels of compliance with the EMT guiding principles and standards, as well as extensive improvements since their initial classifications. Through this process, EMTs continue their engagement with the EMT network and maintain strong ongoing commitments to quality care in emergencies.

Table 1. **EMT capabilities reviewed through the reclassification process**

Operational area	Specific area
EMT capacity and capability	Rapidly deployable temporary shelter, outpatient clinic and inpatient facility
	Recognized triage system for emergency and surgical care, including acute medical and obstetric conditions
	Basic/advanced life support
	Capable of a safe uncomplicated delivery with midwifery-level care
	Emergency caesarean section and surgical care[a]
	Patient registration and unique patient-identification system in place
	Temporary isolation capability
	Privacy and confidentiality maintained within the facility
	EMT fully staffed with the right technical skill sets and staffing ratios for the type of EMT
Operating theatre[a]	Surgical documentation available and in use
	Lighting system sufficient to visualize deep intra-abdominal area
	Backup power supply
	Cold chain and drug control including locked drug storage
	Adult and paediatric anaesthesia care
	Emergency surgical (including obstetrics and gynaecological) care
	Reconstructive and specialist surgical care
	Appropriate climate and vector control measures within the operating theatre area
	One-way movement system of surgical instruments and medical devices from contaminated to clean areas for sterilization (i.e. operating theatre to sterilization area)
	Standard operating procedure and available equipment for the reversal of sedation
Technical services	Sterilization
	X-ray (+/–) ultrasound[a]
	Capable of point-of-care and basic rapid detection tests
	ABO and Rh screening[a]
	Walking blood bank (or equivalent) compliant with WHO guidelines for the selection, screening and administration of donor blood[a]
	Documented record of surgical sterilization and traceability procedures[a]
	Appropriate radiation control measures in place to mitigate time/distance and shielding (i.e. provision of appropriate lead shielding and personal dosimeters; a cordoned-off safety area surrounding the X-ray tent, adequate signage, etc.)[a]
	X-ray procedures in compliance with standards of justified practice (i.e. clear record of requests, rationale and reporting in the patients notes)[a]
	Appropriate laboratory equipment and consumables available, with quality assurance to undertake a walking blood bank or alternative[a]
	Appropriate blood donor screening, testing, donation and administration procedures (i.e. clear record of processes noted in patient and donor notes) in place[a]
	Standard operating procedure in place in case of blood transfusion reactions[a]
Pharmacy	Stock within expiry date, medications are labelled (in local language, where possible) and individually dispensed with authorized prescription
	Cold chain/equipment compliance
	WHO essential medication list or equivalent (national)
	A register for scheduled/controlled substances and dispensing is maintained
	Pharmacy stock control system in place
	Daily record (ideally twice a day) of external and internal temperature of the pharmacy
	Reporting procedure in place to manage medication errors

Operational area	Specific area
Referral capacity	Ability to identify and manage referrals to higher/lower levels of care
	Methods of transfer/transport are identified for referral cases
	Available equipment and consumables to support patient transfers
	Referral form available and in use
	Review completeness and accuracy of referral forms (reviewers should indicate the specific forms and the number reviewed)
Medical records and reporting	System to maintain confidential, individual patient records/reports on a regular basis
	Regular reporting using identified national or international reporting format (i.e. Minimum Data Set/MDS)
	There is a unique system to identify and verify patient's identity
	EMT has a paper-based, or paper and electronic, or just electronic-based medical records system in place, with a backup mechanism, if required
	Appropriate data and patient records management, i.e. safe and secure storage of patient records
	Indicate which/how many documents were reviewed
Waste management	Waste management system to ensure patient, staff and community safety, including segregation, handling, treatment and disposal
	Safe handling and disposal of sharps
	Waste management area demarcated/fenced
	EMT uses a segregated coloured-coding system for waste management
	EMT staff use personal protective equipment in handling waste
	Note what waste treatment and disposal system is used
	Note the measures the EMT takes when a needle-stick/sharps injury is reported
	Note use of an incinerator and specify type
Water, hygiene and sanitation	Adequate quantities of safe drinking water available
	Adequate quantity and quality of water to cover handwashing, personal hygiene, cleaning and laundry needs
	Adequate number of toilets and showers for patients and staff (minimum 2 per 100 outpatients and 2 per 20 inpatients)
	Handwashing stations available in all key areas of the facility
	Number of litres of water/day
	Total water storage capacity
	Water treatment plan (filtering, sedimentation, chlorination, flocculation and/or other)
	Proof of water testing and treatment regimens undertaken
	Number of toilets per patient
	Disabled access to toilet facilities
	Number of toilets/staff
Self-sufficiency	Shelters: adequate number of shelters available to provide safe and secure working and living conditions for team members and patients
	Power: capacity to provide power to all required sources, and suitable lighting sources available for a safe working environment
	Communication: emergency communication available, such as BGAN, high-frequency radio, satellite phone, mobile phone
	Climate appropriate shelter system is used and able to maintain comfortable internal operating temperatures
	Fuel is stored safely and has a supporting hazard management plan
	Note the fleet and management system in place

ABO: A positive and negative blood types, B positive and negative blood types, AB positive and negative blood types, O blood type; BGAN: Broadband Global Area Network; EMT: emergency medical team; Rh: Rhesus positive and negative blood types; WHO: World Health Organization.

[a] Only applies to Type 2 or Type 3 EMTs, although, as per the 2021 Blue Book, ultrasound may be used to aid in diagnosis where appropriately trained/skilled clinicians are available.

During all of these reclassification exercises, EMTs demonstrated how learning through initial classification and deployment experiences led to improvements that benefit patients in emergencies. Reclassified EMTs presented strengthened capacities in both technical and operational areas. AUSMAT substantially enhanced their ability to deliver oxygen to hospitalized patients and expanded their rehabilitation capacity, building on lessons from the 2019 Samoa measles outbreak and COVID-19 responses.[5,7] All EMTs also showed improved logistics capacities, such as more robust tents, improved temperature controls, and expanded and more reliable systems for water, sanitation and hygiene. One reclassified EMT, while demonstrating redundant communications capabilities, continued to struggle with administrative hurdles to maintain satellite communications subscriptions.[8] Following the reclassification visits, all EMTs receive reports highlighting strengths and areas for improvement, which will serve as a point of reference in future 5-yearly reclassification exercises.

The process of reclassification helps to maintain strong engagement between the EMTs and the WHO secretariat and reinforces peer-to-peer support through mentoring, peer review and shared commitment to continuous improvement. Through reclassification, all four EMTs demonstrated continuous compliance with published EMT standards and received recommendations from reviewers on further opportunities for improvement.

DISCUSSION

The EMT classification and reclassification processes aim to ensure that populations affected by emergencies receive timely, high-quality and safe care, and that countries requesting and receiving international EMTs have predictability and confidence in the deploying teams. Through the EMT reclassification process, AUSMAT, FEMAT, JDR and NZMAT demonstrated strong commitments to upholding EMT principles and standards and reflected strong commitments to continuous improvement and innovation.

The experience of EMT reclassification in the Western Pacific Region demonstrates the value of continued quality assurance, peer review and commitments to continuous learning and improvement among EMTs. The reclassification process, which was designed to be "lighter" than the initial classification, can also be flexible in the sequencing of steps, as seen by JDR undergoing a field visit during deployment, and FEMAT piloting a hybrid verification team for their site visit with the virtual presence of the regional WHO EMT secretariat. The EMT SAG and secretariat aim to continue refining these processes to reduce costs and enhance flexibility while ensuring continued quality assurance. Additional research, reflection and publication by individual teams on their own reclassification processes would serve as valuable additions to the literature on EMTs and health emergency preparedness and response.

By regularly reviewing continued compliance with WHO-EMT standards, countries can enhance their capacities to provide emergency health care that aligns with local clinical protocols, integrates with local health systems and works towards greater interoperability between medical and public health capacities.[4–6,9,10]

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Conflicts of interest

STC, KW and JEL are associate editors of the *Western Pacific Surveillance and Response* journal. They were not involved in the editorial decision to publish this article. The other authors have no conflicts of interest to declare.

Ethics statement

Ethical clearance was not required for this report.

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Psychological resilience among emergency medical teams in Singapore

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Problem: Emergency medical teams (EMTs) responding to mass casualty incidents attend to casualties in a chaotic, high-pressure and resource-limited environment that is vastly different from their day-to-day work. The nature of mass casualty incidents and the work environment can impact psychological resilience, but the psychological resilience of members of EMTs has not been evaluated.

Context: In Singapore, EMTs are deployed from public hospitals, polyclinics and the Singapore Red Cross to disaster sites, where they triage, stabilize and treat casualties before evacuating them to public hospitals for further management.

Action: Twenty-four members of EMTs responded to a cross-sectional survey based on a psychological resilience tool developed for health-care rescuers involved in mass casualty incidents to evaluate their psychological resilience after a full-scale exercise involving an aviation accident. Respondents completed a psychological resilience tool that was developed by experts in disaster work and research using a modified Delphi approach. There were 27 items across eight domains: optimism, altruism, preparations for disaster rescue, social support, perceived control, self-efficacy, coping strategies and positive growth.

Outcome: The key observations from the survey were that (i) staff demonstrated a strong sense of altruism and had good social support; (ii) staff were not confident about their preparedness, and this led to a lack of optimism, perceived control and ability to deal with emotions; and (iii) it was necessary for respondents to reflect on their experience to find meaning to support growth after the deployment.

Discussion: Optimizing casualty survival and outcomes during mass casualty incidents requires not only excellent procedural training and robust standard operating procedures and work processes but also dedicated efforts to enhance the psychological resilience of members of EMTs.

PROBLEM

Health-care professionals are known to have higher risks of mental illness, substance abuse and suicide compared with the general population.[1] This is attributed to their continual exposure to high-pressure environments and elevated levels of stress at work. Psychological resilience, defined as the ability to mentally and emotionally adapt to adversity, is crucial in maintaining personal and professional well-being, thereby protecting against occupational burnout and post-traumatic stress disorder.[2,3]

There is increasing awareness that health-care professionals experience a variety of psychological consequences when responding to mass casualty incidents (MCIs), in which the number of casualties can overwhelm health-care resources and make it challenging to treat every person.[4] For instance, health-care professionals responding to outbreaks of Ebola virus disease experienced significant psychological distress.[5] Similarly, health-care professionals responding to disasters face considerable mental health challenges, including burnout and post-traumatic stress disorder, which can persist long after the event.[6] The literature

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highlights the necessity for psychological resilience in members of emergency medical teams (EMTs) to help them maintain their performance under extreme conditions.

EMTs must fulfil their roles and responsibilities in unfamiliar environments or potentially hazardous settings that are significantly different from their usual workplace. They also need to deliver care while following standard operating procedures related to medical operations and communications, which may be unfamiliar to them. As such, the nature of MCIs coupled with unfamiliarity with the work environment and work processes can negatively influence the well-being of members of EMTs and impact their response at a disaster site.

While numerous studies have looked at psychological resilience among health-care workers in the hospital setting, notably during outbreaks of diseases such as Ebola virus disease and COVID-19, very few studies have looked specifically at psychological resilience in members of EMTs responding to MCIs.[4–7] Hence, this study aimed to evaluate psychological resilience among members of EMTs deployed to MCIs in Singapore.

CONTEXT

During MCIs, the Singapore Civil Defence Force, an emergency medical service, activates EMTs from public hospitals, polyclinics and the Singapore Red Cross and directs them to a designated area at the disaster site, where casualties are triaged, stabilized and treated before being evacuated to public hospitals for further management.

To prepare for disaster response, EMTs undergo a 1-day Disaster Medical Responder's Course, which covers disaster response operations and processes; roles and responsibilities; command, control and communications; as well as supplies and resources. The goal is to enhance EMTs' preparedness and operational readiness so that they can perform effectively at a disaster site and optimize outcomes for casualties.

Although psychological resilience is recognized as an important element of disaster preparedness and operational readiness, the curriculum of the Disaster Medical Responder's Course includes only one learning outcome related to it, and this focuses on describing psychological support for members of EMTs. This content is delivered through a single didactic lecture covering self-preparation, recognizing emotions and stress reactions, and providing support for oneself and colleagues.

The limited emphasis on psychological resilience in EMT training may leave members of the teams inadequately prepared to manage the intense psychological demands of a disaster response. Without structured training to strengthen their psychological resilience, members of EMTs may struggle with decision-making and emotional regulation, and sustain long-term impacts on their psychological well-being. These could potentially affect the overall effectiveness of their response efforts during MCIs.

ACTION

To determine whether improvements or modifications to psychological resilience training during the Disaster Medical Responder's Course are necessary, we conducted a cross-sectional survey to evaluate the pschological resilience of members of EMTs. The findings will help identify gaps in training so that these may be addressed by incorporating specific content into the curriculum, such as training modules, practical exercises or workshops related to psychological resilience.

The survey was conducted on 30 January 2024, immediately after a full-scale exercise. The scenario involved an aircraft mishap during a flying display, resulting in a crash among spectators. The casualties were simulated with the use of standardized patients and high-fidelity mannequins with moulage. Four EMTs – three from public hospitals and one from the Singapore Red Cross – were deployed and worked closely with the Incident Manager and paramedics from the Singapore Civil Defence Force to manage casualties at the disaster site.

The survey was based on a psychological resilience tool for health-care rescuers involved in MCIs that was developed by Mao et al. using a modified Delphi approach, which included experts in disaster work and research.[8] This tool was the first devised to measure psychological resilience during MCIs. The tool consists of 27 items measured across eight domains: optimism (O), altruism (A), preparations for disaster rescue (P), social support (SS), perceived control (PC), self-efficacy

(SE), coping strategies (CS) and positive growth (PG). Respondents rated each item on a 5-point Likert scale. Information about demographics, work experience and training for MCIs, as well as experience with exercises or actual MCIs was also collected.

OUTCOME

The survey targeted all 32 members of the four EMTs, and 24 (75%) completed it. Among the respondents, the median age was 33 years (interquartile range [IQR]: 30–37), with 12 (50.0%) females, 7 (29.2%) males and 5 (20.8%) who chose not to disclose their gender. They had been working for a median of 10 years (IQR: 7–12). Fourteen (58.3%) had attended the Disaster Medical Responder's Course; 12 (50.0%) had taken part in exercises previously; and 2 (8.3%) had responded to actual MCIs. The results of the survey are shown in (**Table 1**).

Key observations from the responses, including mean values and standard deviations, are summarized below.

- Staff demonstrated a strong sense of altruism, based on their responses to statements about having a desire to help (A1: 4.38±0.58), feeling honoured to work on the front lines (A2: 4.54±0.51) and believing it is their personal responsibility to help others (A3: 4.50±0.59). Additionally, they had good social support for their involvement in MCIs from family (SS1: 4.21±0.78), coworkers (SS2: 4.54±0.51), friends (SS3: 4.42±0.65) and work units (SS4: 4.21±0.66).

- Staff were not confident about their preparedness in terms of physical (P4: 2.54±1.14) and emotional well-being (P3: 3.79±0.88); safety (P1: 3.92±0.88); MCI-specific knowledge, skills and attitudes (P2: 3.79±0.78; SE1: 4.29±0.55; SE3: 4.13±0.68); as well as coping strategies (SE2: 3.92±0.72; CS1: 4.13±0.54). This lack of confidence negatively impacted their optimism when encountering difficulties (O1: 4.04±0.75), solving problems (O2: 3.92±0.78) and bouncing back (O3: 4.33±0.56). They also perceived a lack of control in handling problems (PC1: 3.88±0.85) and solving problems (PC2: 3.79±0.72) while remaining calm (PC3: 4.04±0.75), as well as a lack of ability to manage and express their emotions (CS2: 2.00±1.02; CS3: 3.50±0.83).

- The survey indicated that after deployment, efforts must be extended to help staff reflect on their experience to gain insights (PG1: 4.29±0.55), overcome challenges (PG2: 3.63±1.06) and find meaningful personal growth (PG3: 4.50±0.51) and interpersonal relations (PG4: 3.79±0.78).

DISCUSSION

Psychological resilience sustains clinical decision-making, improves team dynamics, and promotes personal and professional development for members of EMTs during MCIs.[9] Using the observations from this survey, we propose elements of a training framework for psychological resilience.

This training framework for increasing psychological resilience should be anchored in altruism and social support, which are strong, innate, protective factors for psychological resilience: staff should remind themselves of their beliefs and those who share them.[10,11] The goal is to empower EMT staff to use their MCI experience for personal and professional growth: staff should look beyond the deployment and identify takeaways for their work and life.[11] Training sessions should focus on self-preparedness to enhance physical and emotional well-being and safety, as well as equipping team members with MCI-specific knowledge and skills. This could be achieved using simulations to replicate the realism of MCIs, while challenging staff to apply their knowledge and skills in a physically demanding, high-stress and time-sensitive situation. In this framework, team members would be given time and space to identify issues, communicate with each other and solve problems. A team-based approach would underscore the importance of social networks within EMTs and the value of peer support.[12] This would improve the competence and confidence of not just the individual but also the entire EMT as members work collaboratively.[13] Coping strategies – such as mindfulness practices, learning to handle stress, managing conflict and psychological first aid – could also be incorporated into simulation sessions so staff can understand how psychological resilience can enhance their ability to deal with the unique challenges of MCIs.[14,15]

The limitations of this work include the fact that it is a single-country study with a small sample

Table 1. **Results of a survey of psychological resilience among emergency medical teams after a disaster exercise (*n* = 24), Singapore, 30 January 2024**

Domain	Statement	Mean ± standard deviation[a]
Optimism (O)	O1: I think that difficulties are everywhere during and after rescue work.	4.04±0.75
	O2: I tend to think that problems confronted before, during and after deployment will be solved.	3.92±0.78
	O3: I know that I will bounce back and get better no matter how difficult the situation is, with help from others.	4.33±0.56
Altruism (A)	A1: I have a desire to help the victims/survivors after a disaster has occurred.	4.38±0.58
	A2: I am honoured to work on the front line to offer my help to those who are affected by disaster.	4.54±0.51
	A3: I feel that it is a personal responsibility to help others after disasters.	4.50±0.59
Preparations for disaster rescue (P)	P1: I am certain of my safety and that of my family while I am deployed.	3.92±0.88
	P2: I have sufficient knowledge to assess disaster risks and have disaster rescue skills, such as medical rescue skills, knowledge of psychological first aid, ethical rules and field survival skills.	3.79±0.78
	P3: I am emotionally well prepared for disaster rescue.	3.79±0.88
	P4: I feel physically unprepared for disaster relief.	2.54±1.14
Social support (SS)	SS1: My family will provide me with strong support during and after my disaster relief work.	4.21±0.78
	SS2: Coworkers will help me to overcome challenges at the disaster site.	4.54±0.51
	SS3: I have some close friends who will provide me with much encouragement.	4.42±0.65
	SS4: My work unit will provide support to my family and to me, if necessary, when I work in disaster sites.	4.21±0.66
Perceived control (PC)	PC1: How things go during and after deployment will depend on my own actions.	3.88±0.85
	PC2: I can handle various situations at a disaster site.	3.79±0.72
	PC3: I can remain calm during a disaster rescue.	4.04±0.75
Self-efficacy (SE)	SE1: I feel confident that my clinical skills are (will be) of good use for disaster work.	4.29±0.55
	SE2: I can cope well with unexpected problems during disaster rescues.	3.92±0.72
	SE3: I am a competent rescue worker.	4.13±0.68
Coping strategies (CS)	CS1: I always try to find ways to address problems during disaster events.	4.13±0.54
	CS2: When a victim's/survivor's life is threatened, I lose my temper and blame others.	2.00±1.02
	CS3: I am willing to express my emotions to others if I am upset.	3.50±0.83
Positive growth (PG)	PG1: I have gained insight about life from rescue work.	4.29±0.55
	PG2: I tend to see rescue work as a challenge after deployment.	3.63±1.06
	PG3: I find meaning in my deployment.	4.50±0.51
	PG4: After returning from deployment to a disaster site, I have a more harmonious family life.	3.79±0.78

[a] Respondents rated each item on a 5-point Likert scale.

size, which affects the applicability of our suggested training framework for psychological resilience to other settings. The survey was also done following the EMTs' participation in a full-scale exercise instead of an actual MCI, so the results are based on perceptions formed through simulation training rather than real-

world experience. Furthermore, we did not analyse the responses for correlations between scores and characteristics of the members of the EMTs, such as demographics or experience. For instance, the presumed positive effect of participation in an actual MCI on the various domains of this psychological resilience tool could not be ascertained because only two participants had been involved in an actual MCI. Last, the training framework has yet to be developed into a detailed programme, and therefore its impact on psychological resilience is to be determined. Future research can incorporate qualitative methods, such as focus group interviews, to gain a more in-depth understanding of psychological resilience and training needs.

In conclusion, psychological resilience can positively impact the competence, confidence, experience and camaraderie of members of EMTs during MCIs. Through this work, we evaluated the psychological resilience of members of Singaporean EMTs deployed to MCIs and identified current gaps. A training framework should be proposed to incorporate psychological resilience training during the Disaster Medical Responder's Course.

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Conflicts of interest

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Ethics statement

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Report on the 2025 Indo-Pacific Health Security Alliance Meeting in Papua New Guinea: strengthening civil–military coordination for health emergency preparedness and response

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The Indo-Pacific health security alliance (IPhsa) convened its most recent regional coordination meeting on 6–8 May 2025 in Port Moresby, Papua New Guinea. The meeting was hosted by the Government of Papua New Guinea and brought together over 75 participants, comprising IPhsa members, observers and technical partners – including the Pacific Community and the World Health Organization (WHO) – from 15 countries and territories across the Indo-Pacific region.[1] Approximately 60% of the participants were from military/security forces, while 40% represented civilian entities. Co-hosted by the Papua New Guinea Defence Force (PNGDF), the Australian Defence Force (ADF) and the United States Indo-Pacific Command (USINDOPACOM), the event focused on strengthening multisectoral and civil–military coordination for public health emergency preparedness and response.[2]

IPhsa was established in 2022 through a memorandum of cooperation between ADF and USINDOPACOM to counter global health security threats, strengthen regional resilience, and expand civil–military collaboration with like-minded partners and to enhance shared capabilities to safeguard the Indo-Pacific region.[1] The alliance provides a unique platform for civilian and military partners to share resources, undertake technical exchange and participate in simulation-based learning. IPhsa brings together partners with shared interests in advancing health security, including health authorities, military and police forces, disaster management agencies and development partners.[1,3]

The May 2025 IPhsa meeting featured plenary presentations, scenario-based table-top exercises and reflective discussions. These included a keynote presentation by the WHO Regional Office for the Western Pacific on the health-security interface in the context of the Asia Pacific Health Security Action Framework;[4] a presentation of the results of Papua New Guinea's recent Civil–Military Health Security Mapping workshop; experience-sharing from participating countries, including Fiji, Indonesia, Japan, New Zealand and Singapore; and a presentation by the International Committee of the Red Cross regarding international humanitarian law.[1] Sessions highlighted lessons learned from recent emergencies in the region, including measles outbreaks, the COVID-19 pandemic, and the increasing frequency of concurrent and compounding natural and human-induced hazards.

The IPhsa meeting showcased several tools and frameworks to guide cross-sectoral health emergency preparedness and response. These included the *National civil-military health collaboration framework for strengthening health emergency preparedness: WHO guidance document*, the WHO *Strategic toolkit for assessing risks: a comprehensive toolkit for all-*

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hazards health emergency risk assessment (STAR), the WHO *Asia Pacific health security action framework*, the *International Health Regulations (2005) States Parties self-assessment annual reporting tool*, the *United Nations humanitarian civil-military coordination field handbook* (version 2.0), and others.[2,4–7]

Building on presentations, participants engaged in a full-day table-top emergency simulation exercise designed to test civil–military coordination, identify collaboration bottlenecks and provide a platform for future joint efforts.

Participants were asked to complete an anonymous online evaluation at the end of the meeting. In the feedback provided, participants emphasized the need for institutionalizing civil–military coordination, not only during response, but also throughout preparedness and recovery phases. Following the meeting and exercise, participants overwhelmingly indicated that they were better able to identify key actors during emergencies, that they could describe the application of key global frameworks in public health emergencies, and that they could contribute to multidisciplinary teams in health emergency response. Eighty-eight per cent of the participants reported that, because of the meeting, they had identified new opportunities for collaboration, and many said that they would advocate for the development or expansion of civil–military coordination in emergencies in the future (**Box 1**).

PNGDF's leadership in hosting the event and in joining IPhsa as a full member underscored the country's

Box 1. **Illustrative action plans identified by meeting participants**[a]

By December 2026, improve health integration and participation in relevant multisectoral regional and global civil–military forums.
By May 2026, develop a memorandum of understanding for civil–military interoperability.
Within 1 year, develop a contingency plan for disaster and health crises through collaboration with the ministry of health, security forces and other ministries/agencies, including the national disaster management office, local government, private sector, communities and academia.
Enhance civil–military relationships by developing a table-top exercise within 1 year that focuses on civil–military collaboration and partnerships.
By January 2026, establish better coordinated preparedness and response teams.
Within 1 year, strengthen the coordination of a national medical logistics support system for public health emergencies, including the development of a standard operating procedure for joint civil–military logistics and joint training of civil–military partners.
Within 1 year, review and update the memorandum of understanding between defence forces and national health authorities to strengthen civil–military collaboration.
By August 2025, set up a meeting with civilian health partners and defence stakeholders to understand the different roles and responsibilities during emergencies.
Within 1 year, establish a civil–military health committee that will include quarterly meetings, two exercises per year and joint deployments.
By 31 December 2025, organize an inter-agency technical working group for outbreak prevention, preparedness and response to achieve the 7-1-7 targets for outbreak response.[b]
Within 1 year, develop and finalize activation thresholds and response standard operating procedures for a tiered escalation model.
Within 1 year, conduct a meeting of heads of ministries to highlight and strengthen information-sharing across sectors.
By December 2025, develop a national multi-agency programme to address health security and emergency response.
Within 1 year, review the existing civil-military workplan to build policies to mobilize, manage, coordinate and use resources effectively for response.

[a] Edited for clarity and brevity.

[b] The 7-1-7 targets measure the timeliness of three outbreak milestones: detection (target of ≤7 days from emergence), notification (target of ≤1 day from detection) and completion of early response outbreak actions (target of ≤7 days from notification).

growing role in regional health-security efforts. Following the implementation of a hazard mapping workshop in February 2025 and a National Workshop on Advancing Civil-Military Collaboration to Strengthen Health Emergency Preparedness in Papua New Guinea only 1 week before the IPhsa meeting, Papua New Guinea's commitment to strengthening health security action through transparent assessment and coordinated planning was evident.

As global health threats grow more complex and transboundary, initiatives such as IPhsa offer valuable fora to harmonize response efforts, build mutual understanding and create opportunities for collaboration among diverse stakeholders. Continued investment in civil–military coordination, guided by global norms and regional collaboration, will be essential to ensuring that Indo-Pacific countries remain prepared to manage future health threats quickly and effectively, protecting population health, economies, and national and regional security.

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Ethics statement

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Management of an outbreak of invasive group A *Streptococcus* in a rural Australian residential aged-care facility, 2023

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Objective: To outline the management of an outbreak of invasive group A *Streptococcus* (iGAS) in a residential aged-care facility in rural Queensland, Australia, comparing outbreak management with the newly released Australian Series of National Guidelines (SoNG) for this disease and exploring unique aspects of rural iGAS outbreak management.

Methods: An outbreak of iGAS was identified in a rural Queensland residential facility, where two cases occurred within 24 hours. A confirmed case was defined as any individual linked to the facility who had laboratory evidence of group A *Streptococcus* (GAS) in a sterile site. Whole genome sequencing was performed on all confirmed cases. The public health management of this outbreak was conducted according to the Queensland Communicable Disease Control guidelines and was compared with the new SoNG.

Results: A phylogenetic tree confirmed that the two samples clustered closely together with a single allele difference. Chemoprophylaxis was offered to all residents and staff in the affected part of the facility; 95% (42/44) of residents consented to chemoprophylaxis. Increased surveillance for GAS and increased facility cleaning were recommended by the public health unit. No additional cases were identified after 30 days of surveillance. Management of the outbreak largely aligned with the SoNG except for post-outbreak surveillance, which would have been extended under the new guidelines.

Discussion: This paper highlights factors unique to managing iGAS outbreaks in rural areas. Rural workforce factors and access to pathology services impact rural outbreak management, and thus involving local services and considering the local context are vital. The use of chemoprophylaxis continues to be recommended by the SoNG, and in this case was considered to be an important adjunct to other management strategies.

Group A *Streptococcus* (GAS) is a Gram-positive bacterium that causes a wide variety of clinical manifestations, ranging from asymptomatic infections to invasive disease that causes bacteraemia, sepsis or toxic shock syndrome.[1] GAS is spread by person-to-person transmission, most commonly via droplets or broken skin.[2] Each year, GAS causes more than 18 million serious complications and up to 500 000 deaths.[3] GAS affects communities worldwide, and its impact is modulated by the virulence of circulating strains and socioeconomic factors, such as household crowding.[4]

Invasive GAS (iGAS) infections occur when the bacterium enters a sterile location, such as blood, cerebrospinal fluid or deep tissues.[5] The global incidence has been estimated at 600 000 iGAS cases per year, causing more than 160 000 deaths.[6] However, the true burden is difficult to quantify, as many regions lack the facilities, resources and infrastructure to diagnose and monitor iGAS cases.[7]

Invasive infections are associated with high mortality, up to 20% within 7 days.[8] Groups at increased risk of iGAS infection include children younger than 2 years, pregnant women, adults aged 65 years and older, and individuals with comorbidities, such as diabetes or immunosuppression.[2] The incubation period of iGAS is difficult to define, but secondary iGAS cases have been reported up to 30 days after an initial case.[5]

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Many countries have reported increases in iGAS incidence following the COVID-19 pandemic, potentially related to reduced exposure to iGAS during the pandemic, higher rates of circulating respiratory viruses and more virulent strains of iGAS.[1,9–11] Thus, management of iGAS is particularly relevant in this post-pandemic era.

IGAS has been notifiable in Queensland, Australia since 2005 and was made nationally notifiable in 2021.[1,5] The Series of National Guidelines (SoNG) for iGAS (version 1.0), from the Communicable Diseases Network Australia, was released in November 2023.[5] The purpose of this report is to outline the management of an iGAS outbreak in a rural residential aged-care facility in Queensland. This case study was used to examine the differences between the newly released SoNG and the previous Queensland Communicable Disease Control (QCDC) guidelines, and to explore the implications of the new guidelines on management in a rural context.

METHODS

Setting

This outbreak occurred in rural Queensland. The residential aged-care facility includes six wings, housing more than 70 residents and employing 75 staff. Within the facility, four wings share communal areas and entrances (Area A). Two wings are geographically separate, with separate communal areas and entrances (Area B).

The local hospital is staffed by a generalist workforce who work across multiple specialties. Blood cultures are not processed locally but are transported to a regional laboratory, with molecular typing available at a metropolitan site that is more than 400 km from the facility.

Outbreak description and epidemiological investigation

On 14 June 2023, the Darling Downs Public Health Unit received two iGAS notifications from a single residential facility. This met the QCDC criteria for an iGAS outbreak (i.e. two cases within 1 month).[12]

Both cases occurred in female residents in their 90s, and both subsequently died. Both cases were diagnosed in the local hospital. No other iGAS cases were identified within the region in the weeks preceding the outbreak.

Basic demographic data were entered into Queensland's Notifiable Conditions System (NOCS). Enhanced surveillance data, including information about clinical presentation, risk factors and clinical outcomes, were collected through interviews with next of kin, facility staff or both. The investigation sought to identify the source of the outbreak via epidemiological evidence and liaising with local health professionals.

Laboratory methods

Case definitions and confirmatory testing

A confirmed outbreak case was defined as any resident or staff member linked to the facility with culture or nucleic acid testing demonstrating GAS in a sterile site.[5] A contact was any resident or staff member who had resided or worked in the affected area during the 30 days before the outbreak. Visitors were not considered household-like contacts.

Genome sequencing

Whole genome sequencing was performed on all confirmed iGAS cases by the Public Health Microbiology Laboratory, Queensland Health. Sequences were trimmed using Trimmomatic v. 0.36.[13] Trimmed sequences were analysed using Kraken v. 1 for species identification.[14] Sequences were de novo assembled into contigs using SPAdes (St. Petersburg genome assembler) v. 3.12.0.[15] Multilocus sequence typing (MLST) and core genome MLST (cgMLST) analyses were performed in Ridom Seqsphere v. 9.0.8 using the pubMLST (public MLST) schemes.[16,17] A neighbour joining tree was generated from the cgMLST analysis using Ridom Seqsphere v. 9.0.8.

Public health response

This outbreak occurred before the implementation of the SoNG for iGAS and thus was managed in line with the QCDC guidelines. An outbreak management team was convened, performed a risk assessment and identified potential contacts among residents and staff. The team liaised with local hospital infection control, facility and hospital staff, and local general practitioners (GPs). Information regarding cleaning, infection control and wound care was circulated to staff and residents. Staff, residents and families received written information about the risk of iGAS infection and outlining management recommendations.

Local hospitals were advised to increase testing and have a low threshold for treating suspected GAS or iGAS infection (e.g. any case of sepsis). The public health response was monitored by engaging weekly with the facility, liaising with emergency department clinicians, and reviewing cases potentially presenting with iGAS. Passive surveillance was undertaken through NOCS.

Statistical analysis

Line lists were provided by the facility to monitor cases and the completion of chemoprophylaxis. Data were entered into a Microsoft Excel spreadsheet (v. 2305) to support a descriptive analysis of the outbreak.

RESULTS

Epidemiological investigation

Both cases initially presented with cellulitis that progressed to bacteraemia and sepsis. The outbreak timeline is outlined in **Fig. 1**. Both residents lived in Area A, and thus that area was considered affected. No cases were identified in Area B.

Normal skin commensal bacteria were suspected to be the source of the outbreak, given the skin origin of both cases and the lack of other cases among staff or in the community.

Laboratory investigation

Blood cultures from both cases were positive for GAS (genotype *emm4*). A phylogenetic tree based on whole genome sequencing with cgMLST analysis showed the two outbreak samples clustered closely together, with only a single allele difference.

Public health response

Chemoprophylaxis

In line with the QCDC guidelines, chemoprophylaxis was recommended to all residents and staff who had resided or worked in Area A in the 30 days preceding the outbreak.[12] The risk assessment indicated that chemoprophylaxis was not required for hospital staff or patients.

Forty-four residents were identified as contacts, of whom 42 consented to chemoprophylaxis (95%). Treatment was provided without cost to residents by their usual GPs. One resident received benzathine benzylpenicillin, with the remainder receiving phenoxymethylpenicillin (n = 37) or cefalexin (n = 4).

Staff contacts were advised to seek chemoprophylaxis through private GPs, with the costs paid by staff. Consequently, the antibiotic they received was unknown. Fourteen of 75 total staff in the facility (19%) received chemoprophylaxis. The number of staff who worked in Area A during the exposure period is unclear, and thus the true coverage rate is unknown.

All residents and staff commenced chemoprophylaxis within 5 days of outbreak identification.

Surveillance and precautions

In line with the QCDC guidelines, facility and hospital surveillance for GAS and iGAS was increased, and a lower threshold for testing for and treatment of potential cases was adopted. Advice regarding facility cleaning, hand hygiene and wound care practices was provided to the facility and local hospital. No environmental health investigation was possible given the distance to the facility.

Surveillance continued for 30 days, and no additional cases were identified. The outbreak was declared over on 16 July 2023.

Comparison with the new national management guidelines

Management of this outbreak, guided by the QCDC guidelines, largely aligned with the later-released SoNG for iGAS. The differences between the guidelines are summarized in **Table 1**.

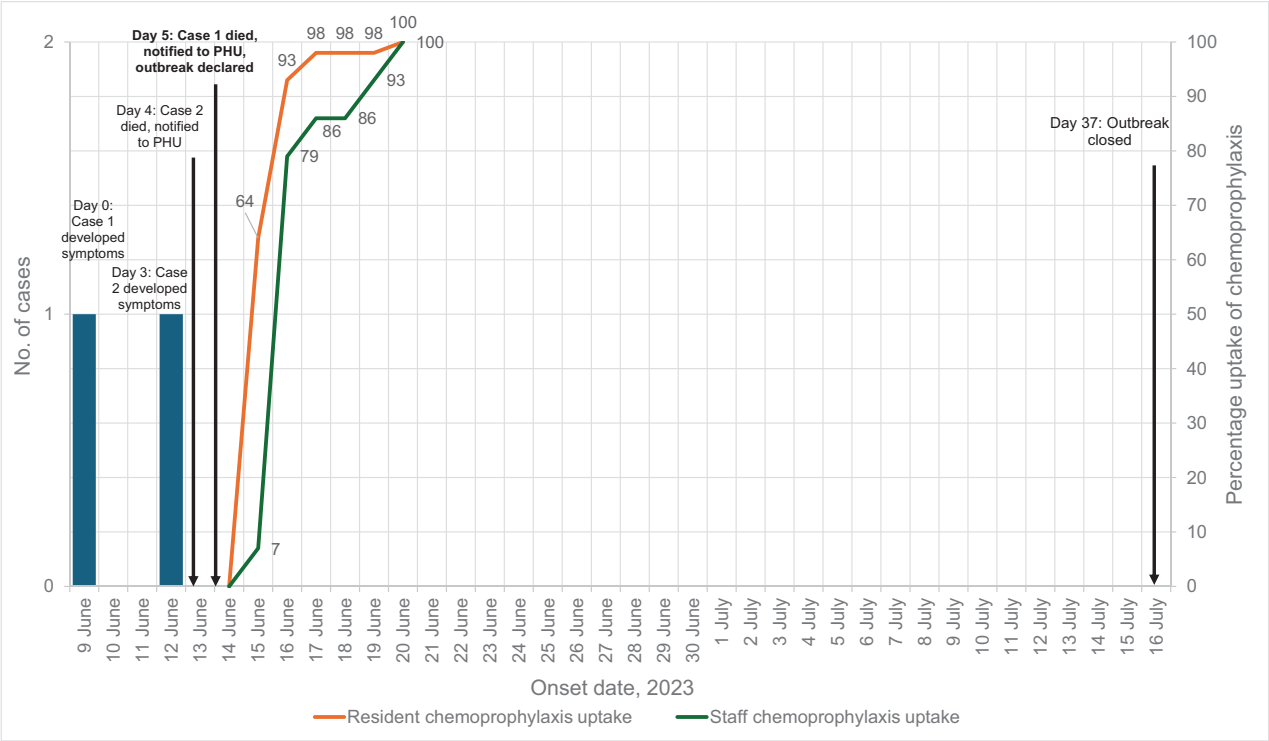
Identification of outbreak or cluster

The change in guidelines did not impact the identification of the outbreak, since the cases developed symptoms within 3 days. The requirement for molecular typing when cases are not household contacts is new, but since the facility is considered a household-like setting, this change did not impact management. Thus, this facility met the outbreak criteria under both the QCDC guidelines and the SoNG.

Table 1. **Comparison of the Queensland Communicable Disease Control guidelines with the Australian Series of National Guidelines (SoNG) for invasive group A *Streptococcus***

Category	Queensland Communicable Disease Control guidelines[12]	SoNG for invasive group A *Streptococcus*[5]	Would this have changed outbreak management?
Terminology	Outbreak	Cluster	No
No. of linked cases required to define an outbreak or cluster	Two cases in 1 month	Two cases in 3 months	No; two cases were reported within 24 hours.
Additional information needed to confirm outbreak	Not applicable	Cases identical on molecular typing (unless cases are household contacts)	No; cases in the residential aged-care facility were classified as household contacts.
Duration of surveillance recommended post-outbreak	30 days	3 months	Yes

Fig. 1. **Timeline of an outbreak of invasive group A Streptococcus (*N* = 2) and subsequent uptake of chemoprophylaxis by consenting residents (42/44) and staff (14/75) in a residential aged-care facility, Queensland, Australia, 2023**



PHU: Darling Downs Public Health Unit.

Chemoprophylaxis

The QCDC guidelines recommended chemoprophylaxis in this case.[12] The SoNG similarly recommends chemoprophylaxis.[5]

Timeline for surveillance

The SoNG recommends post-outbreak surveillance for a minimum of 3 months, compared with 1 month in the QCDC guidelines.[5] Surveillance was ceased at 1 month for this outbreak, in line with the QCDC, although passive surveillance via NOCS continued.[12] Thus, a prolonged surveillance period would have been recommended under the SoNG.

DISCUSSION

This iGAS outbreak raised important issues related to the use of the SoNG in rural outbreaks. Many of these issues also relate to international settings with limited capacity for testing and public health action.

Rural setting

This outbreak highlights the unique features of managing rural outbreaks. An advantage of the rural context is that the relatively small and interconnected medical services in these settings can streamline outbreak management.

However, rural workforce challenges may complicate management. Rural hospitals are commonly staffed by generalist clinicians who work across multiple settings. In this case, local hospital staff provided both general medical and obstetric care. Given the increased risk of secondary iGAS infection in birthing women and neonates, this was a significant consideration in the risk assessment.[5] While no significant risk was identified in this case, the unique context of rural hospitals must be considered.

Similarly, rural residential aged-care facilities experience greater workforce shortages than urban facilities, impacting their ability to cohort staff (i.e. assign staff to specific areas to minimize transmission risk) and recruit casual workers.[18] Similar workforce challenges are likely in many international settings.

Additionally, the lack of on-site pathology services may delay diagnosis. The requirement in the SoNG to confirm iGAS clusters by molecular typing is challenging in rural and international settings where typing is not easily accessible. Thus, in regions without rapid access to pathology services, public health staff may need to consider commencing management of a suspected outbreak before or without typing.

While standardized guidelines present the ideal management actions, it is vital to involve local professionals and consider the context during outbreak management.

Duration of surveillance

The duration of post-outbreak surveillance changed under the SoNG for iGAS. The QCDC guidelines recommended 1 month of surveillance. In comparison, the SoNG for iGAS recommends at least 3 months of post-outbreak surveillance, bringing Australia more in line with American guidelines.[19] In this outbreak, passive surveillance via NOCS continued, and it did not identify any additional iGAS cases. However, lengthening the post-outbreak surveillance period would potentially allow for increased staffing and laboratory resources, and other support over a longer period.

The role of chemoprophylaxis

Both the QCDC guidelines and the SoNG supported chemoprophylaxis in this case. This agreement notwithstanding, the role of chemoprophylaxis in institutional iGAS outbreaks remains unclear. A 2012 review of iGAS outbreaks in care homes in England found that widespread chemoprophylaxis had no benefit in controlling the spread of the outbreak.[20] However, these findings were complicated by a lack of consistency in chemoprophylaxis regimens and thresholds.[20]

Regardless of whether chemoprophylaxis is used, infection control and wound care practices have important roles in managing iGAS outbreaks, and these practices are often significant causative factors in outbreaks.[8,21] In the outbreak reported here, a skin infection was the source of infections in both residents, underscoring the importance of infection control within a vulnerable elderly population.

In this case, chemoprophylaxis was considered a useful adjunct to other outbreak control measures (e.g. infection control) to protect a vulnerable population. In urban settings, alternative approaches, such as staff cohorting and swabbing, may be more feasible. Considering the local context is therefore vital to decision-making.

Limitations

This case study describes a single, small outbreak in a residential aged-care facility. It was managed in accordance with the QCDC guidelines. The SoNG was not released until after the outbreak had ended, and thus post-outbreak surveillance was not in line with the SoNG recommendations, except for the passive surveillance through NOCS. In addition, the distance to the facility prohibited additional assessments (e.g. environmental health), which may have been valuable.

Conclusions

This report outlines the management of an iGAS outbreak within a rural residential aged-care facility. It highlights the importance of considering contextual factors in outbreak management. These findings are also significant for lower-resource settings, where limitations in the workforce, laboratory services and finances may make standard outbreak management difficult to achieve.

Acknowledgements

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Conflicts of interest

The authors have no conflicts of interest to declare.

Ethics statement

This outbreak investigation was performed under the Queensland Public Health Act. This project was reviewed by the Darling Downs Human Research Ethics Committee, which deemed that it did not require ethics review and has accordingly provided a letter of exemption (HREC Reference EX/2023/QTDD/103030).

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Influenza B/Victoria outbreak in a remote mountainous village: Oddar Meanchey Province, Cambodia, July–August 2023

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Objective: A response team was deployed to rural Oddar Meanchey Province, Cambodia, in mid-August 2023, immediately after a cluster of patients with acute febrile illness was reported. The team aimed to identify the cause of the outbreak and analyse the epidemiological characteristics and associated risk factors.

Methods: This retrospective cohort study involved all residents of Prasat Rumdoul Village. A case was defined as a resident with a fever ≥38 °C or a history of fever with symptoms such as cough, sore throat or coryza occurring from 18 July to 18 August. Demographic data, information about infection prevention practices and clinical information were collected using structured questionnaires and analysed using binomial regression. Laboratory samples were collected, and confirmatory laboratory tests and environmental investigations were also conducted.

Results: Among the 126 villagers, 95 cases were identified (attack rate: 75.3%); 52 (54.7%) were female, and the median age was 29 years. Prolonged close contact with individuals who had influenza-like illness significantly increased the risk of infection (adjusted risk ratio [ARR]: 2.19, $P = 0.002$). Protective factors included mask-wearing (ARR: 0.26, $P = 0.003$) and regular handwashing (ARR: 0.85, $P = 0.012$). No villagers had been vaccinated against influenza within the past 1 year. Laboratory tests confirmed influenza type B/Victoria as the causative agent. Poor adherence to preventive measures and crowded living conditions contributed to the outbreak.

Discussion: The outbreak was caused by influenza type B/Victoria, the same strain circulating in nearby Thailand. Public health interventions to improve vaccine accessibility and hygiene-promotion activities would be useful for preventing future outbreaks.

Influenza is a significant global health burden. The World Health Organization (WHO) has estimated that seasonal influenza causes up to 650 000 respiratory illness-associated deaths annually.[1] The disease leads to millions of severe cases worldwide, primarily affecting vulnerable populations such as children and older people, particularly during peak influenza season, which in Cambodia is from May to October.[2-4] The annual influenza-associated hospitalization rate for severe acute respiratory illness (SARI) in Cambodia is highest among children aged under 5 years, with a rate of up to 323 cases/100 000 population.[5] In 2016, the overall nationwide estimated burden of hospitalizations due to influenza-associated SARI was 7547 cases, causing substantial concern about the high rate of hospitalization among young children and older people.[5] A previous review of studies from 13 countries also found that older adults experienced a high rate of influenza-related morbidity.[6]

On 16 August 2023, the Oddar Meanchey Provincial Health Department was notified through the Cambodian Early Monitoring System of a cluster of 18 patients with acute febrile illness among 22 primary school students in Prasat Rumdoul Village, Ampil Commune, Oddar Meanchey Province. Initial hypotheses suggested dengue fever or chikungunya infection as the potential cause. The following day, a response team was deployed to confirm

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the diagnosis, describe the epidemiological characteristics of cases, identify factors associated with the illness and implement measures to control the outbreak; the team comprised staff from the Ministry of Health's Communicable Disease Control (CDC) Department, trainees from the field epidemiology training programme (FETP) and members of rapid response teams from the Provincial Health Department.

METHODS

Epidemiological investigation

Study design and population

A retrospective cohort study was conducted to investigate the cluster of patients with acute febrile illness in Prasat Rumdoul Village. The study encompassed all village residents, including those who were ill and those who were not, to identify the cause of the outbreak and the factors associated with it.

Case definition

A case of influenza-like illness (ILI) was defined as a resident of Prasat Rumdoul Village who between 18 July and 18 August 2023 had a fever of ≥38 °C or a history of fever accompanied by at least one of the following symptoms: cough, sore throat or coryza.

Data collection

A paper-based structured questionnaire was used that had been designed by the investigation team before the interviews. The in-depth interviews were conducted during household visits by trained data collectors to gather information about sociodemographic characteristics, clinical signs and symptoms, preventive practices and exposure history. Due to the lack of access to formal medical records, all information was collected directly from participants through interviews.

The sociodemographic information collected included the respondent's age, sex, education level and occupation. The clinical symptoms asked about included fever, cough, sore throat, runny nose and others. The use of preventive measures during the outbreak period was also assessed, such as the frequency of handwashing and mask-wearing practices. Routine hand hygiene practices evaluated included the use of soap and running water to wash hands, the use of alcohol-based hand sanitizers, or both. Participants were asked to report their handwashing frequency during the study period after contact with or exposure to objects or suspected ILI cases using four response options: "always", "sometimes", "rarely" or "never". For analysis, these responses were coded into two categories: "always" and "sometimes" were coded as "yes", while "rarely" and "never" were coded as "no". Additionally, participants were asked to report how frequently they wore a mask during the study period when they went outside, met with people outside their household or were in crowded areas, with response options including "always", "sometimes", "rarely" or "never". For analysis, these responses were coded into two categories: "always" and "sometimes" were coded as "yes", and "rarely" and "never" were coded as "no".

Respondents were also asked whether they had had close contact with individuals with ILI symptoms for a prolonged period. Close contact was defined as being within approximately 2 metres of an individual with ILI symptoms for a prolonged period, such as sharing a living space, engaging in direct conversation or any other form of prolonged interaction. Participants were asked to report if they had any such close contact during this period, with response options being "yes" and "no".

Data analysis

Stata v. 17 (StataCorp, College Station, TX, USA) was used for data analysis. Descriptive statistics were used to summarize the demographic and behavioural characteristics; other factors were analysed as frequencies and percentages.

A binomial regression model was used to assess associations between risk factors and ILI. Variables with $P < 0.20$ were included in the multivariate binomial regression. $P < 0.05$ was considered statistically significant; the magnitude of the effect was assessed with the adjusted risk ratio (ARR) and 95% confidence intervals (CIs).

Laboratory investigation

Blood samples were collected from symptomatic and recovered individuals to test for dengue, chikungunya and Zika virus infection. Nasopharyngeal samples from symptomatic individuals were collected and stored in a portable, insulated cooler before being sent to the National

Institute of Public Health for reverse transcription–polymerase chain reaction (RT–PCR) testing to identify the influenza type and subtype. COVID-19 rapid diagnostic testing was also performed while the investigators were in the village.

Environmental investigation

CDC Department staff and FETP trainees visited the village during the household survey to observe daily activities and assess adherence to public health and social measures during the outbreak period. Additionally, an informal meeting with village leaders was held to further understand community behaviours and the risk for communicable diseases.

RESULTS

Epidemiological investigation

Among the 126 villagers, 95 ILI cases were identified (attack rate: 75.3%), 52 (54.7%) of whom were female; 31 (32.6%) cases had recovered before the investigation. The median age of cases was 29 years (range: 2–76 years). The investigation revealed varying incidence rates of ILI across demographic variables. The incidence among males was 70.5%, whereas among females it was 80.0% (**Table 1**). Among the different age groups, the highest incidences were observed in those aged 0–4 years and ≥50 years (80.0% each), followed by those aged 15–24 years (78.5%), those aged 5–14 years (77.1%) and those aged 25–49 years (71.1%) (**Table 1**). Attack rates by educational attainment ranged from 69.2% (for those who had completed secondary school to 80.0% (for those who had completed high school. Across occupations, service providers and children were the most affected groups. None of the people in the village had been vaccinated against influenza. Among the 95 ILI cases, 52 patients (54.7%) reported hospitalization at either a private clinic or public hospital (data not shown).

The epidemic curve of the ILI outbreak was developed based on the household survey, covering cases occurring from 18 July to 18 August 2023. The suspected index case occurred on 20 July, and the highest number of cases recorded in a single day was 16 on 10 August. The daily number of cases then began a decreasing trend, with a secondary peak of 14 cases on 15 August (**Fig. 1**).

Regarding clinical signs and symptoms among patients, fever was the most common symptom (100%), followed by coughing or sneezing (83, 87.3%), sore throat (75, 78.9%), headache (73, 76.8%), myalgia (69, 72.6%) and runny nose (66, 69.4%). Orbital pain was reported by 58 (61.1%) patients, while fatigue affected 55 (57.9%). Less common symptoms included abdominal pain (35, 36.8%), vomiting (18, 18.9%), nausea (13, 13.7%) and rash (10, 10.5%).

Prolonged close contact with individuals with ILI between 18 July and 18 August significantly increased the risk of ILI (ARR: 2.19, 95% CI: 1.34–3.57, $P = 0.002$). However, those who reported regularly wearing a mask had a reduced likelihood of developing ILI (ARR: 0.26, 95% CI: 0.11–0.63, $P < 0.003$), as did individuals who practised regular handwashing (ARR: 0.85, 95% CI: 0.76–0.96, $P = 0.012$). Age group, education level, occupation, travel outside of the village for 14 days between 18 July and 18 August, influenza vaccination history and the presence of chronic illness were not associated with infection.

Laboratory investigation

The 11 nasopharyngeal samples collected from cases who were ill at the time of collection all tested negative for COVID-19 via both the rapid diagnostic test and RT–PCR; however, 10 of those 11 samples tested positive for influenza type B/Victoria (data not shown). Twenty-two blood samples drawn from suspected cases who were still presenting with signs and symptoms and from cases who had already recovered tested negative for dengue, chikungunya and Zika virus (data not shown). Blood samples could be collected only from this subset of ILI cases due to limited resources.

Environmental investigation

The environmental investigation conducted by staff from the CDC Department and FETP trainees revealed several significant factors related to the outbreak in the village. The majority of residents exhibited poor adherence to influenza prevention measures, such as mask-wearing, handwashing and physical distancing. It is common practice for villagers to visit others when they are sick, contributing to the rapid spread of communicable diseases. Although the village is small, it is overcrowded, which further facilitates disease transmission, and its remote

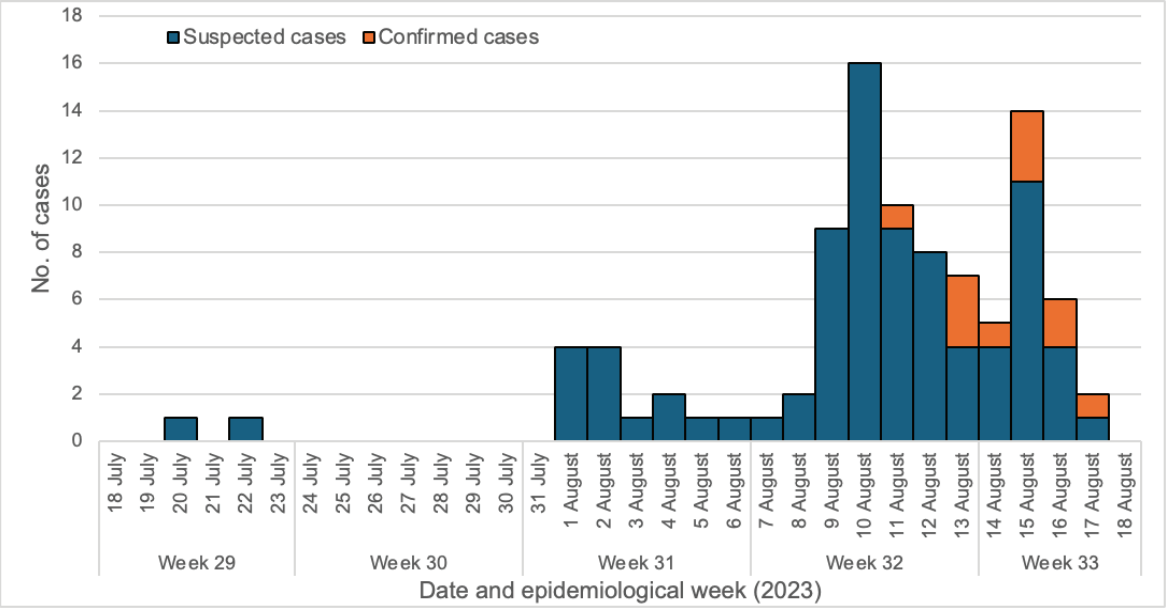
Table 1. **Factors associated with an outbreak of influenza-like illness, Oddar Meanchey Province, Cambodia, 2023**

Variable	No. villagers (N = 126)	No. ILI cases (% incidence) (n = 95)	Crude risk ratio	95% CI	*P*	Adjusted risk ratio	95% CI	*P*
Sex								
Male	61	43 (70.5)	Reference			–	–	–
Female	65	52 (80.0)	1.13	0.92–1.39	0.221	–	–	–
Age group (years)								
0–4	10	8 (80.0)	Reference			–	–	–
5–14	35	27 (77.1)	0.96	0.67–1.38	0.842	–	–	–
15–24	14	11 (78.5)	0.98	0.64–1.48	0.932	–	–	–
25–49	52	37 (71.1)	0.88	0.62–1.26	0.518	–	–	–
≥50	15	12 (80.0)	1	0.67–1.49	1.000	–	–	–
Education level								
No school	51	39 (76.4)	Reference			–	–	–
Primary school	57	43 (75.4)	0.98	0.79–1.21	0.900	–	–	–
Secondary school	13	9 (69.2)	0.90	0.61–1.34	0.620	–	–	–
High school	5	4 (80.0)	1.04	0.65–1.66	0.849	–	–	–
Occupation								
Farmer	70	50 (71.4)	Reference			–	–	–
Student	35	26 (74.2)	1.04	0.81–1.32	0.754	–	–	–
Child	13	11 (84.6)	1.18	0.89–1.55	0.227	–	–	–
Service provider[a]	8	8 (100.0)						
Travel during 14 days between 18 July and 18 August 2023								
Yes	21	18 (85.7)	1.16	0.94–1.44	0.244	–	–	–
No	105	77 (73.3)	Reference					
Influenza vaccination within the past 1 year								
Yes	0	0	–	–	–	–	–	–
No	126	95 (75.4)	–	–	–	–	–	–
Presence of chronic disease								
Yes	19	14 (73.6)	0.97	0.72–1.29	0.855	–	–	–
No	107	81 (75.7)	Reference			–	–	–
Close contact with ILI cases between 18 July and 18 August 2023								
Yes	92	86 (93.4)	3.53	2.01–6.19	< 0.001	2.19	1.34–3.57	0.002
No	34	9 (26.4)	Reference					
Regular mask-wearing behaviour								
Yes	26	4 (15.3)	0.16	0.06–0.41	< 0.001	0.26	0.11–0.63	0.003
No	100	91 (91.0)	Reference					
Hand hygiene behaviour (regular handwashing)								
Yes	46	22 (47.8)	0.52	0.38–0.71	< 0.001	0.85	0.76–0.96	0.012
No	80	73 (91.2)	Reference					

CI: confidence interval; ILI: influenza-like illness; –: not applicable.

[a] This category includes two elders, two motorcycle repairers, two sellers, one deputy village chief and one village chief.

Fig. 1. **Epidemic curve of an outbreak of influenza-like illness in Prasat Rumdoul Village, Oddar Meanchey Province, Cambodia, 18 July to 18 August 2023 (n = 95)**



location makes it challenging to effectively implement and monitor public health interventions. Additionally, many villagers migrate to Thailand for work, thus posing the risk of introducing and spreading infectious diseases. The geographical isolation of the village, situated along the mountainous border with Thailand, impacts access to health-care services and public health resources, complicating efforts to manage and contain disease outbreaks.

Prevention and control measures

Community- and school-based education was initiated immediately to increase awareness about influenza, focusing on prevention methods, recognizing signs and symptoms, and basic management practices, such as encouraging rest and hydration, isolating symptomatic individuals, and seeking care from health facilities if needed. In addition, surveillance was enhanced at the health centre near the village to closely monitor trends in influenza cases and ensure the timely detection of any new infections.

DISCUSSION

This influenza outbreak affected the majority of the village's population. The outbreak is a lens into patterns of influenza epidemiology in a community through the clinical signs and symptoms of the illness, the sociodemographic characteristics of the people in the village, their preventive practices and laboratory results, and the environmental factors associated with the outbreak.

The clinical signs and symptoms reported by cases were compatible with influenza signs and symptoms described by WHO and UpToDate guidelines,[7,8] and the epidemic curve suggested a propagated (i.e. progressive source) epidemic, spread by person-to-person transmission, with an incubation period consistent with the spread of influenza (i.e. 2–7 days). The epidemiological findings were strongly supported by environmental findings and laboratory results, the latter of which confirmed infection with influenza type B/Victoria. During this period, sentinel site data in Cambodia for ILI and SARI indicated predominantly influenza A(H1N1)pdm and no influenza B/Victoria. From the same surveillance system, influenza B/Victoria and predominant influenza A(H1N1)pdm were observed to be circulating in neighbouring Thailand.[9]

This influenza outbreak affected slightly more females than males, while there was no statistically significant difference between age groups, regardless of a respondent's education level or occupation. WHO recommends that children aged under 5 years, adults aged over 65 years and people with chronic illnesses

receive an annual influenza vaccination.[10] However, no one in the village where the outbreak occurred had been vaccinated because the vaccine was not available locally.

A history of travelling outside of the village was not associated with being a case. However, having close contact with someone with ILI between 18 July and 18 August 2023 was associated with becoming a case, while good practices such as regular mask-wearing and good hand hygiene were protective factors. It is likely that the source of infection was within the community.

Having a chronic disease was not associated with becoming a case. However, as much as 55% of the cases were reported to have been hospitalized due to growing concern over dengue illness. In this outbreak, no deaths or severe cases were reported. A previous study indicated that seasonal influenza B has a wide spectrum of clinical presentations, from mild upper respiratory tract symptoms to death from respiratory failure, depending on characteristics such as older age or the presence of a pre-existing medical condition.[11]

Limitations

The index case had no history of travel outside the village or contact with suspected ILI cases, so the original source of infection for the index case could not be identified. Recall bias may have been introduced into the study due to reliance on retrospective data collection through participant interviews about symptoms and preventive measures. In addition, the village is quite small, with a population of 126, which may reduce the statistical power of the study. An additional qualitative study assessing environmental and sociobehavioural practices may help solidify our findings.

Conclusions

The outbreak was confirmed to have been caused by influenza type B/Victoria, which affected the majority of the community's population, and the highest attack rates were among children aged 0–4 years and adults aged ≥50 years. Lack of access to vaccination and having close contact with ILI patients were contributors to the outbreak, while measures such as mask-wearing and good hand hygiene practices proved to be protective. It is essential to improve the availability and accessibility of influenza vaccine, especially for vulnerable populations. Increasing community awareness about influenza through public health campaigns that emphasize the importance of good hygiene practices, such as handwashing and mask-wearing, especially during outbreaks, would be useful for controlling future outbreaks.

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Conflicts of interest

The authors have no conflicts of interest to declare.

Ethics statement

Ethics approval from the national ethical review board was not required, as this investigation was conducted as an emergency response to an infectious disease outbreak. Verbal informed consent was obtained from all participants or their guardians before data collection. The confidentiality of participants and their data was maintained throughout the study.

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Impact of the COVID-19 pandemic on seasonal influenza in the WHO Western Pacific Region, 2016–2024

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Epidemics and pandemics of infectious diseases caused by human respiratory viruses, mainly influenza viruses and coronaviruses, represent a significant global threat to public health, societies and economies. The most recent threat was first detected in 2019 and was caused by a novel coronavirus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which spread rapidly, leading to its characterization as a pandemic. The World Health Organization (WHO) declared COVID-19, the disease caused by SARS-CoV-2, a public health emergency of international concern on 30 January 2020 and a global pandemic on 11 March 2020.[1] Unprecedented and wide-ranging public health measures were implemented globally in response to COVID-19. This perspective paper describes seasonal influenza activity in the WHO Western Pacific Region from 2016 to 2024, assesses the impact of the COVID-19 pandemic on influenza trends and considers implications for future surveillance strategies.

The COVID-19 pandemic interrupted the typical timing, intensity and duration of seasonal influenza activity, resulting in significant declines in seasonal influenza virus detection globally and in the Region.[2–4] This descriptive analysis draws on data from laboratory-confirmed cases of influenza reported to the WHO Global Influenza Surveillance and Response System (GISRS) via its FluNet platform,[5,6] as well as information from seasonal influenza situation reports produced by the WHO Regional Office for the Western Pacific on a biweekly basis.[7]

As of December 2024, the WHO Western Pacific Region comprised 37 countries and areas (hereafter referred to as countries), including 21 Pacific island countries and areas (PICs). The Region is highly diverse: it includes one of the world's most populous countries and some of its smallest; both low- and high-income countries; and several of the world's largest megacities as well as some of the most remote island communities. Countries also vary widely in climate, social and cultural characteristics, and—most notably for the purposes of this paper—in their influenza surveillance capabilities. Some countries have established advanced sentinel syndromic surveillance influenza systems that generate epidemiological and virological data critical for identifying and continuously monitoring antigenic changes in influenza viruses. These systems use the syndromic case definitions for influenza-like illness (ILI), severe acute respiratory illness (SARI) and, in some countries, acute respiratory infection (ARI). Other countries in the Region have more modest surveillance systems and/or rely more heavily on routine indicator-based surveillance methods. Across the Region, 21 national influenza centres in 15 countries are currently part of the GISRS laboratory network and are actively engaged in establishing laboratory surveillance for influenza and other respiratory viruses in their respective countries. As of December 2024, a total of 17 Western Pacific countries reported virological surveillance data to FluNet (including two PICs), and 26 countries reported epidemiological data to FluID (including 20 PICs).

Available FluNet data for the Region are shown in **Fig. 1**, demonstrating that during the height of the COVID-19 pandemic (2020–2021), the incidence of laboratory-confirmed influenza was less than in previous years (2016–2019). In the pre-pandemic period (from October 2016 to October 2019), the reported

[a] World Health Organization Regional Office for the Western Pacific, Manila, Philippines.
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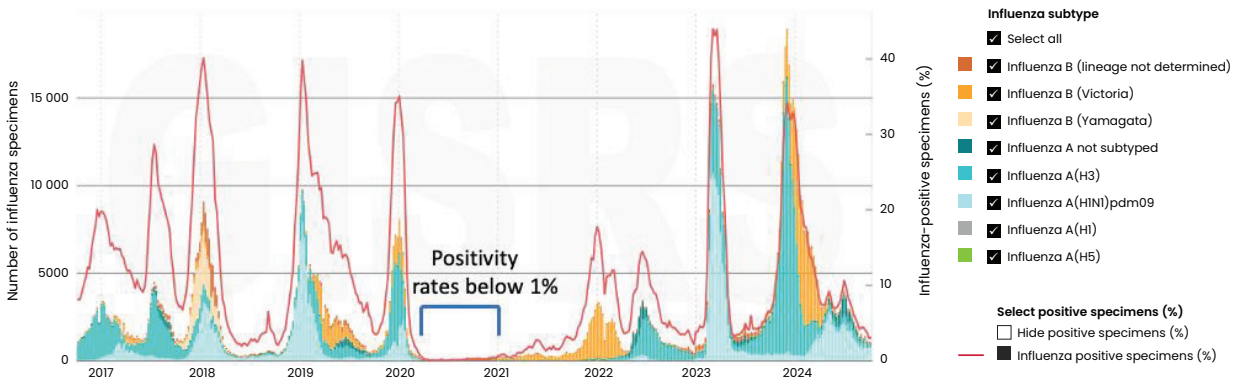
Fig. 1. **Number of specimens positive for influenza by subtype, WHO Western Pacific Region, from 7 October 2016 to 7 October 2024**



Source: WHO FluNet. Data were extracted from FluNet on 16 January 2025.

influenza positivity rate varied seasonally between 1.9% (229/12 181) and 40.0% (9070/22 675), but decreased sharply to below 1% (range: 0–214 positive samples/0–21 400 tested samples) from March 2020 to April 2021 (**Fig. 1**). Influenza cases reported in Japan in the 2020/2021 winter, for example, were estimated to be less than 1/1000 of the typical annual number of cases.[8]

The sharp decline in influenza virus circulation during the COVID-19 pandemic was particularly noticeable in countries with temperate climates. Australia, Japan, New Zealand and the Republic of Korea reported the largest declines.[7] In other countries, such as Malaysia and Viet Nam, a smaller decline was observed.[7] Among the PICs, a decline was observed in Fiji, New Caledonia and Papua New Guinea.[7] In the tropical and subtropical PICs, changes were less pronounced but difficult to interpret given that, in these countries, the circulation of the influenza virus is generally low year-round, does not normally exhibit seasonal patterns and peaks are mostly travel-related.[2] During 2022, influenza virus activity in the Region was lower than before the COVID-19 pandemic but increased in many Western Pacific countries at the end of 2023 and into the start of 2024 (**Fig. 1**).

Observed reductions in reported influenza cases during the COVID-19 pandemic years have been attributed to multiple factors,[2] including the implementation of universal preventive measures (hand sanitization, mask-wearing, physical distancing), as well as reductions in international travel, workplace presence, school attendance and mass gatherings.[2–4,9,10] Other possible contributory factors include the promotion of and increase in influenza vaccination (which has been reported in some countries in the Region) and direct viral interference with SARS-CoV-2.[2,3] It has also been suggested that changes in the epidemiology of influenza viruses may have played a role. Although laboratories continue to test for B/Yamagata lineage viruses, there have been no confirmed detections of B/Yamagata/16/88 lineage viruses since March 2020, suggesting that naturally occurring B/Yamagata viruses are probably no longer circulating in the population. This apparent disappearance may contribute to reduced overall influenza activity, as it removes one of the two major influenza B lineages that previously co-circulated, thereby decreasing the diversity and volume of circulating influenza viruses. Previously, B/Yamagata and B/Victoria lineages co-circulated in variable proportions until March 2020.[5]

It seems unlikely that the Region-wide reduction in the incidence of laboratory-confirmed influenza during the pandemic was associated with a lack of testing. Global data in FluNet indicate that, overall, the level of testing was no lower than it had been in pre-COVID-19 years.[2] Some countries, such as Australia, even increased influenza testing during the COVID-19 pandemic; however, the positivity rate was much lower than that recorded pre-pandemic.[11] Conversely, a meta-analysis concluded that there was a global decline in influenza surveillance during COVID-19; the pooled proportion of samples tested for influenza during the pandemic was 0.48% (95% confidence interval: 0.28–0.68%), compared with 0.69% in 2019 (95% confidence interval: 0.45–0.92%).[12] Nevertheless, there were some notable

exceptions (for example, Canada). It is plausible that these global analyses are masking national variations, with some countries increasing testing and others scaling back during the pandemic. Some of the reasons for the latter include a shift in priorities and funding away from influenza in favour of COVID-19, the closure of outpatient clinics and the preferential referral of persons with ILI for SARS-CoV-2 testing. In some settings, suspected cases may have been referred to hospitals and, thus, were not captured in clinics as ILI/ARI cases.[12] Such factors may well have played out in some of the lower-income PICs in the Region.

The COVID-19 pandemic has emphasized the importance of sustainable influenza surveillance systems for continuous monitoring and reporting of influenza viruses across the Region. Several countries, including some PICs, successfully scaled up their laboratory surveillance capacity during the pandemic, and many have already integrated existing surveillance systems for testing both influenza and SARS-CoV-2 or are in the process of doing so. While the 2018 Asia Pacific Strategy for Emerging Diseases and Public Health Emergencies (APSED) has been a valuable resource,[13] the COVID-19 pandemic has identified areas that need further work. The new Asia Pacific Health Security Action Framework builds on the foundations of APSED, urging countries to establish resilient health systems to prevent, rapidly detect, be ready for and effectively respond to outbreaks with pandemic potential. It also advocates for multisource surveillance through the integration of multiple sources to strengthen early detection and response to public health threats.[14]

The detection of influenza through traditional sentinel surveillance for ARI/ILI/SARI may change due to health-care-seeking behaviours and other compounding factors in emergencies such as those seen during the COVID-19 pandemic. These limitations highlighted weaknesses in relying solely on sentinel systems and underscored the need for complementary data sources. No single-source surveillance system can provide a complete picture of the situation. A multisource surveillance system approach is, therefore, essential for providing comprehensive insights on influenza activity and severity by integrating laboratory, event-based surveillance systems, indicator-based surveillance, as well as multiple indicators such as test positivity, hospitalizations, intensive care unit (ICU) admissions and mortality estimates to monitor severity. In addition to strengthening national systems, timely regional and international information sharing is critical in detecting, assessing risk and responding to emerging threats.

The WHO Regional Office for the Western Pacific is working closely with countries in the Region to strengthen existing sentinel surveillance systems; build sustainable laboratory systems; streamline and enhance timely data reporting; integrate laboratory and epidemiological systems on COVID-19, influenza and other respiratory pathogens; conduct surveillance for zoonotic events; and promote modelling and use of new data sources to improve understanding of severity. By analysing trends in indicators such as hospitalizations, ICU admissions and deaths, it is possible to better forecast epidemics and pandemics, even when case reporting is limited. Such activities contribute to the continuous monitoring of influenza virus evolution and the building of resilient systems at national and subnational levels. This will facilitate improved preparedness, readiness, response and resilience to potential future pandemics caused by respiratory viruses.

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Conflicts of interest

VK is an associate editor of the *Western Pacific Surveillance and Response* journal. She was not involved in the editorial decision to publish this article. The other authors have no conflicts of interest to declare.

Ethics statement

Ethical approval was not necessary for this perspective paper.

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The gendered impact of COVID-19 in the Philippines: a call for gender-responsive public health policies

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The COVID-19 pandemic exposed and deepened gender-related inequalities in Philippine society, particularly in access to health care, economic security and caregiving responsibilities. Women bore the brunt of the crisis, disproportionately working on the front lines while maintaining unpaid caregiving duties. They also comprised the majority of workers in the sectors hit hardest by unemployment. The absence of a gender-responsive framework in the national pandemic response, compounded by traditional gender norms, denied women institutional support and exacerbated their economic and social struggles. While men also faced challenges, the pandemic disproportionately impacted women, necessitating targeted intervention strategies.[1,2]

HEALTH-CARE ACCESS AND CHALLENGES

At critical moments, health-care providers overlooked essential medical care specifically designed for women. The health-care services dedicated to maternal care and birth became less important than the government's urgent COVID-19 emergency work. Pregnant women became more exposed to health dangers because hospital shutdowns combined with travel restrictions compelled them to deliver their babies in risky locations without medical support. A 2020 rapid assessment projected a 26% increase in maternal deaths and a 42% rise in unintended pregnancies in the Philippines because of service disruptions.[3] Many women from marginalized communities struggled to access health care because social norms often prioritized their caregiving responsibilities over their own health needs. Female health-care workers experienced substantial psychological effects, burnout and stress due to their dual responsibilities at work and at home.[4]

In the Philippines, most front-line medical workers during the COVID-19 pandemic were female health-care professionals, and many experienced elevated stress levels. This was largely due to both managing unpaid responsibilities, such as household and caregiving tasks, and continuing to fulfil professional duties. The combined burden of working prolonged shifts in high-risk settings while also maintaining their domestic roles contributed to increased psychological strain, which disproportionately affected women compared with their male colleagues.[4,5] The absence of job-related protections for support for their mental health, hazard pay and programmes to ensure work–life balance increased their psychological challenges. Filipino nurses and caregivers reported high levels of anxiety, burnout and fatigue, driven by patient overload, insufficient personal protective equipment and extended exposure to stress.[4–6] Female health-care workers bore the burden of inadequate workplace policies because their institutions did not support them to manage their dual roles effectively.

ECONOMIC IMPACT

The economic effects were most devastating for women in manual labour and service industries, as these sectors – including retail, domestic work and tourism – experienced mass job terminations. The lockdown measures caused severe financial instability to industries that employed mostly women.[7] The Philippine workforce of employed

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domestic staff, comprised primarily of women, suffered when employers cancelled contracts due to pandemic-induced financial hardship. Wage subsidies and unemployment benefits helped those working in formal industries, which are often male dominated, while informal workers – the majority of whom are women – were largely excluded from economic support mechanisms.[7,8]

The small amount of financial aid that reached informal workers was insufficient to offset prolonged economic disruptions, delaying the country's recovery and deepening gendered economic disparities. For example, a 2021 study in Quezon City found that female informal workers faced a loss of their total income, food insecurity and psychological distress due to closed businesses and disruptions to school schedules.[9] Moreover, the shift to remote work, school closures and suspended childcare services further increased women's unpaid caregiving responsibilities, limiting their ability to seek or maintain employment and participate in the country's economic recovery.[10]

THE ROLE OF GENDER IN HEALTH CARE AND PANDEMIC RESPONSE

Pandemics worsen the gender-based inequalities that persist within health-care facilities and medical systems because of structural biases and insufficiently inclusive public health responses. In the Philippines, although women play vital roles as front-line clinical staff, unpaid caregivers and community health leaders, they often lack equitable access to essential health services, including comprehensive sexual and reproductive health and rights.[11] During the COVID-19 pandemic, services addressing sexual and reproductive health and rights were frequently deprioritized, reinforcing a narrow focus on maternal health while neglecting broader physical, mental and reproductive health needs.[12] A gender-sensitive pandemic response strategy recognizes that men and women experience health emergencies differently due to their differing social, economic and caregiving roles. Adjusting health-care delivery to fit specific needs by using the perspective of gender leads to improved patient outcomes, such as by creating maternal health programmes, and providing mental health support for female caregivers and financial assistance programmes for employed women in vulnerable situations.

Evidence from previous health crises, such as the Ebola virus outbreak in West Africa, has shown that overlooking women's caregiving responsibilities and economic vulnerabilities can slow social and economic recovery and deepen gender inequalities. In contrast, countries that adopted gender-responsive strategies – including supporting women-led community efforts, access to reproductive health services and inclusive health communication – saw more equitable and effective outcomes.[13] During the COVID-19 pandemic, nations that prioritized maternal health and implemented support targeted to women were better positioned to recover fairly. In the Philippines, the absence of such gender-specific measures left many women in rural and low-income communities facing prolonged economic hardship and reduced access to essential health care.[1] Addressing gender disparities is not only a matter of social justice but also a critical factor in building stronger, more resilient health systems and sustaining economic recovery.

RECOMMENDATIONS FOR GENDER-RESPONSIVE POLICIES DURING PUBLIC HEALTH EMERGENCIES

Gender-responsive actions are essential during public health emergencies to address structural inequalities and support equitable recovery. Incorporating gender analysis into disaster preparedness and response enables authorities to identify the specific risks and vulnerabilities that women face and to design interventions that meet those distinct needs. Governments and policy-makers must collect and use data disaggregated by sex and gender to inform policies that promote access to health care, financial stability and psychosocial support for women.[1]

Health systems should ensure continuing access to sexual and reproductive health services, especially for women in low-resource settings where barriers to care are often highest. While it is not always feasible for such services to remain entirely uninterrupted during large-scale crises, investing in telemedicine and mobile health units can help maintain service delivery even during restrictions on travel.[13]

To support female health-care workers and caregivers – groups that are often overlooked in pandemic

planning – mental health programmes tailored to their specific stressors must be integrated into emergency response frameworks. These services should be available to all women experiencing heightened psychological distress during health emergencies, regardless of whether they have caregiving roles.

Economic relief programmes should explicitly include informal workers and low-wage earners, many of whom are women. Providing cash assistance, subsidized childcare and reskilling programmes that align with women's capacities can help reduce their economic vulnerability in the long-term. In addition, workplace policies that recognize caregiving burdens – such as paid family leave and flexible work arrangements – can reduce the pressure women face to choose between paid employment and caregiving. While such policies cannot eliminate these responsibilities, they can offer more equitable support for women's dual roles at home and in the labour force.

The proactive inclusion of women in planning and decision-making processes for pandemic responses will ensure that their needs are adequately represented and addressed. However, global analyses of pandemic governance have shown significant gender gaps in COVID-19 leadership bodies, often resulting in policies that fail to consider the specific experiences and needs of women.[14] Addressing these gaps is critical to designing more equitable and effective health responses. Recovery strategies should also be guided by gender-responsive budgeting, an approach that integrates gender considerations into resource allocation and prioritization.[15] In the Philippines, Quezon City implemented gender-responsive budgeting measures during the pandemic, enabling targeted delivery of social services and reproductive health support to women and girls in vulnerable communities.[16]

These recommendations also align with broader frameworks such as the Sustainable Development Goals (SDGs), particularly SDG3 (good health and well-being), SDG5 (gender equality) and SDG8 (decent work and economic growth). Adopting a systems-thinking lens – which recognizes the linkages between health systems, gender norms, economic structures and policy environments – is essential for creating adaptive, inclusive and resilient pandemic responses.[17]

The World Health Organization's inclusion of gender equality indicators in the Joint External Evaluation process reflects a growing global commitment to gender-responsive approaches to pandemic prevention, and preparedness and response activities. Standardized practices in disaster management increasingly emphasize the integration of gender analysis, enabling authorities to identify the specific vulnerabilities that women face, and to design targeted, effective interventions. Governments and policy-makers must prioritize the collection and use of data disaggregated by sex and gender to guide strategies that address women's health-care needs, economic security and access to social support systems.[1]

Ultimately, recognizing and addressing gender disparities is not only a matter of social equity: it is a strategic necessity for strengthening public health systems, protecting livelihoods and ensuring inclusive recovery.

Conflicts of interest

The author has no conflicts of interest to declare.

Ethics statement

This paper did not require formal ethical approval as it involved no human participants, animals or sensitive data. However, it adheres to ethical guidelines for integrity, transparency and accuracy, ensuring responsible research conduct.

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The rapidly emerging public health threat of rabies in Timor-Leste, 2024–2025

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Rabies is a public health concern in over 150 countries and territories, mainly in Africa and Asia,[1] and causes over 59 000 deaths per year.[2] The rabies virus is usually transmitted to humans through the bite or scratch of an infected animal. In low- and middle-income countries, most human cases result from dog bites, but the virus may also be transmitted by other animals.[3] If symptoms of rabies develop, the disease is almost always fatal, usually within days or months. A One Health approach is essential for the prevention of rabies.[1] It can be prevented through mass dog vaccination and through the provision of post-exposure prophylaxis (PEP) with rabies vaccine and rabies immunoglobulin (RIG) as soon as possible after potential exposure to the virus.[4]

Timor-Leste is a resource-limited nation of 1.4 million people[5] that shares a land border with Indonesia. The country was considered rabies-free until the first human and animal cases were detected in March 2024 in the Special Administrative Region of Oecusse-Ambeno (Oecusse).[6] Since then, it has been detected in dogs and humans in a growing number of municipalities. Any person in Timor-Leste who is bitten or scratched by an animal that could potentially transmit the rabies virus should be assessed for rabies exposure to determine their need for PEP. Access to vaccines and RIG should be increased by strengthening vaccine supply and integrating PEP into routine immunization programmes as well as primary and secondary health care, while increasing public awareness of the risk of rabies following dog bites. This paper briefly describes the evolving rabies situation in Timor-Leste as of July 2025 and offers lessons for other nations in the Indo-Pacific region where rabies may become endemic.

Human rabies in Timor-Leste

Between 1 January 2024 and 31 July 2025, 10 laboratory-confirmed cases of human rabies were reported in residents of five municipalities in Timor-Leste: Bobonaro, Covalima, Ermera, Liquica and Oecusse (**Fig. 1**). All cases were fatal. The median age was 21 years (range 2–54 years), and six (60%) were male. The median incubation period from rabies exposure to symptom onset was 96 days (range 85–251 days). On 16 June 2025, in response to the increasing number of cases, Timor-Leste declared rabies a public health emergency in the country.[7]

Between 1 April 2024 and 7 July 2025, 1987 cases of people being bitten by dogs were reported in Timor-Leste. Of these, 99 (5.0%) were bitten by dogs that tested positive for rabies. The dog bites were classified according to national guidelines for level of severity as follows: 72 (3.6%) were Category I (licks on intact skin); 835 (42.0%) were Category II (soft bite – skin bruised but not bleeding); and 965 (48.6%) were Category III (severe bites or any bat bites).[8] The exposure category was not recorded for 115 (5.8%) cases. The number

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Fig. 1. **Epidemic curve of confirmed human rabies cases by municipality and month of symptom onset, Timor-Leste, 1 January 2024–31 July 2025**

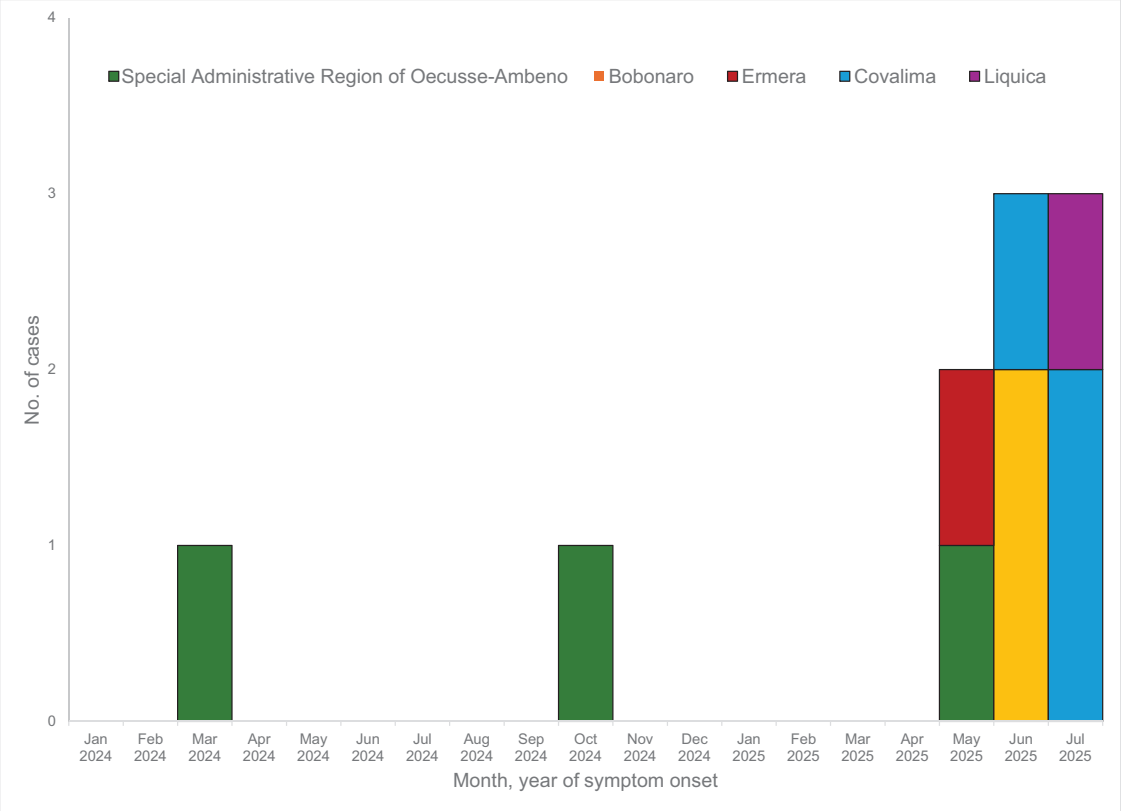

Table 1. **Number of rabies vaccine doses given to dog-bite victims, Timor-Leste, 1 April 2024 to 7 July 2025**

Number of rabies vaccine doses	All dog-bite victims, *n* (%)	Bite victims of rabies-positive dogs, *n* (%)
1	376 (18.9)	26 (26.3)
2	494 (24.9)	11 (11.1)
3	525 (26.4)	19 (19.2)
4	420 (21.1)	38 (38.4)
Unknown vaccination status	172 (8.7)	5 (5.1)
Total	1987 (100)	99 (100)

Only 248 (12.5%) of all dog-bite victims and 52 (52.5%) of victims of rabies-positive dogs received RIG.

of vaccine doses (RABIVAX-S, Serum Institute of India, Pune, India) administered is shown in **Table 1**.

Animal rabies in Timor-Leste

As cases of rabies increased in the neighbouring Indonesian province of Nusa Tenggara Timur in May 2023,[9] the Government of Timor-Leste launched a public awareness campaign and, in January 2024, began an intensive and ongoing mass vaccination programme for dogs, cats and monkeys. As of 7 July 2025, the rabies vaccine had been administered to 52 524 animals: 48 745 dogs, 3530 cats and 249 monkeys.[10]

A surveillance programme for animal rabies in Timor-Leste is ongoing. As of 22 July 2025, 140 animals had tested positive for rabies: 134 dogs, five goats and one pig. Animal detections were reported in five of the

13 municipalities, all in the western part of the country: Aileu, Bobonaro, Covalima, Ermera and Oecusse.

Veterinary surveillance officers have adopted a One Health approach to their response activities. Upon notification of dog-bite incidents or confirmation of rabies-positive animals, veterinary officers promptly inform the health-care services to ensure that potentially exposed individuals are assessed and, if appropriate, receive PEP.

DISCUSSION

Human and animal rabies cases have spread in Timor-Leste following the first human case in March 2024. Positive animal cases have been detected in five municipalities, and there will likely be further spread to other municipalities. Dog vaccination programmes and enhanced surveillance should continue in all municipalities in Timor-Leste to decrease the risk of transmission.

Any person in Timor-Leste who is bitten or scratched by an animal with the potential to transmit rabies (especially dogs, bats, monkeys and cats) should wash the wound immediately and present to a health post, health centre or hospital for rabies PEP assessment. When administered directly after potential exposure, rabies PEP is extremely effective in preventing infection and fatality.

It is important that human rabies vaccines and RIG are accessible in all areas of Timor-Leste, as animals with rabies are likely to continue moving eastward and into municipalities that have not yet been affected. Vaccines and RIG may be in limited supply in remote areas, and access should be ensured to reduce logistical barriers to immediate PEP administration following potential exposure. Mass dog vaccination should also continue.

We observed that only a small proportion of people bitten by dogs received the recommended full course of PEP doses. This could be due to difficulty in accessing health care or a lack of understanding of the risks from dog bites, given that Timor-Leste was until recently rabies-free. Increasing and maintaining high public health awareness through targeted, locally relevant health promotion is critical. Lessons from Timor-Leste may be applied to other nations in the Indo-Pacific region where similar challenges may exist.

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The authors have no conflicts of interest to declare.

Ethics statement

This public health response was conducted in compliance with relevant laws in Timor-Leste. Ethical clearance was not required for this study, as it utilized only secondary data sources.

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Progress on International Health Regulations (2005) core capacities in WHO's Western Pacific Region

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The International Health Regulations (2005; IHR) are a legally binding instrument for the 196 States Parties, including the 194 Member States of the World Health Organization (WHO), requiring them to build and maintain capacities across critical domains to prevent, detect and respond to public health threats. In an analysis of 15 IHR (2005) core capacity scores reported by States Parties in WHO's Western Pacific Region from 2021 to 2023, average regional scores increased from 68% in 2021 to 72% in 2022, then declined to 66% in 2023. Seven States Parties maintained consistently strong scores (≥85%), whereas nine exhibited fluctuations of at least 10 percentage points. Categorizing States Parties into three groups based on geographical and economic characteristics highlighted that core capacities such as financing, food safety and the control of zoonotic diseases were areas requiring additional capacity-building, particularly among Pacific Island States Parties. Low- and middle-income States Parties also reported notable gaps in financing and infection prevention and control. These findings underscore the need to strengthen national coordination and accountability mechanisms. The strategic establishment or designation of a National IHR Authority – a key amendment introduced in the 2024 revision of the IHR – has the potential to enhance implementation by ensuring institutional leadership, fostering multisectoral collaboration and facilitating resource mobilization. However, national efforts alone may not be sufficient. Regional coordination will enhance political commitment and promote coordinated action, thereby strengthening preparedness and response capacities across diverse contexts and supporting more effective implementation of the IHR (2005).

The International Health Regulations (2005; IHR) constitute a legally binding international instrument for 196 States Parties, which include all 194 Member States of the World Health Organization (WHO) as of 1 May 2025. States Parties are obligated to establish, strengthen and maintain the necessary core health capacities across sectors to ensure the rapid detection and timely reporting of and effective responses to public health risks and emergencies, thereby contributing to global health security.[1]

Since 2005, States Parties in WHO's Western Pacific Region, which comprises 27 Member States as of 1 May 2025, have significantly enhanced their IHR (2005) core capacities, including in surveillance, response, risk communication and laboratory systems, thus strengthening public health emergency preparedness and response, as outlined in Annex 1 of the IHR (2005).[2] However, the COVID-19 pandemic revealed vulnerabilities in global health systems, including gaps in preparedness, delays in reporting and insufficient coordination across relevant sectors and borders.[3–6] These challenges underscore the need to further strengthen core capacities and establish more robust mechanisms for multisectoral coordination to secure full implementation. In response, Member States commenced a process in January 2022 to amend the IHR (2005) to address these deficiencies.[7,8]

From 2022 to 2024, the Member State-led Working Group on Amendments to the International Health Regulations (2005) reviewed more than 300 proposed changes to the Regulations in light of experiences during the COVID-19 pandemic. After 2 years of negotiations, a set of amendments was adopted by the Seventy-seventh World Health Assembly in June 2024.[9] The amendments focus on enhanced coordination, capacity-building and rapid response mechanisms across all levels of the health security architecture.[7] These amendments

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aim to strengthen global health security by improving coordination, building core capacities and enabling timely responses to health threats. By meeting these obligations, States Parties are expected to contribute to preventing and mitigating the international spread of diseases.

A key amendment to the IHR (2005) requires the creation of a National IHR Authority (NIA) – that is, a national-level entity designated or established by the State Party to coordinate the implementation of the Regulations within the jurisdiction of the State Party.[10] The NIA is to be responsible for overseeing and ensuring the effective implementation of the IHR (2005). Strong multisectoral coordination is needed to effectively implement core capacities at the human–animal–environment interface; to ensure financial systems can reliably fund prevention, preparedness, response and recovery activities; to manage and reduce the risk of chemical, radiation and food safety incidents; and to maintain whole-of-government and whole-of-society coordination and policies for efficient responses to public health emergencies. These considerations highlight that strengthening core capacities requires not only technical enhancements but also strong political commitment and effective collaboration across multiple sectors.[11]

Importantly, the responsibility of the NIA is different from that of the National IHR Focal Point (NFP). NIAs will be mandated to drive policies, resource allocation and multisectoral engagement, while NFPs focus primarily on communication between WHO and States Parties. Operational NFPs are intended to ensure timely and continual communication with WHO and relevant stakeholders, and aim to ensure that health security information is conveyed accurately and promptly, including notifications, verifications and reports.[12] This precise and timely exchange of information is crucial for ensuring the early detection of and implementing effective responses to public health risks and emergencies, and is in itself a core capacity.[13]

States Parties are expected to establish and maintain the core capacities required under the Regulations. States Parties use the State Party Self-Assessment Annual Reporting (SPAR) tool to systematically evaluate their progress on implementing IHR (2005) core capacities, which they are legally obligated to do under Article 54 of the Regulations.[14] For the 15 capacities in the SPAR tool, States Parties rate their level on a scale of 1–5, with Level 1 indicating limited or no capacity and Level 5 representing advanced or sustained capacity. States Parties submit performance scores, with each level being associated with an approximate percentage, ranging from 0% to 100%, using a standardized methodology. Each indicator assesses specific technical areas, such as surveillance, laboratory capacities and systems, risk communication and community engagement, and financing. Monitoring SPAR results can help to identify gaps and prioritize capacity-building efforts.[15]

This paper analyses the self-reported IHR (2005) core capacities of 27 States Parties in WHO's Western Pacific Region, based on their SPAR submissions. The findings will help States Parties to identify priorities for capacity-strengthening and priorities for implementing IHR (2005) amendments, including designating or establishing a NIA.

METHODS

States Parties use the SPAR tool, updated in 2021, to fulfil their annual reporting obligations under the IHR (2005).[16] For this analysis, scores of States Parties in the Western Pacific Region from 2021 to 2023 were obtained from the electronic SPAR platform, which is publicly available. To analyse core capacities in the Region, the average SPAR score for each of the 15 indicators was calculated, rounded to the nearest whole number and colour coded for the years 2021, 2022 and 2023. The colour coding represents the level of implementation of each core capacity, and higher scores indicate greater capacity, based on self-reporting. The colour scheme is: red (0–20), orange (21–40), yellow (41–60), light green (61–80), dark green (81–100) and grey for unreported.

For the analysis, States Parties were categorized into three groups – high-income, low- and middle-income, and Pacific Island – based on geographical and economic characteristics, using 2023 World Bank classifications.[17] A radar chart was used to visualize the overall score for each core capacity (abbreviated as C1–C15). States Parties with missing data were excluded from the analysis.

RESULTS

A total of 26 States Parties reported on their core capacities in 2023, compared with 19 in 2022 and 22 in 2021 (**Table 1**). All 27 Member States submitted reports

Table 1. **Average score (%) for International Health Regulations (2005) core capacities for States Parties, measured by the Self-Assessment Annual Report tool, WHO Western Pacific Region, 2021–2023**[a]

State Party (*N* = 27)	Year		
	2021	2022	2023
Australia	88	89	89
Brunei Darussalam			71
Cambodia	57	60	68
China	94	93	94
Cook Islands	59	71	68
Fiji	54	48	55
Japan	98	99	99
Kiribati	64		40
Lao People's Democratic Republic	51	53	55
Malaysia	85	89	89
Marshall Islands			53
Micronesia, Federated States of	43	53	53
Mongolia	78	72	66
Nauru			38
New Zealand	85	85	85
Niue		69	50
Palau	47		57
Papua New Guinea			42
Philippines	60	67	64
Republic of Korea	95	99	99
Samoa	49	51	46
Singapore	94	94	94
Solomon Islands	51		51
Tonga	55	70	70
Tuvalu	61		
Vanuatu	74	54	56
Viet Nam	64	52	54
Regional average	**68**	**72**	**66**

Scores: 81–100; 61–80; 41–60; 21–40; 0–20; Unreported

[a] States Parties use the State Party Self-Assessment Annual Reporting (SPAR) tool to rate their level in 15 capacities on a scale of 1–5, with Level 1 indicating limited or no capacity and Level 5 representing advanced or sustained capacity. Parties submit performance scores, with each level being associated with an approximate percentage, ranging from 0% to 100%. The denominators used for each year reflect the number that reported.

at least once during the 3-year period, with 19 reporting every year. The regional average score increased from 68% in 2021 when 22 States Parties reported to 72% in 2022 when 19 reported, and then declined to 66% in 2023 when 26 reported (**Table 1**).

Seven States Parties (Australia, China, Japan, Malaysia, New Zealand, the Republic of Korea and Singapore) maintained strong and stable scores, consistently exceeding 85%. Nine States Parties (Cambodia, the Cook Islands, Kiribati, the Federated States of Micronesia, Niue, Palau, Tonga, Vanuatu and Viet Nam) exhibited large fluctuations in their scores, of 10 points or more. One State Party (Mongolia) reported a slight decline, and two (Cambodia and the Lao People's Democratic Republic) reported steady increases in core capacities across the years.

Among 26 of the 27 States Parties that reported in 2023 (**Fig. 1**), good capacity (≥60% score) was reported

for laboratory (C4), surveillance (C5), health emergency management (C7), health services provision (C8) and risk communication and community engagement (C10). The most significant gaps in core capacities were reported for zoonotic diseases (C12), food safety (C13), chemical events (C14) and radiation emergencies (C15). Scores varied across income and geographical groupings, with high-income States Parties generally posting higher overall scores, while Pacific Island States Parties demonstrated more limited capacity across several domains, and low- and middle-income States Parties reported lower capacities in financing (C3) and infection prevention and control (C9).

DISCUSSION

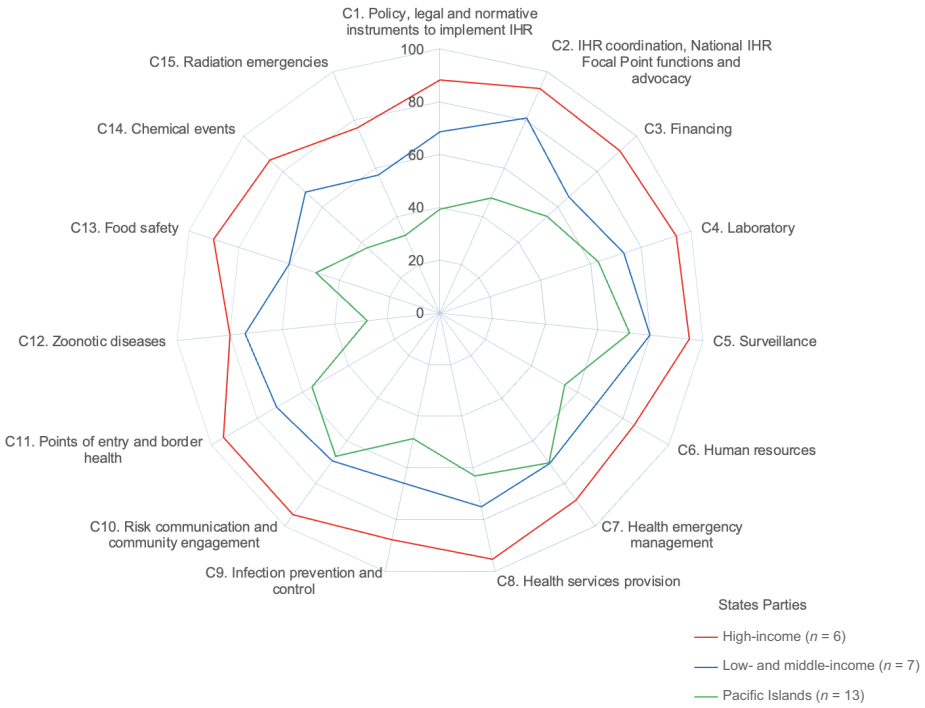
The status of IHR (2005) core capacities among States Parties in WHO's Western Pacific Region reflects diversity in national systems, resources and contexts. High-income countries report consistently high scores, while many Pacific Island and low- and middle-income countries face challenges due to limited human resources, geographical dispersion and reliance on external support for key public health functions. These contextual differences influence not only the development of national capacities but also the comparability of progress across the Region. As a result, regional average scores can be influenced by which States Parties report. One possible reason for the decrease in the average score from 2022 to 2023 is the increase in reporting by some lower-scoring Pacific Island countries, which may have affected the overall regional average. While some States Parties have made notable progress in areas such as surveillance, laboratory services and emergency management, all States Parties have opportunities to further strengthen specific domains, particularly food safety, zoonotic disease control and sustainable financing. Sustained investment and coordination are critical for ensuring that all States Parties can effectively prevent, detect and respond to public health threats.

Joint External Evaluations (JEEs), another key tool within the IHR (2005) Monitoring and Evaluation Framework, complement SPAR by providing external, qualitative assessments that help identify strengths and priorities. In the Western Pacific Region, JEEs conducted in several countries have offered important context to enable better interpretation of SPAR findings, thus providing additional insights for capacity-strengthening, especially when self-assessments may overlook operational challenges. For instance, States Parties in the Pacific Island countries have highlighted persistent workforce shortages, limited surge capacity and the critical need for multisectoral coordination mechanisms to rapidly mobilize external support in response to chemical or radiation emergencies or other acute public health hazards. In particular, geographical dispersion continues to pose significant challenges for Pacific Island States Parties.[18–24]

Meaningful progress has been made by States Parties in strengthening core capacities. For example, by establishing and reinforcing emergency medical teams (EMTs), States Parties have bolstered their ability to rapidly respond to outbreaks and disasters, thus strengthening the IHR (2005) core capacities critical for effective health emergency management and international collaboration. Since the inception of the EMT Initiative in 2010 following the devastating Haiti earthquake, 16 of the 53 WHO-classified EMTs (31%) that have been established are in the Western Pacific Region.[25] Alongside the EMTs classified for international response, nearly every Member State in the Region has established a national EMT or is in the process of doing so. This means that nearly all States Parties in the Region have domestic EMTs ready to provide surge assistance to others in times of crisis. In recent years, EMTs from the Western Pacific Region have deployed to provide rapid clinical care during disasters, outbreaks and mass gathering events, and they have also helped build local capacities during joint training and simulation exercises.[26] Their presence and coordinated action facilitate knowledge transfer and enhance emergency management capacities. The measures taken to establish and reinforce EMTs demonstrate that while many States Parties have relatively small health systems, they can leverage regional solidarity and external technical assistance to address chemical, biological and radiological incidents more effectively.[27–32]

A similar story can be told about the regional uptake of the Global Outbreak Alert and Response Network (GOARN), with 80 of the 320 (25%) global partner institutions coming from the Western Pacific Region.[33] Nearly 90 GOARN missions were conducted in the Region during the COVID-19 pandemic, and the mechanism was more recently used to respond to measles events to bolster clinical management and infection prevention and control activities.[34] The experts deployed not only supported

Fig. 1. **Average score of States Parties (*N* = 26) on specific International Health Regulations (2005) core capacity, by income or geographical area, WHO Western Pacific Region, 2023[a]**



IHR: International Health Regulations (2005).

[a] For this analysis, States Parties in WHO's Western Pacific Region were categorized into three groups based on their geographical and economic characteristics, using 2023 World Bank classifications for reference.[9] High-income States Parties are Australia, Brunei Darussalam, Japan, New Zealand, the Republic of Korea and Singapore. Low- and middle-income are Cambodia, China, the Lao People's Democratic Republic, Malaysia, Mongolia, the Philippines and Viet Nam. The Pacific Island States Parties are the Cook Islands, Fiji, Kiribati, the Marshall Islands, the Federated States of Micronesia, Nauru, Niue, Palau, Papua New Guinea, Samoa, the Solomon Islands, Tonga and Vanuatu. Tuvalu did not report data for 2023 and was excluded from this analysis.

immediate needs but also provided training to prepare health systems for future outbreaks. Many investments in EMTs, GOARN and other surge mechanisms have been supported from within the Region, reflecting strong solidarity, alongside contributions from international partners and other countries. These mechanisms not only strengthen regional response capacities but also enable cross-border collaboration, ensuring that expertise and resources can be mobilized swiftly within and beyond the Western Pacific Region when needed.[35]

While zoonotic diseases (C12) are noted as one of the weaker core capacities across the Region, ongoing regional initiatives aim to strengthen this area through collaborative approaches. Fourteen of 27 States Parties in the Western Pacific Region have established multisectoral coordination mechanisms, integrating the human health, animal health and environmental health sectors to detect and contain zoonotic threats more efficiently.[36,37]

Viet Nam's integrated response to a 2024 *Salmonella* outbreak related to banh mi demonstrated effective multisectoral coordination, ensuring rapid containment. Authorities immediately mobilized laboratories, environmental and epidemiological surveillance, and risk communication, enabling swift confirmation of the outbreak and public advisories to prevent further spread.[38] During the outbreak, the WHO International Food Safety Authorities Network (INFOSAN) played a crucial role in accelerating the exchange of information and coordinating food safety actions. While the IHR (2005) mandates international notification and management of public health risks, INFOSAN facilitates real-time technical collaboration among food safety agencies. By enabling swift data-sharing and coordinated risk mitigation, INFOSAN complemented IHR (2005) mechanisms, ensuring a timely and effective response. As of December 2024, all 27 States Parties in the Western Pacific Region have

INFOSAN contact points. By engaging in the Network, States Parties can bridge capacity gaps, share critical data and coordinate timely responses to protect public health.[39] Investing in food safety has major benefits for strengthening surveillance systems, including for monitoring antimicrobial resistance and providing genomic surveillance of foodborne pathogens and resistant organisms, further adding to the value of the overall food supply chain. Continual regional efforts to improve the management of food safety incidents are critical for food safety systems, especially maintaining sustainable funding and political support.

Despite notable progress in some core capacities, many States Parties still face challenges in managing hazards that require robust, multisectoral coordination, especially chemical (C14), radiological (C15) and food safety (C13) events. The recent amendments to the IHR (2005) underscore the importance of strengthening core capacities to address evolving public health threats. Establishing a NIA provides an opportunity to further strengthen multisectoral collaboration, resource integration and international collaboration. An effectively empowered NIA can coordinate these efforts by engaging multiple stakeholders and driving both whole-of-government and whole-of-society approaches. A well-resourced NIA can optimize resource allocation, streamline decision-making and foster transparent information-sharing, thereby making steady progress towards more robust implementation of the IHR (2005). In turn, this progress helps address persistent gaps in areas such as food safety, chemical and radiological preparedness, and risk communication.

Additionally, cross-border public health threats call for stronger regional coordination. Dedicated regional coordination of political, technical and operational government actors, facilitated by WHO, will strengthen political commitment, coherence and resource mobilization among Member States while enhancing global health collaboration and ensuring swift, equitable responses to crises.[40] For example, where establishing complete domestic capacity is not practical – especially for certain chemical or radiation events – States Parties may benefit from the capacities available through existing regional networks and technical support arrangements, which allow resource-limited States Parties to leverage international expertise, as needed.[41]

These considerations are especially relevant given the low likelihood but potentially high impact of certain incidents, such as chemical or radiation events, in many island settings, as well as the prohibitive costs of maintaining in-country capacities to respond to some of these lower-likelihood hazards. As a result, several Pacific Island States Parties rely on formal agreements with larger neighbours or regional hubs for technical expertise, including laboratory analyses. Such arrangements underscore the need for well–defined protocols and multisectoral mechanisms, particularly in advance of events such as chemical spills, radiation leaks or other complex hazards, to enable the rapid mobilization of external support.[42]

This regional analysis is based on self-reported data from SPAR, which may over- or underestimate actual capacities due to reporting bias or differences in reporting quality and completeness across countries.[43] It is important to note that strengthening data collection and information-sharing practices is crucial for gaining a comprehensive understanding of progress made in improving core capacities. Annual State Party reporting represents an important step in sharing knowledge and in transparency, and these can guide investments and strategic actions. Incorporating qualitative assessments, such as JEEs, alongside SPAR results can highlight the nuances of challenges and opportunities. Regular reporting through the SPAR tool, mandated under the IHR (2005), and the proactive exchange of experiences among States Parties promote transparency, can help identify best practices, can facilitate joint action to address common limitations, and can leverage resources that can be shared across borders. Overall, sustaining progress in IHR (2005) core capacities requires strong national leadership and coordination. NIAs can play a critical role in furthering the implementation of the core capacities in States Parties by aligning policies, resources and multisectoral action, and the NIAs are central to translating assessments into concrete improvements. Strengthening national systems while leveraging regional diversity and collaboration will be key to building resilient systems and enhancing collective health security.

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Conflicts of interest

STC is an associate editor and GS is the executive editor of the *Western Pacific Surveillance and Response* journal. They were not involved in the editorial decision to publish this article. The other authors have no conflicts of interest to declare.

Ethics statement

This regional analysis consists of a review and synthesis of openly available public health data. It does not involve human participants, identifiable personal data or interventions. Based on organizational ethical review policies, such activities do not require formal ethics approval.

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Event-based surveillance in the Republic of Korea: assessment of the effectiveness of Epidemic Intelligence from Open Sources

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In 2023, the Republic of Korea's Korea Disease Control and Prevention Agency (KDCA) enhanced its event-based surveillance practices by using the World Health Organization's (WHO) Epidemic Intelligence from Open Sources (EIOS) to actively screen and share information about potential public health threats to the country. This report describes the preliminary assessment of the results of implementing these enhanced event-based surveillance activities from June to October 2023. During this period, 425 (0.4%) events were detected globally by the KDCA from 99 945 media articles, with the highest frequency reported in Asia (185, 43.5%) and North America (81, 19.1%). The most frequently reported diseases or conditions were dengue fever (111, 26.1%) and mpox (32, 7.5%). Eight events were detected early by the KDCA using EIOS before being officially listed on WHO's Event Information Site (EIS) or in Disease Outbreak News (DON), with an average interval of 20 days (range: 5–41) between the detection date and posting on EIS or DON. Thus, EIOS is efficient in aiding early detection of potential public health threats at the national level. This finding highlights the importance of sustaining international cooperation and support to enhance surveillance capabilities in resource-limited settings and expanding the scope of EIOS, including by incorporating additional sources and sources in additional languages, reducing noise. However, as the current report is based on a descriptive analysis, in the future a systematic evaluation of event-based surveillance using EIOS to identify relevant attributes will need to be conducted.

Event-based surveillance (EBS) is the organized and rapid capture of information about events that are a potential risk to public health.[1] This information includes rumours and other ad hoc reports transmitted through formal channels (e.g. established routine reporting systems) and informal channels (e.g. media). Information obtained through EBS should be rapidly assessed for its potential impact on public health risks, and appropriate responses should be undertaken. The World Health Organization (WHO) has emphasized the importance of developing and implementing EBS systems, alongside indicator-based systems, to rapidly detect public health emergencies and gather information for risk assessments, while adhering to commitments outlined in the International Health Regulations (2005; IHR).[2]

In 2017, WHO launched the Epidemic Intelligence from Open Sources (EIOS) initiative in collaboration with global public health stakeholders.[3] This system collates and categorizes articles daily from various open sources using text mining and analytical modules. The open sources include traditional online media, government and other official websites, and existing web-based EBS tools, such as the Global Public Health Intelligence Network (GPHIN). EIOS has been widely used nationally and internationally to enhance capacities for the early detection of events and to facilitate EBS activities.

In the Republic of Korea, the Korea Disease Control and Prevention Agency (KDCA) joined the EIOS community after the EIOS Global Technical Meeting held in Seoul in 2019. Since then, EIOS has been used on an ad hoc basis to support EBS activities, including active screening and for sharing information about events that have the potential to pose public health threats to the country, such as threats from emerging infectious diseases and unknown pathogens, and events arising from international mass gatherings[4] and new variants of COVID-19. Following standard operating procedures for EBS and risk assessments developed by the Division of Risk Assessment, EBS activities at the KDCA were enhanced

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in 2023 through the routine utilization of EIOS. On 16 May 2023, the Division of Risk Assessment established a daily routine surveillance dashboard within EIOS, using selected categories and sources, to assess the effectiveness of EIOS in detecting public health threats, with a focus on infectious diseases. This report provides an overview of the use of the dashboard and describes a preliminary assessment of using EIOS for EBS activities at the KDCA from 1 June to 31 October 2023. The report highlights the effectiveness of EIOS in aiding in the early detection of potential public health threats caused by infectious diseases at the national level.

METHODS

Data collection process

Supplementary Fig. 1 illustrates the process of EBS activities at the KDCA while monitoring EIOS, including detecting, filtering and verifying information about potential events, as well as conducting daily assessments and weekly discussions, and disseminating information about them. First, detection is conducted daily at the Division by eight trained personnel to capture unstructured information from combined sources, including both the EIOS dashboard (i.e. the daily routine surveillance dashboard) and conventional sources, which include media and other web-based sites that monitor infectious diseases, national health-related ministries or authorities, and official letters from embassies. Second, filtering is performed to screen the information according to selection criteria, such as determining whether there is an unusual or unexpected event or clustered morbidity and mortality (**Supplementary Box 1**). If information might be relevant to more than one of the selection criteria, it is defined as a signal. Third, verification and daily assessments are carried out by cross-checking the validity of the signal with multiple sources, including by collecting reliable additional information, from sources such as press releases or official statements, as well as direct communication through official letters from embassies and IHR National Focal Points. Once verified, a signal is classified as an event – that is, it may be a public health threat to the Republic of Korea. Fourth, weekly discussions are conducted by the Division to determine which events should be communicated based on their urgency and priority, and detailed information is then disseminated within or outside the KDCA accordingly.

Data sources

We used the EBS database, managed by the Division of Risk Assessment. Once a signal is identified as an event through the verification and daily assessment processes, information about an event is recorded, such as the date of detection, event name, affected continents and countries, information sources, event description and modes of communication. To compare the EBS database at the KDCA with information from WHO, data were extracted about events officially posted between 1 June and 31 October 2023 on the WHO Event Information Site (EIS) for IHR National Focal Points and in Disease Outbreak News (DON) as of 5 January 2024, including the posting date, event name and affected countries.

Data analysis

The number of signals (i.e. information screened through initial filtering by trained personnel that might be relevant to the selection criteria) and events identified (i.e. signals that have the potential to pose public health threats, as evaluated through verification and daily assessments) and communication through EBS activities using EIOS were described for the period between 1 June and 31 October 2023.

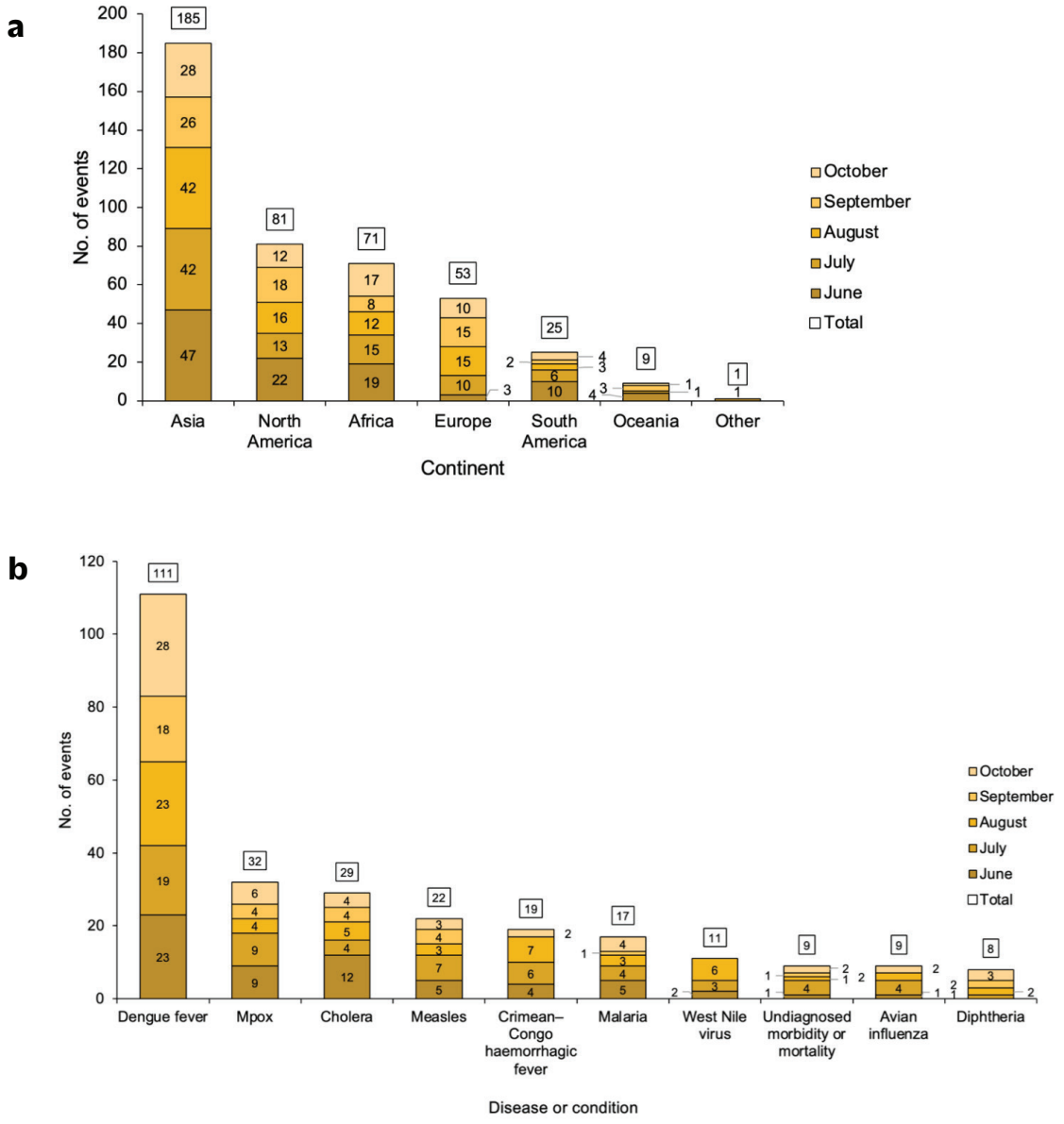
A descriptive analysis of events recorded in the EBS database at the KDCA was carried out. The frequency of events by continent and the 10 most common diseases or conditions by month were analysed. Ongoing events were included if they were related to events previously documented in the EBS database. Additionally, a manual review of data about events on EIS and DON was undertaken to identify events that corresponded to those detected by the KDCA through its EBS activities using EIOS, and the estimated intervals were calculated between the detection date via the KDCA's EBS and the posting date on EIS or on DON. All analyses were conducted using a Microsoft Excel 2021 spreadsheet.

RESULTS

Detection and communication of events

From 1 June to 31 October 2023, a total of 99 945 pieces of information were collected on the EIOS dashboard, excluding data scanned from conventional sources, of which 2844 (2.8%) signals met the selection

Fig. 1. **(a) Number of events by continent and (b) 10 most frequently reported diseases or conditions identified through event-based surveillance activities using Epidemic Intelligence from Open Sources, by month, Korea Disease Control and Prevention Agency, June–October 2023**[a]



[a] The category other refers to an event that occurred in the Southern Hemisphere and could not be classified under the predefined continental categories.

criteria. Following verification and daily assessment of all identified signals, 425 (0.4%) events detected globally had the potential to pose a public health threat to the Republic of Korea. The number of detected events varied slightly by month, ranging from 72 (16.9%) in September and October to 106 (24.9%) in June (**Table 1**). Among the 425 events detected, information about 35 (8.2%) was shared internally with relevant divisions within the KDCA through brief situation analyses or weekly restricted reports about global infectious diseases; information about 96 (22.6%) events was disseminated externally, based on urgency and priority, with information about 51 (53.1%) of these disseminated through weekly open-access reports about global infectious diseases, information about 37 (38.5%) disseminated through online travel health advice platforms and information about 8 (8.3%) disseminated through monthly newsletters for health-care workers (**Table 1**).

Table 1. **Number of signals and events identified, and instances of communication conducted through event-based surveillance activities using Epidemic Intelligence from Open Sources, by month, Korea Disease Control and Prevention Agency, June–October 2023**

Variable	Information[a]	Signals[b]	Events[c]	Communication[d]	
				Internal[e]	External[f]
Total	99 945 (100.0)	2844 (100.0)	425 (100.0)	35 (100.0)	96 (100.0)
June	19 001 (19.0)	717 (25.2)	106 (24.9)	6 (17.1)	19 (19.8)
July	18 441 (18.5)	542 (19.1)	87 (20.5)	5 (14.3)	16 (16.7)
August	20 934 (20.9)	590 (20.7)	88 (20.7)	9 (25.7)	14 (14.6)
September	20 675 (20.7)	546 (19.2)	72 (16.9)	6 (17.1)	24 (25.0)
October	20 894 (20.9)	449 (15.8)	72 (16.9)	9 (25.7)	23 (24.0)
Average no. per working day (n = 153 days)	653.2	18.6	2.8	0.2	0.6

Data are presented as *n* (%).

[a] Information comprises articles pulled into the EIOS dashboard, excluding data scanned from conventional sources.

[b] Signals are defined as information screened by initial filtering by trained personnel that might be relevant to the selection criteria.

[c] Events are defined as signals identified through verification and daily assessment that have the potential to pose public health threats to the Republic of Korea.

[d] Communication is defined as the sharing of detailed information about events that have been determined through weekly discussions to require dissemination, based on urgency and priority.

[e] Internal communication includes sharing brief situation analyses and weekly restricted reports about global infectious diseases with relevant divisions within the Korea Disease Control and Prevention Agency.

[f] External communication includes weekly sharing of open-access reports about global infectious diseases (e.g. https://dportal.kdca.go.kr/pot/bbs/BD_selectBbsList.do?q_bbsSn=1009, in Korean) and monthly newsletters for health-care workers (e.g. http://kdcanewsletter.or.kr, in Korean), as well as updating online travel health advice platforms (e.g. http://xn--now-po7lf48dlsm0ya109f.kr/nqs/oidnow/main.do, in Korean).

Events by continent and disease or condition

The total number of events during the study period varied by continent. The most frequently affected continent was Asia, reporting 185 (43.5%) events. The North American continent reported 81 (19.1%), followed by Africa with 71 (16.7%), Europe with 53 (12.5%) and South America with 25 (5.9%). The fewest events were reported in Oceania (9, 2.1%). Among the 425 global events, the most frequently reported disease was dengue fever, accounting for 111 (26.1%) events, followed by mpox (32, 7.5%) and cholera (29, 6.8%). Other frequently reported diseases or conditions included measles (22, 5.2%), Crimean–Congo haemorrhagic fever (19, 4.5%) and malaria (17, 4.0%) (**Fig. 1**). Additionally, the majority of events were reported by GPHIN and through the EIOS dashboard (313, 73.6%) (**Supplementary Table 1**).

Review of events

After reviewing the data extracted from EIS and DON, we identified 15 events corresponding to those recorded in the EBS database at the KDCA among the events posted on EIS from 1 June to 31 October 2023; five events were excluded as they were not recognized as events by the KDCA, despite being posted by WHO. Of the 15 identified events, seven documented in the EBS database at the KDCA were originally detected through EIS; these included six influenza events identified as being an avian or animal influenza virus from Brazil, China, the Netherlands, the United Kingdom of Great Britain and Northern Ireland, and the United States of America, as well as one event associated with vaccine-derived poliovirus type 2 from the United Republic of Tanzania. The remaining eight events were detected early through EBS using the EIOS dashboard at the KDCA before being officially listed on EIS or DON. The average interval between the detection date via EBS at the KDCA and the posting date on EIS or DON for the eight events was approximately 20 days (range: 5–41) (**Table 2**).

DISCUSSION

Through EBS activities conducted using an EIOS dashboard at the KDCA, a total of 425 events were detected between 1 June and 31 October 2023. Dengue fever accounted for the highest proportion of diseases, followed by mpox. The global upsurge in dengue cases in 2023 compared with prior years was consistently reported, and is partly due to climate change.[5,6] In

Table 2. **Characteristics of eight events detected early through event-based surveillance activities using Epidemic Intelligence from Open Sources at the Korea Disease Control and Prevention Agency, compared with the time events were posted on the World Health Organization's Event Information Site and Disease Outbreak News site, June–October 2023**

Detection date at KDCA[a]	Event[b]	Country	EIS posting date	DON posting date	Interval (days)[c]
29 June	Guillain–Barré syndrome	Peru	16 July	25 July	17
18 July	Dengue fever	Bangladesh	4 August	11 August	17
20 July	Dengue fever	Egypt	9 August	NA	20
21 July	Avian influenza	China	26 July	NA	5
31 August	Dengue fever	Chad	11 October	16 October	41
4 September	Diphtheria	Guinea	12 October	18 October	38
12 September	Nipah virus infection	India	28 September	3 October	16
13 September	Botulism	France	NA	20 September	7

DON: Disease Outbreak News; EIS: Event Information Site; KDCA: Korea Disease Control and Prevention Agency; NA: not applicable.

[a] The detection date is the date when signals were detected through event-based surveillance activities using the EIOS dashboard by trained personnel at the KDCA.

[b] The following events are not included in this table: seven events of avian or animal influenza virus originally detected through EIS, as well as five events posted on EIS that were not identified as events by the KDCA from June to October 2023.

[c] The interval represents the number of days between the detection date at the KDCA and the posting date on either EIS or DON, whichever was earlier.

2023, several local transmission events of dengue were reported in Taiwan (China) in June;[7] Chad in August;[8] and in France, Italy and Spain from June to November.[6] Although dengue is not endemic in the Republic of Korea, and most cases involve travellers infected outside the country, the occurrence of viraemic travel-related cases underscores the potential for local transmission, especially considering the rapid increase in dengue cases globally and in international travel. Therefore, pre-emptive surveillance measures for imported cases remain pivotal to prevent local transmission of dengue virus in the future,[9] as the vector (*Aedes albopictus*) is widespread across the country. In Asia and North America, the continents with the most reported events, the United States, Taiwan (China) and India had the highest counts (data not shown).

Although the types of diseases and conditions reported varied, the majority of those reported from Taiwan (China) were dengue fever, likely influenced by regular updates on the dengue fever outbreak provided by the government following the first local case in June 2023.[7] Hence, caution needs to be exercised when interpreting the results of ongoing events in EBS databases.

This report has at least two limitations. First, detected events were categorized based on unstructured information, including outbreak reports or media articles from the EIOS dashboard and conventional sources; thus, the frequency of events does not indicate the number of confirmed cases. Second, data were not systematically analysed about ongoing events related to events previously documented in the EBS database; therefore, the number of ongoing events might have been overestimated.

The low number or absence of events in parts of Africa and East Asia may reflect limited surveillance and laboratory capacity for disease detection and notification in low- and middle-income countries or challenges regarding language barriers within EIOS. Ganser et al. identified global disparities in EBS performance for disease outbreak detection, with high-income countries demonstrating optimal performance.[10] Additionally, only five Member States from the WHO Western Pacific Region – China, Japan, the Philippines, the Republic of Korea and Singapore – had joined the EIOS community as of 12 December 2023.[11] These observations emphasize the significance of sustaining international cooperation and support to enhance surveillance capabilities in

resource-limited settings and expanding the scope of EIOS, including by incorporating additional sources and languages. This will contribute to improving the completeness of EBS when using EIOS, thus enabling early detection and prompt response to public health threats worldwide.

The average interval between the time an event was detected through the KDCA's EBS activities using EIOS and the posting date for the event on EIS or DON for eight events was approximately 20 days. Original sources of information pooled into the EIOS dashboard for those events included three media articles from GPHIN. These results support the utility of EBS using EIOS to ensure timely detection of potential public health threats at the national level,[12] in alignment with information about country experiences presented by Brazil, Egypt, Iraq and Sierra Leone during the EIOS Global Technical Meeting in 2022.[13] In addition, five events posted on EIS from June to October 2023 were not identified as events following verification and daily assessment by the KDCA. This indicates that there may be variations in the standards used to identify events that reflect differences in the prioritization and potential impact of public health threats between the national and international levels.

Out of a total of 99 945 sources pulled into the EIOS dashboard from 1 June to 31 October 2023, 2844 were classified as signals and 425 as events. This implies a need for human intelligence to filter out irrelevant or duplicate articles from the substantial volume of data in EIOS. While human monitoring by experienced health professionals remains crucial when performing EBS activities using EIOS, such as building new dashboards to reflect monitoring for different priorities and reviewing detected events for verification, future research could explore the potential application of advanced artificial intelligence to improve the performance of EIOS by reducing noise – that is, irrelevant information about events of interest – and enhancing the accuracy of signal identification in EIOS.

In conclusion, despite the recognized need to reduce noise and expand global utilization of EIOS, using EIOS for EBS activities has proven to be efficient in aiding the early detection of potential public health threats at the national level, as reported from the Republic of Korea. However, a systematic evaluation of EBS activities that use EIOS at the KDCA is required to identify relevant attributes, such as timeliness or sensitivity.[14]

Conflicts of interest

The authors have no conflicts of interest to declare.

Ethics statement

No ethics approval was sought for this report as the data were collected through EBS activities that did not require the direct participation of or intervention with human participants.

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