Temporal trends in climate-related extreme weather events and climate-sensitive diseases in Fiji, Kiribati and Vanuatu, 2010–2019

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Objective: Climate change is amplifying health risks in Pacific island countries and territories with extreme weather events, such as cyclones, floods and droughts predicted to contribute to more frequent and severe disease outbreaks. We sought to explore the utility of surveillance data collected by the Pacific Syndromic Surveillance System for identifying temporal associations between extreme weather events and climate-sensitive diseases in selected Pacific island countries and territories.

Methods: We extracted data on extreme weather events from the Emergency Events Database for three selected countries that met our study inclusion criteria (Fiji, Kiribati and Vanuatu) for the period 2010–2019. For each country, timelines were constructed to examine correlations between the extreme weather events and weekly case counts of five syndromes currently monitored by the Pacific Syndromic Surveillance System – diarrhoea, influenza-like illness, dengue-like illness, acute fever and rash, and prolonged fever. The completeness of syndromic reporting was also assessed.

Results: Increases in diarrhoea and influenza-like illness cases were frequently observed following cyclones and floods, particularly in Fiji and Kiribati. Vanuatu also showed increased post-cyclone diarrhoea case counts, though less consistently. Prolonged fever and dengue-like illness trends generally aligned with seasonal rainfall patterns rather than specific extreme weather events, while acute fever and rash displayed variable trends. Reporting consistency generally improved over time, but intermittent gaps persisted.

Discussion: Our descriptive analyses suggest potential associations between cyclones and floods and increased cases of diarrhoea and, to a lesser extent, influenza-like illness. Current limitations in data granularity and completeness underscore the need to strengthen existing regional surveillance systems and integrate health, weather and climate data to enhance early warning systems and public health responses to the impacts of climate change in the Pacific region.

Climate change is exacerbating existing pressures on vulnerable communities and systems worldwide, but particularly in the Western Pacific Region.[1–6] This region includes 22 Pacific island countries and territories (PICTs) of varying sizes and populations, ranging from 10.1 million in Papua New Guinea to 50 in the Pitcairn Islands.[7,8] Many PICTs are low-lying and highly susceptible to sea-level rise, coastal erosion and saline contamination of freshwater resources.[1,3–6] Additional climate concerns include threats to food security through ocean acidification and an increased burden of climate-sensitive diseases, such as dengue, malaria and chikungunya.[1,3–6,9–11] Several studies have cautioned that warming temperatures will expand disease vector ranges, exposing previously unaffected populations to new health risks.[1,3,5,6,11–13] For example, in Fiji, the potential for dengue transmission (relative vectorial capacity) is projected to increase towards 2070 under both low- and high-emission scenarios.[14]

PICTs are also highly exposed to extreme weather events (EWEs) such as cyclones, floods and droughts.[15–17]

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Six PICTs – Fiji, Kiribati, Papua New Guinea, the Solomon Islands, Tonga and Vanuatu – rank among the world's top 20 countries considered most at risk from EWEs.[5,18] EWEs disrupt health services, damage infrastructure, contaminate water supplies, and increase the risk of disease outbreaks such as cholera and typhoid.[11,16,19–23] As climate change intensifies, the frequency and severity of EWEs are expected to increase, further straining health systems already facing resource and capacity constraints.[1,3,24]

Despite being identified as a priority by the Pacific Community (SPC), research on the impact of climate change on climate-sensitive disease epidemiology due to shifting EWE patterns remains limited. This is in part due to a paucity of long-term, high-quality data on the incidence of vector- and waterborne diseases,[1,3,4,6,23,25–29] as many PICTs lack the resources and infrastructure required to support comprehensive disease surveillance, particularly in rural areas. This lack of routine surveillance data hampers efforts to establish causal links between climate-sensitive disease outbreaks and specific EWEs.[1,4,5,10,24,29,30]

Currently operating across all 22 PICTs plus New Zealand under the direction of the Pacific Public Health Surveillance Network (PPHSN), the Pacific Syndromic Surveillance System (PSSS) collates weekly data on five syndromes from a network of participating sentinel sites.[10,24] Although primarily designed to support early warning of disease outbreaks, PSSS data offer a possible alternative data source for climate change impact research.[4,12,20,31] Therefore, the aim of this study was to explore the feasibility of using PSSS data to investigate temporal correlations between weekly case counts of five syndromes and EWEs. The secondary objective was to generate foundational insights to guide future hypothesis-driven climate change research, inform the development of climate-sensitive surveillance systems, and contribute to public health planning and response in the Western Pacific Region.

METHODS

Study design and setting

A retrospective, descriptive, ecological approach was adopted to assess the potential of data collected by the Emergency Events Database (EM-DAT) and PSSS for investigating associations between EWEs and climate-sensitive diseases in three PICTs: Fiji, Kiribati and Vanuatu. These countries were selected because of their geographical representativeness, completeness of PSSS reporting from 2010 to 2019, and vulnerability to EWEs (based on a global ranking of EWE risk).[18] Moreover, these three countries had prioritized climate-sensitive diseases in their inaugural climate change and health vulnerability assessments undertaken in partnership with the World Health Organization (WHO) in 2010–2013.[5,32] Although other PICTs participated in the assessments, PSSS reporting gaps or inconsistencies and the absence of public data and reported EWEs during the study period precluded their inclusion in the analysis.

Data sources

Pacific Syndromic Surveillance System

The PSSS collects weekly syndromic case-count data on five syndromes: acute fever and rash (AFR), diarrhoea, dengue-like illness (DLI) (from week 14, 2017), influenza-like illness (ILI) and prolonged fever (PF). Since its establishment in 2010, the PSSS network has steadily expanded, from 19 sentinel sites across seven PICTs to over 130 sites in 21 participating PICTs by 2019.[10,33] Sentinel sites primarily comprise hospitals, though smaller community-based clinics are also included. Standardized case definitions for included syndromes are applied across all sites (**Table 1**).[24,33] Weekly totals are aggregated at the national level and reported to the WHO Division of Pacific Technical Support. Data are publicly available through weekly PSSS bulletins disseminated via the PPHSN PacNet mailing list. Data are also publicly archived by PPHSN, the WHO Institutional Repository for Information Sharing and ReliefWeb.

For this study, PSSS data for Fiji, Kiribati and Vanuatu from 2010 to August 2018 were sourced from a prior PSSS evaluation,[10] while data from September 2018 to 2019 were extracted from publicly available PSSS bulletins. They were cleaned and standardized by aligning variable names, reporting units and date formats before being merged. This required the conversion of numeric fields stored as text into numeric types, removal of duplicates, differentiation of true zero-reporting from missing data, and the creation of placeholder fields for

Table 1. **Case definitions for the five syndromes reported to the Pacific Syndromic Surveillance System[24]**

Syndrome	Case definition	Important diseases to consider
Acute fever and rash	Sudden onset of fever[a] with acute non-blistering rash	Measles, rubella, meningitis, leptospirosis
Diarrhoea	Three or more loose or watery stools in 24 hours	Viral and bacterial gastroenteritis including cholera, food poisoning, ciguatera fish poisoning
Dengue-like illness	Fever[a] for at least 2 days, plus at least two of the following: • nausea or vomiting • muscle or joint pain • severe headache or pain behind the eyes • rash • bleeding	Dengue
Influenza-like illness	Sudden onset of fever,[a] with cough and/or sore throat	Influenza, other viral or bacterial respiratory infections
Prolonged fever	Any fever[a] lasting 3 or more days	Typhoid fever, leptospirosis, malaria

[a] Fever is defined as a body temperature of 38°C (100.4°F) or higher. If no thermometer was available, fever or chills could be reported by the patient or caregiver.

unreported syndromes in the earlier years. Overlapping reporting periods (2017–2018) were cross-checked before being merged.

Emergency Events Database

EWE data were sourced from EM-DAT, a global repository maintained by the Centre for Research on the Epidemiology of Disasters and WHO.[34] EWEs in EM-DAT are categorized according to the International Peril Classification and Hazard Glossary.[34,35] For the purposes of this study, data were extracted on climate-sensitive EWEs – cyclones, floods, droughts and king tides. All events reported in EM-DAT between 2010 and 2019 were included. Extracted variables included country, affected administrative areas, disaster type and subtype (for floods), event start and end dates and cyclones (names and categories). Impact data (number of persons affected, injured or deceased) were reviewed when available, but were often incomplete and were, thus, excluded from analysis. Each EWE was cross-checked with publicly available ReliefWeb situation reports to improve contextual accuracy.

Data analysis

Analyses were restricted to data covering the timeframe 2010–2019 to avoid confusion with COVID-19-related changes in reporting practices. Descriptive methods were used to explore temporal relationships between weekly national syndromic case counts and EWEs. For each country, timelines were constructed to display weekly syndromic case counts for the five syndromes, the number of health facilities reporting each week and the date of onset of specific EWEs. Timelines were divided into two periods: Period 1 (2010–2014 for Fiji and Kiribati; 2012–2014 for Vanuatu) and Period 2 (2015–2019) (**Table 2**). Given the ecological, exploratory study design and the lack of data granularity (only national weekly case data were available), no inferential statistical analysis or adjustment for possible confounding was performed. However, syndromic reporting completeness was assessed using three measures: mean weekly reporting (the mean number of sites contributing data in a given week), reporting stability (the coefficient of variation [CV] of the number of sites contributing data per week); and the number (and proportion) of zero-report weeks (the number of weeks with no reports from any site). Reporting metrics were reported by country and by reporting period.

All data cleaning, analysis and visualizations were conducted using Stata/SE 17.0.

RESULTS

Between 2010 and 2019, Fiji, Kiribati and Vanuatu collectively experienced 11 cyclones, three floods, three droughts and one king tide. During this period, sentinel sites – up to 14 in Fiji, 14 in Kiribati and 19 in Vanuatu – provided weekly case totals for each of the five syndromes to PSSS (**Fig. 1–3**).

Table 2. **Weekly reporting completeness metrics for Fiji, Kiribati and Vanuatu across two reporting periods (2010–2014/2012–2014 and 2015–2019)**

Country	Period	Maximum number of reporting sites	Total reporting weeks[a]	Reporting sites per week			Zero-report weeks[d]	
				Mean[b]	SD	CV (%)[c]	*n*	% of total reporting weeks
Fiji	2010w46–2014w52	11	215	6.27	2.60	41.5	5	2.33
	2015w1–2019w52	14	255	8.40	4.04	48.1	39	15.3
Kiribati	2010w48–2014w52	14	213	2.13	1.91	89.9	12	5.63
	2015w1–2019w52	2	255	3.64	2.38	65.3	40	15.7
Vanuatu	2012w23–2014w52	7	134	5.36	1.70	31.8	5	3.76
	2015w1–2019w52	14	255	6.86	3.76	54.9	43	16.9

CV: coefficient of variation; SD: standard deviation.

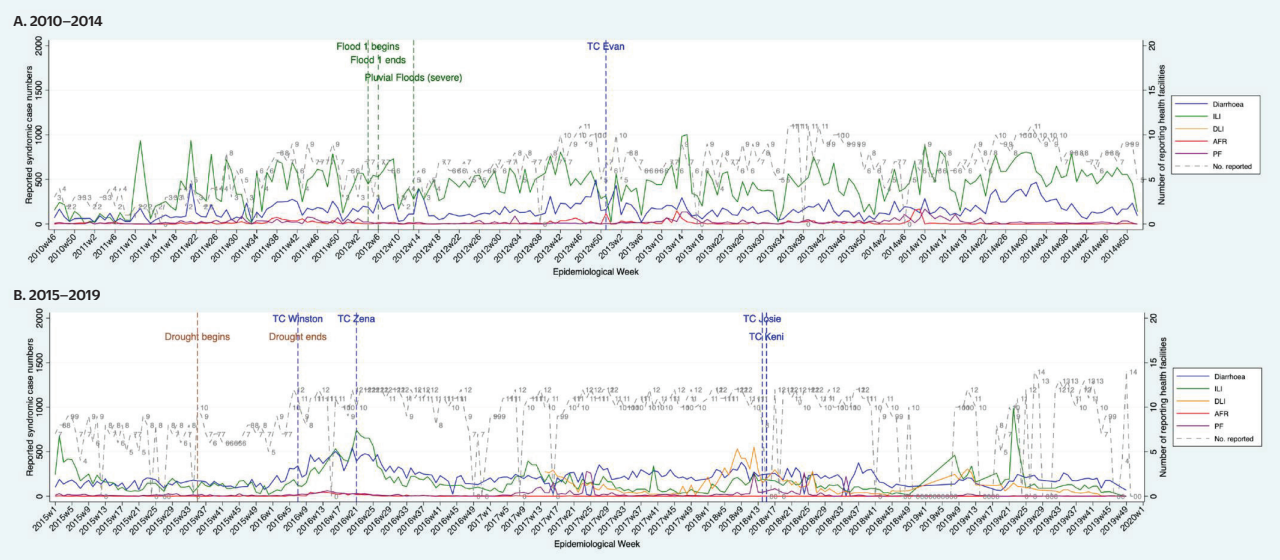
[a] Total reporting week: total number of weeks included in the stated period, reflecting the maximum weekly limit for reports submitted during that period.

[b] Mean reporting sites per week: average number of sentinel sites reporting weekly syndromic data in the stated period.

[c] CV = SD/mean × 100, reflecting relative week-to-week instability in reporting.

[d] Zero-report weeks: number and proportion of weeks in which no site reported data.

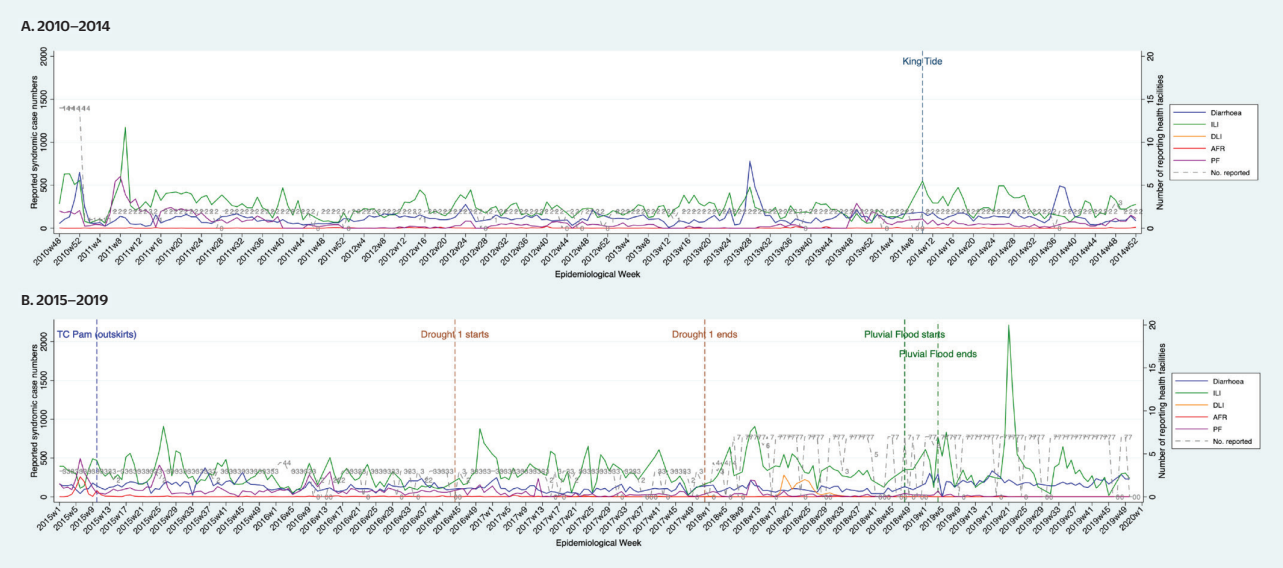
Fig. 1. **Reported syndromic case numbers and extreme weather events in Fiji by epidemiological week, (A) 2010–2014 and (B) 2015–2019**



AFR: acute fever and rash; DLI: dengue-like illness; ILI: influenza-like illness; PF: prolonged fever; TC: tropical cyclone.

The primary y-axis shows the number of reported cases for each syndrome per week. The secondary y-axis represents the number of health facilities reporting each week (total number of clinics reporting per week indicated above the line as "No. reported"). Vertical dashed lines indicate the onset of extreme weather events. As floods and droughts occur over extended periods, the start and end of these events are both indicated.

Fig. 2. **Reported syndromic case numbers and extreme weather events in Kiribati by epidemiological week, (A) 2010–2014 and (B) 2015–2019**



AFR: acute fever and rash; DLI: dengue-like illness; ILI: influenza-like illness; PF: prolonged fever; TC: tropical cyclone.

The primary y-axis shows the number of reported cases for each syndrome per week. The secondary y-axis represents the number of health facilities reporting each week (total number of clinics reporting per week indicated above the line as "No. reported"). Vertical dashed lines indicate the onset of extreme weather events. As floods and droughts occur over extended periods, the start and end of these events are both indicated.

Frequency of extreme weather events and Pacific Syndromic Surveillance System reporting performance by country

Fiji

Fiji, with a population of just under 1 million,[15] experienced five tropical cyclones (TCs) during the study period (2012: TC Evan, 2016: TC Winston, 2016: TC Zena, 2018: TC Josie, 2018: TC Keni), as well as two floods (both in 2012) and a 6-month drought (2015–2016). Comparing the two periods 2010–2014 and 2015–2019, the maximum number of reporting sites rose from 11 to 14 and mean weekly reporting increased from 6.3 sites to 8.4 (**Table 2**). Reporting stability remained moderate but showed slightly greater variability in the second period (CV: 41.5% vs 48.1%), while the number of zero-report weeks increased from 5 (2.3%) to 39 (15.3%), indicating more frequent intermittent disruptions. Overall, Fiji had the highest average number of participating sites and arguably the lowest reporting variability (relative to Kiribati and Vanuatu), although complete weekly coverage was rare and there were recurrent periods of low or absent reporting.

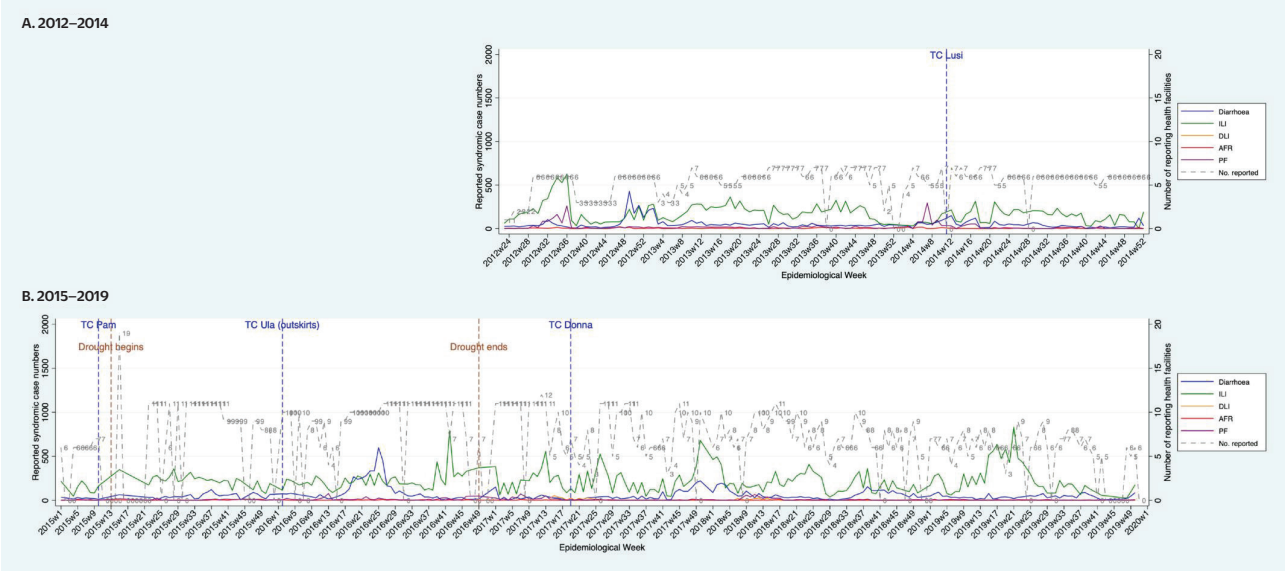
Kiribati

Kiribati, consisting of 33 low-lying atolls and a population of ~121 000,[17] experienced one king tide (2014), one cyclone (2015: TC Pam), a 14-month drought (2016–2017) and a 2-month flood (2018) during the study period. Sentinel site participation was highest in 2010, peaking at 14 sites, but dropped from 2 to 7 sites thereafter (**Fig. 2**). Nevertheless, mean weekly reporting increased from 2.1 to 3.6 sites while the CV declined from 89.9% to 65.3%, indicating that between 2010 and 2014, and 2015 and 2019, participation stability had improved. Zero-reporting weeks, however, increased from 12 (5.6%) to 40 (15.7%), reflecting more frequent periods of complete non-reporting.

Vanuatu

Vanuatu, an archipelago of ~80 islands with an estimated population of 313 000,[16] experienced five cyclones (2012: TC Jasmine, 2014: TC Lusi, 2015: TC Pam, 2016: TC Ula, 2017: TC Donna) and a 2-year drought (2015–2016). Syndromic reporting commenced in 2012, with participation increasing from a maximum of 7 sites

Fig. 3. **Reported syndromic case numbers and extreme weather events in Kiribati by epidemiological week, (A) 2012–2014 and (B) 2015–2019**



AFR: acute fever and rash; DLI: dengue-like illness; ILI: influenza-like illness; PF: prolonged fever; TC: tropical cyclone.

The primary y-axis shows the number of reported cases for each syndrome per week. The secondary y-axis represents the number of health facilities reporting each week (total number of clinics reporting per week indicated above the line as "No. reported"). Vertical dashed lines indicate the onset of extreme weather events. As floods and droughts occur over extended periods, the start and end of these events are both indicated.

between 2012 and 2014 to 19 sites between 2015 and 2019 (**Fig. 3**). Mean weekly reporting increased from 5.4 to 6.9 sites, but CV increased from 31.8% to 54.9%, and zero-reporting weeks rose from 5 (3.8%) to 43 (16.9%), particularly following TC Pam in 2015. Persistent fluctuations were also observed after 2018, despite network expansion.

Temporal trends in climate-sensitive diseases

Diarrhoea

Increases in diarrhoea reports were frequently observed following cyclones and floods in all three PICTs. In Fiji and Kiribati, the number of reported cases of diarrhoea was reduced during drought periods. In Vanuatu, a substantial surge in cases followed TC Ula, which struck the country after a prolonged drought. In all three PICTs, increases in diarrhoea cases were also observed from November to April (during and following the rainy seasons), as well as in the periods between recorded EWEs.

Influenza-like illness

ILI was the most frequently reported syndrome across all three countries and exhibited distinct seasonal patterns, with increases predominantly seen during and following the wet season from November to April (epidemiological weeks 46–17). However, in Fiji, notable surges in ILI were observed following the 2012 floods and TC Winston (2016). Similarly, there was an increase in Kiribati of ILI in the wake of TC Pam (2015) and the 2018–2019 floods. In Vanuatu, all cyclones and floods occurred during the wet season, and none of these events appeared to markedly alter the timing or magnitude of regular seasonal peaks in ILI.

Acute fever and rash

Weekly AFR case counts varied across the three countries. In Kiribati and Vanuatu, AFR cases were generally low and sporadic, with no clear temporal parallels with EWEs, although Vanuatu experienced a notable case surge in early 2015. In Fiji, AFR cases increased following TC Winston in 2016; however, most other outbreaks occurred outside EWE periods.

Prolonged fever

Across Fiji, Kiribati and Vanuatu, PF showed a seasonal pattern, with several outbreaks occurring during the wet season (epidemiological weeks 46–17). In Fiji, surges in

PF were observed following cyclones, such as TC Evan (2012) and TC Winston (2016), but other spikes lacked a clear correlation with EWEs. In Kiribati, PF cases generally remained stable, with small peaks occurring mainly during the wetter months. One peak occurred around the time of TC Pam (2015), but, as in Fiji, other peaks occurred outside of EWE periods. In Vanuatu, PF cases declined during drought periods, while peaks tended to align with seasonal weather changes. Overall, there was a downward trend in PF cases over the course of the study period.

Dengue-like illness

In all three PICTs, DLI was only reported from 2017 onwards. In Fiji, DLI showed a seasonal pattern, typically peaking around March, but showed no obvious temporal correlation with EWEs. In Kiribati, a contained outbreak occurred in 2018 several months after the 2016–2017 drought, which at its peak reached 280 reported cases in a single week. In Vanuatu, two moderate outbreaks were observed, one in 2017 and another in 2018, but overall DLI case reports remained low. The 2017 DLI outbreak predated TC Donna, the only recorded EWE in Vanuatu during the period 2017–2019.

DISCUSSION

This study examined temporal trends in EWEs and syndromic surveillance data during the period 2010–2019 in Fiji, Kiribati and Vanuatu. While fluctuations in case numbers were observed across all syndromes and countries during the study period, temporal associations between EWEs and climate-sensitive diseases were not consistently identifiable. However, some notable patterns were observed, including some that were consistent with previously reported links.

Associations between extreme weather events and climate-sensitive diseases

The most consistent temporal correlations were observed between cyclones and floods and diarrhoeal illness, with increases observed following several events in all three PICTs, albeit not uniformly. This pattern is consistent with evidence that cyclones and floods can damage or overwhelm water, sanitation and hygiene (WASH) infrastructure, increasing contamination of water sources and the risk of enteric disease transmission.[21–23] Furthermore, the observed increase in diarrhoeal illness in Fiji following TC Winston in 2016 (**Fig. 1B**) aligns with trends captured in an evaluation of the Early Warning, Alert and Response System, which documented elevated syndromic signals of diarrhoeal disease post-TC Winston.[19] However, peaks in diarrhoeal illness also coincided with the November–April rainy season. Overall, these findings suggest a potential moderate, context-dependent temporal association between cyclones and floods and diarrhoeal disease in PICTs, with patterns also influenced by seasonality and underlying WASH conditions.

Increases in ILI following cyclones and floods have been reported, particularly where overcrowding in evacuation or relief centres facilitates respiratory virus transmission.[36,37] However, interpretation was complicated in this study by strong underlying seasonality, with ILI trends largely following expected seasonal patterns in all three countries. Cyclones and floods occurred predominantly during the wet seasons when ILI peaks would typically be expected, making it difficult to distinguish EWE-related patterns from seasonal transmission dynamics. Additional factors, including variability in influenza immunization across years and settings, further complicated interpretation.[3] Overall, our evidence for a temporal association between cyclones and floods and ILI was weaker than that for diarrhoeal disease, at best only suggestive on account of inconsistent findings across the study settings and the presence of strong confounders.

Our findings on drought were also mixed and largely inconclusive. Reduced water availability during drought has been linked to reduced transmission of some mosquito-borne diseases, and this may have contributed to the observed reduction in PF cases in Vanuatu during the latter half of the 2015 drought, where case numbers fell to near zero. Vanuatu's prolonged 2015–2016 drought was followed by TC Ula (2016) and a surge in PF cases, possibly due to increased exposure to contaminated water sources, which can occur following heavy rainfall after prolonged dry conditions. However, similar patterns were not consistently observed in either Fiji or Kiribati, where PF trends did not show clear alignment with drought periods.

The lack of consistent drought-related patterns across study settings likely reflects the heterogenous nature of the PF syndrome, which includes both water- and vector-borne infections with differing environmental drivers (**Table 1**).

Table 3. **Recommendations to strengthen climate-health preparedness and response in Pacific island countries and territories**

Recommendation	Key actions
Improve surveillance system performance and data integration	• Enhance Pacific Syndromic Surveillance System data completeness, timeliness and spatial granularity. • Strengthen data integration to support early warning and enable formal assessment of associations between EWEs and climate-sensitive diseases.
Develop and validate predictive early warning tools	• Invest in predictive modelling using high-resolution data (e.g. subnational case counts, rainfall, temperature anomalies). • Develop threshold-based early warning systems to anticipate disease emergencies following EWEs.
Adopt a transdisciplinary, systems-thinking approach	• Interpret disease trends alongside policy changes, interventions (e.g. vector control) and meteorological events • Foster strong partnerships across meteorological, environmental, health and disaster agencies.
Strengthen country-specific climate-health strategies	• Develop national or subnational climate-health vulnerability indices to identify priority risk areas and guide targeted interventions. • Integrate disease preparedness into disaster-risk reduction plans. • Build capacity for ongoing regional assessments and climate-health monitoring.

EWE: extreme weather event.

As a result, drought may have potentially varying and offsetting effects on water- and vector-borne infections that come under the PF umbrella. Notably, Vanuatu exhibited an overall downward trend in PF cases across the study period, which could be either the result of a change in reporting DLI as a separate category in 2017 (when previously DLI was included within PF) or the effects of vector control initiatives such as the World Mosquito Program,[38] or most likely, a combination of both.

Generally, our ability to assess potential associations between EWEs and DLI and AFR was limited. As mentioned above, separate DLI reporting in PSSS was only introduced in 2017. This, combined with the absence of major drought periods between 2017 and 2019, severely curtailed opportunities to investigate drought-related dengue dynamics within the study period. In the case of AFR, investigations were limited by the low case numbers. While a transient increase was observed in Fiji following TC Winston (2016), consistent with a documented rise in leptospirosis cases,[39] most fluctuations occurred outside EWE periods. Overall, AFR trends appeared more consistent with episodic outbreak activity and underlying endemic transmission dynamics than with EWEs.

Status of syndromic surveillance in Pacific island countries and territories

Over the course of our 10-year study period, we observed an increase in both the number of participating sentinel sites and mean weekly reporting. The latter is significant, as it implies an overall improvement in reporting consistency and stability over time in the three countries included in our study. Yet, across Fiji, Kiribati and Vanuatu, full weekly participation was rare and reporting coverage fluctuated substantially, with all three PICTs experiencing zero-reporting weeks. Interestingly, countries with larger networks did not necessarily achieve more consistent levels of reporting; while Kiribati had fewer sites overall, the active sites reported more consistently, whereas countries with larger networks (Fiji and Vanuatu) exhibited greater variability and longer drop-out periods. This may be partly due to differences in the frequency and severity of EWEs experienced by each country. EWE-related service disruptions will have contributed to reporting lapses (due to infrastructure damage and reduced staff availability), and we did note that some reporting lapses coincided with EWEs. However, lapses also occurred outside of EWE periods, suggesting that other health-system barriers and operational challenges persist. While some challenges

will be country- and setting-specific, many are common across PICTs, such as geographical isolation, staffing constraints and competing priorities, and underscore the need for targeted strategies to improve syndromic surveillance reporting stability.[10,40]

Despite the ongoing challenges, this study serves to highlight the value of syndromic surveillance in PICTs. Syndromic surveillance remains a practical and valuable tool for early detection and monitoring of climate-sensitive diseases. As EWEs become more frequent and severe due to climate change, robust syndromic systems will become increasingly important for timely outbreak detection and response in low- and middle-income countries across the Western Pacific Region.[25,40] Therefore, strengthening the PSSS to ensure consistent, high-quality reporting during and after EWEs is critical, and we propose a set of policy actions designed to support public health preparedness and build climate-resilient health systems across the Pacific (**Table 3**).

Strengths and limitations

While this study, the first to describe temporal trends in both climate-related EWEs and climate-sensitive disease symptoms in the Pacific region over an extended period, found value in using PSSS data for climate impact research, several limitations must be acknowledged. First, national-level aggregation of PSSS data precluded more rigorous statistical analysis. More specifically, the absence of granular data for both syndromic cases and EWE impact zones restricted the ability to perform standardized incidence rate calculations, conduct spatial analyses and assess differential effects in subnational geographical units. Second, incomplete reporting was a further constraint. For example, temporary drops in reporting were observed around the time of major EWEs, particularly cyclones, raising the possibility of underreporting during periods of highest risk and reducing our ability to detect associations between EWEs and disease patterns. Third, meteorological events like heavy rainfall, though not classified as disasters, can affect disease dynamics and health outcomes but were not considered in this study. Future research should examine weather patterns beyond EM-DAT classifications, offering a fuller understanding of EWEs on health.

Conclusion

In summary, this descriptive, exploratory analysis of PSSS and EM-DAT data has provided some evidence of temporal associations between EWEs and climate-sensitive diseases, in particular cyclones and floods with diarrhoea and, to a lesser extent, ILI. Although data limitations precluded the establishment of causal relationships, our findings underscore the need to strengthen regional disease surveillance systems, integrate multisectoral data, and invest in resilient health systems to improve detection and response to the health impacts of climate change. This study also served to illustrate the limitations of using event-based EWE data alone to identify patterns in climate-sensitive diseases. Addressing climate change-related health challenges in PICTs requires a transdisciplinary approach integrating knowledge on the environment, health, development, meteorology, epidemiology and the social sciences. It is crucial for a more comprehensive understanding of these complex issues.

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Conflict of interest

The authors have no conflicts of interest to declare.

Ethics statement

This study did not require formal ethical approval, as it was designated a quality assurance activity by SPC, which, in collaboration with WHO as data custodians, coordinates the PSSS and granted permission for data use. The PSSS contains only aggregated data, posing negligible re-identification risk. All analyses adhered

to relevant ethical and legal standards, including the International Health Regulations (2005). Participation in the PSSS is voluntary, and data use complied fully with associated guidelines.

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