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Mass gathering enhanced syndromic surveillance for the 8th Micronesian Games in 2014, Pohnpei State, Federated States of Micronesia

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Pohnpei State's Division of Primary Health Care implemented enhanced surveillance for early warning and detection of disease to support the 8th Micronesian Games (the Games) in July 2014.

The surveillance comprised 11 point-of-care sentinel sites around Pohnpei, Federated States of Micronesia, collecting data daily for eight syndromes using standard case definitions. Each sentinel site reported total acute care encounters, total syndrome cases and the total for each syndrome. A public health response, including epidemiological investigation and laboratory testing, followed when syndrome counts reached predetermined threshold levels.

The surveillance was implemented using the web-based Suite for Automated Global Electronic bioSurveillance Open-ESSENCE (SAGES-OE) application that was customized for the Games. Data were summarized in daily situation reports (SitReps) issued to key stakeholders and posted on PacNet, a Pacific public health e-mail network.

Influenza-like illness (ILI) was the most common syndrome reported (55%, $n = 225$). Most syndrome cases (75%) were among people from Pohnpei. Only 30 cases out of a total of 408 syndrome cases (7%) presented with acute fever and rash, despite the large and ongoing measles outbreak at the time. No new infectious disease outbreak was recorded during the Games. Peaks in diarrhoeal and ILI cases were followed up and did not result in widespread transmission.

The technology was a key feature of the enhanced surveillance. The introduction of the web-based tool greatly improved the timeliness of data entry, analysis and SitRep dissemination, providing assurance to the Games organizers that communicable diseases would not adversely impact the Games.

The 8th Micronesian Games took place in Pohnpei, Federated States of Micronesia, from 19 to 29 July 2014. Participants came from the six Micronesian island countries and territories: Guam, Kiribati, the Marshall Islands, the Federated States of Micronesia, Nauru, the Commonwealth of the Northern Mariana Islands and Palau.

Pohnpei is a small island state of 35 981 people (2010 census). The 8th Micronesian Games held in the area around Kolonia, the main town of Pohnpei, attracted approximately 1700 athletes and officials (Saketa S, Public Health Division, Pacific Community, unpublished

report, 2014). This population influx posed public health risks for the introduction of communicable diseases,¹ as illustrated by a widespread measles outbreak in Pohnpei two months before the Games. This had the potential to overwhelm health services, disrupt the Games and trigger the spread of measles across the Federated States of Micronesia and the wider region.

To mitigate disease risks and aid identification of adverse health events, an enhanced syndromic surveillance system for mass gatherings was implemented by Pohnpei's Division of Primary Health Care (DPHC) in partnership with the country's Department of Health and

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Social Affairs (DHSA), the Pacific Community (SPC) and Johns Hopkins University (JHU). Enhanced surveillance for mass gatherings is increasingly used in large developed nations.² In the Pacific, mass gathering surveillance was used for the 2012 11th Festival of Pacific Arts, Solomon Islands and the 2013 Pacific Mini Games, Wallis and Futuna.^{3,4} Here we describe the enhanced surveillance system implemented by Pohnpei State and discuss some of the sustainable benefits arising from the mass gathering surveillance experience.

METHODS

SPC has developed a three-stage strategy for preparing for and implementing enhanced surveillance for mass gatherings. This approach is summarized in a process map (available online).⁴ The preparation stage includes a disease risk assessment and an assessment of the existing surveillance system to meet the mass gathering surveillance needs. Pohnpei implemented an early warning syndromic surveillance system in 2010 as part of the World Health Organization (WHO)/Pacific Public Health Surveillance Network Pacific Syndromic Surveillance System.⁵ Data are collected daily from the central public hospital (Pohnpei State Hospital) and weekly from the private hospital (Genesis Hospital) for acute fever and rash, prolonged fever, influenza-like illness and diarrhoea syndromes covering important outbreak-prone diseases in Pohnpei State. A weekly surveillance report is disseminated to DHSA and WHO. As an early warning system, the syndromic surveillance system allows the Federated States of Micronesia to meet indicator-based surveillance requirements under the International Health Regulations (2005).⁶ This system was the foundation for the mass gathering surveillance implemented for the Games.

For the Games, the number of sentinel sites was expanded to 11, comprising Games venues, hospitals and community clinics distributed around Pohnpei, the number of syndromes was increased to eight (diseases recorded in parentheses):

- acute fever and rash (AFR) (measles, dengue, rubella, meningitis, leptospirosis);
- influenza-like illness (ILI) (influenza and other viral or bacterial respiratory diseases);
- prolonged fever (typhoid fever, dengue, leptospirosis, malaria);

- fever and jaundice (hepatitis A infection);
- watery diarrhoea (cholera);
- non-watery diarrhoea (viral or bacterial gastroenteritis, including food poisoning and ciguatera fish poisoning);
- foodborne disease outbreak (salmonella, *Staphylococcus*, *Clostridium*, *Campylobacter* and rotavirus infections); and
- heat-related illness (heat cramps, heat exhaustion and heat stroke).

All sentinel sites except the two Games venues were community medical providers operating within their normal hours. Of the two Games sites, the Pohnpei Island Central School (PICS) High School provided a temporary clinic at the Games village for primary care services to athletes and officials, operating seven days a week. The second Games site, the College of Micronesia-FSM dispensary, provided acute, preventive health care and counselling staffed by a full-time nurse and was open Monday to Friday during normal working hours. All sentinel site staff underwent a two-day surveillance training that focused on understanding the syndrome case definitions, accurate completion of the surveillance register and laboratory specimen collection and referral processes.

Each sentinel site manually completed a daily surveillance form that recorded the number of acute care encounters and syndrome cases; the completed forms were collected daily from each sentinel site. The data were entered into the Suite for Automated Global Electronic bioSurveillance OpenESSENCE (SAGES-OE) open-source, web-based application. Developed by JHU, SAGES-OE was designed for surveillance and epidemiological analysis particularly in resource-constrained settings.⁷ It was adapted for the Micronesian Games by JHU in partnership with SPC. Drop-down lists for key variables facilitated efficient data entry and helped to ensure the completeness and consistency of data. When incomplete data were discovered, the relevant sentinel site was contacted. It took approximately five hours each day to collect and enter data.

SAGES-OE analysis and visualization tools were used to summarize the epidemiological situation that was reported in daily situation reports (SitReps). These included totals for encounters and syndromes together

with epidemic curves used to track syndrome trends. SitReps were distributed to stakeholders in the DHSA and the Games organizing committee, and were posted to the Pacific health e-mail network, PacNet. The surveillance was operational from 17 July – two days before the Games – until 6 August, one week after the Games. Eighteen daily SitReps were produced.

Ethics

Ethics committee approval was not required.

RESULTS

There were 5640 encounter cases and 408 syndrome cases from the 11 sentinel sites during the 21 day surveillance period. Sentinel site encounters ranged from 52 to 2040 with a median of 165 and mean of 496. The variance in encounters reflects the highly variable catchments of hospital outpatient departments and smaller community clinics. The Games-specific sentinel site (PICS High School) recorded 3% of all encounters ($n = 165$) and 3% of all syndromic cases ($n = 13$). One site (Wone dispensary) reported no syndromes. [Table 1](#) summarizes acute care encounters and syndrome presentations by sentinel site from 17 July to 6 August 2014. There was a high degree of variation in daily syndrome presentations ([Fig. 1](#)). Overall, syndrome cases represented 7% of encounters (ranging from 2% to 18%). Residents of Pohnpei reported more syndromes (75% of all syndromes, $n = 305$) than those from outside Pohnpei.

The three larger Kolonia town sentinel sites, Pohnpei State Hospital, Genesis Hospital and Pohnpei/Kolonia Community Health Center, accounted for over three quarters of all encounters (77%, $n = 4336$) and a larger proportion (88%, $n = 359$) of all syndrome cases. Pohnpei State Hospital had a third of encounters (36%, $n = 2040$, 61.8 per 1000 encounters) and syndromes (31%, $n = 126$). Pohnpei Community Health Center had the second greatest number of encounters (21%, $n = 1157$), 15% lower than the State Hospital, but it had a greater catchment of cases accounting for half of all syndromes (50%, $n = 202$) and by far the highest rate of syndromes (174.6 per 1000 encounters). The private Genesis Hospital accounted for the third greatest number of encounters (20%, $n = 1139$), but it had a far lower surveillance sensitivity with 8% ($n = 31$) of syndrome

cases (27.2 per 1000 encounters).

ILI was the most prominent syndrome accounting for half of all cases (55%, $n = 225$) followed by watery diarrhoea (24%, $n = 99$), non-watery diarrhoea (9%, $n = 36$) and AFR (8%, $n = 31$). There were two prolonged fever cases. Both fever and jaundice and heat-related illness had one case. No foodborne disease outbreak was reported. Watery diarrhoea (24%) and AFR (8%) accounted for almost one third (32%) of all reported syndromes and are indicative of more severe diseases requiring urgent attention. These cases were prioritized and followed up by the response team.

A marked difference in the sex distribution of syndrome cases was noted in the four sentinel sites in the rural areas with nearly three quarters of cases being female (72%). Whereas the seven sentinel sites in the more populated or urban areas (see [Table 1](#)) had roughly an equal male (52%) and female (48%) representation.

The urban–rural difference was also evident in the distribution of syndromes. [Fig. 2](#) describes the distribution of the four main syndromes, AFR, watery and non-watery diarrhoea, and ILI, in the seven urban area sentinel sites and in the remaining four rural sites. In the urban areas, ILI was the largest syndrome burden (61% of urban syndromes); in the rural areas, non-watery and watery diarrhoea were the two main presenting syndromes (75% of rural syndromes), while ILI was the third highest represented syndrome (21%).

Between 22 and 30 July, 45 clinical samples were collected, comprising 23 nasopharyngeal swabs/aspirate samples for ILI testing and 22 stool samples for watery and non-watery diarrhoea testing. [Fig. 1](#) illustrates the large sample collection peak on 25 July, while the remaining days produced fewer samples.

DISCUSSION

The enhanced surveillance implemented at the 8th Micronesian Games provided important data for public health security reassurance for the Games organizers. The SitReps were well received by the Pacific public health community who posted positive comments on PacNet (personal communication with Dr Eliaser Johnson, DPHC, Pohnpei State). The 31 cases of AFR were followed up, and the ongoing measles outbreak had no detrimental

Table 1. **Summary total encounters and syndromes by reporting sentinel site, Pohnpei State, 17 July to 6 August 2014**

Sentinel site (shaded green: the urban area around Kolonia)	Number encounter cases*	Number syndrome cases* (% of encounters)	Syndrome cases per 1000 encounters	Acute fever and rash	Watery diarrhoea	Non- watery diarrhoea	Influenza- like illness	Prolonged fever	Fever and jaundice	Heat- related illness	Food- borne disease syndrome
Berysin CHC	66	3 (5%)	45.5	0	1	0	2	0	0	0	0
Genesis Hospital	1139	31 (3%)	27.2	2	10	1	18	0	0	0	0
Medpharm CHC	145	7 (5)	48.3	0	0	4	3	0	0	0	0
PICS High School	165	13 (8%)	78.8	0	5	0	5	2	0	1	0
Pohnpei CHC	1157	202 (18%)	174.6	1	24	11	159	6	0	1	0
Pohnpei State Hospital	2040	126 (7%)	61.8	26	49	9	35	6	1	0	0
Sokehs Dispensary	52	4 (8%)	76.9	1	1	2	0	0	0	0	0
COM Dispensary	63	4 (6%)	63.5	0	2	2	0	0	0	0	0
Lukop Dispensary	95	8 (8%)	84.2	0	4	2	2	0	0	0	0
Pohnlangas Dispensary	512	10 (2%)	19.5	1	3	5	1	0	0	0	0
Wone Dispensary	206	0 (0%)	0	0	0	0	0	0	0	0	0
TOTAL	5640	408 (7%)		31	99	36	225	2	1	1	0

* Encounter cases represent all acute care cases visiting a clinic regardless of whether they have one or more of the eight syndromes; e.g. a sprained ankle would be included in the encounter case count.

Syndrome cases represent all acute care cases visiting a clinic who have one or more of the eight syndromes; e.g. a sprained ankle would NOT be included in the syndrome case count.

CHC = Community Health Center

COM = College of Federated States of Micronesia

Fig. 1. **Comparison of daily syndrome counts and laboratory sample submissions, Pohnpei State, 17 July to 6 August 2014 (dates of Games shaded)**

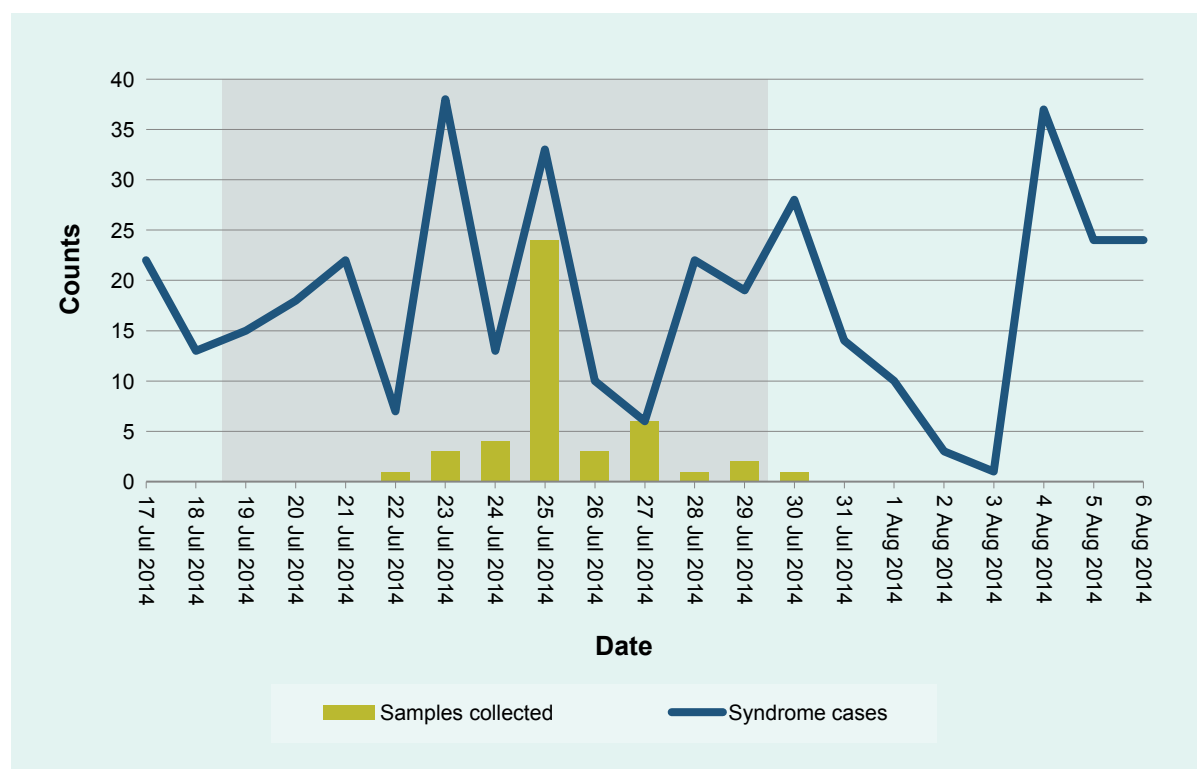
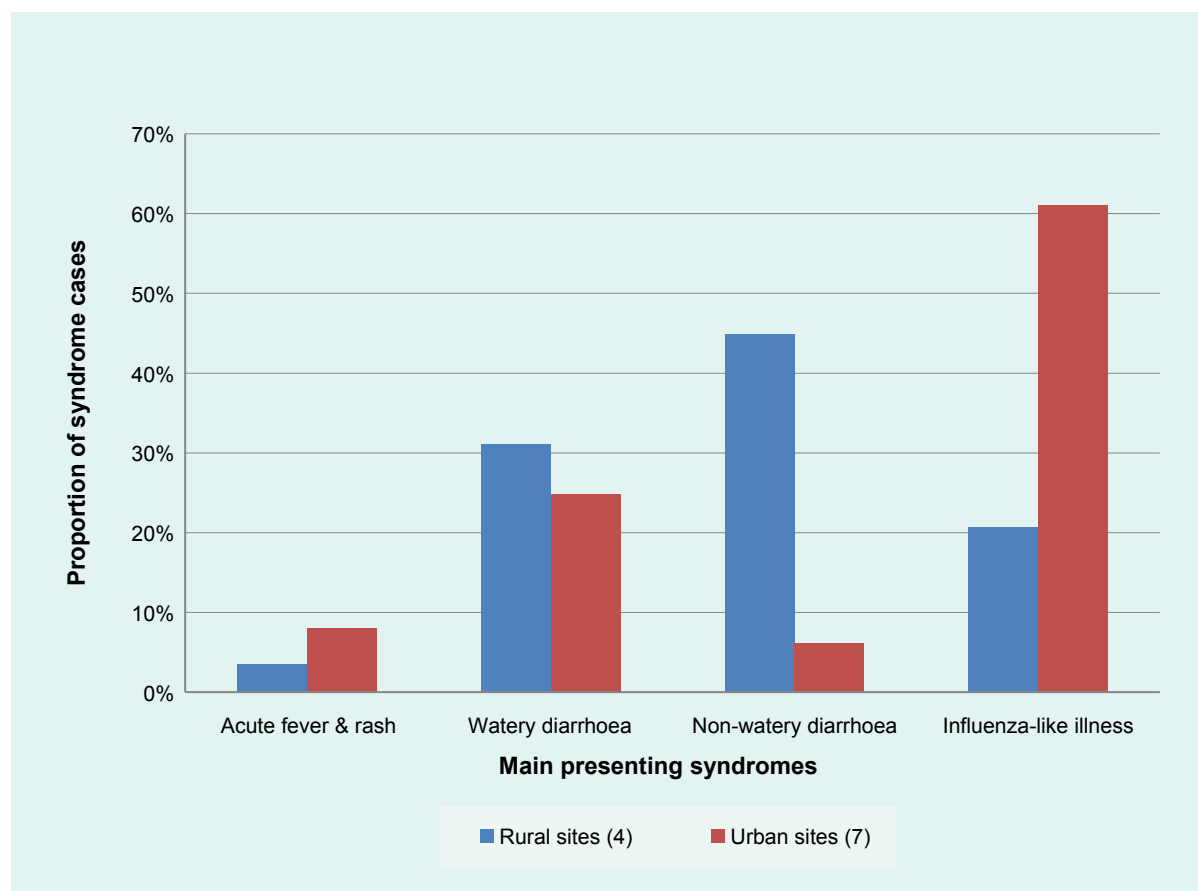


Fig. 2. Distribution of syndrome cases reported in rural and urban point-of-care sentinel sites, Pohnpei State, 17 July to 6 August 2014



impact on the Games. The sentinel sites demonstrated good surveillance coverage and sensitivity; the Games-specific site had the third highest rate of syndrome cases (78.8 per 1000 encounters) but with only 3% (2.9%) of all encounters. This was greater than Pohnpei State Hospital, which had the largest number of encounters (36%) but fewer syndrome cases (61.8 syndrome cases per 1000 encounters).

The web-based SAGES-OE system enabled easy data entry, data storing, data collation and analysis and accelerated SitRep production as multiple users could access data simultaneously. The cloud storage feature helped to reduce local storage server costs as well as increase efficiency and off-site security. However, while SAGES-OE was used in the Pohnpei public health office and regional SPC office, it could not be implemented as a fully networked sentinel site data entry system due to a lack of computers and computer-trained staff. More challenging was the lack of connectivity to all health-care facilities, especially in the rural areas where

wireless connectivity is hampered by low or no coverage. Nevertheless, as a public health tool, SAGES-OE is one of the key success factors of the surveillance and features in the post-Games surveillance sustainability plan of DPHC, where the goal is achieving an integrated surveillance system that allows daily data entry at sentinel sites.

Beyond outbreak detection there are additional benefits to population-representative surveillance data. Surveillance data have intrinsic value as indicators of health service performance.⁸ The regular collection of syndromic surveillance data serves as a powerful evidence base that can be exploited for better-informed health planning and decision-making.⁹ This includes understanding demands on laboratory services during peak times and understanding differences in disease burdens across the population.

The laboratory sample submissions data identified the unequal distribution of samples sent to the laboratory compared to daily syndrome activity (Fig. 1). The single

peak in clinical sample collection contrasts with the greater variation of daily syndrome counts. Identifying the mismatched laboratory sample collection to syndrome case activity can be used to demonstrate to sentinel sites the importance of more regular sample collection as an effective tool to support public health surveillance (i.e. matching sample collection to syndrome activity).

The urban–rural syndrome differences can help identify important public health gaps for better prioritized and more efficient interventions and use of resources. For example, diarrhoea from polluted water sources might be more prevalent in rural areas. Whereas a greater ILI burden in urban areas indicates greater respiratory disease transmission in more densely populated areas while also indicating clean water access and waste water treatment that reduce diarrhoea episodes. This assists prioritization as watery diarrhoea can be indicative of severe diseases requiring urgent attention, particularly in children, indicating the need for different health promotion messaging and interventions. Finally, this information assists in identifying the appropriate type of public health interventions, for example joint public and environmental health responses to watery diarrhoea outbreaks, whereas a joint response is not necessary for ILI.

Challenges and lessons learnt

The enhanced surveillance system implemented for the 8th Micronesian Games demonstrated the need for good planning and preparation including a substantial lead time of at least 12 months to establish and test the web-based surveillance tools; and for areas with low connectivity, to test methods for timely manual data collection. The enhanced surveillance also indicated the importance of adequate staff resourcing to address staff fatigue caused by the intense daily operation of the surveillance for multiple weeks. This point demonstrates the value of a joint implementation in small-island states where resources are limited. The joint implementation with SPC leveraged capability (expertise) and capacity (extra people). Based on the existing syndromic surveillance, the Pohnpei DPHC had the necessary skills and experience to undertake the enhanced surveillance; however, the small team benefited from the support provided by SPC in running the surveillance. Additionally, the use of SAGES-OE was made easier through the partnership between SPC and JHU. Finally, there is a need to ensure effective connection with laboratory

services to ensure that clinical sample collection more closely matches syndrome patterns.

Conclusions and recommendations

The enhanced surveillance system used at the 8th Micronesian Games demonstrated: (1) the value of enhanced surveillance to provide public health security assurance during mass gatherings particularly in the face of significant, existing disease threats; (2) the benefit of web-based tools in improving the efficiency of the surveillance; (3) the potential for sustainable improvements to routine surveillance through leveraging the surveillance experience; (4) and improved health planning and informed decision-making that arise from the evidence base that is generated from the enhanced surveillance. Pohnpei was one of the first places in the Pacific region to implement the web-based SAGES-OE tool for mass gathering surveillance, and the enhanced surveillance implemented for the 8th Micronesian Games in Pohnpei provides a constructive model for future mass gathering surveillance across the Pacific and elsewhere.

Conflicts of interest

None.

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All contributors fulfil the authorship requirements.

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Prevalence of HIV and sexually transmitted infections among young women engaged in sex work aboard foreign fishing vessels in Kiribati

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Objective: To assess the prevalence of HIV and sexually transmitted infections (STIs) among women who board foreign fishing vessels for sex work in Kiribati.

Methods: A cross-sectional study was designed to collect data on behavioural risk factors for STIs and knowledge of and attitudes towards HIV and STIs during 2007. Urine and blood samples were collected to test for HIV and select STIs. Descriptive statistics were performed for sociodemographic and behavioural characteristics, and χ^2 tests were used to assess associations between potential key determinants and the presence of genital *Chlamydia* infection.

Results: Women who boarded foreign fishing vessels for transactional sex were younger, had less education, were less likely to live with a partner and were less likely to be otherwise employed. Although no HIV infections were detected, more than half (57.5%) of the women were diagnosed with an STI. One quarter of the women tested positive for chlamydia, and 40% tested positive for mycoplasma. The presence of chlamydia was strongly associated with age at first sexual intercourse ($P = 0.02$) and number of sexual partners during the prior seven days ($P = 0.02$).

Conclusion: The high rate of STIs in this population of sex workers is concerning given the potential of severe pregnancy-related and chronic health problems and the increased risk of transmission within the general population of Kiribati. We identified a specific sex worker population as a priority group for targeted public health efforts to prevent and control the spread of STIs in Kiribati.

Kiribati is a small island developing state composed of 33 widely dispersed small islands in the northern Pacific Ocean. The country has a population of 92 533, of whom 57.9% are under 25 years of age.¹ Kiribati's large exclusive economic zone, which covers 3.5 million kilometres of ocean, is an important national economic resource, generating income from fishing licenses, access fees and transshipment fees from foreign fleets. The income gained from foreign fishing vessels is critical to local and national economies. Despite the economic benefits, unfavourable consequences have arisen such as an expansion of transactional sex (defined as sex in exchange for money or resources) in Kiribati among fishermen and seafarers from Asia and other Pacific countries with Kiribati women.

Transactional sex in Kiribati is on the rise. The

estimated number of women engaging in transactional sex on relatively urban South Tarawa doubled from 30–50 in 2003 to 60–100 in 2006.² The increasing trend is also apparent on Kiritimati island.²

Foreign fishing vessel crews are in port from days to weeks, during which time local women board the vessels for transactional sex. Some of these women drink alcohol with the foreign fishermen and also engage in sex with local men. Excessive alcohol consumption is prevalent among both men and women, which may lead to sexual assault. Also, the frequency of condom use during these encounters is low.²

Kiribati has an estimated 55 cumulative cases of human immunodeficiency virus (HIV) dating from 1991,³ and the incidence rate for HIV is among the highest in

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the Pacific region.^{4,5} In Kiribati, the most frequently reported mode of HIV transmission is heterosexual contact followed by perinatal transmission.³ In a meta-analysis of studies from 50 low- and middle-income countries, the HIV prevalence among female sex workers was 11.8%.⁶ In the Pacific, a meta-analysis reported a sexually transmitted infection (STI) prevalence of 28.7% in Papua New Guinea.⁷ In Kiribati, the total STI incidence reported from 2000 to 2005 was 30.1 per 10 000 people. Most (62.9%) of the cases were males. However, these figures mask the true burden due to underreporting as STI reporting in Kiribati is limited by laboratory and public health capacity.⁸

At the national level, surveillance and reporting of HIV/AIDS has been in place since 1989. HIV cases are reported by sentinel laboratories to the HIV Programme Coordinator. The Coordinator prepares monthly HIV reports with information on sex, age and mode of transmission. At the time of the study, surveillance and reporting for other STIs were limited by the lack of laboratory and public health information capacity. Besides HIV, other notifiable STIs were gonorrhoea and syphilis. Chlamydia was not a notifiable infection, and testing facilities were not available locally during the time of this study.

In a combined HIV surveillance survey and behavioural surveillance survey from 2004 to 2005, as part of the Second Generation Surveillance Surveys of HIV, other STIs and Risk Behaviours in 6 Pacific Island Countries, seafarers were identified as a high-risk group for both HIV and STIs.⁹ Overall, 9.3% of the seafarers were infected with genital *Chlamydia trachomatis*.⁹ In a report specific to Kiribati, women involved in transactional sex were identified to be at high risk for STIs.³ Women who board foreign fishing vessels for sex are thought to be at particular high risk since they often have multiple partners on the fishing vessels and within the local community.

Although two studies on behavioural risk factors among youth and young women boarding foreign fishing vessels are available,^{10,11} neither of these studies includes information on the prevalence for STIs and HIV in this population. To address this important gap, the present study was undertaken to determine the prevalence of HIV and STIs and assess behavioural risk factors among

women engaged in transactional sex on foreign fishing vessels in Kiribati.

METHODS

Study design

A cross-sectional study was undertaken to determine the HIV and STI prevalence and assess behavioural risk factors among women engaged in transactional sex with foreign seafarers.

Setting

The study was undertaken at two sites in Kiribati: South Tarawa from January to March 2007 and Kiritimati island from May to June 2007. It was structured in the form of a three-day workshop, with days one and two dedicated to participant interviews and sample collection and day three reserved for providing education on STIs and HIV, access to and use of contraceptives, voluntary counselling, confidential testing and human rights.

Participants

As transactional sex contravenes Kiribati custom, a multisectoral approach was adopted to identify women engaged in sex work with foreign seafarers. We worked in conjunction with government agencies, nongovernmental organizations and trained peer educators from the Adolescent Health Development centre to identify, inform and invite potential participants into the study in person. Due to the absence of trained peer educators on Kiritimati, trained counsellors were used. Women who were 18–33 years old, resided in South Tarawa or Kiritimati island and boarded a foreign fishing vessel for sex work within the previous 12 months were invited to participate in the study. The age cut-offs were selected because women below 18 years were unable to provide consent for the study and those above 33 years were unlikely to be involved in transactional sex on foreign fishing vessels. Of the 83 women invited to participate in the study, 80 women met the eligibility criteria. All eligible women agreed to participate in the study. Prior to enrolment, information on the study was provided verbally and through an information sheet. Participation was voluntary, and a signed consent form was obtained from all participants. All participants were compensated with

an amount of 10 Australian dollars. Any women found to have STIs were managed in accordance to the World Health Organization Sexually Transmitted Infections Case Management Guidelines as adapted by the Ministry of Health and Medical Services in Kiribati. Additionally, pre- (before sample collection) and post-test (after receipt of test results) counselling was provided by nurses and officers who had undergone counselling training.

Sample size

Based on the prevalence of chlamydia at 20% among women under 20 years attending an antenatal clinic in Tarawa (2002–2003),⁹ we calculated a target sample size of 88. Sample size was calculated using PS: Power and Sample Size Calculation, version 2.1.31 (William D. Dupont and W. Dale Plummer, Jr., Memphis, Tennessee, USA).

Data and specimen collection

We developed a structured cross-sectional questionnaire and collected blood and urine samples. The questionnaire comprised 65 questions across 11 sections (see [Annex 1](#)), and it was also translated from English to Kiribati language. First, trained counsellors administered one-on-one interviews using the questionnaire with quantitative and qualitative items. During each interview, which lasted 20–30 minutes per participant, counsellors collected information on sociodemographic characteristics, behavioural risk factors for STIs and knowledge of and attitudes towards STIs and HIV. Second, urine and blood samples were collected. Serological testing of blood samples for HIV, syphilis and hepatitis B were conducted locally employing Abbott's Determine test kits (Abbott Laboratories, Tokyo, Japan). Reactive sera for syphilis were referred to the South Eastern Area Laboratory in Sydney, Australia for confirmatory *Treponema pallidum* particle agglutination assays and fluorescent treponema absorbance tests. In addition, frozen urine samples were referred for polymerase chain reaction testing for *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, *Mycoplasma hominis* and *Ureaplasma urealyticum*.

Data management and analysis

Data were entered into an Access database (Microsoft Corporation, Redmond, Washington, USA) on a password-

protected computer and checked and validated using Epi Info, version 3.3.2 (Centers for Disease Control and Prevention, Atlanta, Georgia, USA). Descriptive statistics such as measures of central tendency were performed for sociodemographic characteristics. χ^2 tests were used to assess associations between key determinants and chlamydia infection. The significance level was set at $P < 0.05$. All analyses were performed using SPSS, version 15.0 (SPSS Inc., Chicago, Illinois, USA).

Ethics

At the time of this study, there was no standing human research ethics committee in Kiribati. Therefore, with the support of the Ministry of Health in Kiribati, ethics approval was granted by the Human Research Ethics Committee at the University of New South Wales, Australia (HREC 06313).

RESULTS

Participant characteristics

A total of 80 women, 50 (62.5%) from South Tarawa and 30 (37.5%) from Kiritimati island, participated in this study. The mean age of participants was 21 (SD = 3.6) years with the majority aged 18–20 ($n = 47$, 58.8%). Sociodemographic characteristics of participants by location are reported in [Table 1](#). Half of the study participants had been married ($n = 40$, 50%), and 32 (40%) reported ever being pregnant. Most women did not live with a partner ($n = 64$, 80%) and were away from home (left home and lived with peers due to stigma against sex work and pressure from family members) during the prior 12 months ($n = 50$, 62.5%). More than half ($n = 45$, 56.3%) of the women had never attended school, and 74 (92.5%) were unemployed (other than transactional sex) during the time of interview.

Behavioural characteristics

A higher proportion of women boarded fishing vessels for the purpose of having sex and drinking alcohol ($n = 56$, 70%) than having sex only ($n = 6$, 7.5%) ([Table 2](#)). Most women ($n = 69$, 86.3%) reported having a single partner during each visit. Although condom awareness (ascertained by the question: Have you ever heard of a male condom?) was high (90% in South Tarawa and

Table 1. Demographic characteristics of young women who boarded fishing vessels for sex work in the past 12 months, Kiribati, 2007

Characteristics	Overall (n = 80) n(%)*	South Tarawa (n = 50) n(%)	Kiritimati island (n = 30) n(%)
Age group (years)			
18–20	47 (58.8)	29 (58.0)	18 (60.0)
21–24	22 (27.5)	17 (34.0)	5 (16.7)
≥ 25	11 (13.8)	4 (8.0)	7 (23.3)
Ever been married			
Yes	40 (50.0)	27 (54.0)	13 (43.3)
No	40 (50.0)	23 (46.0)	17 (56.7)
Ever been pregnant			
Yes	32 (40.0)	20 (40.0)	12 (40.0)
No	48 (60.0)	30 (60.0)	18 (60.0)
Living arrangements			
Living with partner	10 (12.5)	7 (14.0)	3 (10.0)
Not living with partner	64 (80.0)	38 (76.0)	26 (86.7)
Not stated	6 (7.5)	5 (10.0)	1 (3.3)
Employment status (other than transactional sex)*			
Employed	6 (7.5)	5 (10.0)	1 (3.3)
Unemployed	74 (92.5)	45 (90.0)	29 (96.7)
Education			
Attended school	35 (43.8)	22 (44.0)	13 (43.3)
Never attended school	45 (56.3)	28 (56.0)	17 (56.7)
Away from home during last 12 months**			
Yes	50 (62.5)	34 (68.0)	16 (53.3)
No	29 (36.3)	15 (30.0)	14 (46.7)
No response/refused	1 (1.3)	1 (2.0)	0 (0)

Note: Percentages may not add to 100% due to rounding.

* Current employment status at the time of interview.

** Women left home and lived with peers due to stigma and pressure from family members.

Table 2. Behavioural characteristics of women who boarded fishing vessels for sex work in the previous 12 months, Kiribati, 2007

	Overall (n = 80) n(%)*
Number of sex partner(s) during each visit	
One partner only	69 (86.3)
History of multiple sex partners during a single visit	10 (12.5)
Not stated	1 (1.3)
Any condom use	
Yes	30 (37.5)
No	21 (26.3)
Don't know	2 (2.5)
No response or refused	27 (33.8)
Frequency of condom use during the previous 30 days	
No sex work during the previous 30 days	7 (8.8)
Every time	9 (11.3)
Sometimes	30 (37.5)
Never	4 (5.0)
Don't know	1 (1.3)
No response or refused	28 (35.0)
Missing	1 (1.3)
Activity on ship	
Sex and alcohol consumption	56 (70.0)
Sex only	6 (7.5)
No response or refused	18 (22.5)

* Percentages may not add to 100% due to rounding.

83.3% in Kiritimati island) (data not shown), there was infrequent use of condoms (37.5%). Only 9 (11.3%) women reported using condoms every time during sex.

Prevalence of STIs and HIV

More than half ($n = 46$, 57.5%) of the women in our study were diagnosed with an STI. Of these, the majority ($n = 27$, 58.7%) tested positive for a single STI. Overall, the prevalence of chlamydia was 25%, syphilis was 6.3% and gonorrhoea was 2.5% (Table 3). Thirty-two (40%) and eight (10%) women were diagnosed with mycoplasma and ureaplasma, respectively. None of the women tested positive for HIV. Prevalence of chlamydia in women was strongly associated with younger age at first sexual intercourse ($P = 0.02$) and total number of sexual partners ($P = 0.02$) but not associated with age or level of education (Table 4).

DISCUSSION

The results of this study show that women who board foreign fishing vessels for sex work tend to have limited education and are young, are not living with a partner and are otherwise unemployed. This study assesses the prevalence of risk behaviours and select STIs among women boarding foreign fishing vessels for transactional sex in Kiribati and shows that more than half (57.5%) of the women were diagnosed with an STI.

The prevalence of STIs in our study was twice as high as the overall prevalence among sex workers in Papua New Guinea (28.7%).⁷ In addition, the prevalence of chlamydia in our study population was higher than other studies of female sex workers.^{7,12,13} The 25% chlamydia incidence in the women in our study is nearly twice that shown in a study of pregnant women from the general population in Kiribati.⁹ This substantial difference highlights the increased STI risk for sex workers and emphasizes the need for public health interventions. In our study, 40% of the participants had ever been pregnant, which underscores the need for prenatal STI screening in this population so any treatable infections can be treated as early as possible. Consistent with studies from other nations,^{14,15} our results also revealed a significant association between chlamydia and a history of contact with two or more sexual partners.

Consistent with previous findings among sex workers

Table 3. Frequency and prevalence of STIs and agents among young women boarding fishing vessels for sex work, Kiribati, 2007

STI	Frequency	Prevalence (%)
Chlamydia	20	25.0
Gonorrhoea	2	2.5
Syphilis	5	6.3
HIV	0	0
Mycoplasma	32	40.0
Ureaplasma	8	10.0
No STI detected*	34	42.5
Any STI	46	57.5
1 STI	27	33.8
2 STIs	17	21.3
3 STIs	2	2.5

HIV = human immunodeficiency virus; STI = sexually transmitted infection.

* Refers only to STIs and agents tested in this study, namely chlamydia, gonorrhoea, syphilis, HIV, mycoplasma and ureaplasma.

in China,¹⁶ the prevalence of urogenital *Mycoplasma hominis* (40%) and *Ureaplasma urealyticum* (10%) was high in this study population. A high prevalence of *Mycoplasma spp.* and *Ureaplasma spp.* could indicate a loss or decrease of lactobacillus species from the vaginal flora and is associated with bacterial vaginosis. Previous studies have shown that the loss of hydrogen peroxide (H₂O₂)-producing *Lactobacillus spp.* can lead to the overgrowth of pathogenic organisms and can increase the risk of transmission of STIs and HIV.¹⁷

None of the women in our study tested positive for HIV; however, high rates of chlamydial infection, which is associated with an increased risk of HIV transmission¹⁸ and low rates of consistent condom use,¹⁹ could increase transmission risk if HIV were introduced into this population.

The high prevalence of STIs among this population of women flags the susceptibility of this group to a range of related severe and permanent health conditions, including but not limited to infertility, ectopic pregnancy, pelvic inflammatory disease and human papillomavirus-associated cancers.^{20,21} In addition, a high prevalence of STIs in the sex worker population increases the risk of introducing STIs into the general population, especially given the low adherence to safer sex practices by sex workers.²²

Participants had a high awareness of condom use

Table 4. Frequency of genital *Chlamydia trachomatis* infections by selected demographic and risk factors among young women boarding fishing vessels for transactional sex, Kiribati, 2007

Characteristic	Overall (n = 80) n(%)	Presence of <i>Chlamydia</i> infection (n = 20) n(%)*	p value
Current age			
< 21 years	47 (58.8)	9 (19.1)	0.15
≥ 21 years	33 (41.3)	11 (33.3)	
Age of first sexual intercourse			
< 18 years	33 (41.3)	5 (15.2)	0.02
≥ 18 years	35 (43.8)	14 (40.0)	
Not stated	12 (15.0)	1 (12.5)	
Education status			
Never attended school	45 (56.3)	10 (22.2)	0.52
Attended school	35 (43.8)	10 (28.6)	
Number of sexual partners during last 7 days			
1 partner	23 (28.8)	4 (17.4)	0.02
≥ 2 partners	31 (38.8)	13 (41.9)	
Not stated	26 (32.5)	3 (11.5)	

* Percentages were calculated by dividing the number of women in the presence of chlamydia infection column by the corresponding women in the overall column. For instance, of the 47 women younger than 21 years old, 9 or 19.1% of them had chlamydia.

(90% and 83.3% for South Tarawa and Kiritimati island, respectively), but many reported minimal or inconsistent condom use. A possible explanation for the infrequent use of condoms could be the lack of availability of condoms when needed. Future studies should investigate the reasons for the inconsistency in condom use contrasted with the high awareness reported. Even among the women reporting condom use, a high percentage of them had an STI (data not shown). This could indicate response bias with participants reporting higher condom use to meet the perceived expectations of the interviewers. Another possible explanation could be that condoms were used incorrectly, for example, the lack of condom use during sexual foreplay.

In our study, a high proportion of women (56%) had never attended a school. Of those that attended a school, high dropout rates were reported from secondary schools. Low education level is not only associated with entry into sex work²³ but is also a risk factor for STIs among women engaged in sex work.²⁴ Besides transactional sex, most women (92.5%) in our study were unemployed. Fewer employment opportunities in Kiribati coupled with a lack of formal education makes it challenging for these women to secure jobs. These socioeconomic factors are some of

the drivers for women to enter sex work in Kiribati.

This study has some limitations that merit consideration. First, the small sample size could have reduced the power of the study to detect true sociodemographic and behavioural differences between those with chlamydia and those without. Recruiting participants was challenging due to Kiribati cultural norms that disapprove of engaging in sex for money and dictate that unmarried women should not be sexually active. Nonetheless, the sample size of our study reflects the small size of the population of women boarding foreign fishing vessels. Second, the survey responses may reflect socially desirable responses; however, we aimed to minimize this bias by using trained counsellors who assured the participants that their responses would be private, confidential and secure. In addition, the counsellors were trained and advised to adopt a non-judgmental approach to the participants' responses. Third, behavioural characteristics, such as condom use, were self-reported and may have been subject to recall issues. Fourth, due to the cross-sectional nature of our study, associations between various factors and STIs cannot be interpreted to infer causality.

Despite these limitations, this is the first study to be conducted among this marginalized group of women in Kiribati. The study has identified risk factors for STI transmission and barriers that need to be addressed specific to this high-risk population. Economic drivers such as limited employment opportunities coupled with the lack of education are some of the reasons women board foreign fishing vessels for sex work.²⁵

The high prevalence of STIs among the women in our study warrants an immediate response to prevent wider community transmission. Public health interventions such as periodic presumptive treatment to decrease morbidity from STIs and shorten the duration of infectiousness to prevent further spread into the community must be implemented promptly.²⁶ We recommend a combined approach, including enhancing existing communicable disease surveillance systems nationwide, strengthening health education to women at high risk of STIs and to the general population, tailoring health programmes to make them more acceptable and accessible to women engaged in transactional sex and promoting efforts to destigmatize these women in Kiribati society. As the prevalence of STIs in this key population group is high, we advocate for follow-up studies to assess the trends of STIs in this population. Future studies could also assess any impact this population may have on the overall epidemiology of STIs or HIV in Kiribati.

Conflicts of interest

None declared.

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