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Concurrent outbreaks of dengue, chikungunya and Zika virus infections – an unprecedented epidemic wave of mosquito-borne viruses in the Pacific 2012–2014

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Since January 2012, the Pacific Region has experienced 28 new documented outbreaks and circulation of dengue, chikungunya and Zika virus. These mosquito-borne disease epidemics seem to become more frequent and diverse, and it is likely that this is only the early stages of a wave that will continue for several years. Improved surveillance and response measures are needed to mitigate the already heavy burden on island health systems and limit further spread to other parts of the world.

Since January 2012, the Pacific is experiencing a high burden of mosquito-borne disease due to concurrent epidemics of dengue, chikungunya and Zika virus infections. So far over 120,000 people have been reported to be affected, a figure that is likely to substantially underestimate the real numbers due to underreporting. For as long as there has been data available from the Region (i.e. 40 years), this epidemic wave of mosquito-borne viruses with 28 new mosquito-borne viral outbreaks (n=25) and circulation (n=3) documented since January 2012 (18 Dengue virus (DENV) serotype 1–4, 7 chikungunya virus and 3 Zika virus infection outbreaks, respectively) is unprecedented (Table) [1-3]. We here present an overview of the surveillance and epidemiology of these mosquito-borne disease epidemics in the Pacific Region, to help facilitate response measures that are needed to mitigate the already heavy burden on island health systems and to limit further spread to other parts of the world.

Surveillance of mosquito-borne viruses in the Pacific Region

The Pacific Public Health Surveillance Network (PPHSN) is a voluntary network of countries, territories and organisations created in 1996. It is dedicated to the promotion of public health surveillance and response to health emergencies in the Pacific Region. It covers 22 Pacific Island countries and territories (hereafter referred to as the Pacific Region) with a population of 10.6 million inhabitants [4]. The network services include the timely exchange of information on outbreak-prone disease through PacNet, an email list with around 680 health professionals, and diagnostic support through a network of laboratories for identification and verification of pathogens.

In 2010, the Pacific Syndromic Surveillance System was introduced in the PPHSN. It monitors four syndromes and aims at improved early warning to complement routine notifiable disease notification systems that generally are not timely and seldom used for regional surveillance purposes in the Pacific Region. The Syndromic Surveillance system is under development and currently includes sentinel reporting from primary healthcare or hospital sites in all countries [5]. Manifest dengue, chikungunya and Zika virus infections have a similar initial clinical presentation and may be reported as any of the first three of the following four monitored syndromes: (i) acute fever and rash, (ii) prolonged fever, (iii) influenza-like illness and (iv) diarrhoea. Due to similar initial clinical features to the three mosquito-borne diseases, concurrent measles epidemics and leptospirosis pose diagnostic challenges in the Region.

There is a need for timely, reliable and detailed data on mosquito-borne virus outbreaks and circulation of the viruses in the Pacific Region. To obtain a comprehensible overview of the present epidemiological picture, several sources of information are used. Further to PacNet, syndromic and laboratory-based surveillance, event-based surveillance (mainly media and personal communications with health professionals) and surveillance by-proxy (reports of exported cases to neighbouring countries) [6] are also important. To facilitate better risk assessments and efficiency of data dissemination, this data is visualized in a recently launched interactive map available from: www.spc.int/phd/epidemics. The map, updated weekly, provides the region for the first time with a dynamic real-time picture of the current epidemic situation.

Table

Characteristics of new dengue, chikungunya and Zika virus infection outbreaks and circulation[a,b], Pacific Region, January 2012–17 September 2014[c] (n=28)

	Country	Month of onset	Latest information	Implicated mosquito borne virus	Summary	Sources
Dengue						
●	Tuvalu	Mar-14	10/07/2014	DENV-2	408 suspected cases with 195 cases positive in rapid tests (NS1/IgM).	[32]
●	Nauru	Mar-14	7/08/2014	DENV-3	251 suspected cases with 91 confirmed using IgM ELISA and/or rapid test. Samples sent for confirmatory serotyping.	[32, 33]
●	Tonga	Feb-14	21/08/2014	DENV-3	Outbreak ongoing; 2 cases of dengue imported into New Zealand since 12 July 2014.	[32–34]
●	New Caledonia	Feb-14	17/09/2014	DENV-3	In 2014, 338 cases of dengue recorded of which 55% were DENV-3. Virus circulation ongoing, with latest reported dengue case on 12 September 2014.	[35]
●	Fiji	15/01/2014[c]	23/06/2014	DENV-2	Circulation of virus, no outbreak declared; 6 confirmed cases of DENV-2 imported into Queensland Australia from January to June 2014.	[33]
●	Vanuatu	Dec-13	20/04/2014	DENV-3	1,561 dengue cases reported; 5 imported cases in Queensland Australia since January 2014 and 10 imported cases in New Caledonia from January to March 2014; 4 cases of DENV with serotype unknown imported into New Zealand since April 2014, of which 1 in July 2014.	[32–35]
●	Kiribati	Nov-13	24/01/2014	DENV-3	As of 16 Jan 2014, 198 suspected dengue cases of which 85 were laboratory-confirmed. Outbreak over, only sporadic cases of fever.	[32], media: Radio New Zealand International
●	Vanuatu	27/10/2012[c]	20/04/2014	DENV-1	Circulation of virus, no outbreak declared; 2 confirmed cases imported into Queensland Australia (1 case in 2013 and 1 case in 2014) and 6 cases into New Caledonia (5 cases in 2013 and 1 case in 2014); 4 cases of dengue serotype unknown imported into New Zealand since April 2014, of which 1 in July 2014.	[33, 35]
●	Fiji	Oct-13	5/06/2014	DENV-3	25,300 suspected cases, 15 deaths. Outbreak is ongoing; 15 confirmed cases imported into Queensland Australia from December 2013 to May 2014.	[33], media: Radio Australia, Fiji Broadcasting Corporation
● ●	French Polynesia	Feb-13	6/09/2014	DENV-1 DENV-3	As of 23 May 2014, 2188 positive cases since February 2013, and between 16 400 and 34 000 clinical visits estimated. 11 severe cases in March 2014 and 5 severe cases requiring hospitalisation in July 2014. DENV1 outbreak is still ongoing, but there are no cases of DENV3 reported since April 2014.	[36]
●	Wallis & Futuna	Jan-13	28/03/2013	DENV-1	88 suspected cases and 16 confirmed of which 11 imported cases from New Caledonia.	[37]
●	Solomon Islands	Dec-12	15/08/2014	DENV-3	7,697 reported cases as of 31 December 2013. As of June 2014, 1,762 suspected cases since January 2014, and 282 out of 1,500 samples tested positive in rapid tests. In March 2014 DENV-3 confirmed. Outbreak still ongoing.	[32, 33], media: Solomon Star
●	Kosrae, Federated States of Micronesia	Sep-12	19/07/2013	DENV-4	729 reported clinical cases; 206 cases laboratory confirmed by rapid diagnostic tests. No deaths reported.	[9, 37]
●	New Caledonia	Sep-12	17/09/2014	DENV-1	Largest ever recorded outbreak of dengue in New Caledonia with 10,978 cases and 5 deaths from September 2012 to September 2013; 338 cases of dengue recorded in 2014 of which 45% were DENV-1. Virus circulation ongoing, with latest reported dengue case on 128 September 2014.	[35]
●	Fiji	15/07/2012[c]	31/12/2012	DENV-2	Circulation of virus, no outbreak declared. 2 imported cases in Queensland Australia;	[33]
●	Kiribati	Mar-12	4/05/2012	DENV-1	243 clinical cases.	[32]
●	Niue	Feb-12	20/07/2012	DENV-1	More than 100 cases.	Media: Radio New Zealand International

	Country	Month of onset	Latest information	Implicated mosquito borne virus	Summary	Sources
Chikungunya						
●	Tokelau	Jul-14	11/09/2014	CHIKV	164 suspected cases reported. CHIKV confirmed.	[32]
●	Samoa	Jul-14	1/09/2014	CHIKV	433 cases reported over 4 weeks. 21 RT-PCR positives out of 59 samples (as of 28 Aug 2014).	[37], media: Samoa Observer
●	American Samoa	Jun-14	17/09/2014	CHIKV	823 probable cases reported, with 15 hospitalisations. CHIKV confirmed.	[37], media Radio New Zealand International
●	Tonga	Feb-14	11/09/2014	CHIKV	Over 10,000 suspected cases reported. Ongoing circulation of CHIKV confirmed.	[32–34]
●	Yap, Federated States of Micronesia	Aug-13	10/09/2014	CHIKV	A total of 1,711 suspected cases identified in Yap State. Circulation of CHIKV reconfirmed.	[37]
●	New Caledonia	Jan-13	2/06/2014	CHIKV	A total of 32 confirmed cases from January to May 2013.	[35]
●	Papua New Guinea	Jun-12	25/11/2013	CHIKV	A major outbreak spread over Papua New Guinea in 2013. Number of cases not reported, but estimated in media to be tens of thousands of cases.	[2], media: Australia Network News, Pacnews
Zika virus infections[d]						
●	Cook Islands	Feb-14	29/05/2014	ZIKV	Outbreak is over. 932 suspected and 50 confirmed cases.	[32], media: Radio New Zealand International
●	New Caledonia	Jan-14	17/09/2014	ZIKV	Imported cases reported in November 2013, first autochtonous case reported in January 2014; 1,400 confirmed cases of which 35 imported cases. Outbreak peaked in April 2014. Last case reported on 2nd August 2014.	[35]
●	French Polynesia	Oct-13	4/05/2014	ZIKV	8,723 suspected cases reported and more than 30,000 estimated clinical visits due to Zika. Outbreak declared over but virus circulation may be ongoing.	[36]

● Cases reported are increasing or peaking
● Cases reported are decreasing or viral circulation is ongoing
● Outbreak is reported to be over and/or no cases have been reported for one year.

CHIKV: chikungunya virus; DENV: dengue virus serotype 1-4; RT-PCR: reverse-transcriptase polymerase chain reaction; ZIKV: Zika virus.

[a] Only incident outbreaks and circulation notified during the reported period. Outbreaks first reported in 2011 (DENV-4 in Marshal Islands, DENV-2 in Yap and circulation of DENV in Papua New Guinea and Fiji) and still ongoing in 2012 are not presented.

[b] An outbreak is considered an outbreak when reported as such or when the first autochtonous cases are reported, and new circulation if there have been no events reported during one year.

[c] Month of start equals the month of first report, as this reflects circulation of virus.

[d] Easter Island experienced a Zika virus infection outbreak starting February 2014, but is not presented in the table as it is not part of the 22 countries and territories of the Pacific Public Health Surveillance Network .

The epidemiology of mosquito-borne viruses in the Pacific Region

Mosquito-borne virus diseases in the Pacific Region have a distinct epidemiology due to small populations scattered over thousands of tropical and sub-tropical islands on both sides of the equator in relative geographic isolation, together with (nowadays) significant people's mobility and thereby exposure to circulating arboviruses through the airline networks of the Asia-Pacific region (Figure 1).

Between January 2012 and 17 September 2014, a total of 28 new mosquito-borne viral outbreaks (n=25) and circulation (n=3) were documented: 18 DENV 1–4 outbreaks (2012: 7; 2013: 6; 2014: 5), 7 chikungunya virus (CHIKV) (2012: 1; 2013: 2; 2014: 4) and 3 Zika virus infection outbreaks (2012: 0; 2013: 1; 2014: 2), respectively.

Looking at the first semester of 2014, the number of outbreaks and circulating mosquito-borne viruses seem to be increasing (Figure 2). During the same period, DENV-3 became the dominating dengue virus, and since Zika virus started to spread in the end of 2013, there was concurrent circulation of DENV-1,-2 and -3, CHIKV and Zika virus (Table, Figure 2)

Dengue

The epidemic pattern of dengue in the Pacific Region has typically presented in form of sporadic or rare epidemics rather than a hyperepidemic/endemic pattern, with one dominating serotype sweeping across the islands every 3 to 5 years, and with varying duration of circulation in different islands largely depending on population size [1,7- 8]. During 2012, there were outbreaks of all four serotypes of DENV documented for the first time during one year (Figure 2) [1]. DENV-1 was the dominating serotype in 2012 and beginning 2013, causing the largest documented dengue outbreak ever in New Caledonia, with 10,978 confirmed cases and 5 deaths from September 2012 to September 2013. Since 2012 there have only been reports of one outbreak with DENV-2 and -4 respectively: DENV- 2 recently caused an outbreak in Tuvalu with 408 suspected cases (4% of the population) and DENV-4 caused a large outbreak in Kosrae in September 2012 to March 2013 with 729 clinical cases (11% of the population) (Table) [9]. Furthermore there have been reports of new circulation of DENV-2 in Fiji. (Table) After having been absent in the region for 18 years, DENV- 3 has after the reintroduction in 2012, become the dominating DENV in the region with five ongoing outbreaks, one of them in Fiji, with 25,300 suspected cases and 15 deaths (Table, Figure 1) [1,10].

Figure 1

Map of newly reported dengue, chikungunya and Zika virus infection outbreaks or new virus circulation[a], Pacific Region[b], January 2012–17 September 2014[c] (n=28)

CHIKV: chikungunya virus; DENV: dengue virus serotype 1-4; ZIKV: Zika virus.

[a] Only incident outbreaks and virus circulation reported during the period. Outbreaks first reported in 2011 (DENV-4 in Marshal Islands, DENV-2 in Yap and circulation of DENV in Papua New Guinea and Fiji) and still ongoing in 2012 are not presented.

[b] The 22 Pacific Island countries and territories that are core members of the Pacific Public Health Surveillance Network and referred to as the Pacific Region.

[c] Real-time interactive map with current epidemiological situation and alerts is available from: www.spc.int?phd/epidemics

Chikungunya

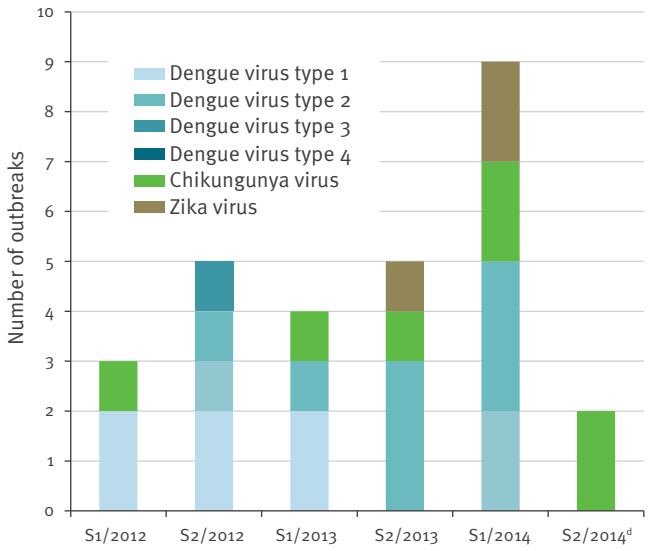
After being reported in the Pacific for the first time in a small tightly controlled outbreak in New Caledonia in 2011 [11], CHIKV is currently becoming established in the Region (Figure 1, Table) [2]. In Papua New-Guinea in 2012-13, the largest epidemic in the Region so far with estimated (though poorly documented) tens of thousands of cases, was caused by the East Central South African (ECSA) lineage of the virus [2]. The Asian lineage of the virus was responsible for the outbreak in Yap State (2013-14) [12] and also in New Caledonia (2013) where CHIKV re-emerged in the middle of a large DENV-1 epidemic and caused a small outbreak, similar to the 2011 outbreak (Table) [13]. Phylogenetic analyses of the CHIKV involved in the outbreaks in Tonga, Samoa and American Samoa are not yet available. Due to the on-going geographic expansion of *Aedes albopictus* in the Pacific region (Figure 3), virus genotype monitoring is a crucial aspect of surveillance.

Zika virus infections

After the first documented Pacific Zika outbreak in Yap in 2007 [14], the Asian lineage of the virus reappeared in French Polynesia in October 2013, and has since caused large outbreaks in New Caledonia (1,400 confirmed cases), Cook Islands (over 900 cases) and Easter Island that is not part of the PPHSN (Figure 1, Table) [3]. In French Polynesia, extrapolation of the 8,746 suspect cases reported by the sentinel surveillance network allows to infer that over 30,000 medical consultations were due to the spread of Zika virus throughout the archipelago. Between November 2013 and February 2014, increased incidence of neurological complications, including 42 cases of Guillain-Barré syndrome, was a unique and worrying feature of the French Polynesia outbreak that warrants further studies [3].

Figure 2

Incidence and aetiology of newly reported mosquito-borne virus outbreaks and circulation[a] by semester[b], Pacific Region, January 2012–17 September 2014[c] (n=28)



S: semester.

[a] An outbreak is considered an outbreak when reported as such, and new circulation of virus if there has been no event with the same virus reported during one year previously.

[b] S1 includes the months from January to June and S2 the months from July to December.

[c] Outbreaks or circulation that started before January 2012 or after 17 September 2014 are not presented in this graph to allow observation of a possible trend over time.

[d] Semester 2 in 2014 is not complete, and only includes reports from two full months out of six.

Discussion and Conclusions

Burden on the Pacific countries and territories

Mosquito-borne outbreaks are greatly exacerbating the pre-existing burden that Pacific Island primary healthcare systems face. If not managed well, the epidemic wave may threaten societies broadly, affecting trade, tourism and work force beyond the direct morbidity and mortality toll [2]. During the chikungunya outbreak in Reunion Island, one third of the around 800,000 inhabitants were infected, peaking at more than 47,000 estimated cases in one week, with estimated productivity loss of €17.4 million (range €6 to €28.9 million) and medical costs of €43.9 million that were met by the French state [15-17]. Much of the burden on the Pacific Region of the concurrent epidemics of all three diseases covered here is unknown and further studies are warranted, especially on co-infection and the effect of sequential infection with different viruses.

Zika virus disease, generally reported to have a mild clinical presentation, was associated with neurological complications during concurrent Zika virus disease and dengue epidemics in French Polynesia [3,18]. The Pacific Region may be particularly vulnerable to communicable diseases due to isolation and immunologically naive populations, but also due to rates of non-communicable disease, such as obesity, diabetes and cardiovascular disease, that are among the world's highest on some islands [19].

The risk for further spread

While there have been efforts to improve surveillance in the Pacific over the past two decades, it is not likely that the extent of the current increase in diversity and frequency of mosquito-borne virus outbreaks in the Pacific can be explained solely by improved surveillance systems. In the island setting of the Indian Ocean, the largest documented CHIKV outbreak lasted four years (2004–2007) [15]. Therefore, considering also the previous dengue outbreaks in the Pacific Region [1-2] and the diversity of the current outbreaks, it seems likely that the Pacific Region is in the early stages of an epidemic wave for the three mosquito-borne viruses that started in 2012 and is likely to continue for several years.

The risk for further spread in the Pacific Region is high for several reasons. Firstly, it is likely that there is little immunity to these diseases, as DENV-3 had not been

circulating in the Region since 1995 [1] and prior to the current wave, CHIKV and Zika virus occurrence in the Pacific was limited to two documented outbreaks [11, 14]. Secondly, competent vectors present in the Region, mainly *Ae. aegypti* and *Ae. albopictus*, but also other local mosquitoes such as *Ae. polynesiensis* or *Ae. hensilli* are known to transmit these viruses (Figure 3) [20]. These species have been incriminated in DENV transmission on epidemiological and/or experimental (laboratory infections) grounds. Several of them are confirmed or strongly suspected vectors of CHIKV and Zika viruses [21]. Thirdly, large population mobility and airline travel facilitate the spread [22].

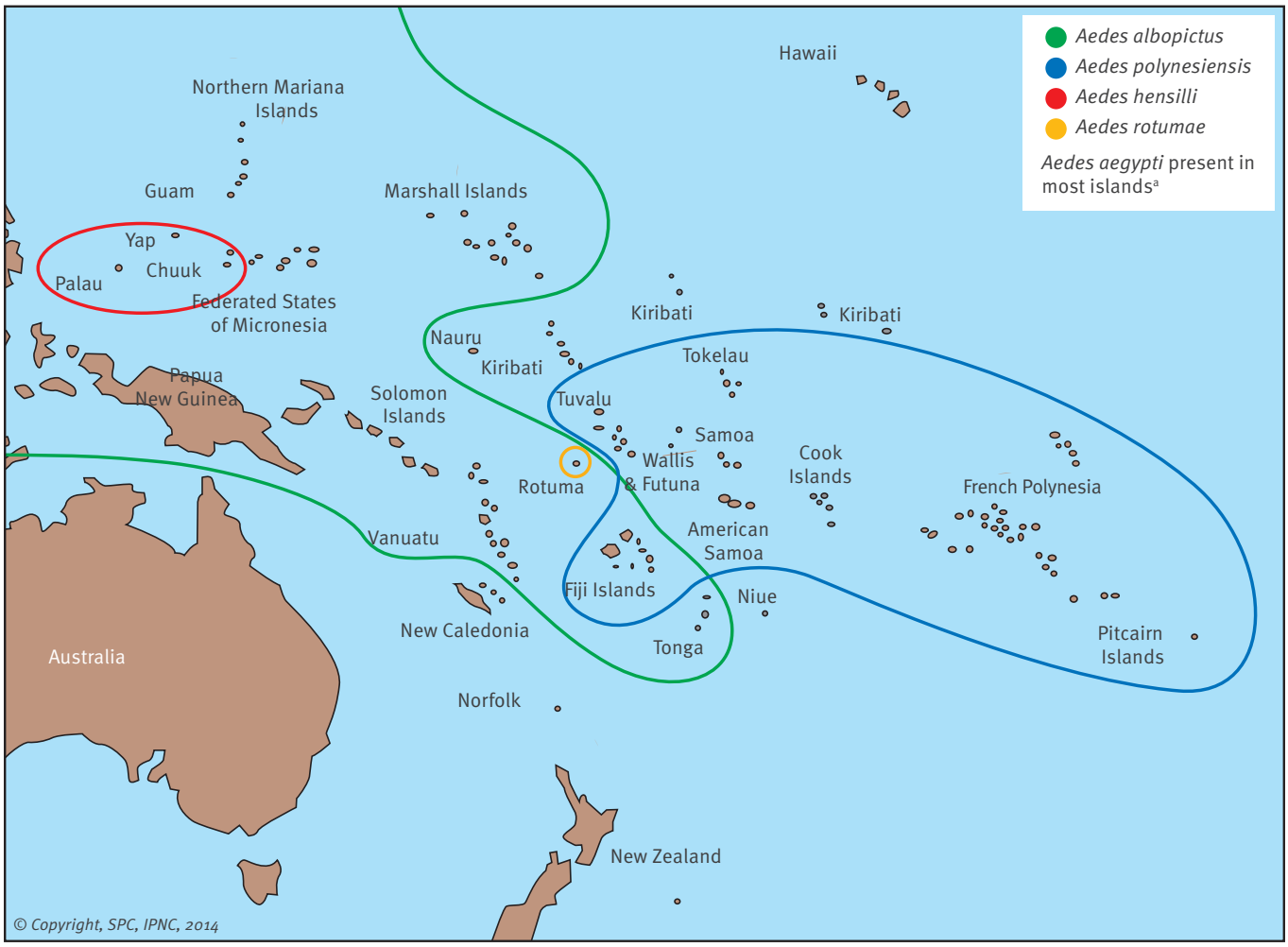
Vector control capacity in the Pacific Region is often limited or insufficient [11]. At present, there is no ongoing entomological surveillance system targeting vectors of dengue and other arboviruses established in the Region except in New Caledonia, Fiji and French Polynesia. The current knowledge about mosquito distribution in the other countries and territories is based on data collected during entomological investigations in surveys from the second half of the 20th century and from some more recent surveys [20]. Interestingly, the three viruses involved in this epidemic wave are not broadly mosquito-borne, but specifically *Aedes (Stegomyia)*-borne.

The cause of the recent increase in mosquito-borne disease in the Pacific Region is largely unknown, but is in line with a global increase of emerging diseases, and likely driven by a combination of socio-economic, environmental and ecological factors [23].

The continuous challenges of dengue and chikungunya [24] and more recently Zika virus infections [25]

Figure 3

Map of the known distribution of *Aedes (Stegomyia)* mosquitoes, vectors of dengue and possible vectors of chikungunya and Zika viruses, Pacific Region as of beginning October 2014



[a] *Aedes aegypti* (not represented on the map) is present throughout most of the region including North Queensland. It is absent from the rest of Australia, New Zealand, Hawaii, Futuna and some other remote islands, and it seems to be currently displaced by *Ae. albopictus* in many locations (e.g. Papua New Guinea and Solomon Islands).
The known or strongly suspected distributions of other vectors are as follows (not exhaustive): *Ae. scutellaris* (Indonesia; Northern Australia, Papua New Guinea); *Ae. marshallensis* (Marshall Islands; Western Kiribati; Kosrae; Pohnpei); *Ae. hebrideus* (Papua New Guinea; Solomon Islands; Vanuatu); *Ae. cooki* (Niue, Vava'u Group, Tonga); *Ae. tongae* (Ha'apai Group, Tonga); *Ae. tabu* (Tongatapu group, Tonga); *Ae. kesseli* (Niua group, Tonga); *Ae. pseudoscutellaris* (Fiji). [25]

for Europe, the re-emergence of dengue in Japan [26], and the first-time chikungunya transmission in the Americas [27], show that these viruses pose a threat to any country with competent vectors. The epidemiology of mosquito-borne viruses in the Pacific may be changing. There are close links between the several European overseas countries and territories in the Pacific Region and Europe and the United States [28]. Considering the extensive airline travel between the Pacific Region and other parts of the world where the viruses have not yet been established e.g. Europe and the United States, it should be of international interest to stay informed of the spread of the current Pacific Region wave of mosquito-borne viruses and to support surveillance and control efforts [2,23,29].

Examples of response from PPHSN partners to the epidemic situation include the provision of support and capacity building to Pacific Islands in surveillance, outbreak investigation and response, and mass-gathering surveillance. The Pacific Outbreak Manual is also being updated to include specific response guidelines for the three viruses [30].

To further enhance surveillance and response measures, Pacific Directors and Ministers of Health have shared the current risk assessment, and the upcoming Pacific International Health Regulations meeting will focus on mosquito-borne diseases. Island primary healthcare-based systems have difficulties to cope with high caseloads and there is a need for early multidisciplinary preparedness and response to face larger outbreaks adequately [2].

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Conflict of interest

None declared.

Authors' contributions

AR, YS, CL, DH conceived the idea of the paper. AR, AM, CL, SD and EB contributed to data gathering and cleaning. AR, CL and AM conducted the analysis. LG gathered and compiled all vector data and analysis. AR and AM drafted the first draft, and all
authors commented and agreed upon the final manuscript.

References

1. Singh N, Kiedrzynski T, Lepers C, Benyon EK. Dengue in the Pacific--an update of the current situation. Pacific Health Dialog. 2005;12(2):111-9.
2. Roth A, Hoy D, Horwood PF, Ropa B, Hancock T, Guillaumot L, et al. Preparedness for threat of chikungunya in the pacific. Emerging Infect Dis. 2014;20(8). http://dx.doi.org/10.3201/eid2008.130696
3. Musso D, Nilles EJ, Cao-Lormeau VM. Rapid spread of emerging Zika virus in the Pacific area. Clin Microbiol Infect. 2014. http://dx.doi.org/10.1111/1469-0691.12707
4. Les populations du Pacifique 2013. [Pacific Island Populations 2013]. French. Nouméa, 2013. Statistics for Development Division, Secretariat of the Pacific Community. Available from: http://www.spc.int/sdd/index.php/en/downloads/doc_download/738-2013-pacific-population-poster
5. Kool JL, Paterson B, Pavlin BI, Durrheim D, Musto J, Kolbe A. Pacific-wide simplified syndromic surveillance for early warning of outbreaks. Global Public Health. 2012;7(7):670-81. http://dx.doi.org/10.1080/17441692.2012.699536
6. Lau CL, Weinstein P, Slaney D. Dengue surveillance by proxy: travellers as sentinels for outbreaks in the Pacific Islands. Epidemiol Infect. 2013;141(11):2328-34. http://dx.doi.org/10.1017/S0950268813000058
7. Dupont-Rouzeyrol M, Aubry M, O'Connor O, Roche C, Gourinat AC, Guigon A, et al. Epidemiological and molecular features of dengue virus type-1 in New Caledonia, South Pacific, 2001-2013. Virol J. 2014;11:61. http://dx.doi.org/10.1186/1743-422X-11-61
8. Morens DM. Dengue fever: a prevention summary for Pacific health workers. Pacific Health Dialog. 1996;3(1):240-52.
9. Centers for Disease Control and Prevention (CDC). Dengue outbreak--Federated States of Micronesia, 2012-2013. MMWR. Morbidity and mortality weekly report. 2013;62(28):570-3.
10. Cao-Lormeau VM, Roche C, Musso D, Mallet HP, Dalipanda T, Dofai A, et al. Dengue virus type 3, South Pacific Islands, 2013. Emerg Infect Dis. 2014;20(6):1034-6. http://dx.doi.org/10.3201/eid2006.131413
11. Dupont-Rouzeyrol M, Caro V, Guillaumot L, Vazeille M, D'Ortenzio E, Thiberge JM, et al. Chikungunya virus and the mosquito vector Aedes aegypti in New Caledonia (South Pacific Region). Vector Borne Zoonotic Dis. 2012;12(12):1036-41. http://dx.doi.org/10.1089/vbz.2011.0937
12. Nhan TX, Claverie A, Roche C, Teissier A, Colleuil M, Baudet JM, et al. Chikungunya virus imported into French polynesia, 2014. Emerg Infect Dis. 2014;20(10):1773-4. http://dx.doi.org/10.3201/eid2010.141060
13. Dupont-Rouzeyrol M, O'Connor O. Phylogénie moléculaire des Arbobirus en Nouvelle-Calédonie. Institut Pasteur de Nouvelle-Calédonie: La Recherche: Rapport d'activité 2013. [Molecular Phylogeny of Arboviruses in New Caledonia. Pasteur Institute of New Caledonia; Annual report 2013. p 24. Doc. n° 156/2014-IPNC/DG of 25 June 2014. Noumea, 2013.] p 24. Doc.n° 156/2014-IPNC/DG du 25 juin 2014. Nouméa, 2013. Available from: http://www.institutpasteur.nc/wp-content/uploads/2013/07/Rapport-2013-IPNC-RECHERCHE-n%C2%Bo-156-26-juin-2014.pdf
14. Duffy MR, Chen TH, Hancock WT, Powers AM, Kool JL, Lanciotti RS, et al. Zika virus outbreak on Yap Island, Federated States of Micronesia. N Engl J Med. 2009;360(24):2536-43. http://dx.doi.org/10.1056/NEJMoa0805715
15. Renault P, Balleydier E, D'Ortenzio E, Baville M, Filleul L. Epidemiology of Chikungunya infection on Reunion Island, Mayotte, and neighboring countries. Med Mal Infect. 2012;42(3):93-101. http://dx.doi.org/10.1016/j.medmal.2011.12.002
16. Lagacherie P. [Coverage of the chikungunya epidemic on Reunion Island in 2006 by the French healthcare system]. Med Trop (Mars). 2012;72 Spec No:97-8.
17. Soumahoro MK, Boelle PY, Gauzere BA, Atsou K, Pelat C, Lambert B, et al. The Chikungunya epidemic on La Reunion Island in 2005-2006: a cost-of-illness study. PLoS Negl

Trop Dis. 2011;5(6):e1197. http://dx.doi.org/10.1371/journal.pntd.0001197

18. Oehler E, Watrin L, Larre P, Leparc-Goffart I, Lastere S, Valour F, et al. Zika virus infection complicated by Guillain-Barre syndrome - case report, French Polynesia, December 2013. Eurosurveill. 2014;19(9). pii: 20720.
19. Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, et al. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet. 2014;384(9945):766-81. http://dx.doi.org/10.1016/S0140-6736(14)60460-8
20. Guillaumot L, Ofanoa R, Swillen L, Singh N, Bossin HC, Schaffner F. Distribution of Aedes albopictus (Diptera, Culicidae) in southwestern Pacific countries, with a first report from the Kingdom of Tonga. Parasit Vectors. 2012;5:247. http://dx.doi.org/10.1186/1756-3305-5-247
21. Ledermann JP, Guillaumot L, Yug L, Saweyog SC, Tided M, Machieng P, et al. Aedes hensilli as a Potential Vector of Chikungunya and Zika Viruses. PLoS Negl Trop Dis 2014 8(10): e3188. http://dx.doi.org/10.1371/journal.pntd.0003188
22. Tatem AJ, Huang Z, Das A, Qi Q, Roth J, Qiu Y. Air travel and vector-borne disease movement. Parasitology. 2012;139(14):1816-30. http://dx.doi.org/10.1017/S0031182012000352
23. Jones KE, Patel NG, Levy MA, Storeygard A, Balk D, Gittleman JL, et al. Global trends in emerging infectious diseases. Nature. 2008;451(7181):990-3. http://dx.doi.org/10.1038/nature06536
24. Chretien JP, Linthicum KJ. Chikungunya in Europe: what's next? Lancet. 2007;370(9602):1805-6. http://dx.doi.org/10.1016/S0140-6736(07)61752-8
25. European Centre for Disease Prevention and Control (ECDC). Rapid risk assessment: Zika virus infection outbreak, French Polynesia. 14 Feb 2014. Stockholm:,ECDC; 2014.
26. DENGUE - JAPAN: (SAITAMA) [Internet]. International Society for Infectious Diseases. 2014 [cited 2014-09-08]. Available with archive number: 20140828.2731079 from: http://www.promedmail.org/.
27. Staples JE, Fischer M. Chikungunya virus in the Americas--what a vectorborne pathogen can do. N Engl J Med. 2014;371(10):887-9. http://dx.doi.org/10.1056/NEJMp1407698
28. Jones J, Gastellu-Etchegorry M, Stenz FK, Baudon C, Bloem SJ, Bondonneau M, et al. Epidemiology, surveillance and control of infectious diseases in the European overseas countries and territories, 2011. Eurosurveill. 2011;16(29). pii: 19923.
29. Kuehn BM. World leaders push to prepare for global threats. JAMA. 2014;311(12):1189-90. http://dx.doi.org/10.1001/jama.2014.2272
30. The Pacific Outbreak Manual. Pacific Public Health Surveillance Network (PPHSN). February 2014. Available from: http://www.spc.int/phs/PPHSN/Publications/Pacific_Outbreak_Manual_wersion1-2.pdf
31. Guillaumot L. Arboviruses and their vectors in the Pacific--status report. Pac Health Dialog. 2005;12(2):45-52.
32. World Health Organization, West Pacific Region (WPRO). Emerging disease surveillance and response. Division of Pacific Technical Support. Weekly Pacific Syndromic Surveillance Report. Fiji: WPRO; 2014. Available from: http://www.wpro.who.int/southpacific/programmes/communicable_diseases/disease_surveillance_response/page/en/index2.html
33. Queensland Government. Queensland Health. Queensland notifiable conditions data. Last updated: 14 Oct 2014. Brisbane: Queensland Health; 2014.Available from: http://www.health.qld.gov.au/ph/cdb/sru_data.asp
34. Institute of Environmental Science and Research Ltd (ESR). Dengue weekly updates. Porirua, New Zealand. For details, contact ESR (Institute of Environmental Science and Research Ltd) (ange.bissielo@esr.cri.nz)
35. La direction des affaires sanitaires et sociales de Nouvelle-Calédonie (DASS). [Department of Health and Social Affairs] Veille sanitaire. French. Nouméa, 2014. [Accessed 17 Sep 2014]. Available from : http://www.dass.gouv.nc/portal/page/portal/dass/observatoire_sante/veille_sanitaire/
36. Bulletin de surveillance et veille sanitaire en Polynésie français - Bureau de veille sanitaire. [Public Health Surveillance and Monitoring in French Polynesia – Public Health Surveillance Office]. French. Accessed 17 Sep 2014. Available from: http://www.spc.int/phs/PPHSN/Surveillance/Routine_reports.htm
37. PacNet country reports. For details in PacNet report archives, contact the Focal Point of the Pacific Public Health Surveillance Coordinating Body (FocalPointPPHSNCB@spc.int‹mailto:FocalPointPPHSNCB@spc.int›)

European Antibiotic Awareness Day: a five-year perspective of Europe-wide actions to promote prudent use of antibiotics

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Following the European Union (EU) Council Recommendation on prudent use of antimicrobial agents in human medicine in 2001, and the success of national campaigns, i.e. Belgium and France, the European Centre for Disease Prevention and Control (ECDC) decided to establish the European Antibiotic Awareness Day (EAAD) on 18 November as platform to support national campaigns across Europe. This article provides an overview of EAAD tools, materials, and activities developed during the first five years. It shows that EAAD has been successful due to good cooperation between ECDC and national institutions, strong political and stakeholder support and evidence-based development of campaign materials. EAAD has provided a platform for pre-existing national campaigns and encouraged similar campaigns to develop where neither political support had been secured, nor financial support had been available. As a result, participating countries have continuously expressed strong support for ECDC to continue its work on EAAD. This has been endorsed by a steadily increasing number of countries participating and the growing interest of varied professional and stakeholder organisations. We conclude that EAAD should continue to act as catalyst for discussion and as mechanism to raise awareness of the public and prescribers about prudent use of antibiotics.

Introduction

The emergence and spread of antibiotic resistance, is recognised as a global problem. Its immediate consequence is that, only a limited number of antibiotics, and sometimes even no antibiotic, is available for the treatment of infections caused by resistant bacteria. Other direct consequences for patients include delayed administration of appropriate antibiotic therapy, longer stays in hospitals, higher healthcare costs and poor patient outcomes [1]. Worldwide action is thus necessary to avert an impending threat to human health [2].

Of the steps that need to be taken to address antibiotic resistance, we believe that improving antibiotic use is the most important action needed to greatly slow the development and spread of antibiotic-resistant bacteria. Antibiotics are frequently used inappropriately or when they are not needed, in both humans and animals.

Following adoption of the European Union (EU) Council Recommendation on the prudent use of antimicrobial agents in human medicine in November 2001, which stated that EU Member States should inform the general public of the importance of prudent use of antimicrobial agents and the success of some national campaigns, such as Belgium and France, the European Centre for Disease Prevention and Control (ECDC) decided in 2008 to establish the European Antibiotic Awareness Day (EAAD) on 18 November as a platform for providing support to national campaigns across the region [3].

Since 2008, numerous health-related and professional organisations, as well as the European Commission and the World Health Organization Regional Office for Europe (WHO/Europe), have partnered with ECDC in preparing communications materials and planning activities targeting both communities and hospitals for EAAD. In 2012, under the banner of EAAD, national campaigns to inform about prudent antibiotic use took place in 43 European countries, with the target audiences selected by campaign organisers at national level, including both general public and prescribers.

This perspective describes the development of materials and tools during the past five years, and provides a review of the activities and achievements of EAAD. It also presents results from the annual questionnaire provided by participating countries and from an independent monitoring of the media coverage.

Development of materials and tools for the campaigns

ECDC endeavoured throughout the year 2008 to provide participating countries with a core set of tools, including a common name 'European Antibiotic Awareness Day' and logo, key messages, a dedicated website and communications materials targeting parents and carers of young children [4,5]. The various steps in preparation for the first EAAD that took place on 18 November 2008 were previously published [6].

In the following years, EAAD has focussed on primary care prescribers (2009) and hospital prescribers (2010). In each case, campaign messages and materials were developed following evidence-based processes, i.e. results of systematic reviews and subsequently they were reviewed by the EAAD Technical Advisory Committee and tested in focus groups representing the target audience in question. The campaign materials included a dedicated EAAD website, logos and visuals i.e., hedgehog mascot and TV and web spots, advertorials and on line banners, factsheets and prescribing check lists, patient brochures, template letters and presentations. All campaign materials were made available on the EAAD website [7].

In 2011 and 2012, the focus of EAAD shifted to consolidation, with new activities to support the national campaigns at a process level as opposed to the development of new content [8,9]. Given the global financial crisis and competing priorities, a number of countries reviewed government support for the annual campaigns. ECDC chose to strengthen its support to the participating countries by providing strategies and tools to support the delivery of the existing key messages and materials including a social media toolkit, and to foster impact evaluation strategies, and a pilot training course on development, implementation and evaluation of prudent antibiotic use campaigns.

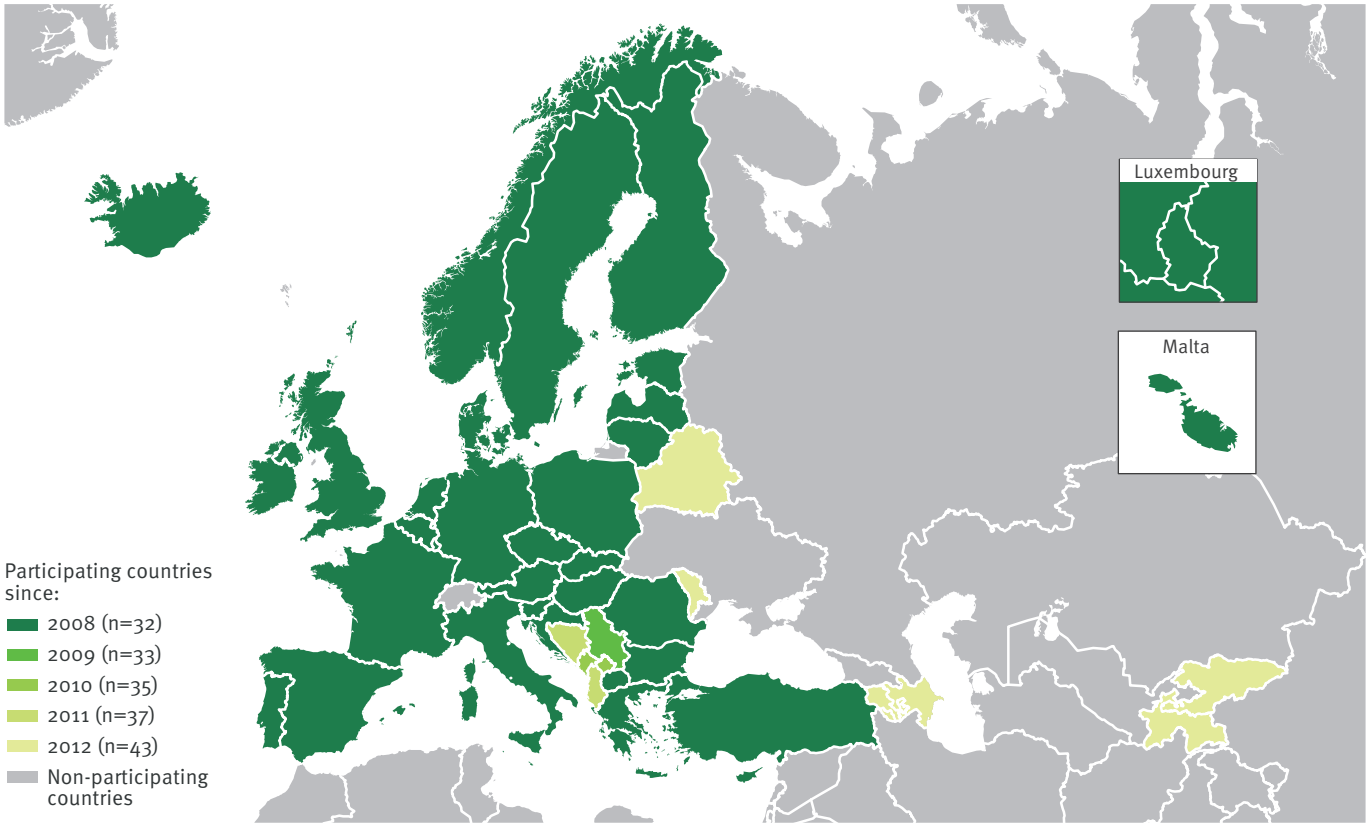
Each year, participating countries answered a questionnaire providing feedback to ECDC on their national activities for EAAD. The scope of this questionnaire is to gather information about the national campaigns: e.g. type and number of the activities, chosen target audience governmental support and EAAD material used to support those activities. In addition since 2010, an independent monitoring of the media coverage of EAAD in terms of print, online and social media is performed.

Coverage of the campaigns

Since 2008, the number of European countries participating in the EAAD has increased year on year. In 2008, all EU Member States plus Norway, Iceland, Croatia,

Figure

Countries participating in the European Antibiotic Awareness Day, 2008–2012



Country	National activities													
	Training	Scientific/professional conference	Publication of articles in medical journals	Distribution of brochures or other materials	Mailing	Communications on treatment recommendations	Advertisements	Press conference	Press release	Public relations activities	Activities targeting schools	Exhibition	Gimmicks	Other
European Union														
Austria		●●●	●●	●				●●●	●●●	●				●●
Belgium		●	●●●	●●	●●	●●●		●●●	●●●●		●	●	●	●
Bulgaria	●●●	●●●●	●●●	●	●●●	●		●●●●	●●●	●●		●		
Croatia		●●●●●	●●	●●●●	●	●		●●●●	●	●●●	●		●	●●●
Cyprus	●●●	●●●		●●●	●	●	●	●●	●●●●	●●●		●		●●
Czech Republic	●	●●●	●●●	●●●	●●●	●●		●●	●●●	●●		●●	●	●●
Denmark		●●●●	●●			●			●●					●●
Estonia		●	●●●●	●●	●●●●	●	●●	●●●	●●●●	●	●			
Finland								●	●●					●●
France	●	●	●	●●		●			●	●				●●
Germany	●●	●●●●●	●●●●						●●●					●●
Greece	●●●	●●	●●●	●●		●●		●●●	●●●	●●●				●●
Hungary		●●●●●	●●	●●●	●●		●	●●●●	●●●●	●●●				
Ireland		●	●	●●●	●●●	●●	●	●●●●	●●●	●●●			●	●●
Italy		●●●		●				●●	●●	●●●	●●			●●●●
Latvia	●	●●●	●●●		●			●	●●	●●				
Lithuania	●	●●●	●●●	●	●		●		●●●	●●	●●●			●●
Luxembourg		●	●	●	●●	●	●	●●	●●	●				●
Malta		●●●	●	●	●●		●	●●	●●	●●				●●
Netherlands			●	●●	●			●	●●●					●●
Poland	●●●●●	●●●●●	●●●●●	●●●●●	●	●●●●	●●●	●●●	●●●●	●●●	●●●	●●●●		●●
Portugal		●●●	●	●●		●●	●	●	●●●	●●●	●●●	●		●
Romania	●	●●●●	●●●	●●	●●●●	●●●		●●●	●●●	●●●				●●
Slovakia	●	●●●	●	●	●	●		●●●	●●●	●	●			
Slovenia	●●	●●●	●●●●		●			●●	●●●	●●				●●●
Spain		●●●●●	●●●●	●●●●	●●●●	●	●●●●	●●●	●●●●	●●●	●●	●●●		●
Sweden		●●	●●●	●	●			●●	●●●					●●●
United Kingdom	●●	●●●●	●●●●	●●●	●●●	●●			●●	●●	●●	●●		●●●●●
European Economic Area														
Iceland		●		●●	●	●●			●●●					●●
Norway	●	●●●	●●●	●●●	●●	●●			●●	●				●●●
Other countries														
Albania		●●●	●	●●		●●	●	●●	●	●●		●		
Bosnia and Herzegovina	●●	●●	●	●●	●	●●	●	●●	●●	●●				
Former Yugoslav Republic of Macedonia		●●●●●	●●●●●	●●●			●	●●●●●	●●●	●●●				●●
Kosovo*	●	●●●		●●●●	●●●●			●●	●●●	●●●				●
Montenegro		●●								●				●●
Serbia	●●	●●	●●		●●●	●		●●●●	●●●	●●●				●●●
Turkey	●●	●●●●		●●●●	●●	●		●●●●	●●●	●●	●●●			●●●

Each dot corresponds to one activity-year.

* This designation is without prejudice to positions on status, and is in line with United Nations Security Council Resolution 1244/99 and the International Court of Justice Opinion on the Kosovo declaration of independence.

	Campaign materials															
	Factsheet	Check list	Advertorial	Online banner	Presentation	Screen saver	Gimmicks	Posters	Leaflets	Patient dialogues	Letters to stakeholders	Web-based materials	Brochures	Television or web spots	Advertisements in print media	Other
		•						•	•		•	•				••
					•			••••	••••		••••	••••		••••		•
	••	•		•	•			••	••	•	•••	••••	•			
	••	••			•			••••	••••		•••	•		•••	••	•
	•••			••	••			•••	••••	•	••	•••	•••	•	•	••
	•••	•••		•••	•	•••	•	••••	••••		•	••••	••	••	••	••
					•			•	•		•	•••				••
	•								•		••••	••••		••		•
	•											••				•
		•	•		•				••		••	••		••		•••
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	•		•		••			•••	•••			•	•	••••	•	••
	••••	•			••	••		••••	••••	•	•••	••••	•	••		
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	••							••	••		•••	•	•	•	•	••
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	••	•						••	•	•	••	•••	••			
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the Former Yugoslav Republic of Macedonia and Turkey participated making a total of 32 countries. Between 2009 and 2012, this number increased to 43 countries, firstly with the addition of other EU enlargement countries: Albania, Bosnia and Herzegovina, Kosovo*, Montenegro and Serbia [10,11]. In 2012, through cooperation with WHO/Europe, Armenia, Azerbaijan, Belarus, Kyrgyzstan, Moldavia and Tajikistan also participated (Figure).

Thirty-two countries initially participated to EAAD in 2008; one additional country in 2009, two additional countries in 2010; in 2011 two further countries joined and six more in 2012. Thus in 2012, a total of 43 European countries participated and in 2013, the number countries reached 45 (unpublished data).

Each participating country has carried out at least one activity targeting the general public, primary care prescribers or hospital prescribers (Table 1). The target audiences have predominantly followed the theme set by ECDC at European level, i.e. twenty-seven of 33 participating countries targeted primary care prescribers in 2009 and 31 of 35 countries targeted hospital prescribers in 2010 [12]. In the subsequent years of consolidation, ECDC has seen a continued focus on all three target audiences with in 2012, 36 of 43 countries organising activities targeted at the general public, 34 at primary care prescribers and 30 at hospital prescribers (Table 1).

Governmental support

Government support has been an essential element in funding and endorsing national campaigns. This support was universal in 2008, but then probably due to financial constraints and/or competing priorities (e.g. the 2009 influenza A(H1N1)pdm pandemic), a number of countries were not able to secure on-going government support for the annual campaigns. In 2009, 23 countries had government support, of which 14 were able to secure funding for their national campaigns as part of this support. The level of government funding further decreased and in 2010 only nine countries remained with government funding. This number increased again by 2012, with 30 countries then receiving support, of which 15 received financial support, from their governments (Table 2).

As government support varied in 2009 and 2010, campaign planners considered a broader scope of alternative groups to provide support and funding, such as professional groups and non-governmental organisations. By 2010, 16 countries reported cooperation with professional groups, such as medical associations and professional healthcare organisations. In 2011 and 2012, this number increased to 27 and 35 countries, respectively, of which 10 countries and 19 countries, respectively, reported receiving sponsorships (Table 2).

Print, online and social media coverage

ECDC has consistently monitored print and online press coverage of EAAD in all 24 official EU languages since 2010. In 2010 and in 2011, 476 and 611 articles related to EAAD were published, respectively, during a four-month period between 15 October and 15 February. In 2012, 446 articles related to EAAD were published in 47 countries worldwide during a two-month monitoring period between 18 October and 28 December. This coverage represented a range of 42 to 72 million visits of news online and a print reach of 18 to 77 million persons.

The EAAD website (http://ecdc.europa.eu/en/EAAD/Pages/Home.aspx) includes communications materials in all EU languages [7]. Analysis of the EAAD website showed around a 200% increase in web traffic i.e., during the week of 18 November each year compared to the previous one. The most visited EAAD pages were the country activities, toolkits, multimedia news release (for English version), as well as the factsheets and national campaigns (for the multilingual websites).

Since 2011, ECDC has increasingly used social media (e.g. Twitter, Facebook) to convey EAAD messages. In 2012, EAAD was mentioned in 1,773 tweets, with over of 3.7 million impressions reached. In 2012, ECDC with WHO/Europe and the European Commission held a joint Twitter chat on 20 November reaching 2.5 million impressions (out of the 3.7 million stated above). EAAD was also mentioned 58-times in the monitored period in blogs, e.g. European Medical Students' Association. The postings focused on the EAAD and the use of antibiotics.

From 2009 to 2012, ECDC broadcasted a TV spot raising awareness on antimicrobial resistance and EAAD on a pan-European TV channel (Euronews), reaching an average of 14 million EU citizens each year and among them an average of 1.5 million people working in the healthcare and medicine sector in Europe.

Discussion

In 2007, when the idea of a European-level initiative to raise awareness about the importance of prudent use of antibiotics was agreed, ECDC hosted two meetings of national antimicrobial resistance (AMR) focal points, nominated by the Member States. In these meetings in September 2007 and March 2008, the form that the initiative should take and the benefits that it could bring were discussed as well as draft campaign materials, and feedback was given. In the end, the initiative was conceived as a day (EAAD) upon which national campaigns could be launched and where the power of many could amount to more than the power of one [6,13–16]. Our analysis after five editions of EAAD, shows that it obviously responded to a need at European level.

The EAAD has provided a platform for pre-existing national campaigns and encouraged similar campaigns to develop in other countries where neither political support had been secured, nor financial support been

Table 2

Overview of government and stakeholders' support received per country, European Antibiotic Awareness Day campaigns, 2008–2012

Country	Government support		Stakeholder support									
	Political support	Financial support	Health professionals	Pharmacies	Patient groups	Non-governmental organisations	Non-pharmaceutical companies	Pharmaceutical companies	Professional societies	Insurance system	Other	WHO/Europe or WHO country office
European Union												
Austria	••••	••	•••	••		•	••	•	••	•	•	
Belgium	••••	•••••	••	•••••			•	•	••••	••••		
Bulgaria	••		••	•		•••	•	•	•••			•
Croatia	•	•••••	•••••	•••••		••••		•	•••			•
Cyprus	••••	•••	••	•			•	•		••		
Czech Republic	••••		••	••••	•		•		••••	••	••	•
Denmark	•	••	••	•					•		••	
Estonia	•		•••						•			
Finland	••	•	•									
France	••••	•••	•						•••	•••	•	
Germany	••••	•••	••						•••		•	
Greece	••	••	•					•	••••		•	
Hungary	••••	••										•
Ireland	•••	••	••••	•••	••				•••		•	
Italy	••••	••	•••						••••		•	
Latvia	••		••			••			•			•
Lithuania	•••••	••	•	•		••	•		••		••	
Luxembourg	•••	•••	••	•••						•••	•	
Malta	••••	••	•••	•					•		•	
Netherlands	••	••	••••	•		••	•			•		
Poland	•••••	•••••	•••	•••		•••••	•		•••••	•	•••	
Portugal	••		••••	••		•	•	•	••		•	
Romania	••••	••	••••			•			•••••		••	
Slovakia	••	•••	•••			••			•	•••	•	
Slovenia	•••	•••	••••						••••	••		•
Spain	•••	•	••••	•••	•				•••		•	
Sweden	••••		••••					•	••		••	•
United Kingdom	•••••	••••	•••••	•••	••	•			••••		••	
European Economic Area												
Iceland	••	•	••									•
Norway	•••	••••	••	•					•		•	
Other countries												
Albania	••	•	••	•		•			•			•
Bosnia and Herzegovina	••		••	•				•	•			
Former Yugoslav Republic of Macedonia	•••••	••	•••••	•		•••••			••••	•	••	•
Kosovo*	••••		••					•	••••			•
Montenegro	••		••						••		•	•
Serbia	••		•••						••			•
Turkey	•••••	•••	••••	••					••••	•••		•

Each dot corresponds to one activity-year.

* This designation is without prejudice to positions on status, and is in line with United Nations Security Council Resolution 1244/99 and the International Court of Justice Opinion on the Kosovo declaration of independence.

available. As a result, year on year, in their reply to the annual questionnaire, countries have expressed their strong support for ECDC to continue its work on the EAAD. This has also been highlighted by a steadily increasing number of countries participating and the growing interest of varied professional and stakeholder organisations.
Evaluation of EAAD in terms of understanding its impact on antibiotic consumption and on antibiotic resistance is difficult because (i) the effects will vary depending on the country as a result of variations in the extent and the intensity of the national campaign in each country and (ii) these effects are unlikely to be immediate as shown from previous national campaigns in some Member States. In addition, it is important to remember that since the campaigns have been applied heterogeneously at national levels, according to local needs and resources, a one size fits all impact analysis evaluation is not appropriate.

Regular opinion polls, i.e. 'Special Eurobarometers' on antimicrobial resistance commissioned by the European Commission, however, should help identify improvements in the knowledge, perception and self-reported attitudes of Europeans with antibiotics [17,18]. Additionally, the effects on antibiotic consumption and on antibiotic resistance in the European countries most active in the campaigns should become visible in the data reported to the European Surveillance of Antimicrobial Consumption Network (ESAC-Net) and the European Antimicrobial Resistance Surveillance Network (EARS-Net), respectively [19–21]. By providing training support on the development, implementation and evaluation of prudent antibiotic use campaigns, ECDC hopes that common evaluation indicators can now be developed at European level and implemented as part of national campaigns from 2014 onwards.

In 2013, ECDC and its partners launched the 6th edition of EAAD on 15 November 2013, with the emphasis that 'Everyone is responsible' for addressing antibiotic resistance and for using antibiotics more prudently, during a European Commission press conference [22]. During this press conference, the results of a recent 'Special Eurobarometer' on the attitudes and knowledge of Europeans about antibiotics, were presented together with a review of new research initiatives related to antimicrobial resistance and the latest surveillance data on resistance trends [21,23]. In particular, the 'Special Eurobarometer' on antimicrobial resistance showed a 5% decrease between 2009 and 2013, in the percentage of Europeans who took antibiotics during the past year and an increasing awareness of Europeans that antibiotics do not kill viruses [18]. These are positive developments that may reflect the continuous efforts made by Member States in the framework of EAAD. This is also the rationale for an annual EAAD to support to national campaigns.

In 2013, ECDC arranged for a first extended global Twitter conversation with its partners in the United States (US), Canada and Australia, and in connection with an EAAD Twitter chat organised jointly with the European Commission and WHO/Europe using the hashtag #EAAD. Dedicated EAAD Twitter (@EAAD_EU) and Facebook (http://facebook.com/eaad.eu) accounts have been set up for the first time. The full evaluation of the 2013 edition of EAAD is currently ongoing. In reply to the annual questionnaire sent by ECDC to evaluate the activities in 2013, 22 of 41 responding countries highlighted that there was a change in their country that could be attributed to the momentum created by EAAD.

Looking to the future, self-medication with antibiotics has been identified as a new focus for EAAD 2014. Concerns about antimicrobial resistance and the need for a more prudent use of antibiotics are of global significance and are progressively being raised on political agendas. A growing number of countries and regions across globe, including the US, Canada and Australia, have aligned the timing of their activities to that of EAAD and the week of 18 November is increasingly being recognised as the moment to raise awareness about prudent use of antibiotics. This is a strong encouragement for the coordinators of the EAAD to continue acting as a global catalyst for discussion and raising awareness about prudent use of antibiotics.

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Conflict of interest

None declared.

Authors' contributions

Sarah Earnshaw - lead author, drafted article; Giovanni Mancarella - co-lead author, drafted article; Andrea Mendez - evaluation; Boyana Todorova - EAAD website; Marybelle Stryk - EAAD social media; Anna-Pelagia Magiorakos - EAAD patient stories and introduction; Enrico Possenti - EAAD audiovisuals; Signe Gilbro - EAAD multi-lingual content; Herman Goossens - EAAD Technical Advisory
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References

1. Cosgrove SE. The relationship between antimicrobial resistance and patient outcomes: mortality, length of hospital stay, and health care costs. Clin Infect Dis. 2006;42 Suppl 2:S82-9. http://dx.doi.org/10.1086/499406
2. Carlet J, Jarlier V, Harbarth S, Voss A, Goossens H, Pittet D, et al. Ready for a world without antibiotics? The Pensières Antibiotic Resistance Call to Action. Antimicrob Resist Infect Control. 2012;1(1):11. http://dx.doi.org/10.1186/2047-2994-1-11
3. Council of the European Union. Council Recommendation of 15 November 2001 on the prudent use of antimicrobial agents in human medicine (2002/77/EC). Official Journal of the European Communities. 2002;45:13-6. Available from: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2002:034:0013:0016:EN:PDF
4. McNulty CA, Johnson AP. The European Antibiotic Awareness Day. J Antimicrob Chemother. 2008;62(5):853-4. http://dx.doi.org/10.1093/jac/dkn410
5. Spyridis N, Sharland M. The European Union Antibiotic Awareness Day: the paediatric perspective. Arch Dis Child. 2008;93(11):909-10. http://dx.doi.org/10.1136/adc.2008.149625
6. Earnshaw S, Monnet DL, Duncan B, O'Toole J, Ekdahl K, Goossens H, et al. European Antibiotic Awareness Day, 2008 - the first Europe-wide public information campaign on prudent antibiotic use: methods and survey of activities in participating countries. Euro Surveill. 2009;14(30)=19280.
7. European Centre for Disease Prevention and Control (ECDC). European Antibiotic Awareness Day. Stockholm: ECDC; Available from: http://www.ecdc.europa.eu/en/eaad/Pages/toolkits.aspx).
8. Eurosurveillance editorial team. European Antibiotic Awareness Day provides platform for campaigns on prudent use of antibiotics for the fourth time. Euro Surveill. 2011;16(46). pii= 20018.
9. Eurosurveillance editorial team. Fifth European Antibiotic Awareness Day on 18 November: joining forces to reduce antibiotic resistance. Euro Surveill. 2012;17(46). pii= 20314.
10. Codiță I. Participation of Romania in the ECDC (European Center for Disease Control) initiative of the Antimicrobial Resistance Awareness Day 2009. Bacteriol Virusol Parazitol Epidemiol. 2010;55(2):74-6, 71-3. English, Romanian.
11. Mazinska B, Hryniewicz W. Kampania edukacyjna Europejski Dzien Wiedzy o Antybiotykach--czy wplynela na zmiane postaw spoleczenstwa w Polsce? [European Antibiotic Awareness Day educational campaign--has it changed public attitudes to antibiotic use in Poland?]. Pol Merkuriusz Lek. 2010;29(173):296-303. Polish.
12. Leaper D. European Union Antibiotic Awareness Day relevance for wound care practitioners. Int Wound J. 2010;7(5):314-5. http://dx.doi.org/10.1111/j.1742-481X.2010.00740.x
13. Finch R, Sharland M. 18 November and beyond: observations on the EU Antibiotic Awareness Day. J Antimicrob Chemother. 2009;63(4):633-5. http://dx.doi.org/10.1093/jac/dkp039
14. Hryniewicz W, Mazinska B. Europejski dzien wiedzy o antybiotykach--dlaczego potrzebny? [European Antibiotic Awareness Day--why needed?]. Pol Merkuriusz Lek. 2009;27(160):261-4. Polish.
15. Lewis MA. Why we must reduce dental prescription of antibiotics: European Union Antibiotic Awareness Day. Br Dent J. 2008;22;205(10):537-8.
16. Stockley JM. European Antibiotic Awareness Day 2010: why doesn't promoting antibiotic awareness always work? J Infect. 2010;61(5):361-3. http://dx.doi.org/10.1016/j.jinf.2010.09.003
17. Special Eurobarometer 338. Antimicrobial resistance, November-December 2009. Brussels, TNS Opinion & Social 2010. Available from: http://ec.europa.eu/health/antimicrobial_resistance/docs/ebs_338_en.pdf
18. Special Eurobarometer 407. Antimicrobial resistance, November 2013. Brussels, TNS Opinion & Social 2010. Available from: http://ec.europa.eu/health/antimicrobial_resistance/docs/ebs_407_sum_en.pdf
19. European Centre for Disease Prevention and Control (ECDC). Surveillance of antimicrobial consumption in Europe, 2011. Stockholm: ECDC; 2014. Available from: http://ecdc.europa.eu/en/publications/Publications/antimicrobial-consumption-europe-surveillance-2011.pdf
20. European Centre for Disease Prevention and Control (ECDC). Antimicrobial resistance surveillance in Europe 2011. Annual report of the European Antimicrobial Resistance Surveillance Network (EARS-Net). Stockholm: ECDC; 2012. Available from: http://ecdc.europa.eu/en/publications/Publications/antimicrobial-resistance-surveillance-europe-2011.pdf
21. European Centre for Disease Prevention and Control (ECDC). Antimicrobial resistance surveillance in Europe 2012. Annual report of the European Antimicrobial Resistance Surveillance Network (EARS-Net). Stockholm: ECDC; 2013. Available from: http://ecdc.europa.eu/en/publications/Publications/antimicrobial-resistance-surveillance-europe-2012.pdf
22. European Commission. Press release database. European Antibiotic Awareness Day 2013: EU steps up its fight against drug-resistant bacteria. IP/13/1081 15/11/2013. Available from: http://europa.eu/rapid/press-release_IP-13-1081_en.htm
23. European Centre for Disease Prevention and Control (ECDC). Carbapenemase-producing bacteria in Europe: interim results from the European Survey on carbapenemase-producing Enterobacteriaceae (EuSCAPE) project. Stockholm: ECDC; 2013. Available from: http://www.ecdc.europa.eu/en/publications/Publications/antimicrobial-resistance-carbapenemase-producing-bacteria-europe.pdf

Decreased varicella and increased herpes zoster incidence at a sentinel medical deputising service in a setting of increasing varicella vaccine coverage in Victoria, Australia, 1998 to 2012

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We performed an ecological study using sentinel consultation data from a medical deputising service to assess the impact of increasing coverage with childhood varicella vaccine on the incidence risk of varicella and zoster in the population served by the deputising service in Victoria, Australia from 1998 to 2012. Following a successful vaccination programme, the incidence of varicella in Australia was modelled to decrease and the incidence of zoster to increase, based on a theoretical decrease in boosting of zoster immunity following a decrease in wild varicella virus circulation due to vaccination. Incidence risks (consultation proportions for varicella and zoster) were directly age-standardised to the Melbourne population in 2000, when varicella vaccine was first available. Age-standardised varicella incidence risk peaked in 2000 and halved by 2012. Age-standardised zoster incidence risk remained constant from 1998 to 2002, but had almost doubled by 2012. The increase in zoster consultations largely reflected increases in people younger than 50 years-old. Although causality cannot be inferred from ecological studies, it is generally agreed that the decrease in varicella incidence is due to increasing varicella vaccine coverage. The possible indirect effect of the vaccine on zoster incidence is less clear and ongoing monitoring of zoster is required.

Introduction

In 1998 the World Health Organization recommended adding varicella vaccine to routine childhood vaccination schedules where it could be shown to be of relative public health and socio-economic importance, where it was affordable and where sustained coverage could be achieved [1]. The United States had implemented universal childhood varicella vaccination three years earlier, leading to a decline in varicella incidence, related deaths and hospitalisations [2]. In 2004 the European Working Group on Varicella recommended routine varicella vaccination for all healthy children between 12 and 18 months and for all susceptible children before their 13th birthday, and catch-up vaccination in older children and adults without a reliable history of varicella and who were at risk of transmission and exposure [3]. The introduction of varicella vaccine into the childhood schedule with subsequent significant decrease in varicella in the community has been reported from Navarre in Spain [4] and Bavaria in Germany [5] but not all European countries have a universal varicella vaccine programme [6].

Part of the reluctance to introduce universal varicella vaccination in some European countries was related to the theoretical possibility that high coverage with varicella vaccine in children would lead to an increase in zoster. This possibility is based on the hypothesis that T-cell-mediated immunity to zoster is boosted by repeated exposure to circulating wild varicella virus and that this boosting will decrease following the decrease in circulating wild virus due to varicella vaccination. This is known as the Hope-Simpson hypothesis [7]. Assuming this hypothesis to be true, modelling in England [8-10], Finland [11], the United States [12] and Australia [13] suggested an increase in zoster incidence for as many as 60 years would accompany a decrease in varicella incidence following widespread use of varicella vaccine in childhood. Australia nonetheless licensed varicella vaccine in 2000 and added it to the publicly funded national immunisation programme in November 2005 for all children 18 months of age, with a catch-up vaccine for children aged from 10 to <14 years. From 1 July 2013 the monovalent vaccine was replaced with a combined measles-mumps-rubella-varicella (MMRV) vaccine [14]. Varicella vaccine coverage for children aged less than 2 years in Australia was estimated as 83% by March 2011 [15] but sufficient doses of vaccine had been distributed in the state of

Victoria by 2002, prior to public funding, to cover up to 70% of children aged 12 months and a decline in varicella hospitalisations had been noted from 2000 [16]. Zoster vaccine was not available in Australia during the years of the study (1998 to 2012).

Following the introduction of varicella vaccine, a variety of approaches have been used to monitor varicella and zoster incidence (reviewed in Reynolds et al. [17]). All reviewed studies documented a decrease in varicella incidence but no change, or an increased incidence, in zoster. More recent studies from the United States have shown increases in zoster incidence in age groups ranging from 40 to 65 years, but often these increases were seen before the introduction of varicella vaccine [18-20]. A gradual increase in zoster incidence, both before and after varicella vaccination, has also been seen in Canada [21], Australia [16] and China [22].

Using data from Victoria, Australia's second most populous state (population in 2010 approximately 5.6 million [23]), we have previously demonstrated the predicted decrease in the number of cases hospitalised for varicella and described an increase in the number of hospitalisations for zoster that began before the introduction of varicella vaccine [16]. However, a recent Australian study showed a slight decrease in age-standardised zoster hospitalisations, and noted that trends in non-hospitalised disease would need to be monitored [24]. In the current study we have used community-derived data from 1998 to 2012 from a deputising medical service, fulfilling the role of a general practice sentinel surveillance scheme, to investigate the modelled changes in varicella and zoster incidence related to the introduction of a universal childhood varicella vaccination programme in Australia.

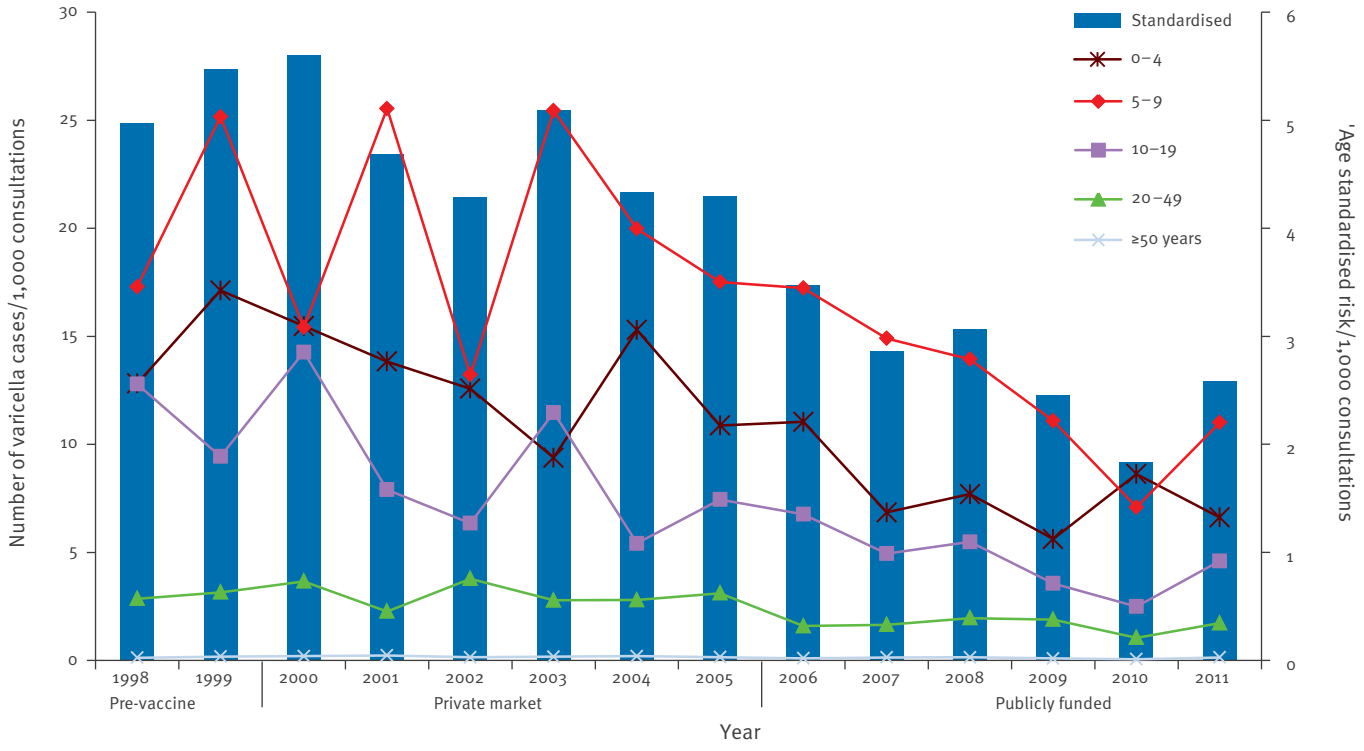
Methods

We used sentinel data from a Melbourne-based medical deputising service, known as the National Home Doctor Service [25], which provides after-hours (after 4 p.m. on weekdays and at any time during the weekend) medical treatment on behalf of 650 general practices in Melbourne and Geelong, the two largest population centres in Victoria. Deputising service doctors are all general practitioners (GPs), working in a service that has been operating for more than four decades and which was accredited by the Royal Australian College of General Practitioners in 2002. Patients are typically those who would be seen with acute problems in general practice but are instead visited at home or in an aged-care facility. The ageing of the population and increasing demand on GPs to visit elderly patients in their homes or aged-care facility has meant that the deputising service has an increasingly elderly patient base. Total consultations have increased from approximately 73,000 in 1998 to 149,000 in 2012 (data extracted from the deputising service database). GPs enter the details of each consultation into a purpose-designed database that includes a free-text diagnosis field. All entries are subject to quality assurance.

The Victorian Infectious Diseases Reference Laboratory has password-protected access to the clinical database maintained by the deputising service. Ethical approval for the ongoing use of deputising service data for

Figure 1

Deputising service consultations for varicella, age standardised and by age group, Victoria, Australia, 1998–2012



surveillance was granted by the Human Research Ethics Committees at the Victorian Department of Health in October 2002. We conducted searches for consultations with 'chicken'/'varicella' or 'zoster'/'shingles' recorded in the diagnosis field between 1998 and 2012. Data were extracted by week of consultation and age. We grouped the data into the age groups 0–4, 5–9, 10–19, 20–49 and ≥50 years for varicella and <50, 50–59, 60–69, 70–79 and ≥80 years for zoster and calculated the incidence risk for varicella and zoster as the age-specific proportion of consultations per 1,000 patients (hereafter referred to as the incidence risk) for all study years.

We then directly age-standardised the deputising service consultation proportion (incidence risk) estimates to the Melbourne population in 2000 [23]. We further analysed data according to the three periods of vaccine availability: (i) pre-2000, when no vaccine was available; (ii) 2000–05, when vaccine was available on the private market; and (iii) after 2005, when the vaccine was funded by the national immunisation programme. Proportions were compared using a two-sample test of proportions. Trends in the age-specific and age-standardised proportions over the period of the study were analysed using a non-parametric test for trend developed by Cuzick as an extension of the Wilcoxon rank sum test (STATA version 10.0; StataCorp LP). For all analyses we accepted $p<0.05$ as the threshold for statistical significance.

Results

The age-standardised varicella incidence risk rose from 5.0 per 1,000 patients in 1998 to 5.6 per 1,000 patients in 2000 (p=0.157), and then fell to 2.0 per 1,000 patients in 2012 (p for trend=0.001 from 1998 to 2012) (Figure 1). In the shorter period from 2005, since the introduction of varicella vaccine into the publicly funded national immunisation programme, the age-standardised varicella incidence risk fell from 4.3 per 1,000 patients to 2.0 per 1,000 patients in 2012 (p for trend=0.023). The age-standardised varicella incidence risk decreased significantly over each period of vaccine availability. During the period of no vaccine (1998 to 1999) the incidence risk was 5.2 per 1,000 patients. It subsequently decreased to 4.7 per 1,000 patients during the period of availability on the private market (2000 to 2005) and fell again to 2.5 per 1,000 patients during the period when the vaccine was publicly funded (2006 to 2012) (Table).

Age-group specific varicella incidence risk decreased significantly for all age groups during 2000 to 2012 (p for trend<0.01 for all except those aged 50 years and older, p=0.02) (Figure 1). Varicella incidence risk calculated for each period of vaccine availability showed

Table

Number and proportion per 1,000 consultations of varicella and zoster cases by age group and period of varicella vaccine availability, Victoria, Australia, 1998–2012

Cases by age group in years and age-standardised risk	1998–99 Pre-vaccine n (proportion per 1,000 consultations)[a]	2000–05 Private market n (proportion per 1,000 consultations)[a]	2006–12 Publicly funded n (proportion per 1,000 consultations)[a]
Varicella			
0–4	160 (14.96)	369 (12.84)	415 (6.93)[b,c]
5–9	95 (21.29)	229 (19.21)	265 (11.27)[b,c]
10–19	66 (11.07)	137 (8.75)	128 (4.54)[b,c]
20–49	146 (3.01)	288 (3.10)	205 (1.61)[b,c]
≥50	13 (0.16)	45 (0.19)	60 (0.12)[c]
Total	480 (3.06)	1.068 (2.67)[d]	1.073 (1.39)[b,c]
Age-standardised risk of varicella consultations	5.22	4.70[d]	2.54[b,c]
Zoster			
<50	40 (0.58)	140 (0.94)[d]	285 (1.15)[b]
50–59	15 (1.04)	72 (2.27)[d]	152 (3.33)[b,c]
60–69	32 (2.57)	79 (2.46)	200 (3.90)[b,c]
70–79	71 (3.32)	183 (3.23)	370 (3.75)
≥80	137 (4.03)	429(3.57)	1016 (3.15)[b,c]
Total	295 (1.87)	903 (2.26)[d]	2023 (2.62)[b,c]
Age-standardised risk of zoster consultations	1.03	1.41[d]	1.81[b,c]

[a] Unless otherwise indicated.
[b] $p<0.05$ for comparison 1998–99 and 2006–12.
[c] $p<0.05$ for comparison 2000–05 and 2006–12.
[d] $p<0.05$ for comparison 1998–99 and 2000–05

small decreases for people aged under 20 years between 1998 to 1999 (no vaccine) and 2000 to 2005 (privately available). However, statistically significant decreases were seen after the vaccine was publicly funded (2006 to 2012) (Table). The age distribution of varicella consultations remained similar over the three periods of different vaccine availability, with the highest proportion of varicella consultations among 5 to 9 year-olds, followed by under 5 year-olds. Varicella consultations remained very uncommon in patients aged at least 50 years (Table).

Changes in zoster incidence risk between 1998 and 2012 were not as clear as those for varicella. Although there was a significant increase in the age-standardised zoster incidence risk, ranging from 1.0 per 1,000 patients in 1998 to 1.8 per 1,000 patients in 2012 (p for trend=0.005), the change was not uniform. The increase was significant in people aged younger than 70 years (p for trend <0.01 for people aged under 60 years and p for trend=0.02 for 60–69 year olds (Figure 2)) but there was no increase for people aged 70 years and over. When the data were collapsed into the three periods of vaccine availability, the incidence risk for those aged less than 70 years increased, consistent with the trend data (Table 1). However, a significant decrease was seen in zoster incidence risk of cases aged 80 years and older across each period of vaccine availability (Table).

Discussion

In the 15 years from 1998 to 2012, the age-standardised varicella incidence risk, estimated from medical consultations at the deputising service, halved while the age-standardised incidence risk of zoster almost doubled. Both changes were statistically significant when analysed according to distinct periods of vaccine availability. We have used consultation proportions as a measure of incidence risk in a specific patient group because we were unable to determine the population base of the deputising service and thus were not able to calculate population-based incidence rates. However, the recent study from Bavaria, Germany, also used population proportions in sentinel paediatric practices to describe a change in the varicella infection pattern in the community [5]. The decrease in varicella incidence risk is consistent with our previous results based on hospital discharge data [16] and reports from other countries [4,5,26].

We have also previously reported an increase in zoster incidence in hospital data, as predicted by modelling [13], largely driven by an increase in those aged over 80 years [16]. Deputising service data by age were not available to us at the time of our earlier report, and the overall number of zoster consultations (not age standardised) was observed to increase from 2001 [16]. Although the deputising service data reported here indicate variability in zoster consultations, we have described a clear increasing trend in presentations for zoster in community patients younger than 70 years, and found some indication of a decreased number of consultations for zoster in the community among those aged 80 years and older. A mixed picture of age-related changes in zoster has been reported from various data sources in various countries [18,19,27,28]. However, compared with many other countries, Australia has relatively high childhood varicella vaccine coverage,

Figure 2

Deputising service consultations for zoster, age standardised and by age group, Victoria, Australia, 1998–2012

which may impact on zoster, as well as varicella, incidence. An increase in zoster incidence among younger patients, for any reason, may be easier to detect in the community, since these patients will be less likely to require hospitalisation for zoster and may not be detected in studies of inpatients. On the other hand, changes in zoster incidence among older patients, especially those older than 80 years, may be easier to detect in hospitalised patients [16,24], whether due to disease severity or changed thresholds for hospital admissions among the elderly.

Our study has a number of limitations. The feasibility of using general practice sentinel surveillance to monitor varicella and zoster has recently been demonstrated in Spain [29], but a deputising service is not often used for sentinel surveillance. However Victorian data from the National Home Doctor Service have previously demonstrated comparable evidence on influenza-like illness in the community to that provided by other sentinel practices in Victoria [30]. We have recently extended this comparison to revise thresholds for influenza surveillance in Victoria and have demonstrated that the two sentinel systems detect influenza community circulation within one week of each other [31]. The deputising service is also used to monitor gastroenteritis in the community in Victoria and has shown concordance between gastrointestinal illnesses seen by GPs from the deputising service and community-based outbreaks due to norovirus [32]. The concordance between sentinel deputising service and sentinel general practice surveillance for influenza-like illness and gastroenteritis demonstrates the applicability of the deputising service to community-based surveillance of infectious diseases.

Surveillance detects only a proportion of all disease. Less severe cases of varicella and zoster are not likely to present to any medical service, including the deputising service, while more severe cases will present to a hospital. There are also differences between the deputising service and clinic-based general practice. Whereas the five most common reasons for presentations to Australian general practices in 2009–10 were for prescriptions, a general check-up, having a pathology test or reviewing results, providing an immunisation and fever [33], the five most common reasons for deputising service consultations were falls, respiratory tract infection, review (unspecified), gastroenteritis and urinary tract infection (data extracted from the deputising service database). This difference confirms that the deputising service is more likely to see patients with an acute problem. However changes in those who consult, in treatment-seeking behaviour or the healthcare system could have influenced the trends we have reported.

The deputising service covers most of the Melbourne and Geelong metropolitan areas, which includes a large and diverse population. Data on socio-economic status or other determinants of health are not routinely collected by the deputising service. While people who use the deputising service may not be representative of those who consult in general, there is no financial disincentive to use the deputising service, as consultations are free to the patient at the time of consultation. This has not changed during the study period. The population base for deputising service consultations among those aged less than 50 years remained relatively constant over the study period, making it likely that the increase in zoster consultations seen in this age group is not a result of overall changes in the proportion of this age group consulting.

However, the proportion of older patients seen by the deputising service GPs increased substantially. In 2000, 25% (14,947/60,329) of patients were aged 80 years and above, but this had increased to 39% (61,110/157,025) by 2012. These variations do not affect trends in proportions within age groups and we have controlled for these changes in summary data by direct age standardisation to the Melbourne population in 2000.

We did not validate the diagnosis fields used by the deputising service and it is possible that the search algorithm may generate some false positives where entries such as 'query chickenpox' would be counted as an episode of varicella. However, we extracted the same diagnosis terms for all years, assuming biases and anomalies that might be present would not change by year. Quality assurance should minimise misspelling that may otherwise result in missed records using text-based search terms.

Although ecological studies cannot be used to infer causality they are nonetheless used as evidence to support the success of vaccination programmes, including the childhood varicella programme in Victoria and elsewhere. Where the relationship is less direct, as with varicella vaccination and zoster, it is more difficult to make an inferential connection. We are not able to conclude that the increase in zoster incidence risk in community patients seen by the deputising service GPs is caused by high coverage with varicella vaccine, as has been suggested by modelling studies. Equally, we cannot conclude that increasing varicella vaccine coverage does not, or will not, play a role in transient increasing zoster incidence within the community. These community-based data add to growing evidence of increasing zoster – for whatever reason – and highlight the need for multiple surveillance systems that track different population groups or different levels of illness severity for the decades over which zoster is modelled to change [9,12,24]. The increase in zoster suggests that the introduction of an adult zoster vaccination programme could be beneficial, depending on the age of vaccine administration, the effectiveness of the vaccine and the duration of protection [34].

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Conflict of interest

None declared.

Authors' contributions

Conceived the idea: KG, HK. Designed the analysis: HK, KC, KG. Performed the analysis: KC, KG. Wrote the paper: HK, KC, KG, HG. Approved the final version: HK, KG, HG, KC.

References

1. Varicella vaccines. WHO position paper. Wkly Epidemiol Rec. 1998;73(32):241-8.
2. Schmid DS, Jumaan AO. Impact of varicella vaccine on varicella-zoster virus dynamics. Clin Microbiol Rev. 2010;23(1):202-17. http://dx.doi.org/10.1128/CMR.00031-09
3. Rentier B, Gershon AA; European Working Group on Varicella. Consensus: varicella vaccination of healthy children--a challenge for Europe. Pediatr Infect Dis J. 2004;23(5):379-89. http://dx.doi.org/10.1097/01.inf.0000122606.88429.8f
4. Garcia Cenoz M, Castilla J, Chamorro J, Martinez-Baz I, Martinez-Artola V, Irisarri F, et al. Impact of universal two-dose vaccination on varicella epidemiology in Navarre, Spain, 2006 to 2012. Euro Surveill. 2013;18(32):pii=20552.
5. Streng A, Grote V, Carr D, Hagemann C, Liese JG. Varicella routine vaccination and the effects on varicella epidemiology - results from the Bavarian Varicella Surveillance Project (BaVariPro), 2006-2011. BMC Infect Dis. 2013;13:303. http://dx.doi.org/10.1186/1471-2334-13-303
6. Stefanoff P, Polkowska A, D'Ancona FP, Giambi C, Bruhl DL, O'Flanagan D, et al. Varicella and herpes zoster surveillance and vaccination recommendations 2010-2011. VENICE II Consortium, 2010. Available from: http://venice.cineca.org/report_final_varicella.pdf
7. Hope-Simpson RE. The nature of herpes zoster: a long-term study and a new hypothesis. Proc R Soc Med. 1965;58:9-20.
8. van Hoek AJ, Melegaro A, Zagheni E, Edmunds WJ, Gay N. Modelling the impact of a combined varicella and zoster vaccination programme on the epidemiology of varicella zoster virus in England. Vaccine. 2011;29(13):2411-20. http://dx.doi.org/10.1016/j.vaccine.2011.01.037
9. Brisson M, Edmunds WJ, Gay NJ, Law B, De Serres G. Modelling the impact of immunization on the epidemiology of varicella zoster virus. Epidemiol Infect. 2000;125(3):651-69. http://dx.doi.org/10.1017/S0950268800004714
10. Brisson M, Edmunds WJ, Law B, Gay NJ, Walld R, Brownell M, et al. Epidemiology of varicella zoster virus infection in Canada and the United Kingdom. Epidemiol Infect. 2001;127(2):305-14. http://dx.doi.org/10.1017/S0950268801005921
11. Karhunen M, Leino T, Salo H, Davidkin I, Kilpi T, Auranen K. Modelling the impact of varicella vaccination on varicella and zoster. Epidemiol Infect. 2010;138(4):469-81. http://dx.doi.org/10.1017/S0950268809990768
12. Schuette MC, Hethcote HW. Modeling the effects of varicella vaccination programs on the incidence of chickenpox and shingles. Bull Math Biol. 1999;61(6):1031-64. http://dx.doi.org/10.1006/bulm.1999.0126
13. Gidding HF, Brisson M, Macintyre CR, Burgess MA. Modelling the impact of vaccination on the epidemiology of varicella zoster virus in Australia. Aust N Z J Public Health. 2005;29(6):544-51. http://dx.doi.org/10.1111/j.1467-842X.2005.tb00248.x
14. Australian Government Department of Health and Ageing. The Australian immunisation handbook. 10th ed. Canberra: Commonwealth of Australia; 2013. Available from: http://www.health.gov.au/internet/immunise/publishing.nsf/Content/Handbook10-copyright
15. Ward K, Dey A, Hull B, Quinn HE, Macartney K, Menzies R. Evaluation of Australia's varicella vaccination program for children and adolescents. Vaccine. 2013;31(10):1413-9. http://dx.doi.org/10.1016/j.vaccine.2012.12.052
16. Carville KS, Riddell MA, Kelly HA. A decline in varicella but an uncertain impact on zoster following varicella vaccination in Victoria, Australia. Vaccine. 2010;28(13):2532-8. http://dx.doi.org/10.1016/j.vaccine.2010.01.036
17. Reynolds MA, Chaves SS, Harpaz R, Lopez AS, Seward JF. The impact of the varicella vaccination program on herpes zoster epidemiology in the United States: a review. J Infect Dis. 2008;197 Suppl 2:S224-7. http://dx.doi.org/10.1086/522162
18. Rimland D, Moanna A. Increasing incidence of herpes zoster among Veterans. Clin Infect Dis. 2010;50(7):1000-5. http://dx.doi.org/10.1086/651078
19. Leung J, Harpaz R, Molinari NA, Jumaan A, Zhou F. Herpes zoster incidence among insured persons in the United States, 1993-2006: evaluation of impact of varicella vaccination. Clin Infect Dis. 2011;52(3):332-40. http://dx.doi.org/10.1093/cid/ciq077
20. Hales CM, Harpaz R, Joesoef MR, Bialek SR. Examination of links between herpes zoster incidence and childhood varicella vaccination. Ann Intern Med. 2013;159(11):739-45. http://dx.doi.org/10.7326/0003-4819-159-11-201312030-00006
21. Russell ML, Dover DC, Simmonds KA, Svenson LW. Shingles in Alberta: Before and after publicly funded varicella vaccination. Vaccine. 2013. pii: S0264-410X(13)01249-8.
22. Wu PY, Wu HD, Chou TC, Sung FC. Varicella vaccination alters the chronological trends of herpes zoster and varicella. PloS One. 2013;8(10):e77709. http://dx.doi.org/10.1371/journal.pone.0077709
23. Australian Bureau of Statistics (ABS). 3101.0 - Australian demographic statistics, Sep 2011. Canberra: ABS [Accessed 30 Jun 2011]. Available from: http://www.abs.gov.au/ausstats/abs@.nsf/mf/3101.0/
24. Heywood AE, Wang H, Macartney KK, McIntyre P. Varicella and herpes zoster hospitalizations before and after implementation of one-dose varicella vaccination in Australia: an ecological study. Bull World Health Organ. 2014;92(8):593-604. http://dx.doi.org/10.2471/BLT.13.132142
25. National Home Doctor Service. [Accessed 10 Jan 2014]. Available from: http://www.homedoctor.com.au/
26. Marin M, Meissner HC, Seward JF. Varicella prevention in the United States: a review of successes and challenges. Pediatrics. 2008;122(3):e744-51. http://dx.doi.org/10.1542/peds.2008-0567
27. Russell ML, Schopflocher DP, Svenson L, Virani SN. Secular trends in the epidemiology of shingles in Alberta. Epidemiol Infect. 2007;135(6):908-13. http://dx.doi.org/10.1017/S0950268807007893
28. Jardine A, Conaty SJ, Vally H. Herpes zoster in Australia: evidence of increase in incidence in adults attributable to varicella immunization? Epidemiol Infect. 2011;139(5):658-65. http://dx.doi.org/10.1017/S0950268810001949
29. Pérez-Farinós N, Ordobás M, García-Fernández C, Garcia-Comas L, Ca-ellas S, Rodero I, et al. Varicella and herpes zoster in Madrid, based on the Sentinel General Practitioner Network: 1997-2004. BMC Infect Dis. 2007;7:59. http://dx.doi.org/10.1186/1471-2334-7-59
30. Coory M, Grant K, Kelly H. Influenza-like illness surveillance using a deputising medical service corresponds to surveillance from sentinel general practices Euro Surveill. 2009;14(44):pii=19387.
31. Tay EL, Grant K, Kirk M, Mounts A, Kelly H. Exploring a proposed WHO method to determine thresholds for seasonal influenza surveillance. PloS One. 2013;8(10):e77244. http://dx.doi.org/10.1371/journal.pone.0077244
32. Victorian Infectious Diseases Reference Laboratory (VIDRL). Norovirus surveillance 2013. Melbourne: VIDRL. [Accessed 15 Mar 2013]. Available from: http://www.vidrl.org.au/surveillance/norovirus-surveillance/
33. Britt H, Miller GC, Charles J, Henderson J, Bayram C, Pan Y, et al. General practice activity in Australia 2009–10. General practice series number 27. Canberra: Australian Institute of Health and Welfare (AIHW); 2010. Available from: http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=6442472722
34. Hales CM, Harpaz R, Ortega-Sanchez I, Bialek SR; Centers for Disease Control and Prevention (CDC). Update on recommendations for use of herpes zoster vaccine. MMWR Morb Mortal Wkly Rep. 2014;63(33):729-31.

Letter to the Editor: Caution needed when using gridded meteorological data products for analyses in Africa

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The recent paper by Ng et al., *Association between temperature, humidity and ebolavirus disease outbreaks in Africa, 1976 to 2014* [1], addresses an important issue: whether there are meteorological conditions associated with the onset of human Ebola virus disease outbreaks. However, the findings presented in this study are undermined by the use of a gridded climate dataset built, for the region in question, on little-to-no actual meteorological data.

Ng et al. perform their analysis using University of East Anglia Climate Research Unit (CRU) gridded estimates of surface meteorological conditions [2]. This 0.5° resolution global dataset merges monthly meteorological station observations with a global land surface climatology. The derived time series of CRU surface variables have been validated through comparison with other gridded climate products; however, these comparisons were made using hemispheric and other large regional spatial averages of the gridded data. Validation was not reported at the local 0.5° resolution of the gridded data. Furthermore, Harris et al. found discrepancies from other gridded datasets 'mostly in regions and/or time periods with sparser observational data' [2].

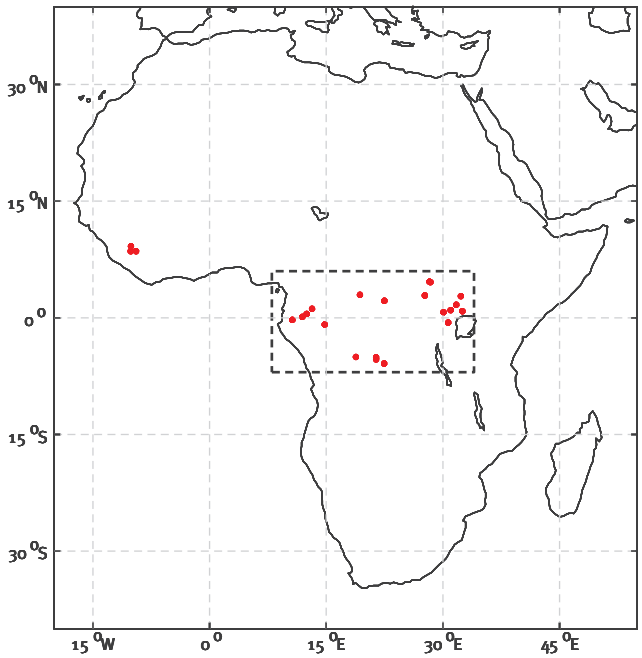
Ng et al. used the CRU dataset to identify temperature and humidity conditions associated with the onset of 28 Ebola virus disease outbreaks in Africa during 1976 to 2014. All the Ebola virus disease outbreaks included in this analysis, with the exception of the current West African Ebola virus disease outbreak, occurred in central Africa between 8–34°E and 7°S–6°N (Figure 1). Within this region of more than 3 million km², during 1976 to 2012, fewer than 40 stations per month provided temperature data for construction of the CRU dataset and no stations provided humidity (i.e. vapour pressure) data (Figure 2). Indeed, since 1992, on average fewer than seven stations per month provided temperature data for construction of the CRU dataset.

The CRU dataset uses a land surface climatology and a correlation decay distance (CDD) that spatially interpolates station records to inform estimates in all grid cells, including those without stations [2]. Even after accounting for this CDD, there are regions of central Africa with no station temperature record signal, and most of Africa has no vapour pressure signal (Figure 3).

These issues are not minor. The CRU dataset is designed and validated for large-scale climate analyses; however, the analysis performed by Ng et al. explored local conditions associated with the onset of specific Ebola virus disease outbreaks. The CRU dataset is likely not appropriate for this analysis; consequently, the Ng et al. study conclusions must be qualified. In other instances, for example, in analyses of meteorological conditions associated with malaria in the Kenyan highlands, the findings made using the CRU dataset

Figure 1

Locations of Ebola virus disease outbreaks included in the analysis of Ng et al. [1].



The dashed box outlines the region (7°S–6°N, 8–34°E) in which the majority of Ebola virus disease outbreaks have occurred.

were significantly different from those made using a richer complement of station observations, accessed through collaboration with the Kenyan Meteorological Department [3]. Unfortunately, local meteorological station records are often non-existent or difficult to access in much of Africa.

Study of the relationships between meteorological conditions and infectious disease outbreaks is important research. It is vital the best meteorological records be identified, made available and used for these analyses [4], and that these analyses be postponed or qualified in the absence of good records.

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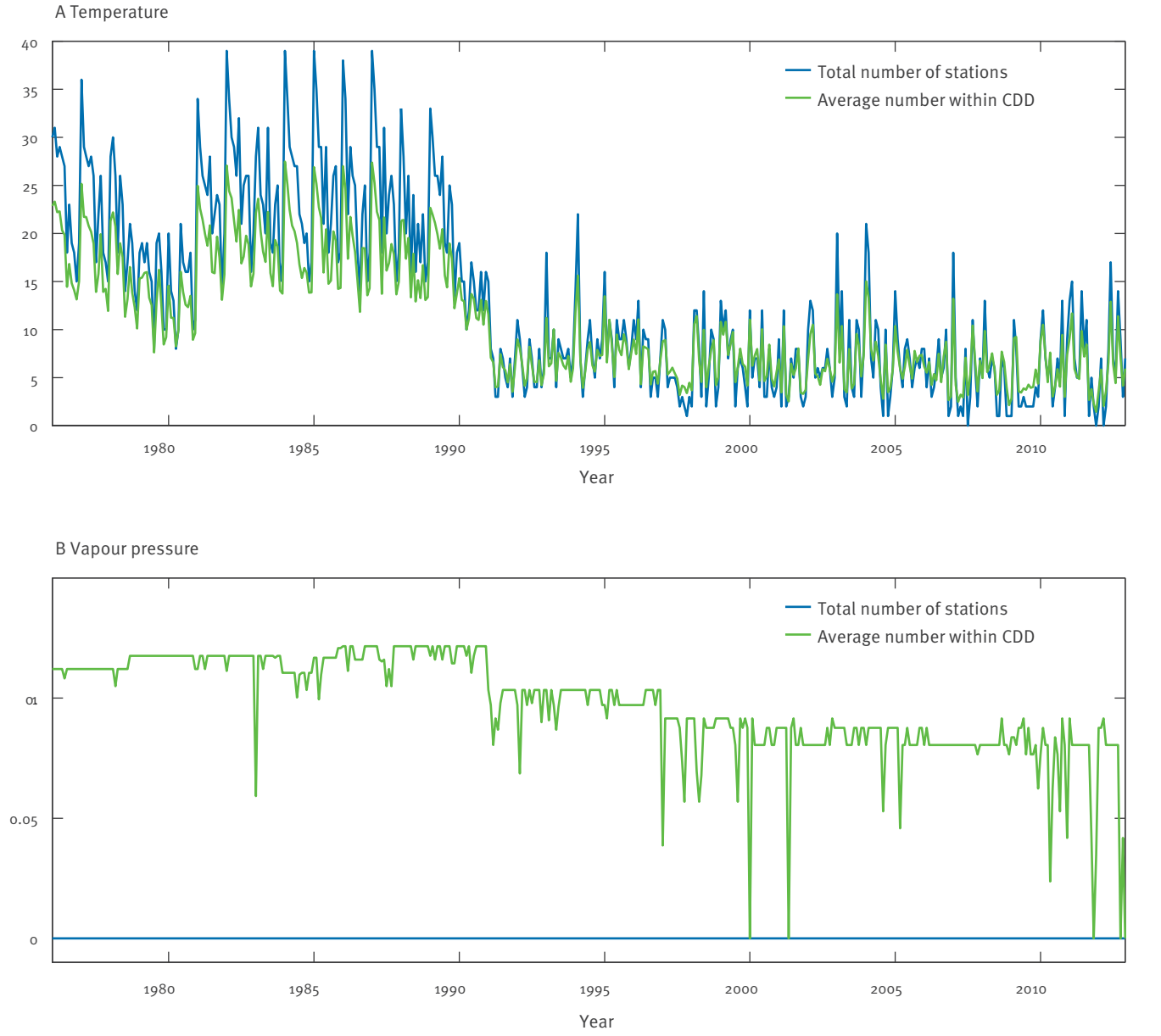
Figure 2

Time series of total station records for the region 7°S–6°N, 8–34°E used in construction of the University of East Anglia Climate Research Unit dataset



CDD: correlation decay distance.

Time series of total station records used in construction of the University of East Anglia Climate Research Unit dataset within the region 7°S–6°N, 8–34°E (green), as well as the mean number of station records within the CDD of each grid cell within that region (blue). Shown for temperature (panel A) and vapour pressure (panel B).

Conflict of interest

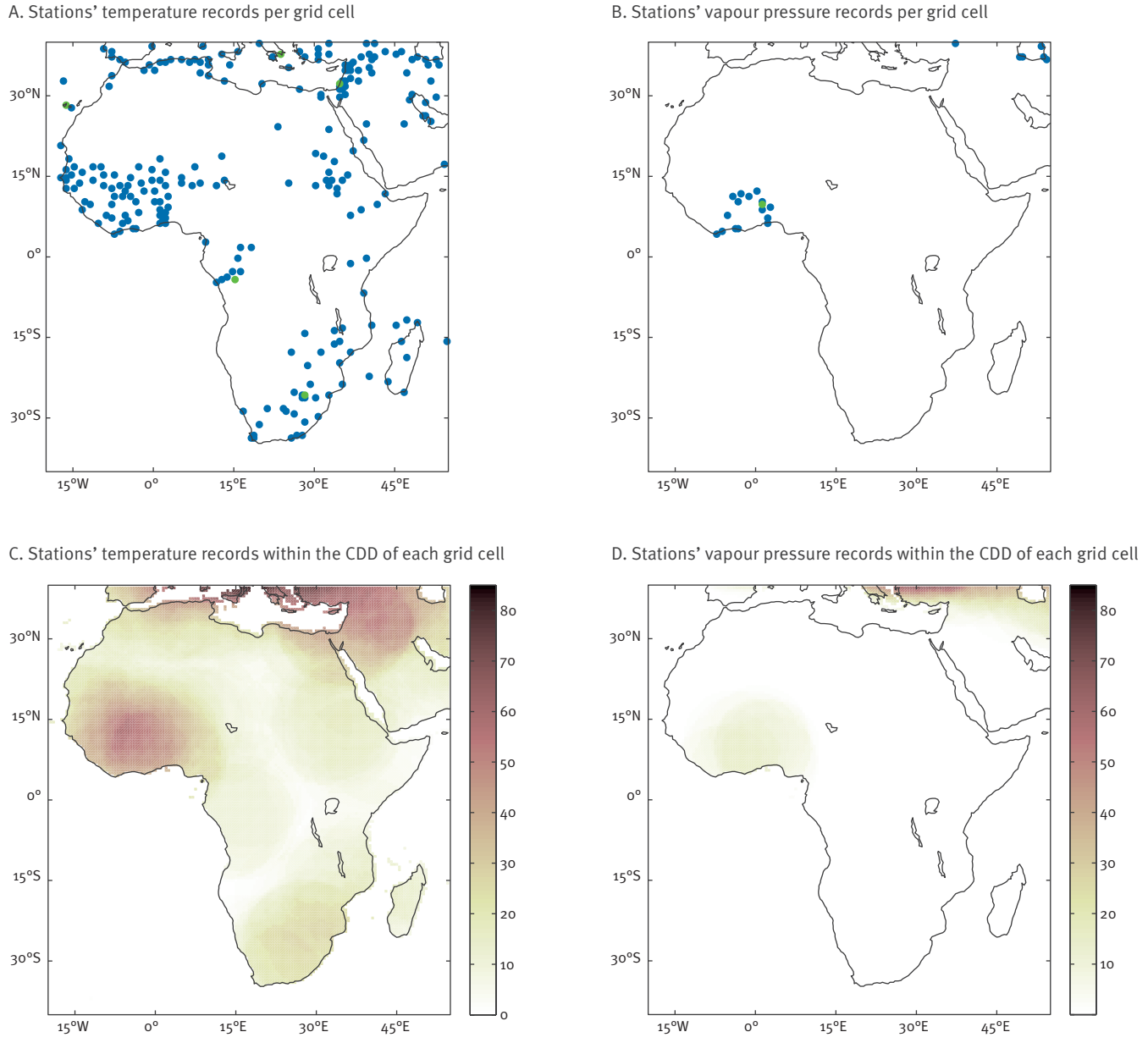
The author discloses consulting for JWT and Axon Advisors.

References

1. Ng S, Basta NE, Cowling BJ. Association between temperature, humidity and ebolavirus disease outbreaks in Africa, 1976 to 2014. Euro Surveill. 2014;19(35):pii=20892.
2. Harris I, Jones PD, Osborn TJ, Lister DH. Updated high-resolution grids of monthly climatic observations – the CRU TS3.10 Dataset. Int J Climatol. 2013;34:623-42.
3. Omumbo JA, Lyon B, Waweru SM, Connor SJ, Thomson MC. Raised temperatures over the Kericho tea estates: revisiting the climate in the East African highlands malaria debate. Malaria J. 2011;10:12.
4. International Research Institute for Climate and Society (IRI). A gap analysis for the implementation of the Global Observing System Programme in Africa. Palisades, NY: IRI; 2006. Available from: http://iri.columbia.edu/docs/publications/GapAnalysis.pdf

Figure 3

Plots of distribution station records included in construction of the University of East Anglia Climate Research Unit dataset for January 1996



CDD: correlation decay distance.
In panels A and B, blue dots indicate one station, green dots indicate two stations.

Authors' reply: Station data and modelled climate data in Africa

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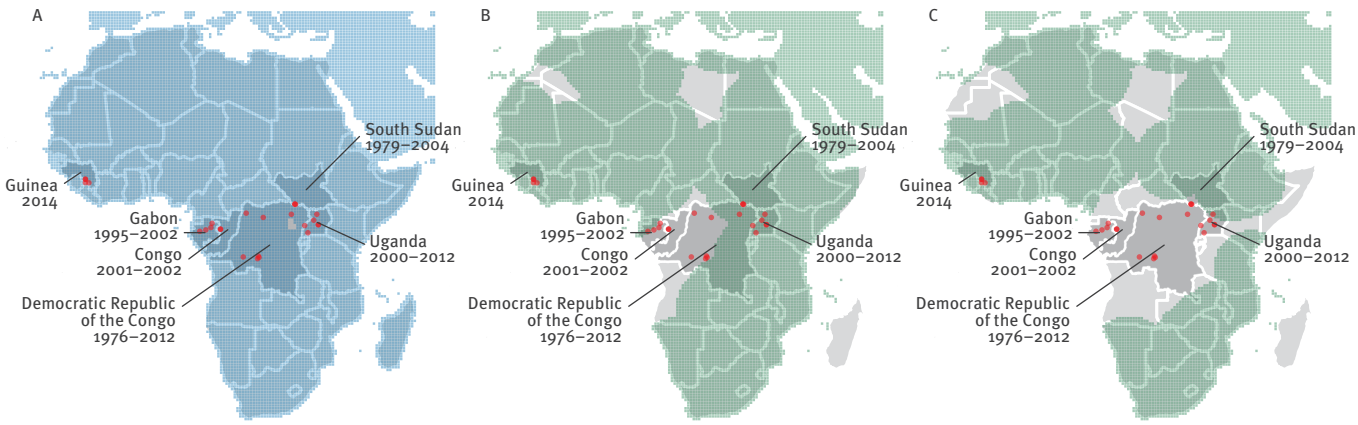
We thank Dr Shaman for his valuable comments [1] on our article [2]. We agree that it is challenging to study environmental determinants of diseases in locations where data are scarce. There are certainly weaknesses in the University of East Anglia Climate Research Unit (CRU) TS 3.21 dataset that could have affected our conclusions. This dataset was based on large climate datasets gathered by the World Meteorological Organization and the United States National Oceanographic and Atmospheric Administration. To maximise the use of available climate data, particularly in regions with imperfect station coverage, historical data, distant station data and station data of related climatic variables were processed and interpolated to provide modelled climatic data at a global scale. Technical details are available in an article written by Harris et al. [3].

The distribution of the 0.5° grid cells containing valid station data for mean temperature within the correlation decay distance in 1996 is shown in panel A of the Figure. Correlation decay distance was defined as the distance at which zonally averaged climatic conditions are no longer significantly correlated at the 95% confidence interval [3]. All of the Ebola virus disease outbreaks we studied occurred within the grid cells where at least one station data point was available. As reported by Harris et al., station data for vapour pressure were not widely available and these were inferred from station data on mean temperature and diurnal temperature range [3]. We show the distribution of grid cells containing valid station data points for these two predictor variables within correlation decay distance in 1980 in panel B of the Figure and in 1996 (panel C). Station data for mean temperature and

Figure

Grid cells containing one or more station data points within correlation decay distance



A. Area shaded in blue represents 0.5° grid cells containing station data for mean temperature within correlation decay distance in 1996.
B. Area shaded in green represents 0.5° grid cells containing station data for mean temperature and diurnal temperature range within correlation decay distance in 1980.
C. Area shaded in green represents 0.5° grid cells containing station data for mean temperature and diurnal temperature range within correlation decay distance in 1996.

Red circles represent the Ebola virus disease outbreak areas.

Source: [3].

diurnal temperature were not available in some previous Ebola virus disease outbreak areas and were less readily available for more recent years. Therefore the modelled climate data for these locations were mainly influenced by historical norms. New et al. [4] showed vapour pressure historical norms were widely available for all outbreak areas included in our analyses.

In our analyses, we standardised the climatic variables locally (standard deviation from the average climatic condition at the same location) to represent climatic condition as a variable varying seasonally above and below the average condition within the same outbreak location. Non-systematic discrepancies between the locally standardised modelled and the actual seasonal variation in climatic conditions added to the total noise presence in the data (random error). This noise was reflected in the confidence intervals of our estimates. Discrepancies that led to systematic bias might have some degree of influence on our main conclusion. Here we provide two examples of systematic discrepancies and their potential effects on our main conclusion.

Scenario 1

If the modelled seasonal variation in climate was consistently lagged behind or consistently phased ahead of the actual variation at a high number of outbreak locations, our analyses were vulnerable to systemic bias (e.g. humidity always peaked earlier at the predictor stations compared with the outbreak locations where climate data are interpolated). This type of systematic asynchrony influenced the best-fitting lag period of the model (maximum of three months allowed) and our main results may or may not be affected depending on the length of lag time between the modelled and actual climate variation.

Scenario 2

If the modelled climate data consistently inflated or consistently deflated the amplitude of seasonal variation in climatic conditions at many outbreak locations, our analyses were vulnerable to systemic bias (e.g. the locally standardised modelled data always showed larger peaks and/or troughs compared with the actual time series). Consistent deflation would have led to overestimation of the magnitude of odds ratios of zoonotic introduction associated with the standard deviation from mean climate conditions. Conversely, consistent inflation would have led to underestimation.

Conflict of interest

BJC reports receiving research funding from MedImmune Inc and consults for Crucell NV. The authors report no other potential conflicts of interest.

References

1. Shaman J. Letter to the Editor: Caution needed when using gridded meteorological data products for analyses in Africa. Euro Surveill. 2014;19(41):pii=20930. Available from: http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=20930
2. Ng S, Basta, NE, Cowling, BJ. Association between temperature, humidity and ebolavirus disease outbreaks in Africa, 1976 to 2014. Euro Surveill. 2014;19(35):pii=20892.
3. Harris I, Jones PD, Osborn TJ, Lister DH. Updated high-resolution grids of monthly climatic observations – the CRU TS3.10 Dataset. Int J Climatol. 2014;34(3):623–42.
4. New M, Hulme M, Jones P. Representing twentieth-century space–time climate variability. Part I: Development of a 1961–90 mean monthly terrestrial climatology. J Climate. 1999;12(3):829-56.

First European guidelines on syndromic surveillance in human and animal health published

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On 11 October 2014, the first European guidelines on syndromic surveillance in human and animal health, the 'Triple-S guidelines for designing and implementing a syndromic surveillance system', were published [1].The guidelines are one of the main outcomes of the European Union (EU) –funded project 'Triple-S', which main aim has been to increase the European capacity for near-real time surveillance and monitoring of health-related events in the animal and the human health sectors.

The Triple-S guidelines provide evidence-based recommendations and suggestions for each step of the set-up, use and assessment of a syndromic surveillance system. They aim to encourage a common understanding of the structure and utility of systems, and improve communication among European countries on critical public health threats. The guidelines are designed to be useful in the context of the wide range of health systems and data sources found in European countries, and their main principles can be applied globally. The guidelines are intended for public health professionals and epidemiologists working in human or animal health surveillance who would like to use syndromic surveillance to support existing surveillance systems and public health monitoring.

Triple-S was a project co-financed by the EU through the Executive Agency for Health and Consumers. It started in September 2010 and formally ended in December 2013, and was coordinated by the French Institute for Public Health Surveillance (InVS) in Paris. It involved twenty four organisations from thirteen European countries. As an outcome of the first meeting, held in November 2010, an updated definition of 'syndromic surveillance' was published in 2011 [2].

All publications originating from the Triple-S project, including the guidelines and reports on conducted inventories and site visits, can be found on the Triple-S web site (www.syndromicsurveillance.eu).

References

1. Triple-S. The syndromic surveillance project. Triple-S; Oct 2014. Available from: http://www.syndromicsurveillance.eu/
2. 2. Triple S Project. Assessment of syndromic surveillance in Europe. Lancet, 2011;378(9806):1833-4.