HHS Public Access

Author manuscript

Travel Med Infect Dis. Author manuscript; available in PMC 2019 July 12.

Published in final edited form as:

Travel Med Infect Dis. 2018 ; 23: 27–33. doi:10.1016/j.tmaid.2018.04.001.

Maritime varicella illness and death reporting, U.S., 2010–2015

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Abstract

Background: Ships destined for, or departing from, U.S. ports of entry must report certain signs and symptoms of potentially communicable diseases of public health interest among travelers to the Division of Global Migration and Quarantine (DGMQ) at the Centers for Disease Control and Prevention.

Methods: We reviewed ships' varicella case and outbreak reports from January 2010 through December 2015.

Results: DGMQ received 967 reports of varicella and 13 reports of herpes zoster. Most varicella case-patients were 20–49 years of age (84.7%, 472/557) and were cruise ship crew members (78.4%, 758/967). Most often, cruise ship crew member case-patients were born in or held passports from Indonesia (21.7%, 80/369), Philippines (17.6%, 65/369), or India (17.3%, 64/369). Ninety-nine varicella outbreaks were reported, including 439 varicella cases and one herpes zoster case; 97 (98.0%) outbreaks occurred on cruise ships, and 90.2% of associated cases were among crew members (397/440). Most varicella cases were in crew members, who are adults often from tropical regions where varicella immunity is acquired later in childhood or young adulthood or without varicella vaccination programs.

Conclusion: Varicella vaccination as appropriate for susceptible travelers, particularly crew members, before maritime travel may decrease risk of varicella infection and prevent outbreaks on ships.

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Potential conflicts of interest

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Keywords

Chickenpox; Disease outbreak; Herpes zoster; Travel; Ships

1. Introduction

U.S. Customs and Border Protection reported 13.5 million passengers and 5.1 million crew members arrived at U.S. ports by cruise ships, and 35,000 passengers and 0.9 million crew members by cargo ships, in 2014 [unpublished data provided to the Centers for Disease Control and Prevention (CDC) by U.S. Customs and Border Protection]. The Centers for Disease Control and Prevention's (CDC) Division of Global Migration and Quarantine (DGMQ) has jurisdiction over measures to prevent the entry and spread of communicable diseases that arrive through U.S. ports of entry. Ships arriving at a U.S. port of entry are required to report any shipboard deaths, suspected or confirmed cases of quarantinable diseases, and illness signs and symptoms of public health interest (e.g., fever with skin rash) among passengers or crews to the DGMQ Quarantine Station at or nearest the U.S. port of arrival [1–3].

Varicella, commonly known as chickenpox, is one of the most commonly reported communicable diseases on maritime vessels, comprising 35% of maritime illness reports submitted to DGMQ from 2010 to 2014 [3–5]. Varicella is caused by the *varicella-zoster* virus (VZV) and is characterized by a generalized, pruritic maculopapular vesicular rash that lasts up to a week. Varicella is highly contagious, with secondary attack rates among susceptible close contacts as high as 90% [6]. Reactivation of VZV results in herpes zoster, or shingles. VZV can be transmitted by direct contact with vesicular fluid of skin lesions of varicella or herpes zoster, inhalation of aerosolized fluid from skin lesions of acute cases, or inhalation of infected respiratory tract secretions [6]. Exposure to herpes zoster can cause varicella in contacts without history of varicella disease or vaccination. Varicella is usually a mild disease in children, but adults and immunocompromised persons are at higher risk for severe presentations with complications. Death from varicella infection is rare and is more likely in immunocompromised persons [6].

Varicella is endemic worldwide, but its epidemiology varies by climate [6,7]. In temperate climates, most children are infected by 10 years of age, with peak incidence during late winter or early spring. In tropical climates, children acquire varicella at older ages, and a higher proportion of young adults remain susceptible, resulting in a higher proportion of cases occurring among adults. Relatively few countries have recommended any varicella vaccination program, a majority of these countries being higher socioeconomic status countries [8]. In the United States, introduction of the varicella vaccination program has led to declines in varicella incidence, hospitalizations, and deaths, and has resulted in the elimination of varicella seasonality [6]. Although varicella vaccination is not required to enter the United States or for maritime travel or work, varicella vaccination in response to cases occurring on ships has been recommended as a measure to reduce spread of varicella on ships [4,7]. Cruise voyages last on average 7 days but can be several hours to several months in length, and cruise ships can carry up to 3000 passengers and 1000 crew [9].

Introduction of varicella in the semi-closed environment of maritime conveyances where close contact is common can facilitate person-to-person transmission of varicella [4].

This analysis aims to identify and analyze reporting trends of varicella in passengers and crew members and describe varicella outbreaks on board maritime vessels from 2010 to 2015.

2. Materials and methods

Illnesses and deaths reported to any DGMQ Quarantine Station are captured in the Quarantine Activity Reporting System (QARS), a secure, web-based database. Investigators queried QARS for maritime varicella and herpes zoster reports from January 1, 2010, to December 31, 2015. A manual review of documentation and communication attached to varicella and herpes zoster case reports was completed to collect variables not recorded in QARS database fields. Reports with a final diagnosis of varicella, varicella/zoster, or zoster as determined by a Quarantine Medical Officer were included in the initial list of cases.

Analysis of varicella and herpes zoster cases included description by patient's age and gender, vessel type, traveler type, traveler country of origin, illness symptoms, time on board before symptom onset, hospitalization, and death. Month of symptom onset was analyzed to describe seasonal trends. Time on board was defined as the number of days between the embarkation date and symptom onset date. Response to individual cases was described, including time from symptom onset to isolation and from symptom onset to report to DGMQ.

Additionally, varicella outbreaks on ships were quantified and characterized by number of cases reported in the outbreak, ship type, index case characteristics, days of clinical illness, duration of outbreak response, index case time on board before symptom onset, number of contacts, and response. An outbreak was defined as 3 or more cases with a final diagnosis of varicella occurring on the same ship within a 42-day period. A person was considered a contact if he/she reported 5 or more minutes of face-to-face contact with a person with varicella during the infectious period, from 2 days before rash onset until lesions are crusted (generally 4–6 days after rash onset), or direct contact with the fluid from skin lesions of persons with varicella or herpes zoster [4]. The case with the earliest reported symptom onset date in an outbreak was considered the index case. Cases with the same symptom onset date were reviewed to identify the earliest case; the case identified as the index case in QARS was considered the index case if investigators were unable to determine the earliest case. Days of clinical illness during an outbreak were calculated as the number of days between the index case's symptom onset date and seven days after symptom onset of the last case. Seven days was chosen because this typically is the longest duration of varicella clinical illness. Duration of outbreak response was defined as the number of days between the index case's symptom onset date and 42 days (two incubation periods) after symptom onset date of the last reported case in an outbreak.

Statistical differences for proportions and frequencies were evaluated using a chi-square test; Fisher's exact test was used when expected cell sizes were small. For continuous variables,

statistical differences were compared using independent sample t-tests. Two sided p-values < 0.05 were considered statistically significant. Analyses were performed using SAS 9.3 (Cary, NC). All data used for this analysis were collected in the course of routine public health practice, in accordance with CDC's statutory authority. This analysis was considered non-research under CDC policy, and was therefore outside the scope of IRB review requirements.

3. Results

From January 2010 through December 2015, DGMQ received 967 reports of varicella and 13 reports of herpes zoster from maritime vessels. The majority of varicella cases were among cruise ship crew members (78.4%, 758/967). Among those with reported demographic data (Table 1), most varicella case-patients were male (79.9%, 520/ 651) and between the ages of 20 and 49 years (84.7%, 472/557). Almost all cases of varicella and herpes zoster had rash (99.8%, 978/980), and about half had fever (52.9%, 518/980). Hospitalization was reported for few patients with varicella (2.5%, 20/539); one varicella death was reported in a cargo ship crew member (0.1%, 1/967). Of the 13 herpes zoster cases, 4 were among cruise ship passengers, 7 among cruise ship crew members, and 2 in cargo ship crew members. One herpes zoster case in a cargo ship crew member was identified as the index case in an outbreak with 3 additional varicella cases among crew members.

Cruise ships reported 758 cases of varicella in crew members and 142 cases in passengers (84.2% and 15.8%, respectively) (Table 2). Crew member case-patients were most often either born in or held a passport from Indonesia (21.7%, 80/369), Philippines (17.6%, 65/ 369), or India (17.3%, 64/369) (Fig. 1). Passenger case-patients were most often from the United States (23.4%, 18/77), United Kingdom (11.7%, 9/77), Canada (9.1%, 7/77), or Sweden (9.1%, 7/77) (Fig. 2). Of the 399 crew member and 99 passenger case-patients with data on age, median age was 31 years (range 20–63 years) and 11 years (range 3 months–72 years), respectively. Among crew members and passengers with reported sex and age, more case-patients were male (passenger: 56.6%, 60/106; crew: 82.5%, 395/479). For crew members, the median number of days on a ship before symptom onset was 54, ranging from 6 days before boarding to 404 days on board. The median number of days passengers were on board a ship before reported symptom onset was 3, ranging from 8 days before boarding to 85 days on board.

The reported number of days between rash onset and isolation was significantly higher in passenger than crew member cases, albeit the difference is small (1.1 vs. 0.6, p = 0.047) (data available for 269 cases), while the reported number of days between rash onset and report date to DGMQ was not different between crew member and passenger cases (2.9 for both) (data available for 764 cases). Cruise ships reported cases in every month of the year, with no distinct seasonal pattern of varicella reports (Fig. 3). Of the 487 cruise ship travelers with reported hospitalization data, 4 (0.8%) hospitalizations were reported, all among crew members.

Cargo ships reported 63 (6.5%) cases of varicella during the study period (Table 1); no distinct seasonality was identified (Fig. 3). Almost all case-patients were male (98.4%); and the median age was 32 years (range 19–61 years). Varicella case-patients were most often from or held a passport from Philippines (33/51, 64.7%), India (9/51, 17.7%), China (2/51, 3.9%), or the United States (2/51, 3.9%). The median number of days on board before symptom onset was 15, ranging from 2 days before boarding the ship to 289 days on board.

The average number of days between rash onset and isolation of case-patients was 1.2 (standard deviation 1.4), and the average number of days between rash onset and report to DGMQ was 5.7 (standard deviation 9.5). A cargo ship reported the only varicella death during the study period (1/63, 1.6%) [10]; 31.3% (15/48) of the varicella case-patients reported by cargo ships were hospitalized.

Four cases of varicella were reported from ships not classified as cruise or cargo ships. Travelers on these ships were male and 10–49 years of age; 3 of 4 were crew members. All reported rash, and 3 of 4 reported fever. All were on board 10–21 days before illness onset. One traveler was hospitalized.

3.1. Varicella outbreaks

A total of 99 outbreaks of varicella were reported from January 2010 through December 2015 and included 439 cases of varicella and one case of herpes zoster; the case of herpes zoster was the index case in an outbreak. Cruise ships reported 97 (98.0%) of the outbreaks (Table 3), and the majority of the outbreak-associated cases were among crew members (90.2%, 397/440). Outbreak size ranged from 3 to 14 reported cases, with a median of 3 cases per outbreak. Index case-patients were identified for all reported outbreaks; 79 (79.8%) were crew members, and 20 (20.2%) were passengers. One (1.0%) outbreak had only passenger cases, and 69 (69.7%) outbreaks had only crew member cases. Of the 29 outbreaks with both passenger and crew member cases, 19 (65.5%) index cases were passengers and 10 (34.5%) were crew members. The median number of days of clinical illness in outbreaks was 33 days, with a range of 7–146 days.

Outbreak response generally lasted between 56 and 112 days (75.8%, 75/99, median 68 days). The median number of days on board the ship before the index case-patient’s symptom onset was 8, ranging from 4 days before boarding to 282 days on board. A majority of passenger index cases had symptom onset less than 10 days on board (94.7%, 18/19). More crew member index cases had symptom onset after 21 days on board (55.9%, 33/59).

Data on contacts of case-patients on ships were available for 49 of the 99 outbreaks (49.5%) (Table 3). These 49 outbreaks included 236 varicella cases (49 index cases and 187 non-index cases) and 2627 reported contacts identified. Documentation from ship-led investigations sent to DGMQ reported that 13 of the 187 non-index varicella cases (7.0%) were identified as contacts of a case during ship-led contact investigations. The remaining 174 of the 187 non-index cases (93.0%) were not identified contacts of a case during an initial investigation; instead they were identified and reported as part of an outbreak when they presented with varicella symptoms. Data on varicella immunity status of contacts was

available for 40 outbreaks (40.4%), in which 1722 persons were contacted during investigations (Table 3). A majority of contacts had not received varicella vaccine (15.3%, 264/1722) or did not know their varicella immunity status (67.7%, 1166/1722).

4. Discussion

Review of DGMQ's Quarantine Activity Reporting System data from 2010 through 2015 shows that varicella is an important condition of public health interest for maritime travelers and industry. Varicella can be introduced into the ship by both crew members and passengers. Generally, varicella cases occurred more often in crew members who were adults from tropical countries where varicella epidemiology differs from that in the United States and were thus more likely to be susceptible. Because controlling outbreaks on ships can be challenging due to the semi-closed environment and opportunities for close contact, vaccination of crew members before boarding a ship may be a more effective approach for decreasing the risk of varicella infection and preventing outbreaks on board ships.

Maritime travelers can be from all over the world. Passengers who developed varicella on ships were more likely to originate from temperate countries (e.g., United States, Canada, United Kingdom), whereas crew members were more often from tropical countries. This analysis found that a majority of varicella cases on ships were among crew members who were most frequently from Indonesia, Philippines, and India (similar to all crew members) [unpublished data provided to the Centers for Disease Control and Prevention (CDC) by U.S. Customs and Border Protection, 2015]. These and some other tropical countries do not have varicella immunization programs, and varicella immunity there is typically acquired later in childhood and young adulthood. Therefore, a higher proportion of adults remain susceptible to varicella and may develop disease if exposed to VZV [7]. Outbreaks of varicella among adult immigrants from tropical countries have been reported in countries with temperate climate [11–13].

The semi-closed environment of a ship where travelers are in close contact with one another while on board but embark and disembark in various locations can facilitate exposure to and transmission of varicella among susceptible travelers. Studies have described varicella transmission in other semi-closed environments [14–16]. Cruise ship populations regularly change with new groups of passengers boarding the ship each voyage and crew rotating. Cargo ship crew members may disembark on voyages that typically include many countries and ports throughout the world. The rapid movement of vessels between ports leads to increased exposure risk to varicella among crew members and passengers [17,18].

We also report on transmission of VZV on board ships. Overall, more outbreaks had crew members identified as index cases; however, less than half of the crew member index cases associated with outbreaks reported varicella symptoms within 10 days of boarding the ship. It is possible that many crew members contracted varicella while on board ships or when they disembarked during the voyage or by contact with a traveler not identified in an outbreak investigation. Passengers are on the ship for less time than crew members, and in this analysis 98% reported symptom onset within 10 days on board. Therefore it is likely that passengers may have been infected with VZV before boarding a ship. More outbreaks

with both crew members and passengers identified passengers as the index cases, which may suggest that varicella was introduced on the ship by passengers, initiating outbreaks among susceptible crew members. The risk of exposure to varicella appears to be year-round for susceptible travelers, as no discernable seasonal trend for varicella cases reported from ships was identified (Fig. 1). Adults have a higher incidence than children of complications, hospitalization, and death (although rare) due to varicella [6,19]. Crew members on cargo and cruise ships who are susceptible, therefore, have a higher risk of complications if they are infected with varicella. Additional risk of exposure to varicella for susceptible persons comes from travelers with herpes zoster, as a person with active herpes zoster can transmit VZV to susceptible contacts [6].

Controlling the spread of varicella on board can be difficult. DGMQ recommends that travelers who develop varicella or herpes zoster while on board a ship be medically evaluated. Travelers who develop varicella should be isolated in their cabins or quarters until all lesions have crusted over or no new lesions appear within a 24-h period [4]. Passengers and crew members who may have been exposed to a person suspected of having varicella should be identified and assessed for evidence of immunity to varicella [4]. Contacts who have no evidence of immunity should be provided with postexposure prophylaxis varicella vaccine within 3–5 days of exposure. Susceptible crew members who do not receive vaccination should have no contact with passengers and minimize contact with other crew members from the 8th through the 21st day after exposure. Ship medical staff should actively monitor all susceptible crew members up to 21 days after exposure [4].

Implementation of measures to control varicella outbreaks on ships remains challenging. Our findings that the median number of days of clinical illness in outbreaks was 33 and > 80% of outbreak responses lasted 56 or more days confirm these challenges. Identification of all contacts and recall of immune status are important aspects for controlling spread of varicella. However, we found that most cases associated with outbreaks likely were not identified during contact investigations, and information on the immunity of contacts was frequently missing. It may be difficult for travelers to remember who they may have exposed unless it was a roommate or close friend or colleague, given the regularly changing population on many maritime conveyances. Previous studies have found that proof of immunity has been inconsistent among travelers [18,20,21]. Additionally, both cruise and cargo ships carry limited medical crew and supplies; therefore, a ship’s response to a single case of varicella may be limited, hindering response during an outbreak. Cargo ships typically are not staffed with physicians, and that lack can delay the diagnosis, treatment, and reporting of varicella case-patients. Because of the challenges in isolating cargo ship crew members on board, crew members who need to be isolated often disembark the ship and are isolated in hospitals or hotels until well. This policy could explain for the high number of cargo ship varicella case-patients being hospitalized in our study. The unique factors associated with controlling varicella on ships suggest that the strategy to identify and isolate cases and to identify and vaccinate contacts as cases occur is not sufficient to halt outbreaks in these settings.

Varicella vaccination of susceptible crew members may be an effective way to reduce spread of varicella on ships; varicella vaccination has been shown to be cost-effective for the

general population [4,18,22]. One dose of varicella vaccine is estimated to be 70%–90% effective against infection, while 2 doses are ~92% effective [6]. Varicella vaccination is not required to enter the United States or for maritime travel or work; however, CDC recommends that cruise ship crew members have documented proof of immunity to vaccine preventable diseases, including varicella, and that cruise ship passengers be up-to-date with routine vaccinations before travel [7]. In the United States, varicella vaccination is included in childhood immunization programs and also recommended for susceptible persons 13 years or older who have no contraindications [6,22]. Since our study found that varicella was most often reported in crew members, efforts to vaccinate crew members likely would result in the reduction of cases or disruption of spread while on board.

This analysis has several limitations. Reporting of illness and death on board cruise and cargo ships is passive and likely underestimates varicella on ships. Similarly, outbreaks of varicella may have gone unreported or underreported, both in size and existence of outbreak, to DGMQ because of this passive surveillance. Although the ability to compare the risk of contracting varicella on a ship versus the overall risk in the United States or other populations would have been helpful, due to limitations in these data, an accurate, meaningful estimate of maritime varicella risk could not be calculated. Additionally, passengers may be more reluctant than crew members to seek medical care or report symptoms immediately while traveling, resulting in a longer time between rash onset and isolation when compared to crew members. CDC's protocols for collecting data on varicella cases and recommendations for outbreak management changed during the study period, resulting in missing data. Because some cases were not identified as part of an outbreak at the time of reporting or were identified retrospectively by review of ships' medical logs, additional information requested from ships during varicella outbreaks was not available.

5. Conclusion

We documented that maritime travelers arriving at US ports of entry are at risk for VZV exposure year round. Most varicella cases on ships were among crew members. While some passengers or crew members may board the ship already infected, most crew members acquire varicella during voyage. Management of varicella cases on board is critical to protecting the health of susceptible and high-risk travelers. Although investigation of contacts of cases is recommended, our analysis showed that contact investigations have limited success in controlling spread of varicella because index cases may not accurately identify all potential contacts. Given the year-round VZV exposure on ships, the risk for severe varicella illness and complications for adults, and the limited efficacy of contact investigations, varicella vaccination before maritime travel could be a more effective strategy to reduce the risk of varicella infection and protect the health of travelers.

Acknowledgements

The authors would like to thank CDC Quarantine Stations, other DGMQ and CDC staff, and all partners involved in the public health response and reporting of maritime illness and deaths.

Funding

This study/report was supported in part by an appointment to the Applied Epidemiology Fellowship Program administered by the Council of State and Territorial Epidemiologists and funded by the CDC Cooperative Agreement Number [1U38OT000143–03].

Abbreviations:

CDC	Centers for Disease Control and Prevention
DGMQ	Division of Global Migration and Quarantine
VZV	*varicella-zoster* virus
QARS	Quarantine Activity Reporting System

References

[1]. Division of Global Migration and Quarantine. Federal Regulations for Reporting Death or Illness on Ships Destined for the United States. Available at: https://www.cdc.gov/quarantine/maritime/federal-regulations-reporting-illness-death-ships-destined-united-states.html. Accessed 29 Mar 2017.

[2]. Division of Global Migration and Quarantine. Guidance for Cruise Ships: How to Report Onboard Death or Illness to CDC. Available at: http://www.cdc.gov/quarantine/cruise/reporting-deaths-illness/guidance-how-report-onboard-death-illness.html. Accessed May 24, 2016.

[3]. Stamatakis CE, Rice ME, Washburn FM, Krohn KJ, Bannerman M, Regan JJ. Maritime illness and death reporting and public health response, United States, 2010–2014. Trav Med Infect Dis 2017;19:16–21.

[4]. Division of Global Migration and Quarantine. Guidance for Cruise Ships on Varicella (Chickenpox) Management. Available at: http://www.cdc.gov/quarantine/cruise/management/guidance-cruise-ships-varicella.html.

[5]. Cramer EH, Slaten DD, Guerreiro A, Robbins D, Ganzon A. Management and control of varicella on cruise ships: a collaborative approach to promoting public health. J Trav Med 2012;19(4):226–32.

[6]. Centers for Disease Control and Prevention. Varicella In: Hamborsky J, Kroger A, Wolfe C, editors. Epidemiology and prevention of vaccine-preventable diseases. 13th ed Washington D.C: Public Health Foundation; 2015 p. 353–76.

[7]. Centers for Disease Control and Prevention. CDC yellow book 2018: health information for international travel. New York: Oxford University Press; 2017.

[8]. Wutzler P, Bonanni P, Burgess M, Gershon A, Safadi MA, Casabona G. Varicella vaccination - the global experience. Expet Rev Vaccine 2017;16(8):833–43.

[9]. World Health Organization. International travel and health: Travel by Sea. Available at: http://www.who.int/ith/mode_of_travel/sea_travel/en/.

[10]. Ellis M, Luna-Pinto C, George T, et al. Notes from the field: varicella fatality on a cargo vessel — Puerto Rico, 2015. MMWR (Morb Mortal Wkly Rep) 2017;66(15):410. [PubMed: 28426644]

[11]. Kjersem H, Jepsen S. Varicella among immigrants from the tropics, a health problem. Scand J Publ Health 1990;18(3):171–4.

[12]. Woernle C, Higginbotham G, Judy R, Gordon E. Varicella outbreaks among Mexican adults—Alabama, 2000. MMWR Morb Mortal Wkly Rep 2000;49(32):735–6. [PubMed: 11411828]

[13]. Lesens O, Baud O, Henquell C, Lhermet A, Beytout J. Varicella outbreak in Sudanese refugees from Calais. J Trav Med 2016;23(5):1–3.

[14]. Fajardo M, Seward J, Ludwig S, Johnson J, Wharton M. Varicella susceptibility and validity of history among U.S. Coast Guard recruits: an outbreak-based study. Mil Med 2003;168(5):404–7. [PubMed: 12775178]

[15]. Nichols RA, Averbeck KT, Poulsen AG, et al. Household size is critical to varicellazoster virus transmission in the tropics despite lower viral infectivity. Epidemics 2011;3(1):12–8. [PubMed: 21420656]

[16]. Levy MH, Quilty S, Young LC, Hunt W, Matthews R, Robertson PW. Pox in the docks: varicella outbreak in an Australian prison system. Publ Health 2003;117(6):446–51.

[17]. Acevedo F, Diskin AL, Dahl E. Varicella at sea: a two-year study on cruise ships. Int Marit Health 2011;62(4):254–61. [PubMed: 22544501]

[18]. Idnani N Varicella among seafarers: a case study on testing and vaccination as a cost effective method of prevention. Int Marit Health 2010;61(1):32–5. [PubMed: 20496326]

[19]. Marin M, Watson TL, Chaves SS, et al. Varicella among adults: data from an active surveillance project, 1995–2005. J Infect Dis 2008;197:S94–100. [PubMed: 18419417]

[20]. Mitruka K, Felsen CB, Tomianovic D, et al. Measles, rubella, and varicella among the crew of a cruise ship sailing from Florida, United States, 2006. J Trav Med 2012;19(4):233–7.

[21]. Szymanowski P, Lipman H, Fishbein D, Chandra C. Epidemiology of varicella among passengers and crew on international conveyances, United States, 2005–2008. Int J Infect Dis 2010;14(1). e177.

[22]. Marin M, Güris D, Chaves SS, Schmid S, Seward JF. Prevention of varicella: recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Recomm Rep 2007;56(RR-04):1–40.

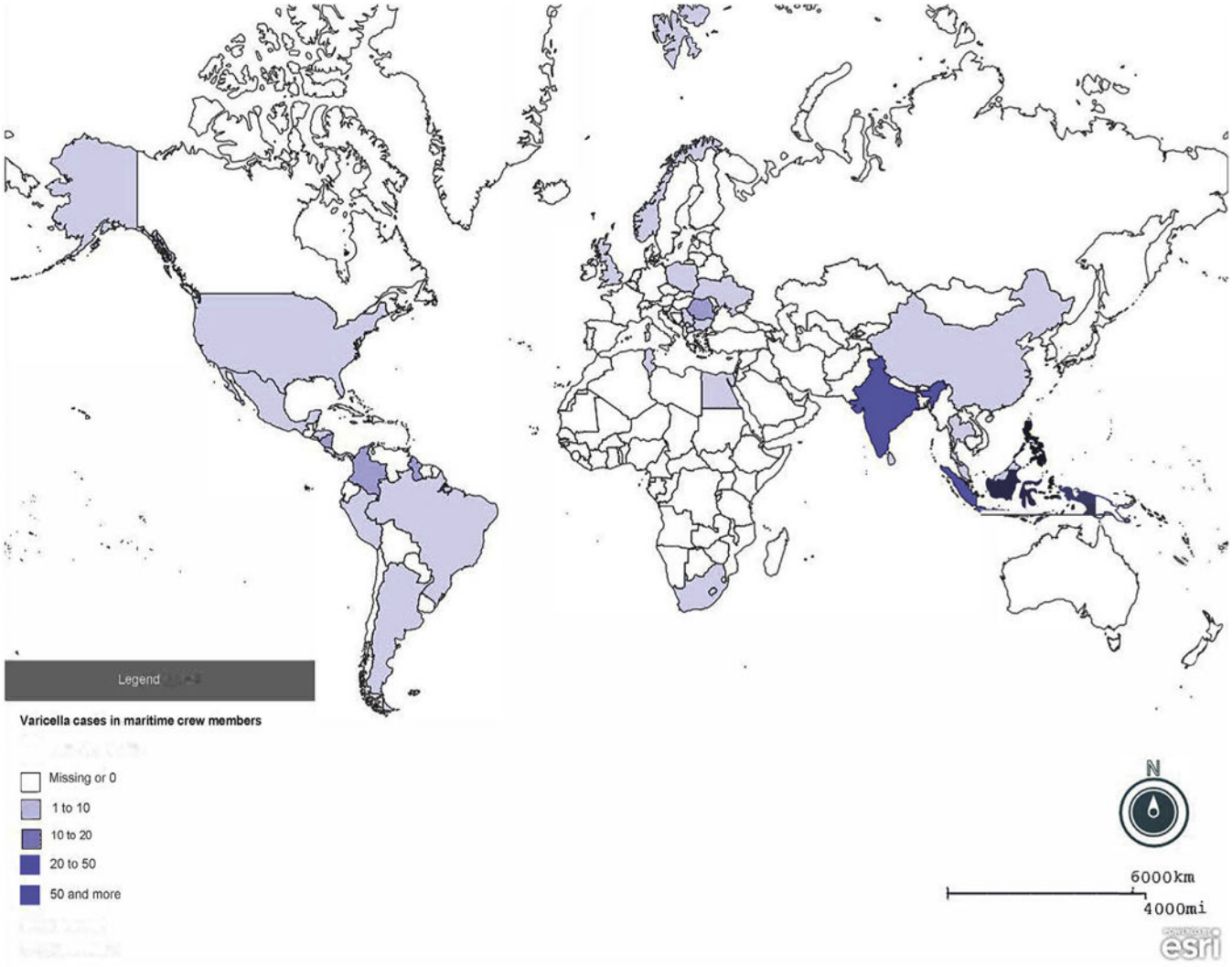

Fig. 1.

Countries of origin of maritime crew members from cruise and cargo vessels with varicella reported to Division of Global Migration and Quarantine, January 2010–December 2015 (n = 423).

Fig. 2.

Countries of origin of maritime passengers from cruise and cargo vessels with varicella reported to Division of Global Migration and Quarantine, January 2010–December 2015 (*N* = 79).

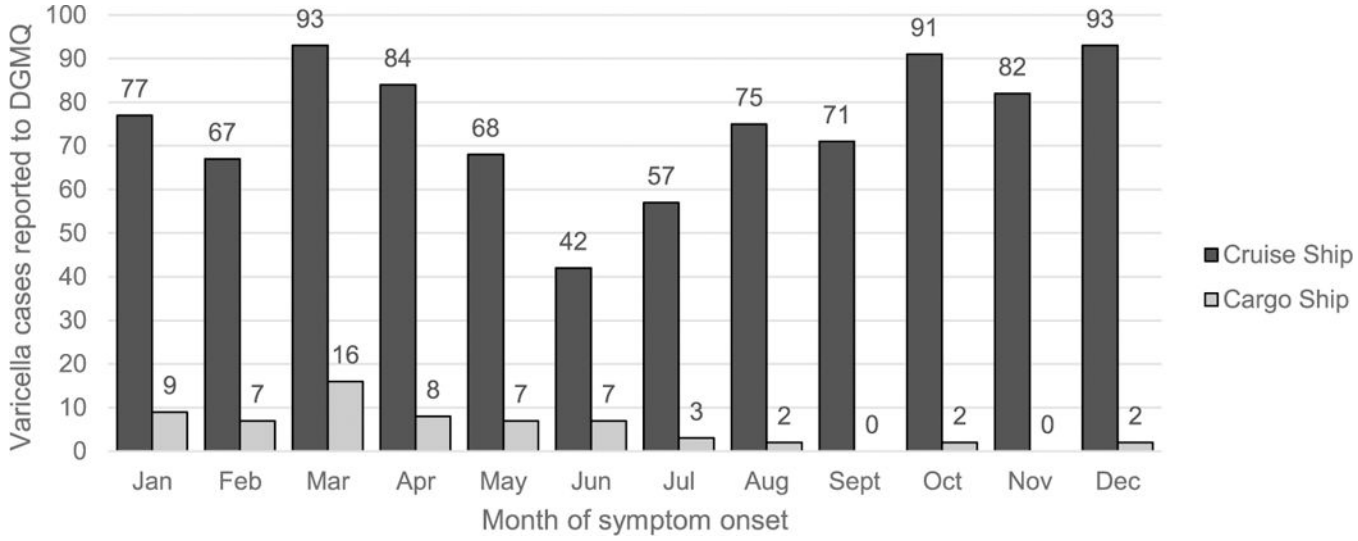

Fig. 3.

Month of symptom onset of varicella cases reported to Division of Global Migration and Quarantine from cruise and cargo ships, January 2010–December 2015 (n = 963).

Table 1

Characteristics of varicella cases in maritime travelers reported to Division of Global Migration and Quarantine, January 2010–December 2015.

	All[a] (*N* = 967)		Cargo ship (*N* = 63)		Cruise ship (*N* = 900)	
	n/N	**%**	**n/N**	**%**	**n/N**	**%**
Gender						
Male	520/651	79.9	61/62	98.4	455/585	77.8
Female	131/651	20.1	1/62	1.6	130/585	22.2
Age						
< 1	3/557	0.5	0/55	0.0	3/498	0.6
1–9	46/557	8.3	0/55	0.0	46/498	9.2
10–19	20/557	3.6	1/55	1.8	18/498	3.6
20–49	472/557	84.7	51/55	92.7	418/498	83.9
50 +	16/557	2.9	3/55	5.5	13/498	2.6
Traveler type						
Crew member	823/967	85.1	62/63	98.4	758/900	84.2
Passenger	144/967	14.9	1/63	1.6	142/900	15.8
Symptoms						
Rash	978/980	99.8	63/63	100.0	898/900	99.8
Fever	518/980	52.9	34/63	53.9	478/900	53.1
Time onboard before illness onset[b,c]						
Less than 10 days	346/771	44.9	18/51	35.3	328/716	45.8
10–21 days	53/771	6.9	9/51	17.7	44/716	6.2
21–150 days	252/771	32.7	19/51	37.3	229/716	32.0
150 + days	120/771	15.6	5/51	9.8	115/716	16.1
Case-patient outcome						
Hospitalized	20/539	2.5	15/48	31.3	4/487	0.8
Deaths	1/967	0.1	1/63	1.6	0/900	0.0

[a] Four cases from ships that were not classified as cruise or cargo are included. Travelers on these ships were male and 10–49 years of age; 3 of 4 were crew members. All reported rash, and 3 of 4 reported fever. All were on board 10–21 days before illness onset. One traveler was hospitalized.

[b] Date of fever onset was used as the date of symptom onset. If fever was not reported, date of rash onset was used. If no symptom onset dates were reported, the date the case was reported was used as the date of symptom onset.

[c] For passengers the embarkation date of the vessel was used if missing. For crew members, reports were reviewed, and those still missing were left missing. This information may be missing for crew members if they have been on board a long time and don't remember, or it was not reported and was more frequently missing for crew members than passengers. One cluster embarkation date was set to missing as the embarkation date for the index case could not be determined.

Table 2

Characteristics of varicella cases in cruise ship travelers reported to Division of Global Migration and Quarantine, January 2010–December 2015.

	Crew member (*N* = 758)		Passenger (N = 142)		Comparison
	n/N	%	n/N	%	p-value
Gender					< 0.0001
Male	395/479	82.5	60/106	56.6	
Female	84/479	17.5	46/106	43.4	
Age					< 0.0001
<1	0/399	0.0	3/99	3.0	
1–9	0/399	0.0	46/99	46.5	
10–19	0/399	0.0	18/99	18.2	
20–49	394/399	98.8	24/99	24.2	
50+	5/399	1.3	8/99	8.1	
Symptoms					
Rash	756/758	99.7	142/142	100.0	1.0000
Fever	411/758	54.2	67/142	47.2	0.123
Time on board before symptom onset					< 0.0001
Less than 10 days	190/575	33.0	138/141	97.9	
10–21 days	42/575	7.3	2/141	1.4	
21–150 days	228/575	39.7	1/141	0.7	
150 + days	115/575	20.0	0/141	0.0	
Outcome					
Hospitalized	4/399	1.0	0/88	0.0	1.0000
Death	0/758	0.0	0/142	0.0	

Table 3

Characteristics of outbreaks of varicella on cruise and cargo ships reported to Division of Global Migration and Quarantine, January 2010–December 2015 (*N* = 99 outbreaks).

	Mean/ median	Standard deviation	n/N	%
Cases per outbreak	4.4/3	2.35		
Ship type				
Cruise ship			97/99	98.0
Cargo ship			2/99	2.0
Index case-patients traveler type				
Crew member			79/99	79.8
Passenger			20/99	20.2
Duration of outbreak response				
Less than 56 days			16/99	16.2
Between 56 and 112 days			75/99	75.8
More than 112 days			8/99	8.1
Contact investigation (*N* = 49 outbreaks)				
Contacted			2627/2627	100.0
Interviewed			1354/2627	51.5
Follow-up information reported			830/2627	31.6
Diagnosed with varicella			13/2627	1.6
Immune status of contacts (*N* = 40 outbreaks)				
Not vaccinated			264/1722	15.3
History of disease			264/1722	15.3
Vaccinated			22/1722	1.3
Immunity established by serology			6/1722	0.4
Unknown			1166/1722	67.7
Received postexposure vaccination (*N* = 40 outbreaks)			935/945	98.9