

# Varicella among seafarers: a case study on testing and vaccination as a cost-effective method of prevention

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## ABSTRACT

**Background.** Many individuals together in semi-confined settings increase the risk of outbreaks of infectious diseases. A single case of varicella on a cruise ship can thus result in rapid spread and elevated costs for the cruise provider in terms of repatriation, ship diversion, law suits, and loss in current and potential future revenue. Control of varicella involves attention to good personal hygiene, safe food and water handling, and use of vaccine.

**Objectives.** To test crewmembers during their pre-employment medical examination to determine who might be susceptible to contract varicella if exposed, to vaccinate those at risk, and to see whether the benefits of testing and vaccination outweigh the costs.

**Material and methods.** Tests were conducted on 121 Indian seafarers for varicella IgG and IgM antibodies during their pre-employment medical examination in Mumbai and Goa from December 1st to December 23rd 2008. Cases without IgG antibodies to varicella (IgG negative) were administered vaccine.

**Results.** Twenty (16.5%) seafarers who tested IgG negative and one who tested equivocally were administered the vaccine. One hundred (82.7%) tested positive for IgG antibodies and were therefore not vaccinated. None tested positive for IgM antibodies, indicating no active infection.

**Conclusions.** One in six Indian seafarers tested IgG negative and was thus at risk to contract varicella if exposed. Testing for varicella IgG and IgM antibodies, followed by vaccination when necessary, is a cost-effective method to prevent an expensive outbreak in the semi-confined setting of a cruise ship and is recommended as a mandatory part of the pre-employment medical examination for Indian seafarers.

## INTRODUCTION

“Emporiatrics” is the modern term coined to describe the science and health of travellers. The word actually comes from the Greek *emporos*, meaning “one who goes onboard a ship as a passenger,” and *iatrike*, meaning “medicine” [1]. Travel by sea is one of the earliest forms of transportation. According to the Cruise Line International Association, an estimated 12 million North Americans took a cruise in 2006 ([www.cruising.org/press/overview2008](http://www.cruising.org/press/overview2008)). These large cruise ships can serve as a gathering place or a melting pot, so to speak, for the global community, where passen-

gers and crew from around the world bring together a diversity of cultures, as well as medical and immunizational backgrounds and health risk behaviours. Cruise voyages can last from several hours (gambling cruises) to several months (around the world and semester-at-sea cruises); however, the average duration of cruise travel is about seven days. This time period permits ample opportunities for passengers and crew (medical personnel included) to come into repeated and prolonged contact through shared activities, such as games and dining, and through resources such as food and water, resulting in opportunities for exposure and

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transmission of communicable diseases. In addition, as cruise ships make multiple port stops, where differences in sanitation standards may exist as well as disease exposure risks, embarking passengers and crew can import and spread communicable diseases on board.

One such infectious disease (varicella or chickenpox) is caused by the varicella zoster virus (VZV). It is a highly contagious illness caused by primary infection with the varicella zoster virus. It generally begins with a vesicular skin rash appearing in two or three waves, mainly on the body and head rather than the hands, and becoming itchy raw pockmarks – small open sores which heal mostly without scarring. Chickenpox has a 10–21 day incubation period and is spread easily through aerosolized droplets from the nasopharynx of ill individuals or through direct contact with secretions from the rash. Following primary infection there is usually lifelong protective immunity from further episodes of chickenpox. Chickenpox is rarely fatal, although it is generally more severe in adults than in children. Pregnant women and those with a suppressed immune system are at highest risk of serious complications. The most common late complication of chicken pox is shingles, caused by reactivation of the varicella zoster virus decades after the initial episode of chickenpox [2]. An outbreak of an infectious disease such as varicella on board a semi-confined space like a cruise ship can therefore lead to large scale damage. The aims of this study was to test crewmembers during their pre-employment medical examination to determine who might be susceptible to contract varicella if exposed, to vaccinate those at risk, and to see whether the benefits of testing and vaccination outweigh the costs.

## MATERIAL AND METHODS

### CASES

The subjects used in this study were 121 Indian seafarers employed on cruise ships, consecutively undergoing their pre-employment medical examination (PEME) at two locations in India – Mumbai (Colaba) and Goa (Porvorim) – between December 1st and December 23rd 2008. All were young males between the ages of 21 and 42 years and were employed in the lower ranks of assistant waiter, snack steward, security guard, etc. Proper consent for testing was obtained from all.

### BLOOD TESTING

Blood was drawn by venepuncture, using routine precautions, and collected in a Vacutainer containing a clot activator gel. The separated serum was tested the same day for antibodies to varicella IgG and IgM, simultaneously, using Varicella-Zoster-Virus IgM ELISA and VIDAS Varicella Zoster IgG testing kits (Biomérieux Inc., USA) [3]. Proper handling

and storage of all test materials was done according to the testing kit literature to maintain accuracy. Positive anti-IgG test indicates immunity towards varicella, so positive cases were not to be vaccinated or retested. Positive anti-IgM test indicates active infection, and such cases were to be retested in four weeks for anti-IgG, and if still found negative, were to be vaccinated. However, positive anti-IgM cases were expected to turn anti-IgG positive on retesting as the active infection causes the development of anti-IgG antibodies to varicella. Cases that tested negative for anti-IgG and anti-IgM were to be administered the vaccine.

### VACCINATION

After ruling out all contraindications listed on the vaccine product information, all anti-IgG negative cases were administered the VARILRIX vaccine (Glaxo-Smith-Kline pharmaceuticals, Australia) [4]. VARILRIX is a lyophilized preparation of the live attenuated Oka strain of varicella-zoster virus, obtained by propagation of the virus in MRC5 human diploid cell culture. Each 0.5 ml dose of the reconstituted vaccine contains not less than 103.3 plaque-forming units (PFU) of the varicella-zoster virus. The vaccine also contains amino acids, human albumin, lactose, neomycin sulphate, and polyalcohols. VARILRIX meets the World Health Organization requirements for biological substances and for varicella vaccines [4].

VARILRIX was administered as a single dose by subcutaneous injection after reconstitution, and the upper arm (deltoid region) was the preferred site of injection. No major adverse events were reported to vaccination beside the usual minor rash, fever, etc. The date of the first dose was marked on a vaccination card and the cases were instructed to report back after six weeks to receive the second dose or, if travelling at that time, to take the second dose at their place of convenience. A record of vaccination was kept for future reference. The varicella vaccine has been reported to be moderately effective in adults with some cases still not acquiring immunity even after vaccination [5, 6]. However, this was the best-known method of prevention of varicella.

The cost per IgG test and per vaccine was obtained to perform a cost-benefit analysis.

## RESULTS

Out of the 121 cases, 20 (16.5%) seafarers who tested IgG negative and one who tested equivocally were administered the vaccine. One hundred (82.7%) tested positive for IgG antibodies and were therefore not vaccinated. None of the cases tested positive for IgM antibodies, indicating no active infection. This indicates that 100 crew members either had the disease earlier or had been vaccinated. From the history given by these 100 crew members, about 25 thought they might have had chicken pox during childhood,

while another 35 thought they had been vaccinated against the disease, but the recollection was uncertain and these numbers could not be trusted.

Of the 20 cases that tested negative, none recalled vaccination or disease, but this information was also unreliable.

At an approximate cost of USD 50 per test, the total cost of testing was around USD 6,000. Additionally, at an average cost of USD 40–50 for 2 doses of the vaccine, the cost of vaccination of the 20 IgG negative cases was approximately USD 800–1000. This would bring the total cost of testing and vaccination in this sample to a little over USD 7,000.

## DISCUSSION

Infections can be life threatening for seafarers and passengers on cruise ships and can lead to major costs and disruption for maritime employers (owners, stakeholders, manning agents). Preventive measures are therefore essential. Detecting and preventing the spread of infectious diseases during cruises is important not only to protect the health of cruise travellers but also to avoid global dissemination of diseases in home communities through disembarking passengers and crew members [7, 8]. Where large numbers of susceptible passengers are carried, as on cruise ships, outbreaks of infectious diseases such as chicken pox, can be severe, and crew immunization should be considered.

In the present study, 100 seafarers tested positive, but few of them remembered having had chickenpox or being vaccinated. This highlights the fact that one cannot rely solely on the medical history given by crew members. Testing is therefore a more accurate way to determine their immune status. (Revised, from Results)

From the above results, it can be seen that there is a moderately important large number of crew members in the study who tested 'negative' for the varicella IgG test, displaying poor or no immunity to the VZV. This cohort of the population is at clear risk of contracting chickenpox when exposed to the virus in a closed population, or during an epidemic. The method of prevention that we advocate here is vaccination with the varicella live attenuated vaccine to develop immunity in these crew members. Testing 121 Indian seafarers and vaccinating the 21 that tested negative for varicella cost a little more than USD 7,000. If testing and vaccination were not carried out, and if even 1 out of the 20 cases that tested negative, acquired varicella, and spread it to a handful of other crew members and passengers, the total cost of on-board treatment, quarantine, repatriation, ship diversion, law suits, etc. would clearly result in expenses far higher than USD 7,000, as well as significant loss in current and potential future revenue. Thus prevention benefits outweigh costs even for a disease with a low incidence rate. Vaccination is one method of prevention. Other methods of prevention

should also be considered in individuals at risk of serious disseminated varicella infection, i.e. the immunocompromised, pregnant women, and neonates. Immunocompromised individuals should be advised to avoid contact with people with varicella or zoster. If contact has been made, prophylaxis with passive immunization or antiviral chemotherapy should be considered. Heightened disease surveillance efforts by cruise lines in cooperation with public health authorities and awareness among cruise ship travellers have led to the detection of illnesses of potential public health significance that might otherwise have gone unnoticed [9, 10]. Communicable diseases occurring onboard cruise ships reflect similar onshore events, but transmission risk is enhanced by the crowded semi-closed cruise ship environment, with increased opportunities for interpersonal interaction [11]. In addition, an estimated one third of cruise travellers are senior citizens who, along with travellers with underlying chronic health problems, are at increased risk of morbidity from infectious agents [12–16]. Health professionals working on board cruise ships should also be tested and fully immunized, including confirmed protection from laboratory testing. Ship operators and employers have a duty to protect the health and safety of their workers as well as their clientele (the passengers). In practical terms, implementing this general duty of care means that they are responsible for minimizing the risks of infection by advocating preventive measures such as immunizations.

In conclusion, 16.5% of Indian seafarers tested Varicella IgG negative. Testing for IgG and IgM antibodies against varicella, followed by vaccination when necessary, is a cost-effective method to prevent an expensive outbreak in the semi-confined setting of a cruise ship and is recommended as a mandatory part of the pre-employment medical examination for Indian seafarers.

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