



Respiratory infections and gastrointestinal illness on a cruise ship: A three-year prospective study



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Summary *Background:* Cruise ships carry a large number of people in confined spaces providing an environment for transmission of infections. The aim of this study is to estimate the incidence of and describe the spectrum of respiratory infections and gastrointestinal illness among passengers and crew of cruise Ship A.

Material and methods: The study was carried out from January 2011 to December 2013 on cruise Ship A, including passengers and crew who presented with symptoms suggestive of acute respiratory infection (ARI), influenza-like illness (ILI) and gastrointestinal illness (GI). Advice about preventive measures of respiratory and gastrointestinal infections and influenza vaccination was given to passengers and crew. Data were collected by using one standardized form per patient.

Results: The most common destination was Northern Europe (90.7%). The mean duration of cruise was 10.6 days; 440 passengers and 421 crew members who sought medical attention were studied (mean age 72.6 ± 9.5 and 33 ± 7 years, respectively). ILI, ARI and GI were diagnosed in 32.7%, 15.9%, 17% and 10.9%, 80%, 0.2% of ill passengers and crew, respectively. The association of ARI, ILI and GI incidence in passengers was statistically significant with season,

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destination and duration of travel; the incidence for all illnesses was higher during winter, for travel to South America and for >14 days (p -value<0.001).

Conclusion: ARI, ILI and GI continue to pose a burden on cruise travel; therefore pre-travel advice is crucial for passengers and crew regarding respiratory and gastrointestinal infections. Surveillance and implementation of control measures are important for outbreak prevention.

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1. Introduction

The cruise industry has shown a dynamic growth for the last 30 years as a result of cruise travel popularity with more extensive itineraries than ever before. From 2003 to 2013, the number of passengers has increased from 12.0 million to 21.3 million (+77%) with 2.0% growth achieved in 2013 [1]. North America's share of the global cruise market has moved to 55.5% in 2013. At the same time Europe's share has risen from 22.5% in 2003 to 30.0% in 2013, while the share of the rest of the World rose from 9.0% to 14.5% over the 10-year period. Common destinations include the Caribbean, the Mediterranean, Europe, and Alaska [1]. The United Nations World Tourism Organization (UNWTO) reports that 5% of global tourists arrived at their destination by water, cruise and ferry in 2013 [2,3].

The increased number of people travelling by ship and the increases in itineraries may expose travellers to infectious diseases, such as gastrointestinal and respiratory infections. Cruise ship passengers and crews are also at risk for new patterns of old diseases or newly recognized causes of diseases [4]. During a cruise, passengers and crew from many countries intermingle for long periods in semi-enclosed compartments. Activities on board such as dining and entertainment increase the possibility of contact between passengers and crew. The average cruise lasts 6–7 days, well within the period for incubation and transmission of many infectious diseases. After disembarkation travellers may spread acquired infections further in their communities [3].

Gastrointestinal illness (GI) is common in travellers; one study of package holiday tourists reported travellers' diarrhoea in 24% of travellers questioned [5]. The risk of contracting diarrhoea in those travelling from high to low income countries is even higher [6–8]. Norovirus outbreaks can occur in a variety of settings, in particular in those with close living quarters, including cruise ships [9–11]. Norovirus-associated GI can be especially challenging to control on cruise ships due to the shared living and dining areas, rapid turnover of passengers, and the potential to bring norovirus on board [12–14]. The majority of diarrhoeal disease outbreaks investigated by the Centers for Disease Control and Prevention (CDC) Vessel Sanitation Program (VSP) with a confirmed etiology were caused by norovirus [15].

Acute respiratory infections (ARI) and influenza like illness (ILI) can occur all year round among cruise ship passengers and crew aboard ships. Outbreaks may occur as a result of the importation of influenza by embarking passengers and crew [3,16–23]. Elderly travellers and other

persons with underlying health problems are at increased risk for complications of influenza virus infection [17].

The aim of this study was to estimate the incidence of and describe the spectrum of GI and respiratory infections on cruise Ship A, in passengers and crew members, as well as response management in order to develop strategies for preventive and control measures.

2. Material and methods

The study was carried out from January 2011 to December 2013, on cruise Ship A. The port of origin was a European port depending on the cruise itinerary. The study group included patients, passengers and crew members, who presented with symptoms suggestive of ARI, ILI and GI. Passengers and crew of Ship A were advised prior to their trip about preventive measures of respiratory and gastrointestinal infections and influenza vaccination. Definition criteria for ARI included any symptom of acute respiratory infection (e.g. rhinorrhoea, sore throat, cough, dyspnoea) with no fever, and for ILI cough or sore throat and fever (≥ 37.8 °C) [24]. In case of ILI suspicion, Rapid Influenza (A and B) Detection Test (RIDT) was performed with oropharyngeal or rhinopharyngeal swab. The results of the tests performed for ARI and ILI (e.g. rapid tests for Streptococcus, Influenza A and B) were described as a. test not done (ND), b. positive result (P) and c. negative result (N). Definition criteria for GI included a) diarrhoea (3 loose or watery bowel motions over 24 h), or b) vomiting and one more symptom, such as abdominal cramps, or myalgia, or headache, or fever ≥ 37.8 °C, associated with one or more loose or watery bowel motion over 24 h and report to the medical staff or captain by the passenger or crew member [15]. The results of the tests performed for GI (e.g. rapid tests for Norovirus) were described as a. test not done (ND), b. positive result (P) and c. negative result (N).

The following data were collected prospectively, using one standardized form per patient: demographic data, travel characteristics such as date of departure, season (according to European seasons), countries of itinerary and duration of the cruise, past medical and immunization history, medication, allergies, smoking history and history of alcohol consumption. In addition, the questionnaire included information about symptoms and signs such as temperature, rhinorrhoea, cough, dyspnoea, sore throat, headache, myalgia, vomiting, and diarrhoea, clinical findings, rapid tests performed (e.g. influenza A/B, Streptococcus, Norovirus, Salmonella, Shigella etc), other tests such as Complete Blood Count (CBC), Liver Function Tests (LFTs), electrolytes, creatinine and imaging such as Upper

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