

# Passenger accidents and injuries reported during 3 years on a cruise ship

Eilif Dahl

Institute of Medicine, University of Bergen, and the Norwegian Centre for Maritime Medicine,  
Department of Occupational Medicine, Haukeland University Hospital, Helse Bergen HF, Bergen, Norway

## ABSTRACT

**Background.** The objective was to register and analyze data from all passenger injuries reported to the medical centre of a cruise ship with a median passenger load of 719 per day during a three-year period, and to determine high risk areas, equipment, and behaviour.

**Methods.** All reported passenger injuries were registered at first visit. An injury was “serious” if it led to hospitalization ashore or if full recovery was not expected within two weeks.

**Results.** During 3 years, 663 injuries (62.7% women) were reported aboard; 12.5% were classified as serious. The victims’ median age was 72 (range: 1–97) years. The incidence rate was 0.8 injuries per 1000 passenger-days. Most victims (65.3%) suffered injuries aboard, 3.6% on tenders, and 31.1% ashore. The most common accident locations aboard were cabins (20.1%) and bathrooms (13.4), and ashore, streets (29.6%) and buses (16.1%). Slips/trips/falls caused 44.8% of injuries aboard and 69.4% ashore ( $p < 0.001$ ). The most frequently injured body part was the lower extremity (43.0%), and open wounds the most common injury type (41.6%). More wounds and fractures/dislocations occurred ashore than aboard ( $p < 0.05$ ). Only 2% were hospitalized in port, while 5% were referred to specialists in local ports and returned to the ship. There were no helicopter evacuations or ship diversions.

**Conclusions.** Passenger injuries contribute considerably to the workload of the medical team aboard. A well-equipped, competent medical staff will effectively treat most injuries aboard and thus reduce the number of costly and inconvenient helicopter evacuations, ship diversions, port referrals, and medical disembarkations.

## INTRODUCTION

The cruise industry has expanded greatly in recent decades, and more than 12 million North Americans went on cruises in 2006 [1]. The cruise companies are concerned about passenger and crew injuries and accurately register data from all injuries occurring during each cruise to detect patterns to prevent future accidents. The accident reports comprise all injuries registered at the medical centre aboard.

Few detailed studies on passenger injuries on cruise ships have been published, and they comprise only series covering periods from a few months [2–6] to one year [7].

The aim of the present study was to register and analyze data from all passenger injuries reported to the medical centre of a medium-sized cruise ship during a three-year period to identify high risk areas, equipment, and behaviour.

## MATERIALS AND METHODS

### SHIP, ITINERARY, AND MEDICAL STAFF

The ship is a medium-sized, modern luxury cruise ship of Bahamian registry with a capacity of more than 1000 passenger and 650 crew members. During the 3-year study

□ Prof. Eilif Dahl, MD, MHA, PhD, Division for Liver, Gastrointestinal, and Paediatric Surgery at Rikshospitalet, Oslo University Hospital, 0027 Oslo, Norway.  
Tel: (+47) 22 56 23 24; fax: (+47) 22 56 31 12; cell phone: (+47) 959 21 759; e-mail: eilifdahl@hotmail.com

The author has worked part time for a number of cruise companies as an independent maritime medical consultant and as a ship’s doctor. He has not received any financial support or funding of any kind for this study.

period it cruised worldwide, including transatlantic and transpacific crossings. There were two distinctly different patient groups onboard: The vacationing passengers and the working crew. Crew accidents on the same ship during the same 3-year period have been published previously [8].

The medical centre, staffed by one physician and two nurses from Scandinavia, was equipped for most simple diagnostic and therapeutic procedures. One nurse was always on-call. The doctor had separate office hours for passengers and crew twice every day and was on 24-hour call for emergencies at sea. Medical service for passenger injuries was free of charge if they occurred on the ship, during tender transport to and from the ship at anchor, within the perimeter of the ports (on piers and in terminals), and during shore excursions arranged through the ship. There was a service charge for treatment of passenger injuries sustained while the passenger was ashore during **private** tours or arrangements.

Eight different Scandinavian physicians, all with previous shipboard experience, worked aboard from 2 to 22 cruises each during the study period.

## DEFINITIONS

All persons aboard were considered **“passengers”**, except **“crew members”** and **“contractors”**. (A **“crew member”** is a person who has been subjected to standardized pre-employment examinations and has been assigned an official crew number, and the term **“crew”** comprises all officers, staff, and ratings working on board. A **“contractor”** is a worker occasionally hired to do short-term maintenance or installations aboard [8].)

An injury was classified as **“serious”** if life-threatening without emergency treatment, if it caused the victim to leave the ship for hospitalization in a local port or for further specialized medical attention at home (equivalent to medical sign-off of a crew member), or if full recovery was not achieved or expected within two weeks of the accident. (The two-week limit was chosen because an average cruise lasted about that long). All other injuries were considered **“minor”** (“non-serious”).

## PASSENGER DEMOGRAPHICS

Passenger demographic data were collected from the official lists of the cruise line. Sex and age distribution was determined from the passenger lists of 4 long cruises comprising 1,193 different passengers: 51% were women and 49% men (a previously published 106-day world cruise from January to May 2004) [5]. The women’s median age was 69 years and 50% were between 59 and 75 years old. The men’s median age was 68 years and 50% were between 51 and 75 years old. Most passengers were North-American (71%), followed by Japanese (9%).

## DATA COLLECTION

Accident data were registered continuously for 3 years (1095 days) – from July 2003 to August 2006 – comprising 85 cruises lasting 6 to 30 (median: 12) days. The number of passengers aboard varied between 403 and 1035 depending on the type of cruise and the number of participants on overland tours.

The study was based on the ship’s accident report system: Every accident or injury occurring on the ship, during tender transport to and from the ship at anchor, within the perimeter of the ports (on piers and in terminals), and during shore excursions arranged through the ship and involving a passenger that resulted in a consultation on board, regardless how slight, was registered by the ship’s doctor on a standard form. Passenger injuries sustained during private tours or arrangements ashore were only registered if they resulted in a port hospitalization or a specialist referral from the ship’s doctor to a specialist in a local port or at home. Since the number of minor injuries occurring ashore during private arrangements was not reported, the total number of injuries treated aboard will be even higher than stated, and the indicated proportion between the serious and minor injuries aboard and ashore will be somewhat different.

During the first visit the following data were registered: date of accident; the patient’s sex, age, and nationality; location of accident (on board, ashore or on a tender or lifeboat); equipment involved; cause of injury; type of injury (main diagnosis); injured body region(s); X-rays taken (yes/no); and main type of treatment. Only the most serious injury of each patient (plus its treatment) was included in the statistics. At follow-up visits, information was added about the number of days until (expected) healing or full recovery; referral to specialist services (specified) in port and/or at home after leaving the ship; medical evacuation; and hospitalization in port. The accident reports were used systematically for on board accident investigations, future accident prevention and quality assurance, and the above data were forwarded after each cruise to the company’s medical consultant to be entered into an anonymous database for statistical evaluation. The study was exempt from institutional review.

## STATISTICS

The results were expressed as median and full range. Yates-corrected chi-square test was used for comparison of frequency distribution. Differences were considered significant when  $p < 0.05$ .

## RESULTS

During the period of 3 years (1095 days), 663 accidents, 416 in women (62.7%) and 247 in men (37.3%), were reported. The average number of passengers aboard during

**Table 1. Accident locations aboard.** Number (and percentage) of passenger accidents that happened on the ship and were reported to the medical centre on a cruise ship during a 3-year period, according to accident location and sex of the victim

Accident location aboard	Number of women (%)	Number of men (%)	All injuries (%)
Cabin incl. balcony	54 (19.9)	33 (20.5)	<b>87 (20.1)</b>
Bathroom***)	40 (14.7)	18 (11.2)	<b>58 (13.4)</b>
Outdoor sports area***)	10 (3.7)	29 (18.0)	<b>39 (9.0)</b>
Open deck	26 (9.6)	13 (8.1)	<b>39 (9.0)</b>
Lounges & bars	27 (9.9)	8 (5.0)	<b>35 (8.1)</b>
Spa/gym**)	30 (11.0)	4 (2.5)	<b>34 (7.9)</b>
Restaurants	18 (6.6)	15 (9.3)	<b>33 (7.6)</b>
Corridors	20 (7.3)	8 (5.0)	<b>28 (6.5)</b>
Stairs	16 (5.9)	10 (6.2)	<b>26 (6.0)</b>
Pool	7 (2.6)	6 (3.7)	<b>13 (3.0)</b>
Gangway	5 (1.8)	6 (3.7)	<b>11 (2.5)</b>
Shops	6 (2.2)	2 (1.3)	<b>8 (1.8)</b>
Children's playground	2 (0.7)	4 (2.5)	<b>6 (1.4)</b>
Theatre	4 (1.5)	2 (1.2)	<b>6 (1.4)</b>
Laundry	4 (1.5)	1 (0.6)	<b>5 (1.1)</b>
Elevators	2 (0.7)	1 (0.6)	<b>3 (0.7)</b>
Casino	1 (0.4)	1 (0.6)	<b>2 (0.5)</b>
<b>Sum</b>	<b>272 (100)</b>	<b>161 (100)</b>	<b>433 (100)</b>

Women versus men: \*\*)  $p < 0.01$ ; \*\*\*)  $p < 0.001$

the time period was 719 per day, yielding an incidence rate of 0.8 per 1000 passenger-days – and a passenger risk of sustaining an injury at about 1 per 1,200 cruising days. Their median age at the time of accident was 72 years (women: median 72 and range 1–97 years; men: median 71 and range 1–91 years). Twenty-five persons (17 women) reported 2 accidents, 4 (2 women) reported 3, while 1 woman and 1 man reported 4 accidents.

Eighty-three injuries (12.5%) were classified as **“serious”**. The median age of persons with serious and minor injuries was similar (69 versus 72 years), and the rate of serious accidents was not significantly higher in women than in men (13.9% versus 10.1%; ns).

X-rays were taken on board in 261 (39.4%) cases; in 44.5% of the women and 30.8% of the men. X-rays were taken of 66 (79.5%) of the 83 persons with serious injuries.

The number of accidents varied between 89 and 128 per 6 months with no clear pattern of increase or decrease with time during the 3-year period. When comparing accidents aboard and ashore, there seemed to be a higher proportion of injuries aboard during the first 6 months than the last 6-months of the study (76% versus 67%), but the decrease was not statistically significant.

## ACCIDENT LOCATIONS ON AND OFF THE SHIP (TABLES 1, 2)

Most (65.3%) suffered injuries aboard, 3.6% on a moving lifeboat/tender while 31.1% were caused by accidents ashore. Table 1 shows the location of all accidents aboard, according to sex. The most frequent accident location aboard was the victim's cabin (20.1%), followed by the bathroom

(13.4%), outdoor sports areas (9%), and open decks (9%). More women than men were injured in the bathroom ( $p < 0.001$ ) and in the spa ( $p < 0.01$ ), while more men than women were hurt in outdoor sports areas aboard ( $p < 0.001$ ). Most sports injuries aboard happened on the paddle tennis court (10 women, 27 men).

Table 2 displays the locations of reported passenger accidents that occurred while the victims were off the vessel, according to sex. The most frequent accident location off the ship was on the street (29.6%), followed by buses (16.1%), a pier (14.8%), and the ship's tenders (10.4). There was no significant sex difference regarding accident locations off the ship.

Thirteen registered accidents ashore occurred during private tours; 11 (85%) of these injuries were classified as “serious”.

## ACCIDENT CAUSES/PRECIPITATING EVENTS (TABLE 3)

A long list of items were claimed to have triggered accidents. Only four (doors, steps, sills, and chairs) were involved in more than ten accidents each, but none of them caused significantly more frequent injuries in women than in men.

Trips, slips, and falls accounted for more than half of all injuries, while more than one forth resulted from blunt hits (hitting or being hit) (Table 3). There was a higher percentage of trips, slips, and falls among accidents ashore than aboard ( $p < 0.001$ ), while a higher percentage of pull injuries took place aboard ( $p < 0.5$ ). There were relatively more accidents caused by pulls ( $p < 0.05$ ) and by foreign bodies ( $p < 0.01$ ) among the men than the women. Most outdoor

**Table 2. Accident locations off the ship.** Number (and percentage) of passenger accidents that happened off the ship (ashore and during tender transport) and were reported to the medical centre on a cruise ship during a 3-year period, according to accident location and sex of the victim. Thirteen of the accidents happened during private tour arrangements, the remainder during transport to or from the ship at anchor (tender/lifeboat), within the port perimeter (terminal/pier), or during shore excursions arranged through the ship

Accident location off the ship	Number of women (%)	Number of men (%)	All injuries (%)
Street, unspecified	45 (31.4)	23 (26.4)	<b>68 (29.6)</b>
Bus	25 (17.5)	12 (13.8)	<b>37 (16.1)</b>
Terminal/pier	21 (14.7)	13 (14.9)	<b>34 (14.8)</b>
Tender/lifeboat*)	13 (9.1)	11 (12.6)	<b>24 (10.4)</b>
Stairs, unspecified	8 (5.6)	4 (4.6)	<b>12 (5.2)</b>
Museum/church	5 (3.5)	5 (5.8)	<b>10 (4.3)</b>
Hotel/restaurant/shop	5 (3.5)	5 (5.8)	<b>10 (4.3)</b>
Beach	4 (2.8)	5 (5.8)	<b>9 (3.9)</b>
Nature excursion**)	4 (2.8)	5 (5.8)	<b>9 (3.9)</b>
Boat	5 (3.5)	3 (3.4)	<b>8 (3.5)</b>
Bike/motorbike	2 (1.4)	1 (1.1)	<b>3 (1.3)</b>
Bathroom	2 (1.4)	0	<b>2 (0.9)</b>
Unknown (on private tour)	4 (2.8)	0	<b>4 (1.8)</b>
<b>Sum</b>	<b>143 (100)</b>	<b>87 (100)</b>	<b>230 (100)</b>

\*) Transport to and from the ship at anchor

\*\*\*) Includes slipping on grass (n = 2), face hit by golf ball, safari, walking in snow, rafting, skiing in sand, tripping on lava rock, falling off donkey

**Table 3. Precipitating event/type of accident.** Number (and percentage) of all passenger injuries that happened aboard, on the tenders, and ashore and were reported to the medical centre on a cruise ship during a 3-year period, according to accident location and precipitating event/type of accident

Precipitating event	Number of accidents aboard (%)	Number of accidents ashore (%)	Number of accidents on tenders (%)	All injuries (%)
Slip/trip/fall***)	194 (44.8)	143 (69.4)	9 (37.5)	<b>346 (52.2)</b>
Hit (active & passive)	127 (29.3)	48 (23.3)	13 (54.1)	<b>188 (28.3)</b>
Pull*)	25 (5.7)	3 (1.5)	1 (4.2)	<b>29 (4.4)</b>
Cut	16 (3.7)	6 (2.9)	0	<b>22 (3.3)</b>
Crush	19 (4.4)	2 (0.9)	0	<b>21 (3.2)</b>
Foreign body	17 (3.9)	0	0	<b>17 (2.6)</b>
Insect bites	8 (1.9)	1 (0.5)	0	<b>9 (1.3)</b>
Fluid (hot & cold)	8 (1.9)	0	0	<b>8 (1.2)</b>
Massage	5 (1.2)	0	0	<b>5 (0.8)</b>
Other	14 (3.2)	3 (1.5)	1 (4.2)	<b>18 (2.7)</b>
<b>Sum</b>	<b>433 (100)</b>	<b>206 (100)</b>	<b>24 (100)</b>	<b>663 (100)</b>

Aboard versus ashore: \*) p < 0.05; \*\*\*) p < 0.001

sports injuries happened during paddle tennis (27 men, 10 women). Five passengers (one man) reported injuries after a massage aboard.

Eleven burns were caused by hot instruments (flat iron, curling iron), hot beverages and chemicals; all but one burn happened aboard (Table 4).

Alcohol intoxication was only noted as a contributing factor in 7 injuries (4 women), 2 of them (1 woman) involving personal violence (fights).

Severe weather conditions (strong winds, rough seas) were mentioned in 33 (20 women) cases. Twenty-two weather-related accidents happened aboard, whereas eleven were off the vessel (six during tender rides, two in small tour crafts, and three on the pier where two women were hit by flying umbrellas and one was “just blown over”).

#### TYPE OF INJURY (TABLE 4)

The most frequent type of injury was an open wound, which together with contusion accounted for 70% of all injuries (Table 4). More men than women had open wounds (48% versus 38%; p < 0.05), while more women than men had contusions (32% versus 22%; p < 0.01), fractures, and dislocations (12% versus 7%; p < 0.05). Wounds were more common ashore than aboard (47.1% versus 38.1%; p < 0.05), as were fractures and dislocations (16% versus 6.9%; p < 0.01).

#### MAIN INJURED BODY REGIONS (TABLE 5)

The lower extremity was the most frequently injured region (43.0%), followed by the upper extremity (33.2%) and the head and neck (15.2%). Twenty-seven per cent of the lower extremity injuries involved the calf, followed by the

**Table 4. Type of injury.** Number (and percentage) of all passenger accidents that happened aboard, on the tenders, and ashore and were reported to the medical centre on a cruise ship during a 3-year period, according to accident location and type of injury

Precipitating event	Number of accidents aboard (%)	Number of accidents ashore (%)	Number of accidents on tenders (%)	All injuries (%)
Wounds*)	165 (38.1)	97 (47.1)	14 (58.3)	<b>276 (41.6)</b>
Contusions	131 (30.3)	49 (23.8)	6 (25.0)	<b>186 (28.1)</b>
Sprains + strains	64 (14.8)	24 (11.6)	3 (12.5)	<b>91 (13.7)</b>
Fractures + dislocations**)	30 (6.9)	33 (16.0)	1 (4.2)	<b>64 (9.6)</b>
Insect bites + allergic reactions	14 (3.2)	1 (0.5)	0	<b>15 (2.3)</b>
Foreign bodies	13 (3.0)	1 (0.5)	0	<b>14 (2.1)</b>
Burns (thermal + chemical)	10 (2.3)	1 (0.5)	0	<b>11 (1.7)</b>
Other a)	6 (1.4)	0	0	<b>6 (0.9)</b>
<b>Sum</b>	<b>433 (100)</b>	<b>206 (100)</b>	<b>24 (100)</b>	<b>663 (100)</b>

Including 1 drowning

Aboard versus ashore: \*)  $p < 0.05$ ; \*\*)  $p < 0.01$ **Table 5. Main injured body region.** Number (and percentage) of all passenger accidents that happened aboard, on the tenders, and ashore and were reported to the medical centre on a cruise ship during a 3-year period, according to accident location and most seriously injured body region

Precipitating event	Number of accidents aboard (%)	Number of accidents ashore (%)	Number of accidents on tenders (%)	All injuries (%)
Lower extremity	175 (40.4)	97 (47.1)	13 (54.2)	<b>285 (43.0)</b>
Upper extremity	141 (32.6)	70 (34.0)	9 (37.5)	<b>220 (33.2)</b>
Head/neck/throat	69 (15.9)	30 (14.5)	2 (8.3)	<b>101 (15.2)</b>
Other body regions	48 (11.1)	9 (4.4)	0	<b>57 (8.6)</b>
<b>Sum</b>	<b>433 (100)</b>	<b>206 (100)</b>	<b>24 (100)</b>	<b>663 (100)</b>

knee (21%) and the ankle (19%). Only 21 accidents involved the hip and proximal thigh, but 11 of them caused “serious” injuries, of which 8 were fractures requiring surgery. Among the injuries of the upper extremity, the forearm was involved in 31%, followed by finger (20%) and hand (18%). Back injuries ( $n = 25$ ) represented less than 4% of all injuries, and only 3 were considered “serious”.

## TREATMENT

“ICE” (ice, compression, elevation) and wound closure were the most frequent primary treatments (25% each). In 131 passengers, open wounds were closed with sterile tape and/or tissue glue and in 37 sutures were used. Twelve fractures and dislocations were reduced on board. Twelve of fourteen foreign bodies were successfully removed in the ship’s medical centre, while obstructing food had to be removed ashore by oesophagoscopy, and a wayward dildo from the sigmoid by colonoscopy. The Heimlich manoeuvre was carried out successfully twice aboard.

## REFERRALS AFTER ACCIDENTS

Thirty-three passengers (5.0%; 20 women, 13 men) were referred to medical specialists in local ports and returned to the ship the same day: Orthopaedic surgeon (16), emergency physician (6), ophthalmologist (4), gastroenterologist (2),

radiologist (2), neurosurgeon (1), dentist (1), and chiropractor (1). Six women (0.9%) interrupted their cruise to go home to see a specialist. Another 64 passengers (9.7%; 37 women, 27 men) were referred to specialists at home after completing their cruise.

## EVACUATIONS AND HOSPITALIZATIONS IN PORT AND AFTER ACCIDENTS

Thirteen passengers (2.0%; 11 women, 2 men) were hospitalized in a local port: One went directly to intensive care, 4 were primarily treated in emergency rooms, and 8 went to orthopaedic wards. One patient was airlifted to another island shortly after admittance. Helicopter evacuations or ship deviations because of passenger injury were not needed during the 3-year period, but two women had emergency evacuations done by tenders to the nearest port. An elderly man disappeared at sea, an apparent suicide. Otherwise there were no known deaths resulting from injuries.

## DISCUSSION

There are no international or national demands regarding the reporting of passenger injuries on cruise ships. Injury reporting is not mandatory for passengers, as opposed to crew, but all cruise companies are very concerned about accident prevention, not least for legal reasons. They there-



fore encourage all passengers and crew to report any injury, regardless of how small, to the medical centre aboard for proper diagnostic work-up, treatment, and follow-up, as well as proper investigation of possible causes, for damage control, and prevention of similar accidents in future.

Most ships use the same reporting practices for crew and passenger injuries [8]. The cruise companies are accumulating a lot of accident documentation, but most of this information is for internal company use only. Thus, public knowledge about the extent of passenger injuries on cruise ships is rather limited.

A study comprising 161 cruises between 1993 and 1998 showed a significantly higher consultation rate in German than in American passengers; a discrepancy that was allegedly caused by different insurance coverage [9]. To ensure that all accidents connected with the presently studied ship were reported, medical consultations for all injuries were treated free of charge, except those occurring during private arrangements ashore. Furthermore, there was easy access to the medical centre aboard 24 hours a day for injuries and other emergencies. Thus the present study quite accurately comprises all accidents that happened aboard, on tenders, and on local piers and terminals, as well as during shore excursions arranged through the ship. Accidents that happened ashore to passengers while on their own were not systematically reported, and only those are included that were serious enough to require more than simple treatment aboard, such as referrals by the ship's doctor to specialists or hospitals in port, or for immediate follow-up when the patient returned home. Accidents ashore are therefore underreported, and the proportion of "serious" versus "minor" injuries aboard and ashore is somewhat skewed. It is a limitation of the present study that it, therefore, underestimates the workload of the medical staff aboard caused by passenger accidents. Still, the study shows that more than one injury report was made every two days, and time-consuming X-ray studies were performed in connection with about 40% of them. As a previous short-term series [5] showed that every passenger injury leads to an average of 4.4 consultations, we can conclude that passenger injuries contribute considerably to the workload of the medical staff aboard.

The overall incidence rate of injuries per 1000 passenger-days was 0.8; the same as in a one-year study of four ships cruising from the USA [7], but much lower than that (3.2) on a much smaller ship doing summer cruises in Antarctica [6]. Ship size and rough seas is likely to have contributed to the difference, as motion sickness was by far the most common reason to see the polar ship's physician. On the other hand, the passenger injury rate of the present study was noticeably higher than the incidence rate of the crew of the same ship during the same time period (0.5

[8], which might reflect the crew's younger age and higher degree of accident prevention awareness.

Most of the passenger injuries were minor, in agreement with others [6, 10]. Only 12% were considered "serious injuries", but what "serious" means depends on its definition. In the present study, "not healed within seven days" was rejected to avoid including simple wounds, as they were not considered healed until the sutures had been removed – routinely after 10–12 days. "Not healed within two weeks" was chosen because the average cruise was approximately that long, and the passengers were lost to follow-up after disembarking. And therefore "not healed within 30 days after injury", a definition often used in medical reports and insurance statistics, would be too speculative for our series. However, the important point is that all accidents are potentially dangerous, and by continuously reporting, evaluating, and acting on all accidents happening aboard, more serious injuries may be prevented.

The most frequent accident locations were "at home away from home": One third happened in the passengers' own cabins and bathrooms. This is in contrast to another study in which 22% of the accidents happened on deck and only 12% in cabins, an indication of where more time is spent on shorter cruises [7]. Other explanations for frequent accidents in the cabins may be narrow space, lower attention of the passengers "at home", and lack of warning and assistance by ship's personnel inside cabins.

Despite an almost equal proportion of male and female passengers, there were more female than male accident victims, in agreement with other cruise studies [6, 7]. But the rate of serious injuries was not higher in women than in men, although more women than men had fractures. In accordance with "conventional wisdom", more women than men were injured in the bathroom and the spa, while men were more frequently injured in the outdoor sports areas aboard. Paddle tennis was the most physically challenging sports activity on the ship, and not surprisingly most sports related injuries occurred at the paddle tennis court.

Slips, trips, and falls top the list of international seafarers' accidents [11]. A large questionnaire study found that 43% of crew accidents on merchant ships were related to slips, trips, and falls [12]. That is a figure more than twice as high as in our study on crew injuries [8], but it corresponds well with our present findings in passengers: 45% of the injuries on board followed slips, trips, and falls. The "vast majority" of the passenger injuries on Antarctic cruises were due to falls aboard the ship [6]. The precipitating event in 60% of injured travellers hospitalized in Alaska was a slip, trip, or fall, and most of them were female cruise passengers [13].

Curiously, in the present study the percentage of passenger injuries related to slips, trips, and falls was even higher (69%) for accidents ashore, where streets and buses were

the most common accident locations. Many falls, both aboard **and** on land, suggest that the various medical conditions of the elderly passengers contribute to their unsteadiness [4]; many use medication that has vertigo listed as a common adverse effect, and others have found that lack of glasses and unsuitable shoes caused accidents [10].

Although the ship had many repeat passengers, reflected in the fact that some reported several injuries months and years apart, most are only on board for a short time and cannot, unlike the seafarers, be properly educated about preventive measures and do not routinely use anti-slip footwear. By using the injury reports, the ship management has therefore tried to localize and eliminate accident causes aboard. But despite continuous efforts to do just that, no significant accident decrease was noted during the 3-year study period. However, there was a trend toward fewer accidents on the ship and more accidents ashore toward the end of the study. And some specific improvements could be noted; for example, one particular accident-haunted lounge disappeared from the reports when two poorly lighted steps were replaced by a gently sloping wheelchair ramp.

It is "internationally agreed" that the upper extremities, particularly the hands, are the most frequently injured body parts in seafarers [11]. This is in agreement with our crew study in which finger and hands were the most frequently injured regions [8]. However, as found by others [10], the most frequently injured body part among the passengers in the present study was the lower extremity, particularly the shin, while the forearm was the most frequently hurt area of the upper extremity. These findings may reflect a difference between the mostly occupational accidents of the crew and the passengers' injuries of leisure. Shin and forearm injuries were seldom serious. Forearm injuries often represent active or passive protective action, and in several cases bruises and skin tears were caused by crew trying to prevent more serious accidents while helping unsteady passengers on to or off gangways, piers, and lurching tenders.

As in the crew [8], wounds were the most frequent type of injury in cruise passengers. But unlike the seafarers, whose wounds were mainly on their hands and fingers and caused by sharp instruments [8], most passenger wounds were superficial atrophic skin lacerations on forearms and shins, which stemmed from blunt objects, and could be closed by strips of adhesive tape rather than sutures.

Heavy seas is claimed to be the predominant cause in 13% of all accidents among seafarers [11]. In our study, sea movements were mentioned in 25% of the tender accidents, while bad weather was noted in only 5% of the passenger injuries occurring aboard, possibly underreported because ship movement may have been regarded as such an obvious part of ship life that weather conditions were only reported when directly causing the accident.

Fractures, dislocations, and back conditions are injury types that frequently cause medical disembarkation [4, 13, 14]. In the present study a number of victims of such injuries were able to remain on board. The availability of competent medical personnel and proper equipment make it possible to treat conditions on board that otherwise would have to be dealt with ashore [14], and in many ways a cruise ship with highly attentive and service-minded hotel and medical staff is an ideal place for recuperation [5].

Injuries because of fights aboard were extremely rare and, as noted by others [10], alcohol intoxication was only mentioned in a few injury cases despite the fact that alcohol is readily available and is an integrated part of the cruise experience.

Almost one third of the reported injuries happened ashore during activities somehow connected with the ship, and in addition there were an unknown number of unreported minor passenger injuries during private arrangements off the vessel. In contrast, only 11% of passengers on shorter cruises had injuries ashore [7].

Passengers on their own ashore or on private tours are totally responsible for the medical expenses resulting from injuries sustained ashore. Companies in local ports that cooperate with the ship to arrange shore excursions for passengers must have insurance cover for their tours. However, such insurance may only cover treatment in local hospitals, which may not be of a standard expected by typical cruise passengers [7, 14]. Whenever a passenger has to disembark for medical reasons before cruise completion, the ship must move on, and the ship's local port agent has to take over and make all the practical arrangements for the patient and their travelling companions. During the study period only one patient was hospitalized ashore, and costly ship deviations and helicopter evacuations were not necessary. Only once did the ship stop outside an unscheduled port to hospitalize a patient by tender, and one other time the ship's departure was delayed shortly because tender transport had to be arranged for a patient.

However, mass casualties occurring on a small island can easily overwhelm local resources, and the cruise companies must be prepared to become directly involved and handle such crises. Recently, 16 passengers from another cruise line were hospitalized after a bus accident during a shore excursion on a small Caribbean island. Unconvinced by the local facilities, the cruise company promptly arranged for successful emergency evacuation of all involved persons to Miami within 24 hours, utilizing three air ambulances and a charter plane, thus setting a standard for future actions [15].

Still, when booking a cruise, passengers are well advised to buy private travel health insurance to cover both medical costs and repatriation [4, 13].

In conclusion, passenger accidents contribute considerably to the workload of the medical staff on cruise ships. The typical victim is an elderly woman who falls in her cabin aboard and sustains a wound on her lower leg, followed by closure of the wound with sterile tape and an uneventful recovery during the cruise. About one third of reported injuries happen off the ship, most frequently from slips and trips on streets and buses. A well-equipped, competent medical staff will effectively treat most passenger injuries aboard and thus reduce referrals to medical specialists ashore, helicopter evacuations, ship diversions, and medical disembarkation. Our findings may be of value for the prevention of shipboard accidents, for the planning of new ships, for medical professionals considering cruise ship work, and as background for further discussions on international guidelines for cruise medicine.

## REFERENCES

1. Cruise Lines International Association. 2008 CLIA Cruise Market Overview. Statistical cruise industry data through 2007. [www.cruising.org/press/overview2008](http://www.cruising.org/press/overview2008) (accessed 2008; 11–05).
2. Dahl E. Almenpraksis til sjøs (General practice at sea). *Tidsskr Nor Laegefor* 1979; 99: 327–330.
3. DiGiovanna T, Rosen T, Forsett R, Sivertson K, Kelen GD. Shipboard medicine: A new niche for emergency medicine. *Ann Emerg Med* 1992; 21: 1476–1479.
4. Dahl E. Anatomy of a world cruise. *J Travel Med* 1999; 6: 168–171.
5. Dahl E. Medical practice during a world cruise: a descriptive epidemiological study of injury and illness among passengers and crew. *Internat Marit Health* 2005; 56, 1–4: 115–128.
6. Bledsoe GH, Brill JD, Zak D, Guohua L. Injury and illness aboard an Antarctic cruise ship. *Wilderness Environ Med* 2007; 18: 36–40.
7. Peake DE, Gray CL, Ludwig MR, Hill CD. Descriptive Epidemiology of injuries and illness among cruise ship passengers. *Ann Emerg Med* 1999; 33: 67–72.
8. Dahl E, Ulven A, Horneland AM. Crew accidents reported during 3 years on a cruise ship. *Internat Marit Health* 2008; 59:19–33.
9. Tomaszewski R, Nahorski WL. Interpopulation study of medical attendance aboard a cruise ship. *Internat Marit Health* 2008; 59: 61–68.
10. Jaremin BM. Traumas and accidents on a passenger vessel. The 4<sup>th</sup> International Symposium on Maritime Health, Oslo, Norway, 1994. Abstract 32.
11. Hudson D, Nilsen P, Dahl E, Mode N, Ekman R. Factors associated with injuries occurring aboard vessels in Alaska: differences between residents and nonresidents. *J Travel Med* 2006; 13: 67–72.
12. Prina LD, Orazi UN, Weber RE. Evaluation of emergency air evacuations of critically ill patients from cruise ships. *J Travel Med* 2001; 8: 285–292.
13. Caumanns C. Occupational accidents and injury patterns in merchant seamen. *Internat Marit Health* 2001; 52: 39–43.
14. Jensen OC, Sørensen JFL, Canals ML, Hu Y, Nikolic N, Mozer AA. Non-fatal occupational injuries related to slips, trips and falls in seafaring. *Am J Ind Med* 2005; 47: 161–171.
15. Dahl E. Cruise medicine on land (The cruise connection). *International Maritime Health Association Newsletter April 2009*; 9: 16–17 ([www.imha.net](http://www.imha.net)).