Wien Klin Wochenschr (2009) 121: 137–143
DOI 10.1007/s00508-008-1135-x
Printed in Austria

Wiener klinische Wochenschrift
The Middle European Journal of Medicine

An outbreak of norovirus gastroenteritis in an Austrian hospital, winter 2006–2007

Rainer Fretz[1,2], Daniela Schmid[1], Sandra Jelovcan[1], Rosi Tschertou[3], Elke Krassnitzer[3], Michael Schirmer[3], Markus Hell[4], Franz Allerberger[1]

[1] Austrian Agency for Health and Food Safety (AGES), Vienna, Austria
[2] European Programme for Intervention Epidemiology Training (EPIET), Stockholm, Sweden
[3] General Hospital of the Elisabethinen, Klagenfurt, Austria
[4] Salzburger Landeskliniken, Salzburg, Austria

Norovirus-Ausbruch in einem österreichischen Krankenhaus, Winter 2006–2007

Zusammenfassung. *Hintergrund:* Noroviren können von Mensch-zu-Mensch direkt fäkal-oral oder aerosolassoziiert sowie indirekt über Vehikel wie Lebensmittel oder kontaminierte Oberflächen übertragen werden. In der Umwelt kann das Virus einige Tage lang überleben und somit zu prolongierten Ausbrüchen führen. Beschrieben wird hier ein durch Noroviren in der Zeit von Dezember 2006 bis Februar 2007 verursachter Ausbruch in einem Österreichischen Krankenhaus der Regelversorgung.

Methoden: Durchgeführt wurde eine deskriptiv-epidemiologische Ausbruchsuntersuchung. Die Gesamtkosten, verursacht durch den Einnahmenausfall aufgrund von Abteilungssperrungen, durch die Krankheitsausfälle der Mitarbeiter und durch die zusätzlichen Reinigungskosten, wurden ermittelt. Patientenstuhlproben auf Norovirus-RNS getestet.

Resultate: Im Gesamten konnten im betroffenen Krankenhaus 90 Personen mit Symptomen einer Noroviren-Gastroenetritis mit einem Erkrankungsbeginn zwischen 1. Dezember 2006 und 13. Februar 2007 identifiziert werden. 56 Patienten und 14 Krankenhausmitarbeiter erfüllten die Definition des Krankenhaus-Ausbruchsfalles (77,8%). Insgesamt waren 20 erkrankte Personen (22,2%) nicht Teil des Ausbruchs; 13 Personen akquirierten ihre Norovirus-Infektion in der Community und 7 Personen mit einer klinisch-suspekten Noroviren-Gastroenetritis waren mit einer krankenhaus-externen gesundheitsversorgender Einrichtung assoziiert. Die Abteilung der Fachrichtung Innere Medizin war mit 46 Patienten-Fällen und 6 Mitarbeiter-Fällen die am meisten betroffene Abteilung. Die nosokomiale Befallsrate betrug 5,9% (56/947) für die zwischen dem 1. Dezember 2006 und dem 13. Februar 2007 hospitalisierten Patienten. Die Befallsrate für die in der gleichen Zeitperiode beschäftigten 120 Krankenhausmitarbeiter betrug 11,7% (14/120). Nachgewiesen wurde ein Norovirus GGII.4 Variante 2006b (weitläufig zirkulierend in Europa in der Saison 2006/2007). Die kalkulierten Ausbruchsgesamtkosten für die Abteilung der Inneren Medizin beliefen sich auf € 80.138.

Schlussfolgerung: Die Beeinträchtigung der Patientenversorgung und die verursachten Ausbruchsgesamtkosten rechtfertigen die strikte Implementierung von adequaten und rechtzeitigen evidenzbasierten Ausbruchskontrollmaßnahmen.

Summary. *Background:* Norovirus is easily spread from person to person by the fecal-oral route and through aerosols or by vehicles such as contaminated food or water. The virus is able to survive in the environment for many days, which enables outbreaks to be prolonged. We describe a norovirus outbreak and its control measures in an Austrian secondary-level hospital during December 2006 – February 2007.

Methods: A descriptive-epidemiological investigation of the outbreak was undertaken. We also determined outbreak costs, including the estimated lost revenue associated with department closures and the cost of sick leave and cleaning expenses. Selected stool specimens were tested for norovirus RNA.

Results: In the hospital, 90 persons with symptoms and signs consistent with norovirus gastroenteritis with clinical onset between December 1, 2006 and February 13, 2007 were identified. Out of these, 56 patients and 14 persons among the hospital staff fulfilled the definition of an outbreak case (77.8%), and 20 cases (22.2%) were identified as non-outbreak cases including 13 community-acquired cases of norovirus gastroenteritis and 7 clinical-suspected cases of norovirus gastroenteritis associated with health care facilities other than the affected hospital. The Department of Internal Medicine was the mainly affected department (46 patient-cases and 6 staff-cases). Considering hospital patients, who have been hospitalised between December 1, 2006 and

Correspondence: Dr. Rainer Fretz, Agentur für Gesundheit und Ernährungssicherheit (AGES), Kompetenzzentrum Infektionsepidemiologie, Währingerstraße 25a, 1096 Wien, Austria,
E-mail: Rainer.Fretz@ages.at

February 13, 2007 as cohort at risk of nosocomial norovirus infection, the nosocomial hospital outbreak attack-rate was 5.9% (56/947). A total of 120 hospital staff members worked in the period from December 1 to February 13, which makes an attack-rate among the hospital staff of 11.7% (14/120). Norovirus strain GII.4 variant 2006b was detected, which has been circulating widely in Europe since 2006. The total cost of the outbreak for the Department of Internal Medicine was € 80,138.

Conclusions: The significant disruption of patient care and the cost of this single nosocomial outbreak support strict implementations of adequate and timely control measures based on evidence-based recommendations.

Key words: Norovirus, hospital, outbreak investigation, revenue loss.

Introduction

Circulation of norovirus within the general community is common and outbreaks occur frequently during the winter months ('winter vomiting') and often affect closed or semi-closed settings such as residential homes, nursing homes, staff accommodation blocks and hospitals [1, 2]. The onset of illness is usually rapid and there is no prodrome. Vomiting is the prominent symptom; diarrhea tends to be short-lived and less severe than with other causes of gastroenteritis. Norovirus infection affects people of all age groups, but the burden of illness is highest in the young and elderly, the incubation period is 15–48 h, and excretion of virus in feces begins a few hours before the onset of symptoms and can continue for up to 10 days [1, 3]. A recent study suggest even a longer period with a median of norovirus excretion of 28 days after inoculation (range 13–56 days) [4]. Norovirus is easily spread from person to person by the fecal-oral route, or through aerosols and by vehicles such as contaminated food or water [1]. The virus is able to survive in the environment for many days, which enables outbreaks to be prolonged [2, 5]. Nosocomial outbreaks of gastroenteritis are a major disruption to health services in many countries [6]. Attack rates may be very high, affecting more than 50% of ward patients and staff [2, 3]. When a norovirus outbreak is suspected it is strongly advised that control measures such as cohort isolation of infected hospital patients and banning ill medical staff from work are implemented immediately without waiting for virological confirmation [1, 7]. The nosocomial outbreaks of gastroenteritis published in the literature represent only the tip of the iceberg of all of the nosocomial outbreaks that occur, because many are not considered worthy of publication [5, 8]. This clearly does not reflect the true public health significance of nosocomial norovirus outbreaks considering that 40% of 1877 norovirus outbreaks in England and Wales 1992–2000 occurred in hospitals [9]. So far, we are aware of only one published hospital-associated norovirus outbreak in Austria [1]. We report on a norovirus outbreak affecting an Austrian hospital (hospital X) from December 1, 2006 until February 13, 2007. The hospital has 176 beds and provides secondary-level care. As the result of heavy media pressure and the continuous occurrence of new cases which clustered in time despite implementation of outbreak control measures, on February 6, 2007 the hospital mandated the Competence Centre for Infectious Disease Epidemiology at the Austrian Agency for Health and Food Safety (AGES) with the outbreak investigation.

Methods

The objectives of the descriptive-epidemiological investigation were to identify the characteristics of the hospital norovirus outbreak with regards to time, place and person, to identify reasons for such a prolonged course, to evaluate the implemented outbreak control measures, and to determine the outbreak costs.

Outbreak case definition

A confirmed outbreak case of hospital X was a (1) person hospitalised at least two days within the time period from December 1, 2006 to February 13, 2007 in hospital X or worked as hospital staff member in hospital X within that particular time period, (2) who fell sick with diarrhea or vomiting not before December 1, and who fell sick not earlier than 48 hours following admission to hospital X (this criteria was exclusive for the hospitalised patients), (3) who had a stool specimen tested negative for gastroenteritis causing bacteria and (4) who had a stool specimen tested positive for norovirus by RT-PCR.

A probable hospital outbreak case was a person who fulfilled criteria 1 and 2.

A person who was admitted to hospital X with symptoms and signs consistent with norovirus gastroenteritis (vomiting or diarrhoea and stool specimens negative for diarrhoea causing bacteria) or who showed these symptoms and signs within 48 hours following admission in the period from December 1, 2006 to February 13, 2007 was declared as a non-outbreak case which was either defined as a clinical-laboratory confirmed case of norovirus gastroenteritis or as a clinical-suspected case of norovirus gastroenteritis.

Assuming the persons hospitalised in hospital X in the time period from December 1, 2006 to February 13, 2007 as the cohort at risk of acquiring nosocomial norovirus gastroenteritis, the nosocomial attack rate was measured as the number of confirmed or probable outbreak cases of nosocomial norovirus gastroenteritis occurred in that particular time period divided by the number of the members of the cohort at risk. In the period from December 1, 2006 to February 13, 2007 a total of 947 persons were hospitalised. The attack rate among the hospital staff was measured as the number of confirmed or probable outbreak cases among the staff occurred in the particular time period divided by the number of hospital staff having worked in that period. In that particular time period 120 persons of the hospital staff worked.

Evaluation of outbreak control measures

All measures taken were preciously ascertained including date and location of implementation and assessed for appropriateness and justification by cross-checking against the evidence-based recommendations of the Austrian guidelines on the management of norovirus outbreaks in healthcare settings [10]. The control measures were documented in detail (mode of application of methods) by the hygiene team of the hospital X and the records were made available for cross-checking. Individual measures were compared with defined categories based on the checklist and were assessed with a score system

(3: full accordance; 2: wide accordance; 1: minimal accordance; 0: missing).

Microbiological investigation

Stool samples were examined for *Clostridium difficile* toxin, shigella, salmonella, campylobacter and enterohemorrhagic *Escherichia coli* as described elsewhere [11], and were tested for norovirus at the Institute of Medical and Chemical Laboratory Diagnostics at the General Hospital Klagenfurt by using the High Pure Viral RNA Kit (Roche Diagnostics GmbH, Germany) and the MutaREAL® Norovirus real time RT-PCR Kit (Immundiagnostik AG, Germany). Norovirus genotyping was performed by the national norovirus reference laboratory at the Austrian Agency for Health and Food Safety, as described elsewhere [12, 13].

Results

Descriptive epidemiology

In the hospital X, a total of 90 persons with symptoms and signs consistent with norovirus gastroenteritis with clinical onsets in the time period from December 1, 2006 to February 13, 2007 were reported. Out of these, 56 hospitalised patients including 19 laboratory confirmed NV-infection fulfilled the definition of an outbreak case (i.e., nosocomial outbreak cases), 14 outbreak cases were identified among the hospital staff including 1 confirmed outbreak case, and 20 cases were identified as non-outbreak cases including 13 community-acquired cases of norovirus gastroenteritis (including 2 clinical-laboratory confirmed cases) and 7 clinical-suspected cases of norovirus gastroenteritis associated with health care facilities other than hospital X. Out of these 20 non-outbreak cases, 12 were already admitted with symptoms consistent with norovirus gastroenteritis.

Primarily, 24 outbreak cases including 5 hospital staff members occurred in the time period from December 1 to 9, 2006 and affected the Department of Internal Medicine, Med II, with 22 cases (including 4 hospital staff) and the Department of Intensive Care with 2 cases (including 1 hospital staff member). Three non-outbreak cases (including 1 clinical-laboratory confirmed case of norovirus gastroenteritis and 1 clinical-suspected case of norovirus gastroenteritis, admitted at the Department of Internal Medicine, Med II; and 1 clinical-suspected case of norovirus gastroenteritis at the Department of Surgery) occurred on December 2, 3 and 7.

A second cluster of cases including 11 cases at the Department of Internal Medicine, Med II, (including one staff member) occurred from December 22 to 27, 2006. On January 8, 2007 a third cluster of 8 cases among hospitalised patients only at the Department of Internal Medicine, Med II, occurred. In addition further 27 outbreak cases occurred on the departments of Internal Medicine, Med II, (n = 11, including 1 staff member), departments of Surgery (n = 4), of Orthopedics (n = 10, including 5 staff member) and of Internal Medicine, Med III, (2 hospital staff cases) from January 8 to February 11. A total of 17 non-outbreak cases were registered in the time period from January 11, 2007 to February 13, which were isolated either immediately at admission or after having developed the suspected signs and symptoms within the 48 hours following admission (including 1 clinical-laboratory confirmed case of NV-gastroenteritis), see Fig. 1.

In the Department of Internal Medicine, Med II, 46 of 51 cases (90.2%) in hospitalized persons were defined as hospital-acquired infection, 2 cases (3.9%) as community-acquired and 3 cases (5.9%) as related to a healthcare facility other than hospital X.

In the period from December 1, 2006 to February 13, 2007 a total of 947 persons were hospitalised. Considering these hospital patients as cohort at risk of nosocomial norovirus infection, the nosocomial hospital outbreak attack-rate was 5.9% (56/947). A total of 120 hospital staff members worked in the period from December 1, 2006, to February 13, 2007, which gives an attack-rate of 11.7% (14/120) among the hospital staff. Among the 56 hospitalized outbreak cases, 43 were women (76.8%) with a median age of 80.0 years (interquartile range: 77.7–85.8) and 13 were men (23.2%) with a median age of 81.5 years (interquartile range: 79.2–85.2).

Control measures taken and evaluation of outbreak control measures

As a consequence of the outbreak, the second floor of the Department of Internal Medicine, Med II, was closed to new admissions on three occasions: December 3–14, 2006; December 25, 2006 – January 2, 2007; January 30

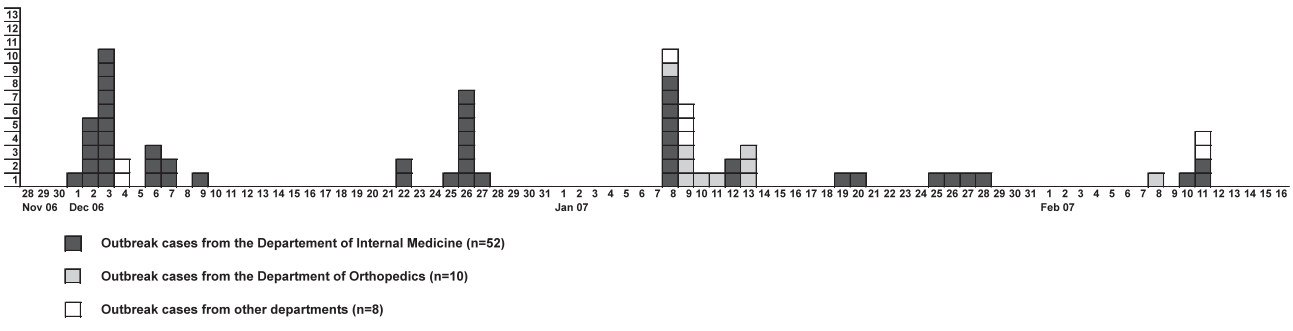

Fig. 1. Outbreak cases (n = 70) in hospital X by disease onset, December 1, 2006 – February 13, 2007

– February 7, 2007. A disused hospital ward waiting for general refurbishment on the third floor was temporally used as isolation ward between January 9 and 23, 2007 (Fig. 2), after first being thoroughly cleaned and disinfected, and adequately equipped. A temporary facility for changing clothing was installed for staff and visitors entering and leaving the isolation ward. During this period, suspected cases were transferred directly to the isolation ward.

The implemented outbreak control measures were cross-checked against 41 categories in total based on national guidelines on the management of norovirus outbreaks. Thirty-four of 41 categories (82.9%) were in full accordance with the guidelines, five (12.2%) were in wide accordance and two (4.9%) were missing.

Enforced hand hygiene and environmental cleaning, cohort isolation of infected hospital patients, banning ill medical staff from working and awareness-building in general were implemented on December 3, 2006 and maintained until February 15, 2007. The second floor of the Department of Internal Medicine was closed to new admissions three times and a temporary isolation ward was put into operation, as described above. Two floor disinfectants (Terralin® 0.5%, TPH® protect) with unconfirmed virucidal action against norovirus and not recommended in the national guidelines were in use December 3, 2006 – January 31, 2007. The floor disinfectant (Perform®) in use after February 1, 2007 and the products used for hand disinfection (Desderman® N, Sterillium® Virugard) were all approved as effective against noroviruses and was used properly in terms of duration of application and concentration.

Determination of outbreak costs

Because of bed closures, a total of 369 patient days were lost in the Department of Internal Medicine during the outbreak period (December 1, 2006 – February 15, 2007) compared to the same period in the previous 12 months. From the number of patient days lost and the daily charge of € 123 per patient (department-specific revenue according to Austrian performance-oriented hospital financing), we calculated a revenue loss of € 45,387. Additional expenses were € 18,375 for increased nursing care (extra staffing of temporary isolation ward) and € 2016 for microbiological diagnosis (including norovirus diagnosis). Lost productivity costs due to hospital staff members on sick leave totalled € 9264. The expenses for an external expert on infection control totalled € 648 and additional costs for cleaning by an external company totalled € 522. The pharmacy reported additional expenses of € 2241 for disinfectants and € 207 for additional demand for parenterals (fluid replacement). The reopening of an empty ward as temporary isolation facility required construction work costing € 1478. Overall, the revenue loss for the Department of Internal Medicine totalled € 80,138.

Laboratory investigation

A total of 23 stool samples (22 cases of hospitalized persons and 1 case of hospital staff) tested positive for norovirus and negative for *Clostridium difficile* toxin, shigella, salmonella, campylobacter and enterohemorrhagic *Escherichia coli*. The exact number of stool specimens tested for norovirus could retrospectively not be ascertained. Only one stool specimen from a case in a hospitalized patient was available for genotyping: Norovirus strain GII.4 variant 2006b was detected.

Discussion

We describe a prolonged norovirus outbreak in a 176-bed hospital in Austria between December 1, 2006 and February 13, 2007 with a total of 90 persons with symptoms and signs consistent with norovirus gastroenteritis. 56 hospitalised patients fulfilled the definition of a nosocomial outbreak case, 14 outbreak cases were identified among the hospital staff, and 20 cases were identified as non-outbreak cases of which 13 cases acquired the norovirus infection in the community and 7 cases were associated with health care facilities other than hospital X. The median age of the cases was 80.0 years for female hospitalized persons, respectively 81.5 years for male hospitalized persons. Population-based studies show that advanced age may enhance the transmission of norovirus [6]. 46 nosocomial outbreak cases on the

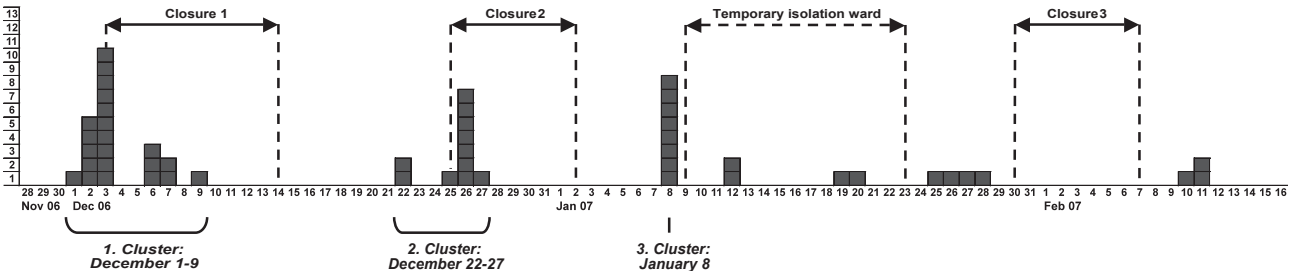

Fig. 2. Onset of symptoms of 52 cases of norovirus infection fulfilling the outbreak case definition in the Department of Internal Medicine, Med II, (confirmed and probable cases of hospitalized persons, n = 46; and hospital staff members, n = 6) December 1, 2006 – February 13, 2007. Indicated are three clusters of cases (cluster 1: December 1–9, 2006; cluster 2: December 22–27, 2006; cluster 3: January 8, 2007), three periods of closure of the department to new admissions (closure 1: December 3–14, 2006; closure 2: December 25, 2006 – January 2, 2007; closure 3: January 30 – February 7, 2007) and the period of use of the temporary isolation ward (January 9–23, 2007)

Department of Internal Medicine, Med II, occurred out of 167 persons hospitalised in that certain risky period. This results in a nosocomial outbreak attack rate at the Department of Internal Medicine, Med II, of 27.5%. The 5 nosocomial outbreak cases at the Department of Orthopedics among a total of 258 persons hospitalised in the risky period results in a nosocomial outbreak attack rate at the Department of Orthopedics of 1.9%. The attack rate among the hospital staff of the Department of Internal Medicine, Med II, was 16.2% (6 staff cases out 37 staff members on duty in the risky period) versus 23.8 % at the Department of Orthopedics (5 out of 21 staff). Because of restricted resources for ascertaining information on the stay of patients at Departments of Internal Medicine and Orthopedics, we were not able to calculate incidence rates of nosocomial norovirus gastroenteritis, which would have allowed an accurate comparison of the attack rates between these two departments.

The control measures were implemented as soon as the causative pathogen was suspected. Attack rates within closed institutions (hospitals and nursing homes) can be in the range of 30–50% among ward patients and staff [1, 3]; high attack rates may reflect late implementation of control measures or a patient population more susceptible to transmission [7].

In the Department of Internal Medicine, Med II, 90.2% of cases in hospitalized persons were defined as hospital-acquired infection, 3.9% as community-acquired and 5.9% as related to a healthcare facility other than hospital X. The real number of nosocomial (hospital-acquired) cases among the patients at risk may have been even higher considering that 48 h (used as the lower limit for clinical onset after admission) is the longest incubation period [1]; thus, patients who had onset not earlier than 24 hours after admission instead of the used 48 hours criteria for differentiation between hospital-acquired or not hospital-acquired infection may also have been infected in the hospital. However, this is an important finding, because norovirus outbreaks in hospitals commonly reflect the epidemic situation in the community and consequently cases of community- and healthcare facility-acquired infection may occur as shown by hospital outbreaks in Switzerland between 2001 and 2005. In each hospital outbreak, a significant number of patients had acquired their infection outside the hospital, i.e. in the community [2, 7, 14]. Continuation of new admissions of patients with norovirus infections poses a challenge to infection control staff already strained by their efforts to contain nosocomial transmission. We did not identify any member of staff as a probable source for norovirus infection among hospitalized patients; the primary case among the staff occurred on December 3, 2006, and the primary case among hospital-patients occurred on versus December 1, 2006. Mattner et al. recently categorized published nosocomial norovirus outbreaks into those triggered by patients and those triggered by staff: in general, more patients are affected in index-patient outbreaks than in index-staff outbreaks; staff appear to be similarly affected by both categories of outbreak index group [15].

Three clusters of cases were recognized in the Department of Internal Medicine (Fig. 2). The combination of a molecular and epidemiologic approach would have allowed epidemiological links between the different clusters to be established or dismissed, especially when outbreak strains are common in the community [16]; however, only a single stool specimen from a case in a hospitalized patient was sent for genotyping at the national norovirus reference centre. The isolate was identified as a norovirus strain GII.4 variant 2006b, a variant that has been circulating widely across Europe since 2006 [17]. We were therefore unable to establish definite links between the three clusters of cases in the Department of Internal Medicine. The transmission patterns within the first two clusters suggested mixed transmission: person-to-person spread and contact with contaminated environment. Although the key question of whether the use of disinfectants on environmental surfaces, rather than cleaning with detergents only, reduces nosocomial infection rates still awaits conclusive studies [18], transmission of norovirus due to environmental contamination might have been a result of the use of inappropriate floor disinfectants between December 3, 2006 and January 31, 2007.

Strategies to reduce the rates of nosocomial norovirus infection should conform to established guidelines, with an emphasis on enforced hand hygiene and thorough environmental cleaning and use of approved disinfectants [19]. Although the third cluster may have been caused by a point source, possibly airborne transmission after aerosolization of vomit, the transmission mode could not be determined. Single clusters of cases may also represent independent outbreaks resulting from import of the pathogen from the community into the hospital and consequent propagation among department staff and to unaffected patients [2, 5, 20].

The second floor of the Department of Internal Medicine had to be closed to new admissions three times during the outbreak. Total closure of an affected medical department is one of the most expensive infection control measures during investigation of a nosocomial outbreak. Hansen et al. analyzed nosocomial outbreaks published during the past 40 years and demonstrated that such expensive measures are likely to be necessary in viral infections of the gastrointestinal tract; for example, the closure rate in norovirus outbreaks was 44.1% [21], possibly reflecting the high transmissibility and low infectious dose of this pathogen. Closure of a department is more frequently considered when care of older patients is involved (closure rate of geriatric patient care wards: 30.3%); in these patients it is especially difficult to implement sufficient infection control measures such as isolation in private rooms and high compliance with use of hand disinfectants [21]. In the present outbreak, a temporary isolation ward with specially installed changing rooms was put into operation January 9–23, 2007 but first had to be cleaned and disinfected, adequately equipped and additional personnel had to be organized. The first and second closures to new admissions and the opening of the isolation ward seemed to be correct measures in order to

decrease the number of new cases; the third closure appeared unnecessary but should be considered in light of the heavy media pressure.

Norovirus infection has been a notifiable communicable disease in Austria since 2006 but only when a foodborne transmission route is at least suspected, consequently the annual economic burden of norovirus infection on healthcare is unknown [10]. This outbreak description is the second published norovirus outbreak in a hospital setting in Austria. The only other report is that of Schmid et al., who reported on a nursing home-related hospital outbreak of norovirus in 2004 [1], but a far greater number of outbreaks in Austrian hospitals should be expected. A recent study in Sweden reported that the GII.4 genotype dominated as a cause of nosocomial outbreaks of viral gastroenteritis and that arrival of new variants was associated with large nationwide epidemics. According to that study, 30,000–35,000 episodes of nosocomial norovirus-like infections occurred in 80 of 82 major Swedish hospitals affected in 2002–2003 [22].

The economic costs of a norovirus outbreak in an Austrian healthcare setting have not been estimated before. The extra costs due to the norovirus outbreak in the Department of Internal Medicine with 57 cases (51 cases of hospitalized persons) totalled € 80,138, of which € 45,387 in lost revenue and € 18,375 for staffing the temporary isolation ward were the biggest items. In a Swiss hospital in 2003 the financial impact of a norovirus outbreak with 45 cases (16 cases of hospitalized persons) totalled $40,675 [23] and in the USA in 2004 costs associated with a large outbreak in two different units with 355 cases (90 cases of hospitalized persons) were estimated to be $657,644 [24]. Although cost estimates vary (because of regional distinctions, differences in number of cases, varieties of affected wards, differences in reimbursement of hospital services and cost calculations), the main conclusion remains the same: to avoid unnecessary expense during an outbreak it is important to follow evidence-based recommendations on control measures in order to limit pathogen spread at the earliest possible stage [21]. It is in the best interest of institutions to react early, because norovirus outbreaks may be explosive and may rapidly disrupt services [24]. We can conclude that in the Austrian outbreak described here the prompt implementation of the hospital's already existing norovirus infection-control policy (enforced hand hygiene and environmental decontamination – although initially using disinfectants without proven anti-norovirus activity – cohort care, excluding affected staff, terminal cleaning before re-opening rooms) was very effective in containing and limiting the spread of the agent and in keeping the attack rates as low as possible during the prolonged period of the outbreak (approximately 2.5 months).

Lastly, we stress the importance of storing norovirus-positive specimens for later phylogenetic analysis after testing or sending isolates to the national norovirus reference laboratory at the Austrian Agency for Health and Food Safety. Only the combination of molecular typing methods and epidemiological investigation allows determination of epidemiological links between different clusters of cases.

References

1. Schmid D, Lederer I, Pichler AM, et al (2005) An outbreak of norovirus infection affecting an Austrian nursing home and a hospital. Wien Klin Wochenschr 117: 802–808
2. Fretz R, Svoboda P, Lüthi TM, et al (2005) Outbreaks of gastroenteritis due to infections with norovirus in Switzerland, 2001–2003. Epidemiol Infect 133: 429–437
3. Lopman BA, Brown DW, Koopmans M (2002) Human caliciviruses in Europe. J Clin Virol 24: 137–160
4. Atmar RL, Opekun AR, Gilger MA, et al (2008) Norwalk virus shedding after experimental human infection. Emerg Infect Dis 14: 1553–1557
5. Cheesbrough JS, Green J, Gallimore CI, et al (2000) Widespread environmental contamination with Norwalk-like viruses (NLV) detected in a prolonged hotel outbreak of gastroenteritis. Epidemiol Infect 125: 93–98
6. Lopman BA, Andrews N, Sarangi J, et al (2005) Institutional risk factors for outbreaks of nosocomial gastroenteritis: survival analysis of a cohort of hospital units in South-west England, 2002–2003. J Hosp Infect 60: 135–143
7. Fretz R (2005) How important is the norovirus relationship to gastroenteritis [Article in German]. Wien Klin Wochenschr 117: 785–788
8. Gastmeier P, Stamm-Balderjahn S, Hansen S, et al (2005) How outbreaks can contribute to prevention of nosocomial infection: analysis of 1,022 outbreaks. Infect Control Hosp Epidemiol 26: 357–361
9. Lopman BA, Adak GK, Reacher MH, et al (2003) Two epidemiologic patterns of norovirus outbreaks: surveillance in England and Wales, 1992–2000. Emerg Infect Dis 9: 71–77
10. Anonymous (2006) Guidelines on the management of outbreaks of norovirus infection in healthcare settings [in German]. Austrian Agency for Health and Food Safety, Vienna. Download: www.ages.at/uploads/media/Noroviren_2006_02.pdf
11. Anonymous (2001) Standardisierung und Qualitätssicherung in mikrobiologischer Labordiagnostik. Richtlinien. Liebeswar G (ed) Innsbruck: Bundesministerium für soziale Sicherheit und Generationen. ISBN 3-86123-126-0
12. Miller I, Gunson R, Carman WF (2002) Norwalk like virus by light cycler PCR. J Clin Virol 25: 231–232
13. Oh DY, Gaedicke G, Schreier E (2003) Viral agents of acute gastroenteritis in German children: prevalence and molecular diversity. J Med Virol 71: 82–93
14. Uçkay I, Fretz R, Schmid H, et al (2007) The norovirus outbreaks of winter 2004/2005 in Switzerland: basic recommendations for hospitals. Hyg Med 32: 120–125
15. Mattner F, Mattner L, Borck HU, et al (2005) Evaluation of the impact of the source (patient versus staff) on nosocomial norovirus outbreak severity. Infect Control Hosp Epidemiol 26: 268–272
16. Lopman BA, Gallimore C, Gray JJ, et al (2006) Linking healthcare associated norovirus outbreaks: a molecular epidemiologic method for investigating transmission. BMC Infect Dis 6: 108
17. Kroneman A, Vennema H, Harris J, et al (2006) Increase in norovirus activity reported in Europe. Euro Surveill 11: E061214.1
18. Dettenkofer M, Block C (2005) Hospital disinfection: efficacy and safety issues. Curr Opin Infect Dis 18: 320–325
19. Hota B (2004) Contamination, disinfection, and cross-colonization: are hospital surfaces reservoirs for nosocomial infection? Clin Infect Dis 39: 1182–1189

20. Fretz R, Schmid H, Kayser U, et al (2003) Rapid propagation of norovirus gastrointestinal illness through multiple nursing homes following a pilgrimage. Eur J Clin Microbiol Infect Dis 22: 625–627
21. Hansen S, Stamm-Balderjahn S, Zuschneid I, et al (2007) Closure of medical departments during nosocomial outbreaks: data from a systematic analysis of the literature. J Hosp Infect 65: 348–353
22. Johansen K, Mannerqvist K, Allard A, et al (2008) Norovirus strains belonging to the GII.4 genotype dominate as a cause of nosocomial outbreaks of viral gastroenteritis in Sweden 1997–2005. Arrival of new variants is associated with large nation-wide epidemics. J Clin Virol 42: 129–134
23. Zingg W, Colombo C, Jucker T, et al (2005) Impact of an outbreak of norovirus infection on hospital resources. Infect Control Hosp Epidemiol 26: 263–267
24. Johnston CP, Qiu H, Ticehurst JR, et al (2007) Outbreak management and implications of a nosocomial norovirus outbreak. Clin Infect Dis 45: 534–540