Journal of Hospital Infection (2008) **70**, 272–277

Available online at www.sciencedirect.com

ScienceDirect

www.elsevierhealth.com/journals/jhin

Summer influenza outbreak in a home for the elderly: application of preventive measures

J. Gaillat [a,*], G. Dennetière [b], E. Raffin-Bru [c], M. Valette [d], M.C. Blanc [c]

[a] *Infectious Disease Unit, Annecy Central Hospital, France*
[b] *Annecy Local Health Authority, France*
[c] *Veyrier du Lac Nursing Home, France*
[d] *National Influenza Reference Centre, Lyon, France*

Received 22 October 2007; accepted 15 July 2008
Available online 16 September 2008

KEYWORDS
Influenza outbreak;
Nursing home;
Oseltamivir;
Summer

Summary Influenza outbreaks occasionally occur in nursing homes (NHs) despite vaccination, but occurrence during summer is a rare event. We describe an influenza outbreak during a heatwave in 2005, and discuss the usefulness of rapid diagnosis in facilitating early intervention as well as appropriate infection control measures. An outbreak was observed in a single NH with 81 residents (mean age 88 years) and 48 healthcare workers (HCWs) and lasted seven days. Fever, cough and wheezing were reported as the main symptoms in 32 affected residents (39.5%) and 6 (12.5%) HCWs. Influenza was suspected and provisionally confirmed by a rapid diagnostic test performed on specimens from four patients. The outbreak was further confirmed by culture and reverse transcriptase–polymerase chain reaction in seven out of 10 residents. The strain was similar to the winter epidemic strain of the 2004–2005 season: H3N2A/New York/55/2004. As soon as the outbreak was confirmed, a crisis management team was set up with representatives of the local health authority and NH staff. A package of measures was implemented to control the outbreak, including patient isolation and the wearing of surgical masks by all residents and staff. A therapeutic course of oseltamivir was prescibed to 19/32 symptomatic patients and to 5/6 HCWs, and 47 residents and 42 remaining HCWs received a prophylactic post-exposure regimen. The outbreak ended within 48 h. Case fatality rate was 15.6% among residents. Pre-outbreak influenza vaccine coverage among the residents was 93.5% and 41.7% in HCWs. The rapid diagnostic test enabled prompt action to be taken, which facilitated infection control measures.

* Corresponding author. Address: Infectious Diseases Department, Centre Hospitalier de la Région d'Annecy, 1 Avenue de l'Hôpital, Metz-Tessy, BP 90074, 74374, Pringt Cedex, France. Tel.: +33 450883303; fax: +33 50883155.
E-mail address: j.gaillat@ch-annecy.fr

0195-6701/$ - see front matter
doi:10.1016/j.jhin.2008.07.009

Introduction

The occurrence of an influenza outbreak in a nursing home (NH) for the elderly remains possible even when there is vaccination coverage.[1,2] Nevertheless, immunisation of the residents is the cornerstone of prevention.[3,4] Such recommendations are justified by the reduction in mortality of nearly 68% and of hospital admissions for influenza or its complications by 53% in immunised elderly persons.[5] The low level of immunity (30–40%) achieved in elderly persons has led to proposals to immunise staff and the efficacy of this approach has been demonstrated.[2–4,6,7] The effect can be explained by reducing the risk of circulation of the influenza virus as well as its introduction into the NH by members of the nursing staff. In the event of an outbreak in a NH it has been proposed that patient isolation should be backed up by antiviral prophylaxis using oseltamivir, a neuraminidase inhibitor.[4,8,9] These measures depend on the rapid recognition of an influenza outbreak, which is particularly difficult when it occurs outside the normal epidemic period because of the non-specific nature of symptoms. Rapid diagnostic tests are available but they need to be interpreted in the light of prevailing circumstances.

We report an outbreak which occurred in a NH in the early summer of 2005 (32/81 residents affected) with a case mortality rate of 16% (5/32) and infection in exposed nursing staff (6/48). This outbreak presented an opportunity to apply and evaluate the rapid diagnostic tools available as well as the therapeutic and prophylactic measures recommended by the French National Health Service.[9]

Description of the outbreak

Setting, sequence of events

The NH comprised two separate blocks where the residents lived in three units: units A (29 beds) and B (26 beds) in the main building and unit C (26 beds) in the second building. The two dining rooms were located in the main building, one being used by most of the residents and the other generally being reserved for the 12 residents who needed special care. At the time of the outbreak, the residents were 19 males and 62 females with a mean age of 88 years (range: 72–101), 18 (22.2%) of whom were highly dependent.

The outbreak started abruptly. Cases were defined by fever $>38\,^{\circ}C$ combined with a cough and/or respiratory signs. The occurrence of cases is summarised in Figure 1. The first cluster of cases occurred on 27 June, when the protection measures against a heatwave were implemented, namely residents spending the whole day in an air-conditioned dining room. More cases occurred over the following six days, later cases being found chiefly among the nursing staff. In all, 32/81 residents showed signs meeting the case definition, giving an attack rate of 39.5%. Both buildings and all floors were affected without any differences in rate. The first patient to show symptoms of a respiratory infection had had clinical manifestations on 25 June. He dined in the same dining room as the residents who presented as a cluster two days later and some had eaten at the same table. The index case was a self-caring person, independently mobile throughout the communal areas of the home. Out of the 12 most dependent residents, who normally ate in the separate dining room but who had been in the air-conditioned room on 27–29 June, 11 (91.7%) displayed clinical signs from 29 June. The average age of sick individuals was no different from those who remained healthy. The illness was significantly more common in residents who were relatively immobile.

Among the 48 staff who were in contact with the residents during the outbreak, six developed respiratory symptoms with fever.

Diagnostic investigations were carried out on one hospitalised patient on 1 July who had fever, cough, shortness of breath, rhonchi, prostration and normal chest radiography. A rapid diagnostic test (RDT) (Influenza test, QuickVue, Quidel Corp., San Diego, CA, USA) carried out on nasopharyngeal excretions on 1 July gave a positive result. An RSV rapid diagnosis test (NOW® RSV, Binax Inc, Scarborough, ME, USA) was negative. On the same day samples were collected from 10 residents showing the symptoms for <24 h. Only three out of the 10 samples were locally processed but they were all positive for influenza. These results were considered sufficient to diagnose the outbreak. Eleven nasopharyngeal swabs were tested by the National Influenza Reference Centre (NIRC) at Lyon: 10 collected on 1 July and one on 6 July from a staff member who developed fever after 48 h of prophylactic treatment. Reverse transcriptase–polymerase chain reaction (RT–PCR) testing was carried out as described by Stockton, and virological cultures were initiated on Madin–Darby canine kidney cells. Both RT–PCR and culture confirmed the diagnosis of influenza A in seven residents.[10] Three remained negative with both techniques. The staff member was both PCR and culture negative. The antigenic characterisation of the isolated viruses, performed by haemagglutination inhibition test according to the WHO procedure, showed

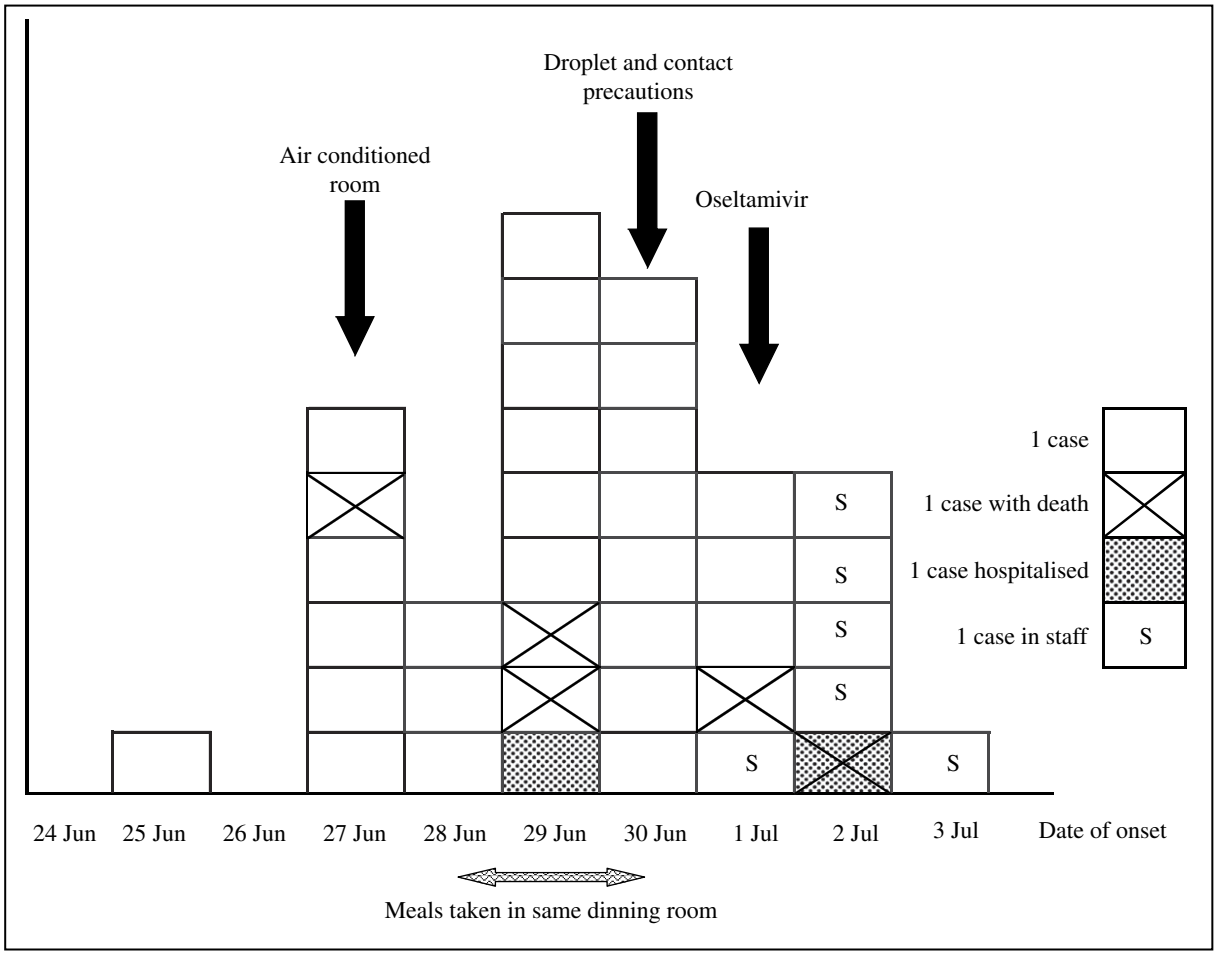

Figure 1 Dates of occurrence of new influenza cases at nursing home, 25 June to 3 July 2005.

that the outbreak was caused by a strain related to the H3N2 prototypes A/California/7/2004 and A/New York/55/2004.[11] Thus it could be defined as a native rather than an imported infection.

Management of the outbreak

Before the diagnosis of influenza had been formally confirmed, a report of an acute respiratory infection outbreak was sent to the local health authority by NH managers on the morning of 30 June. A crisis management team was set up with representatives of the local health authority and NH staff. Isolation of sick residents and further measures to prevent transmission (wearing of surgical masks) were implemented.

When the diagnosis was established (evening of 1 July), oseltamivir treatment (75 mg twice daily for five days) was started in all 19 patients who had had symptoms for $<$48 h. Thirteen patients did not receive oseltamivir: 10 had had symptoms for $>$48 h and three were already dead. Only one course of treatment was not completed (the patient died 24 h later). A post-exposure prophylactic course of seven days of 75 mg daily was instituted for 47 asymptomatic residents, of whom two refused to be treated.

Post-exposure prophylactic treatment was also offered to 42 HCWs and curative treatment was given to five out of six sick members of staff (sick staff were asked to stay at home until they recovered). One member of staff stopped the course after 24 h because of gastrointestinal side-effects. Side-effects and tolerability of oseltamivir were not systematically assessed among either residents or staff.

Evolution of the outbreak

The outbreak came to an abrupt end, with no further cases among residents or staff from the second day after instituting case isolation and antiviral treatment with oseltamivir. The case fatality rate in the residents was 15.6% (5/32). In the group of patients who received a therapeutic

course of oseltamivir, two died, one 15 days later, probably from myocardial infarction and the other, a woman with Waldenström's macroglobulinaemia, within 24 h of starting treatment. The other three patients who died had not received treatment, symptoms having been present for over 48 h. They died in the NH rapidly after the start of respiratory symptoms; no diagnostic test or lung X-ray was performed. Two out of the 32 sick residents (6.2%) were admitted to hospital.

A search for the index case revealed that one resident at the NH had had symptoms from 25 June. Interviews with family members who had visited this resident did not demonstrate any external source for the infection. This resident was considered to be the likely index case.

The vaccination coverage of the residents in the NH was 93.7%, all immunised on 10 October 2004 with Vaxigripp®. Coverage of the staff was at 41.7% (20/48, Vaxigripp® between 16 October and 29 November 2004). None of the staff members with influenza symptoms had been immunised.

Discussion

This outbreak is noteworthy for a number of reasons. Firstly, it arose in the summer, the heatwave plan having been implemented which meant that all the residents were together in one confined area; secondly, the cause of the outbreak was identified and prophylactic measures were introduced promptly through the use of an RDT; thirdly, coordination between the various health officials was implemented as soon as the outbreak had been recognised; and finally, the outbreak ended abruptly with no further deaths once infection control measures had been introduced.

Summer influenza outbreaks are rare but have been reported in the community, on cruise ships, in NHs in the USA and in late April in France.[12–16] In this outbreak a striking feature was the effect of the preventive heatwave measures. Assembling all the residents in a confined, air-conditioned area probably led to an unusually efficient spread of the virus affecting all residents irrespective of their normal location within the establishment. This is in contrast to other outbreaks which have raised questions concerning the effect of architecture.[17] The emergence of infection among the nursing staff confirms that they were infected from sick residents. Avoiding contact between symptomatic and healthy persons is a commonsense measure which was not observed in the early stages of the outbreak. This was caused partly because of preoccupation with the heatwave measures and partly because the possibility of an influenza outbreak was not initially considered, since it was thought to be unlikely outside the usual influenza season.

This outbreak also demonstrated the role of an RDT in quickly evaluating cases of respiratory febrile illness. An RDT for RSV must also be performed during an institutional outbreak.[18] The period of viral circulation is longer in the case of RSV.[19] Parainfluenza virus types 2–3 and metapneumovirus are also potential pathogens but there is no commercial rapid diagnostic test available. An initial positive result for influenza in the RDT always requires confirmation. The QuickVue test with a sensitivity of 73% and specificity of 96% has only a poor positive predictive value (36%), taking into account the low prevalence of influenza outside the normal season (at most 2%).[1] Positive results in the first three new samples confirmed that the influenza virus was involved. The strain was found to be the same one which circulated in the 2004–2005 winter although the winter epidemic had ended in the week of 20–27 March 2005. During or just outside the epidemic season it is cost-effective to perform virological diagnostic tests before giving therapeutic or prophylactic treatment in a community setting, and a priori more so in an institutional setting.[20]

The similarity to the seasonal epidemic strain raises the issue of effectiveness of the vaccine, given the high attack rate and mortality despite high vaccine coverage (93.7%). As it happened, during the 2004–2005 season, the circulating virus was slightly different from that used in producing the vaccine, thus reducing its effectiveness.

Outbreaks in NHs can occur despite a coverage of $>80\%$.[3,4] The role of vaccination should not be underestimated even if it is of limited use in institutions. Notably, well-matched vaccines prevented pneumonia [vaccine efficacy (VE) 46%, 30–58] and hospital admission (VE 45%, 16–64) for, and deaths from, influenza or pneumonia (VE 42%, 17–59), and reduced all-cause mortality (VE 60%, 23–79).[21] In a prospective study, the vaccine coverage in institutions with outbreaks (84%) was the same as in homes where there was no outbreak (83%).[1] In the outbreak reported here, the long interval between vaccination and the outbreak of influenza may be a relevant factor, given that the antibody response is weaker in the elderly than in young adults.[22] The risk of an influenza outbreak must be considered in all clusters of respiratory illness with fever, even if there is a high vaccine coverage, and outside the influenza season. Vaccination of staff members also allows

them protection in the event of an outbreak. The vaccination coverage of the staff improved the following year; it was 72.5% in 2006, but decreased in 2007 to 65.3%. In France, influenza vaccination is only recommended and is not compulsory.

Managing this outbreak was based on measures devised in the event of clusters of respiratory infections in NHs. The occurrence in summer probably led to a delay in reporting to the local health authority. At the time of the first patient's admission to hospital, awareness of the cluster prompted immediate isolation in the infectious diseases ward, as well an early aetiological diagnosis. The outbreak was confirmed by speedy investigation of samples from the institution itself. Thereafter consultation between the management of the home, the local health authority and the infectious disease specialist took place in order to provide the treatment and prophylaxis with oseltamivir. Notably, there was no problem in obtaining a supply of the drug on the same day through the designated pharmacy, although this can pose difficulties.[23] The certainty of the virological diagnosis obviated the need to treat empirically, which would have arisen if only clinical criteria had been followed; thus extra costs were avoided.[24]

Partial isolation measures were introduced for the sick residents by 30 June, and from 48 h after introduction of the complete package of measures no new cases occurred (Figure 1). However, it cannot be said that the use of the oseltamivir was the sole factor leading to the cessation of new cases since the attack rate was already decreasing when oseltamivir was introduced. It is possible that the simultaneous exposure of all the residents during a short period of time led to the short-lived outbreak. An outbreak does, however, come to a quicker and more abrupt end when antivirals are prescribed at an earlier stage and to a large number of people.[25] Isolation measures alone are insufficient, as is treating only symptomatic cases. In 11 outbreaks in Ontario it was observed that a rapid end of the outbreak only occurred after instituting oseltamivir treatment (after amantadine failure in five cases treated and in five receiving primary prophylaxis).[25] Certainly, the earlier the diagnosis is made, and measures for antiviral prophylaxis and treatment are put in place, the clearer the benefits. Prescribing prophylactic treatment to the residents was justified due to the high likelihood of contact between residents when they were assembled in the air-conditioned room.

Amantadine, acting by blocking the proton pump of M2 protein, and two neuraminidase inhibitors (oseltamivir and zanamivir), are licensed for post-exposure prophylaxis/prevention in adults.[8] The duration of prophylactic treatment varies between publications, ranging from 6 weeks down to 5 days, alternative strategies recommending 10 days or until the end of the outbreak has been officially declared.[26–28] Prophylaxis can be short if the outbreak is halted rapidly.[29] In this particular case the recommended 7 days were sufficient and less expensive.

The treatment was well-tolerated but there was no systematic evaluation of side-effects. Other authors have similarly described good tolerance in this setting.[24] It would seem that side-effects, particularly gastrointestinal, occur less commonly in the elderly than they do in younger persons. Among the nursing staff at least one person stopped taking the treatment and several did not fully comply with the prescribed doses.

This outbreak was an opportunity to apply the French national recommendations for management of such outbreaks and specifically to assess the coordination between the various organisations involved, which achieved a concerted response with minimal delay. The role of prophylactic treatment has not been well-defined. The existence of asymptomatic carriers dictates that this should be given to as many as possible, as soon as possible after contacts between the residents have occurred. This outbreak served as a reminder of the need to immunise care staff, in order to protect not only the residents but also themselves.

Acknowledgements

We thank J. Wiersum for the English translation.

Conflict of interest statement
None declared.

Funding sources
None.

References

1. Monto AS, Rotthoff J, Teich EM, *et al*. Detection and control of influenza outbreaks in well vaccinated NH populations. *Clin Infect Dis* 2004;**39**:459–464.
2. Stevenson C, McArthur M, Abraham E, McGeer A. Prevention of influenza and pneumococcal pneumonia in Canadian long term care facilities: how are we doing? *Can Med Assoc J* 2001;**164**:1413–1419.
3. Anonymous. Calendrier vaccinal 2005 et autres avis du Conseil supérieur d'Hygiène publique de France relatifs à la vaccination. *BEH* 2005;**29–30**:141–156.
4. Anonymous. Centres for Disease Control and Prevention. Prevention and control of influenza: recommendations of

the Advisory Committee on Immunization Practices (ACIP). *Morb Mortal Wkly Rep* 2005;**54**(RR-8):1—44.
5. Gross PA, Hermogenes AW, Sacks H, Lau J, Levanowsky RA. The efficacy of influenza vaccine in elderly persons. A meta-analysis and review of the literature. *Ann Intern Med* 1995;**123**:518—527.
6. Potter J, Stott DJ, Roberts MA, *et al*. Influenza vaccination of health care workers in long term-care hospitals reduces the mortality of elderly patients. *J Infect Dis* 1997;**175**:1—6.
7. Carmen WF, Elder AG, Wallace LA, *et al*. Efficacy of influenza vaccination of health-care workers on mortality of elderly people in long term care: a randomised controlled trial. *Lancet* 2000;**355**:93—97.
8. Anonymous. National Institute for Clinical Excellence. Guidance on the use of oseltamivir and amantadine for the prophylaxis of influenza. *Technol Appraisal* 2003;**67**(292): 1—32.
9. Anonymous. Protocole de mise en place de la chimio-prophylaxie dans une collectivité de personnes âgées lors d'une épidémie de grippe, en période de circulation du virus grippal. Ministère de la Santé, Direction Générale de la Santé Complément à la circulaire N°444 du 17 septembre 2004.
10. Stockton J, Ellis JS, Saville M, Clewley JP, Zambon C. Multiplex PCR for typing and subtyping influenza and respiratory syncytial viruses. *J Clin Microbiol* 1998;**36**:2990—2995.
11. Palmer DF, Dowdle WR, Coleman MT, Schild GC. Advanced laboratory technicals for immunological diagnostic. In: *Procedural guide, Part 2: Haemagglutination-inhibition test. Immunology series*, **6**. Atlanta: US Department of Health, Education and Welfare, P.H.S; 1975. p. 25—62.
12. Wolf DG, Rekhtman D, Kerem E, *et al*. A summer outbreak of influenza A virus infection among young children. *Clin Infect Dis* 2004;**39**:595—597.
13. Miller JM, Tam TW, Maloney S, *et al*. Cruise-ships: high risk passengers and the global spread of new influenza viruses. *Clin Infect Dis* 2000;**31**:433—438.
14. Centres for Disease Control and Prevention. Influenza A — Florida and Tennessee, July—August 1998, and virologic surveillance of influenza, May—August 1998. *Morb Mortal Wkly Rep* 1998;**47**:756—759.
15. Gaspard P, Mosnier A, Cohen, *et al*. Surveillance des infections grippales: évaluation de treize épisodes de grippe dans des collectivités accueillant des personnes âgées et/ou démentes par le GROG. Géronto-Alsace. *Hygiènes* 2005;**5**:361—368.
16. Kohn MA, Farley TA, Sundin D, *et al*. Three summertime outbreaks of influenza type A. *J Infect Dis* 1995;**172**:246—249.
17. Paul Drinka, Krause PN, Schilling M, Miller B, Shult P, Gravenstein S. Report of an outbreak: NH architecture and influenza-A attack rates. *J Am Geriatr Soc* 1996;**44**:910—913.
18. Falsey AR, Hennessey PA, Formica MA, Cox C, Walsh EE. Respiratory syncytial virus infection in elderly and high-risk adults. *N Engl J Med* 2005;**352**:1749—1759.
19. Ellis SE, Coffey CS, Mitchel EF, Dittus RS, Griffin MR. Influenza- and respiratory syncytial virus-associated morbidity and mortality in the NH population. *J Am Geriatr Soc* 2003;**51**:761—767.
20. Rothberg MB, Bellantonio S, Rose DN. Management of influenza in adults older than 65 years of age: cost-effectiveness of rapid testing and antiviral therapy. *Ann Intern Med* 2003; **139**:321—329.
21. Jefferson T, Rivetti D, Rudin M, Di Pietrantonj C, Demicheli V. Efficacy and effectiveness of influenza vaccines in elderly people: a systematic review. *Lancet* 2005; **366**:1165—1174.
22. Mitzuto S, Reiko S, Naohito T. Antibody response to influenza vaccination in NH residents and healthcare workers during four successive seasons in Niigita, Japan. *Infect Control Hosp Epidemiol* 2005;**26**:859—866.
23. Hill T, Platzer A, Reyes C. Influenza death in spite of immunization and prophylaxis. *Clin Infect Dis* 2005;**40**:492—493.
24. Hardling R, Hayward A, Watson JM. Implications of the incidence of influenza-like illness in NHs for influenza chemoprophylaxis: descriptive study. *Br Med J* 2004;**329**:663—664.
25. Bowles SK, Lee W, Simor AE, *et al*. Use of oseltamivir during influenza outbreaks in Ontario nursing-homes, 1999—2000. *J Am Geriatr Soc* 2002;**50**:608—616.
26. Peters PH, Gravenstein S, Norwood P, *et al*. Long-term use of oseltamivir for the prophylaxis of influenza in a vaccinated frail older population. *J Am Geriatr Soc* 2001;**49**: 1025—1031.
27. Shijubo N, Yamada G, Takahashi M, Tokunoh T, Suzuki T, Abe S. Experience with oseltamivir in the control of NH influenza A outbreak. *Intern Med* 2002;**41**:366—370.
28. Guy RJ, Di Natale R, Kelly HA, *et al*. Influenza outbreak in aged-care facilities: staff vaccination and the emerging use of antiviral therapy. *Med J Aust* 2004;**180**:640—642.
29. Drinka PJ, Gravenstein S, Shilling M, Krause P, Miller BA, Shult P. Duration of antiviral prophylaxis during outbreaks of influenza A. *Arch Intern Med* 1998;**158**:2155—2159.